June 2005

FES 05-11

Final Programmatic Environmental Impact Statement on

WIND ENERGY DEVELOPMENT

on BLM-Administered Lands in the Western United States

Volume 1: Main Text

U.S. Department of the Interior
Bureau of Land Management

BLM

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Washington, D.C. 20240
http://www.blm.gov

Dear Reader:

Enclosed is the Final Programmatic Environmental Impact Statement (PEIS) on Wind Energy Development on Bureau of Land Management (BLM)-Administered Lands in the Western United States, including proposed amendments to selected land use plans. The Final PEIS analyzes three alternatives for managing wind energy development on BLM-administered lands. The alternatives are: 1) the proposed action, which would implement a Wind Energy Development Program, establish policies and best management practices (BMPs) for wind energy right-of-way (ROW) authorizations, and amend 52 BLM land use plans; 2) the no action alternative, which would allow continued wind energy development under the terms and conditions of the BLM Interim Wind Energy Development Policy, and 3) a limited wind energy development alternative, which would allow wind energy development only in selected locations.

As stated above, the proposed action would establish a comprehensive program to address wind energy development on BLM-administered lands. The policies and BMPs developed under the proposed Wind Energy Development Program would establish minimum requirements for management of individual wind energy projects. The proposed policies identify management objectives and address the administration of wind energy development activities. The proposed BMPs identify required mitigation measures that would need to be incorporated into project-specific plans and stipulations. In addition, the proposed action would amend 52 BLM land use plans which are listed in Appendix C of the Final PEIS. The proposed plan amendments include the (1) adoption of programmatic policies and BMPs where wind energy development would be considered and (2) identification of specific areas where wind energy development would not be allowed. The purpose of the proposed plan amendments is to facilitate preparation and consideration of potential wind energy development ROW applications on BLM-administered lands, but not to eliminate the need for site-specific analysis of individual development proposals.

The Draft Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States was made available for public review and comment from September 10, 2004 to December 10, 2004. The Draft PEIS was posted on the project Web site at http://windeis.anl.gov and provided on request as a CD or printed document. More than 120 individuals and organizations participated in the public comment process, including more than 60 recognized organizations (public and private). About 77% of the documents were received via the project Web-site and 23% were received via regular mail. On the basis of comment categorization, approximately 718 individual comments were identified.

Volume 3 of the Final PEIS contains the public comments on the Draft PEIS and the BLM's responses. Public comments addressed a broad range of issues. About 31% of the comments were categorized as addressing ecological issues, including monitoring and mitigation; 21% addressed policy issues; 17% addressed avian issues, 10% addressed bat issues; 8% addressed issues related to the scope of the PEIS and the alternatives evaluated; 6% addressed sage-grouse issues; 6% addressed transmission issues; and 4% of the comments addressed land use issues. The remainder of the issues were divided across a number of topics (each comprising less than 3% of the total), including engineering, cumulative impacts, cultural resources, economics, visual impacts, wind resource modeling approach, noise, regulatory issues, water, waste, air quality, geology, and transportation issues. (The percentages total more than 100% because many of the comments can be categorized under more than one key issue). Public comments on the Draft PEIS, including the proposed plan amendments, and internal BLM review comments were incorporated into the Final PEIS. Public comments resulted in the addition of clarifying text, but did not significantly change the proposed action or proposed land use plan amendments.

Copies of the Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States, including the proposed plan amendments (Appendix C), have been sent to the Environmental Protection Agency, DOI Office of Environmental Policy and Compliance, DOI Library, and the governors' office in each of the 11 western states. Copies of the Final PEIS, including the proposed plan amendments, are available at the BLM State Offices in the 11 western states and the BLM Washington Office, Public Affairs Office. Interested persons may also review the Final PEIS and proposed plan amendments on the Internet at http://windeis.anl.gov.

Instructions for filing a protest regarding the proposed plan amendments may be found at 43 CFR 1610.5. A protest may only raise those issues which were submitted for the record during the NEPA/planning process. E-mail and faxed protests will not be accepted as valid protests unless the protesting party also provides the original letter by either regular or overnight mail postmarked by the close of the protest period. Under these conditions, the e-mail or faxed protest will be considered as an advance copy and it will receive full consideration. If you wish to provide such advance notification, please direct faxed protests to the attention of the BLM protest coordinator at 202-452-5112, and emails to Brenda_Hudgens-Williams@blm.gov.

Please direct the follow-up letter to the appropriate address provided below.

The protest must contain:

a. The name, mailing address, telephone number, and interest of the person filing the protest.
b. A statement of the specific plan(s) by name and the amendment(s) being protested.
c. A copy of all documents addressing the issue(s) that the protesting party submitted during the NEPA/planning process or a statement of the date they were discussed for the record.
d. A concise statement explaining why the protestor believes the proposed land use plan amendment(s) is wrong.

All protests must be in writing and mailed to the following address:

Regular Mail:	Overnight Mail:
Bureau of Land Management	Bureau of Land Management
Director (210)	Director (210)
Attention: Brenda Williams	Attention: Brenda Williams
P.O. Box 66538	1620 L Street, N.W., Suite 1075
Washington, D.C. 20035	Washington, D.C. 20036

Individual respondents may request confidentiality. If you wish to withhold your name or street address from public review or from disclosure under the Freedom of Information Act, you must state this prominently at the beginning of your written comment. Such requests will be honored to the extent allowed by law. All submissions from organizations and businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will be available for public inspection in their entirety.

A decision shall be rendered promptly on the protest. The decision will be in writing and will be sent to the protesting party by certified mail, return receipt requested.

Following the resolution of any protests and completion of the consistency reviews by the governors of states affected by land use plan amendments, approval of the Program for Wind Energy Development on BLM-Administered Lands in the Western United States and amendment of selected land use plans will be documented in a Record of Decision that will be made available to the public and provided on request to interested parties. For additional information, you may contact Lee Otteni, Bureau of Land Management, Farmington Field Office, 1235 La Plata Highway, Suite A, Farmington, NM 87401, (505) 599-8911 or visit the Wind Energy Development Programmatic EIS Web site at windeis.anl.gov.

Sincerely,

Ray Brady
Group Manager, Lands and Realty

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Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States

Volume 1: Main Text

U.S. Department of the Interior
Bureau of Land Management

June 2005

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NOTATION

The following is a list of acronyms and abbreviations, chemical names, and units of measure used in this document. Some acronyms used only in tables may be defined only in those tables.

GENERAL ACRONYMS AND ABBREVIATIONS

ac	alternating current
ACEC	Area of Critical Environmental Concern
ACGIH	American Conference of Governmental Hygienists
AGFD	Arizona Game and Fish Department
APLIC	Avian Power Line Interaction Committee
ARS	*Arizona Revised Statutes*
ASM	American Society of Mammalogists
AusWEA	Australian Wind Energy Association
AWEA	American Wind Energy Association
BEPA	Bald and Golden Eagle Protection Act of 1940
BLM	Bureau of Land Management
BLMCA	Bureau of Land Management, California State Office
BLMCO	Bureau of Land Management, Colorado State Office
BLMID	Bureau of Land Management, Idaho State Office
BLMNV	Bureau of Land Management, Nevada State Office
BLMUT	Bureau of Land Management, Utah State Office
BLMWY	Bureau of Land Management, Wyoming State Office
BLS	U.S. Bureau of Labor Statistics
BMP	best management practice
BOR	U.S. Bureau of Reclamation
BPA	Bonneville Power Administration
BWEA	British Wind Energy Association
CAA	Clean Air Act
CDCA	California Desert Conservation Area
CDFG	California Department of Fish and Game
CDW	Colorado Division of Wildlife
CEC	Commission for Environmental Cooperation
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CNHP	Colorado Natural Heritage Program
CRADA	Cooperative Research and Development Agreement
CRMP	cultural resources management plan
CRS	Center for Resource Solutions

NOTATION (Cont.)

CWA	Clean Water Act
CX	Categorical Exclusion
dc	direct current
DNL	day-night average sound level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DTI	Department of Trade and Industry
DWIA	Danish Wind Industry Manufacturers Association
EA	environmental assessment
EECA	Energy Efficiency and Conservation Authority
EERE	Office of Energy Efficiency and Renewable Energy
EFSEC	Energy Facility Site Evaluation Council
EIA	Energy Information Administration
EIS	environmental impact statement
ELCC	effective load-carrying capability
ELF	extremely low-frequency
EMF	electric and magnetic fields
EMI	electromagnetic interference
E.O.	Executive Order
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
ESA	Endangered Species Act of 1973
ESRI	Environmental Systems Research Institute, Inc.
EWEA	European Wind Energy Association
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FLPMA	Federal Land Policy and Management Act of 1976
FR	*Federal Register*
FY	fiscal year
GE	General Electric
GIS	geographic information system
GSP	gross state product
HAP	hazardous air pollutant
HAWT	horizontal axis wind turbine
HMMH	Harris Miller Miller & Hanson, Inc.

NOTATION (Cont.)

IEC	International Electrotechnical Commission
IFG	Idaho Fish and Game
IM	Instruction Memorandum
IREC	Interstate Renewable Energy Council
ISDA	Idaho State Department of Agriculture
L_{dn}	day-night average sound level
L_{eq}	equivalent sound pressure level
MBTA	Migratory Bird Treaty Act of 1918
MFP	Management Framework Plan
MNHP	Montana Natural Heritage Program
MOA	military operations area
MPDS	maximum potential development scenario
MTR	military training route
NAAQS	National Ambient Air Quality Standards
NAGP	North American Grouse Partnership
NCA	National Conservation Area
NDOW	Nevada Department of Wildlife
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969
NEPDG	National Energy Policy Development Group
NERC	North American Electric Reliability Council
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NLCS	National Landscape Conservation System
NMDGF	New Mexico Department of Game and Fish
NMFS	National Marine Fisheries Service
NMNHP	New Mexico Natural Heritage Program
NMRPTC	New Mexico Rare Plant Technical Council
NNHP	Nevada Natural Heritage Program
NOA	Notice of Availability
NOI	Notice of Intent
NOS	National Ocean Service
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	*National Register of Historic Places*
NSC	National Safety Council
NWCC	National Wind Coordinating Committee

NOTATION (Cont.)

O&M	operation and maintenance
OHV	off-highway vehicle
ONHP	Oregon Natural Heritage Program
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PCB	polychlorinated biphenyl
PEIS	programmatic environmental impact statement
PERI	Princeton Energy Resources International
P.L.	Public Law
PM	particulate matter
$PM_{2.5}$	particulate matter with a mean aerodynamic diameter of 2.5 μm or less
PM_{10}	particulate matter with a mean aerodynamic diameter of 10 μm or less
POD	Plan of Development
PTC	Production Tax Credit
R&D	research and development
RCRA	Resource Conservation and Recovery Act of 1976
RMP	Resource Management Plan
RMRCC	Rocky Mountain Regional Coordinating Committee
ROD	Record of Decision
ROI	return on investment
ROS	Recreation Opportunity Spectrum
ROW	right-of-way
RPS	renewable portfolio standard
RSA	rotor-swept area
SCADA	supervisory control and data acquisition
SDWA	Safe Drinking Water Act of 1974
SHPO	State Historic Preservation Office(r)
SIAP	Smithsonian Institution Affiliations Program
SIP	State Implementation Plan
SMP	suggested management practice
TIO	technology improvement opportunity
TLV	threshold limit value
TSCA	Toxic Substances Control Act of 1976
TVA	Tennessee Valley Authority
UDWR	Utah Division of Wildlife Resources
USACE	U.S. Army Corps of Engineers
USC	*United States Code*
USDA	U.S. Department of Agriculture

NOTATION (Cont.)

USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VAWT	vertical axis wind turbine
VOC	volatile organic compound
VRM	Visual Resource Management
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WECC	Western Electricity Coordinating Council
WGFD	Wyoming Game and Fish Department
WindPACT	Wind Partnerships for Advanced Component Technologies
WinDS	Wind Deployment System
WRA	wind resource area
WTGS	wind turbine generator system
WYNDD	Wyoming Natural Diversity Database

CHEMICALS

CO	carbon monoxide
CO_2	carbon dioxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
Pb	lead
SO_2	sulfur dioxide

UNITS OF MEASURE

ac-ft	acre foot (feet)
°C	degree(s) Celsius
cm	centimeter(s)
dB	decibel(s)
dB(A)	A-weighted decibel(s)
°F	degree(s) Fahrenheit
ft	foot (feet)
ft^2	square foot (feet)
gal	gallon(s)
GW	gigawatt(s)
h	hour(s)
ha	hectare(s)
Hz	hertz
in.	inch(es)
kg	kilogram(s)
kHz	kilohertz
km	kilometer(s)
km^2	square kilometer(s)
kV	kilovolt(s)

kW	kilowatt(s)
kWh	kilowatt-hour(s)
L	liter(s)
lb	pound(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mi	mile(s)
mi^2	square mile(s)
mpg	mile(s) per gallon
mph	mile(s) per hour
MW	megawatt(s)
Pa	pascal(s)
ppm	part(s) per million
psi	pound(s) per square inch
rpm	rotation(s) per minute
s	second(s)
t	metric ton(s)
TWh	trillion watt-hours
W	watt(s)
yd^3	cubic yard(s)
µg	microgram(s)
µm	micrometer(s)

ENGLISH/METRIC AND METRIC/ENGLISH EQUIVALENTS

The following table lists the appropriate equivalents for English and metric units.

Multiply	By	To Obtain
English/Metric Equivalents		
acres	0.4047	hectares (ha)
cubic feet (ft^3)	0.02832	cubic meters (m^3)
cubic yards (yd^3)	0.7646	cubic meters (m^3)
degrees Fahrenheit (ºF) –32	0.5555	degrees Celsius (ºC)
feet (ft)	0.3048	meters (m)
gallons (gal)	3.785	liters (L)
gallons (gal)	0.003785	cubic meters (m^3)
inches (in.)	2.540	centimeters (cm)
miles (mi)	1.609	kilometers (km)
pounds (lb)	0.4536	kilograms (kg)
short tons (tons)	907.2	kilograms (kg)
short tons (tons)	0.9072	metric tons (t)
square feet (ft^2)	0.09290	square meters (m^2)
square yards (yd^2)	0.8361	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)
yards (yd)	0.9144	meters (m)
Metric/English Equivalents		
centimeters (cm)	0.3937	inches (in.)
cubic meters (m^3)	35.31	cubic feet (ft^3)
cubic meters (m^3)	1.308	cubic yards (yd^3)
cubic meters (m^3)	264.2	gallons (gal)
degrees Celsius (ºC) +17.78	1.8	degrees Fahrenheit (ºF)
hectares (ha)	2.471	acres
kilograms (kg)	2.205	pounds (lb)
kilograms (kg)	0.001102	short tons (tons)
kilometers (km)	0.6214	miles (mi)
liters (L)	0.2642	gallons (gal)
meters (m)	3.281	feet (ft)
meters (m)	1.094	yards (yd)
metric tons (t)	1.102	short tons (tons)
square kilometers (km^2)	0.3861	square miles (mi^2)
square meters (m^2)	10.76	square feet (ft^2)
square meters (m^2)	1.196	square yards (yd^2)

EXECUTIVE SUMMARY

ES.1 BACKGROUND

The U.S. Department of the Interior (DOI), Bureau of Land Management (BLM), is responsible for the development of wind energy resources on BLM-administered lands. Currently, about 500 MW of installed wind capacity occurs under right-of-way (ROW) authorizations administered by the BLM in accordance with the requirements of the Federal Land Policy and Management Act of 1976 (FLMPA) (*United States Code*, Title 43, Section 1701 [43 USC 1701]) and the BLM's Interim Wind Energy Development Policy (BLM 2002).

This interim policy was developed, in part, in response to the National Energy Policy recommendations that the Departments of the Interior, Energy, Agriculture, and Defense work together to increase renewable energy production (NEPDG 2001). The interim policy is consistent with the requirements of Executive Order (E.O.) 13212, "Actions to Expedite Energy-Related Projects," issued May 2001, that federal agencies take appropriate actions, to the extent consistent with applicable law, to expedite projects to increase the production, transmission, or conservation of energy. To further support wind energy development on public lands and also to minimize potential environmental and sociocultural impacts, the BLM is seeking to build on the interim policy to establish a Wind Energy Development Program.

The BLM has determined that the establishment of a Wind Energy Development Program would be a major federal action as defined by the National Environmental Policy Act of 1969 (NEPA). Thus, the BLM has prepared this programmatic environmental impact statement (PEIS). The objectives of the PEIS are to (1) assess the environmental, social, and economic impacts associated with wind energy development on BLM-administered land, and (2) evaluate a number of alternatives to address the question of whether the proposed action presents the best management approach for the BLM to adopt, in terms of mitigating potential impacts and facilitating wind energy development.

The U.S Department of Energy (DOE) has cooperated in the preparation of this PEIS in support of the BLM's proposed action to establish a Wind Energy Development Program for BLM-administered lands. The DOE supports the objectives of the PEIS and recognizes that these objectives are consistent with both E.O. 13212 and recommendations of the National Energy Policy. The DOE anticipates it will be involved in future wind energy development projects on BLM-administered lands, particularly with respect to transmission system interconnects and related issues.

The Final PEIS consists of three volumes. Volume 1 contains the main text of the PEIS. Volume 2 contains Appendices A through F. Volume 3 contains the comment and response document. Volume 3 has not been printed for distribution but is provided on a compact disc in a pocket attached to the back cover of Volume 2.

ES.2 SCOPING PROCESS

The "Notice of Intent to Prepare a Programmatic Environmental Impact Statement (EIS) to Evaluate Wind Energy Development on Western Public Lands Administered by the Bureau of Land Management" (the NOI) was published in Volume 68, page 201, of the *Federal Register* (68 FR 201) on October 17, 2003. This initiated the scoping period, which lasted from October 17, 2003, to December 19, 2003. During that period, the BLM invited the public and interested groups to provide information and guidance on the scope of the PEIS and alternatives to the proposed action, suggest issues that should be examined, and express their concerns and opinions on resources in the western United States that wind energy development might impact. Public scoping meetings were held in Sacramento, California; Salt Lake City, Utah; Cheyenne, Wyoming; Las Vegas, Nevada; and Boise, Idaho.

It is estimated that as many as 5,000 people participated in the scoping process by attending public meetings, providing comments, requesting information, or visiting the Wind Energy Development PEIS Web site (http://windeis.anl.gov). All comments received equal consideration in developing the alternatives and analytical issues evaluated in this PEIS. The results of the scoping process were documented in a report issued in January 2004 (BLM 2004) that summarizes and categorizes the major themes, issues, and concerns of the written and verbal comments. The scoping summary report and copies of the individual letters, facsimiles, and comments received electronically during scoping are available on the Wind Energy Development PEIS Web site.

In addition to public scoping, government-to-government consultation was initiated with all Tribal entities with a potential interest in wind energy development on BLM-administered lands.

ES.3 PUBLIC REVIEW OF THE DRAFT PEIS

The Notice of Availability (NOA) of the Draft PEIS was published on September 10, 2004 (69 FR 175). This began a 90-day public comment period on the Draft PEIS, which lasted from September 10 to December 10, 2004. During this period, the BLM invited the public and interested groups to comment on the content of the Draft PEIS.

The Draft PEIS was posted in its entirety on the Wind Energy Development PEIS Web site. Printed copies of the document and CDs containing the electronic files comprising the document were mailed upon request. More than 120 people and organizations participated in the public comment process by providing Internet-based comments or postal letters. Approximately 718 individual comments were received. The BLM reviewed all comments and made changes to the PEIS, as appropriate.

Responses to comments are provided in Volume 3 of the Final PEIS. Volume 3 has not been printed for distribution but is provided on a compact disc in a pocket attached to the back cover of Volume 2.

ES.4 SCOPE OF THE ANALYSIS

The scope of the PEIS analysis includes an assessment of the positive and negative environmental, social, and economic impacts; discussion of relevant mitigation measures to address these impacts; and identification of appropriate, programmatic policies and best management practices (BMPs) to be included in the proposed Wind Energy Development Program. The scope includes all BLM-administered lands in the western United States, excluding Alaska. They are located in 11 states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. A maximum potential development scenario (MPDS) was developed to help define the potential magnitude of future wind energy development activities on BLM-administered lands within these states. Additional modeling was conducted to consider the impact of various economic factors affecting wind energy development and to define how much wind power might be generated over the next 20 years in the 11-state study area.

The PEIS also assesses the proposed amendment of 52 BLM land use plans. The proposed amendments include (1) adoption of the proposed programmatic policies and BMPs, and (2) identification of specific areas where wind energy development would not be allowed. None of the proposed amendments address designation of lands for competitive ROW bidding processes, although this was identified as a possibility in the NOI. Interest in competitive bidding processes currently is limited to two areas and would be addressed in local BLM land use planning efforts.

The analysis is based on current, available, and credible scientific data. Programmatic policies and BMPs incorporated into the BLM's proposed Wind Energy Development Program are based on an interpretation of these scientific data and decisions on relevant mitigation requirements. Direct and indirect impacts of wind energy development on the environment, social systems, and the economy, as discussed at the programmatic level, have been evaluated. Cumulative impacts associated with the proposed action have also been evaluated.

As a programmatic evaluation, this PEIS does not evaluate site-specific issues associated with individual wind energy development projects. A variety of location-specific factors (e.g., soil type, watershed, habitat, vegetation, viewshed, public sentiment, the presence of threatened and endangered species, and the presence of cultural resources) will vary considerably from site to site, especially over an 11-state region. In addition, the variations in project size and design will greatly determine the magnitude of the impacts from given projects. The combined effects of these location-specific and project-specific factors cannot be fully anticipated or addressed in a programmatic analysis; such effects must be evaluated at the project level.

ES.5 ALTERNATIVES

This PEIS analyzes three alternatives. It analyzes the potential impacts associated with the BLM's proposed action to implement a Wind Energy Development Program. It also assesses potential impacts associated with two alternatives to the proposed action, which present different management options for wind energy development on BLM-administered land. The alternatives are defined as follows:

- *Proposed action: implement a Wind Energy Development Program.* Under this alternative, the BLM proposes to implement a comprehensive program to address issues associated with wind energy development on BLM-administered lands under the MPDS. The proposed program would establish policies and BMPs to address the administration of wind energy development activities and identify minimum requirements for mitigation measures. These programmatic policies and BMPs would be applicable to all wind energy development projects on BLM-administered lands. Site-specific and species-specific concerns, and the development of additional mitigation measures, would be addressed in project-level reviews, including NEPA analyses, as required. To the extent appropriate, future project-specific analyses would tier off of the analyses conducted in this PEIS and the decisions in the resultant Record of Decision (ROD) to allow project-specific analyses to focus just on the critical, site-specific issues of concern. In addition, under this alternative, a number of BLM land use plans would be amended to address wind energy development, including adoption of the programmatic policies and BMPs and identification of exclusion areas. Upon final approval of the proposed Wind Energy Development Program, the Interim Wind Energy Policy (BLM 2002) will be replaced by a new policy that incorporates the programmatic policies and BMPs evaluated in this PEIS. Elements of the interim policy addressing applications, authorizations, competitive interests, and due diligence will not be changed by the proposed program requirements.

- *No action alternative*. Under this alternative, the BLM would continue administering wind energy development ROW authorizations in accordance with the terms and conditions of the Interim Wind Energy Development Policy (BLM 2002). Analysis and review of wind energy development, including NEPA analyses and development of required mitigation measures, would be conducted on a project-by-project basis. Individual land use plan amendments would occur on a plan-by-plan basis without the benefit of the overarching, comprehensive analysis provided by this PEIS.

- *Limited wind energy development alternative*. Under this alternative, additional wind energy development on BLM-administered land would occur only in areas where it currently exists, is under review, or has been approved for development at the time the ROD for this PEIS is published. For the purposes of establishing an upper bound on the potential impacts of this alternative, it was assumed that all proposed wind energy projects on BLM-administered land currently under review would be approved for development by the time the ROD is published (anticipated for July 2005). Future expansion of wind energy development would be allowed at existing project areas; however, no additional BLM-administered land would be made available for development. Under these restrictions, development would be limited to locations where development currently exists: Palm Springs, California; Ridgecrest, California; and Arlington, Wyoming; and locations where it is currently being reviewed: the Table Mountain Wind Generating Facility, Nevada; Cotterel Mountain Wind Farm Project, Idaho; and Walker Ridge, California.

ES.6 SUMMARY OF IMPACTS

Potential adverse impacts to natural and cultural resources could occur during each phase of wind energy development (i.e., site monitoring and testing, construction, operation, and decommissioning) if effective mitigation measures are not implemented. The nature and magnitude of these impacts would vary by phase and would be determined by the project location and size. Potential direct impacts would include use of geologic and water resources; creation or increase of geologic hazards or soil erosion; water quality degradation; localized generation of airborne dust; generation of noise; alteration or degradation of wildlife habitat or sensitive or unique habitat; interference with resident or migratory fish or wildlife species, including protected species; alteration or degradation of plant communities, including the occurrence of invasive vegetation; land use changes; alteration of visual resources; release of hazardous materials or wastes; increased traffic; increased human health and safety hazards; and destruction or loss of paleontological or cultural resources. More limited, potential indirect impacts also could occur to cultural and ecological resources.

Effective mitigation measures could be implemented to address many of the direct and indirect adverse impacts that could occur. For some resources, minimum requirements could be established that would effectively mitigate impacts at all potential development sites. For other resources, however, such as ecological and visual resources, mitigation would be better defined at the project level to address site-specific and species-specific concerns.

The potential impacts of wind energy development on local and regional economies would be largely beneficial, depending upon the size of the project and the resultant wind power capacity.

The proposed action and its alternatives present options for the management of wind energy development on BLM-administered lands. A brief summary of the effectiveness of each of the alternatives at mitigating potential adverse impacts and facilitating wind energy development is provided in the following sections.

ES.6.1 Proposed Action: Implement the Wind Energy Development Program

The proposed Wind Energy Development Program policies and BMPs would establish a comprehensive mechanism for ensuring that the impacts of wind energy development on BLM-administered lands would be kept to a minimum. The proposed policies and BMPs were generated on the basis of an impact analysis conducted for the PEIS and reviews of relevant mitigation measures; they would be applicable to all wind energy development projects. These elements of the program, along with the proposed amendment of BLM land use plans, would likely result in shorter time lines and reduced costs for wind energy projects, thereby facilitating development.

In terms of facilitating wind energy development, implementation of the proposed action is expected to minimize some of the delays that currently occur for wind energy development projects and reduce costs. In addition, the proposed program would ensure consistency in the way ROW applications and authorizations for wind energy development are managed. These benefits would be realized as a result of the emphasis on site-specific and species-specific concerns during the project-level environmental analyses, the amendment of numerous land use plans to address wind energy development, and the potential to tier future NEPA analyses off of this PEIS and decisions in the resultant ROD.

In terms of mitigating adverse environmental impacts, the proposed policies would identify specific lands on which wind energy development would not be allowed; establish requirements for public involvement, consultation with other federal and state agencies, and government-to-government consultation; define the need for project-level environmental review; establish requirements for the scope and content of the project Plan of Development (POD); and incorporate adaptive management strategies. The proposed BMPs would establish environmentally sound and economically feasible mechanisms to protect and enhance natural and cultural resources. They would identify the issues and concerns that must be addressed by project-specific plans, programs, and stipulations during each phase of development. Mitigation measures protecting these resources would be required to be incorporated into project PODs; this would include incorporation of specific programmatic BMPs as well as the incorporation of additional mitigation measures contained in other, existing and relevant BLM guidance, or developed to address site-specific or species-specific concerns.

Implementation of the proposed program would ensure that potential adverse impacts to most of the natural and cultural resources present at wind energy development sites, except wildlife and visual resources, would be minimal to negligible. This includes potential impacts to soils and geologic resources, paleontological resources, water resources, air quality, noise, land use, and cultural resources not having a visual component. Potential impacts to wildlife would be considerably reduced by the programmatic BMPs and by the requirement that site-specific and species-specific concerns be addressed comprehensively at the project level. While it is possible that adverse impacts to wildlife could occur at some of the future wind energy development sites, the magnitude of these impacts and the degree to which they could be successfully mitigated would vary from site to site. Similarly, the proposed program would reduce potential impacts to visual resources, although the degree to which this could be achieved would be site-specific; this includes cultural resources that have a visual component (e.g., sacred landscapes). The proposed program would require that the public be involved in and informed regarding potential visual impacts of a specific project during the project approval process. Minimum requirements regarding project design would be incorporated into individual project plans. Ultimately, determinations regarding the magnitude of potential visual impacts would be made by local stakeholders.

Finally, with respect to potential environmental impacts, the proposed requirement for the BLM and operators to adopt adaptive management strategies would further ensure that potential environmental impacts would be kept to a minimum. This includes requirements for periodic review and revision of programmatic policies and BMPs; comprehensive site monitoring programs, including metrics for measuring impacts; and protocols for incorporating monitoring observations and new mitigation measures into standard operating procedures and project-specific BMPs.

The potential economic impacts of the proposed action would generally be beneficial to local and regional economies. The projected development would result in new jobs and increased income, gross state product, sales tax, and income tax in each of the 11 states during both construction and operation. Impacts to residential property values associated with proximity to wind energy projects were not calculated in this PEIS; however, other studies of these impacts suggest that there would not be any measurable negative impacts.

In terms of cumulative impacts under the proposed action, the potential for wind energy development on BLM-administered lands, as projected by the MPDS, is relatively small compared both with other commercial uses of BLM-administered lands and with projected levels of wind energy development on non-BLM-administered lands. Under the proposed action, potential environmental impacts would be mitigated to the maximum extent possible by the programmatic policies and BMPs. Provided that the level of development falls within the MPDS projections for the next 20 years and that the proposed policies and BMPs are implemented, the cumulative impacts of the proposed action are unlikely to be significant. Individual site-specific wind energy projects on BLM-administered lands that are within the scope of this cumulative analysis and in accordance with the Wind Energy Development Program described by the proposed action are considered to have been adequately addressed by the PEIS.

ES.6.2 No Action Alternative

Under this alternative, wind energy development would be subject to the terms and conditions of the Interim Wind Energy Development Policy (BLM 2002). The interim policy establishes some restrictions on lands that can be developed and includes requirements for environmental review of individual projects in accordance with NEPA. Comprehensive guidance regarding mitigation of potential adverse impacts is not included in the interim policy. In addition, under this alternative, land use plan amendments to address wind energy development would occur only on a plan-by-plan basis.

In terms of facilitating development, the absence of a BLM Wind Energy Development Program would likely cause wind energy development on BLM-administered lands to occur at a slower pace than under the proposed action. The anticipated benefits of the Wind Energy Development Program, in terms of the availability of comprehensive BMP requirements, land use plan amendments, and tiered NEPA analyses, would not be realized under the no action alternative. One can predict that without these benefits, the length of time needed to review, process, and approve ROW applications for wind energy projects would increase. Extended time lines usually translate into increased costs, and the cost per unit of wind power developed would likely be greater under the no action alternative than under the proposed action. This could result in delays in establishing necessary project financing and power market contracts. Furthermore, developers may elect to avoid delay and uncertainty by shifting their projects to state, Tribal, and private land with potentially less federal environmental oversight.

In terms of mitigating adverse environmental impacts, implementation of the interim policy requirements for project-specific environmental reviews would likely result in the development of effective mitigation measures for individual wind energy projects. In that event, the potential adverse impacts to natural and cultural resources would be similar to those of the proposed action. The absence of a Wind Energy Development Program, however, could result in inconsistencies in the type and degree of mitigation required for individual projects.

Economic benefits also would be realized locally and regionally under the no action alternative. However, if the amount of wind energy development was reduced as a result of real or perceived impediments to development on BLM-administered lands, the economic benefits to local communities adjacent to BLM-administered lands in the west could be reduced.

ES.6.3 Limited Wind Energy Development Alternative

Under this alternative, the amount of wind energy development would be greatly restricted in comparison to both the proposed action and the no action alternative. Therefore, in terms of facilitating wind energy development, this alternative would be the least effective of the three alternatives considered. In terms of mitigating potential environmental impacts, the required project-specific reviews, including NEPA analyses, would likely result in effective mitigation so that local impacts would be reduced to the greatest extent possible. Potential regional impacts, including beneficial economic impacts, would be lower under this alternative because of the limited level of development on BLM-administered lands.

ES.7 CONCLUSIONS

This PEIS is consistent with the requirements promulgated by the FLPMA; NEPA (42 USC 4321), as amended; and Council on Environmental Quality regulations (*Code of Federal Regulations*, Title 40, Parts 1500–1508 [40 CFR Parts 1500–1508]). A scoping process was conducted to obtain input from individuals, public interest organizations, and governmental agencies, and this input was used to develop the alternatives and issues considered in the PEIS. The Draft PEIS was made available for public review, and comments received during that review were considered and incorporated into the PEIS as appropriate. The Final PEIS meets all administrative and procedural requirements.

On the basis of the impact analyses presented in this PEIS, it appears that the proposed action would present the best approach for managing wind energy development on BLM-administered lands. The proposed Wind Energy Development Program is likely to result in the greatest amount of wind energy development over the next 20 years, at the lowest potential cost to industry. Simultaneously, the proposed action would provide the most comprehensive approach for ensuring that potential adverse impacts are minimized to the greatest extent possible. And, finally, the proposed action is likely to provide the greatest economic benefits to local communities and the region as a whole. As a result, the proposed action appears to best meet the objectives of the National Energy Policy recommendations to increase renewable energy production on federal lands.

ES.8 REFERENCES

BLM (Bureau of Land Management), 2002, "Instruction Memorandum No. 2003-020, Interim Wind Energy Development Policy," issued by the Director of the Bureau of Land Management, Washington, D.C., Oct. 16.

BLM, 2004, *Summary Report of Scoping Comments Received on the Bureau of Land Management Wind Energy Development Programmatic Environmental Impact Statement*, prepared by Argonne National Laboratory, Argonne, Ill., for Bureau of Land Management, Lands and Realty Group, Washington, D.C., Jan.

NEPDG (National Energy Policy Development Group), 2001, *National Energy Policy*, *Reliable, Affordable, and Environmentally Sound Energy for America's Future*, Washington, D.C., May.

1 INTRODUCTION

On May 18, 2001, the President issued Executive Order (E.O.) 13212, "Actions to Expedite Energy-Related Projects," establishing a policy that federal agencies should take appropriate actions, to the extent consistent with applicable law, to expedite projects to increase the production, transmission, or conservation of energy. In that same month, the President's National Energy Policy Development Group (NEPDG) recommended to the President, as part of the National Energy Policy, that the Departments of the Interior, Energy, Agriculture, and Defense work together to increase renewable energy production (NEPDG 2001). In July 2001, the Departments created an interagency task force to address the issues associated with increasing renewable energy production on federal lands (DOE and DOI 2002). The task force developed a Memorandum of Understanding (MOU) among the U.S. Department of Energy (DOE), U.S. Department of the Interior (DOI), U.S. Department of Agriculture (USDA), U.S. Environmental Protection Agency (EPA), Council on Environmental Quality (CEQ), and the members of the Western Governors' Association to establish a framework for cooperation between western states and the federal government to address energy problems facing the West and to facilitate renewable energy production.

The DOI's Bureau of Land Management (BLM) administers approximately 261.8 million acres (106 million ha) of public lands in the United States. This administrative responsibility must address stewardship, conservation, and resource use, including the development of energy resources in an environmentally sound manner. Wind energy is one of many energy resources now being developed on federal lands, with approximately 500 MW of installed wind capacity currently occurring on BLM-administered lands under right-of-way (ROW) authorizations administered by the BLM in accordance with the requirements of the Federal Land Policy and Management Act of 1976 (FLPMA) (*United States Code*, Title 43, Section 1701 et seq. [43 USC 1701 et seq.]). The BLM continues to receive new wind energy project proposals on BLM-administered lands.

The BLM, in cooperation with the DOE, has prepared this programmatic environmental impact statement (PEIS) to (1) assess the environmental, social, and economic impacts associated with wind energy development on BLM-administered land, and (2) evaluate a number of alternatives to determine the best management approach for the BLM to adopt, in terms of mitigating potential impacts and facilitating wind energy development.

1.1 PURPOSE AND NEED

1.1.1 BLM's Purpose and Need

As stated above, the BLM is responsible for the development of energy resources on BLM-administered lands in an environmentally sound manner. To address increased interest in wind energy development and to implement the National Energy Policy recommendation to increase renewable energy production, the BLM undertook efforts to evaluate wind energy potential on public lands and establish wind energy policy. In 2002, the BLM issued an Interim Wind Energy Development Policy (BLM 2002a) (Appendix A) that establishes requirements for processing applications for wind energy site testing and monitoring and commercial wind energy development projects.

To support wind energy development on public lands and also to minimize potential environmental and sociocultural impacts, the BLM proposes to build on the interim policy to establish a Wind Energy Development Program. Anticipated elements of the BLM's proposed Wind Energy Development Program include (1) an assessment of wind energy development potential on BLM-administered lands through 2025 (a 20-year period); (2) policies regarding the processing of wind energy development ROW authorization applications; (3) best management practices (BMPs) for mitigating the potential impacts of wind energy development on BLM-administered lands; and (4) amendments of specific BLM land use plans to address wind energy development.

The BLM has determined that the proposed action to establish a Wind Energy Development Program would be a major federal action as defined by the National Environmental Policy Act of 1969 (NEPA). Thus, the BLM has prepared this PEIS.

1.1.2 DOE's Purpose and Need

The DOE has cooperated in the preparation of this PEIS in support of the BLM's proposed action to establish a Wind Energy Development Program for BLM-administered lands. The DOE supports the objectives of the PEIS to assess the impacts of wind energy development and to develop a programmatic approach incorporating the anticipated elements identified in Section 1.1.1. The DOE recognizes that these objectives are consistent with both E.O. 13212 and recommendations of the National Energy Policy. The DOE anticipates it will be involved in future wind energy development projects on BLM-administered lands, particularly with respect to transmission system interconnects and related issues.

1.2 SCOPE OF THE ANALYSIS

This PEIS evaluates the potential impacts associated with the BLM's proposed action to develop a Wind Energy Development Program, as described in Section 2.2. It also assesses potential impacts associated with alternatives to the proposed action. These alternatives, which present different management options for wind energy development on BLM-administered land, are described in Sections 2.3 and 2.4.

The "Notice of Intent to Prepare a Programmatic Environmental Impact Statement (EIS) to Evaluate Wind Energy Development on Western Public Lands Administered by the Bureau of Land Management" (the NOI) was published in Volume 68, page 201, of the *Federal Register* (68 FR 201) on October 17, 2003. As stated in the NOI, the scope of the analysis includes an assessment of the positive and negative environmental, social, and economic impacts; discussion of relevant mitigation measures to address these impacts; and identification of appropriate programmatic policies and BMPs to be included in the proposed Wind Energy Development Program. The scope includes all BLM-administered lands in the western United States, excluding Alaska. They are located in 11 states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. A maximum potential development scenario (MPDS) has been developed to help define the potential magnitude of future wind energy development activities on BLM-administered lands within these states (Section 2.2.1).

Also as stated in the NOI, potential land use plan amendments have been assessed (Section 2.2.4). The proposed amendments include (1) adoption of the proposed programmatic policies and BMPs and (2) identification of specific areas where wind energy development would not be allowed. None of the proposed amendments address designation of lands for competitive ROW bidding processes, although this was identified as a possibility in the NOI. Interest in competitive bidding processes currently is limited to two areas in California — the Palm Springs-South Coast Field Office and Ridgecrest Field Office — and will be addressed in local BLM land use planning efforts.

The analysis conducted in preparation of this PEIS was based on current, available, and credible scientific data. Programmatic policies and BMPs incorporated into the BLM's proposed Wind Energy Development Program are based on an interpretation of these scientific data and decisions on relevant mitigation requirements. Direct and indirect impacts of wind energy development on the environment, social systems, and the economy, as discussed at the programmatic level, have been evaluated. Cumulative impacts associated with the proposed action have also been evaluated.

As a programmatic evaluation, this PEIS does not evaluate site-specific issues associated with individual wind energy development projects. A variety of location-specific factors (e.g., soil type, watershed, habitat, vegetation, viewshed, public sentiment, the presence of threatened and endangered species, and the presence of cultural resources) will vary considerably from site to site, especially over an 11-state region. In addition, the variations in project size and design will greatly determine the magnitude of the impacts from given projects. The combined effects of these location-specific and project-specific factors cannot be fully anticipated or addressed in a programmatic analysis; such effects must be evaluated at the project level. Thus, this PEIS identifies the range of potential impacts and identifies relevant mitigation measures. The proposed program establishes policies and BMPs to mitigate impacts that will apply to all wind energy development projects on BLM-administered lands. These proposed policies and BMPs are general in nature and do not address site-specific and species-specific issues and concerns. Site-specific and species-specific issues will be addressed during individual project reviews. Individual project analyses, review, and approval may tier off of the PEIS but will not be supplanted by it.

1.3 RELATIONSHIP OF THE BLM'S PROPOSED ACTION TO OTHER BLM PROGRAMS, POLICIES, AND PLANS

The BLM develops land use plans to guide activities, stewardship goals, and management approaches. Most of the land use plans in the 11-state study area do not specifically address wind energy development, although they contain many provisions, stipulations, and guidelines that are relevant to wind energy development activities. Currently, BLM Field Offices follow the Interim Wind Energy Development Policy (BLM 2002a) (Appendix A) in their review and consideration of wind energy development projects.

The BLM's proposed Wind Energy Development Program evaluated in this PEIS will replace the Interim Wind Energy Development Policy and provide expanded direction for these types of projects. The proposed program will establish policies and BMPs that are specific to issues associated with wind energy development. Elements of the interim policy addressing applications, authorizations, competitive interests, and due diligence will not be changed by the proposed program requirements. Issues that are relevant but not unique to wind energy development (e.g., road construction and maintenance, wildlife management, hazardous materials and waste management, cultural resource management, and pesticide use) will also be addressed in the proposed policies and BMPs, but not at the same level of detail as that provided in other existing BLM program-specific mitigation guidance documents. Other existing BLM program-specific guidance will apply to wind energy development projects and will not be replaced by the policies and BMPs of the proposed program.

As part of the proposed action, a number of existing land use plans would be amended to address wind energy development (Section 2.2.4). Additional land use plans may be amended or revised in the future to directly incorporate the policies and BMPs contained in the BLM's proposed Wind Energy Development Program. Alternatively, BLM Field Office staff may choose to implement elements of the program on a project-by-project basis only. Each wind energy development project would be evaluated individually, and the appropriate programmatic policies and BMPs and local stipulations would be applied.

1.4 ORGANIZATION OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

This PEIS consists of three volumes. Volume 1 contains Chapters 1 through 10. A brief summary of each of these components follows:

- Chapter 1 provides a discussion of the purpose and need for the proposed action; the scope of analysis; and the relationship of the proposed action to other BLM programs, policies, and plans.

- Chapter 2 provides descriptions of the proposed action and alternatives to the proposed action assessed in this PEIS. These alternatives present different options for managing wind energy development on BLM-administered lands. The description of the proposed action includes discussions of the MPDS and the elements of the proposed Wind Energy Development Program. This chapter also provides a summary section comparing the management alternatives on the basis of their effectiveness at mitigating potential impacts and facilitating wind energy development, as discussed in detail in Chapter 6.

- Chapter 3 presents information describing wind energy projects, including descriptions of typical activities conducted during each phase of development; regulatory requirements; health and safety aspects; hazardous materials and waste management; transportation considerations; and relevant existing guidelines on mitigation.

- Chapter 4 describes the affected environment of the 11-state study area, with general descriptions of the natural, cultural, and socioeconomic conditions. These descriptions provide the level of detail needed to support a programmatic evaluation and identify site-specific factors that would need to be examined at the project level.

- Chapter 5 describes potential impacts to the affected environment that could occur on BLM-administered lands under the MPDS described in Chapter 2. It also discusses relevant impact mitigation measures and describes the process for selecting which mitigation measures were appropriate for inclusion in the programmatic BMPs of the proposed Wind Energy Development Program.

- Chapter 6 describes the potential impacts of the proposed action and the alternatives described in Chapter 2. This analysis evaluates the effectiveness of the management approaches at mitigating potential impacts and facilitating wind energy development on BLM-administered lands.

- Chapter 7 describes the consultation and coordination activities conducted in the course of this PEIS, including public scoping, public comment on the Draft PEIS, government-to-government consultation, coordination with BLM State and Field Offices, and interagency consultation and coordination. It also discusses the potential adoption of the PEIS by other organizations.

- Chapters 8 through 10 provide references cited in this PEIS, the list of preparers, and a glossary.

Volume 2 contains six appendices:

- Appendix A provides the Interim Wind Energy Development Policy (IM 2003-020) (BLM 2002a) in its entirety.

- Appendix B describes the methodologies the National Renewable Energy Laboratory (NREL) used to construct the MPDS and to project the amount of wind power generation over the next 20 years. It also contains maps showing potential Class 3 and higher wind resources for each BLM Field Office in the 11-state study area.

- Appendix C contains a list of each of the land use plans that are proposed for amendment through this PEIS. For each plan, the proposed change is listed along with the rationale for the change.

- Appendix D provides information about wind energy technology.

- Appendix E contains information about regulations and statutes that may be relevant to wind energy development.

- Appendix F contains detailed descriptions of ecoregions in the 11-state study area and state maps showing the overlap of potentially developable wind resources within the ecoregions.

Volume 3 contains the comment and response document. In this volume, each of the public comment documents received on the Draft PEIS is presented in its entirety along with the BLM's responses to each individual comment. Volume 3 has not been printed for distribution but is provided on a compact disc in a pocket attached to the back cover of Volume 2.

2 PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

Wind energy development on BLM-administered lands is managed through ROW authorizations in accordance with the terms and conditions of the BLM's Interim Wind Energy Development Policy (BLM 2002a) (Appendix A). The BLM proposes to revise the interim policy through development of a Wind Energy Development Program that would establish comprehensive policies and BMPs addressing wind energy development.[1] Alternatives to this proposed action present options for the management of wind energy development on BLM-administered lands. Under each alternative, wind energy development would occur in accordance with the requirements of the FLMPA. The objective of this PEIS is to evaluate whether the proposed action presents the best management approach that the BLM could adopt.

This chapter identifies and describes the proposed action and its alternatives, including no action. A comparison of the alternatives is provided in Section 2.6.

2.2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action, assessed in Section 6.1, is for the BLM to implement a Wind Energy Development Program to address issues defined by the MPDS. The BLM believes that developing and implementing the Wind Energy Development Program would provide the following benefits:

- *Amendment of land use plans.* The BLM proposes that this PEIS would provide the necessary level of NEPA analysis to support the amendment of land use plans to address wind energy development in those planning areas that have the potential for future wind energy development.

- *Tiering of project-specific environmental analyses.* The BLM proposes that future, project-specific environmental analyses for wind energy development would tier off of the analyses conducted in this PEIS and the decisions in the resultant Record of Decision (ROD), and thereby allow the project-specific analyses to focus just on the critical, site-specific issues of concern.

- *Development of comprehensive policies and BMPs.* The BLM proposes that the Wind Energy Development Program would provide comprehensive policies and BMPs that would provide guidance applicable to all wind energy development projects on BLM-administered lands.

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[1] The text box on the next page titled "Policies, BMPs, and Stipulations" provides definitions for each of these terms.

Policies, BMPs, and Stipulations

Policy: A plan of action adopted by an organization. Policies adopted as part of the proposed Wind Energy Development Program would establish a system for the administration and management of wind energy development on BLM-administered lands.

Best Management Practice: A practice (or combination of practices) that is determined to provide the most effective, environmentally sound, and economically feasible means of managing an activity and mitigating its impacts. BMPs adopted as part of the proposed Wind Energy Development Program would identify for the BLM, industry, and stakeholders the best set of practices for developing wind energy and ensuring minimal impact to natural and cultural resources.

Stipulation: A restriction that is insisted upon as a condition of agreement. ROW authorizations issued by the BLM will include project-specific stipulations defining the conditions for wind energy development on BLM-administered lands. The policies and BMPs of the proposed Wind Energy Development Program would provide a baseline set of stipulations; additional stipulations would be developed, as needed, to address site-specific issues and concerns, on the basis of relevant land use plan requirements, other BLM mitigation guidance, and mitigation measures identified and discussed in Chapter 5 of this PEIS.

- *Consistency of ROW application and authorization process.* The BLM proposes that implementation of a Wind Energy Development Program would result in greater consistency in the ROW application and authorization process.

The following sections describe the development scenario analyzed in this PEIS (Section 2.2.1), the phases of wind energy development addressed (Section 2.2.2), the proposed policies and BMPs for wind energy development (Section 2.2.3), and the proposed amendment of land use plans (Section 2.2.4).

2.2.1 Description of the Maximum Potential Development Scenario

An MPDS has been developed for BLM-administered lands in 11 western states. The MPDS identifies the spatial distribution of the maximum possible extent of future wind energy development activities that may occur on BLM-administered lands over the next 20 years (i.e., 2005 through 2025). A variety of factors (e.g., economic, social, and political constraints), beyond the BLM's control or influence, are likely to limit wind energy development to some level below that projected in the MPDS. However, the MPDS is evaluated in this PEIS as representing an upper bound of potential impacts and showing where the potential development might occur.

The MPDS was constructed by the National Renewable Energy Laboratory (NREL), a DOE laboratory focused on research of renewable energy resources. NREL has modeled and mapped the wind resources in each of the states and has assigned class designations to indicate the potential for wind power generation. Wind power classes range from 1 to 7; Class 7 has the highest potential wind power generation and Class 1 has the lowest. On the basis of projected wind technology development, NREL has determined that wind resources in Class 3 and higher could be economically developable over the next 20 years (i.e., the time frame for the PEIS analysis). In this PEIS, Class 3 resources have been characterized as having medium potential; resources in Classes 4 and higher have been characterized as having high potential.

In constructing the MPDS, NREL applied screening criteria to BLM-administered lands within the 11-state study area. These screens included (1) location of BLM-administered lands determined to be off limits for wind energy development by virtue of statutory or administrative controls (i.e., Wilderness Areas, Wilderness Study Areas, National Monuments, and National Conservation Areas [NCAs]),[2] and (2) occurrence of Class 3 or higher wind resources. The MPDS, therefore, identifies where BLM-administered lands that have the potential to be developed on the basis of land status and wind resources are located.

A detailed description of the methodology used to develop the MPDS is provided in Appendix B, along with Field Office-level maps depicting the location of the BLM-administered lands with the potential for wind energy development over the next 20 years (i.e., lands passing the screening criteria applied in NREL's evaluation). Figure 2.2.1-1 depicts the distribution of BLM-administered lands within the 11-state study area with medium (Class 3 wind resources) or high (Classes 4 through 7 wind resources) potential for wind energy development. As this map shows, lands with potential for development exist in each of the 11 states but are concentrated in specific portions of each state and are significantly present in Wyoming and Montana. Table 2.2.1-1 presents the total number of potentially developable acres of BLM-administered land in each of the 11 states.

NREL used a separate model, the Wind Deployment System (WinDS), to project the amount of wind power that might be generated over the next 20 years in the 11-state study area. The WinDS model, also described in detail in Appendix B, estimates the degree to which wind energy technology will contribute to electricity generation over time, considering issues such as access to and cost of transmission capacity, the intermittency of wind power, wind technology developments, and potential barriers to wind resource development.[3] A summary of the estimated new wind power generation for BLM-administered and other lands within each state over the next 20 years is provided in a discussion of economic impacts in Section 5.13 (Tables 5.13-1 through 5.13-3).

Because the WinDS model takes into account the myriad factors that will determine how much wind power will be generated over time, the model's results can be used to approximate the amount of wind energy development that might occur on BLM-administered lands and, thus,

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2 Wind energy development is permitted in one NCA, the California Desert Conservation Area (CDCA), in accordance with the provisions of the *California Desert Conservation Area Plan 1980, as Amended* (BLM 1999).

3 Barriers to wind resource development include a variety of factors. As discussed in Appendix B, Section B.2.2.1, the WinDS model excludes wind resource areas that may be environmentally sensitive or unlikely to be developed because of their ownership, designation, land use, physical attributes, or other constraints.

FIGURE 2.2.1-1 BLM-Administered Lands with Medium or High Potential for Wind Energy Development

TABLE 2.2.1-1 Summary of Potentially Developable and Economically Developable BLM-Administered Land within the 11-State Study Area (acres)[a]

State	Total Surface Land[b]	Total Potentially Developable Land[c]	Total Economically Developable Land[d]
Arizona	12,200,000	210,000	1,500
California	15,200,000	1,595,000	72,300
Colorado	8,400,000	208,000	4,200
Idaho	12,000,000	956,000	9,100
Montana	8,000,000	5,172,000	1,800
Nevada	47,800,000	1,157,000	34,700
New Mexico	13,400,000	1,542,000	9,800
Oregon	16,100,000	1,183,000	9,700
Utah	22,900,000	671,000	12,700
Washington	400,000	38,000	600
Wyoming	18,400,000	7,902,000	3,700
Total	174,700,000	20,634,000	160,100

[a] To convert acres to hectares, multiply by 0.4047.

[b] Source: BLM (2005b). Totals may be off due to rounding.

[c] Acreage estimates generated by the MPDS modeling.

[d] Acreage estimates generated by the WinDS model.

the number of acres that might be economically developable. Whereas the MPDS identifies all the potentially developable lands and shows their locations, the WinDS model output indicates how many total acres might be economically developable. The WinDS model, however, does not identify where the economically developable BLM-administered land is located. Table 2.2.1-1 presents the results of the WinDS model in terms of total number of BLM-administered acres likely to be developed over the next 20 years on the basis of economic factors. These results indicate that only a small portion of BLM-administered lands within each state are likely to be involved in wind energy development.

2.2.2 Phases of Wind Energy Development on BLM-Administered Lands

The impact analyses address issues related to the different phases of wind energy development at a programmatic level. All phases of wind energy development are included in the analyses: site monitoring and testing, construction, operation, and decommissioning. Typical activities that occur during each of these phases are described in Chapter 3, along with discussions of regulatory requirements; health and safety issues; hazardous materials and waste management considerations; transportation requirements; and relevant, existing mitigation guidance for wind energy projects. Site-specific and species-specific issues pertaining to these phases of development are not within the scope of this PEIS and will be addressed in project-specific NEPA documents.

2.2.3 The BLM's Proposed Wind Energy Development Program

The BLM proposes to adopt a number of policies and BMPs as part of the proposed Wind Energy Development Program. These policies and BMPs have been formulated on the basis of a detailed, comprehensive analysis of the potential impacts of wind energy development under the MPDS and relevant mitigation measures (Chapter 5). Reviews of existing, relevant mitigation guidance (Section 3.6) and comments received during scoping and public review of the Draft PEIS (Sections 7.1 and 7.2) were also conducted. On the basis of these reviews, the BLM identified programmatic policies and BMPs that would be applicable to all wind energy development projects on BLM-administered lands.

The BLM proposes that these policies and BMPs would establish the minimum requirements for management of individual wind energy projects. The proposed policies express the desired outcomes the BMPs are intended to achieve. In addition, the proposed policies address the administration of wind energy development activities, and the proposed BMPs identify required mitigation measures that would need to be incorporated into project-specific Plans of Development (PODs) and ROW authorization stipulations. Additional mitigation measures would be applied to individual projects, in the form of stipulations in the ROW authorization as appropriate, to address site-specific and species-specific issues.

This section presents the proposed policies and BMPs. Upon final approval of the BLM's proposed Wind Energy Development Program, the Interim Wind Energy Development Policy (BLM 2002a) (Appendix A) would be replaced by a new policy that incorporates the programmatic policies and BMPs evaluated in this PEIS. Elements of the interim policy addressing applications, authorizations, competitive interests, and due diligence will not be changed by the proposed program requirements.

2.2.3.1 Proposed Policies

The BLM proposes to adopt the following policies as part of its proposed Wind Energy Development Program:

- The BLM will not issue ROW authorizations for wind energy development on lands on which wind energy development is incompatible with specific resource values. Lands that will be excluded from wind energy site monitoring and testing and development include designated areas that are part of the National Landscape Conservation System (NLCS) (e.g., Wilderness Areas, Wilderness Study Areas, National Monuments, NCAs,[4] Wild and Scenic Rivers, and National Historic and Scenic Trails) and Areas of Critical Environmental Concern (ACECs).[5] Additional areas of land may be excluded from wind energy development on the basis of findings of resource impacts that cannot be mitigated and/or conflict with existing and planned multiple-use activities or land use plans.

- To the extent possible, wind energy projects shall be developed in a manner that will not prevent other land uses, including minerals extraction, livestock grazing, recreational use, and other ROW uses.

- Entities seeking to develop a wind energy project on BLM-administered lands shall consult with appropriate federal, state, and local agencies regarding specific projects as early in the planning process as appropriate to ensure that all potential construction, operation, and decommissioning issues and concerns are identified and adequately addressed.

- The BLM will initiate government-to-government consultation with Indian Tribal governments whose interests might be directly and substantially affected by activities on BLM-administered lands as early in the planning process as appropriate to ensure that construction, operation, and decommissioning issues and concerns are identified and adequately addressed.

- Entities seeking to develop a wind energy project on BLM-administered lands, in conjunction with BLM Washington Office and Field Office staff, shall consult with the U.S. Department of Defense (DoD) regarding the location of wind power projects and turbine siting as early in the planning process as appropriate. This consultation shall occur concurrently at both the installation/field level and the Pentagon/BLM Washington Office level. An interagency protocol agreement is being developed to establish a consultation process and to identify the scope of issues for consultation. Lands withdrawn for military purposes are under the administrative jurisdiction of the DoD or a military service and are not available for issuance of wind energy authorizations by the BLM.

- The BLM will consult with the U.S. Fish and Wildlife Service (USFWS) as required by Section 7 of the Endangered Species Act of 1973 (ESA). The specific consultation requirements will be determined on a project-by-project basis.

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4 Wind energy development is permitted in one NCA, the California Desert Conservation Area (CDCA), in accordance with the provisions of the *California Desert Conservation Area Plan 1980, as Amended* (BLM 1999).

5 Although the MPDS developed for this PEIS (Section 2.2.1 and Appendix B) did not exclude all of these lands at the screening level, they will be excluded from wind energy development.

- The BLM will consult with the State Historic Preservation Office (SHPO) as required by Section 106 of the National Historic Preservation Act of 1966 (NHPA). The specific consultation requirements will be determined on a project-by-project basis. If programmatic Section 106 consultations have been conducted and are adequate to cover a proposed project, additional consultation may not be needed.

- Existing land use plans will be amended, as appropriate, to (1) adopt provisions of the BLM's proposed Wind Energy Development Program, (2) identify land considered to be available for wind energy development, and (3) identify land that will not be available for wind energy development.

- The level of environmental analysis to be required under NEPA for individual wind power projects will be determined at the Field Office level. In certain instances, it may be determined that a tiered environmental assessment (EA) is appropriate in lieu of an EIS. To the extent that this PEIS addresses anticipated issues and concerns associated with an individual project, including potential cumulative impacts, the BLM will tier off of the decisions embedded in this PEIS and limit the scope of additional project-specific NEPA analyses. The site-specific NEPA analyses will include analyses of project site configuration and micrositing considerations, monitoring program requirements, and appropriate mitigation measures. In particular, the mitigation measures discussed in Chapter 5 may be consulted in determining site-specific requirements. Public involvement will be incorporated into all wind energy development projects to ensure that all concerns and issues are identified and adequately addressed. In general, the scope of the NEPA analyses will be limited to the proposed action on BLM-administered lands; however, if access to proposed development on adjacent non-BLM-administered lands is entirely dependent on obtaining ROW access across BLM-administered lands and there are no alternatives to that access, the NEPA analysis for the proposed ROW may need to assess the environmental effects from that proposed development. The BLM's analyses of ROW access projects may tier off of this PEIS to the extent that the proposed project falls within the scope of the PEIS analyses.

- Site-specific environmental analyses will tier from the PEIS and identify and assess any cumulative impacts that are beyond the scope of the cumulative impacts addressed in the PEIS.

- The existing Categorical Exclusion (CX) applicable to the issuance of short-term ROWs or land use authorizations may be applicable to some site monitoring and testing activities. The relevant CX, established for the BLM in the DOI Departmental Manual 516, Chapter 11, Sec. 11.5, E(19) (DOI 2004), encompasses "issuance of short-term (3 years or less) rights-of-way or land use authorizations for such uses as storage sites, apiary sites, and construction sites where the proposal includes rehabilitation to restore the land to its natural or original condition."

- The BLM will require financial bonds for all wind energy development projects on BLM-administered lands to ensure compliance with the terms and conditions of the ROW authorization and the requirements of applicable regulatory requirements, including reclamation costs. The amount of the required bond will be determined during the ROW authorization process on the basis of site-specific and project-specific factors. The BLM may also require financial bonds for site monitoring and testing authorizations.

- Entities seeking to develop a wind energy project on BLM-administered lands shall develop a project-specific POD that incorporates all proposed BMPs (Section 2.2.3.2) and, as appropriate, the requirements of other existing and relevant BLM mitigation guidance, including the BLM's interim off-site mitigation guidance (BLM 2005a) (Section 3.6.2). Additional mitigation measures will be incorporated into the POD and into the ROW authorization as project stipulations, as needed, to address site-specific and species-specific issues. The POD will include a site plan showing the locations of turbines, roads, power lines, other infrastructure, and other areas of short- and long-term disturbance.

- The BLM will incorporate management goals and objectives specific to habitat conservation for species of concern (e.g., sage-grouse), as appropriate, into the POD for proposed wind energy projects.

- The BLM will consider the visual resource values of the public lands involved in proposed wind energy development projects, consistent with BLM Visual Resource Management (VRM) policies and guidance. The BLM will work with the ROW applicant to incorporate visual design considerations into the planning and design of the project to minimize potential visual impacts of the proposal and to meet the VRM objectives of the area.

- Operators of wind power facilities on BLM-administered lands shall consult with the BLM and other appropriate federal, state, and local agencies regarding any planned upgrades or changes to the wind facility design or operation. Proposed changes of this nature may require additional environmental analysis and/or revision of the POD.

- The BLM's proposed Wind Energy Development Program will incorporate adaptive management strategies to ensure that potential adverse impacts of wind energy development are avoided (if possible), minimized, or mitigated to acceptable levels. The programmatic policies and BMPs will be updated and revised as new data regarding the impacts of wind power projects become available. At the project-level, operators will be required to develop monitoring programs to evaluate the environmental conditions at the site through all phases of development, to establish metrics against which monitoring observations can be measured, to identify potential mitigation measures, and to establish protocols for incorporating monitoring observations and additional mitigation measures into standard operating procedures and project-specific stipulations.

2.2.3.2 Proposed BMPs

The BLM proposes that the following BMPs be applied to all wind energy development projects to establish environmentally sound and economically feasible mechanisms to protect and enhance natural and cultural resources. These proposed BMPs were derived from the mitigation measures discussed in Chapter 5 but are limited to those measures that are applicable to all wind energy development projects (Section 5.15). These BMPs would be adopted as required elements of project-specific PODs and/or as ROW authorization stipulations. They are categorized by development activity: site monitoring and testing, development of the POD, construction, operation, and decommissioning. The proposed BMPs for development of the POD identify required elements of the POD needed to address potential impacts associated with subsequent phases of development.

Some of the proposed BMPs address issues that are not unique to wind energy development but that are more universal in nature, such as road construction and maintenance, wildlife management, hazardous materials and waste management, cultural resource management, and pesticide use and integrated pest management. For the most part, however, the level of detail provided by the BMPs is less specific than that provided in other, existing BLM program-specific mitigation guidance documents (Section 3.6.2). As required by proposed policy (Section 2.2.3.1), mitigation measures identified in or required by these existing program-specific guidance documents would be applied, as appropriate, to wind energy development projects; however, they are not discussed in detail in the programmatic BMPs proposed here.

In summary, stipulations governing specific wind energy projects would be derived from a number of sources: (1) the proposed BMPs discussed in this section; (2) other, existing and relevant program-specific mitigation guidance (Section 3.6); and (3) the mitigation measures discussed in Chapter 5. Guidelines for applying and selecting project-specific requirements include determining whether the measure would (1) ensure compliance with relevant statutory or administrative requirements, (2) minimize local impacts associated with siting and design decisions, (3) promote postconstruction stabilization of impacts, (4) maximize restoration of previous habitat conditions, (5) minimize cumulative impacts, or (6) promote economically feasible development of wind energy on BLM-administered land.

2.2.3.2.1 Site Monitoring and Testing

- The area disturbed by installation of meteorological towers (i.e., footprint) shall be kept to a minimum.

- Existing roads shall be used to the maximum extent feasible. If new roads are necessary, they shall be designed and constructed to the appropriate standard.

- Meteorological towers shall not be located in sensitive habitats or in areas where ecological resources known to be sensitive to human activities (e.g., prairie grouse) are present. Installation of towers shall be scheduled to avoid disruption of wildlife reproductive activities or other important behaviors.

- Meteorological towers installed for site monitoring and testing shall be inspected periodically for structural integrity.

2.2.3.2.2 Plan of Development Preparation

General

- The BLM and operators shall contact appropriate agencies, property owners, and other stakeholders early in the planning process to identify potentially sensitive land uses and issues, rules that govern wind energy development locally, and land use concerns specific to the region.

- Available information describing the environmental and sociocultural conditions in the vicinity of the proposed project shall be collected and reviewed as needed to predict potential impacts of the project.

- The Federal Aviation Administration (FAA)-required notice of proposed construction shall be made as early as possible to identify any air safety measures that would be required.

- To plan for efficient use of the land, necessary infrastructure requirements shall be consolidated wherever possible, and current transmission and market access shall be evaluated carefully.

- The project shall be planned to utilize existing roads and utility corridors to the maximum extent feasible, and to minimize the number and length/size of new roads, lay-down areas, and borrow areas.

- A monitoring program shall be developed to ensure that environmental conditions are monitored during the construction, operation, and decommissioning phases. The monitoring program requirements, including adaptive management strategies, shall be established at the project level to ensure that potential adverse impacts of wind energy development are mitigated. The monitoring program shall identify the monitoring requirements for each environmental resource present at the site, establish metrics against which monitoring observations can be measured, identify potential mitigation measures, and establish protocols for incorporating monitoring observations and additional mitigation measures into standard operating procedures and BMPs.

- "Good housekeeping" procedures shall be developed to ensure that during operation the site will be kept clean of debris, garbage, fugitive trash or waste, and graffiti; to prohibit scrap heaps and dumps; and to minimize storage yards.

Wildlife and Other Ecological Resources

- Operators shall review existing information on species and habitats in the vicinity of the project area to identify potential concerns.

- Operators shall conduct surveys for federal- and/or state-protected species and other species of concern (including special status plant and animal species) within the project area and design the project to avoid (if possible), minimize, or mitigate impacts to these resources.

- Operators shall identify important, sensitive, or unique habitats in the vicinity of the project and design the project to avoid (if possible), minimize, or mitigate impacts to these habitats (e.g., locate the turbines, roads, and ancillary facilities in the least environmentally sensitive areas; i.e., away from riparian habitats, streams, wetlands, drainages, or critical wildlife habitats).

- The BLM will prohibit the disturbance of any population of federal listed plant species.

- Operators shall evaluate avian and bat use of the project area and design the project to minimize or mitigate the potential for bird and bat strikes (e.g., development shall not occur in riparian habitats and wetlands). Scientifically rigorous avian and bat use surveys shall be conducted; the amount and extent of ecological baseline data required shall be determined on a project basis.

- Turbines shall be configured to avoid landscape features known to attract raptors, if site studies show that placing turbines there would pose a significant risk to raptors.

- Operators shall determine the presence of bat colonies and avoid placing turbines near known bat hibernation, breeding, and maternity/nursery colonies; in known migration corridors; or in known flight paths between colonies and feeding areas.

- Operators shall determine the presence of active raptor nests (i.e., raptor nests used during the breeding season). Measures to reduce raptor use at a project site (e.g., minimize road cuts, maintain either no vegetation or nonattractive plant species around the turbines) shall be considered.

- A habitat restoration plan shall be developed to avoid (if possible), minimize, or mitigate negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. The plan shall identify revegetation, soil stabilization, and erosion reduction measures that shall be implemented to ensure that all temporary use areas are restored. The plan shall require that restoration occur as soon as possible after completion of activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.

- Procedures shall be developed to mitigate potential impacts to special status species. Such measures could include avoidance, relocation of project facilities or lay-down areas, and/or relocation of biota.

- Facilities shall be designed to discourage their use as perching or nesting substrates by birds. For example, power lines and poles shall be configured to minimize raptor electrocutions and discourage raptor and raven nesting and perching.

Visual Resources

- The public shall be involved and informed about the visual site design elements of the proposed wind energy facilities. Possible approaches include conducting public forums for disseminating information, offering organized tours of operating wind developments, and using computer simulation and visualization techniques in public presentations.

- Turbine arrays and turbine design shall be integrated with the surrounding landscape. Design elements to be addressed include visual uniformity, use of tubular towers, proportion and color of turbines, nonreflective paints, and prohibition of commercial messages on turbines.

- Other site design elements shall be integrated with the surrounding landscape. Elements to address include minimizing the profile of the ancillary structures, burial of cables, prohibition of commercial symbols, and lighting. Regarding lighting, efforts shall be made to minimize the need for and amount of lighting on ancillary structures.

Roads

- An access road siting and management plan shall be prepared incorporating existing BLM standards regarding road design, construction, and maintenance such as those described in the BLM 9113 Manual (BLM 1985) and the *Surface Operating Standards for Oil and Gas Exploration and Development* (RMRCC 1989) (i.e., the Gold Book).

Ground Transportation

- A transportation plan shall be developed, particularly for the transport of turbine components, main assembly cranes, and other large pieces of equipment. The plan shall consider specific object sizes, weights, origin, destination, and unique handling requirements and shall evaluate alternative transportation approaches. In addition, the process to be used to comply with unique state requirements and to obtain all necessary permits shall be clearly identified.

- A traffic management plan shall be prepared for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan shall incorporate measures such as informational signs, flaggers when equipment may result in blocked throughways, and traffic cones to identify any necessary changes in temporary lane configuration.

Noise

- Proponents of a wind energy development project shall take measurements to assess the existing background noise levels at a given site and compare them with the anticipated noise levels associated with the proposed project.

Noxious Weeds and Pesticides

- Operators shall develop a plan for control of noxious weeds and invasive species, which could occur as a result of new surface disturbance activities at the site. The plan shall address monitoring, education of personnel on weed identification, the manner in which weeds spread, and methods for treating infestations. The use of certified weed-free mulching shall be required. If trucks and construction equipment are arriving from locations with known invasive vegetation problems, a controlled inspection and cleaning area shall be established to visually inspect construction equipment arriving at the project area and to remove and collect seeds that may be adhering to tires and other equipment surfaces.

- If pesticides are used on the site, an integrated pest management plan shall be developed to ensure that applications would be conducted within the framework of BLM and DOI policies and entail only the use of EPA-registered pesticides. Pesticide use shall be limited to nonpersistent, immobile pesticides and shall only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.

Cultural/Historic Resources

- The BLM will consult with Indian Tribal governments early in the planning process to identify issues regarding the proposed wind energy development, including issues related to the presence of cultural properties, access rights, disruption to traditional cultural practices, and impacts to visual resources important to the Tribe(s).

- The presence of archaeological sites and historic properties in the area of potential effect shall be determined on the basis of a records search of recorded sites and properties in the area and/or, depending on the extent and reliability of existing information, an archaeological survey. Archaeological sites and historic properties present in the area of potential effect shall be reviewed to determine whether they meet the criteria of eligibility for listing on the *National Register of Historic Places* (NRHP).

- When any ROW application includes remnants of a National Historic Trail, is located within the viewshed of a National Historic Trail's designated centerline, or includes or is within the viewshed of a trail eligible for listing on the NRHP, the operator shall evaluate the potential visual impacts to the trail associated with the proposed project and identify appropriate mitigation measures for inclusion as stipulations in the POD.

- If cultural resources are present at the site, or if areas with a high potential to contain cultural material have been identified, a cultural resources management plan (CRMP) shall be developed. This plan shall address mitigation activities to be taken for cultural resources found at the site. Avoidance of the area is always the preferred mitigation option. Other mitigation options include archaeological survey and excavation (as warranted) and monitoring. If an area exhibits a high potential, but no artifacts were observed during an archaeological survey, monitoring by a qualified archaeologist could be required during all excavation and earthmoving in the high-potential area. A report shall be prepared documenting these activities. The CRMP also shall (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of artifacts and destruction of property on public land.

Paleontological Resources

- Operators shall determine whether paleontological resources exist in a project area on the basis of the sedimentary context of the area, a records search for past paleontological finds in the area, and/or, depending on the extent of existing information, a paleontological survey.

- If paleontological resources are present at the site, or if areas with a high potential to contain paleontological material have been identified, a paleontological resources management plan shall be developed. This plan shall include a mitigation plan for collection of the fossils; mitigation could include avoidance, removal of fossils, or monitoring. If an area exhibits a high potential but no fossils were observed during survey, monitoring by a qualified paleontologist could be required during all excavation and earthmoving in the sensitive area. A report shall be prepared documenting these activities. The paleontological resources management plan also shall (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of fossils on public land.

Hazardous Materials and Waste Management

- Operators shall develop a hazardous materials management plan addressing storage, use, transportation, and disposal of each hazardous material anticipated to be used at the site. The plan shall identify all hazardous materials that would be used, stored, or transported at the site. It shall establish inspection procedures, storage requirements, storage quantity limits, inventory control, nonhazardous product substitutes, and disposition of excess materials. The plan shall also identify requirements for notices to federal and local emergency response authorities and include emergency response plans.

- Operators shall develop a waste management plan identifying the waste streams that are expected to be generated at the site and addressing hazardous waste determination procedures, waste storage locations, waste-specific management and disposal requirements, inspection procedures, and waste minimization procedures. This plan shall address all solid and liquid wastes that may be generated at the site.

- Operators shall develop a spill prevention and response plan identifying where hazardous materials and wastes are stored on site, spill prevention measures to be implemented, training requirements, appropriate spill response actions for each material or waste, the locations of spill response kits on site, a procedure for ensuring that the spill response kits are adequately stocked at all times, and procedures for making timely notifications to authorities.

Storm Water

- Operators shall develop a storm water management plan for the site to ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion.

Human Health and Safety

- A safety assessment shall be conducted to describe potential safety issues and the means that would be taken to mitigate them, including issues such as site access, construction, safe work practices, security, heavy equipment transportation, traffic management, emergency procedures, and fire control.

- A health and safety program shall be developed to protect both workers and the general public during construction, operation, and decommissioning of a wind energy project. Regarding occupational health and safety, the program shall identify all applicable federal and state occupational safety standards; establish safe work practices for each task (e.g., requirements for personal protective equipment and safety harnesses; Occupational Safety and Health Administration [OSHA] standard practices for safe use of explosives and blasting agents; and measures for reducing occupational electric and magnetic fields [EMF] exposures); establish fire safety evacuation procedures; and define safety performance standards (e.g., electrical system standards and lightning protection standards). The program shall include a training program to identify hazard training requirements for workers for each task and establish procedures for providing required training to all workers. Documentation of training and a mechanism for reporting serious accidents to appropriate agencies shall be established.

- Regarding public health and safety, the health and safety program shall establish a safety zone or setback for wind turbine generators from residences and occupied buildings, roads, ROWs, and other public access areas that is sufficient to prevent accidents resulting from the operation of wind turbine generators. It shall identify requirements for temporary fencing around staging areas, storage yards, and excavations during construction or decommissioning activities. It shall also identify measures to be taken during the operation phase to limit public access to hazardous facilities (e.g., permanent fencing would be installed only around electrical substations, and turbine tower access doors would be locked).

- Operators shall consult with local planning authorities regarding increased traffic during the construction phase, including an assessment of the number of vehicles per day, their size, and type. Specific issues of concern (e.g., location of school bus routes and stops) shall be identified and addressed in the traffic management plan.

- If operation of the wind turbines is expected to cause significant adverse impacts to nearby residences and occupied buildings from shadow flicker, low-frequency sound, or EMF, site-specific recommendations for addressing these concerns shall be incorporated into the project design (e.g., establishing a sufficient setback from turbines).

- The project shall be planned to minimize electromagnetic interference (EMI) (e.g., impacts to radar, microwave, television, and radio transmissions) and comply with Federal Communications Commission [FCC] regulations. Signal strength studies shall be conducted when proposed locations have the potential to impact transmissions. Potential interference with public safety communication systems (e.g., radio traffic related to emergency activities) shall be avoided.

- The project shall be planned to comply with FAA regulations, including lighting regulations, and to avoid potential safety issues associated with proximity to airports, military bases or training areas, or landing strips.

- Operators shall develop a fire management strategy to implement measures to minimize the potential for a human-caused fire.

2.2.3.2.3 Construction

General

- All control and mitigation measures established for the project in the POD and the resource-specific management plans that are part of the POD shall be maintained and implemented throughout the construction phase, as appropriate.

- The area disturbed by construction and operation of a wind energy development project (i.e., footprint) shall be kept to a minimum.

- The number and size/length of roads, temporary fences, lay-down areas, and borrow areas shall be minimized.

- Topsoil from all excavations and construction activities shall be salvaged and reapplied during reclamation.

- All areas of disturbed soil shall be reclaimed using weed-free native grasses, forbs, and shrubs. Reclamation activities shall be undertaken as early as possible on disturbed areas.

- All electrical collector lines shall be buried in a manner that minimizes additional surface disturbance (e.g., along roads or other paths of surface disturbance). Overhead lines may be used in cases where burial of lines would result in further habitat disturbance.

- Operators shall identify unstable slopes and local factors that can induce slope instability (such as groundwater conditions, precipitation, earthquake activities, slope angles, and the dip angles of geologic strata). Operators also shall avoid creating excessive slopes during excavation and blasting operations. Special construction techniques shall be used where applicable in areas of steep slopes, erodible soil, and stream channel crossings.

- Erosion controls that comply with county, state, and federal standards shall be applied. Practices such as jute netting, silt fences, and check dams shall be applied near disturbed areas.

Wildlife

- Guy wires on permanent meteorological towers shall be avoided.

- In accordance with the habitat restoration plan, restoration shall be undertaken as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.

- All construction employees shall be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. In addition, pets shall not be permitted on site during construction.

Visual Resources

- Operators shall reduce visual impacts during construction by minimizing areas of surface disturbance, controlling erosion, using dust suppression techniques, and restoring exposed soils as closely as possible to their original contour and vegetation.

Roads

- Existing roads shall be used, but only if in safe and environmentally sound locations. If new roads are necessary, they shall be designed and constructed to the appropriate standard and be no higher than necessary to accommodate their intended functions (e.g., traffic volume and weight of vehicles). Excessive grades on roads, road embankments, ditches, and drainages shall be avoided, especially in areas with erodible soils. Special construction techniques shall be used, where applicable. Abandoned roads and roads that are no longer needed shall be recontoured and revegetated.

- Access roads and on-site roads shall be surfaced with aggregate materials, wherever appropriate.

- Access roads shall be located to follow natural contours and minimize side hill cuts.

- Roads shall be located away from drainage bottoms and avoid wetlands, if practicable.

- Roads shall be designed so that changes to surface water runoff are avoided and erosion is not initiated.

- Access roads shall be located to minimize stream crossings. All structures crossing streams shall be located and constructed so that they do not decrease channel stability or increase water velocity. Operators shall obtain all applicable federal and state permits.

- Existing drainage systems shall not be altered, especially in sensitive areas such as erodible soils or steep slopes. Potential soil erosion shall be controlled at culvert outlets with appropriate structures. Catch basins, roadway ditches, and culverts shall be cleaned and maintained regularly.

Ground Transportation

- Project personnel and contractors shall be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow and to reduce wildlife collisions and disturbance and airborne dust.

- Traffic shall be restricted to the roads developed for the project. Use of other unimproved roads shall be restricted to emergency situations.

- Signs shall be placed along construction roads to identify speed limits, travel restrictions, and other standard traffic control information. To minimize impacts on local commuters, consideration shall be given to limiting construction vehicles traveling on public roadways during the morning and late afternoon commute time.

Air Emissions

- Dust abatement techniques shall be used on unpaved, unvegetated surfaces to minimize airborne dust.

- Speed limits (e.g., 25 mph [40 km/h]) shall be posted and enforced to reduce airborne fugitive dust.

- Construction materials and stockpiled soils shall be covered if they are a source of fugitive dust.

- Dust abatement techniques shall be used before and during surface clearing, excavation, or blasting activities.

Excavation and Blasting Activities

- Operators shall gain a clear understanding of the local hydrogeology. Areas of groundwater discharge and recharge and their potential relationships with surface water bodies shall be identified.

- Operators shall avoid creating hydrologic conduits between two aquifers during foundation excavation and other activities.

- Foundations and trenches shall be backfilled with originally excavated material as much as possible. Excess excavation materials shall be disposed of only in approved areas or, if suitable, stockpiled for use in reclamation activities.

- Borrow material shall be obtained only from authorized and permitted sites. Existing sites shall be used in preference to new sites.

- Explosives shall be used only within specified times and at specified distances from sensitive wildlife or streams and lakes, as established by the BLM or other federal and state agencies.

Noise

- Noisy construction activities (including blasting) shall be limited to the least noise-sensitive times of day (i.e., daytime only between 7 a.m. and 10 p.m.) and weekdays.

- All equipment shall have sound-control devices no less effective than those provided on the original equipment. All construction equipment used shall be adequately muffled and maintained.

- All stationary construction equipment (i.e., compressors and generators) shall be located as far as practicable from nearby residences.

- If blasting or other noisy activities are required during the construction period, nearby residents shall be notified in advance.

Cultural and Paleontological Resources

- Unexpected discovery of cultural or paleontological resources during construction shall be brought to the attention of the responsible BLM authorized officer immediately. Work shall be halted in the vicinity of the find to avoid further disturbance to the resources while they are being evaluated and appropriate mitigation measures are being developed.

Hazardous Materials and Waste Management

- Secondary containment shall be provided for all on-site hazardous materials and waste storage, including fuel. In particular, fuel storage (for construction vehicles and equipment) shall be a temporary activity occurring only for as long as is needed to support construction activities.

- Wastes shall be properly containerized and removed periodically for disposal at appropriate off-site permitted disposal facilities.

- In the event of an accidental release to the environment, the operator shall document the event, including a root cause analysis, appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts. Documentation of the event shall be provided to the BLM authorized officer and other federal and state agencies, as required.

- Any wastewater generated in association with temporary, portable sanitary facilities shall be periodically removed by a licensed hauler and introduced into an existing municipal sewage treatment facility. Temporary, portable sanitary facilities provided for construction crews shall be adequate to support expected on-site personnel and shall be removed at completion of construction activities.

Public Health and Safety

- Temporary fencing shall be installed around staging areas, storage yards, and excavations during construction to limit public access.

2.2.3.2.4 Operation

General

- All control and mitigation measures established for the project in the POD and the resource-specific management plans that are part of the POD shall be maintained and implemented throughout the operational phase, as appropriate. These control and mitigation measures shall be reviewed and revised, as needed, to address changing conditions or requirements at the site, throughout the operational phase. This adaptive management approach would help ensure that impacts from operations are kept to a minimum.

- Inoperative turbines shall be repaired, replaced, or removed in a timely manner. Requirements to do so shall be incorporated into the due diligence provisions of the ROW authorization. Operators will be required to demonstrate due diligence in the repair, replacement, or removal of turbines; failure to do so could result in termination of the ROW authorization.

Wildlife

- Employees, contractors, and site visitors shall be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. In addition, any pets shall be controlled to avoid harassment and disturbance of wildlife.

- Observations of potential wildlife problems, including wildlife mortality, shall be reported to the BLM authorized officer immediately.

Ground Transportation

- Ongoing ground transportation planning shall be conducted to evaluate road use, minimize traffic volume, and ensure that roads are maintained adequately to minimize associated impacts.

Monitoring Program

- Site monitoring protocols defined in the POD shall be implemented. These will incorporate monitoring program observations and additional mitigation measures into standard operating procedures and BMPs to minimize future environmental impacts.

- Results of monitoring program efforts shall be provided to the BLM authorized officer.

Public Health and Safety

- Permanent fencing shall be installed and maintained around electrical substations, and turbine tower access doors shall be locked to limit public access.

- In the event an installed wind energy development project results in EMI, the operator shall work with the owner of the impacted communications system to resolve the problem. Additional warning information may also need to be conveyed to aircraft with onboard radar systems so that echoes from wind turbines can be quickly recognized.

2.2.3.2.5 Decommissioning

General

- Prior to the termination of the ROW authorization, a decommissioning plan shall be developed and approved by the BLM. The decommissioning plan shall include a site reclamation plan and monitoring program.

- All management plans, BMPs, and stipulations developed for the construction phase shall be applied to similar activities during the decommissioning phase.

- All turbines and ancillary structures shall be removed from the site.

- Topsoil from all decommissioning activities shall be salvaged and reapplied during final reclamation.

- All areas of disturbed soil shall be reclaimed using weed-free native shrubs, grasses, and forbs.

- The vegetation cover, composition, and diversity shall be restored to values commensurate with the ecological setting.

2.2.4 Proposed Land Use Plan Amendments under the PEIS

Analyses conducted in this PEIS support the amendment of specific land use plans for land where potentially developable wind resources are located. Plans proposed for amendment under this PEIS are identified in Table 2.2.4-1. Proposed amendments include (1) adoption of the proposed programmatic policies and BMPs, and (2) identification of specific areas where wind energy development would not be allowed. Information describing how each plan would be amended and the rationale for each change are provided in Appendix C. By virtue of the proposed policy, wind energy development would be excluded on all NLCS lands[6] and ACECs. Although the NOI for this PEIS (68 FR 201, October 17, 2003) indicated that the land use plan amendments would also identify some lands as suitable for competitive ROW bidding processes, they were not identified for any of the plans included in Table 2.2.4-1. Interest in competitive ROW bidding processes currently is limited to two areas in California — the Palm Springs-South Coast Field Office and Ridgecrest Field Office — and would be addressed in local BLM land use planning efforts.

Some plans within the 11-state study area were excluded from amendment under this PEIS for a variety of reasons, including these: (1) if developable wind resources (i.e., Class 3 or higher) are not present in the planning area, (2) if the plan was previously amended or revised to adequately address wind energy development, (3) if the plan currently is being amended or revised in a separate NEPA review and that amendment or revision will address wind energy development, or (4) if some other reason(s) exist(s) to exclude the plan from amendment under this PEIS (e.g., a plan revision is scheduled in the foreseeable future).

Other land use plans could be amended or revised at some point in the future to address wind energy development. The BLM anticipates that the analyses contained in this PEIS would be incorporated into those amendments and revisions, as appropriate. In particular, it is anticipated that appropriate policies and BMPs would be incorporated into these future amendments and revisions and that it would be possible to tier off of the decisions in the ROD for the PEIS.

2.3 DESCRIPTION OF THE NO ACTION ALTERNATIVE

Under the no action alternative, assessed in Section 6.2, wind energy development would continue on BLM-administered land and NEPA analyses would be prepared on a project-by-project basis. Wind energy projects would be developed through ROW authorizations in accordance with the Interim Wind Energy Development Policy (BLM 2002a) (Appendix A). The interim policy addresses site monitoring and testing activities, commercial development, ROW terms, and environmental review.

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6 Wind energy development is permitted in one NCA, the California Desert Conservation Area (CDCA), in accordance with the provisions of the *California Desert Conservation Area Plan 1980, as Amended* (BLM 1999).

TABLE 2.2.4-1 Land Use Plans Proposed for Amendment under the PEIS

State	Land Use Plan and Field Office[a]
Arizona	Ongoing and upcoming land use plan amendments being conducted outside the scope of this PEIS will address wind energy development in Arizona for those areas where developable wind resources are present.
California	Ongoing and upcoming land use plan amendments being conducted outside the scope of this PEIS will address wind energy development in California for those areas where developable wind resources are present.
Colorado	Royal Gorge RMP, Royal Gorge Field Office San Luis RMP, includes La Jara, Saguache, and Del Norte Field Offices and the San Luis Valley Public Lands Center
Idaho	Cascade RMP, Four Rivers Field Office Challis RMP, Challis Field Office Jarbidge RMP, Jarbidge Field Office Kuna MFP, Four Rivers Field Office Lemhi RMP, Salmon Field Office Owyhee RMP, Owyhee Field Office Twin Falls MFP, Burley Field Office
Montana	Billings RMP, Billings Field Office Garnet RMP, Missoula Field Office Headwaters RMP, Butte Field Office Judith-Valley-Phillips RMP, Lewistown and Malta Field Offices West Hi Line RMP, Lewiston Field Office
Nevada	Elko RMP, Elko Field Office Las Vegas RMP, Las Vegas Field Office Paradise-Denio MFP, Winnemucca Field Office Shoshone-Eureka RMP, Battle Mountain Field Office Sonoma-Gerlach MFP, Winnemucca Field Office Tonopah RMP, Battle Mountain Field Office, Tonopah Field Station Wells RMP, Elko Field Office
New Mexico	Carlsbad RMP, Carlsbad Field Office Mimbres RMP, Las Cruces Field Office Roswell RMP, Roswell Field Office White Sands RMP, Las Cruces Field Office
Oregon[b]	Andrews/Steens RMP, Andrews/Steens Field Office Brothers/LaPine RMP, Deschutes and Central Oregon Field Offices Coos Bay RMP, Coos Bay Field Office Eugene RMP, Eugene Field Office John Day RMP, Central Oregon Field Office Medford RMP, Medford Field Office Salem RMP, Salem Field Office Southeast Oregon RMP, Malheur and Jordan Resource Areas Three Rivers RMP, Three Rivers Field Office Two Rivers RMP, Deschutes and Central Oregon Field Offices Upper Deschutes RMP, Deschutes Field Office

TABLE 2.2.4-1 (Cont.)

State	Land Use Plan and Field Office[a]
Utah	Cedar-Beaver-Garfield-Antimony RMP, Cedar City Field Office Escalante MFP, Kanab Field Office Paria MFP, Kanab Field Office Pinyon MFP, Cedar City Field Office Randolph MFP, Salt Lake Field Office St. George RMP, St. George Field Office Vermillion MFP, Kanab Field Office Zion MFP, Kanab Field Office
Washington	Spokane RMP, Wenatchee and Border Field Offices
Wyoming	Buffalo RMP, Buffalo Field Office Cody RMP, Cody Field Office Grass Creek RMP, Worland Field Office Green River RMP, Rock Springs Field Office Lander RMP, Lander Field Office Newcastle RMP, Newcastle Field Office Washakie RMP, Worland Field Office

[a] Abbreviations: MFP = Management Framework Plan; RMP = Resource Management Plan.

[b] The Andrews/Steens RMP is currently being revised; upon completion, it will replace the Andrews MFP and revise part of the Three Rivers RMP. The Upper Deschutes RMP is also being revised; upon completion, it will replace a portion of the Brothers/LaPine RMP. The proposed amendments discussed in Appendix C for the Andrews/Steens RMP and Upper Deschutes RMP will be applied to whatever plans are in existence at the time the ROD is issued for this PEIS.

Although the interim policy places no specific restrictions on which BLM-administered land may be subject to wind energy development, for the purposes of this PEIS, it is assumed that only that land identified in the MPDS has the potential for development under the no action alternative (i.e., exclusions of Wilderness Areas, Wilderness Study Areas, National Monuments, and NCAs would apply to the no action alternative). This assumption provides the best possible estimate of where wind energy development might occur under the no action alternative, although less wind energy development might be expected to occur because of differences in management approach.

Under the no action alternative, the interim policy would not be replaced by the BLM's proposed Wind Energy Development Program. BMPs to prevent or mitigate impacts associated with wind energy development would be developed on a case-by-case basis only. Individual land use plans could be amended to address wind energy development issues. This would occur, however, on a plan-by-plan basis without the benefit of the overarching, comprehensive analysis provided by this PEIS, including consideration of cumulative impacts on a regional scale. Project reviews would continue on an individual, case-by-case basis without a comprehensive mechanism for moving the projects forward or for ensuring consistency among BLM planning areas.

2.4 DESCRIPTION OF THE LIMITED WIND ENERGY DEVELOPMENT ALTERNATIVE

The limited wind energy development alternative, assessed in Section 6.3, would allow additional wind energy development on BLM-administered land only in areas where it currently exists (i.e., restricted to existing wind energy projects in Wyoming and California), is under review, or has been approved for development at the time the ROD for this PEIS is published. For the purposes of establishing an upper bound on the potential impacts of this alternative, it was assumed that all proposed wind energy projects on BLM-administered land currently under review would be approved for development by the time the ROD is published (anticipated for July 2005). Future expansion of wind energy development would be allowed at existing project areas; however, no additional BLM-administered land would be made available for development under this alternative.

Under this alternative, wind energy development on BLM-administered lands would be restricted to six specific areas. Three of these areas include places where wind energy development already exists on BLM-administered lands. The other three include the locations of project applications that are currently undergoing NEPA review. At this time, it is expected that additional wind energy projects would not be approved for development by the time the ROD related to this PEIS is published. The locations for development under this limited development scenario are discussed in Sections 2.4.1 and 2.4.2.

2.4.1 Existing Wind Energy Development

Wind energy development already exists on BLM-administered lands at the following locations:

- *Palm Springs, California*. Wind energy projects located near Palm Springs are concentrated in the San Gorgonio Pass area.[7] Up to 5,487 acres (2,221 ha) of land in this area are determined to be suitable for wind energy development. Of these lands, 2,300 acres (931 ha) of private and 3,187 acres (1,290 ha) of BLM-administered public lands are presently developed for wind energy production. All public lands within the pass are available for wind energy proposals, and most of the available lands are developed.

  The BLM's Palm Springs-South Coast Field Office manages 19 wind energy ROW authorizations in this area that generate more than 215 MW/h of electrical power and provide $557,393 in annual rental to the federal government. Current projects on BLM-administered lands include (1) monitoring and maintaining compliance on existing ROWs, (2) processing proposals to expand facilities or replace older wind turbines with newer and more efficient turbines, and (3) offering an additional 285 acres (115 ha) of

[7] BLM (2003k) provides more information about the wind energy development on BLM-administered lands in this area.

public lands for wind energy authorizations using the competitive ROW bidding process. Potential expansions to the wind energy projects located on BLM-administered lands are anticipated to provide an additional 40 MW/h, to be developed over a 10-year period (i.e., by 2015).

Appropriate NEPA analyses were conducted for initial development of these BLM-administered lands and will continue to be conducted for future development and expansion activities. Public input is sought as project proposals are analyzed and decisions are coordinated with other jurisdictions, including state, county, and city governments. The BLM wind energy program in this area is managed under the *California Desert Conservation Area Plan, as Amended* (BLM 1999), which allows for the consideration of wind energy proposals on all lands within the California Desert Conservation Area, except those areas that are preliminarily recommended as suitable for wilderness designations. In addition, the BLM works with Riverside County to adopt appropriate county ordinances as requirements for development on BLM-administered lands. Proposed projects on both private and public lands involve a concurrent and often joint analysis by both the BLM and the county. ESA issues are addressed through consultation with the USFWS, which has issued a Biological Opinion on each project proposal.

- *Ridgecrest, California*. Wind energy projects located near Ridgecrest are concentrated in the Tehachapi Pass area. Approximately 900 acres (364 ha) of BLM-administered lands have been developed with about 200 turbines. The aggregate installed capacity that is currently operational on BLM-administered lands is 42.61 MW. Potential expansions to the wind energy projects located on BLM-administered lands are anticipated to provide an additional 150 MW, to be developed over a 10-year period (i.e., by 2015).

- *Wyoming Wind Project, Arlington, Wyoming*. The Wyoming Wind Project, located near Arlington, Wyoming, has a total generating capacity of more than 1,300 MW of electricity, with more than 180 turbines on BLM and non-BLM-administered lands.[8] The project has been developed in phases and consists of two discrete locations: Foote Creek Rim and Simpson Ridge. The Foote Creek Rim site is approximately 5,000 acres (2,023 ha) in size, approximately 950 acres (385 ha) of which are BLM-administered lands. The Simpson Ridge site, which is about 55,600 acres (225,000 ha) in total size, includes about 16,124 acres (6,525 ha) of BLM-administered lands. Future expansion of wind energy capacity on BLM-administered lands in this area is not anticipated.

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8 BLMWY (2004) provides more information about the wind energy development located on BLM-administered lands in this area.

The BLM released the Final EIS for this project in August 1995. A ROD and ROW authorization were issued in July 1997 (BLM 1995, 1997).

2.4.2 Proposed Wind Energy Projects Currently under Review

The following locations currently have wind energy project applications undergoing NEPA review:

- *Table Mountain Wind Generating Facility, Nevada*. The Table Mountain Wind Generating Facility is proposed for development on a project area of approximately 4,500 acres (1,821 ha) of BLM-administered lands located about 20 mi (32 km) southwest of Las Vegas (PBS&J 2002). The proposed facilities would disturb about 325 acres (132 ha) of BLM-administered lands. The project is anticipated to generate 150 to 205 MW of electricity, with approximately 153 turbines. The Final EIS for this project was released in July 2002 (PBS&J 2002); a ROD for this project has not been issued yet. This project, if approved, is expected to be operational within 2 years (i.e., by 2007), assuming that there are no delays in the NEPA or ROW authorization process.

- *Cotterel Mountain Wind Farm Project, Idaho*. The Cotterel Mountain Wind Farm Project is proposed to be located on BLM-administered lands in Cassia County, southeast of the town of Burley.[9] The proposed project, located within the Burley Field Office, will entail installation of about 130 turbines for a total potential generating capacity of 200 MW. The project area is about 4,480 acres (1,813 ha) in size, all of which are BLM-administered lands. The actual acreage to be disturbed by the proposed facilities has not yet been identified but will be substantially less than the acreage of the project area. The BLM issued a "Notice of Intent to Prepare an Environmental Impact Statement/Land Use Plan Amendment" in the *Federal Register* (67 FR 77801–77802) on December 19, 2002. That EIS is currently under preparation. This project, if approved, is expected to be operational within 2 years (i.e., by 2007), assuming that there are no delays in the NEPA or ROW authorization process.

- *Walker Ridge, California.* A wind project has been proposed for development on BLM-administered lands within the Ukiah Field Office. The proposed project would be located on Walker Ridge in Lake and Colusa Counties. The total project area would encompass about 8,200 acres (3,318 ha) and would involve about eighty 1.5-MW turbines with a total generating capacity of about 120 MW. The actual acreage to be disturbed by the proposed facilities has not yet been identified but will be substantially less than the acreage of the

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9 Windland Incorporated (2004) provides more information about the proposed Cotterel Mountain Wind Farm Project.

project area. The BLM has determined that an EIS is necessary to analyze the impacts of the proposal and to amend the 1984 related land use plan. A "Notice of Intent to Prepare a Plan Amendment and Environmental Impact Statement for Wind Energy, Ukiah Field Office, California," was published in the *Federal Register* on August 12, 2003 (68 FR 47928–47929). Preparation of an EIS has not yet started. An EIS would be prepared before any development could occur at this location.

2.5 ALTERNATIVES AND ISSUES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

An alternative consisting of no wind energy development on BLM-administered land was not evaluated because wind energy development already occurs on BLM-administered land. This alternative also contradicts the Interim Policy on Wind Energy Development (BLM 2002a) (Appendix A).

No other alternatives were suggested during the scoping process.

2.6 COMPARISON OF ALTERNATIVES

Analysis of the potential environmental, social, and economic impacts that could occur as a result of wind energy development on BLM-administered lands under the MPDS is presented in detail in Chapter 5, along with a discussion of relevant mitigation measures. The proposed action and its alternatives, which present different options for the management of wind energy development on BLM-administered lands, are evaluated in Chapter 6 in terms of their effectiveness in mitigating potential adverse impacts and facilitating wind energy development.

On the basis of the evaluations in Chapter 6, this section provides a comparison of the alternatives. The objective of this comparison is to address the question of whether the proposed action presents the best management approach for the BLM to adopt. Factors that should be considered include the impact of the alternatives on (1) the pace and cost of wind energy development, (2) the environment, and (3) the economy.

2.6.1 Comparison of Impacts on the Pace and Cost of Wind Energy Development

Each of the alternatives would impact the pace and cost of wind energy development differently. The proposed action to implement a Wind Energy Development Program would likely minimize some of the delays and costs currently associated with development on BLM-administered lands by providing programmatic guidance, facilitating land use plan amendments, and ensuring consistency in the ROW application and authorization process. In comparison, the no action alternative likely would cause development to occur at a slower pace, with potentially greater costs, because the benefits of the proposed action would not be realized.

The limited wind energy development alternative would result in the least amount of development on BLM-administered lands because of restrictions imposed under this alternative.

2.6.2 Comparison of Environmental Impacts

The proposed Wind Energy Development Program would incorporate policies and BMPs that establish mitigation requirements for all projects. These programmatic policies and BMPs are designed to ensure that potential impacts associated with wind energy development would be kept to a minimum. They address land exclusions, public involvement, consultation with other agencies, government-to-government consultation, the need for and scope of project-level reviews, specific mitigation measures, and adaptive management strategies. Site-specific and species-specific issues not addressed in the programmatic policies and BMPs would be addressed at the project level, as necessary. The proposed action, therefore, would provide a comprehensive approach for ensuring that environmental impacts would be minimized to the greatest extent possible. In contrast, under the no action alternative, the BLM would continue to address environmental impact issues at the project level in accordance with the terms and conditions of the Interim Wind Energy Development Policy (BLM 2002a) (Appendix A). While it is likely that these efforts also would result in effective project-specific impact mitigation, the potential for inconsistencies in the type and degree of required mitigation would exist. Similarly, under the limited wind energy development alternative, it is likely that effective environmental impact mitigation would occur by virtue of the ongoing project-specific evaluations. Overall, however, there would be fewer environmental impacts on a regional level as a result of this third alternative because of the restricted level of development.

The possibility exists under the no action and limited wind energy development alternatives for development activities to be focused more on state, Tribal, or private lands. Under the no action alternative, this could occur because development on BLM-administered lands would be more difficult than under the proposed action. Under the limited wind energy development alternative, this could occur because development on BLM-administered lands would be limited to just six locations. The resultant development on nonfederal lands potentially would be subject to less federal environmental oversight.

Indirect environmental impacts could be greater under the no action and limited wind energy development alternatives if they resulted in less wind energy development regionally. Less wind energy development could translate into additional development of traditional energy sources. As discussed in Section 6.4.2, land area disturbance, air quality, water use, and waste generation impacts associated with traditional energy sources are generally greater than those associated with wind energy.

2.6.3 Comparison of Economic Impacts

Regarding economic impacts, the greatest benefits to states, local communities, and the BLM would likely be realized under the proposed action. Similar benefits could be realized under the no action alternative; however, the absence of a comprehensive Wind Energy

Development Program would be likely to slow the pace of development on BLM-administered lands and thus delay economic benefits to local communities adjacent to BLM-administered lands in the West. Under the limited wind energy development alternative, benefits would be realized in those areas where wind energy development would be allowed; however, overall, there would be far fewer benefits regionally than would occur under either the proposed action or the no action alternatives.

2.6.4 Summary of Comparison

In conclusion, on the basis of these comparisons, it appears that the proposed action would present the best approach for managing wind energy development on BLM-administered lands. The proposed action to implement the Wind Energy Development Program would likely result in the greatest amount of wind energy development over the next 20 years, at the lowest potential cost to industry and the federal government. Simultaneously, the proposed action would provide the most comprehensive approach for ensuring that potential adverse impacts would be minimized to the greatest extent possible. And, finally, the proposed action would likely provide the greatest economic benefits to local communities and the region as a whole. As a result, the proposed action appears to best meet the objectives of the National Energy Policy recommendations to increase renewable energy production on federal lands and is consistent with the requirements of E.O. 13212, “Actions to Expedite Energy-Related Projects” (U.S. President 2001a).

3 OVERVIEW OF WIND ENERGY PROJECTS

3.1 DESCRIPTION OF WIND ENERGY PROJECTS

The following sections describe the activities likely to occur during each of the major phases associated with the development of a wind energy project: site testing and monitoring, construction, operation, and decommissioning. An overview of wind energy technology, including discussions of terminology, turbine design, existing commercial wind projects, and research and development, is presented in Appendix D. The descriptions in this section are based upon the information presented in Appendix D, literature reviews, and interviews with wind energy developers.

3.1.1 Site Monitoring and Testing Activities

Site monitoring and testing involve the collection of sufficient amounts of meteorological data to accurately characterize the wind regime. These data are used to support decisions on whether the wind resources at the site are suitable for development and, if so, the appropriate number, type, and location of wind turbines.

The collection of meteorological data requires the erection of meteorological towers equipped with weather instruments. These towers can be as high as 165 ft (50 m); meteorological data, however, are collected at appropriate heights as determined by the site-specific wind resources and terrain. In general, most sites can be adequately characterized with 10 or fewer towers, although the required number of towers depends on the size of the project area and the complexity of the terrain. The towers are interconnected with data collection and integration equipment. This equipment is usually in a weatherproof enclosure centrally located between the towers. Data may be communicated by radio transmitter to a remote location for processing or aggregated electronically on the site and collected periodically by maintenance personnel.

Meteorological towers are typically metal (galvanized or painted), lattice-type structures, and many are equipped with self-erecting capabilities. However, composite materials are also being used.[1] Heavy-duty all-wheel-drive pickup trucks or medium-duty trucks are usually sufficient to transport the towers to the site; many towers are permanently mounted to their own trailers. It is estimated that it takes less than 1 day to erect each tower. Towers and instruments are relatively lightweight and often do not require belowground foundations, especially if they are to be in service for limited periods of time; however, guy wires may be necessary for the larger towers in very windy areas. Some smaller towers are designed to be erected directly from their transport trailers, with the trailer effectively serving as the foundation. The towers typically do not require signal lights, but as developers seek to install taller towers so that the elevation of meteorological instruments approximates the hub heights of anticipated turbines, meteorological towers may become subject to FAA signal lighting requirements. Such taller towers may also

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1 Although the classical design for meteorological towers has been the open lattice type, some manufacturers are now offering smooth-skinned towers (e.g., IsoTruss Structures, Inc. 2004; see also Compositesworld 2003).

require subsurface foundations, especially if they are expected to remain in service beyond the site testing period and throughout the operational phase of the wind energy project. Signal cables used during the site monitoring and testing phase are not likely to be buried. As noted above, at least some of the monitoring towers would remain operational throughout the life of the site and would ultimately require a more permanent installation. For these towers, subsurface foundations may be required.

Very little in the way of site modification is necessary during this phase. Only the most remote sites require construction of a minimum-specification access road, which may be upgraded later to become the site's main access road. Only a small crew is required to erect the meteorological towers, and typically no personnel support facilities are required.

Meteorological data, such as data on wind speed and direction, wind shear, temperature, and humidity, are typically collected over a period of at least 1 year. However, some developers may choose to collect data for as long as 3 years to account for anticipated annual weather variations. This is permitted under the terms of the BLM's Interim Wind Energy Development Policy (BLM 2002a) (Appendix A), which allows ROW authorizations for site monitoring and testing for up to 3 years. During this phase, the site is unattended, with periodic visits by maintenance personnel. At the end of the site monitoring and testing phase, temporary towers are removed.

3.1.2 Site Construction Activities

The specific requirements of construction are very site dependent. The following discussion is intended to represent typical expected construction activities. However, some qualifiers to these construction activities are also introduced because of unique site conditions. Construction of a wind energy development project is likely to involve the following major actions: establishing site access; performing site grading; constructing lay-down areas and an on-site road system; removing vegetation from construction and lay-down areas (primarily for fire safety); excavating for tower foundations; installing tower foundations; erecting towers; installing nacelles and rotors; installing permanent meteorological towers (as necessary); constructing the central control building and a weatherproof equipment and parts storage area (which may be separate or combined with the control building); constructing electrical substations; interconnecting towers, the control building, meteorological towers, and substations with power-conducting cables and signal cables; and performing shake-down tests. Additional activities may also be necessary at very remote locations or for very large wind energy projects; they can include constructing temporary offices, sanitary facilities, or a concrete batching plant.

Site development strategies and construction schedules are also very site dependent. While many wind energy development projects can be constructed in 1 year or less, very large projects consisting of hundreds of turbines may be developed in phases. The schedules for each phase are dictated by electric power market conditions and can stretch over several years. Market forces and phased development notwithstanding, developers can be expected to develop sites in accordance with economies of scale whenever possible. To take full advantage of such economies, similar activities are likely to be completed throughout the entire site over a continuous period during site development. (For example, specialty crews would be brought to the site to complete all of their functions throughout the site, such as grading, excavating for tower foundations, installing tower foundations, erecting the towers, and installing the nacelles and rotors.) Each of the major aspects of site development is discussed in detail in one of the following subsections.

3.1.2.1 Site Access, Clearing, and Grade Alterations

Specifications for the main access road would be dictated by the expected weights of the vehicles transporting turbine components and the construction and lifting equipment that would be used during construction.[2] Because some of the turbine components are extremely long (e.g., blades) or heavy (e.g., nacelles containing all drivetrain components except the rotor), ROW clearances and minimum turning radii also become critical parameters for road design. Typically, access roads would be a minimum of 10 ft (3 m) wide, but they may need to be as much as 30 ft (9 m) wide to accommodate wide or excessively long loads (PBS&J 2002). A ROW approximately twice the final width of the road would typically be required. All ground disturbances would likely be confined to the ROW. Finally, because of the anticipated weight of the turbine components and electrical transformers that would be brought to the site, maximum grade becomes a critical road design parameter.[3] While straight-line access roads would obviously minimize distance and cost, the combination of turning clearance requirements and maximum grade can be expected to result in access roads climbing a hill to follow a serpentine path. Other site-specific factors, such as streams and immovable obstacles, would also dictate the path. At a minimum, construction of the access road would require removing vegetative cover. Because candidate sites can be in forested areas, clearing the road path may also involve some tree removal. Depending on subsurface stratigraphy, surface soils may need to be excavated, and gravel and/or sand may need to be imported to establish a sufficiently stable road base. The road is expected to have all-weather capability but is not likely to be paved. Compacted gravel is the most likely finishing material. Although the ideal path would be chosen to avoid grade changes as much as possible, some grade alterations can nevertheless be anticipated. Engineered storm water control may be necessary, and natural drainage patterns are likely to be altered, at least on a local scale. In sites with near-surface aquifers, provisions for subsurface drainage may be required to maintain road stability. The road base itself may also act as an artificial path for subsequent groundwater movements. Although wetlands would be avoided, roadways in the vicinity of wetlands may still need to be evaluated for their impacts on the wetlands.

Transportation logistics have become a major consideration for wind energy development projects because of the trend toward larger rotors and taller towers. Depending on contractual arrangements, either the site developer or the turbine manufacturer (or a transportation subcontractor) is responsible for securing all necessary permits (Steinhower 2004). Depending

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2 It is conceivable that some sites would require multiple access paths; however, it is expected that only one main path would be established over which the heavy and/or large construction equipment and turbine components would be brought to the site.

3 See Table D-2, Appendix D, for anticipated ranges of turbine component sizes and weights.

on the location of the manufacturer's fabrication plant, transportation may involve ship, barge, rail, and/or road transport. While the majority of environmental impacts would occur while creating access to the site from existing public highways, previously disturbed public or private roadways may also need to be altered to accommodate heavy and/or oversized transport vehicles. It is reasonable to expect that special road transportation permits would be required for some vehicles, and modifications to existing roads may also be necessary. Excessive weight may require fortification of existing bridges. Large loads may require the temporary removal of height or turning radius obstacles.

On-site roads can also be expected to be built to the minimum specifications necessary to support vehicles for transporting turbine components and construction and lifting equipment. Constructing both the access road and the on-site roads may also involve fording streams or creeks. However, if fording a river with a permanent structure is unavoidable, it is likely that the development costs would increase to the point that either an alternative access route would be selected, or the site would no longer be considered a viable candidate for development. However, as mentioned previously, fortifications of existing bridges on public or private roads would still be within the realm of possibility.

On the basis of experience to date, the final footprint of the wind energy development project (turbine towers, control buildings, transformer pads, electric substations, roads, and other ancillary structures) is likely to be no more than 5 to 10% of the total acreage of the site. Additional areas would incur temporary impacts resulting from the construction of equipment lay-down areas and crane staging areas, as they are needed; such areas then would be reclaimed. There is some flexibility as to where lay-down areas would be located, and developers are likely to adapt to site conditions to keep creation of these areas as simple as possible. At a minimum, the construction of equipment lay-down areas and crane staging areas could involve removing vegetation for purposes of safety, access, and visibility during lifting operations. Additional controls may be necessary regarding the final disposition of this biomass. Although surface soils may not need to be removed from the construction zone, some regrading might occur to create relatively level areas, and rock and/or gravel are expected to be laid down to give these areas all-weather accessibility and to support the weights of vehicles and staged equipment. It is estimated that as much as 1 to 3 acres (0.4 to 1.2 ha) of land area may need to be cleared for each turbine, and numerous lay-down and crane staging areas can be anticipated over the period of site development. However, depending on the turbine array, the same areas would likely support erection of more than one turbine. Regardless of whether regrading occurs, the soils in these lay-down areas can be expected to be compacted as a result of construction and transportation vehicle traffic and the temporary storage of equipment and construction materials. In addition to the clearing of lay-down and crane staging areas, intervening areas may also need to be cleared of trees to provide overhead clearance for suspended turbine components being brought into position. Some areas cleared for construction purposes would be revegetated with indigenous vegetation once construction is completed. However, smaller areas around towers, control buildings, and electrical substations would have to be maintained free of vegetation throughout the operating life of the wind energy project for safety and access purposes. These areas are likely to be covered in rock or gravel to ensure all-weather accessibility.

3.1.2.2 Foundation Excavations and Installations

The tall towers anticipated in future wind energy development projects would require substantial foundations, nominally extending to depths of 35 to 40 ft (11 to 12 m), depending on subsurface conditions. On the basis of what is already known about subsurface stratigraphy, geotechnical studies may need to be performed to establish foundation specifications. Geotechnical surveys, if necessary, would involve numerous borings with hollow core augers to nominal depths of 40 ft (12 m) or less to recover subsurface soil cores for analysis and compressive strength testing (performed at an off-site location).

Installation of tower foundations would involve excavations to the required depths (probably 40 ft [12 m] below grade or less), with the diameters of excavations roughly the same as the diameter of the tower base (nominally 15 to 20 ft [5 to 6 m], depending on the turbine model selected). The latest foundation construction methods involve installing a vertical reinforced concrete ring of a nominal 1-ft (0.3-m) thickness rather than installing a monolithic concrete pillar approximately equivalent to the entire diameter of the tower. Developers of the proposed Table Mountain Wind Generating Facility in Nevada intend to use approximately 80 yd^3 (61 m^3) of 4,000-pounds-per-square-inch (psi) test concrete and an additional 80 yd^3 (61 m^3) of 1,000-psi test concrete for each foundation for the 140 to 280 towers for each turbine (NEG Micon Model 900 or NEG Micon Model 1500) (PBS&J 2002). An average of 6,000 gal (22,712 L) of water would be used to produce this much concrete. Once the concrete has cured (nominally 28 days), the remaining spaces inside and outside the ring within the excavation would be backfilled with the excavated materials. While this would accommodate much of the volume of the material initially excavated, some excavated material would remain and would need to be redistributed on the site. In certain areas, subsurface materials may have the potential of imparting acidic character to precipitation runoff; thus care may need to be taken in stockpiling excavation materials or redistributing excess. Throughout the period of foundation installation, precipitation or groundwater that accumulates within the open excavations would need to be removed. Depending on prevailing subsurface conditions, foundation excavations may also require drilling or blasting.

Although the latest construction methods minimize the amount of concrete necessary for the foundation, it may still be necessary to construct a temporary concrete batching plant on the site, especially if haul distances from existing or specially constructed off-site concrete plants are excessive.[4] Depending on available materials on site, constituents of the concrete (aggregate and sand) may also need to be hauled to the on-site batching plant. Electrical power for the batching plant would be provided by a portable diesel engine/generator set (nominally, 125-kW capacity). The land area required for a typical batching plant and aggregate material storage areas can be expected to be on the order of 10 acres (4 ha) or less. Like the equipment lay-down areas, surface vegetation would need to be removed, some regrading of surface soils might be required, and soils are expected to be heavily compacted as a result of batching plant activities, including

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4 The working time for concrete is dependent on a number of factors, including ambient temperature and humidity, as well as the strength of the concrete mix. It is assumed that for the strength required in a tower foundation, the concrete would have a “working time” of 1 hour or less.

associated truck traffic. The batching plant and any excess concrete constituents are expected to be removed at the end of the concrete-pouring phase. In the Table Mountain example, the 160 yd^3 (122 m^3) of concrete to be used in each tower foundation would require 18 to 20 typical concrete-hauling trucks to deliver concrete to the site from an off-site location. Also, at the same time as tower foundations are poured, foundations for the control building and any other on-site material storage buildings, as well as pads for each electrical transformer, would be poured. It is expected that all on-site buildings would be of modest proportion and require only slab-on-grade foundations, at the most, augmented by frost-resistant perimeter footings. The use of innovative self-erecting towers made of lightweight composite materials may reduce requirements for tower foundations.

No major maintenance is expected to be performed on site on construction and lifting equipment; however, fluid levels would be maintained. Because most of this equipment cannot be transported on public roads, it is most likely that fuel would be staged on site in portable tanks. These tanks are expected to be staged at or near the lay-down areas and resupplied throughout the construction period by commercial vendors. Even at the largest construction sites, the total volume of fuel (primarily diesel fuel) present on site is not expected to exceed 1,000 gal (3,785 L).

3.1.2.3 Tower Erection and Nacelle and Rotor Installation

The same lifting equipment would be used for tower erection and for nacelle and rotor installations. Staging areas for the erecting cranes would need to be established. Like material and equipment lay-down areas, these crane staging areas would have their surface vegetation removed and be regraded to relatively level surfaces, then indigenous soils remaining in these areas would be heavily compacted. Depending on indigenous soils, gravel and rock may need to be placed on the staging area to support the weight of the crane and to provide all-weather access. Crane staging areas may be as large as 1 to 2 acres (0.4 to 0.8 ha). Depending on the geometry of the turbine array, the same crane staging area may be used for erecting multiple turbines. Taller towers are expected to arrive on site in segments (typically, segments would be no longer than 66 ft [20 m] in length) and be welded/bolted together as the tower is erected. The nacelles are expected to contain an already assembled drivetrain. The rotor and blades would be installed individually after the nacelle was installed on top of the tower. Figures 3.1.2-1, 3.1.2-2, and 3.1.2-3 show typical installations of a tower, nacelle, and rotor, respectively. Because of the modular nature of major turbine components and the preassembly of major subsystems, installation of these elements would proceed quickly; each tower erection and turbine and rotor installation would be completed in 3 days or less. (Longer periods would be required for towers whose lower segments were constructed of concrete, to allow for adequate curing of the concrete before it was allowed to bear the weight of the remainder of the tower, nacelle, and rotor.) It is anticipated that very small amounts of paints, lubricants, and grease would be used during installation.

FIGURE 3.1.2-1 Arial View of Preparations to Erect a Wind Turbine Tower at the Public Service of Colorado Ponnequin Wind Farm, Weld County, Colorado (Source: NREL 2004a, Photo #08607. Photo credit: Warren Getz.)

3.1.2.4 Miscellaneous Ancillary Construction

Additional construction activities would include the installation of electric transformers and substations and power-conducting cables and signal wires. For some wind energy projects, electric transformers might be installed at the base of each turbine to perform initial conditioning of the power generated by that turbine before that power was delivered to an on-site central electric substation.[5] In other installations, power cables from each turbine would connect directly to a central substation. For very large wind energy projects, more than one substation may be constructed. The footprints of substations are expected to be 5 acres (2 ha) or less in size and, notwithstanding control and storage buildings and on-site roads, would represent the footprint of greatest contiguous area on the site. Conventional construction methods are expected to be sufficient for these facilities. The ground vegetation would be cleared, and rock or gravel would be placed over the entire area to ensure drainage.

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5 However, some turbine manufacturers install a dedicated transformer in the nacelle. See, for example, the large-capacity turbine models offered in Gamesa Eolica (2004). Other designs call for a transformer for each turbine positioned on the ground near the tower base.

FIGURE 3.1.2-2 Wind Turbine Nacelle Installation at Golden Prairie Wind Farm, Lamar, Colorado (Source: NREL 2004b. Photo # 13060. Photo credit: David Jager.)

For electrical safety, one or more grounding rods may be installed. Alternatively, a metal grounding grid or metal net may be installed over the entire footprint of the substation. These grounding features would also provide for lightning grounding. On rocky sites with little to no soil mantle, adequate electrical grounding may be problematic and may require the installation of a grounding well reaching to the uppermost saturated zone below the ground surface. Each turbine tower would have similar lightning grounding needs. Either ground rods, grounding grids, or, if necessary, grounding wells would need to be installed for each tower. Concrete pads would be installed for each transformer. With the exception of only the largest models used, the

FIGURE 3.1.2-3 Installation of a Rotor on a General Electric 1.5-MW Wind Turbine at the Klondike, Oregon, Wind Farm (Source: NREL 2004c, Photo #11919. Photo credit: Paul Woodin.)

transformers would be sealed. For the largest models, installation may involve adding dielectric fluids after they are positioned on their foundations. Transformer bushings, switches, capacitors, and other dielectric fluid-containing electrical devices are likely to use mineral-oil-based dielectric oils with no polychlorinated biphenyls (PCBs).

Construction of the control building would involve either conventional construction techniques or the placement of a prefabricated building on a concrete foundation. An additional storage building for parts and equipment might also be constructed, or these functions could be incorporated into the control building. Some limited amount of maintenance or repair on turbine components might also be provided for, in conjunction with parts and equipment storage. Ambient conditions within the control building would need to be maintained to meet equipment operating requirements and/or to support the presence of maintenance personnel.[6] Conventional propane space heating would likely be installed. At remote sites subject to severe weather, emergency sleeping quarters would also likely be incorporated into the control building. Although electric power demands of the control building and the operating equipment could be

6 At some larger wind energy projects, a small number of maintenance personnel may be present daily during business hours.

supplied by the on-site substation, emergency electricity power generation would also likely be provided by a commercially available diesel engine/generator set.

Power-conducting cables and signal cables would interconnect the turbine towers with the control building and the electrical substation.[7] Where the soil mantle permits, it is expected that these cables would be buried to a nominal depth of 4 ft (1.2 m); they might be bedded in sand for additional protection against frost heave.[8] Standard trenching techniques are expected to be sufficient. However, on rocky sites where trenching is not possible or difficult, it may be necessary for the cables to be suspended from conventional power poles.

During the construction phase, potable water and sanitary facilities would need to be established to support the construction crews. Potable water would be provided from off-site sources. Sanitary facilities would most likely be satisfied by portable latrines.

Throughout the construction phase, fugitive dust may have a significant but localized impact on certain soil conditions. Fugitive dust may result from the disturbance of ground surfaces, removal of vegetative cover, vehicle traffic, and material handling (e.g., materials handled in an on-site concrete batching plant). The issue of fugitive dust may be further exacerbated by the fact that the candidate site is located within a windy area. Such impacts are typically mitigated by keeping disturbed surface areas to an absolute minimum and by the regular application of water to access roads and on-site roads and other disturbed areas throughout the construction phase. For example, developers of the proposed Table Mountain Wind Generating Facility anticipate using an average of 120,000 gal (454,249 L) of water per day during construction to effect adequate dust control across the entire 4,500-acre (1,821-ha) site (PBS&J 2002). In the Table Mountain example, the water will be purchased from a nearby municipality and trucked daily to the site (an average of 30 trips per day for a typically sized water truck of 4,000-gal [15,142-L] capacity). Where no such sources are readily available, it is possible that water may be obtained from nearby surface water features. Precisely coordinated construction schedules, as well as limitations on certain activities during windy periods, could also be employed to mitigate fugitive dust from surface-disturbed areas. Water recovered from on-site wells or surface water features would not need to be treated to drinking water standards before being used for fugitive dust control.

Finally, because the BLM's multiple-use management objectives are inconsistent with fencing the entire project area, site security requirements would be limited to fencing the electrical substation and locking the turbine tower access doors. Temporary fences or barricades may need to be erected during some portions of the construction phase in accordance with applicable OSHA regulations (Title 29, Part 1910.2C, of the *Code of Federal Regulations* [29 CFR 1910.26]) or as a result of the application of "safe work" practices in order to prevent

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7 Typically, only one central substation would be necessary for each wind energy project. However, when projects span large distances, it is conceivable that each separated cluster of wind turbines may be served by its own substation.

8 Burying the cables can greatly reduce maintenance demands, reduce vandalism problems, eliminate obstructions for bird strikes, improve site safety, and virtually eliminate weather-related downtime. Burying cables may also be necessary to preserve the wind energy projects for other simultaneous land uses.

unauthorized entry of individuals or animals into hazardous active construction zones and to provide for the safety of the construction workforce during periods when open excavations are present. Temporary equipment storage areas may also be temporarily fenced.

3.1.3 Site Operation

Even though the operation of a wind energy development project can be monitored and controlled from a remote location, larger sites may be attended during business hours by a small maintenance crew of six or fewer individuals (Steinhower 2004). For smaller sites, maintenance personnel may be on call but not necessarily at the site.

Regardless of whether the site is attended during normal business hours, all major components of the wind turbines are expected to undergo routine maintenance. This would involve the use of small amounts of greases, lubricants, paints, and/or coatings for corrosion control. Depending on the scale of operations, the wind energy project may include a maintenance shop facility. Wastes resulting from component maintenance typically include small amounts of gear oil and lubricating oils from yaw motors or of transmission and glycol-based coolants from transmissions equipped with forced-flow radiator cooling loops. Most turbine designers construct their turbines in modular fashion. Thus, it is likely that most major overhauls or repairs of turbine components would involve removing the component from the site to a designated off-site repair facility. Because most towers are equipped with lifting devices of sufficient capacity to lower or raise individual drivetrain components, a crane should not be needed for such component replacements.

Operators are likely to take advantage of the latest advances in wind turbine technologies over the lifetimes of their sites in order to remain competitive in the energy market. This may result in "repowering" all or part of the site by replacing existing turbines with ones incorporating state-of-the-art technologies or with larger and more cost-efficient turbines. Repowering may also involve replacing some electrical power management and conditioning equipment. All proposals to repower or otherwise modify a site over its operating life would be reviewed and approved by the BLM and could result in modifications to the terms of the original ROW authorization.

3.1.4 Site Decommissioning

With some exceptions, site decommissioning would involve the reverse of site development. Typical decommissioning procedures are described below.

All turbines and their towers would be dismantled and either recycled at other wind energy projects, sold for scrap, or disposed of off site as solid waste after fluid removal. Turbine towers constructed partially of concrete would be broken up. Broken concrete could be used by highway departments for road base or bank stabilization. Electronic equipment would be recycled or disposed of (in some cases as hazardous waste because of the heavy metals present). Transformers and electrical control devices would either be reused in other applications or sold as scrap after fluid removal. Turbine foundations and belowground cable runs are expected to be left in place.[9]

The access road, on-site roads, rock or gravel in the electrical substations, transformer pads, and building foundations would be removed and recycled if no longer needed. Disturbed land areas covered in rock or gravel or building/tower footprints would be restored to original grade (which would include adjusting soil compaction that might have resulted from previous uses) and reseeded or replanted with indigenous vegetation.

Dismantlement of electrical substations and storage buildings would be accompanied by inspection for the presence of industrial contamination from minor spills or leaks and decontamination as necessary.

3.2 REGULATORY REQUIREMENTS FOR WIND ENERGY PROJECTS

This section identifies the major laws, regulations, E.O.s, compliance instruments, and policies that may impose environmental protection and compliance requirements on the site monitoring and testing, construction, operation, and decommissioning phases of a wind energy project on BLM-administered land. The laws and regulations discussed in this section may not apply to every wind project; each project must be assessed on the basis of its activities, location, and other circumstances.

The BLM conducts its operations in accordance with the FLPMA (43 USC 1701 et seq.) and in an environmentally safe manner in compliance with all applicable statutes, regulations, and standards. In addition, E.O. 12088, "Federal Compliance with Pollution Control Standards" (U.S. President 1978), requires federal agencies (including the BLM) to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA) of 1976, Clean Air Act (CAA), Noise Control Act of 1972 (NCA), Clean Water Act (CWA), and Safe Drinking Water Act (SDWA). Other compliance requirements may include the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA), hazardous material transportation law, ecological resources requirements (e.g., ESA), and cultural and paleontological resources requirements.

The BLM has established an Interim Wind Energy Development Policy (BLM 2002a) (Appendix A). This policy provides guidance on processing ROW applications for wind energy site testing and monitoring facilities as well as applications for wind energy development projects on BLM-administered land. Under this policy, all wind energy applications would be processed in accordance with the requirements of Title V of FLPMA and 43 CFR Part 2800, "Rights-of-Way, Principles and Procedures." Details regarding the applications and authorizations for wind energy projects are set forth in the policy. In addition, the policy requires

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9 However, to accommodate revegetation over turbine footprints, the foundations may need to be removed to a depth of at least 3 ft (1 m) below the initial grade, with sufficient indigenous soils added to cover the foundations and establish a root zone of sufficient depth.

that all wind energy project ROW applications, whether for site testing and monitoring or for commercial development, be subjected to environmental review in accordance with the requirements of NEPA and that such development be in compliance with the requirements of the ESA, Migratory Bird Treaty Act of 1918 (MBTA), NHPA, and other appropriate laws.

The potentially applicable laws and regulations have been divided into general categories, described below. A listing of the laws and regulations by category is provided in Appendix E.

- *Wind energy project siting*. The construction and operation of a wind energy project, including generation and substations, may require siting approval or certification from state energy authorities. Approval may also be needed to connect to the local electric grid system. In addition, certain states, including California, Montana, and Washington, have equivalent environmental policy acts tied to the issuance of state-level environmental permits.

- *Land use.* Depending on the location of a proposed wind energy project, special land use determinations may need to be made, particularly if the project is to be sited in or would impact environmentally sensitive or protected areas.

- *Floodplains and wetlands.* If project facilities are located in wetland areas or adjacent to other water bodies, their placement will be subject to all applicable statutory requirements and associated regulations, such as Section 404 of the CWA.

- *Water bodies and wastewater.* The discharge of wastewater (e.g., sanitary wastewater treatment systems or rinse/test waters) from the construction or operation of a wind energy project into waters of the United States or waters of a state may require a National Pollutant Discharge Elimination System (NPDES) permit or the state equivalent. According to administrative and judicial interpretation, the navigable waters of the United States encompass any body of water whose use, degradation, or destruction would or could affect interstate or foreign commerce. These bodies of water include, but are not limited to, interstate and intrastate lakes, rivers, streams, wetlands, playa lakes, prairie potholes, mudflats, intermittent streams, and wet meadows. In addition, the CWA requires an NPDES permit, or state equivalent, for storm water discharges from industrial activities or from construction activities disturbing more than 5 acres (2 ha) of land. Also, under the Storm Water Phase II Final Rule, small construction activities disturbing between 1 and 5 acres (0.4 and 2 ha) of land are subject to NPDES permitting requirements.

- *Groundwater, drinking water, and water rights.* The provision of drinking water from wells or surface water to a transient noncommunity water system at wind energy facilities would require compliance with the SDWA. In addition, the withdrawal of groundwater for industrial or drinking water purposes may require approvals or permits.

- *Source water protection.* Under the SDWA, Protection of Underground Sources of Drinking Water (42 USC 300h-7), each state is to establish a wellhead protection program to delineate wellhead protection areas, identify potential sources of contamination, and establish control measures to prevent contamination of drinking water sources. If hazardous chemicals or materials are used during the construction or operation of a wind energy project that is located within a wellhead protection area, reporting or control measures may apply.

- *Cultural resources.* If paleontological or historical sites are found to be located on the site where a wind energy project is proposed, certain consultations and mitigation actions may be required. In addition, the BLM has entered into agreements with the affected SHPOs providing for cooperation concerning cultural resources disturbed on BLM-administered lands located in that state (e.g., the Cultural Resources Programmatic Agreement [PA] among the BLM, Advisory Council on Historic Preservation, and National Conference of State Historic Preservation Officers signed March 26, 1997).

- *Wildlife.* The construction and operation of a wind energy project may impact wildlife or their habitats. The BLM manages public lands to protect and improve habitat for all federal status, BLM-designated sensitive (i.e., the list published by the BLM state office of species occurring on public lands whose populations or habitats are rare or in significant decline), and state listed species. The BLM evaluates all projects and activities occurring on public lands to ensure that they will not contribute to the need to list species as threatened or endangered.

- *Air quality.* Air emissions from wind energy project construction and operation are subject to the CAA (42 USC 7401 et seq.), as amended. Although air emissions from the operation of the actual wind energy equipment are expected to be minimal, other air emissions that occur during construction and operation may be subject to regulation. The CAA provides that each state must develop and submit for approval to the EPA a State Implementation Plan (SIP) for controlling air pollution and air quality in that state, and that each state must develop its own regulations to monitor, permit, and control air emissions within its boundaries. The CAA also requires that federal actions conform to the appropriate SIPs (42 USC 7506). Under Section 112(r) of the CAA, owners and operators of facilities that produce, process, handle, or store specific hazardous substances above threshold quantities must meet certain requirements for planning and reporting and risk management planning requirements (40 CFR Part 68).

- *Noise.* Noise impacts may result from the construction and operation of a wind energy project. The EPA has not published regulations on noise levels from construction operations. The agency has, however, issued guidelines for outdoor noise levels that are consistent with the protection of human health and welfare against hearing loss, annoyance, and activity interference (EPA 1974). Such guidelines state that undue interference with activity and annoyance will not occur if outdoor levels of noise are maintained at an energy equivalent of 55 decibels (dB). However, these levels are not to be construed as legally enforceable standards.

- *Hazardous materials.* Hazardous materials may be used in the construction and operation of a wind energy project. In addition, fuels, petroleum, oils, and lubricants may be stored and used at wind energy project facilities during construction, operation, and decommissioning phases; however, quantities present during operations would be minimal.

- *Pesticides and noxious weeds.* Pesticides may have to be applied during the construction and operation of a wind energy project to control pests and weeds. Such applications must comply with the Federal Insecticide, Fungicide, and Rodenticide Act and state equivalent requirements. In addition, wind energy sites are subject to federal provisions to control noxious weeds and invasive species and may be subject to regulations governing state-established control areas.

- *Solid waste.* Solid wastes would be generated during the construction, operation, and decommissioning of wind energy projects and must be managed in accordance with the Solid Waste Disposal Act and all state and local requirements for solid waste accumulation, collection, transportation, and disposal.

- *Hazardous waste and PCBs.* Hazardous wastes generated during the construction, operation, and decommissioning of wind energy projects (e.g., used solvents and paints) must be accumulated, collected, transported, and disposed of in accordance with RCRA. PCBs are not likely to be used during the construction and operation of new wind energy projects; however, if they are, they must be managed in accordance with the TSCA.

In addition to these categories, the construction and operation of a wind energy project on BLM-administered land that has valid mining claims must not materially interfere with the claimant's right to mine, remove, or sell the minerals from the claim (30 USC Ch. 2). Also, depending on the activities, location, and other circumstances, the construction of a wind energy project may be required to consider impacts on local populations, including E.O. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (U.S. President 1994), and E.O. 13045, "Protection of Children from Environmental Health Risks and Safety Risks" (U.S. President 1997). Certain states may have specific requirements with regard to nuisances, including Arizona (Environmental Nuisances [*Arizona Revised Statutes* (ARS) 49-141 et seq.] and Light Pollution [ARS 49-1101 et seq.]) and New Mexico (Night Sky Protection Act [74-12-1 *New Mexico Statutes Annotated* (NMSA) 1978 et seq.]).

3.3 HEALTH AND SAFETY ASPECTS OF WIND ENERGY PROJECTS

Potential human health and safety issues related to construction and operation of typical wind energy projects are described in this section. On the basis of expected major activities associated with future wind energy projects described in Section 3.1, the following sections identify physical hazards to workers and potential safety and health issues for the general public.

3.3.1 Occupational Hazards

The types of activities that typically occur during construction, operation, and maintenance of a wind energy development project include a variety of major actions, such as establishing site access; excavating and installing the tower foundations; erecting towers; constructing the central control building, electrical substations, meteorological towers, and access roads; and routine maintenance of the turbines and ancillary facilities. Construction and operations workers at any facility are subject to risks of injuries and fatalities from physical hazards. While such occupational hazards can be minimized when workers adhere to safety standards and use appropriate protective equipment, fatalities and injuries from on-the-job accidents can still occur. Occupational health and safety are protected through the federal Occupational Safety and Health Act (29 USC 651 et seq.), and states may have additional laws and regulations that build on that law.

Some of the occupational hazards associated with wind energy projects are similar to those of the heavy construction and electric power industries, while others are unique to wind energy projects (i.e., heights, high winds, energized systems, and rotating/spinning equipment). In particular, the hazards of installing and repairing turbines are similar to those of building and maintaining bridges and other tall structures (Sørensen 1995). Gipe (1995) reports 14 fatalities worldwide and several serious injuries in the United States between the 1970s and mid-1990s attributable to wind energy projects; most were from construction-related accidents, although 5 fatalities occurred during operation or maintenance of the turbines. In contrast, Sørensen (1995) reports 20 fatalities and hundreds of injuries during wind turbine construction. It is likely that these results are not statistically representative because several of the fatalities occurred in the early years of wind technology development (Gipe 1995). However, they highlight the types of serious hazards to workers that can occur at a wind energy project (e.g., falls, neglecting to use a safety belt, and electric burns).

Accident rates have been tabulated for most types of work, and risks can be calculated on the basis of historical industrywide statistics for use in a site-specific impact assessment. The U.S. Bureau of Labor Statistics (BLS) and the National Safety Council (NSC) maintain statistics on the annual number of injuries and fatalities by industry type (NSC 2002). The expected annual number of worker fatalities and injuries for specific industry types can be calculated on the basis of BLS and NSC rate data and the number of annual full-time equivalent workers required for construction and operations activities at a wind energy project. While the BLS does not break out wind energy projects as an industry type, it can be assumed that, in general, the types of activities required of these employees would be similar to those required of workers in the construction, transportation, public utilities, and electric services industries (NSC 2002).

As noted above, in addition to hazards that are typical of other industries, there are some occupational hazards specific to wind farms. The International Electrotechnical Commission (IEC), a worldwide organization for standardization in the electrical and electronic fields, has published minimum safety requirements for wind turbine generator systems (WTGSs) (IEC 1999). The IEC requires that the WTGS manufacturer provide an operator's instruction manual with supplemental information on special local conditions. The manual should include system safe operating limits and descriptions, start-up and shutdown procedures, alarm response actions, and an emergency procedures plan (IEC 1999). The emergency procedures plan should identify probable emergency situations and the actions required of operating personnel. The emergency procedures plan should address overspeeding, icing conditions, lightning storms, earthquakes, broken or loose guy wires, brake failure, rotor imbalance, loose fasteners, lubrication defects, sandstorms, fires, floods, and other component failures.

Chemical exposures during construction and operation of a typical wind energy project are expected to be routine and minimal and mitigated by using personal protective equipment and/or engineering controls to comply with OSHA permissible exposure limits (PELs) (DOL 1997) that are applicable for construction activities. The potential for ozone exposure in a wind turbine is nonexistent because synchronous or asynchronous generators that are brushless and make alternating current (ac) would be used; thus, they would not create sparks like a brushing generator would in making direct current (dc) (Robichaud 2004).

3.3.2 Public Safety

One of the primary safety hazards of wind turbines occurs if a rotor blade breaks and parts are thrown off. This could occur as a result of rotor overspeed, although such an occurrence has been extremely rare and happens mostly with older and smaller turbines (Hau 2000). Material fatigue can also cause a blade to break (Hau 2000). The difficulty of predicting the trajectory of a broken rotor blade makes the quantitative determination of safety risk very uncertain (Hau 2000). However, it is known that these types of events are very rare and the probability of a fragment hitting a person is even lower (Manwell et al. 2002; Hau 2000). A blade or turbine part has rarely traveled farther than 1,640 ft (500 m) from the tower; usually most pieces land within 328 to 656 ft (100 to 200 m) (Manwell et al. 2002). Today, with proper engineering design and quality control, blade throw should rarely occur. A related issue, ice throw, can occur if ice builds up on the turbine blades. A sufficient safety zone or setback from residences, roads, and other public access areas is often required by permitting agencies (Manwell et al. 2002). In addition to blade and ice throws, these setbacks may also mitigate potential noise and visual impacts (Gipe 1995). Ultimately, any calculation of the risk for such incidents also needs to consider simultaneous land uses for the wind energy project that may cause individuals in addition to wind project workers to be in the vicinity of rotating blades.

Another potential public safety issue is unauthorized or illegal access to the site facilities and the potential for members of the public to attempt to climb towers, open electrical panels, or encounter other hazards.

Dry vegetation and high winds may combine to cause a potential fire hazard around wind facilities. Under these conditions, fires have started for a variety of reasons, such as electrical shorts, insufficient equipment maintenance, contact with power lines, and lightning. The IEC requires that the design of a WTGS electrical system comply with relevant IEC standards (IEC 1999).

3.3.3 Electric and Magnetic Fields

Exposures to extremely low-frequency (ELF) EMF from natural and anthropogenic sources are so ubiquitous that there has been concern about potential adverse health effects from residential and occupational exposures (Ahlborn et al. 2001). Because they are generated by electric transmission and distribution lines, EMF would be present in the vicinity of overhead power lines and the electric substation. A number of reviews of epidemiological and biological research studies have generally concluded that there is no scientific basis to support a finding of adverse human health effects from EMF (e.g., Jahn 2000), although others have found that there may be an association between EMF and certain diseases (Ahlborn et al. 2001). However, the difficulty of accounting for confounding factors in assessing EMF exposure supports the need for additional research.

The National Institute of Environmental Health Sciences (NIEHS) conducted a 6-year research project specifically addressing health effects of exposure to ELF range fields from power lines (NIEHS 1999). The NIEHS concluded that "the scientific evidence suggesting that ELF-EMF exposure pose any health risk is weak" (p. ii, NIEHS 1999). The report also states, however, that ELF-EMF exposure cannot be considered entirely safe because of the relatively consistent results of epidemiological studies that show a small increased risk of chronic lymphocytic and childhood leukemia with increasing EMF exposure. On the other hand, the report states that laboratory research studies have not been able to consistently support the epidemiological findings, which weakens but does not discount them. Brain et al. (2003) suggest that the failure to observe effects from EMF in bioassay systems may be due to the selection of EMF exposure metrics.

Regarding the occupational environment, while there is the potential for any generator to produce EMF, the 60-Hz ac frequencies are thought to be too low to damage human tissue (Robichaud 2004). Definitive data are not available, however.

3.3.4 Aviation Operations and Electromagnetic Interference

The two main aviation safety considerations in the development of a wind energy project are (1) the physical obstruction of the tower itself and (2) the effects on communications, navigation, and surveillance systems, such as radar (DTI 2002). The potential vertical obstruction of the wind turbine, like any tall structure, could pose a hazard to aircraft arriving or departing at a nearby airfield as well as to military training and other low-flying aircraft (DTI 2002).

With respect to radar, moving wind turbine blades interfere with radar by essentially creating radar echoes (AWEA 2004). According to the British Wind Energy Association (BWEA 2004), radar installations can be modified to eliminate this problem: “This study concludes that radars can be modified to ensure that air safety is maintained in the presence of wind turbine farms. Individual circumstances will dictate the degree and cost of modification required, some installations may require no change at all whilst others may require significant modification.”

Wind turbines have the potential to interfere with electromagnetic signals that make up much of modern communication networks (Burton et al. 2001). In addition to radar, interference with other electromagnetic transmissions can occur when a large wind turbine is placed between a radio, television, or microwave transmitter and receiver (Manwell et al. 2002). Disruptions of public safety communication systems (e.g., radio traffic related to emergency response activities) may be a potential public safety issue. EMI from wind turbines is affected by blade construction and rotational speed (Manwell et al. 2002). Modern blades made of glass-reinforced epoxy (a material similar to fiberglass) should not create any electrical disturbance (CRS 2004). However, lightning protection on blade surfaces can increase EMI (Manwell et al. 2002).

3.3.5 Low-Frequency Sound

In addition to more audible noise (Section 5.5.3.1), wind turbines are capable of generating low-frequency sound waves (Hau 2000). Low-frequency sound is considered to be in the range of 20 to 80 Hz, and infrasound is in the range of 1 to < 20 Hz (ACGIH 2001). Low-frequency sound is generally the result of wind turbulence that causes the aerodynamic lift forces at the rotor blades to rapidly change (Hau 2000). Moller and Lydolf (2002) conducted a survey of 198 people in Denmark about complaints regarding infrasound and low-frequency noise and found that almost all participants experienced a sensory perception of sound. They perceived the sound not only with their ears but also as a vibration in their bodies or external objects (Moller and Lydolf 2002). This study supports earlier research results indicating that low-frequency sound is disturbing, irritating, and even tormenting to some people. Insomnia, headaches, and heart palpitations were also reported as secondary effects.

Infrasound and low-frequency noise are ubiquitous, since they are generated from natural sources (e.g., earthquakes, wind) and anthropogenic sources (e.g., automobiles, industrial machinery, household appliances) and are common in urban environments (Leventhall 2003). Because low-frequency noise and infrasound have numerous sources, propagate efficiently, and are inefficiently attenuated in buildings, their effects (including those on human health) have been the subject of considerable research. Leventhall (2003) reviewed much of the published literature on the effects of low-frequency noise on humans and concluded that the primary effect of infrasound appears to be annoyance. He also found that there is not much agreement in the many studies of the biological effects of infrasound on humans. However, while infrasound does not appear to result in “dramatic health effects,” exposure at a perceptible level can “produce symptoms including weariness, annoyance, and unease”; these symptoms may present safety concerns in certain occupational settings (p. 55, Leventhall 2003). Infrasound also has been found to have negative effects on mental performance; however, the ACGIH (2001) considers these to be the result of the relaxation effects of infrasound and not an adverse health impact.

It is clear that certain individuals exposed to infrasound and low-frequency sound experience stressful ear, central nervous system, and other resonance-related symptoms. However, there does not appear to be serious health consequences from exposure (Leventhall 2003). The ACGIH (2001) recommends threshold limit values (TLVs) of 1 to 80 Hz of sound to protect against auditory pain and the sensation of throat-tickling and choking. However, the TLV also includes a note stating that infrasound and low-frequency sound exposures that cause unwanted vibrations and pressure sensations should be avoided. Low-frequency sound emissions in rotors can be reduced by careful turbine design that reduces flow velocity and optimizes rotor clearance to the tower (Hau 2000), and by the establishment of a sufficient safety zone or setback from residences, roads, and other public access areas. In addition, while wind turbines with a downwind rotor generate considerably higher infrasound levels, modern turbines with the rotor located upwind of the tower produce very low levels of infrasound (Jakobsen 2004).

3.3.6 Shadow Flicker

Shadow flicker refers to the phenomenon that occurs when the moving blades of wind turbines cast moving shadows that cause a flickering effect (Manwell et al. 2002). When the sun is behind the blades and the shadow falls across occupied buildings, the light passing through windows can disturb the occupants (Gipe 1995). Shadow flicker is recognized as an important issue in Europe but is generally not considered as significant in the United States (Gipe 1995). The American Wind Energy Association (AWEA 2004) states that shadow flicker is not a problem during the majority of the year at U.S. latitudes (except in Alaska where the sun’s angle is very low in the sky for a large portion of the year). In addition, it is possible to calculate if a flickering shadow will fall on a given location near a wind farm and for how many hours in a year (AWEA 2004). While the flickering effect may be considered an annoyance, there is also concern that the variations in light frequencies may trigger epileptic seizures in the susceptible population (Burton et al. 2001). However, the rate at which modern three-bladed wind turbines rotate generates blade-passing frequencies of less than 1.75 Hz, below the threshold frequency of 2.5 Hz, indicating that seizures should not be an issue (Burton et al. 2001).

3.4 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

3.4.1 Hazardous Materials

Proponents of activities on BLM-administered lands, including wind energy projects, are required by BLM policy to provide a comprehensive list of the hazardous and/or extremely hazardous materials that will be produced, used, stored, transported, or disposed of during the proposed action. Proponents must also comply with all applicable federal and state regulations regarding notices to federal and local emergency response authorities and development of applicable emergency response plans. For the purposes of this discussion, hazardous materials are defined as those chemicals listed in the EPA Consolidated List of Chemicals Subject to Reporting under Title III of the Superfund Amendments and Reauthorization Act of 1986. Extremely hazardous materials are defined by federal regulation in 40 CFR Part 355.

Construction, operation, and decommissioning activities at a wind energy project would require the use of some hazardous materials, although the variety and amounts of hazardous materials present during operation would be minimal. Types of hazardous materials that may be used include fuels (e.g., gasoline, diesel fuel), lubricants, cleaning solvents, paints, pesticides, and explosives. (Table 3.4.1-1 provides a complete list of hazardous materials associated with a typical wind energy project.)

Compliance with all applicable federal and state regulations regarding notices to federal and local emergency response authorities and development of applicable emergency response plans are required for hazardous materials when quantities on hand exceed amounts specified in regulations.

3.4.2 Solid and Hazardous Wastes

Limited quantities of both solid and hazardous wastes would be generated during the construction, operation, and decommissioning of a wind energy project. Wastes meeting the definition of hazardous waste under RCRA must be managed in accordance with all applicable federal and state regulations. Possible sources of these wastes are described in this section; operators are required to determine which of these wastes are hazardous.

Solid wastes produced during construction of a wind energy development project would include containers, dunnage and packaging materials for turbine components, and miscellaneous wastes associated with assembly activities. Solid wastes resulting from the presence of the construction work crews would include food scraps and other putrescible wastes. Solid wastes produced during the operational phase would be very limited and consist primarily of office-related wastes generated at the control facility and food wastes from the maintenance crews who might be present on the site during business hours. All such wastes are expected to be nonhazardous, and typically they are containerized on site and periodically removed by commercial haulers to existing off-site, appropriately permitted disposal facilities. Generally, food service and housing are not provided on site.

Industrial wastes that would be generated during the construction phase would include minor amounts of paints and coatings and spent solvents associated with the assembly of turbines and towers. Minor amounts of wastes associated with the on-site maintenance of off-road construction equipment would also be generated. However, it is anticipated that such on-site maintenance activity would be limited to that which is immediately necessary to keep the equipment in running condition. Routine, periodic maintenance, such as oil, coolant, and filter changes, is expected to be performed off site.

TABLE 3.4.1-1 Hazardous Materials Associated with a Typical Wind Energy Project

Hazardous Material	Uses	Typical Quantities Present
Fuel: diesel fuel[a]	Powers most construction and transportation equipment during construction and decommissioning phases.	Less than 1,000 gal (3,785 L); stored in aboveground tanks during construction and decommissioning phases.[b]
	Powers emergency generator during operational phase.	Less than 100 gal (379 L); stored in aboveground tanks to support emergency power generator throughout the operation phase.
Fuel: gasoline[c]	May be used to power some construction or transportation equipment.	Because of the expected limited number of construction and transportation vehicles utilizing gasoline, no on-site storage is likely to occur throughout any phase of the life cycle of the wind energy project.
Fuel: propane[d]	Most probable fuel for ambient heating of the control building.	Typically 500 to 1,000 gal (1,893 to 3,785 L); stored in aboveground propane storage vessel.
Lubricating oils/grease/ hydraulic fluids/gear oils	Lubricating oil is present in some wind turbine components and in the diesel engine of the emergency power generator.	Limited quantities stored in portable containers (capacity of 55 gal [208 L] or less); maintained on site during construction and decommissioning phases.
	Maintenance of fluid levels in construction and transportation equipment is needed.	Limited quantities stored in portable containers (capacity of 55 gal [208 L] or less); stored on site during operational phase.
	Hydraulic fluid is used in the rotor driveshaft braking system and other controls.	
	Gear oil and/or grease are used in the drivetrain transmission and yaw motor gears.	
Glycol-based antifreeze	Present in some wind turbine components for cooling (e.g., 5 to 10 gal [19 to 38 L] present in recirculating cooling system for the transmission).	Limited quantities (10 to 20 gal [38 to 76 L] of concentrate) stored on site during construction and decommissioning phases.
	Present in the cooling system of the diesel engine for the emergency power generator.	Limited quantities (1 to 10 gal [4 to 38 L] of concentrate) stored on site during operational phase.

TABLE 3.4.1-1 (Cont.)

Hazardous Material	Uses	Typical Quantities Present
Lead-acid storage batteries and electrolyte solution	Present in construction and transportation equipment. Backup power source for control equipment, tower lighting, and signal transmitters.	Limited quantities of electrolyte solution (< 20 gal [76 L]) for maintenance of construction and transportation equipment during construction and decommissioning phases. Limited quantities of electrolyte solution (< 10 gal [38 L]) for maintenance of control equipment during operational phase.
Other batteries (e.g., nickel-cadmium [NI-CAD] batteries)	Present in some control equipment and signal-transmitting equipment.	No maintenance of such batteries is expected to take place on site.
Cleaning solvents	Organic solvents (most probably petroleum-based but not RCRA-listed) used for equipment cleaning and maintenance. Where feasible, water-based cleaning and degreasing solvents may be used.	Limited quantities (< 55 gal [208 L]) on site during construction and decommissioning to maintain construction and transportation equipment. Limited quantities (< 10 gal [38 L]) on site during operational phase to maintain equipment.
Paints and coatings[e]	Used for corrosion control on all exterior surfaces of turbines and towers.	Limited quantities (< 50 gal [189 L]) for touch-up painting during construction phase. Limited quantities (< 20 gal [76 L]) for maintenance during operational phase.
Dielectric fluids[f]	Present in electrical transformers, bushings, and other electric power management devices as an electrical insulator.	Some transformers may contain more than 500 gal (1,893 L) of dielectric fluid.
Explosives	May be necessary for excavation of tower foundations in bedrock. May be necessary for construction of access and/or on-site roads or for grade alterations on site.	Limited quantities equal only the amount necessary to complete the task. On-site storage expected to occur only for limited periods of time as needed by specific excavation and construction activities.
Pesticides	May be used to control vegetation around facilities for fire safety.	Pesticides would likely be brought to the site and applied by a licensed applicator as necessary.

Footnotes appear on next page.

TABLE 3.4.1-1 (Cont.)

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[a] It is assumed that commercial vendors would replenish diesel fuel stored on site as necessary.

[b] This value represents the total on-site storage capacity, not the total amounts of fuel consumed. See footnote a. On-site fuel storage during construction and decommissioning phases would likely be in aboveground storage tanks with a capacity of 500 to 1,000 gal (approximately 2,000 to 4,000 L). Tanks may be of double-wall construction or may be placed within temporary, lined earthen berms for spill containment and control. At the end of construction and decommissioning phases, any excess fuel as well as the storage tanks would be removed from the site, and any surface contamination resulting from fuel handling operations would be remediated. Alternatively, rather than store diesel fuel on site, the off-road diesel-powered construction equipment could be fueled directly from a fuel transport truck.

[c] Gasoline fuel is expected to be used exclusively by on-road vehicles (primarily automobiles and pickup trucks). These vehicles are expected to be refueled at existing off-site refueling facilities.

[d] Delivered and replenished as necessary by a commercial vendor.

[e] It is presumed that all wind turbine components, nacelles, and support towers would be painted at their respective points of manufacture. Consequently, no wholesale painting would occur on site. Only limited amounts would be used for touch-up purposes during construction and maintenance phases. It is further assumed that the coatings applied by the manufacturers during fabrication would be sufficiently durable to last throughout the operational period of the equipment and that no wholesale repainting would occur.

[f] It is assumed that transformers, bushings, and other electrical devices that rely on dielectric fluids would have those fluids added during fabrication. However, very large transformers may be shipped empty and have their dielectric fluids added (by the manufacturer's representative) after installation. It is further assumed that servicing of electrical devices that involves wholesale removal and replacement of dielectric fluids would not likely occur on site and that equipment requiring such servicing would be removed from the site and replaced. New transformers, bushings, or electrical devices are expected to contain mineral-oil-based, or synthetic dielectric fluids that are free of PCBs; some equipment may instead contain gaseous dielectric agents (e.g., sulfur hexafluoride [SF_6]) rather than liquid dielectric fluids.

Industrial wastes would also be generated during the operational phase. These wastes would include used oils and lubricants and spent coolants removed from turbine drivetrain components as a result of routine preventative maintenance or unexpected repair activities. Maintenance intervals are likely to be based on actual hours of operation for each turbine rather than being isochronal (i.e., based on elapsed calendar time). The introduction of filters, either as original equipment or as retrofits, can extend lubricating fluid change-out intervals even further. External filter systems are commercially available for high-viscosity fluids typically used in wind turbine transmissions (C.C. Jensen Group 2004). Used transmission oil wastes are, of course, completely eliminated with turbines that utilize direct drive designs. More sophisticated wind turbines may be equipped with sensors that monitor the condition of the lubricating fluid, thus allowing maintenance intervals to be extended. Typically, a transmission is expected to contain 10 gal (37 L) or less of lubricating fluid that will likely be changed out an average of every 2 to 3 years (of turbine operation, not calendar time). Coolant systems for transmissions typically contain 20 to 30 gal (76 to 114 L) of a 50% aqueous solution of ethylene glycol that can be expected to be changed every 3 to 4 years. Yaw control gears can be expected to contain less than 10 gal (37 L) of gear oil that may be changed no more than once every 5 years. Climate extremes at a given wind energy project may alter these maintenance schedules slightly. Although federal regulations do not categorically identify spent lubricating oils, hydraulic fluids, or coolants as hazardous wastes, some state regulations may. Nonetheless, it is standard practice that all such wastes be containerized, characterized in accordance with applicable federal or state regulations, stored on site for brief periods of time, and subsequently transported by a licensed hauler to appropriately permitted off-site disposal facilities.

Industrial wastes associated with equipment maintenance also would include solvents and cleaning agents. Judicious choice of solvents should prevent such wastes from meeting the federal or applicable state regulatory definitions of hazardous wastes. In the event of the wholesale failure of a turbine drivetrain component, that component is expected to be removed and transported from the site for repair or disposal. No major rebuilding of components is expected to occur on site.

Industrial wastes may also result during construction and decommissioning phases as well as during the operational phase as a result of leaks or accidental spills. Existing regulations and standard work practices require that spill debris (recovered spilled material as well as contaminated environmental media) be removed, containerized, characterized, stored briefly, and subsequently hauled off site by a licensed hauler to appropriate treatment, storage, or disposal facilities. Leaks from turbine drivetrain equipment can be expected to be initially contained within the nacelle or the support tower and may not, therefore, constitute a release to the environment. In the event of a spill of battery electrolyte, spill response may also involve elementary neutralization of the free acid to stabilize this corrosive waste for transportation to off-site treatment, storage, or disposal facilities.

To mitigate impacts from leaks of hazardous materials or industrial wastes during on-site storage, materials storage and dispensing areas (e.g., fueling stations for off-road construction equipment), as well as waste storage areas, are typically equipped with secondary containment features. Likewise, fluid-containing transformers may also be installed within secondary containment features or be designed in such a way that their outer cases serve as containment devices. To further mitigate adverse impacts and ensure timely response to accidental leaks or spills, appropriate spill containment and recovery equipment could be maintained at the wind energy project.

Finally, during decommissioning, substantial quantities of solid wastes and industrial wastes could result from dismantlement of a wind energy project. Fluids drained from turbine drivetrain components (e.g., lubricating oils, hydraulic fluids, coolants) are likely to be similar in chemical composition to spent fluids removed during routine maintenance and would be managed in the same manner as analogous maintenance-related wastes. Tower segments are expected to be stored on site for a brief period and eventually sold as scrap. Likewise, turbine components (emptied of their fluids) may have some salvage value. Electrical transformers are expected to be removed from the site and available for other applications elsewhere (in most cases, without the need for removing dielectric fields). Substantial amounts of broken concrete from tower and building foundations as well as rock or gravel from on-site roads or electrical substations would also result from decommissioning. All such materials are expected to be salvageable for use in road-building or bank stabilization projects. Miscellaneous materials without salvage value are expected to be nonhazardous and should be removed from the site by a licensed hauler and delivered to appropriately permitted disposal facilities.

3.4.3 Wastewater

Especially during the construction and decommissioning phases, and, to a lesser extent, during the operational phase, sanitary wastewater is generated by the work crews or maintenance personnel present on site. During the construction and decommissioning phases, work crews of 50 to 100 individuals may be present. During the operational phase, a maintenance crew of 6 individuals or fewer is likely to be present on the site daily during business hours. Wastewater would be collected in portable facilities and periodically removed by a licensed hauler and introduced into existing municipal sewage treatment facilities.

3.4.4 Storm Water and Excavation Water

Except in those instances of spills or accidental releases, storm water runoff from the site and excavation waters are not expected to have industrial contamination but may contain sediment from disturbed land surfaces.

3.4.5 Existing Contamination

It is possible that wind energy projects would be proposed for areas at which other industrial activities had previously taken place (or are ongoing). In those situations, industrial contamination may be encountered during site development, especially during foundation and cable trench excavations. Once identified, all such contamination would need to be characterized, and a separate plan to remove contamination or stabilize it in place would need to be developed. Additional agreements may be needed to negotiate specific responsibilities for characterizing and remediating contamination.

3.5 TRANSPORTATION CONSIDERATIONS

A variety of transportation operations are necessary to support wind energy development. Table 3.5-1 summarizes representative transportation requirements for each phase of development. The majority of transportation operations would involve material and equipment moved to the site during the construction phase. The types and amounts of material and equipment required for construction of the wind energy development project would depend on site characteristics as well as the design selected. The following discussion provides a general overview of the expected transportation requirements during development, focusing on the unique considerations posed by the wind turbines, towers, and rigging equipment necessary to erect them.

In general, the heavy equipment and materials needed for site access, site preparation, and foundation construction are typical of road construction projects and do not pose unique transportation considerations. The types of heavy equipment required would include bulldozers, graders, excavators, front-end loaders, compactors, and dump trucks. Typically, the equipment would be moved to the site by flatbed combination truck and would remain on site through the duration of construction activities. Typical construction materials hauled to the site would include gravel, sand, and water, which are generally available locally. Ready-mix concrete might also be transported to the site, if available. The movement of equipment and materials to the site during construction would cause a relatively short-term increase in the traffic levels on local roadways during the construction period.

As discussed in Section 3.1.2.1, transportation logistics have become a major consideration for wind energy development projects; the trend is toward larger rotors and taller towers and the associated equipment needed to erect them. Depending on the design, some of the turbine components would be extremely long (e.g., blades) or heavy (e.g., the nacelle containing all drivetrain components except the rotor). (Table D-2, Appendix D, has anticipated ranges of turbine component sizes and weights.) The size and weight of these components would dictate the specifications for site access roads for required ROWs, turning radii, and fortified bridges. It is estimated that each wind turbine generator would require between 5 and 15 truck shipments of components, some of which could be oversized or overweight.

Erecting the towers and assembly of the wind turbine generators would require a main crane with a capacity likely to be between 300 and 750 tons (272 and 680 t), depending on the design. A 300-ton (272-t) main crane would require 15 to 20 truckloads, including several overweight and/or oversized shipments (Wood 2004). A 750-ton (680-t) crane would require up to 50 truckloads, including overweight/oversized shipments (Wood 2004). In addition, main crane assembly would require a smaller assist crane, and several assist cranes would likely be required for rotor/hub assembly. Cranes would remain on site for the duration of construction activities.

In the United States, the transportation regulation system has unique rules, regulations, and oversized permit requirements for each state. This system requires transporters to evaluate the type of shipment being planned, its origin, and destination (Smith 2002). Demonstrating to permit officials that all possible means have been assessed or used to either minimize travel distances or select appropriate bypass routes is critical in obtaining permits (Smith 2002). Typically, the transport company develops detailed transportation plans based on specific object sizes, weights, origin, destination, and unique handling requirements. The final transportation plan is developed after alternative approaches have been evaluated, costs refined, and adjustments have been made to comply with unique state requirements.

Overweight permits usually are issued with specific dates during which transport is prohibited. These dates are state specific but tend to eliminate periods during the spring when frozen ground is thawing. Over-dimension permits are likely to have travel time limits in congested areas, limiting movement to non-rush-hour periods.

Depending on the origin and destination sites, shipments of components and main cranes within the United States could be made by truck, rail, or barge. If rail or barge were utilized, the cargo would require unloading at the nearest transfer point followed by overland transportation to the site by truck.

TABLE 3.5-1 Representative Transportation Requirements

Project Phase/Activity	Equipment/Material	Transportation Requirements	Access Road Requirements	Special Requirements
Monitoring and Testing				
	Meteorological towers	Heavy duty all-wheel-drive pickup trucks or medium-duty trucks. 1 to 2 trucks per tower.	Minimum-specification access road.	None.
Construction				
Site and road grading and preparation	Heavy earthmoving equipment: bulldozers, graders, excavators, front-end loaders, compactors, dump trucks	Heavy equipment typically transported to the site using combination trucks with flatbed or goose-neck trailers. Equipment requirements are site dependent. Typical construction may require 10 to 20 pieces of heavy equipment.	Improved access road.	None. Loads expected to be legal-weight, under 80,000 lb (36,287 kg).
Road, pad, and lay-down areas	Sand and gravel	Delivered from on- or off-site sources in dump trucks. Quantity required is site dependent.	Improved access road.	None. Loads expected to be legal-weight, under 80,000 lb (36,287 kg).
Tower foundations	Premixed concrete, or aggregate, sand, cement, and water for an on-site batch plant	Premixed concrete could be delivered in approximately 10-yd^3 (8-m^3) trucks from off-site sources. Alternatively, raw material for an on-site concrete batch plant could be delivered by dump truck. Approximately 15 to 20 truck shipments per foundation.	Improved access road.	None. Loads expected to be legal-weight, under 80,000 lb (36,287 kg).

TABLE 3.5-1 (Cont.)

Project Phase/Activity	Equipment/Material	Transportation Requirements	Access Road Requirements	Special Requirements
General	Water (potable, dust suppression, concrete batch plant)	Tens of thousand of gallons likely required per day. Water could be obtained from on-site wells or trucked from off-sites sources. Off-site shipments typically in 4,000- to 5,000-gal (15,142- to 18,927-L) tank trucks. Approximately 10 to 30 shipments per day.	Improved access road.	None. Loads expected to be legal-weight, under 80,000 lb (36,287 kg).
WTGS components	Rotors, nacelle, transformer, control units, tower sections	WTGS design dependent. Depending on source, components may be transported by ship, barge, rail, or truck to the vicinity of the site. Components shipped to the site using combination trucks with flatbed or goose-neck trailers. Some shipments (e.g., rotors, nacelle) likely overweight and/or oversized. Typically 5 to 15 truckloads per WTGS.	Improved access road. Limited turning radius and grades due to size and weight. Bridges may need to be fortified and overhead obstructions (e.g., transmission lines) rerouted.	Overweight and/or oversized loads require specialized equipment and state-specific permits. Traffic management requires consideration (e.g., flaggers, escort vehicles, and travel time restrictions).
WTGS assembly and installation	Cranes: 300- to 750-ton (272- to 680-t) capacity main crane, 70-ton (64-t) capacity assist crane, driveable assembly cranes	Required crane capacity dependent on WTGS design. A 300-ton (272-t) main crane would require 15 to 20 truckloads, including several overweight/oversized shipments. A 750-ton (680-t) crane would require up to 50 truckloads, including overweight/oversized shipments. Several smaller, driveable cranes required for main crane assembly and rotor assembly.	Same as WTGS components.	Same as WTGS components.

TABLE 3.5-1 (Cont.)

Project Phase/Activity	Equipment/Material	Transportation Requirements	Access Road Requirements	Special Requirements
WTGS interconnections and transmission lines	Trenching or augering equipments, line trucks	WTGS design dependent.	Improved access road.	None. Loads expected to be legal-weight, under 80,000 lb (36,287 kg).
Operation				
	Operation and maintenance personnel	Pickup or medium-duty trucks.	Minimum-specification access road.	None.
Decommissioning				
Foundation removal, site regrading, recontouring	Heavy earthmoving equipment: bulldozers, graders, excavators, front-end loaders, dump trucks	Heavy equipment typically transported to the site using combination trucks with flatbed or goose-neck trailers.	Improved access road.	None. Loads expected to be legal-weight, under 80,000 lb (36,287 kg).
WTGS and tower disassembly	Cranes: 300- to 750-ton (272- to 680-t) capacity main crane, 70-ton (64-t) capacity assist crane	Similar to assembly requirements. Required crane capacity may be less than that required for initial assembly, depending upon the method used during decommissioning.	Similar to WTGS components.	Similar to WTGS components.
Equipment, debris removal	Medium- and heavy-duty trucks	Debris, dismantled equipment would be shipped for recycling, reuse, or disposal. Level of activity would be site and design dependent.	Improved access road.	None.

During operations, larger sites may be attended during business hours by a small maintenance crew of six individuals or fewer. Consequently, transportation activities would be limited to a small number of daily trips by pickup trucks, medium-duty vehicles, or personal vehicles. It is possible that large components may be required for equipment replacement in the event of a major mechanical breakdown. However, such shipments would be expected to be infrequent.

With some exceptions, transportation activities during site decommissioning would be similar to those during site development and construction. Heavy equipment and cranes would be required for dismantling turbines and towers, breaking up tower foundations, and regrading and recontouring the site to the original grade. With the possible exception of a main crane, oversized and/or overweight shipments are not expected during decommissioning activities because the major turbine components can be disassembled, segmented, or size-reduced prior to shipment.

3.6 EXISTING MITIGATION GUIDANCE

The establishment of BMPs, guidelines, or stipulations is a standard method for ensuring that the impacts of specific activities on the surrounding environment are kept to a minimum. Toward that end, a number of organizations have developed guidance to mitigate the impacts of wind power projects. In developing policies and BMPs for inclusion in the BLM’s proposed Wind Energy Development Program, existing guidance has been reviewed, and relevant and appropriate elements have been incorporated into the BLM’s proposed program (Section 2.2.3).

While some of the potential impacts associated with wind energy development projects described in Chapter 5 are unique to this type of activity, a large portion of the potential impacts (e.g., road construction and habitat fragmentation) are common to other types of development activities on public lands. For this reason, existing BLM guidance and planning documents established for other types of development activities (i.e., nonwind energy activities) also have been reviewed and considered for inclusion in the BLM’s proposed Wind Energy Development Program.

3.6.1 Existing Guidance on Wind Energy Development in the United States and Abroad

A number of organizations have developed or are in the process of developing guidance regarding the development of wind energy projects and mitigation measures. While many of the existing guidelines have been incorporated into the BLM’s proposed program (Section 2.2.3), the specific requirements of the proposed policies and BMPs have been defined on the basis of reviews and analyses conducted in the course of this PEIS and, therefore, may vary from those put forth by other organizations.

The following text briefly identifies the key organizations that have issued or are developing comprehensive wind energy guidelines and describes the elements of their recommendations. Readers are advised to obtain the complete guidance documents from each organization if they wish to obtain more information.

- *American Wind Energy Association (AWEA).* The AWEA Siting Committee currently is developing a document that identifies and discusses issues and potential solutions related to siting wind energy projects (Jodziewicz 2004).

- *Australian Wind Energy Association (AusWEA).* The AusWEA published a document entitled *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia* to facilitate the development of "high quality" wind energy projects in Australia (AusWEA 2002). These guidelines were modeled after guidelines previously published by the BWEA and the European Wind Energy Association (EWEA) described below. These guidelines provide an overview of the technical, commercial, environmental, consultative, and contractual considerations related to the different phases of wind power project development. With respect to environmental and socioeconomic considerations that should be addressed during the site selection, feasibility study, and detailed assessment phases, the guidelines identify visual resources, ecological resources, archaeological and historical heritage, conservation and recreational uses, proximity to dwellings, noise levels, EMI, aircraft safety, construction traffic safety, economic impacts, and decommissioning requirements. Impact mitigation methods for design, construction, and operation stages are provided.

- *British Wind Energy Association (BWEA).* The BWEA issued its *Best Practice Guidelines for Wind Energy Development* to facilitate the development of appropriately sited and sensitively developed wind power projects (BWEA 1994). Similar to the AusWEA guidelines, these guidelines address the technical, commercial, environmental, and consultative considerations associated with the different phases of wind power development.

- *European Wind Energy Association (EWEA).* The EWEA issued its *European Best Practice Guidelines for Wind Energy Development* to facilitate the development of appropriately sited and sensitively developed wind power projects (EWEA 1999). The document provides guidelines for activities to be undertaken during each phase of project development, including initial site selection, detailed assessment, monitoring, and final site clearance. It addresses technical, commercial, environmental, and consultative considerations. Environmental aspects discussed in the document include visual resources, noise, ecological resources, archaeological and historical resources, hydrology, telecommunications interference, aircraft safety, other safety concerns, traffic management, road construction, electrical connections, economic impacts, global environmental effects, and tourism and recreation.

- *National Wind Coordinating Committee (NWCC).* In 2002, the NWCC published a revised handbook entitled *Permitting of Wind Energy Facilities* that was prepared by its own Siting Subcommittee (NWCC 2002). The handbook is intended to serve as a guide for those involved in evaluating wind projects and "to assist stakeholders to be informed participants in the wind energy development decision-making process" (p. 1, Executive Summary). It provides an overview of wind development and permitting activities, guidelines for structuring a permitting process (including planning and monitoring phases), and a discussion of specific permitting and siting considerations and mitigation strategies. Siting considerations addressed in this handbook include land use, noise, birds and other biological resources, visual resources, soil erosion and water quality, public health and safety, cultural and paleontological resources, solid and hazardous wastes, and air quality and climate.

- In 1999, the NWCC published a document entitled *Studying Wind Energy/Bird Interactions: A Guidance Document* prepared by its Avian Subcommittee (NWCC 1999). This document provides an overview of wind energy/bird interactions for regulators and stakeholders as well as more technical information regarding the concepts and tools for studying such interactions. It is intended to serve as a reference document for assessing the suitability of proposed sites and the potential effects of a proposed project on birds of concern. It also recommends methods, metrics, and definitions for use in studies of wind energy/bird interactions.

- *U.S. Fish and Wildlife Service (USFWS).* The USFWS issued *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* in 2003 (USFWS 2003). These voluntary guidelines, prepared by the USFWS Wind Turbine Siting Working Group, address the evaluation of potential wind energy development sites, location and design of turbines and associated structures, and pre- and post-construction research and monitoring needs. Specifically, the guidelines provide a site evaluation process with checklists, a series of site development and turbine design and operation recommendations, and a literature review of impacts of wind turbines on wildlife. The USFWS plans to evaluate these guidelines and modify them as necessary on the basis of their performance in the field and the latest scientific and technical discoveries. The USFWS also has issued interim guidelines for protecting birds from the siting, construction, operation, and decommissioning of communication towers (Clark 2000), some of which could be applicable to both turbines and meteorological towers at a wind energy development project. In addition, the USFWS worked jointly with the Avian Power Line Interaction Committee to develop guidelines for protecting birds from electrocution and collisions with power lines (APLIC and USFWS 2005), some of which are applicable to wind energy development.

- *Washington Department of Fish and Wildlife (WDFW).* The WDFW issued *Wind Power Guidelines*, which addresses baseline and monitoring studies for wind energy projects and habitat mitigation concerns (WDFW 2003b). These guidelines define the purpose and scope of preproject habitat and wildlife assessment studies, recommend methods for avoiding or minimizing impacts to wildlife, and establish requirements for operational monitoring activities. They also establish a framework for ensuring habitat mitigation through both restoration and acquisition of replacement habitat.

3.6.2 Existing BLM Mitigation Guidance Relevant to Wind Energy Development

The BLM has developed many program-specific guidance documents that establish mitigation requirements for a variety of activities. This guidance comes in many forms: plans, manuals, handbooks, instruction memoranda, environmental memoranda, technical references, BMPs, standards, directives, and other such documents. While none of the existing guidance, other than the Interim Wind Energy Development Policy (BLM 2002a) (Appendix A), directly addresses wind energy development, guidance is provided on topics relevant to wind energy development.

A number of the key sources for relevant mitigation guidance are discussed in this section. The proposed Wind Energy Development Program includes policies and BMPs requiring that relevant BLM mitigation guidance be incorporated into individual wind energy development project PODs, as appropriate, to address site-specific issues.

3.6.2.1 BLM Land Use Plans

The BLM's land use plans are planning and management documents that (1) define how resources will be managed within a specific planning area or subdivision of a planning area, and (2) establish restrictions on activities to be undertaken in that planning area or subdivision. The land use planning process is the key tool that the BLM uses to protect resources and designate uses on federal lands that it manages. These plans help ensure that the public lands are managed in accordance with applicable laws and regulations under the principles of multiple use and sustained yield; recognizing the nation's need for domestic sources of minerals, food, timber, and fiber while protecting the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water, and archaeological values. The BLM develops land use plans in accordance with federal requirements and BLM regulations and planning policies. Depending on when a land use plan was written or last revised, it may exist as a Management Framework Plan (MFP), the original format, or as a newer Resource Management Plan (RMP).

Land use plans typically are organized according to the resources present in the planning area. For each identified resource (e.g., wildlife, minerals, recreation areas), the plan will identify management objectives and management actions. Often the management actions establish restrictions or stipulations regarding the use or development of the given resource. The scope of a given land use plan is dictated by the resources that are present in the corresponding planning area. For example, if oil and gas resources do not exist in a planning area, the corresponding land use plan will not contain management objectives or actions related to this resource. However, many resources are common to virtually all BLM planning areas, and the corresponding land use plans establish management actions to ensure appropriate resource management. Many of these are resources that might be impacted by wind energy development projects: wildlife (including federal- and state-protected species), wildlife habitat, soils, water resources, cultural and historic resources, visual resources, recreation areas, and forestry resources. In addition, many land use plans establish restrictions or stipulations specific to relevant management issues, such as hazardous materials management, fire management, and wild horse management.

3.6.2.2 Guidance for Oil and Gas Development

Many organizations, including the BLM, have developed mitigation guidance specific to oil and gas exploration and development and related ROW activities. These guidance documents are too numerous to identify and describe comprehensively in this PEIS. A review of many of them, however, indicated that they generally address the same issues identified in BLM guidance, described below, although to varying degrees of specificity and control (Western Governors' Association 2004; WGFD 2004a; ALL Consulting and Montana Board of Oil and Gas Conservation 2002; NPS 2002).

The BLM's "Gold Book" (RMRCC 1989) provides guidelines for operators conducting oil and gas and related ROW activities on BLM-administered lands. To supplement the guidance provided in the Gold Book, the BLM Washington Office, Fluid Minerals Group, has identified BMPs specific to fluid minerals development activities, including oil and gas operations and related ROW activities (BLM 2004a-e). The stated goal of these BMPs is to promote environmental resource protection and sustainable development of energy resources on public lands. The guidance provided by the BMPs recognizes that site variability defines the most appropriate management practices, and that there is no single solution applicable to all areas.

In addition, in February 2005, the BLM issued Instruction Memorandum No. 2005-069, *Interim Offsite Compensatory Mitigation for Oil, Gas, Geothermal and Energy Rights-of-Way Authorizations*, which outlines interim policy for the use of off-site mitigation for BLM authorizations for oil, gas, geothermal, and energy ROW programs, including wind energy development (BLM 2005a). Compensatory mitigation is defined in the memorandum as mitigation actions that are undertaken off site to compensate for an impact by replacing or providing substitute resources or environments. This off-site mitigation can be immediately adjacent to the area impacted but can also be located anywhere in the same general geographic area. According to the memorandum, off-site compensatory mitigation measures must be voluntary on the part of the applicant.

3.6.2.3 Other BLM Program-Specific Mitigation Guidance

The BLM has issued many program-specific documents addressing environmental issues relevant to wind energy projects. The topics covered by these documents that reasonably can be identified as relevant include land use planning; NEPA; visual resource management; road construction and maintenance; wildlife management (including special status species, ESA species, threatened and endangered species, and sage-grouse management); ACECs; hazardous materials and waste management; cultural resource management; Native American consultations; pesticide use and integrated pest management; and occupational health and safety. Additional program-specific guidance may be relevant, depending on project-specific factors.

A comprehensive review of these BLM program-specific mitigation documents is beyond the scope of this PEIS, although discussion of many of these documents is included in sections of Chapters 4 and 5. Readers are advised to obtain the complete guidance documents if they wish to obtain more information. Electronic copies of some of the BLM directives, manuals, and handbooks are available at http://www.blm.gov/nhp/efoia/.

4 AFFECTED ENVIRONMENT

Because this PEIS provides an assessment of environmental, social, and economic issues at a programmatic level and not at the site-specific level, the descriptions of the affected environment presented in this chapter do not provide detailed information about conditions that exist at specific project locations. Rather, these descriptions provide the level of detail needed to support the programmatic impact assessment presented in Chapter 5. Information needed to assess the range of potential impacts that may occur because of wind energy development on BLM-administered lands and to identify effective mitigation measures that may be applicable at individual sites is presented. In addition, the many site-specific factors that must be evaluated at the project level are identified.

4.1 GEOLOGIC RESOURCES AND SEISMIC SETTING

Any type of construction or industrial activity has the potential to impact soil, sand and gravel resources, and other sources of rock. These impacts can occur within the specific area of construction as a result of excavation, grading, and so forth, or regionally as a result of extraction and the use of building materials. In addition, construction activities can impact or be impacted by local seismic and geologic hazard conditions. The impacts would vary by location and depend on the local geology. Detailed studies of soil, sand, gravel, and other aggregate resources, as well as the seismic setting, would need to be conducted, as discussed in the following sections, to define the affected environment for an individual project.

4.1.1 Geologic Resources

The type and distribution of soils vary widely across the western states and also may vary considerably within a specific wind energy project site. Specific soil types and thicknesses at a given site will determine the degree of potential erosion and/or compaction problems and the associated engineering requirements for activities that could disturb soils (e.g., excavations, grading and clearing surfaces, road construction, and structural foundations). Detailed soil surveys may be required wherever extensive soil disturbance is possible at a site.

Sand and gravel deposits and rocks suitable for use in construction occur throughout the western states. These resources may be present within a specific wind energy project site, in the immediate vicinity, or some distance away. Detailed reviews of the availability of these resources in sufficient quantities to meet the project-specific needs would need to be conducted. Specifically, the location, quality, and potential competing uses of these materials would need to be characterized.

4.1.2 Seismic Setting

Many parts of the western United States are seismically active, with varying degrees of potential for earthquakes. In addition, other geologic hazards exist, such as the potential for landslides and rock falls. The potential for volcanic activity exists as well, although this is less widespread. Detailed reviews of the local geology and seismic setting would be required to identify which hazards are present at a specific wind energy project site and, therefore, to determine the need for engineering controls.

4.2 PALEONTOLOGICAL RESOURCES

Paleontological resources are the fossilized remains of plants and animals. Some fossil remains have major scientific value. Greater attention is often given to vertebrate fossils than to invertebrate fossils because of their rarity; however, some invertebrate fossils are also rare. The rarity of such specimens and the unique information that can be gleaned from these items emphasizes the need for their protection. No laws specifically address paleontological resources; some protection is offered, however, through the Antiquities Act of 1906 to specimens of significant scientific value. Two other federal acts, the Archaeological Resources Protection Act of 1979 and the Federal Cave Resources Protection Act of 1988, protect fossils found in primary context and from significant caves, respectively. Fossils on federal lands (e.g., BLM-administered lands) are further protected by laws penalizing the theft or degradation of property of the U.S. government (Theft of Government Property [62 Stat. 764, 18 USC 1361] and FLPMA [Public Law (P.L.) 94-579; 90 Stat. 2743; 43 USC 1701]).

The large number of productive fossil-bearing geological landforms found on federal land in the American West has encouraged the BLM to provide guidance on protecting this resource. Guidance on the treatment of paleontological resources is given in the 2000 Report by the Secretary of the Interior on Fossils on Federal Land (DOI 2000). Further guidance is provided in the BLM Manual titled *8270 — Paleontological Resource Management* (BLM 1998). Procedures for managing this resource are identified in an attachment to BLM Manual 8270, the Paleontological Resources Handbook 8270-1. The goal of the BLM program is to locate, evaluate, manage, and protect paleontological resources on public lands. (See Section 4.7.4 for a description of designated ACECs.)

To date, no comprehensive inventory of fossils and no systematic inventory of fossil-bearing areas on BLM-administered lands have been conducted. Most assessments and inventories of paleontological resources on public lands are conducted on a project-specific basis. BLM Field Offices maintain records of the paleontological finds made on the lands they manage. Often this information is held by the primary state repository for fossil finds in that area. Site-specific information regarding paleontological resources would need to be collected to define the affected environment for an individual project.

4.3 WATER RESOURCES

The availability and quality of water resources are major issues in many portions of the 11-state study area. Large portions of the region have very dry climates, and water availability can become a limiting factor on all kinds of development and, consequently, on population growth. Both surface water and groundwater resources are highly valued commodities; water rights are strictly enforced, and all water use is closely evaluated. Activities that use water resources or have the potential to impact the quality of water resources must be reviewed within the context of local and regional water concerns. Detailed studies of water resources need to be conducted to define the affected environment for an individual project. In this PEIS, Section 3.2 and Appendix E provide discussions of applicable regulations regarding water resources, such as the CWA and the SDWA.

4.3.1 Groundwater

Groundwater quality and availability vary widely across the western states. The availability of groundwater resources to support site construction activities would need to be assessed at the project level, along with other characteristics such as groundwater quality, depth to groundwater, and local groundwater uses. At some sites, the hydrologic regime may need to be characterized to assess the relationship at a specific site between groundwater and surface water resources, including wetlands, if any, and to determine whether groundwater resources are recharged locally.

4.3.2 Surface Water

While surface water resources also vary widely across the western states, they are fairly limited in many areas that are quite arid. The presence of both permanent and ephemeral surface water bodies would need to be assessed at the project level, along with other characteristics such as water quality; water use by humans, livestock, and wildlife; surface runoff patterns; and hydrologic connectivity to local groundwater resources, if any.

4.4 AIR QUALITY

Air quality changes over time as economic development occurs and regulatory programs affect the emissions from sources. At the time a site is proposed for wind energy development, the air quality at that site would need to be assessed. The following discussion provides a general picture of air quality in the 11-state study area and comments on the current major regulatory programs. The text box on the next page titled “Air Quality Terms” provides definitions for some of the terms used in this section.

The affected air environment can be characterized in terms of concentrations of the criteria pollutants carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), nitrogen dioxide (NO_2), ozone (O_3), and lead (Pb). The EPA has established National Ambient Air Quality Standards (NAAQS) for these pollutants. There are two standards for particulate matter, one for particulates less than 10 µm in diameter (PM_{10}) and one for particulates less than 2.5 µm in diameter ($PM_{2.5}$). Table 4.4-1 lists the NAAQS. Some states have additional standards for these pollutants and standards for other pollutants. One of the goals of air quality regulatory programs is to ensure that concentrations of pollutants in the air do not exceed these standards.

Air Quality Terms

National Ambient Air Quality Standards (NAAQS) are established by the U.S. Environmental Protection Agency (EPA) for criteria pollutants. The primary NAAQS specify maximum ambient (outdoor air) concentrations of the criteria pollutants that would protect public health with an adequate margin of safety. Secondary NAAQS specify maximum concentrations that would protect public welfare. Some of the NAAQS for averaging times of 24 hours or less allow the standard values to be exceeded a limited number of times per year.

Ozone (O_3) is formed in the atmosphere by chemical reactions involving nitrogen oxides (NO_x) and volatile organic compounds. The reactions are energized by sunlight. Emissions of NO_x and volatile organic compounds are controlled to reduce ozone levels.

Particulate Matter (PM) is dust, smoke, and other solid particles, and liquid droplets in the air. The size of particulates is important and is measured in micrometers (µm). A micrometer is 1 millionth of a meter (0.000039 in.).

Volatile Organic Compounds (VOCs) are organic vapors in the air that can react with other substances, principally NO_x, to form ozone. VOCs have many sources such as solvents, combustion, and evaporation of fuels.

Areas where air quality exceeds the NAAQS are called nonattainment areas, and states must develop plans (called State Implementation Plans or SIPs) for attaining and maintaining the NAAQS. These plans generally include emissions reduction measures, such as limitations on stationary source emissions, and work practice standards. There are no nonattainment areas for NO_2 (EPA 2004a). Tailpipe emissions from mobile sources (cars, trucks, construction equipment, etc.) are regulated by the federal government except in California, which has its own mobile source programs and regulations.

Figures 4.4-1 and 4.4-2 show counties in the 11-state study area with nonattainment areas for PM_{10}, CO, and O_3 (1-hour standard).[1,2] These pollutants are associated mostly with emissions from construction activities for wind energy projects. In addition, parts of four Arizona counties are nonattainment for SO_2, and part of one county in Montana is nonattainment for Pb; however, neither SO_2 nor Pb is emitted in appreciable quantities by development or operation of wind energy projects. A highlighted county may contain more than one

1 Nonattainment areas for $PM_{2.5}$ have not been designated; this document concentrates on PM_{10}. The conclusions would be the same for $PM_{2.5}$.

2 On April 15, 2004, the EPA designated nonattainment areas for the 8-hour O_3 standard (EPA 2004b). Both O_3 standards will remain in effect for some time, and states have yet to prepare plans for meeting the 8-hour standard. Since O_3 nonattainment should have little, if any, impact on development and operation of wind energy projects, only the counties containing nonattainment areas under the older 1-hour standard are shown in the figure. A list of the 8-hour nonattainment areas and the associated counties can be found in EPA (2004b).

TABLE 4.4-1 National Ambient Air Quality Standards

Pollutant	Averaging Time	Ambient standard[a] (Value)[b]	Type[c]
SO_2	3 hours	1,300 (0.5)	S
	24 hours	365 (0.14)	P
	Annual	80 (0.03)	P
NO_2	Annual	100 (0.053)	P,S
CO	1 hour	40,000 (35)	P
	8 hours	10,000 (9)	P
O_3	1 hour	235 (0.12)	P,S
	8 hours	157 (0.08)	P,S
PM_{10}	24 hours[d]	150	P,S
	Annual[d]	50	P,S
$PM_{2.5}$	24 hours[d]	65	P,S
	Annual[d]	15	P,S
Pb	Calendar quarter	1.5	P,S

[a] Refer to 40 CFR Part 50 for detailed information on attainment determination and methods for monitoring.

[b] Values that are not in parentheses are in $\mu g/m^3$. Parenthetical values are part(s) per million (ppm) by volume.

[c] P = primary (health-based) standard; S = secondary (welfare-based) standard.

[d] Implementation of the standard has been delayed, and states have not developed attainment plans.

Source: 40 CFR Part 50.

nonattainment area, and a particular nonattainment area may be a small fraction of a highlighted county. Nonattainment areas also change as air quality changes over time. Site-specific air quality would need to be assessed at all sites, even those not located in or close to nonattainment areas.

The NAAQS establish maximum pollutant levels that should not be exceeded. The Prevention of Significant Deterioration (PSD) program limits the deterioration of existing air quality in areas with air cleaner than the NAAQS levels. This program establishes a baseline level of air quality and specifies increments that cap the increases in pollutant levels above that baseline. The program applies to sulfur oxides, PM_{10}, and NO_2 emitted by new or modified major sources. Smaller increments apply in special areas, such as National Parks and Wilderness Areas (Class I areas), than in other areas (Class II areas). An operating wind energy development project would not be a major source.

FIGURE 4.4-1 Counties with a PM_{10} Nonattainment Area (Source: EPA 2004a)

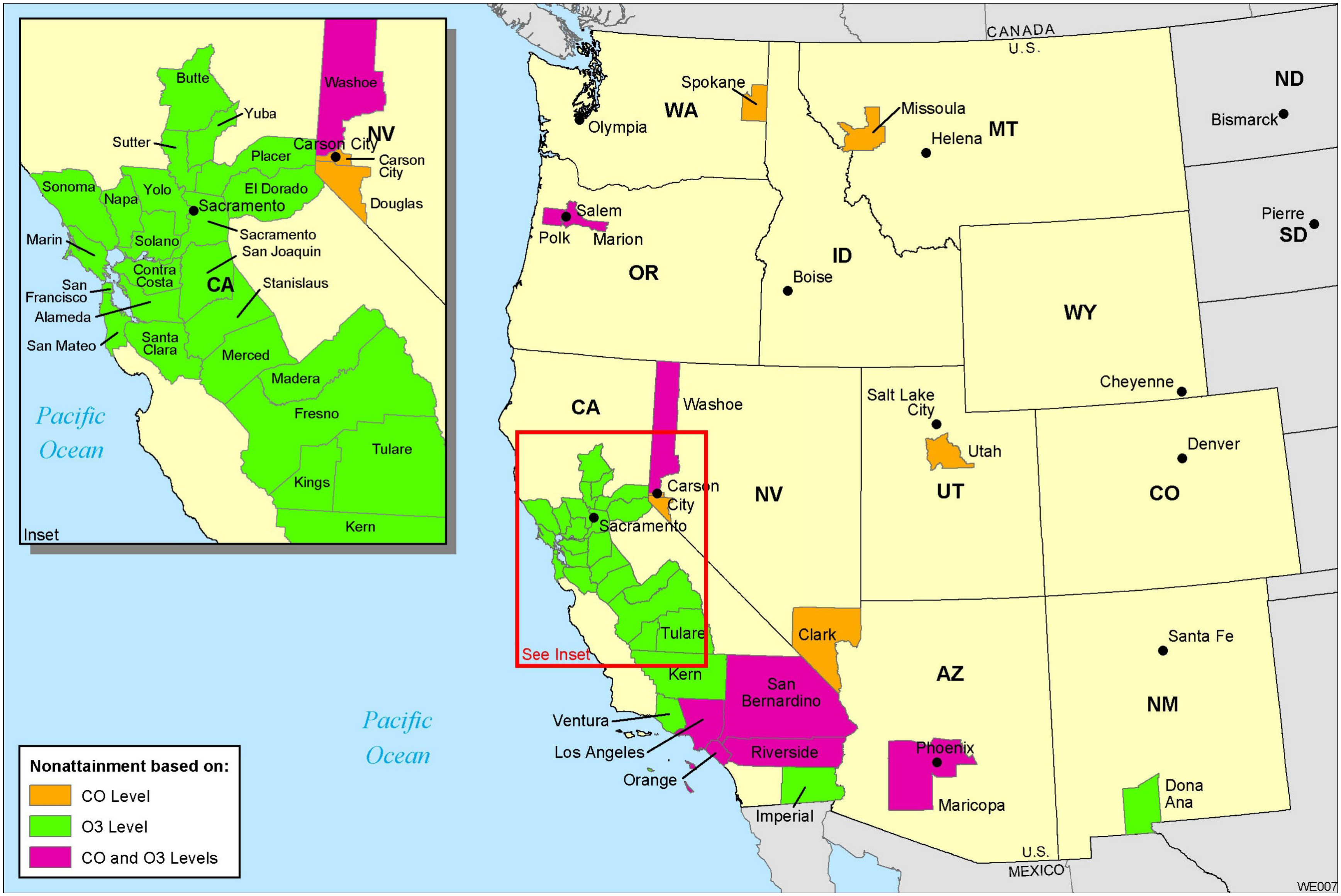

FIGURE 4.4-2 Counties with a 1-Hour Ozone or a Carbon Monoxide Nonattainment Area (Source: EPA 2004a)

The EPA and the states also control air toxics or hazardous air pollutants (HAPs), substances judged to have adverse impacts on human health when present in the ambient air. The EPA and some states have issued lists of substances regulated as air toxics. The specific substances listed and the types of regulations applied differ among jurisdictions. Again, given its small emissions, an operating wind energy project would probably not be regulated for emissions of air toxics.

4.5 NOISE

This section presents a brief discussion of environmental noise fundamentals, background noise levels, noise propagation, and noise standards and guidelines.

4.5.1 Fundamentals of Acoustics

Sound can be defined as any pressure variation that the human ear can detect. Noise is defined as "unwanted sound."

The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB ("threshold of hearing") to about 140 dB ("threshold of pain"). The normal audible frequency range is approximately 20 Hz to 20 kHz. The A-weighted scale, denoted as dB(A), approximates the range of human hearing by filtering out lower frequency noises, which are not as damaging as the higher frequencies. It is used in most noise ordinances and standards. To provide a frame of reference, rustling leaves have a decibel level of 10 dB(A); conversational speech, 60 dB(A); and aircraft takeoff, 120 dB(A).

While A-weighted sound may adequately indicate the level of sound at a given instant in time, it does not account for the duration of the sound or that sound levels can vary with time. In wind turbine assessment, two descriptors (L_{eq} and L_{dn}) are generally used to describe this variation. The equivalent sound pressure level (L_{eq}) is a single number that, if continuous during a specific time period, would contain the same total energy as the actual time-varying sound. The day-night average sound level (L_{dn} or DNL) is the average A-weighted sound level over a 24-hour period, with a 10-dB penalty artificially added to nighttime (10:00 p.m. to 7:00 a.m.) sound levels to account for more noise-sensitive activities (e.g, TV viewing or sleep) during that period.

The effects of noise on people can be classified into three general categories: (1) subjective effects of annoyance, nuisance, and dissatisfaction; (2) interference with activities such as speech, sleep, and learning; and (3) physiological effects such as anxiety or hearing loss. The sound levels associated with environmental noise generally produce effects only in the first two categories.

Whether a noise is objectionable will vary depending on the type of noise (tonal, broadband, low frequency, or impulsive) and the circumstances and sensitivity of the individual who hears it. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by the hearer.

The human response to changes in decibel levels has the following characteristics (NWCC 1998):

- A 3-dB change in sound level is considered a barely noticeable difference;

- A 5-dB change in sound level will typically result in a noticeable community response; and

- A 10-dB change, which is generally considered to be a doubling of the sound level, almost certainly causes an adverse community response.

However, at many wind energy project sites on BLM-administered lands, large fluctuations in broadband noise are common, and even a 10-dB increase would be unlikely to cause an adverse community response. In addition, noise containing discrete tones (tonal noise) is much more noticeable and more annoying at the same relative loudness level than other types of noise, because it stands out against background noise.

4.5.2 Characterization of Background Noise Levels

Wind energy projects in the United States are mostly located in undeveloped hilly terrain in rural or remote areas. While these areas have low human population densities, they may have high populations of some animal species. Ambient noise levels at these sites are quite low. Typically, primary noise sources around the project area would include noise caused by wind and vehicular traffic along the major roads. Other noise sources would be farm machinery (e.g., tractors) and animal noise (e.g., dog barking and bird chirping). In general, background noise levels (i.e., noise from all sources not associated with a wind energy facility) are higher during the day than at night. For a typical rural environment, background noise is expected to be approximately 40 dB(A) during the day and 30 dB(A) at night (Harris 1979), or about 35 dB(A) as DNL (Miller 2002).

4.5.3 Noise Propagation

To predict the noise level at receptor locations from a known power level, a number of sound propagation mechanisms should be considered. Major factors determining noise levels at the receptor (Anderson and Kurze 1992) include the following:

- Source characteristics (e.g., sound power, directivity and source height);

- Geometric spreading as the result of the distances from the noise source to the receptor;

- Atmospheric air absorption, which depends strongly on frequency and relative humidity but less strongly on temperature and pressure;
- Ground effects resulting from vegetation (e.g., grass, shrubbery and trees);
- Intervening topography between the source and the receptor or man-made or natural barrier/structures; and
- Meteorological factors resulting from atmospheric inhomogeneities (i.e., refraction because of vertical wind and temperature gradients, and air turbulence).

Sound propagation involves the complicated interactions of many attenuation elements, especially among the factors listed above. In general, noise levels from a point source, such as a compressor or wind turbine, decrease about 6 dB per doubling of distance from the point source because of the way sound spreads. However, noise levels from along a line source, such as highways or transmission lines, decrease about 3 dB per doubling of distance.

The overall effect on noise propagation is a complex site-specific combination of the factors described above. In many screening applications, only the geometric spreading term is assumed to predict noise levels at receptor locations of interest. For a refined analysis, a sound propagation model that integrates most of the sound attenuation mechanisms described above would be required. The effects of two meteorological factors (wind direction and changes in temperature with height) are discussed below.

Sound propagation for horizontal distances less than about 330 ft (100 m) is essentially independent of atmospheric conditions. For locations at greater distances from a given source, wind direction can cause considerable differences in sound levels between upwind and downwind locations. The typical increase of wind speed with height will bend the path of sound to “focus” it in the downwind direction and make a “shadow” in the upwind direction. Upwind sound levels will be lower, and downwind levels higher, than if there were no wind.

In addition, changes in temperature with height play a major role in sound propagation. During the day, air temperature tends to decrease with height. In contrast, on a clear night, the temperature often increases with height (a condition known as a temperature inversion). Because the speed of sound varies with temperature, sound tends to bend (refract) upward during the day, leading to reduced sound levels on the ground; it bends downward during inversions, leading to higher sound levels on the ground. These temperature effects are uniform in all directions from the source, whereas the wind affects receptors primarily in the upwind and downwind directions.

4.5.4 Noise Standards and Guidelines

The Noise Control Act of 1972, along with its subsequent amendments (Quiet Communities Act of 1978 [42 USC Parts 4901–4918]), delegates to the states the authority to regulate environmental noise and directs government agencies to comply with local community noise statutes and regulations. Although no federal noise regulations exist, the EPA has promulgated noise guidelines (EPA 1974). Similarly, most states have no quantitative noise-limit regulations. Many local governments, however, have enacted noise ordinances to manage community noise levels. The noise limits specified in such ordinances are typically applied to define noise sources and specify a maximum permissible noise level. They are commonly enforced by the police, but also may be enforced by an agency that issues development permits.

In particular, some state or local governments have set permissible environmental noise limits for regulatory purposes. Nonetheless, complaints about noise from wind energy projects may still occur, even when fixed-level noise criteria or standards are met (NWCC 2002). This is because of the changes between the relative level of broadband turbine and background noises. If tonal components exist, higher levels of broadband background noise are needed to effectively mask the tone(s). In this respect, it is common for community noise standards to incorporate a penalty for pure tones, typically 5 dB(A). Also, the impact of noise depends on what people are doing: lower levels of noise will be more objectionable during sleeping hours than during the day. Many European countries (Gipe 1995) and some states in the United States have lower noise standards during night hours.

The EPA guideline recommends an L_{dn} of 55 dB(A) to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974). This level is not a regulatory goal but is “intentionally conservative to protect the most sensitive portion of the American population” with “an additional margin of safety.” For protection against hearing loss in the general population from nonimpulsive noise, the EPA guideline recommends an L_{eq} of 70 dB(A) or less over a 40-year period.

4.6 ECOLOGICAL RESOURCES

The following discussions of the ecological resources that may be affected by wind energy development on BLM-administered lands are presented from an ecoregion and ecological resource perspective.

4.6.1 Ecoregion Distribution and Associated Vegetation in the 11 Western States

Ecoregions delineate areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources present in the area (Omernik 1987). Ecoregions are based on unique combinations of geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. A number of individuals and organizations have characterized North America on the basis of ecoregions (e.g., Omernik 1987; CEC 1997; Bailey 1995). The intent of such ecoregion classifications has been to provide a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. The ecoregion discussions presented in this PEIS follow the Level III ecoregion classification based on Omernik (1987) and refined through collaborations among EPA regional offices, state resource management agencies, and other federal agencies (EPA 2002).

Existing wind energy projects in the United States can be found in a variety of habitat types, including cultivated agriculture, native grasslands, shrub steppe, desert scrub, and forest (Erickson et al. 2002). The 11 western states in the study area encompass 34 ecoregions (Figure 4.6.1-1), each of which supports a diverse flora. The number of ecoregions within any one state ranges from 5 in Nevada to 12 in California. The areal coverage of an ecoregion within any 1 state varies greatly among the 11 western states. In some states, ecoregions account for as little as 1 mi^2 (3 km^2) (e.g., the Puget Sound and Colorado Plateau ecoregions in Oregon and New Mexico, respectively [Table 4.6.1-1]). In contrast, the portion of the Central Basin and Range ecoregion within Nevada encompasses about 82,000 mi^2 (213,200 km^2). The general vegetation types that occur in the 34 ecoregions and the states in which the ecoregions occur are discussed in Appendix F.

4.6.2 Wildlife

As discussed in the previous section and Appendix F, the various ecoregions encompassed by BLM-administered lands include a diversity of plant communities and species which, in turn, provide a wide range of habitats that support diverse assemblages of terrestrial wildlife (Table 4.6.2-1). The specific species that may be associated with any particular wind energy development project will depend on the specific location of the project and on the plant communities and habitat present at the site. The following discussions present general descriptions of the wildlife species that may be affected by wind energy development projects on BLM-administered lands.

4.6.2.1 Amphibians and Reptiles

The 11 states in which wind energy development may occur on BLM-administered land support a wide variety of amphibians and reptiles (Table 4.6.2-1), some of which may occur at or in the vicinity of individual wind energy development projects. The number of amphibian species reported from these states ranges from as few as 12 species in Wyoming, upwards to 66 species in California. The amphibians reported from these states include frogs, toads, and salamanders that occupy a variety of habitats, including forested headwater streams in mountain regions, marshes and wetlands, and xeric habitats in the desert areas of the Southwest. The number of reptile species reported from these states ranges from 18 species from Montana, to 143 species reported from New Mexico (Table 4.6.2-1). The reptile species include a wide variety of turtles, snakes, and lizards.

4.6.2.2 Birds

Several hundred species of birds have been reported from the 11 western states where wind energy development may occur (Table 4.6.2-2). The fewest number of species has been reported from Idaho (270 species); more than 300 species have been reported from each of the other states, and 636 species from California (Grenfell et al. 2003). The coastal states (California,

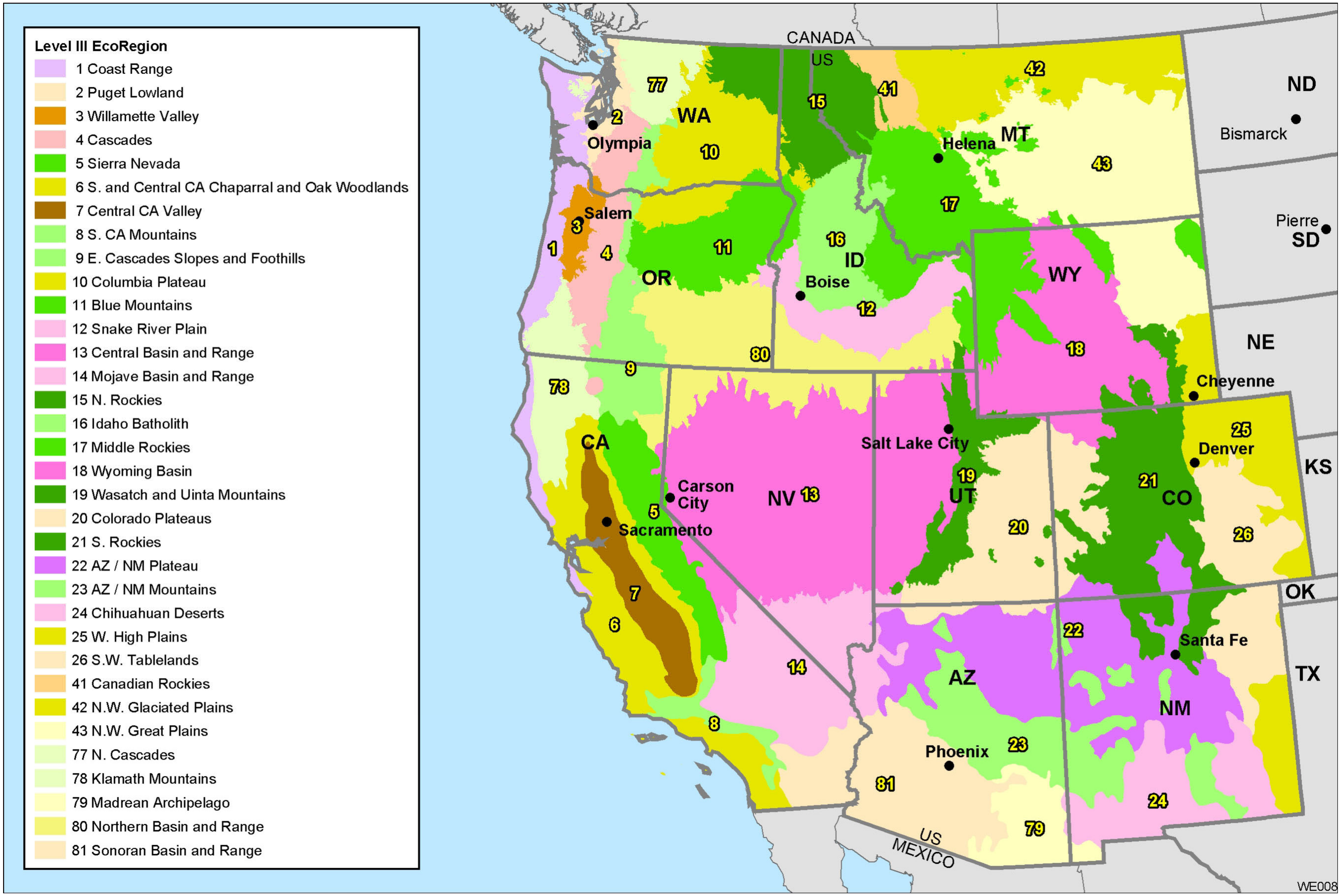

FIGURE 4.6.1-1 Ecoregions of the 11 Western States (Source: EPA 2002)

TABLE 4.6.1-1 Ecoregion Location and Coverage (mi^2) in the 11 Western States

Ecoregion Number and Name	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming
1. Coast Range	–[a]	5,014	–	–	–	–	–	9,037	–	6,607	–
2. Puget Lowland	–	–	–	–	–	–	–	1	–	6,351	–
3. Willamette Valley	–	–	–	–	–	–	–	5,335	–	413	–
4. Cascades	–	572	–	–	–	–	–	11,215	–	6,142	–
5. Sierra Nevada	–	19,976	–	–	–	386	–	–	–	–	–
6. Southern and Central California Chaparral and Oak Woodlands	–	38,657	–	–	–	–	–	–	–	–	–
7. Central California Valley	–	17,761	–	–	–	–	–	–	–	–	–
8. Southern California Mountains	–	6,916	–	–	–	–	–	–	–	–	–
9. Eastern Cascades Slopes and Foothills	–	7,967	–	–	–	–	–	10,561	–	3,161	–
10. Columbia Plateau	–	–	–	1,479	–	–	–	6,826	–	23,791	–
11. Blue Mountains	–	–	–	2,637	–	–	–	23,928	–	815	–
12 Snake River Plain	–	–	–	19,702	–	–	–	992	–	–	12
13. Central Basin and Range	–	5,303	–	545	–	82,060	–	–	31,765	–	–
14. Mojave Basin and Range	6,083	29,498	–	–	–	13,706	–	–	751	–	–
15. Northern Rockies	–	–	–	12,112	11,228	–	–	–	–	8,262	–
16. Idaho Batholith	–	–	–	21,230	2,045	–	–	–	–	–	–
17. Middle Rockies	–	–	–	10,430	30,408	–	–	–	–	–	19,582
18. Wyoming Basin	–	–	3,511	507	435	–	–	–	1,138	–	45,881
19. Wasatch and Unita Mountains	–	–	–	640	–	–	–	–	16,805	–	198
20. Colorado Plateaus	3,427	–	12,299	–	–	–	1	–	33,069	–	–
21. Southern Rockies	–	–	39,323	–	–	–	9,759	–	365	–	5,979
22. Arizona/New Mexico Plateau	31,196	–	5,179	–	–	43	37,474	–	–	–	–
23. Arizona/New Mexico Mountains	23,886	–	–	–	–	–	17,983	–	–	–	–
24. Chihuahuan Deserts	435	–	–	–	–	–	28,874	–	–	–	–
25. Western High Plains	–	–	23,878	–	–	–	10,250	–	–	–	6,825
26. Southwestern Tablelands	–	–	19,902	–	–	–	15,759	–	–	–	–
41. Canadian Rockies	–	–	–	–	7,267	–	–	–	–	–	–
42. Northwestern Glaciated Plains	–	–	–	–	37,018	–	–	–	–	–	–
43. Northwestern Great Plains	–	–	–	–	58,585	–	–	–	–	–	19,338
77. North Cascades	–	–	–	–	–	–	–	–	–	11,713	–
78. Klamath Mountains	–	12,702	–	–	–	–	–	6,039	–	–	–
79. Madrean Archipelago	14,658	–	–	–	–	–	1,436	–	–	–	–
80. Northern Basin and Range	–	2,309	–	14,273	–	14,367	–	22,953	1,002	–	–
81. Sonoran Basin and Range	34,199	10,899	–	–	–	–	–	–	–	–	–

[a] A dash indicates that an ecoregion is not present in the state.

Source: Modified from EPA (2002); see Figure 4.6.1-1 for ecoregion locations.

TABLE 4.6.2-1 Number of Wildlife Species in the 11 Western States

State	Amphibians	Reptiles	Mammals	Birds
Arizona	26	103	134	529
California	66	92	223	636
Colorado	18	49	130	473
Idaho	15	24	111	270
Montana	20	18	122	398
Nevada	17	57	132	456
New Mexico	39	143	274	550
Oregon	31	29	159	484
Utah	17	56	134	426
Washington	26	28	146	456
Wyoming	12	27	121	419

Sources: AGFD (2001); ASM (2004a,b); CDW (2004); Colorado Field Ornithologists (2004); Colorado Herpetological Society (2003); Grenfell et al. (2003); Hunt 2004; IFG (2004b); MNHP (2003a); NMDGF (2004); NNHP (2002a-d, 2004); Oregon Bird Records Committee (2003); Sonoran Audubon Society (2004); University of Oregon (2004); University of Washington (2000, 2001); Utah Conservation Data Center (2004a-c); Utah Ornithological Society (2004); Washington Ornithological Society (2002); WGFD (2004b).

Oregon, and Washington) include oceanic species (e.g., boobies, gannets, frigate birds, fulmars, and albatrosses) that would not be expected to occur in areas of wind energy development. In each of the states, there are also a variety of species that, while reported, are considered transient, irregular visitors. These species occur only infrequently and are typically considered to be wayward individuals whose presence is due in part to storms or other weather conditions.

4.6.2.2.1 Migratory Routes. Many of the bird species identified from the 11 western states are seasonal residents within individual states and exhibit seasonal migrations. These birds include waterfowl, shorebirds, raptors, and neotropical songbirds. The 11 western states where wind energy development may occur on BLM-administered lands fall within two of the four major North American migration flyways (Lincoln et al. 1998) — the Central Flyway and the Pacific Flyway (Figure 4.6.2-1). Birds migrating north from wintering areas to breeding areas use these pathways in the spring, and birds migrating southward to wintering areas use them in the fall. Each flyway encompasses broad geographic areas and includes many specific routes and subroutes, the use of which varies by species. Consideration of these more specific routes will be an important parameter for identifying site-specific concerns related to migratory birds (see Section 5.9).

TABLE 4.6.2-2 Number of Bird Species, by Order, Occurring in the 11 Western States

Order	AZ	CA	CO	ID	MT	NV	NM	OR	UT	WA	WY
Gaviformes – Loons	4	5	4	7	1	2	4	5	4	5	4
Podicipediformes – Grebes	7	7	6	–[a]	6	5	6	6	6	6	6
Procellariiformes – Albatrosses, Fulmars, Shearwaters, Petrels, and Storm-Pertrels	5	31	–	–	–	–	1	19	–	18	–
Pelicaniformes – Tropic Birds, Boobies, Gannets, Pelicans, Cormorants, Anhingas, and Frigate Birds	10	16	6	2	2	3	6	6	4	8	3
Ciconiiformes – Bitterns, Herons, Egrets, Ibises, Spoonbills, and Storks	17	17	17	7	6	9	18	12	15	11	15
Ciconiiformes – Vultures	3	3	1	1	1	2	2	1	1	1	1
Anseriformes – Swans, Geese, Ducks	38	50	39	27	31	26	38	44	37	43	39
Falconiformes – Kites, Eagles, Hawks, and Osprey	22	18	18	11	11	11	21	14	18	14	14
Falconiformes – Caracaras and Falcons	6	6	6	4	5	4	6	6	3	7	6
Galliformes – Chachalacas, Pheasants, Grouse, Ptarmigan, Turkeys, and Quail	9	12	14	13	11	6	11	12	13	13	11
Gruiformes – Rails, Gallinules, Coots, Limpkins, and Cranes	8	9	10	5	6	6	8	6	6	5	8

TABLE 4.6.2-2 (Cont.)

Order	AZ	CA	CO	ID	MT	NV	NM	OR	UT	WA	WY
Charadriiformes – Auks, Murres	–	16	2	–	–	–	1	12	1	14	2
Columbiformes – Pigeons, Doves	8	9	7	2	2	4	8	4	8	5	7
Psittaciformes – Parrots	1	10	–	–	–	–	–	–	–	–	–
Cuculiformes – Cuckoos, Roadrunners, and Anis	4	4	4	1	2	2	4	1	3	2	2
Strigiformes – Owls	23	14	14	13	15	11	13	15	14	15	15
Caprimulgiformes – Nightjars	5	6	4	2	2	4	6	2	3	2	2
Apodiformes – Swifts	4	5	3	3	4	2	3	3	4	3	2
Apodiformes – Hummingbirds	18	12	10	4	5	6	16	8	8	6	7
Trogoniformes – Trogans	2	–	–	–	–	–	1	–	–	–	–
Coraciiformes – Kingfishers	2	1	1	1	1	1	1	1	1	1	1
Piciformes – Woodpeckers	15	17	12	10	10	12	14	14	12	13	14
Passeriformes – Flycatchers, Kingbirds, Phoebes	34	30	23	11	12	17	32	21	19	18	18
Passeriformes – Shrikes	2	3	2	2	2	2	2	2	2	2	2
Passeriformes – Vireos	12	12	10	4	4	5	12	8	9	5	6
Passeriformes – Jays, Crows	11	11	10	8	8	8	11	9	9	10	9
Passeriformes – Larks	1	2	1	1	1	1	1	1	1	2	1
Passeriformes – Swallows	8	8	7	6	6	7	9	7	7	7	7
Passeriformes – Chickadees, Titmice	5	5	3	5	4	3	5	5	3	4	3
Passeriformes – Verdin, Bushtits, and Wrentits	2	2	1	1	–	2	2	2	2	1	1
Passeriformes – Nuthatches and Creepers	4	4	4	4	4	4	4	4	4	4	4
Passeriformes – Wrens	8	8	8	6	6	7	9	6	7	6	8
Passeriformes – Dippers	1	1	1	1	1	1	1	1	1	1	1

TABLE 4.6.2-2 (Cont.)

Order	AZ	CA	CO	ID	MT	NV	NM	OR	UT	WA	WY
Passeriformes – Mockingbirds and Thrashers	9	10	7	11	4	5	8	5	8	4	4
Passeriformes – Starlings and Accentors	1	1	1	1	1	1	1	1	1	2	1
Passeriformes – Wagtails and Pipits	4	8	2	1	2	1	2	3	1	5	2
Passeriformes – Waxwings	2	2	2	2	2	2	2	2	2	2	2
Passeriformes – Silky Flycatchers	1	2	1	–[a]	–	1	1	1	1	–	–
Passeriformes – Wood Warblers	50	46	46	13	16	14	47	40	38	30	40
Passeriformes – Tanagers	5	4	4	1	1	3	4	3	3	2	4
Passeriformes – Towhees, Sparrows, and Longspurs	40	38	35	19	26	22	38	31	33	29	33
Passeriformes – Cardinals, Grosbeaks, Bunting, Dickcissel	11	10	10	3	4	8	10	7	7	5	8
Passeriformes – Blackbirds and Orioles	18	17	15	9	11	7	17	16	15	15	13
Passeriformes – Finches	12	16	14	11	14	7	14	16	15	11	17
Passeriformes – House Sparrow	1	1	1	1	1	1	1	1	1	1	1

[a] A dash indicates that the order has not been reported in the state.

Sources: Sonoran Audubon Society (2004); Grenfell et al. (2003); Colorado Field Ornithologists (2004); IFG (2004b); MNHP (2003a); NNHP (2002b); NMDGF (2004); Oregon Bird Records Committee (2003); Utah Ornithological Society (2004); Washington Ornithological Society (2002); WGFD (2004b).

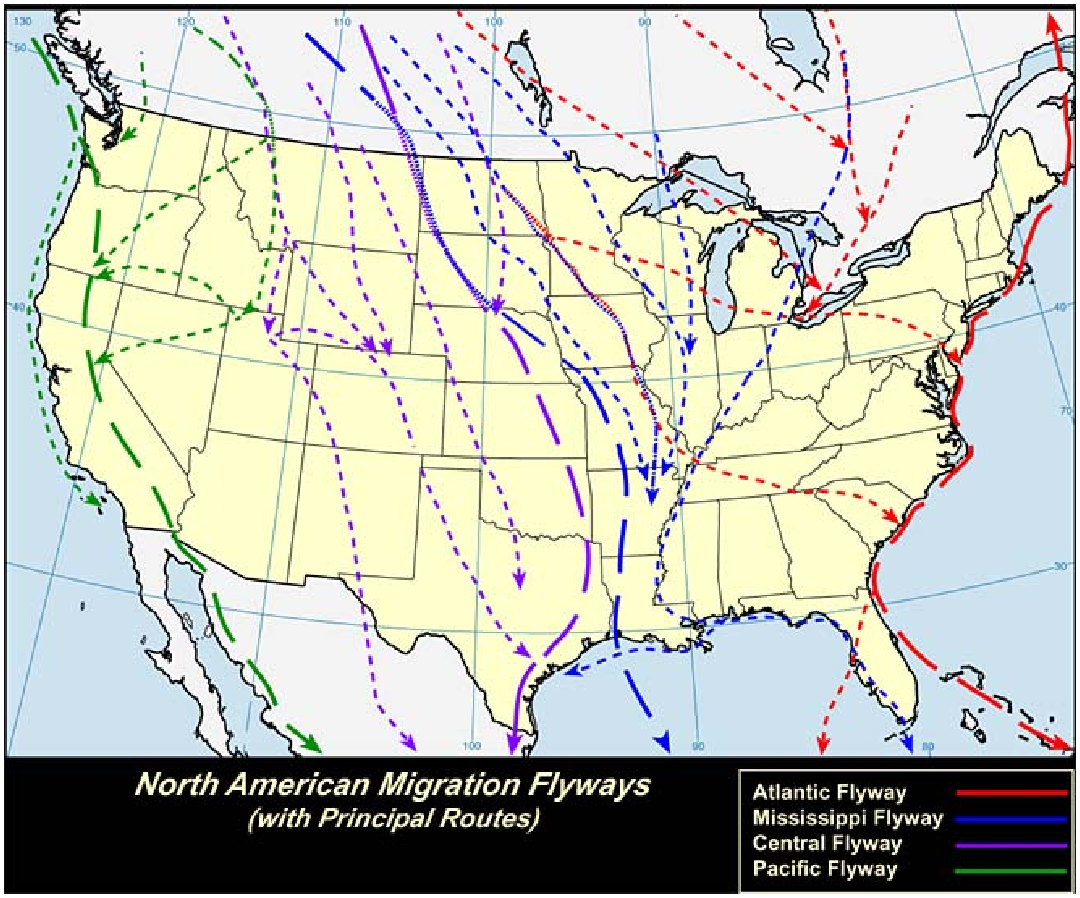

FIGURE 4.6.2-1 North American Migration Flyways (Used with permission of copyright@birdnature.com, April 14, 2004)

The Central Flyway includes the Great Plains-Rocky Mountain routes (Lincoln et al. 1998). These routes extend from the northwest Arctic coast southward between the Mississippi River and the Rocky Mountains, and encompass all or most of the states of Wyoming, Colorado, and New Mexico, and portions of Montana, Idaho, and Utah (Figure 4.6.2-1). The westernmost route in Montana crosses the continental divide and passes through the Great Salt Lake Valley before turning eastward. This flyway is relatively simple; the majority of birds make relatively direct north and south migrations between northern breeding grounds and southern wintering areas.

The Pacific Flyway includes the Pacific Coast Route, which occurs between the eastern base of the Rocky Mountains and the Pacific coast of the United States. This flyway encompasses the states of California, Nevada, Oregon, and Washington, and portions of Montana, Idaho, Utah, Wyoming, and Arizona (Figure 4.6.2-1). Birds migrating from the Alaskan Peninsula follow the coastline to near the mouth of the Columbia River, then travel inland to the Willamette River Valley before continuing southward through interior California (Lincoln et al. 1998). Birds migrating south from Canada pass through portions of Montana and Idaho and then migrate either eastward to enter the Central Flyway, or turn southwest along the

Snake and Columbia River valleys and then continue south across central Oregon and the interior valleys of California (Birdnature.com 2004). This route is not as heavily used as some of the other migratory routes in North America (Lincoln et al. 1998).

4.6.2.2.2 Waterfowl and Shorebirds. Waterfowl (ducks, geese, and swans) and shorebirds (plovers, sandpipers, and similar birds) represent two of the most abundant groups of birds reported from the 11 western states (Table 4.6.2-2). The number of reported waterfowl species ranges from 26 species from Nevada to 50 species from California; the number of reported shorebird species ranges from 11 species from Nevada to 63 species in California (Table 4.6.2-2). Many of these species exhibit extensive migrations from breeding areas in Alaska and Canada to wintering grounds in Mexico and southward (Lincoln et al. 1998). While many of these species nest in Canada and Alaska, a number of species, such as the avocet, willet, spotted sandpiper, gadwall, and blue-winged teal, also nest in many of the western states where similar habitats are present (National Geographic 1999). Most are ground-level nesters, and many forage in flocks (sometimes relatively large) on the ground or water.

4.6.2.2.3 Songbirds. Songbirds (also referred to as passerines or perching birds) of the order Passeriformes represent the most diverse category of birds; the warblers and sparrows represent the two most diverse groups of passerines (Table 4.6.2-2). The greatest number of warbler species are reported from California and Colorado (46 species each), New Mexico (47 species), and Arizona (50 species). These same states also have the greatest number of reported sparrow species, with 35 species from Colorado, 38 species from California and from New Mexico, and 40 species from Arizona (Table 4.6.2-2).

The passerines exhibit a wide range of seasonal movements; some species are year-round residents in some areas and migratory in others, and still other species migrate hundreds of miles or more (Lincoln et al. 1998). Nesting occurs in vegetation from near ground level to the upper canopy of trees. Some species, such as the thrushes and chickadees, are relatively solitary throughout the year, while others such as swallows and blackbirds, may occur in small to large flocks at various times of the year. Foraging may occur in flight (i.e., swallows and swifts), in vegetation, or on the ground (i.e., warblers, finches, thrushes).

4.6.2.2.4 Gallinaceous Birds. Gallinaceous birds (sometimes referred to as upland gamebirds) of the order Galliformes include grouse, turkeys, pheasants, quail, and prairie-chickens. The number of species of gallinaceous birds in the 11 western states ranges from 6 in Nevada, 9 in Arizona, and between 11 to 14 species in the other 9 states (Table 4.6.2-2). All of the gallinaceous birds within the 11 western states are year-round residents. They are ground-dwelling birds, and their flight is generally brief but strong. The males perform elaborate courting displays, which for some species occur yearly at the same strutting grounds, known as leks (National Geographic 1999).

A number of the western gallinaceous bird species inhabit forested or open forest habitats; these species include the wild turkey (*Meleagris gallopavo*), ruffed grouse *(Bonasa* *umbellus*), spruce grouse (*Falcipennis canadensis*), blue grouse (*Dendragapus obscurus*), and California quail (*Callipepla californica*). The gallinaceous bird species that inhabit sagebrush, prairies, and grasslands include the lesser prairie-chicken (*Tympanuchus pallidicinctus*), sharp-tailed grouse (*Tympanuchus phasianellus*), Gunnison sage-grouse (*Centrocercus minimus*), and greater sage-grouse (*Centrocercus urophasianus*). The last two species are often discussed together and referred to as simply sage-grouse.

4.6.2.2.5 Birds of Prey and Vultures. The birds of prey include the raptors (hawks, falcons, eagles, kites, caracaras, and osprey), owls, and vultures, and many of these species represent the top avian predators in many ecosystems. The number of species of raptors ranges from 15 from Idaho and Nevada, to 27 reported from New Mexico and 28 from Arizona (Table 4.6.2-2). Common species include the sharp-shinned hawk, red-tailed hawk, northern harrier, Swainson's hawk, American kestrel, and the golden eagle. The number of species of owl ranges from 11 from Nevada to 23 from Arizona, with most states reporting 13 or more species (Table 4.6.2-2); these include the great horned owl, short-eared owl, and burrowing owl. The raptors and owls vary considerably among species with regard to their seasonal migrations; some species are nonmigratory (year-round residents), others are migratory in the northern portions of their ranges and nonmigratory in the southern portions of their ranges, and still other species are migratory throughout their ranges.

The raptors forage on a variety of prey, including small mammals, reptiles, other birds, fish, invertebrates, and at times, carrion. They typically perch on trees, utility posts, highway signs, and other high structures that provide a broad view of the surrounding topography; they may soar for extended periods of time at relatively high altitudes. These raptors forage from either a perch or on the wing (depending on the species), and all forage during the day. The owls also perch on elevated structures and forage on a variety of prey, including mammals, birds, and insects. Forest-dwelling species typically forage by diving on a prey item from a perch, while open country species hunt on the wing while flying low over the ground. While generally nocturnal, some owl species may be active during the day (Owl Research Institute 2004).

The vultures are represented by three species; the turkey vulture, which occurs in each of the western states; the black vulture, which is reported from Arizona, California, and New Mexico; and the endangered California condor, reported from Arizona and California and considered an accidental visitor in Nevada. These birds are large soaring scavengers that feed on carrion.

4.6.2.2.6 Regulatory Framework for Protection of Birds. The regulatory framework for protecting birds includes the ESA, the MBTA, Bald and Golden Eagle Protection Act of 1940 (BEPA), and E.O. 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds" (U.S. President 2001b). The ESA is discussed in Section 4.6.5.1; the other regulations are discussed below:

- The MBTA implements a variety of treaties and conventions among the United States, Canada, Mexico, Japan, and Russia. This treaty makes the take, killing, or possession of migratory birds, their eggs, or nests unlawful, except as authorized under a valid permit. ("Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb.) Most of the bird species reported from the 11 western states are classified as migratory under this act. The USFWS maintains a list of migratory birds protected by the MBTA (USFWS 2004c).

- The BEPA provides for the protection of both bald and golden eagles by prohibiting the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit.

- Under E.O. 13186, each federal agency that is taking an action that has or is likely to have negative impacts on migratory bird populations must work with the USFWS to develop an agreement to conserve those birds. The protocols developed by this consultation are intended to guide future agency regulatory actions and policy decisions.

4.6.2.3 Mammals

More than 100 species of mammals have been reported from each of the 11 western states where wind energy development may occur on BLM-administered lands; some of these species may be present at or in the vicinity of areas of potential wind energy development. The highest number of mammal species has been reported from New Mexico (274) and the lowest from Idaho (111). Game species include squirrel, deer, elk, bighorn sheep, antelope, and bear, while a number of species such as the mustelids (mink), beaver, and fox are trapped for their fur. Nongame species include a wide variety of mice, moles, and shrews.

The coastal states of California, Oregon, and Washington also support a variety of marine mammals, including seals, dolphins, and whales. These species would not be affected by wind energy development projects on BLM-administered lands.

One group of mammals that may be especially affected by wind energy development projects are the bats (Erickson et al. 2002). The bats that occur in the western United States may overwinter in caves, mines, or hollow trees, and in summer roost in similar habitats as well as in man-made structures (e.g., buildings and bridges) (Harvey et al. 1999). Several species migrate up to 800 mi (1,300 km) or farther from winter roosts in Mexico and Central America, to caves in the southwestern United States and farther northward. Bats are primarily nocturnal, although some species fly early in the evening (sometimes before sunset); occasionally, they will fly during daylight hours (Harvey et al. 1999).

The number of bat species reported from each of the states ranges from 14 species in Idaho to 28 in Arizona (Table 4.6.2-3). Four families of bats occur in the United States (Bat Conservation International 2002a), and of the 11 western states with BLM-administered

TABLE 4.6.2-3 Number of Bat Species, by Family, in the 11 Western States

State	Phyllostomidae (Leaf-nosed bats)	Vespertilionidae (Vesper bats)	Molossidae (Free-tailed bats)	Mormoopidae (Ghost-faced bats)
Arizona	3	19	5	1
California	2	18	4	–[a]
Colorado	–	16	2	–
Idaho	–	14	–	–
Montana	–	15	–	–
Nevada	2	18	3	–
New Mexico	3	21	3	–
Oregon	–	14	1	–
Utah	–	16	2	–
Washington	–	15	–	–
Wyoming	–	15	1	–

[a] A dash indicates that no species of the family has been reported from that state.

Sources: ASM (2004a,b); Bat Conservation International (2002b,c); CDW (2004); Grenfell et al. (2003); IFG (2004b); Pulliam (2005); NMDGF (2004); Utah Conservation Data Center (2004c); WGFD (2004b).

lands, only Arizona has reported bat species from all four families. In contrast, all bat species reported from Idaho, Montana, and Washington belong to the same family, Vespertilionidae (the vesper bats).

The vesper bats represent the majority of bat species reported from the 11 western states (Table 4.6.2-3) and are also the most widespread of the bats. Twenty-five species of vesper bats have been reported from the western states; 13 species have been reported from each of the 11 western states. Species include pallid bat, big brown bat, little brown myotis, and hoary bat (Table 4.6.2-4). The Vesper bats roost in rocky crevices, buildings, and trees (under bark or in foliage) (Harvey et al. 1999). These bats are insectivores and typically forage after sunset.

Four species of leaf-nosed bats have been reported from only 4 of the 11 western states; California, Arizona, New Mexico, and Nevada. These species are the Mexican long-tongued bat, the lesser long-nosed bat, the California leaf-nosed bat, and the long-nosed bat (Table 4.6.2-4). The leaf-nosed bats inhabit caves, mines, buildings, bridges, culverts, and occasionally trees. These bats generally emerge in late evening, with some species foraging on fruit, nectar, and pollen, and others on insects (Harvey et al. 1999).

Five species of free-tailed bats have been reported from the western states (Table 4.6.2-4), with one species reported from eight states and another species from six states. The free-tailed bats typically roost in trees and high crevices (such as under roof shingles, bridges, and caves), and many species need to drop 26 to 33 ft (8 to 10 m) from a roost before

TABLE 4.6.2-4 Bat Species Reported from the 11 Western States

Phyllostomidae (Leaf-nosed bats)	Vespertillionidae (Vesper bats)	Molossidae (Free-tailed bats)	Mormoopidae (Ghost-faced bats)
Mexican long-tongued bat	Western red bat	Greater bonneted bat (greater mastiff bat)	Ghost-faced bat
Lesser long-nosed bat	Eastern red bat	Underwood's bonneted bat (mastiff bat)	
California leaf-nosed bat	Pallid bat	Pocketed free-tailed bat	
Long-nosed bat	Townsend's big-eared bat	Big free-tailed bat	
	Big brown bat	Mexican (Brazilian) free-tailed bat	
	Spotted bat		
	Allen's big-eared bat		
	Silver-haired bat		
	Desert red bat		
	Red bat		
	Hoary bat		
	Western yellow bat		
	Southwestern myotis		
	Keen's myotis		
	Northern long-eared myotis		
	California myotis		
	Western small-footed myotis		
	Long-eared myotis		
	Little brown bat		
	Fringed myotis		
	Cave myotis		
	Long-legged myotis		
	Yuma myotis		
	Western pipistrelle		
	Eastern pipistrelle		

Sources: ASM (2004a,b); Bat Conservation International (2002b,c); CDW (2004); Grenfell et al. (2003); IFG (2004b); NNHP (2002c); NMDGF (2004); Utah Conservation Data Center (2004c); WGFD (2004b).

they can fly. Some species, such as the Mexican (Brazilian) free-tailed bat, may fly up to 10,000 ft (3,000 m) above ground (McCracken 1996). The free-tailed bats feed on insects.

Only one species of ghost-faced bats has been reported from the western states, and this species (Peter's ghost-faced bat, *Mormoops megalophylla*) has been reported only from Arizona (Bat Conservation International 2002b). This bat usually occurs in lowland areas, roosting in caves and mine shafts and occasionally buildings; this bat emerges in late evening and feeds on insects (Harvey et al. 1999).

4.6.3 Aquatic Biota and Habitats

The 11 western states contain a variety of aquatic habitats, which in turn support a wide diversity of aquatic biota. These habitats include small desert springs in the southwest that support unique and endemic fish species such as the desert pupfish; the blue ribbon trout waters of the Colorado, Green, and Snake Rivers; thousands of lakes and reservoirs; the salmon rivers of California, Oregon, and Washington; and the coastal marine habitats of the Pacific coast. Sport fish throughout the 11 western states include a variety of species, including trout and salmon, catfish, sunfish, bass, suckers, perch, walleye, and pike. Nonsport fish include numerous species of minnows, shiners, dace, and other species. In addition to the fish, the aquatic habitats also support a tremendous variety of aquatic invertebrates, including molluscs, crustaceans, and insects.

4.6.4 Wetlands

Wetlands are considered a valuable ecological resource because of their important roles in providing fish and wildlife habitat, maintaining water quality, and flood control. Total wetland area present within any 1 of the 11 western states, on the basis of estimates from the 1980s, ranges from about 236,349 acres (95,688 ha) in Nevada to 1,393,900 acres (564,332 ha) in Oregon (Table 4.6.4-1). These estimates represent less than 2.5% of the total surface area of any of the 11 western states, and for six of the states less than 1% of the total state surface area. As throughout the United States, wetlands in the western states have experienced a major decline in abundance because of human disturbance, ranging from 27% in Montana to 91% in California (Table 4.6.4-1).

4.6.5 Threatened and Endangered Species

The western states encompassed by this PEIS provide habitat that supports hundreds of species of plants and animals that are threatened, endangered, or of special concern at the national, regional, and state level. Some of these species and their habitats may occur in BLM-administered lands and surrounding areas identified as potentially suitable for wind energy development.

4.6.5.1 Species Listed under the Endangered Species Act

The ESA was passed in 1973 to address the decline of fish, wildlife, and plant species in the United States and throughout the world. The purpose of the ESA is to conserve “the ecosystems upon which endangered and threatened species depend” and to conserve and recover listed species (ESA 1973; Section 2). The law is administered by the USFWS and the Commerce Department’s National Marine Fisheries Service (NMFS). The USFWS has primary responsibility for terrestrial and freshwater organisms, while the NMFS is primarily responsible for marine species such as salmon and whales.

Under the law, species may be listed as either “endangered” or “threatened.” The ESA defines an endangered species as any species that is in danger of extinction throughout all or a significant portion of its range (ESA 1973; Section 3(6)). A threatened species is one that is likely to become an endangered species within the foreseeable future throughout all or a

TABLE 4.6.4-1 General Status of Wetlands in the 11 Western States

State	Total Wetland Acres (1980s estimate)	Current Wetland Status	Wetland Loss (%) (1780s to 1980s)
Arizona	600,000 (242,915 ha)	Wetlands cover < 1% of the state; most extensive wetlands are in riparian zones.	36
California	454,000 (183,806 ha)	Wetlands cover < 1% of the state; significant economic and environmental value; provide water quality maintenance, flood and erosion control, prevention of saltwater intrusion, and wildlife habitat.	91
Colorado	999,999 (404,858 ha)	Wetlands cover about 1.5% of the state; occur in all areas of the state; include forested wetlands, marshes, alpine snow glades, and wet and salt meadows.	50
Idaho	385,700 (156,154 ha)	Wetlands cover < 1% of the state.	56
Montana	840,298 (340,202 ha)	Wetlands cover < 1% of the state.	27
Nevada	236,349 (95,688 ha)	Wetlands cover < 1% of the state; among the most economically and ecologically valuable state lands; provide flood, erosion control, water quality improvement, and wildlife habitat; desert wetlands include playa lakes and riparian areas; mountain wetlands include fens and glacial lake areas. Current estimates identify approximately 760,000 acres (308,000 ha) of playa wetlands in the state (NDOW 2005).	52
New Mexico	481,899 (195,101 ha)	Wetlands cover < 1% of the state, most in the east and north; wetland types include forested wetlands, bottom land shrublands, marshes, fens, alpine snow glades, wet and salt meadows, shallow ponds, and playa lakes; riparian and playa lake wetlands are especially important to migratory waterfowl and wading birds.	33
Oregon	1,393,875 (564,332 ha)	Wetlands cover about 2.2% of the state; about 86% freshwater wetlands and 14% tidal wetlands; freshwater wetlands support about one-third of the vertebrate wildlife species in the state.	38

TABLE 4.6.4-1 (Cont.)

State	Total Wetland Acres (1980s estimate)	Current Wetland Status	Wetland Loss (%) (1780s to 1980s)
Utah	558,000 (225,911 ha)	Wetlands cover about 1% of the state; include the shallows of small lakes, reservoirs, ponds, and streams, riparian wetlands, marshes, wet meadows, mud and salt flats, and playas; largest wetlands in the state surround Great Salt Lake.	30
Washington	938,000 (379,757)	Wetlands cover about 2.1% of the state.	31
Wyoming	1,250,000 (506,073 ha)	Wetlands cover about 2% of the state; most diverse ecosystems in the state; Bear River wetland is one of the most productive and diverse bird habitats in the state.	38

Sources: Dahl (1990); Yuhas (1997); Oregon Wetlands Joint Venture (2002).

significant part of its range (ESA 1973; Section 3(20)). All species of plants and animals, except pest insects, are eligible for listing as endangered or threatened. The ESA also affords protection to "critical habitat" for threatened and endangered species. Critical habitat is defined as the specific areas within the geographical area occupied by the species at the time it is listed, on which are found physical or biological features essential to the conservation of the species and which may require special management considerations or protection (ESA 1973; Section 3(5)(A and B)). Except when designated by the Secretary of the Interior, critical habitat does not include the entire geographical area that can be occupied by the threatened or endangered species (ESA 1973; Section 3(5)(C)).

Some species may also be candidates for listing (ESA 1973; Section 6(d)(1) and Section 4(b)(3)). The USFWS defines proposed species as any species that is proposed in the *Federal Register* to be listed under Section 4 of the ESA. Candidate species are those for which the USFWS has sufficient information on their biological status and threats to propose them for listing as endangered or threatened under the ESA, but for which development of a listing regulation is precluded by other higher priority listing activities (USFWS 2004a). The NMFS defines candidate species as those proposed for listing as either threatened or endangered or whose status is of concern, but for which more information is needed before they can be proposed for listing. Candidate species receive no statutory protection under the ESA, but by definition these species may warrant future protection under the ESA.

Currently, 1,265 plant and animal species are listed as threatened or endangered under the ESA (USFWS 2004b). The 11 western states where BLM-administered lands may be suitable for wind energy development support 657 listed species, composed of 389 endangered species and 268 threatened species. Among the western states, Montana and Wyoming have the fewest listed species (15 each), while California has the greatest number of listed species (310) (Table 4.6.5-1).

Table 4.6.5-2 provides a summary of the number of threatened and endangered plants, invertebrates, fish, and wildlife present in each of the 11 western states. For most states, plants and fish represent the categories with the most listed species. For example, plants account for more than 50% of listed species in California and Utah, and for more than 30% of all listed species in other states (Table 4.6.5-2). Fish account for 30% or more of all listed species in Arizona, New Mexico, Nevada, Oregon, and Washington. While some of the listed species, such as the marine mammals and sea turtles, would not occur at locations where wind energy development may take place on BLM-administered lands, other species may be present in areas where wind energy development is possible.

4.6.5.2 BLM Listed Species

On the lands that it administers, the BLM is required to manage plant and wildlife species that are listed or proposed under the ESA, which has nine sections containing requirements or authorizations that apply to the BLM (ESA Sections 2, 4, 5, 6, 7, 9, 10, 11, and 18). These are addressed in the BLM Manual titled *6840 — Special Status Species Management* (BLM 2001), which establishes Special Status Species policy for plant and animal species and the habitats on which they depend. The Special Status Species policy refers not only to species listed under the ESA, but also to those designated by the State Director as Sensitive. BLM Manual 6840 defines a sensitive species as a species that could easily become endangered or extinct in the state.

TABLE 4.6.5-1 Number of Threatened, Endangered, and Candidate Species as Designated under the Endangered Species Act in the 11 Western States

State	Endangered	Threatened	Candidate
Arizona	36	19	11
California	210	81	11
Colorado	16	15	11
Idaho	9	14	4
Montana	6	9	4
Nevada	23	14	5
New Mexico	23	16	10
Oregon	22	26	8
Utah	24	19	10
Washington	14	27	12
Wyoming	7	8	3

TABLE 4.6.5-2 Number of Species, by Taxonomic Category, Listed as Threatened or Endangered under the Endangered Species Act in the 11 Western States

State	Plants	Invertebrates	Fish	Amphibians	Reptiles	Mammals	Birds
Endangered							
Arizona	12	1	10	1	–[a]	8	4
California	134	25	14	8	3	18	8
Colorado	6	1	4	–	–	2	3
Idaho	–	5	2	–	–	1	1
Montana	–	–	2	–	–	1	3
Nevada	2	1	17	1	1	–	1
New Mexico	7	3	6	–	–	4	3
Oregon	11	1	5	–	1	2	2
Utah	11	2	7	–	–	2	2
Washington	4	–	3	–	1	4	2
Wyoming	1	–	3	1	–	1	1
Threatened							
Arizona	7	–	7	1	2	–	2
California	45	6	13	1	7	3	6
Colorado	7	1	1	–	–	3	3
Idaho	4	1	4	–	–	4	1
Montana	3	–	1	–	–	3	2
Nevada	6	1	5	–	–	1	1
New Mexico	6	–	6	1	1	–	2
Oregon	7	2	9	–	2	2	4
Utah	13	–	1	–	1	2	2
Washington	6	1	11	–	1	4	4
Wyoming	3	–	–	–	–	4	1
Candidate							
Arizona	3	4	1	1	1	–	1
California	8	1	–	–	–	1	1
Colorado	5	–	1	1	–	1	3
Idaho	1	–	–	1	–	1	1
Montana	1	1	1	–	–	–	1
Nevada	2	–	–	2	–	–	1
New Mexico	–	4	1	–	2	1	2
Oregon	2	1	–	2	–	1	2
Utah	5	3	–	–	–	–	2
Washington	5	1	–	1	–	2	3
Wyoming	–	–	1	–	–	1	1

[a] A dash indicates no species are listed in that category.

Source: USFWS (2004b).

Criteria in BLM Manual 6840 for designating a species as sensitive are as follows:

1. The species is under ESA status review by the USFWS or NMFS;

2. The numbers of individuals of the species are declining so rapidly that federal (ESA) listing may become necessary;

3. The species has typically small or widely dispersed populations; or

4. The species inhabits an ecological refugium or other specialized or unique habitat.

Under BLM Manual 6840, the BLM is required to use other agencies' lists (such as threatened and endangered lists, watch lists, and species of concern lists issued by various state and federal agencies; see Section 4.6.5.3). For example, the BLM Utah State Office currently uses the Utah Division of Wildlife Resources sensitive animals list as the BLM list.

The number of sensitive species varies among the 11 western BLM State Offices (Table 4.6.5-3). Similarly, which species may occur at a wind energy development project would depend on the particular state in which the project is located, the species list for that state, and the specific location (and associated habitats) of the proposed project, and would need to be addressed in the site-specific environmental analysis.

TABLE 4.6.5-3 Number of BLM-Designated Sensitive and Special Status Species in the 11 Western States[a]

State	Plants[b]	Invertebrates	Fish	Amphibians	Reptiles	Mammals	Birds
Arizona	75	21	5	–[c]	16	14	6
California	423	17	3	10	11	17	7
Colorado	81	1	13	5	7	6	13
Idaho	161	21	22	8	7	29	50
Montana	127	–	9	1	2	13	21
Nevada	106	72	25	3	6	31	33
New Mexico	67	11	13	4	6	30	9
Oregon	NA[d]	NA	NA	NA	NA	NA	NA
Utah	100	27	22	4	13	17	18
Washington	NA	NA	NA	NA	NA	NA	NA
Wyoming	38	–	8	4	1	9	15

[a] Those taxa considered sensitive or of special status by the BLM State Office occurring on BLM-administered lands.

[b] For some states, the "Plants" category includes vascular plants, lichens, mosses, bryophytes, and fungi.

[c] A dash indicates no "sensitive or special status" species listed.

[d] NA = information not available.

Sources: AGFD (2003); BLMCA (2004); BLMCO (2000); BLMID (2004); BLMNV (2003); BLMUT (2003); BLMWY (2002), MNHP (2003a,b); NMRPTC (2004); NMDGF (2003); UDWR (1998).

4.6.5.3 State Listed Species

Each of the 11 western states also has species identified that are of state concern. Some species are listed per a specific definition and afforded protection and/or management under a state regulation. Other species are on some form of watch list; these species are tracked with regard to their abundance and distribution within a state by organizations, such as the state Natural Heritage Program. Table 4.6.5-4 summarizes the numbers of species, within broad taxonomic categories, that are listed within each of the 11 western states. The species that occur on BLM-administered lands and that may be affected by a specific wind energy development project would depend upon the location of that particular project, and would need to be addressed in the site-specific environmental analysis.

4.7 LAND USE

This section describes the wide range of typical land uses that may occur on BLM-administered lands that have the potential for wind energy development over the next 20 years. It also describes possible land use on adjacent lands.

4.7.1 Management of BLM-Administered Lands

The BLM manages lands within the 11 western states for a variety of land uses, including recreation, conservation, mining, oil and gas leasing, livestock grazing, communication sites, and

TABLE 4.6.5-4 Number of Species Listed as Threatened, Endangered, Sensitive, or of Special Status under Individual State Classifications in the 11 Western States[a]

State	Plants	Invertebrates	Fish	Amphibians	Reptiles	Mammals	Birds
Arizona	458	40	30	11	34	41	71
California	222	3	19	8	8	17	24
Colorado	647	2	23	7	10	13	19
Idaho	316	–[b]	16	4	4	19	20
Montana	550	83	27	10	11	31	79
Nevada	319	162	64	5	4	28	23
New Mexico	150	87	36	9	23	81	73
Oregon	828	235	68	22	11	41	88
Utah	1,241	27	22	4	13	17	18
Washington	288	25	45	10	8	37	41
Wyoming	505	–	30	12	17	59	97

[a] For specific listing categories and definitions, see AGFD (2003); CDFG (2004a,b); CDW (2003); CNHP (2004); IFG (2004a,b); MNHP (2003a,b); NMDGF (2003); NMNHP (2003); NMRPTC (2004); NNHP (2004); ONHP (2001); UDWR (1998, 2003); WDFW (2004); WDNR (2003a,b); WYNDD (2003).

[b] A dash indicates no “sensitive or special status” species listed.

ROW corridors (e.g., for roads, transmission lines, and pipelines) (BLM 2003 a-j). BLM-administered lands are managed within a framework of numerous laws, the most comprehensive of which is the FLPMA. The FLPMA established the “multiple use” management framework for public lands, the principal tenets of which are that no single resource or use of public lands would dominate. It is the mission of the BLM to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations (BLM 2000).

Under the multiple-use framework, the BLM’s management responsibilities include:

- Recreation opportunities, including both dispersed recreation and site-specific recreation activities, interpretation, and other visitor education activities;
- Commercial activities, including energy and mineral development, livestock grazing, and timber sales;
- Wild free-roaming horses and burros;
- Paleontological, archaeological, and historic sites;
- Fish and wildlife habitat;
- Transportation systems, including roads, trails, and bridges;
- Wilderness Areas and Wild and Scenic Rivers;
- Rare and vulnerable plant communities; and
- Public land survey system (BLM 2000).

In managing these responsibilities, the BLM is faced with a number of challenges to address impacts associated with the following:

- *Community growth.* The BLM needs to increase demands for conservation of open space, community expansion and ROWs, sales and permits for sand and gravel, access for recreation, dedication of habitat for special status species, and fire and resource management activities associated with the wildland/urban interface.
- *Sustainable resource decisions.* The BLM needs to enhance its information base on resource assessments, land use plans, and environmental impact analyses to reflect changing resource conditions and emerging demands on the public lands.

- *Special areas.* The BLM must assess the condition of these areas (see Section 4.7.4 for a discussion of the special areas), identify emerging threats, and initiate critical management to protect these at-risk assets.

- *Energy and minerals.* Development of these resources requires new resource assessments, land use plans, and environmental impact assessments to ensure that they are sustainable over time.

- *Habitat conservation.* The BLM must manage the use of public lands for livestock grazing, timber harvesting, and recreation to ensure that the burden of conserving the recovery of many special status species falls on the public lands and not on adjacent private lands.

- *Safe visits.* The BLM must maintain buildings, recreation and administrative sites, trails, roads, bridges, dams, and other sites in a way that ensures the public's protection (BLM 2000).

Table 4.7.1-1 provides a summary of BLM-administered lands, BLM-administered minerals underlying federal surface lands, Tribal lands where the BLM has trust responsibility for mineral operations, and subsurface mineral estates underlying private or state trust land within each of the 11 western states.

TABLE 4.7.1-1 Overview of Surface and Subsurface Lands Managed and Administered by the BLM within the 11 Western States (millions of acres)[a]

State	Surface Land[b]	Subsurface Mineral Estates Underlying Federal Surface Lands[c]	Tribal Lands Where the BLM Has Trust Responsibility for Mineral Operations[c]	Subsurface Mineral Estates Underlying Private or State Trust Land[c]
Arizona	12.2	33.0	20.7	3.0
California	15.2	47.0	0.6	2.5
Colorado	8.4	27.1	0.8	5.9
Idaho	12.0	37.0	0.6	1.8
Montana	8.0	27.5	5.5	11.7
Nevada	47.8	56.1	1.2	0.2
New Mexico	13.4	36.0	8.4	9.5
Oregon	16.1	34.2	0.8	1.7
Utah	22.9	33.9	2.3	1.2
Washington	0.4	11.6	2.6	0.3
Wyoming	18.4	30.9	1.9	12.2
Total	174.7	374.3	45.4	50.0

[a] Values provided are in millions of acres. To covert to millions of hectares, multiply by 0.4.

[b] Source: BLM (2005b). Totals may be off due to rounding.

[c] Source: BLM (2003a-j).

Commercial use activities on BLM-administered lands include livestock grazing; timber sales; oil, gas, geothermal, and coal production; mineral exploration and mining; and ROWs. Table 4.7.1-2 summarizes the best available information on the acreage of commercial use activities for each of the 11 western states. No acreage was available related to mineral materials (salable) and exploration and mining activities (locatables) for any of the 11 western states. Other commercial uses occur on BLM-administered lands (e.g., guides and outfitters and special uses, such as filming); however, a summary of these uses for the 11 western states was not available.

Commercial land uses have had varying impacts on the environmental conditions of western lands. For example, grasslands, riparian areas, and other habitats have been greatly influenced by grazing operations. Oil and gas leasing, coal production, and mineral extraction also have major impacts, at least locally, on the environment. In fiscal year (FY) 2002, more than 390 million tons (354 million metric tons [t]) of coal was mined on BLM-administered lands (BLM 2003a-j). ROWs can also have a major impact by eliminating, fragmenting, and altering existing land conditions. In FY 2002, more than 3,100 new ROWs were authorized on BLM-administered lands within the 11 western states (BLM 2003a-j).

4.7.2 Aviation Considerations

A general air navigation concern is associated with tall structures. Therefore, there could be siting concerns relative to the locations of airports and flight patterns and air space associated with the airports because of the turbines and meteorological towers located at wind energy projects. The FAA has to be contacted for any proposed construction or alteration of objects within navigable airspace under any of the following categories:

- Proposed objects more than 200 ft (61 m) above ground level at the structure's proposed location;

- Within 20,000 ft (6,096 m) of an airport or seaplane base that has at least one runway longer than 3,200 ft (975 m), and the proposed object would exceed a slope of 100:1 horizontally from the closest point of the nearest runway;

- Within 10,000 ft (3,048 m) of an airport or seaplane base that does not have a runway more than 3,200 ft (975 m) in length, and the proposed object would exceed a 50:1 horizontal slope from the closest point of the nearest runway; and/or

- Within 5,000 ft (1,524 m) of a heliport and the proposed object would exceed a 25:1 horizontal slope from the nearest landing and takeoff area of that heliport (FAA 2000).

The FAA could recommend marking and/or lighting a structure that does not exceed 200 ft (61 m) above ground level, or that is not within the distances from airports or heliports mentioned above, because of its particular location (FAA 2000).

TABLE 4.7.1-2 Commercial Use Activity on BLM-Administered Lands in the 11 Western States

	Commercial Use Activity						
State	Grazing Permits (acres)[a, b]	Timber Sales (acres harvested)[c]	Oil and Gas Leasing (acres in producing status)[c]	Geothermal Production (acres in producing leases)[c]	Coal Production (acres in producing leases)[c]	Nonenergy Leasables (acres under lease)[c]	ROWs (acres)[c]
Arizona	11,500,045	–[d]	–	–	–	4	315,522
California	8,150,165	318	70,361	14,720	–	36,772	216,410
Colorado	7,732,687	27	1,317,236	–	95,095	21,762	181,916
Idaho	11,789,170	1,973	–	–	–	43,274	285,082
Montana with Dakotas	8,120,526	674	1,036,098	–	44,681	1,409	243,382
Nevada	45,824,954	–	15,338	16,640	–	1,560	624,861
New Mexico with Oklahoma	12,558,882	–	4,058,953	1,280	60,784	136,396	402,266
Oregon/Washington	13,601,477	23,993	–	–	521	–	2,504,191
Utah	22,089,791	–	895,482	3,840	116,854	87,117	392,048
Wyoming with Nebraska	17,494,288	–	3,580,113	–	192,309	84,286	316,073
Total	158,861,985	26,985	10,973,581	36,480	510,244	412,580	5,481,750

a To convert to hectares, multiply by 0.4047.

b Source: BLM (2005b).

c Sources: BLM (2003a-j); Stamm (2004).

d A dash indicates that the data were not available.

The numbers of public airports that occur in each of the 11 western states are as follows: Arizona – 82, California – 263, Colorado – 79, Idaho – 120, Montana – 123, Nevada – 55, New Mexico – 62, Oregon – 98, Utah – 49, Washington – 140, and Wyoming – 42 (AirNav.com 2004). This does not include the numerous private and military use facilities that occur in these states.

4.7.3 Military Installations

Navigation concerns also exist where tall structures are located within military airspace, referred to as military operations areas (MOAs); military training routes (MTRs); or next to military testing and training ranges. An MOA is airspace designated for military training activities, including aerobatics, air combat tactics, formation training, and other activities. An MTR is made up of a series of linked segments of airspace within which various training activities are conducted. Although not required to, military aircraft typically fly an MTR along a defined centerline that governs the plane's height and course. The floor and ceiling for both MOA and MTR airspace are defined, and, in either type of space, the floor may extend all the way down to the earth's surface. Military ranges consist of both ground and airspace assets used for composite force training, tactics development, and testing. Thus, wind turbines potentially can intrude upon these airspaces if not located properly. Incompatibility with military missions could be a basis for permit denial should there be no available mitigation options. Figure 4.7.3-1 shows the locations of MOAs and MTRs in the western United States. Table 4.7.3-1 summarizes the number of major U.S. military installations located within the 11 western states.

Wind turbines can be a source of radar clutter that can interfere with both ground and airborne radar operations. For example, tracking of an aircraft flying over a wind energy project could be difficult since the responses between the aircraft and the turbines may not be distinguished. Wind development projects could also interfere with aircraft radar target identification and terrain-following radar. Prepermit coordination would be necessary for site-specific projects where radar interference may be an issue.

4.7.4 Conservation System

A number of designated conservation system units occur within the 11 western states. These include National Parks, National Historic and Scenic Trails, National Wildlife Refuges, Wild and Scenic Rivers, and federally designated Wilderness Areas. These resources are scientifically, ecologically, culturally, educationally, and recreationally important and represent a significant part of the natural and cultural heritage of the United States (BLM 2000). Some BLM-administered lands require special management to protect historic, natural, cultural, scenic, and fish and wildlife resources.

The BLM has recently established the NLCS to provide an overall framework for managing special areas designated by Congress or the President on public lands (BLM 2000). The NLCS includes BLM's National Conservation Areas (NCAs), National Monuments,

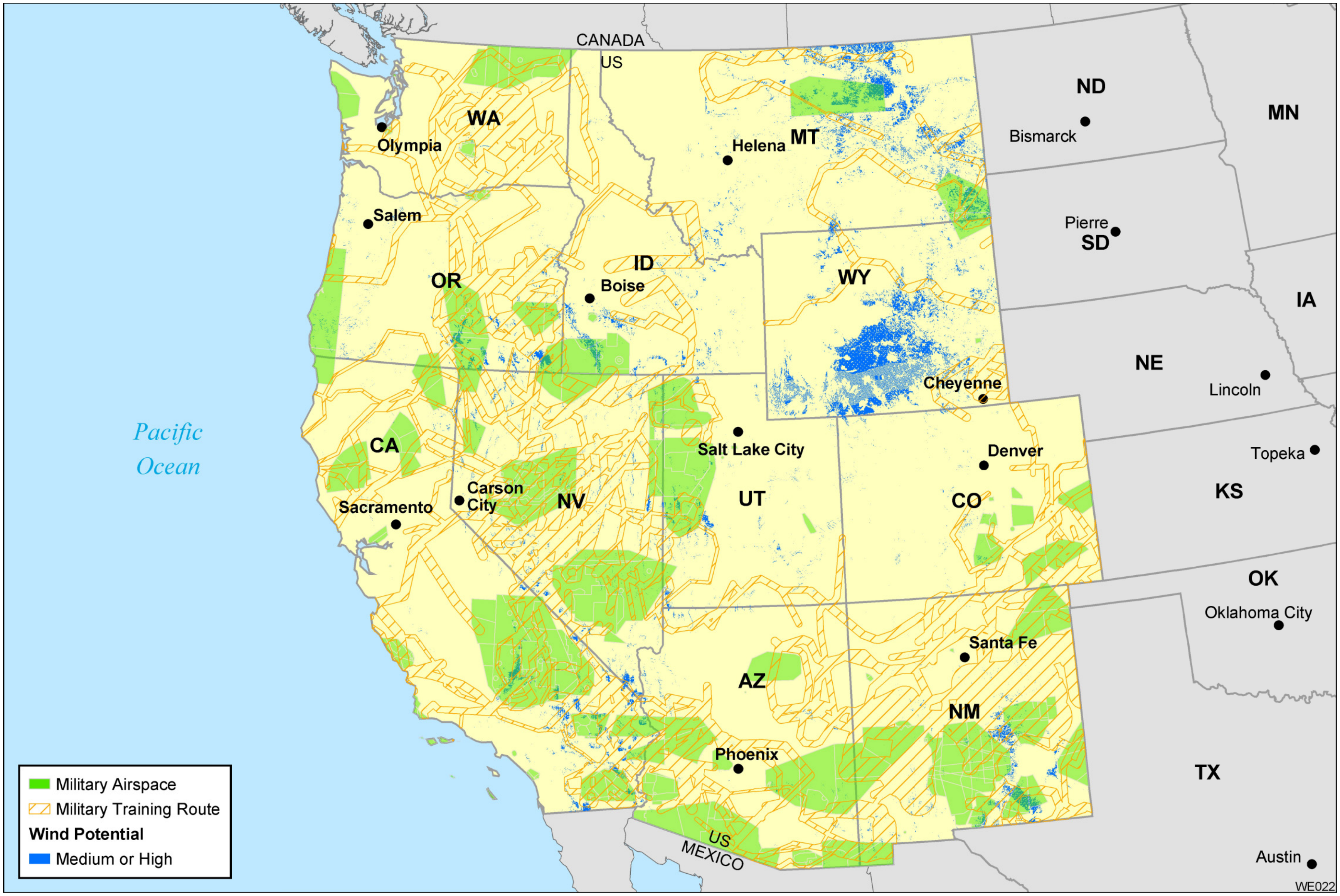

FIGURE 4.7.3-1 Locations of MOAs and MTRs in the Western United States

TABLE 4.7.3-1 Number of Major Military Installations Located in the 11 Western States

State	Army	Army Guard	Navy	Air Force	Air Force Guard/ Reserve	Marines	Total
Arizona	8	0	1	6	2	2	19
California	13	11	47	17	6	9	103
Colorado	4	1	0	8	0	0	13
Idaho	0	1	1	2	1	0	5
Montana	1	1	0	2	1	0	5
Nevada	1	1	0	4	1	0	7
New Mexico	1	0	0	6	0	0	7
Oregon	8	4	0	2	0	0	14
Utah	5	2	0	5	0	0	12
Washington	5	0	16	2	1	0	24
Wyoming	0	2	0	1	1	0	4

Source: GlobalSecurity.org (2004).

National Recreation Areas, Forest Reserves, Outstanding National Areas, Cooperative Management and Protection Areas, Wilderness Areas, Wilderness Study Areas, Wild and Scenic Rivers, National Scenic Trails, and National Historic Trails (BLM 2000). A BLM brochure on the NLCS (available at http://www.blm.gov/nlcs) provides links to maps that show the locations of the various NLCS areas and to the individual NCAs and National Monuments. Other areas that have important values, but that are not part of the NLCS, include the ACECs and Wild Horse and Burro Herd Management Areas (BLM 2000). The following is a brief description of the special areas included in the NLCS, ACECs, and Wild Horse and Burro Management Areas.

The NCAs are designated by Congress to conserve, protect, enhance, and manage public land areas for the benefit and enjoyment of present and future generations. NCA features may include natural, recreational, cultural, wildlife, aquatic, archaeological, paleontological, historical, educational, and/or scientific resources. National Monuments are designated to protect objects of scientific and historic interest by public proclamation by the President (under the Antiquities Act of 1906) or by Congress as historic landmarks, historic and prehistoric structures, or other objects of historic or scientific interest on public lands (BLM 2005c).

Wilderness Areas are designated by Congress and are areas that are part of the National Wilderness Preservation System to ensure preservation and protection of their natural conditions. They are generally 5,000 acres (2,023 ha) or more in size, offer outstanding opportunities for solitude or primitive and unconfined types of recreation, and may also contain ecological, geological, or other features that have scientific, scenic, or historical value. Wilderness Study

Areas are areas designated by a federal land-management agency (i.e., the BLM, U.S. Forest Service [USFS], National Park Service [NPS], and USFWS) as having wilderness characteristics, thus making them worthy of consideration by Congress for wilderness designation. While Congress considers whether to designate the Wilderness Study Areas as permanent Wilderness Areas, the federal agency managing the Wilderness Study Area does so in a manner to prevent impairment of the area's suitability for wilderness designation (BLM 2005c).

A river or river section is designated as a Wild and Scenic River by Congress or the Secretary of the Interior, under the authority of the Wild and Scenic Rivers Act of 1968. These special areas are managed to protect outstanding scenic, recreational, geologic, fish and wildlife, historic, cultural, or other values, and to preserve the river or river section in its free-flowing condition. The law recognizes three classes of rivers: wild, scenic, and recreational (BLM 2005c).

National Historic and Scenic Trails are designated by Congress under the National Trails System Act of 1968. National Historic Trails follow as closely as possible the original trails or routes of travel with national historical significance. Such designation identifies and protects historic routes and their historic remnants and artifacts for public use and enjoyment (BLM 2005c). National Scenic Trails are extended trails that offer maximum outdoor recreational potential and provide enjoyment of the various qualities through which they pass (e.g., scenic, historical, natural, and cultural).

Designated ACECs include public lands where special management attention and direction are needed to protect and prevent irreparable damage to important historic, cultural, and scenic values, fish, or wildlife resources or other natural systems or processes; or to protect human life and safety from natural hazards. ACEC designation indicates that the BLM recognizes the significant values of the area and intends to implement management to protect and enhance the resource values. Land use plans outline management objectives and prescriptions for each ACEC. All ACECs are considered land use authorization avoidance areas since they are known to contain resource values that will pose special constraints for and possibly denial of applications for land uses that cannot be designed to be compatible with the management objectives and prescriptions for the ACEC (BLM 2005c).

There are 197 Wild Horse and Burro Herd Management Areas in the western states that encompass close to 33.2 million acres (13.4 million ha) of public land. To protect the herds, as well as the environment in which they live, Congress enacted the Wild Free-Roaming Horse and Burro Act of 1971, as amended. This act requires the protection and management of wild horses and burros to assure a thriving, natural ecological balance and a multiple-use relationship on their ranges. The BLM is responsible for implementing this act and for assuring healthy, viable wild horse and burro populations within the Herd Management Areas (BLM 2000).

Table 4.7.4-1 summarizes the lands discussed above (plus other areas considered "public land treasures") that are under BLM stewardship for the 11 western states.

TABLE 4.7.4-1 Public Land Treasures under BLM Stewardship in the 11 Western States

	Public Land Treasure[a]					
State	National Monuments[b,c]	Cultural Resources[d]	Wilderness Areas[b,c]	Wilderness Study Areas[b,c]	Natural Conservation, Recreation and Protection Areas[b,c]	Areas of Critical Environmental Concern[c]
Arizona	5 monuments (1,774,930 acres)[e]	27,454 acres inventoried (276 properties recorded)	47 areas (1,396,466 acres)	2 areas (63,930 acres)	3 areas (120,407 acres)	50 areas (638,110 acres)
California	3 monuments (291,390 acres)	29,618 acres inventoried (314 properties recorded)	76 areas (3,612,312 acres)	77 areas (974,769 acres)	2 areas (10,728,368 acres)	143 areas (1,664,108 acres)
Colorado	1 monument (163,892 acres)	45,788 acres inventoried (1,482 properties recorded)	4 areas (139,524 acres)	54 areas (621,737 acres)	2 areas (179,907 acres)	66 areas (621,589 acres)
Idaho	1 monument (273,847 acres)	43,469 acres inventoried (549 properties recorded)	1 area (802 acres)	66 areas (1,341,709 acres)	1 area (483,074 acres)	95 areas (580,973 acres)
Montana	2 monuments (375,027 acres)	22,100 acres inventoried (229 properties recorded)	1 area (6,000 acres)	40 areas (450,823 acres)	–[f]	41 areas (248,576 acres)
Nevada	–	98,364 acres inventoried (1,921 properties recorded)	24 areas (990,319 acres)	85 areas (3,822,421 acres)	3 areas (1,060,396 acres)	36 areas (1,358,234 acres)
New Mexico	1 monument (4,114 acres)	40,891 acres inventoried (1,159 properties recorded)	3 areas (139,281 acres)	60 areas (970,532 acres)	1 area (227,100 acres)	151 areas (559,001 acres)
Oregon/ Washington	1 monument (52,947 acres)	58,148 acres inventoried (471 properties recorded)	5 areas (193,863 acres)	98 areas (2,706,708 acres)	2 areas (425,650 acres)	190 areas (746,278 acres)
Utah	1 monument (1,870,800 acres)	77,550 acres inventoried (1,133 properties recorded)	3 areas (27,720 acres)	99 areas (3,255,490 acres)	–	59 areas (1,267,389 acres)
Wyoming	–	84,623 acres inventoried (1,676 properties recorded)	–	42 areas (575,841 acres)	–	38 areas (696,894 acres)
Total	15 monuments (4,806,947 acres)	528,005 acres inventoried (9,210 properties recorded)	161 areas (6,515,287 acres)	623 areas (14,783,960 acres)	14 areas (13,224,902 acres)	873 areas (8,417,391 acres)

TABLE 4.7.4-1 (Cont.)

State	Public Land Treasure[a]						
	National Historic Trails[b]	National Recreation Trails[d]	National Scenic Trails[b]	National Natural Landmarks[c,d]	Research Natural Areas[c]	Wild and Scenic Rivers[c]	Wild Horse and Burro Population[d]
Arizona	2 trails (89 mi)[g]	1 trail (1 mi)	–	2 areas (4,398 BLM acres)	9 areas (14,056 acres)	–	220 horses 2,331 burros
California	3 trails (362 mi)	8 trails (90 mi)	1 trail (189 mi)	9 areas (76,997 BLM acres)	15 areas (43,512 acres)	6 rivers, 78 mi (24,800 acres)	2,465 horses 997 burros
Colorado	1 trail (85 mi)	–	–	2 areas (1,036 BLM acres)	10 areas (4,665 acres)	–	840 horses 0 burros
Idaho	4 trails (439 mi)	5 trails (20 mi)	1 trail (13 mi)	5 areas (212,640 BLM acres)	50 areas (45,181 acres)	–	690 horses 0 burros
Montana[h]	2 trails (313 mi)	2 trails (39 mi)	1 trail (30 mi)	3 areas (14,227 acres)	–	1 river, 149 mi (89,300 acres)	159 horses 0 burros
Nevada	3 trails (816 mi)	1 trail (1 mi)	–	2 areas (9,600 acres)	–	–	18,999 horses 866 burros
New Mexico[h,i]	2 trails (186 mi)	5 trails (36 mi)	1 trail (202 mi)	6 areas (9,927 BLM acres)	12 areas (27,852 acres)	2 rivers, 71 mi (22,720 acres)	54 horses 0 burros
Oregon/ Washington	2 trails (24 mi)	3 trails (201 mi)	1 trail (42 mi)	7 areas (6,714 BLM acres)	72 areas (143,584 acres)	23 rivers, 811 mi (259,552 acres)	2,411 horses 15 burros
Utah	3 trails (569 mi)	1 trail (12 mi)	–	3 areas (33,760 BLM acres)	2 areas (6,453 acres)	–	2,972 horses 110 burros
Wyoming	5 trails (1,262 mi)	1 trail (2 mi)	1 trail (164 mi)	6 areas (48,130 BLM acres)	–	–	5,686 horses 0 burros
Total[j]	9 trails (4,145 mi)	27 trails (402 mi)	2 trails (640 mi)	45 areas (417,429 BLM acres)	170 areas (285,205 acres)	32 rivers, 1,109 mi (396,372 acres)	34,496 horses 3,526 burros

Footnotes on next page.

TABLE 4.7.4-1 (Cont.)

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[a] See the glossary in Chapter 10 for a description of each of the public land treasures.

[b] Source: BLM (2005c).

[c] BLM (2005b).

[d] Source: BLM (2003a–j).

[e] To convert acres to hectares, multiply by 0.4047.

[f] A dash indicates not listed on BLM-administered lands for that state.

[g] To convert miles to kilometers, multiply by 1.609.

[h] The recreation use for Montana includes North and South Dakota. The BLM-administered surface acres in Montana are about 96% of the total for all three states.

[i] The recreation use for New Mexico includes Oklahoma, Texas, and Kansas. The BLM-administered surface acres in New Mexico are about 95% of the total for all four states.

[j] The total may not equal the numbers for the individual states because a given public land treasure may occur in more than one state (e.g., the California National Historic Trail occurs in six states).

4.7.5 Recreation Land Uses

Table 4.7.5-1 lists the number of recreational areas within the 11 western states that are managed by various federal agencies (i.e., the BLM, Bureau of Reclamation [BOR], USFWS, NPS, U.S. Department of Transportation (DOT), National Ocean Service [NOS], U.S. Army Corps of Engineers (USACE), and Smithsonian Institution Affiliations Program [SIAP]) (Recreation.gov 2003). The types of recreational areas are quite diverse. Those managed by the BLM include National Monuments and Natural Landmarks; Wilderness Areas; Wilderness Study Areas; Natural Conservation, Recreation, and Protection Areas; ACECs, National Historic and Scenic Trails; Research Natural Areas; and Wild and Scenic Rivers (Table 4.7.4-1). In addition, the BLM manages more than 3,500 recreation sites and facilities. The BOR and USACE primarily manage reservoirs, lakes, and dams. Recreational areas managed by the USFS are

TABLE 4.7.5-1 Number of Recreational Areas within the 11 Western States Managed by Federal Agencies

	Managing Agency[a]									
State	BLM	BOR	DOT	USFWS	NOS	NPS	SIAP	USACE	USFS	Total
Arizona	110[b]	14	1	14	0	27	10	1	45	222
California	130[c]	36	3	26	6	39	12	23	66[d]	341
Colorado	25[b]	34	6	8	0	17	2	5	41[e]	138
Idaho	56[f]	17	0	7	0	10	1	4	14	109
Montana	8[b]	12	0	22	0	8	2	2	21	75
Nevada	62[g]	4	2	6	0	10	7	0	13	104
New Mexico	34	11	4	10	0	17	4	7	24	111
Oregon	57[d]	24	6	13	1	8	0	19	52	180
Utah	89	25	2	6	0	16	0	0	19	157
Washington	12	19	2	22	2	16	2	13	34	122
Wyoming	40	23	0	9	0	11	0	0	20	113

[a] Abbreviations: BLM = Bureau of Land Management, BOR = Bureau of Reclamation, DOT = U.S. Department of Transportation, USFWS = U.S. Fish and Wildlife Service, NOS = National Ocean Service, NPS = National Park Service, SIAP = Smithsonian Institution Affiliations Program, USACE = U.S. Army Corps of Engineers, USFS = U.S. Forest Service.

[b] Includes one area comanaged with the USFS.

[c] Includes 12 areas comanaged with the USFS.

[d] Includes two areas comanaged with the USFS.

[e] Includes one area comanaged with the USFWS and one area comanaged with the NPS.

[f] Includes one area comanaged with the NPS.

[g] Includes four areas comanaged with the USFS and four comanaged with the NPS.

Source: Recreation.gov (2003).

mostly associated with National Forests and Wilderness Areas. The USFWS-managed recreational areas include National Wildlife Refuges, Wildlife Management Areas, Wilderness Areas, waterfowl production areas, and hatcheries. Areas managed by the NPS include National Monuments, National Parks, recreational areas, and national historic sites. The DOT-managed recreational areas are the America's Byways. This is an umbrella term used for the 96 distinct and diverse roads designated by the U.S. Secretary of Transportation, which include the National Scenic Byways and the All-American Roads. The NOS manages national marine sanctuaries and estuarine research reserves; while the SIAP manages various historical, natural, and art museums.

In addition to the federally managed recreational areas, there are a number of state parks, recreational areas and sites, or points of interest within the 11 western states. For example, Table 4.7.5-2 lists the number of state parks in each of the 11 states and the Web addresses for each state. Most of the Web sites have maps showing the locations of the state parks and links to each park.

Generally, the BLM provides recreational opportunities where they are compatible with other authorized land uses, while minimizing risks to public health and safety and maintaining the health and diversity of the land (BLM 2000). Specific BLM-administered lands and the various recreational opportunities available on those lands can be obtained by either state or recreational activity (Recreation.gov 2003). Table 4.7.5-3 provides the estimated recreational use in visitor days for BLM-administered lands within the 11 western states for FY 2002.

TABLE 4.7.5-2 Number of State Parks Located within the 11 Western States

State	Number of State Parks	Web Site
Arizona	29	http://www.pr.state.az.us/parksites.html
California	279	http://www.parks.ca.gov/parkindex/results.asp
Colorado	40	http://www.parks.state.co.us/default.asp
Idaho	27	http://www.idahoparks.org/parks/parks-atoz.html
Montana	42	http://parks.fwp.state.mt.us/parks/default.aspx
Nevada	24	http://parks.nv.gov/parkmap.htm
New Mexico	31	http://www.emnrd.state.nm.us/nmparks
Oregon	181	http://www.oregonstateparks.org/searchpark.php
Utah	40	http://parks.state.ut.us/visiting/tour.htm
Washington	117	http://www.parks.wa.gov/alpha.asp
Wyoming	12	http://wyoparks.state.wy.us/Sphslist.htm

TABLE 4.7.5-3 Estimated Recreational Use (Visitor Days) on BLM-Administered Lands within the 11 Western States, FY 2002

	Recreational Activity							
	Boating – Motorized	Boating – Row, Float, or Paddle	Swimming and Other Water Activities	Camping and Picknicking	Fishing	Hunting	Driving for Pleasure	Interpretation, Education, and Viewing Land Resources
Arizona	1,876,634	43,939	743,321	9,752,558	57,712	283,286	75,025	417,176
California	9,003	169,595	105,538	8,864,551	92,925	205,436	466,519	354,616
Colorado	3,982	91,922	8,959	956,287	75,870	533,151	243,982	361,942
Idaho	165,881	534,522	51,171	1,221,756	438,416	663,603	239,583	276,755
Montana[a]	60,007	104,925	17,678	950,496	213,292	465,706	69,678	185,782
Nevada	20,297	21,419	31,221	1,872,354	179,843	972,140	410,212	284,928
New Mexico[b]	6,300	18,236	2,674	420,888	79,927	304,986	147,024	163,170
Oregon/Washington	158,240	330,291	126,629	2,458,284	540,977	693,062	586,408	582,154
Utah	40,177	410,794	43,214	2,417,647	57,106	176,623	727,616	1,648,140
Wyoming	507	93,966	878	695,379	173,242	402,901	235,495	175,059

	Recreational Activity						
	Nonmotorized Travel	Off-Highway Vehicle Travel	Specialized Motor Sports, Events, and Activities	Specialized Nonmotor Sports, Events, and Activities	Snowmobile and Other Winter Motorized Travel	Nonmotorized Winter Activities	Total
Arizona	541,836	356,591	56	280,060	–[c]	344	14,428,538
California	1,003,840	2,760,845	6,643	2,741,271	4,142	2,381	16,787,305
Colorado	550,859	400,637	11,758	246,326	11,758	11,371	3,497,128
Idaho	257,914	271,472	958	253,360	57,926	299,482	4,732,799
Montana[b]	167,028	137,386	–	51,844	22,400	21,690	2,467,912
Nevada	421,839	382,991	102,018	445,564	14,805	26,126	5,185,757
New Mexico[c]	308,875	173,428	2,475	159,980	68	128	1,788,159
Oregon/Washington	514,506	331,068	3,856	388,413	4,062	21,961	6,739,551
Utah	1,591,086	579,718	2,719	180,361	1,498	2,490	7,879,189
Wyoming	187,452	172,162	30	118,183	34,122	6,100	2,295,476
Total							65,801,814

Footnotes on next page.

TABLE 4.7.5-3 (Cont.)

[a] The recreation use for Montana includes North and South Dakota. The BLM-administered surface acres in Montana are about 96% of the total for all three states.

[b] The recreation use for New Mexico includes Oklahoma, Texas, and Kansas. The BLM-administered surface acres in New Mexico are about 95% of the total for all four states.

[c] A dash indicates not listed on BLM-administered lands for that state.

Source: BLM (2003a-j).

The Recreation Opportunity Spectrum (ROS) is one of the means that the BLM uses to inventory, plan, and manage recreational opportunities. Seven elements provide the basis for inventorying and delineating recreational settings: access, remoteness, naturalness, facility and site management, visitor management, social encounters, and visitor impacts. On the basis of these elements, six recreation opportunity classes have been developed:

1. *Primitive:* Large areas of about 5,000 acres (2,023 ha) or more located at least 3 mi (5 km) from the nearest point of motor vehicle access;

2. *Semiprimitive nonmotorized:* Areas of about 2,500 acres (1,012 ha) located at least 0.5 mi (0.8 km) from the nearest point of motor vehicle access;

3. *Semiprimitive motorized.* Areas of about 2,500 acres (1,012 ha) located within 0.5 mi (0.8 km) of primitive roads and two-track vehicle trails;

4. *Roaded natural.* Areas near improved and maintained roads;

5. *Rural.* Areas characterized by a substantially modified natural environment; and

6. *Urban.* Areas located near paved highways where the landscape is dominated by human modification.

Management of these lands to provide a natural-appearing environment with minimal evidence of humans and on-site controls increases from urban to primitive classes (USFS 2001).

The BLM also distinguishes recreational use on the basis of the level of use and management requirements. Special Recreation Management Areas require recreation activity plans and a major investment in facilities or supervision of more intensive activities. Extensive Recreation Management Areas, however, offer mostly unstructured, dispersed, and low-intensity recreational opportunities that require a minimum amount of facilities and management (PBS&J 2002).

4.8 VISUAL RESOURCES

4.8.1 Introduction

Visual resources refer to all objects (man-made and natural, moving and stationary) and features (e.g., landforms and water bodies) that are visible on a landscape. These resources contribute to the scenic or visual quality of the landscape, that is, the visual appeal of the landscape. A visual impact is the creation of an intrusion or perceptible contrast that affects the scenic quality of a landscape. A visual impact can be perceived by an individual or group as either positive or negative, depending on a variety of factors or conditions (e.g., personal experience, time of day, weather/seasonal conditions).

The BLM's responsibility for managing visual (scenic) resources of public lands is established by law. NEPA requires that measures be taken to "assure for all Americans…aesthetically pleasing surroundings" and the FLPMA states that "public lands will be managed in a manner which will protect the quality of scenic values of these lands."

Methods have been developed to assist federal agencies responsible for visual resource planning and assessing visual resource impacts. The BLM conducts visual inventories and analyses within the guidelines established in its VRM System (BLM 1986a,b). The BLM uses the procedures and methods to support decision making for planning activities and reviews of proposed developments on BLM-administered lands. Since 1980, the BLM has used the system to evaluate thousands of projects on public lands while minimizing their visual impacts. Approximately 90% of the oil, gas, and electric transmission ROWs in the western United States are dependent, in part, on passages across federal lands. The BLM alone administers nearly 85,000 ROWs, constituting approximately 25,000 mi (40,234 km) of pipelines and 75,000 mi (120,701 km) of electric transmission corridors. The BLM processes applications for solar, wind, geothermal, and fossil fuel energy exploration and production. In addition, the BLM manages off-highway vehicle (OHV), mountain bike, horseback riding, hiking, rafting, and other recreational uses that also have the potential for adverse visual impacts.

The VRM system consists of three phases: (1) inventory of scenic values; (2) establishment of BLM VRM objectives (i.e., VRM Classes); and (3) design, mitigation, and evaluation of the project to meet established VRM classes. To arrive at a visual resource classification, the procedure for inventorying scenic values looks at the intrinsic scenic quality of a view, the level of public concern (sensitivity) to changes in that view, and the distance between viewers and the view. The text box on the next page discusses the BLM's VRM system for inventorying scenic values. The final result of the inventory process is the assignment of a Visual Resource Class that portrays the relative value of visual resources and provides a tool for managing visual objectives. These Visual Resource Classes and the associated objectives are used to provide the basis for the consideration of visual resources in the BLM's resource management planning process.

Once visual resources are inventoried and visual management classes are delineated, then potential impacts of a proposed project can be evaluated relative to management objectives for the affected area. The vulnerability of visual resources to impact-producing visual contrasts then determines the need for adjustments or mitigation of the proposed wind energy development.

The BLM's visual resource contrast rating is a systematic process to analyze potential visual impacts of proposed projects and activities (BLM 1986b). Its purpose is to assist BLM staff not trained in the design arts to apply basic design principles to resolve visual impacts. Simulation methods should be used to inform contrast rating and should therefore be integrated to reach final contrast rating decisions.

Contrast rating is the BLM's measure of the degree to which management activity affects the visual quality of a landscape. It depends on the visual contrast created between a project and the existing landscape. Contrast is assessed by comparing project features (explained in a

The BLM VRM System: Inventory of Scenic Values

Scenic Quality Evaluation. BLM inventory guidelines rate the apparent scenic quality of discrete areas of land as A, B, or C on the basis of their landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications (BLM 1986a). A-rated areas have outstanding or distinctive diversity or interest, B-rated areas have common or average diversity or interest, and C-rated areas have minimal diversity or interest.

Sensitivity Level Analysis. Sensitivity levels measure public concern for scenic quality. Areas are assigned a high, medium, or low sensitivity level by analyzing indicators of public concern: types of users, amount of use, public interest, adjacent land uses, special areas, and other factors that may be indicators of visual sensitivity. Special areas such as Wilderness Study Areas, Wild and Scenic Rivers, and Scenic Roads or Trails require special consideration for protection of their scenic quality.

Distance Zone Delineation. The visual impact of a particular project will become less perceptible with increasing distance between the viewer and the project. The BLM VRM system uses three distance zones to account for this effect. It looks at locations (routes) such as highways, rivers, or other viewing locations from which a viewer could observe a particular site. The foreground-middleground zone includes areas at a distance of less than 3 to 5 mi (5 to 8 km) from the viewer. Viewed areas beyond the foreground-middleground zone but usually less than 15 mi (24 km) from the viewer are in the background zone. Areas hidden from view in the foreground-middleground zone or background zone are in the seldom-seen zone.

Visual Resource Classification. Areas are assigned to one of four classes based on the scenic quality, visual sensitivity, and distance zones. Each class has an objective that determines the management objectives for that area:

- Class I Objective: Preserve the existing character of the landscape. The level of change should be very low and must not attract attention.
- Class II Objective: Retain the existing character of the landscape. Allow a low level of change that should not attract the attention of a casual observer.
- Class III Objective: Partially retain the existing character of the landscape. Allow a moderate level of change that may attract attention but should not dominate the view of a casual observer.
- Class IV Objective: Provide for management activities that require major modifications of the existing character of the landscape. The level of change may be high and may dominate the view and be the major focus of viewer attention.

detailed project description) with the major features of the existing landscape (contained in the VRM classes/objectives). The basic design elements of form, line, color, and texture are used to make this comparison and to describe the visual contrast created by the project. Comparisons are made from key observation points, critical viewpoints, typical views of representative landscapes, and views of special features. The contrast rating process is a means of determining impacts and of identifying measures to mitigate those impacts. If visual simulations are to be used, contrast ratings should not be completed until simulation results can be considered.

The BLM regards simulation, or visualization, as a valuable tool for effectively evaluating the impacts of a proposed project. Visual simulations are an important means of portraying the relative scale, extent, and other characteristics of a project. They are strongly recommended for potentially high-impact projects in order to better represent views from key observation points during the contrast rating procedure. The BLM acknowledges in its guidance that simulations help public groups visualize and respond to development proposals. However, no specific guidance is provided in the VRM or land use planning processes for public participation mechanisms in the contrast rating process. Basic standards, methods, and techniques for visual simulation are described in the BLM's visual simulation training courses.

4.8.2 BLM Visual Resource Management in the Western United States

Landscapes and their visual qualities, like other public resources, exist in a dynamically changing physical, social, and economic context resulting in shifting and competing demands for their use. The following summary of the BLM's challenges in managing landscape, visual, and scenic resources is adapted from *Great American Landscapes* (Cownover and Dawson-Powell 2003). It describes the context within which the BLM manages the visual resources of western lands.

The BLM administers more land than any other federal agency. It is responsible for "multiple use" of approximately 264 million acres (107 million hectares). Most of these lands are located in the West, the fastest growing region of the United States, and many are near growing communities. Relative to the East, much of the western United States is an expansive and diverse place of open vistas, dry and desert lands, rugged and mountainous terrain, complex vegetation zones, wild and rural landscapes, extensive coastlines, and, until recently, sparse population. Emerging trends pose increasing challenges to the BLM's efforts to preserve scenic character and open space while balancing ever-increasing local, regional, and national resources demands. The FLPMA gave the BLM its multiple use mandate to manage public lands and resources for the benefit of present and future generations in a manner that protects the range of resource values on public lands; and scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values.

As the West has changed over the past two decades, its rapidly expanding population, shifting demographics, and residential growth have placed increasing demands and expectations on the BLM's multiple use management of visual resources on public lands. Towns and cities have expanded outward to reach once-remote BLM-administered lands. More than 4,100 communities, with a combined population of 22.2 million people, now live within 25 mi (40 km) of BLM-administered lands and waters. More than 40% of the BLM-administered lands are close to major population centers in the West. Western recreation activities such as OHV use, hunting, hiking, and camping, have increased simultaneously with increases in traditional uses of public lands for livestock grazing, mining, and energy development, thus creating an environment in which the BLM-administered lands are often the center of both conflict and opportunity.

4.9 CULTURAL RESOURCES

Cultural resources include archaeological sites and historic structures and features that are protected under the NHPA, as amended (P.L. 89-665). Cultural resources also include traditional cultural properties, that is, properties that are important to a community's practices and beliefs and that are necessary for maintaining the community's cultural identity. Cultural resources refer to both man-made and natural physical features associated with human activity and, in most cases, are finite, unique, fragile, and nonrenewable.

Cultural resources that meet the eligibility criteria for listing on the NRHP are considered "significant" resources and must be taken into consideration during the planning of federal projects (see text box). Federal agencies are also required to consider the effects of their actions on sites, areas, and other resources (e.g., plants) that are of religious significance to Native Americans[3] as established under the American Indian Religious Freedom Act (P.L. 95-341). Native American graves and burial grounds are protected by the Native American Graves Protection and Repatriation Act (P.L. 101-601).

National Register Criteria for Evaluation (36 CFR 60.4)*

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or

B. that are associated with the lives of persons significant in our past; or

C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. that have yielded or may be likely to yield, information important in prehistory or history.

* Additional *criteria considerations* are also provided in 36 CFR 60.4.

The NHPA is the overarching law concerning the management of cultural resources. Numerous other regulatory requirements, however, pertain to cultural properties and are presented in Table 4.9-1. These laws are applicable to any wind energy development project undertaken on federal land or requiring federal permitting or funding. The NHPA created the framework within which cultural resources are managed in the United States. The law required that each state appoint an SHPO to oversee the management of cultural resources in that state, and it created the Advisory Council on Historic Preservation, which provides national oversight and dispute resolution. The SHPO is also designated as the repository for all cultural resource information in each state. Section 106 of the NHPA, defines the process for the identification of a cultural resource and the process for determining if a project will adversely affect the resource. The NHPA establishes the processes for consultation among interested parties, the agency conducting the undertaking, and the SHPO, and for government-to-government consultation

3 These acts refer specifically to Native Americans, Native Alaskans, and Native Hawaiians.

TABLE 4.9-1 Cultural Resource Laws and Regulations

Law or Order Name	Intent of Law or Order
Antiquities Act of 1906	This law makes it illegal to remove cultural resources from federal land without permission. It also allows the President to establish historical monuments and landmarks.
E.O. 11593, Protection and Enhancement of the Cultural Environment (1971)	E.O. 11593 requires federal agencies to inventory their cultural resources and to record, to professional standards, any cultural resource that may be altered or destroyed.
Archaeological and Historic Preservation Act (1974) (AHPA)	The AHPA directly addresses impacts to cultural resources resulting from federal activities that would significantly alter the landscape. The focus of the law is the creation of dams and the impacts resulting from flooding, worker housing, creation of access roads, etc.; however, its requirements are applicable to any federal action.
Archaeological Resources Protection Act of 1979 (ARPA)	The ARPA established civil and criminal penalties for the destruction or alteration of cultural resources and established professional standards for excavation.
American Indian Religious Freedom Act of 1978 (AIRFA)	The AIRFA protects the right of Native Americans to have access to their sacred places. It requires consultation with Native American organizations if an agency action will affect a sacred site on federal lands.
Native American Graves Protection and Repatriation Act of 1990 (NAGPRA)	The NAGPRA requires federal agencies to consult with the appropriate Native American tribes prior to the intentional excavation of human remains and funerary objects. It requires the repatriation of human remains found on the agencies' land.
E.O. 13006, Locating Federal Facilities on Historic Properties in our Nation's Central Cities (1996)	E.O. 13006 encourages the reuse of historic downtown areas by federal agencies.
E.O. 13007, Indian Sacred Sites (1996)	E.O. 13007 requires that an agency allow Native Americans to worship at sacred sites located on federal property.
E.O. 13287, Preserve America (2003)	E.O. 13287 encourages the promotion and improvement of historic structures and properties to encourage tourism.
E.O. 13175, Consultation and Coordination with Indian Tribal Governments (2000)	E.O. 13175 requires federal agencies to coordinate and consult with Indian Tribal governments whose interests might be directly and substantially affected by activities on federally administered lands.

between U.S. government agencies and Native American Tribal governments. The NHPA, in Section 106, also addresses the appropriate process for mitigating adverse effects. The NHPA applies to federal undertakings and undertakings that are federally permitted or funded.

Cultural resources on BLM-administered land are managed primarily through the application of the above identified laws. Guidance on the application of the laws is provided through PAs developed among the BLM, the National Council of SHPOs, and the Advisory Council on Historic Preservation, and through state-specific PAs concerning cultural resources. Further guidance is provided through the 8100 Series manuals and handbooks, which outline cultural resource management on BLM-administered land.

BLM offices have been actively engaged in inventorying the property they manage for cultural resources as required by Section 110 of the NHPA. The offices also conduct project-specific surveys in areas that were not previously surveyed. Once an area is surveyed and cultural resources are identified, an assessment of the relative importance of the resources must be made. The laws protect only those sites that are eligible for the NRHP. Guidance on how to apply the NRHP criteria is provided in numerous NPS documents. Guidance is also provided in the BLM 8100 Series manuals.

As of April 2004, 317 cultural resources had been determined eligible on BLM-administered land in the western United States. Across all lands in these 11 states, a total of 12,778 cultural resources are either eligible for listing on the NRHP or listed on the NRHP (ParkNet 2004). Because this number includes only known sites that have been reported to the NPS, it is likely that a considerable number of cultural resources that have been identified as potentially eligible have not yet been listed on the NRHP. Moreover, the majority of BLM-administered land in the 11 western states has yet to be surveyed for cultural resources. More than 9,000 properties have been recorded during inventories of slightly more than 500,000 acres (202,344 ha) out of a total of 174 million acres (70.4 million ha) of BLM-administered land, as indicated in Table 4.7.4-1. As a result, it is quite likely that the number of eligible sites on BLM-administered lands is greater than currently recorded. The types of sites listed on the NRHP in the western United States include archaeological sites, historic buildings, bridges, historic trails, prehistoric dwellings, historic districts, water features (e.g., canals, ditches), and cultural landscapes. (See also Section 4.7.4 for a brief discussion of National Historic and Scenic Trails and other conservation areas established under the NLCS.)

Traditional cultural properties and other areas of concern to Native Americans and other cultural groups can include a wide range of tangible and intangible resources (e.g., archaeological sites, funerary objects, medicinal plants, and sacred landscapes). Government-to-government consultation is the only means of identifying the affected environment for a particular site-specific project. It is difficult, if not impossible, to place boundaries on locations of traditional significance. Where boundaries might be defined, Tribal members may not be willing to disclose such information for a variety of reasons. Cultural sensitivity to the need to protect important places is required. Types of valued traditional resources may include, but are not limited to, archaeological sites, burial sites, traditional harvest areas, trails, certain prominent geological features that may have spiritual significance (i.e., sacred landscapes), and viewsheds of sacred locations (including all of the above).

4.10 ECONOMICS

In this section, the contribution of wind energy development to electricity production capacity in the 11-state study area is briefly described. In addition, five key measures of economic development are described: population, gross state product (GSP), personal income, employment, and tax revenues (sales and state income). For each development measure, data are presented for five 10-year intervals; the years 2005, 2015, and 2025 to describe the period during which impacts are assessed, and 1990 and 2000 to describe historical trends in the preceding period. Forecasts for each measure are based on annual growth rates over the period 1980 to 2003 and the U.S. Bureau of Census population forecast for the period 1995 to 2025 (U.S. Bureau of the Census 2001).

4.10.1 Wind Energy Contributions to Electricity Production Capacity

On the basis of data forecasting the development of electricity production capacity by fuel type in each of the 11 western states, as presented in the *Annual Energy Outlook 2004* (DOE 2004a) and State Electricity Profiles (DOE 2004b), renewable energy sources are expected to provide an important share of energy capacity growth in a number of states over the period 2005 through 2025. This is the case particularly in Idaho, Montana, Oregon, and Washington, where renewables are expected to equal or exceed the share of fossil fuel generating capacity in these states. California also is expected to have a large share of capacity dedicated to renewable energy. Currently, the importance of renewable energy sources in these states is largely due to the contribution of hydropower resources. Wind energy contributions to overall electricity production capacity over the same time period, however, are expected to make up almost 10% of new capacity in most states.

Energy market forecasts, such as those described above, can be impacted by legislative actions. For example, if the federal Production Tax Credit (PTC) for wind is extended by Congress, wind energy development is likely to accelerate in the near term. Also, renewable portfolio standards (RPSs) can increase renewable energy development, including wind energy development, in a given state. To date, RPSs have been established in Arizona, California, Nevada, and New Mexico and are also being considered in other western states. RPS laws require investor-owned utilities to produce or otherwise procure a minimum amount or percentage of their electricity from renewable energy sources, including wind. The percentage requirements vary among the states. Some states have adopted other types of policies to support greater renewable energy development, such as financial incentives, establishment of renewable energy development funds, or requirements that utilities offer "green power" purchase options to their customers. These policies are likely to increase interest in wind energy development on BLM-administered and other lands. The Interstate Renewable Energy Council (IREC 2004) lists state renewable energy incentives.

4.10.2 Population

Total population in the 11 states stood at 61.4 million in 2000 and is expected to reach 65.5 million by 2005 and 87.1 million by 2025 (Table 4.10.2-1). Population in the 11 states is concentrated in California, which had more than 55% of the total regional population in 2000. The population in California is expected to increase from 35.6 million to 50.8 million between 2005 and 2025.

Population in the 11 states grew at an annual average rate of 2.3% over the period 1990 to 2000. Growth within the region was fairly uneven over the period, with relatively high growth rates in Nevada (5.2%) and Arizona (3.4%). Growth rates in Colorado, Idaho, and Utah were all close to the average for the region, with lower than average rates in the remaining states.

4.10.3 Gross State Product

GSP, or the total value of goods and services produced in a state, amounted to a total of $2.4 trillion for the 11 states in 2001 and is expected to reach $2.5 trillion by 2005 and almost $3.4 trillion at the end of the forecast period in 2025 (Table 4.10.3-1). Almost 60% ($1.4 trillion) of GSP in the 11 states was produced in California in 2001. California GSP is expected to reach $2.1 trillion by 2025.

TABLE 4.10.2-1 Total Population (millions) in the 11 Western States

State	1990	2000	Growth Rate 1990–2000 (%)	2005	2015	2025
Arizona	3.7	5.1	3.4	5.7	6.3	7.0
California	29.8	33.4	1.3	35.6	42.5	50.8
Colorado	3.3	4.3	2.7	4.7	5.1	5.4
Idaho	1.0	1.3	2.5	1.4	1.6	1.7
Montana	0.8	0.9	1.2	1.0	1.0	1.1
Nevada	1.2	2.0	5.2	2.3	2.4	2.6
New Mexico	1.5	1.8	1.8	2.0	2.3	2.6
Oregon	2.8	3.4	1.9	3.7	4.0	4.4
Utah	1.7	2.2	2.6	2.5	2.7	3.0
Washington	4.9	5.9	1.9	6.3	7.1	7.9
Wyoming	0.5	0.5	0.8	0.5	0.6	0.7
Total	51.2	61.4	2.3	65.5	75.7	87.1

Source: U.S. Bureau of the Census (2001).

TABLE 4.10.3-1 Total Gross State Product ($ billions 2003) in the 11 Western States

State	1990	2001	Growth Rate 1990–2001 (%)	2005	2015	2025
Arizona	96.9	166.9	5.1	179.4	200.0	221.1
California	1,124.7	1,412.1	2.1	1,474.6	1,763.4	2,105.1
Colorado	105.2	180.5	5.0	191.4	207.8	223.2
Idaho	25.0	38.3	4.0	41.5	45.8	49.2
Montana	18.9	23.5	2.0	24.7	26.3	27.7
Nevada	44.5	82.3	5.7	89.9	95.4	101.0
New Mexico	38.3	57.6	3.8	61.5	70.3	79.9
Oregon	81.3	124.7	4.0	131.2	145.2	158.5
Utah	44.1	73.2	4.7	78.7	87.7	94.9
Washington	162.6	231.6	3.3	244.3	276.0	306.0
Wyoming	18.9	21.2	1.0	22.6	25.6	27.9
Total	1,760.4	2,412.2	3.7	2,539.8	2,943.6	3,394.4

Sources: U.S. Bureau of the Census (2001); U.S. Department of Commerce (2003a).

The annual average growth rate in GSP for all 11 states was 3.7% over the period 1990 to 2001. Growth rates were quite varied across the states, with higher than average rates for Nevada (5.7%), Arizona (5.1%), and Colorado (5.0%). Below-average growth rates occurred in California (2.1%), Montana (2.0%), and Wyoming (1.0%).

4.10.4 Personal Income

Growth rates in personal income were highest in Nevada over the period 1990 to 2002 at 5.5% (Table 4.10.4-1). With the exception of California (2.1%), personal income growth rates in the remaining states were within one percentage point of the 11-state average rate of 3.4%.

Despite low growth in personal income during the 1990s, California generated almost 60% of personal income in the 11 states, producing almost $1.2 trillion in 2002. The state is expected to generate $1.5 trillion in 2015 and $1.7 trillion in 2025. For the 11 states as a whole, personal income is expected to increase from $2.0 trillion in 2002 to $2.4 trillion in 2015 and $2.8 trillion in 2025.

TABLE 4.10.4-1 Total Personal Income ($ billions 2003) in the 11 Western States

State	1990	2002	Growth Rate 1990–2002 (%)	2005	2015	2025
Arizona	89.1	14.6	4.2	153.7	171.4	189.4
California	922.9	1,181.6	2.1	1,223.0	1,462.7	1,746.0
Colorado	91.6	152.9	4.4	159.3	173.1	185.9
Idaho	22.6	34.4	3.5	36.3	40.1	43.1
Montana	17.5	23.2	2.4	24.0	25.6	26.9
Nevada	35.5	67.1	5.5	71.2	75.6	80.1
New Mexico	32.0	45.4	2.9	47.6	54.4	61.8
Oregon	73.5	102.8	2.8	106.7	118.0	128.8
Utah	36.5	57.2	3.8	60.3	67.2	72.7
Washington	138.2	202.7	3.2	210.9	238.5	264.2
Wyoming	11.5	15.6	2.6	16.3	18.5	20.1
Total	1,471.0	2,028.7	3.4	2,109.5	2,444.7	2,819.0

Sources: U.S. Bureau of the Census (2001); U.S. Department of Commerce (2003b).

4.10.5 Employment

Over the period 1990 to 2003, employment growth rates were higher in Nevada (4.4%) and Arizona (3.4%) than elsewhere in the 11 states (Table 4.10.5-1). At 1.1%, growth rates in California were somewhat less than the average rate of 2.5%.

Almost 53% (14.4 million) of all employment in the 11 states (27.2 million) is concentrated in California. Employment in Washington, Arizona, and Colorado in 2003 stood at 2.7 million, 2.3 million, and 2.2 million, respectively; the remaining states support less than 2 million jobs. Employment in the 11 states as a whole is projected to increase to 32 million in 2015 and to 37 million in 2025. California is projected to have almost 60% (21.1 million) of all jobs in the 11 states by 2025.

4.10.6 Sales Tax Revenues

There were fairly wide variations in trends in sales tax revenues across the 11 states (Table 4.10.6-1). During the 1990s, higher-than-average annual growth in sales tax revenues occurred in Nevada (7.1%), Wyoming (6.3%), Colorado (5.2%), Arizona (4.9%), and Oregon (4.9%). The average annual growth rate for the 11 states as a whole during the period 1992 to 2000 was 3.7%.

TABLE 4.10.5-1 Total Employment (millions) in the 11 Western States

State	1990	2003	Growth Rate 1990–2003 (%)	2005	2015	2025
Arizona	1.5	2.3	3.4	2.4	2.6	2.9
California	12.5	14.4	1.1	14.8	17.7	21.1
Colorado	1.5	2.2	2.7	2.2	2.4	2.6
Idaho	0.4	0.6	3.1	0.6	0.7	0.7
Montana	0.3	0.4	2.3	0.4	0.4	0.5
Nevada	0.6	1.1	4.4	1.1	1.2	1.3
New Mexico	0.6	0.8	2.3	0.8	0.9	1.0
Oregon	1.2	1.6	1.7	1.6	1.8	1.9
Utah	0.7	1.1	3.1	1.1	1.2	1.3
Washington	2.1	2.7	1.7	2.7	3.1	3.4
Wyoming	0.2	0.3	1.8	0.3	0.3	0.3
Total	21.7	27.2	2.5	28.0	32.3	37.0

Source: U.S. Bureau of Labor Statistics (2004).

TABLE 4.10.6-1 Total Sales Taxes ($ billions 2003) in the 11 Western States

State	1990	2000	Growth Rate 1990–2000 (%)	2005	2015	2025
Arizona	4.5	6.5	4.9	7.2	8.0	8.9
California	34.6	42.4	2.6	44.6	53.3	63.6
Colorado	3.4	5.1	5.2	5.6	6.0	6.5
Idaho	0.9	1.2	3.1	1.3	1.4	1.6
Montana	0.3	0.3	2.5	0.3	0.4	0.4
Nevada	2.2	3.8	7.1	4.4	4.6	4.9
New Mexico	2.1	2.6	2.5	2.8	3.2	3.6
Oregon	0.7	1.0	4.9	1.0	1.1	1.2
Utah	1.7	1.5	-1.8	1.6	1.8	2.0
Washington	9.7	12.3	3.0	13.2	14.9	16.5
Wyoming	0.4	0.6	6.3	0.7	0.8	0.9
Total	60.5	77.4	3.7	82.6	95.6	110.0

Source: U.S. Bureau of the Census (2004).

Sales tax revenues are projected to grow for the 11 states as a whole, from $82.6 billion in 2005 to $110.0 billion in 2025. Growth is also expected for each individual state over the period 2005 through 2025, with revenues in the largest generating state, California, projected to reach $63.6 billion in 2025.

4.10.7 State Income Tax Revenues

The majority of the 11 states experienced moderately large annual increases in state income tax revenues during the 1990s (Table 4.10.7-1). Growth rates in California (8.3%), Colorado (7.9%), New Mexico (7.9%), and Utah (7.1%) were all higher than the average for the 11-state region (6.6%). Montana (3.9%) experienced relatively slow growth in revenues.

The share of overall income tax revenues generated in California (74%) was significantly higher than the shares for sales tax revenues in 2000. California produced $42.3 billion in income taxes in 2000, compared with $57.4 billion for the 11-state region. Oregon is the second largest state income tax producer, with $4.4 billion in 2000. Revenues for the entire region are projected to increase from $57.4 billion in 2000 to $71.2 billion in 2015 and $83.1 billion in 2025. Revenues in California are expected to reach $53.1 billion in 2015 and $63.4 billion in 2025.

TABLE 4.10.7-1 Total Income Taxes ($ billions 2003) in the 11 Western States

State	1990	2000	Growth Rate 1990–2000 (%)	2005	2015	2025
Arizona	1.6	2.5	5.7	2.7	3.0	3.3
California	22.3	42.3	8.3	44.4	53.1	63.4
Colorado	2.1	3.8	7.9	4.2	4.5	4.9
Idaho	0.7	1.1	6.3	1.2	1.3	1.4
Montana	0.4	0.5	3.9	0.6	0.6	0.6
Nevada	–[a]	–	–	–	–	–
New Mexico	0.5	1.0	7.9	1.0	1.2	1.4
Oregon	2.9	4.4	5.4	4.7	5.2	5.7
Utah	1.0	1.8	7.1	2.0	2.2	2.4
Washington	–	–	–	–	–	–
Wyoming	–	–	–	–	–	–
Total	31.5	57.4	6.6	60.8	71.2	83.1

[a] A dash indicates that there are currently no state income taxes in Nevada, Washington, and Wyoming.

Source: U.S. Bureau of the Census (2004).

4.11 ENVIRONMENTAL JUSTICE

E.O. 12898 (U.S. President 1994) formally requires federal agencies to incorporate environmental justice as part of their missions. Specifically, it directs them to address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

The analysis of potential environmental justice issues associated with wind energy development projects followed guidelines described in the CEQ's *Environmental Justice Guidance under the National Environmental Policy Act* (CEQ 1997b). The analysis method has three parts: (1) the geographic distribution of low-income and minority populations in the affected area is described; (2) an assessment of whether the impacts of construction and operation of the wind turbines would produce impacts that are high and adverse is conducted; and (3) if impacts are high and adverse, a determination is made as to whether these impacts would disproportionately impact low-income or minority populations.

A description of the geographic distribution of low-income and minority population groups was based on demographic data from the 2000 Census (U.S. Bureau of the Census 2001). The following definitions of individuals were used to define low-income and minority populations:

- *Minority*. Persons are included in the minority category if they classify themselves as belonging to any of the following racial groups: Hispanic, Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander.

  Beginning with the 2000 Census, where appropriate, the census form allows individuals to designate multiple population group categories to reflect their ethnic or racial origin. In addition, persons who classify themselves as being of multiple racial origin may choose up to six racial groups as the basis of their racial origins. The term minority includes all persons, including those classifying themselves in multiple racial categories, except those who classify themselves as not of Hispanic origin and as White or "Other Race" (U.S. Bureau of the Census 2001).

  A minority population exists where the percentage of minority persons for any given geographic unit, a state, for example, is more than 20 percentage points higher than the percentage of minority persons for the reference geographic unit, the 11-state region, for example. A minority population also exists in any geographic unit where the number of minority persons exceeds 50% of the total population.

- *Low-Income*. Low-income individuals are defined as individuals who fall below the poverty line. The poverty line takes into account family size and age of individuals in the family. In 1999, for example, the poverty line for a family of five with three children below the age of 18 was $19,882. For any given family below the poverty line, all family members are considered as being below the poverty line for the purposes of analysis (U.S. Bureau of Census 2001).

A low-income population exists where the percentage of low-income persons for any given geographic unit, a state, for example, is more than 20 percentage points higher than the percentage of low-income persons for the reference geographic unit, the 11-state region, for example. A low-income population also exists in any geographic unit where the number of low-income persons exceeds 50% of the total population.

The data in Table 4.11-1 show the minority and low-income composition of total population for each of the 11 states and for the 11-state region based on 2000 Census data and CEQ guidelines. Individuals identifying themselves as Hispanic or Latino are included in the table as a separate entry. However, because Hispanics can be of any race, this number also includes individuals identifying themselves as being part of one or more of the population groups listed in the table.

Large numbers of minority individuals occur in some of the 11 states potentially hosting wind energy developments on BLM-administered land. In New Mexico, 55% of the population is classified as minority, with 53% in California, 36% in Arizona, and 35% in Nevada. While the percentage of minority individuals in any of the 11 states does not exceed the regional average of 41.0% by 20 percentage points or more, the number of minority persons in New Mexico and California exceeds 50% of the total population, meaning that these states have minority populations according to CEQ guidelines. The number of low-income individuals does not exceed the regional average of 12.8% by 20 percentage points or more in any of the states, and does not exceed 50% of the total population in any of the states, meaning that there are no low-income populations in these states when assessed at a state-wide level.

TABLE 4.11-1 Minority and Low-Income Composition for the Populations in Each of the 11 States and the 11-State Region

Parameter	Arizona	California	Colorado	Idaho	Montana	Nevada
Total population	5,130,632	33,871,648	4,301,261	1,293,953	902,195	1,998,257
White, Non-Hispanic	3,274,258	15,816,790	3,202,880	1,139,291	807,823	1,303,001
Hispanic or Latino	1,295,617	10,966,556	735,601	101,690	18,081	393,970
Non-Hispanic or Latino Minorities	560,757	7,088,302	362,780	52,972	76,291	301,286
One race	484,385	6,185,307	290,059	34,711	62,523	252,055
Black or African American	149,941	2,181,926	158,443	4,889	2,534	131,509
American Indian or Alaskan Native	233,370	178,984	28,982	15,789	54,426	21,397
Asian	89,315	3,648,860	93,277	11,641	4,569	88,593
Native Hawaiian or Other Pacific Islander	5,639	103,736	3,845	1,200	425	7,769
Some other race	6,120	71,681	5,512	1,192	569	2,787
Two or more races	76,372	903,115	72,721	18,261	13,768	49,231
Total minority	1,856,374	18,054,858	1,098,381	154,662	94,372	695,256
Low-income	698,669	4,706,130	388,952	148,732	128,355	205,685
Percent minority	36.2	53.3	25.5	12.0	10.5	34.8
Percent low-income	13.6	13.9	9.0	11.5	14.2	10.3

TABLE 4.11-1 (Cont.)

Parameter	New Mexico	Oregon	Utah	Washington	Wyoming	11-State Region
Total population	1,819,046	3,421,399	2,233,169	5,894,121	493,782	61,359,463
White, Non-Hispanic	813,495	2,857,656	1,904,265	4,652,490	438,799	36,210,708
Hispanic or Latino	765,386	275,314	201,559	441,509	31,669	15,226,952
Non-Hispanic or Latino Minorities	240,165	288,469	127,345	800,122	23,314	9,921,803
One Race	214,372	205,736	96,037	624,196	17,150	8,466,411
Black or African American	30,654	53,325	16,137	184,631	3,504	2,917,493
American Indian or Alaskan Native	161,460	40,130	26,663	85,396	10,238	856,835
Asian	18,257	100,333	36,483	319,401	2,670	4,413,399
Native Hawaiian or Other Pacific Islander	992	7,398	14,806	22,779	264	168,853
Some other race	3,009	4,550	1,948	11,989	474	109,831
Two or more races	25,793	82,733	31,308	175,926	6,164	1,455,392
Total minority	1,005,551	563,783	328,904	1,241,631	54,983	25,148,755
Low-income	328,933	388,740	206,328	612,370	54,777	7,867,671
Percent minority	55.3	16.5	14.7	21.1	11.1	41.0
Percent low-income	18.1	11.4	9.2	10.4	11.1	12.8

Source: U.S. Bureau of the Census (2001).

5 POTENTIAL IMPACTS OF WIND ENERGY DEVELOPMENT AND ANALYSIS OF MITIGATION MEASURES

This chapter describes the potential positive and negative environmental, social, and economic impacts that could occur as a result of wind energy development on BLM-administered lands under the MPDS described in Chapter 2. It also presents information about relevant mitigation measures that can be applied to reduce these impacts.[1] This information was derived from comprehensive reviews of wind energy development activities (as described in Chapter 3); published data regarding wind energy development impacts; existing, relevant mitigation guidance (see Section 3.6); and standard industry practices.

After all relevant mitigation measures were identified, they were further evaluated to identify appropriate BMPs for inclusion in the proposed Wind Energy Development Program (Section 2.2.3). The primary purpose of this evaluation was to limit the programmatic BMPs to those that would be applicable to all wind energy development projects on BLM-administered lands. Sections 5.1 through 5.14 present the potential impacts and possible mitigation measures for each resource that could be implemented as project-specific stipulations. Section 5.15 discusses the evaluation process used to identify the programmatic BMPs.

Because this is a programmatic evaluation, site-specific and species-specific issues associated with individual wind energy development projects are not assessed in detail. Rather, this PEIS identifies the range of possible impacts on resources present in the 11-state study area. This assessment considers both direct and indirect impacts. Direct impacts are those effects that result solely and directly from the proposed wind energy development, such as soil disturbance, habitat fragmentation, or noise generation. Indirect impacts are those effects that are related to the proposed development but that are the result of some intermediate step or process, such as changes in surface water quality because of soil erosion at the construction site.

Depending upon which resource is being evaluated, direct and indirect impacts may be (1) confined to a specific long-term footprint of development (e.g., the immediate footprint of a turbine foundation), (2) limited to the entire project area (e.g., habitat fragmentation resulting from the network of roads, turbines, and ancillary structures), or (3) extended over a much larger area beyond the project area (e.g., visual impacts that can be observed many miles away from the project). This assessment discusses potential impacts and mitigation measures across all of these areas as they are relevant to specific resources.

This impact assessment is based on descriptions of wind energy development projects and activities associated with each phase of development presented in Chapter 3. The potential magnitude of the impacts are defined, in part, by the MPDS and WinDS model estimates for

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[1] Mitigation measures that may be applicable to reduce impacts of wind energy development but that are not relevant to development on BLM-administered lands were not included in this chapter. These include measures that address issues that are not likely to be encountered on BLM-administered lands (e.g., development in close juxtaposition to residences and other public spaces) and measures that run counter to existing BLM policies and management decisions (e.g., requirements for fencing around the entire wind energy development site).

each of the 11 states, as discussed in Section 2.2.1 and Appendix B. The MPDS estimates the amount and location of BLM-administered lands that are potentially developable on the basis of wind resources and land status, and the WinDS model estimates the number of acres of land that are likely to be economically developable given various constraints. The WinDS model output, however, does not predict where the economically developable lands are located. As Table 5-1 shows, economically developable lands make up a small percentage of the potentially developable lands. For the purposes of this impact assessment, the MPDS estimates were used to define where wind energy development might occur (i.e., in which ecological regions, on what types of landscapes), and the WinDS model estimates were used to define the amount of BLM-administered lands that would be developed through ROW authorizations (i.e., the project areas). The amount of land impacted by a long-term footprint at a specific site would vary depending upon a number of factors, including site terrain and project design. As discussed in Section 3.1.2.1, on the basis of experience to date, the long-term, final footprint would likely be no more than 5 to 10% of the total acreage of the site. This is a conservative estimate, including lands underlying turbine towers, control buildings, transformer pads, electric substations, roads, and other ancillary structures. Table 5-1 shows the estimated number of acres of BLM-administered lands that could be impacted by a long-term footprint in each state.

TABLE 5-1 Estimated Number of Acres of BLM-Administered Lands Likely To Be Impacted by Wind Energy Development under the Proposed Action (acres)[a]

State	Total Potentially Developable Lands[b]	Total Economically Developable Lands[c]	Total Acreage with Long-Term Footprint[d]
Arizona	210,000	1,500	150
California	1,595,000	72,300	7,230
Colorado	208,000	4,200	420
Idaho	956,000	9,100	910
Montana	5,172,000	1,800	180
Nevada	1,157,000	34,700	3,470
New Mexico	1,542,000	9,800	980
Oregon	1,183,000	9,700	970
Utah	671,000	12,700	1,270
Washington	38,000	600	60
Wyoming	7,902,000	3,700	370
Total	20,634,000	160,100	16,010

[a] To convert to hectares, multiply by 0.4047.

[b] Acreage estimates generated by the MPDS model.

[c] Acreage estimates generated by the WinDS model.

[d] Acreage estimates equal to 10% of the economically developable lands.

5.1 GEOLOGIC RESOURCES

A wind energy development project can impact geologic resources and soils in several different ways, including the use of geologic resources (e.g., sand and gravel), activation of geological hazards, and increased soil erosion.

5.1.1 Site Monitoring and Testing

Generally, the impacts during site monitoring and testing are relatively limited and temporary. Typically, during this phase of development, excavation activities and road construction for access to the project area would be very limited. Some clearing or grading may be needed for installing monitoring towers and monitoring equipment enclosures. Heavy-duty all-wheel-drive pickup trucks would be used to bring monitoring towers to the site; this, however, would not likely require major road construction. As a result, very little, if any, geologic resources would likely be used, and it is unlikely that activities would activate geological hazards or increase soil erosion. Thus, impacts to geologic resources and soils are expected to be negligible to small, unless extensive excavation or road construction occurs. (Section 5.1.2 discusses the resulting impacts if major construction is needed during the site monitoring and testing phase.)

5.1.2 Site Construction

The types of activities during the construction phase that would impact geologic resources and soils include clearing, excavation, blasting, trenching, grading, and heavy vehicle traffic.

5.1.2.1 Use of Geologic Resources

Sand and gravel and/or quarry stone would be needed during the construction phase. These materials would most likely be mined as close to the potential wind energy development site as possible. If existing quarries were not used to provide these resources, excavation from a new source would disturb the land surface, thus creating the potential local soil erosion. The sand and gravel and/or quarry stone would be used for:

- *Access roads.* New access roads may need to be constructed or existing roads may need to be upgraded to accommodate heavy and/or oversized vehicles. Roads would need to be a minimum of 10 ft (3 m) wide but could be as much as 30 ft (9 m) wide. The amount of material that would be needed would depend on the number, length, and size of the access roads.

- *Concrete for buildings, substations, transformer pads, wind tower foundations, and other ancillary structures.* Each tower foundation would nominally extend to depths of 40 ft (12 m) or less, depending on local soil conditions. The diameter of a tower base is generally 15 to 20 ft (5 to 6 m), depending on the turbine model. The vertical reinforced-concrete-ring foundation has a nominal ring thickness of 1 ft (0.3 m).

- *On-site lay-down and crane staging areas.* The geologic material would be used to improve soil-bearing capacity.

5.1.2.2 Potential Geological Hazards

Geological hazards that could affect the construction and operation of a wind energy development site include landslides, rock falls, earthquakes, and volcanic activities. Earthquakes and volcanic activities happen in areas under specific geologic conditions and are determined by the local geology. Site construction activities can destabilize slopes if they are not conducted properly. Slope failures can occur naturally or be enhanced by slope modifications that change the local groundwater regimes and slope angles. In regions that have active earthquakes or volcanoes, heavy precipitation, or where geologic hazards are common, slope stability is sensitive to minor changes of landscape because of human intervention. Also, the water quality downslope of a failed slope can be adversely affected. During the construction phase, the activities that can potentially activate geological hazards include:

- Slope (or grade) increase resulting from site grading or construction of access roads;

- Toe-cutting at the bases of slopes for construction of on-site structures or access roads; and

- Alteration of natural drainage patterns (e.g., alterations of slope or implementation of on-site storm water controls) or increase of precipitation infiltration (e.g., from clearing vegetation, backfilling with permeable materials, roadbed fracturing due to heavy vehicles) that can increase pore pressure, which weakens the strength of soils on slopes or causes accelerated soil erosion, thereby creating slope instability.

5.1.2.3 Soil Erosion

Soil erosion can be aggravated locally through ground surface disturbance. The impact of soil erosion includes soil nutrient loss and degradation of water quality in nearby surface water bodies. The magnitude of the impact depends on the project size, erosion potential of the soil, local terrain, vegetation covers, and the distance from a site to nearby surface water bodies. The activities that could contribute to soil erosion include:

- *Ground surface disturbance on site, at borrow sites, and along access roads.* Ground surface disturbance would occur during the construction or installation of access roads, wind tower pads, staging areas, lay-down areas, substations, transformer pads, underground cables, and other on-site structures. The extraction of geologic materials from borrow areas or quarries would also result in ground surface disturbance.

- *Heavy equipment traffic*. Heavy vehicles can disturb or destroy originally stable soil conditions and enhance soil erosion by both wind and surface runoff.

- *Surface runoff pattern disturbance.* Construction activities (e.g., grading and excavation) and the implementation of on-site storm water controls (e.g., culverts and drainage ditches along roads) could alter surface runoff patterns by diverting natural drainage into new areas and locally increasing runoff volume.

5.1.3 Site Operation

After construction, the geologic and soil conditions may stabilize with time, particularly if appropriate mitigation measures are implemented during the construction phase (Section 5.1.5). The amount of time this would take would depend in part on the mitigation measures used on site during and following construction, as well as local environmental conditions. Once the system reaches equilibrium again, the environmental impact during the operation phase would largely be limited to soil erosion induced by vehicle traffic on unpaved roads.

5.1.4 Site Decommissioning

The impacts on geologic resources and soils during decommissioning would primarily involve potential soil erosion. The stabilized soil system would be disturbed again with the removal of all access roads, on-site roads, substations, buildings, and other structures. The potential impacts would be largely the same as those described for soil erosion during the construction phase.

5.1.5 Mitigation Measures

The potential for impacts to geologic resources and soils would occur primarily during construction and decommissioning. The following mitigation measures could reduce impacts:

- The size of disturbed land should be minimized as much as possible. Existing roads and borrow pits should be used as much as possible.

- Topsoil removed during construction should be salvaged and reapplied during reclamation. Disturbed soils should be reclaimed as quickly as possible or protective covers should be applied.

- Erosion controls that comply with county, state, and federal standards should be applied. Practices such as jute netting, silt fences, and check dams should be applied near disturbed areas.

- On-site surface runoff control features should be designed to minimize the potential for increased localized soil erosion. Drainage ditches should be constructed where necessary but held to a minimum. Potential soil erosion should be controlled at culvert outlets with appropriate structures. Catch basins, drainage ditches, and culverts should be cleaned and maintained regularly.

- Operators should identify unstable slopes and local factors that can induce slope instability (such as groundwater conditions, precipitation, earthquake activities, slope angles, and dip angles of geologic strata). Operators also should avoid creating excessive slopes during excavation and blasting operations. Special construction techniques should be used where applicable in areas of steep slopes, erodible soil, and stream channel/wash crossings.

- Borrow material should be obtained only from authorized and permitted sites.

- Access roads should be located to follow natural contours of the topography and minimize side hill cuts.

- Foundations and trenches should be backfilled with originally excavated materials as much as possible. Excavation material should be disposed of only in approved areas to control soil erosion and to minimize leaching of hazardous constituents. If suitable, excess excavation materials may be stockpiled for use in reclamation activities.

5.2 PALEONTOLOGICAL RESOURCES

Significant paleontological remains could be encountered on BLM-administered lands in the 11 western states. Paleontological resources are generally identified on a project-specific basis. Because fossils only appear in sedimentary rock formations, this is an efficient initial screen as to the potential for the presence of fossils in a project area. Many states maintain a database or repository for information on past paleontological finds either through the SHPO or through a designated repository, such as a university. Additional information regarding the presence of paleontological resources may be provided by amateur fossil hunters. If there is a strong potential for fossil remains to be present in a project area, a survey would be required. The following subsections describe the potential impacts to paleontological resources should they be present in a project area and the relevant mitigation measures.

5.2.1 Site Monitoring and Testing

Impacts to paleontological resources could potentially occur during site monitoring and testing; however, the causes of possible impacts would be limited to minor ground-disturbing activities and the potential for unauthorized collection of fossils. Typically, excavation activities and road construction for access to the project area would be very limited. Some clearing or grading may be needed for installing monitoring towers and equipment enclosures. If more extensive excavation or road construction is needed during this phase, more extensive impacts are possible (see Section 5.2.2 for a discussion of the possible impacts during construction).

Vehicular traffic and ground clearing (such as the removal of vegetation cover) could affect certain more delicate fossils directly or indirectly through an increased potential for erosion if the project area has significant potential to contain such resources. Borings for geotechnical surveys and for the installation of guy wires could impact paleontological resources; however, because these activities would affect small localized areas, the likelihood of an impact (i.e., destroying the resource) is small in most cases. Finally, the collection of fossils by workers or fossil hunters using the access roads to get to areas previously inaccessible to the public would be another possible impact. Although the activities during the monitoring and testing phase are characterized as temporary actions, paleontological resources are nonrenewable and once impacted (i.e., removed or damaged) are not likely to be recovered or recreated in the appropriate context for scientific analysis.

5.2.2 Site Construction

The construction of the infrastructure necessary for wind energy development has the greatest potential to impact paleontological resources because of the increased ground disturbance during this phase. Impacts can occur both locally through construction activities on site and remotely at off-site locations where construction materials are excavated.

The access roads capable of supporting the large trucks necessary to transport the towers would require vegetation removal, grading, potential blasting, and the laying of aggregate materials collected either locally or remotely from an off-site source. Grading and blasting would directly impact fossils if they are present in the area. The construction of wind turbines may also require the widening of existing roads and reinforcement of bridges. However, these activities are unlikely to impact paleontological resources since they occur in previously disturbed areas. The creation of access roads could also modify drainage patterns and possibly result in impacts caused by erosion. Erosion has the potential to alter fossil beds, including the possible separation of a collection of fossils.

Construction of a turbine can disturb as much as 3 acres (1 ha), with tower foundations extending 35 to 40 ft (11 to 12 m) below the surface. Construction of the foundation may require blasting, and the immediate area around the tower would be compacted by the heavy vehicles. In addition to towers, the construction of support buildings, storage buildings, and pads for transformers would also require leveling and grading. The towers would also likely have lightning protection that could require drilling down to the closest aquifer; however, given the small size of this excavation, it is unlikely that this construction would impact fossils.

In addition to access roads and the actual footprint for the turbines, the construction of lay-down areas, staging areas for cranes, turnaround areas, and if concrete is used, a batching plant may be necessary and lines may be buried. All of these activities would require ground leveling and soil removal.

One of the greatest threats to paleontological resources is people removing fossils rather than reporting them. Development of a wind energy project would bring numerous workers into the area, which would require the creation of new roads; such roads would give the public access to areas that were previously inaccessible. These factors pose a great risk to the resource, which could be minimized by training and educating the workforce and the public, as well as by monitoring of the area by a paleontologist (Section 5.2.5).

5.2.3 Site Operation

Very few impacts to paleontological resources would be expected during operation. The incidence of unauthorized fossil collection (i.e., looting) would increase with increasing numbers of personnel present at the site. Most activities associated with operation of a wind energy development project would not result in earthmoving activities or increases in erosion. The access to the public provided by the new roads installed during the construction phase would present the greatest threat to the resource.

5.2.4 Site Decommissioning

Decommissioning of a wind energy development project has a limited potential for affecting paleontological resources because these resources are nonrenewable and would either have been removed professionally prior to construction (if mitigation measures are followed as described in Section 5.2.5), or would have been already disturbed or destroyed by prior activities. Foundation removal represents a slight opportunity for additional disturbance; this work, however, would likely stay within the area disturbed during construction; alternatively, foundations could be left in place. The vegetation would be allowed to reestablish on access roads and cleared areas; although it is possible that improved access to the area would remain after the removal of the development. This could allow for increased removal of fossils by amateurs since the area would no longer be periodically monitored.

5.2.5 Mitigation Measures

To mitigate or minimize potential paleontological resource impacts, the following mitigation measures could be adopted:

- Operators should determine whether paleontological resources exist in a project area on the basis of the sedimentary context of the area, a records search for past paleontological finds in the area, and/or a paleontological survey.

- A paleontological resources management plan should be developed for areas where there is a high potential for paleontological material to be present. Management options may include avoidance, removal of the fossils, or monitoring. If the fossils are to be removed, a mitigation plan should be drafted identifying the strategy for collection of the fossils in the project area. Often it is unrealistic to remove all of the fossils, in which case a sampling strategy can be developed. If an area exhibits a high potential but no fossils were observed during surveying, monitoring could be required. A qualified paleontologist should monitor all excavation and earthmoving in the sensitive area. Whether the strategy chosen is excavation or monitoring, a report detailing the results of the efforts should be produced.

- If an area has a strong potential for containing fossil remains and those remains are exposed on the surface for potential collection, steps should be taken to educate workers and the public on the consequences of unauthorized collection on public lands.

5.3 WATER RESOURCES

A wind energy project can impact surface water and groundwater in several different ways, including the use of water resources, changes in water quality, alteration of the natural flow system, and the alteration of interactions between the groundwater and surface water. For the most part, however, wind energy development does not require much water, except during the construction phase and, to a lesser extent, during decommissioning. These water uses are temporary, and during the operations phase, water use would be minimal. This section describes the types of impacts that might occur during each phase of development.

5.3.1 Site Monitoring and Testing

Generally, the impacts during site monitoring and testing would be relatively limited because new access roads might not be needed, on-site activities would be limited and temporary, and the size of the work crew would be small. As a result, very little, if any, water would likely be used during this phase of development. If water was needed, it would probably be trucked in from off site. Impacts to water resources, local water quality, water flows, and surface water/groundwater interactions are expected to be negligible to small, unless extensive excavation or road construction occurs.

5.3.2 Site Construction

Most of the impacts on water resources would occur during construction.

5.3.2.1 Use of Water Resources

A number of construction activities would use water. Because the construction phase may last more than 1 year, potentially large amounts of water would be needed. The water may be trucked in from off site or obtained from local groundwater wells or surface water bodies near the facility, depending upon the availability of those sources. Activities related to use of water resources would include:

- Water used for dust control during the construction of access roads, clearing of vegetation, grading, and road traffic;
- Water used for making concrete used in the foundations of wind towers, substations, central control buildings, and various personnel support facilities; and
- Water used by the construction crew.

5.3.2.2 Water Quality

Many construction activities associated with a wind energy development project could alter the quality of surface water and, to a lesser extent, groundwater. These include:

- Activities that aggravate soil erosion, such as activities that disturb the ground surface, heavy equipment traffic, activities that alter surface runoff patterns, and extraction of geologic materials from borrow areas or quarries (Section 5.1.2.3);
- Weathering of freshly exposed soil or spoils from foundation excavation, quarry or borrow pit operations, or access road construction, which would release various chemicals through oxidation and leaching processes;
- Discharges of wastewater or sanitary water; and
- Pesticide application, unless use is limited to nonpersistent, immobile pesticides and applied only in accordance with label and application permit directions and stipulations.

5.3.2.3 Alteration of Water Flow Systems

Natural surface water and groundwater flow systems could be potentially impacted by construction activities. Surface water flows may be diverted on site and off site by access road systems or storm water control systems. Excavation activities or geologic material extraction may alter surface overflow and groundwater flow. The withdrawal of surface water and groundwater for water uses and the discharge of wastewater and storm water would also affect the water flows of the surface water bodies and groundwater.

5.3.2.4 Alteration of Surface Water/Groundwater Interaction

Construction activities could alter the interaction between surface water bodies and local groundwater in systems where the two resources are hydrologically connected. In these circumstances, extracting water from one source eventually could affect the other source as well. Similarly, altering the water quality of one source could affect the water quality of other sources at downgradient locations. Impacts also could occur if construction activities (e.g., excavation, blasting, trenching) create a conduit between a surface water body and a groundwater aquifer, or between two aquifers, by breaching the hydrologic barrier. This could result in unwanted dewatering or recharge of any of these water resources, depending on local hydrogeologic conditions. In addition, storm water control systems and any other activity that alters the ground surface could affect groundwater infiltration as well as the response time of a nearby surface water body.

5.3.3 Site Operation

As various construction and related activities diminish, the environment will reestablish a new equilibrium. If appropriate mitigation measures are implemented during the construction phase (Section 5.3.5), potential impacts to water during site operation would be limited to the degradation of water quality as a result of improper pesticide use or vehicle traffic.

5.3.4 Site Decommissioning

The impacts on water resources during decommissioning would depend on the decommissioning activities involved. Such activities may involve removal of all access roads, on-site roads, transformer pads, and building foundations. Originally disturbed land areas would likely be restored to their original grade and revegetated. Water wells may be abandoned in place. The potential impacts would largely be the same as those described for the construction phase.

5.3.5 Mitigation Measures

Potential water resource impacts would mostly occur during the site construction and decommissioning phases. Mitigations measures that could reduce such impacts include:

- The size of cleared and disturbed lands should be minimized as much as possible. Existing roads and borrow pits should be used as much as possible.

- Topsoil removed during construction should be salvaged and reapplied during reclamation. Disturbed soils should be reclaimed as quickly as possible or protective covers should be applied.

- Operators should identify unstable slopes and local factors that can induce slope instability (such as groundwater conditions, precipitation, earthquake activities, slope angles, and dip angles of geologic strata). Operators also should avoid creating excessive slopes during excavation and blasting operations. Special construction techniques should be used where applicable in areas of steep slopes, erodible soil, and stream channel/wash crossings.

- Erosion controls that comply with county, state, and federal standards should be applied. Practices such as jute netting, silt fences, and check dams should be applied near disturbed areas.

- Operators should gain a clear understanding of the local hydrogeology. Areas of groundwater discharge and recharge and their potential relationships with surface water bodies should be identified.

- Operators should avoid creating hydrologic conduits between two aquifers during foundation excavation and other activities.

- Proposed construction near aquifer recharge areas should be closely monitored to reduce the potential for contamination of said aquifer. This may require a study to determine localized aquifer recharge areas.

- Foundations and trenches should be backfilled with originally excavated material as much as possible. Excess excavated material should be disposed of only in approved areas.

- Existing drainage systems should not be altered, especially in sensitive areas such as erodible soils or steep slopes. When constructing stream or wash crossings, culverts or water conveyances for temporary and permanent roads should be designed to comply with county standards, or if there are no county standards, to accommodate the runoff of a 10-year storm. Potential soil erosion should be controlled at culvert outlets with appropriate structures. Catch basins, roadway ditches, and culverts should be cleaned and maintained regularly.

- On-site surface runoff control features should be designed to minimize the potential for increased localized soil erosion. Drainage ditches should be constructed where necessary but held to a minimum. Potential soil erosion should be controlled at culvert outlets with appropriate structures. Catch basins, drainage ditches, and culverts should be cleaned and maintained regularly.

- Pesticide use should be limited to nonpersistent, immobile pesticides and should only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.

5.4 AIR QUALITY

The activities involved in developing and constructing a wind energy development project would vary greatly among sites. Potential impacts would need to be assessed for each site on the basis of that site's air quality and the anticipated extent and duration of the site monitoring and testing, construction, operation, and decommissioning activities. Activities at all sites would need to be carried out in conformance with the applicable SIPs. The following discussion identifies the activities associated with each phase of development and identifies the associated pollutants. On the basis of the limited extent and duration of activities, minimal air quality impacts are expected during monitoring and testing and operation. Nonetheless, each site must be assessed based on its unique characteristics. Construction and decommissioning activities would have the greatest air quality impact and should be subjected to the most thorough analysis for a specific site.

Certain activities are common to most or all of the phases of wind energy development. Table 5.4-1 lists these common activities and identifies the pollutants they produce and the site-specific factors upon which they depend. There may be other factors involved; the table identifies those most commonly used to estimate emissions. The text box on this page discusses emissions associated with vehicles.

Vehicle Emissions

Vehicles include both light-duty vehicles, such as cars, vans, and pickups; heavy-duty vehicles, such as trucks; and construction equipment. Vehicles can be powered by either gasoline or diesel engines. There are two sources of emissions associated with vehicles: tailpipe emissions and emissions from dust that becomes airborne as the vehicle passes, so-called fugitive dust, or road dust. Tailpipe emissions include CO, NO_x, PM_{10}, SO_2, VOCs, and air toxics. SO_2 emissions are higher from diesel-powered vehicles. The reentrained dust is primarily PM_{10}. On dirt roads, the reentrained dust exceeds the particulates from the tailpipe.

5.4.1 Site Monitoring and Testing

As noted in Section 3.1.2, the site monitoring and testing phase could last up to 3 years. The operations involved in setting up the towers and gathering the data would include:

- Limited worker and equipment vehicle traffic on access and site roads to carry in the towers,

TABLE 5.4-1 Pollutants and Factors Influencing Emissions from Common Activities Associated with a Wind Energy Development Project

Activity	Pollutants	Factors
Vehicular traffic	CO, NO_x, VOCs, particulates, SO_2, air toxics	Vehicle-miles traveled (VMT)[a]
Vehicle fugitive dust from paved and unpaved roads	Particulates	VMT, road conditions (e.g., silt loading, silt content, moisture content, and vehicle weight)
Construction fugitive dust from earthmoving activities	Particulate	Acres disturbed
Construction equipment exhaust	CO, NO_x, VOCs, particulates, SO_2, air toxics	Volume of fuel used
Concrete batch plant[b]	Particulates	Volume of concrete produced
Emergency generators[b]	CO, NO_x, VOCs, particulates, SO_2, air toxics	Volume of fuel used or hours of operation

[a] VMT on a road is the product of the number of vehicles traveling the road and the miles traveled by each vehicle.

[b] May not be present at all sites.

- Worker vehicle traffic for performance of routine maintenance,
- Possible limited brush clearing at tower sites, and
- Erection of meteorological towers.

These operations would generate fugitive dust from road travel and brush clearing and tailpipe emissions from vehicular exhaust. However, these activities would all be limited in extent and duration, and, except in unusual circumstances where access road construction or disturbance of large areas is required, should have no appreciable impact on air quality.

5.4.2 Site Construction

Before beginning a construction project, a construction permit from the state or local air agency is generally required. Most jurisdictions do not require modeling of the air quality impacts since the major air impacts of construction projects are local and temporary. Instead, agencies condition the permit to require that certain mitigation practices be conducted, such as watering areas to be disturbed, to control emissions of fugitive dust. It is important to consult with the cognizant agency prior to beginning construction or any on-site activities, including monitoring and testing and decommissioning activities. Agencies may also have special regulations for the type of temporary, portable concrete batch plants that might be used during construction of a wind energy development project.

Section 3.1.2 describes four stages of construction: site access, clearing, and grade alterations; foundation excavations and installations; tower erection and nacelle and rotor installation; and miscellaneous ancillary construction. Each of these is discussed below.

5.4.2.1 Site Access, Clearing, and Grade Alterations

These actions upgrade access to the site and prepare it for actual construction. Activities required for both road construction and site preparation include:

- Worker and equipment vehicle traffic on access roads;
- Removal of vegetative cover;
- Road construction involving excavation, moving soils, and grading;
- Construction of lay-down areas, staging areas, and pads; and
- Possibly blasting.

Emissions generated during these operations would include tailpipe emissions from worker vehicles, material delivery trucks, and water trucks, and the emissions from diesel equipment, such as bulldozers, scrapers, dump trucks, loaders, and rollers. Fugitive dust from disturbed soils would be a major source of particulate emissions. Blasting, if required, would produce small amounts of CO, NO_X, and particulates.

5.4.2.2 Foundation Excavations and Installations

The activities associated with these actions would vary, depending on conditions at the site and may include:

- Worker traffic on access roads;
- Delivery vehicle traffic;
- Grading;
- Operation of construction equipment, such as loaders and trucks;
- Removal of vegetative cover;
- Possible boring, pile driving, or blasting of rock;

- Excavation of soils;
- Possible installation and operation of one or more concrete batch plants and preparation of the storage areas for the sand and aggregate needed as raw materials;
- Possible operation of on-site diesel generators for the batch plants;
- Pouring of concrete for tower foundations, pads, and on-site buildings:
  - Delivery of concrete in mixer trucks over access and site roads, or
  - Operation of the on-site batch plant and on-site delivery of concrete;
  - Operation of ancillary equipment, such as small mixers, vibrators, and concrete pumps; and
- Backfilling of tower bases.

Construction equipment operations would generate fugitive dust from vehicle travel and the movement and transportation of soil (grading, excavation, backfilling, and dumping). In addition, diesel engines would be the primary source of tailpipe emissions. Additional tailpipe emissions would be generated by worker and delivery vehicles and the operation of ancillary construction equipment. Use of on-site power from diesel generators for the batch plant and smaller generators for equipment, such as concrete vibrators and pumps, would also result in emissions of the same pollutants as vehicle tailpipes.

Concrete batching would produce fugitive particulates associated both with truck travel and mixing of concrete. Storage piles associated with the concrete batching would also be sources of fugitive dust.

Blasting, if required, would produce small amounts of CO, NO_X, and particulates. Drilling and pile driving would produce fugitive dust as well as tailpipe emissions from the associated power units.

5.4.2.3 Wind Turbine Erection

Unless a self-erecting tower is used, a large lifting crane would be needed to erect a turbine. Activities associated with the erection of the wind turbine towers and installation of the nacelles and rotors would include:

- Worker traffic on access and site roads;
- Traffic associated with transportation of the dismantled crane to and from the site;

- Delivery vehicle traffic associated with delivery of tower sections and turbine parts;

- Transportation and assembly of a large lifting crane and movement of the crane between tower sites, unless self-erecting towers are used; and

- Use of a crane to lift the tower sections, nacelles, and rotors into place.

Emissions from these operations would be fugitive and tailpipe emissions from worker vehicles, delivery vehicles, and movement and operation of the crane. Emissions similar to tailpipe emissions would also result from the diesel power unit used in a self-erecting tower.

5.4.2.4 Miscellaneous Ancillary Construction

Miscellaneous ancillary construction activities would include:

- Worker traffic on access roads;

- Delivery vehicle traffic;

- Construction of on-site control and storage buildings;

- Construction of electrical substations; and

- Installation of electrical interconnections among turbines, control buildings, and substations.

Emissions would include particulates and tailpipe emissions resulting from worker vehicles and delivery vehicles. Construction would produce fugitive particulates from earthmoving, backfilling, and grading as well as the tailpipe emissions from construction equipment. Trenching for buried electrical lines or erection of utility poles would produce fugitive particulate emissions.

5.4.3 Site Operation

The operation of a wind energy development project would not adversely impact air quality. Operational activities would include operation of the wind turbines and associated maintenance activities. Maintenance activities during operation would not include construction and would be limited to routine maintenance and major overhauls and repairs (Section 3.1.2). Major overhauls and repairs could involve bringing a crane and heavy truck on site to remove and transport the component needing attention. The operations involved would include:

- Operation of the wind turbines themselves,

- Scheduled changes of lubricating and cooling fluids and greases,

- Limited routine worker access traffic associated with maintenance,

- Infrequent heavy overhaul/repair traffic, and

- Possibly routine brush clearing.

Operating wind turbines do not produce direct emissions. There could be some minor VOC emissions during routine changes of lubricating and cooling fluids and greases. The other operations would generate fugitive dust from road travel, vehicular exhaust, and brush clearing in addition to the tailpipe emissions associated with vehicle travel. However, all these activities would be limited in extent and duration and should have no appreciable air quality impact.

5.4.4 Site Decommissioning

As noted in Section 3.1.2, decommissioning is the reverse of the construction process and involves many of the same operations. Turbines and towers would need to be removed. Disturbed land would need to be restored, but belowground structures would probably not be removed. Operations could include:

- Worker and equipment vehicular traffic on access and site roads;

- Use of a heavy crane and hauling trucks to dismantle and remove turbine and tower components;

- Removal of concrete pads and ancillary structures, such as electrical interconnections among turbines, control buildings, and substations; and

- Use of equipment to restore (grading, reseeding, and replanting) disturbed areas.

These operations would produce particulates from road dust, earthmoving, and vehicle tailpipes. In addition, there would be the other tailpipe emissions associated with operation of cranes, trucks, and earthmoving equipment. These emissions would be of limited duration and extent. Depending on the amount of land disturbed, an analysis of the particulate impacts may be needed.

5.4.5 Mitigation Measures

As discussed above, the potential for adverse air quality impacts during the site monitoring and testing and operation phases would be limited. The greatest potential impacts would occur during the construction and decommissioning phases. Generation of fugitive particulates from vehicle traffic and earthmoving activities would need to be controlled both through the permitting process and the application of mitigation measures. Typical measures

(ABC Wind Company, LLC undated; PBS&J 2002) that can be implemented to control particulates and other pollutants include these:

- *Mitigation measures for areas subject to vehicular travel*
  - Access roads and on-site roads should be surfaced with aggregate materials, wherever appropriate.
  - Dust abatement techniques should be used on unpaved, unvegetated surfaces to minimize airborne dust.
  - Speed limits should be posted (e.g., 25 mph [40 km/h]) and enforced to reduce airborne fugitive dust.
- *Mitigation measures for soil and material storage and handling*
  - Workers should be trained to handle construction material to reduce fugitive emissions.
  - Construction materials and stockpiled soils should be covered if they are a source of fugitive dust.
  - Storage piles at concrete batch plants should be covered if they are a source of fugitive dust.
- *Mitigation measures for clearing and disturbing land*
  - Disturbed areas should be minimized.
  - Dust abatement techniques should be used as earthmoving activities proceed and prior to clearing.
- *Mitigation measures for earthmoving*
  - Dust abatement techniques should be used before excavating, backfilling, compacting, or grading.
  - Disturbed areas should be revegetated as soon as possible after disturbance.
- *Mitigation measures for soil loading and transport*
  - Soil should be moist while being loaded into dump trucks.
  - Soil loads should be kept below the freeboard of the truck.

- Drop heights should be minimized when loaders dump soil into trucks.
- Gate seals should be tight on dump trucks.
- Dump trucks should be covered before traveling on public roads.

- *Mitigation measure for blasting*
  - Dust abatement techniques should be used during blasting.

5.5 NOISE IMPACTS

This section describes the potential noise impacts from site monitoring and testing, construction, operation, maintenance, and decommissioning activities associated with wind energy development. Mitigation measures are also presented.

5.5.1 Site Monitoring and Testing

Most activities associated with site monitoring and testing would generate relatively low levels of noise. Potential short-term sources of noise at the beginning or end of this phase could include the use of a grader or bulldozer [about 85 dB(A)] if an access road was needed and there was traffic caused by heavy-duty or medium-duty trucks used to transport the towers to and from the site. A light-duty pickup truck would be used periodically for meteorological data collection and instrument maintenance during the course of the monitoring and testing phase. All these activities would occur during daytime hours when noise is tolerated more than at night, because of the masking effect of background noise. Accordingly, potential impacts of site monitoring and testing activities on ambient noise would be expected to be temporary and intermittent in nature.

5.5.2 Site Construction

The construction phase would include a wide array of activities, including access road construction, grading, drilling and blasting (for tower foundations), construction of ancillary structures, cleanup, and revegetation (see Section 3.1.2 for more details). The noise levels generated by construction equipment would vary significantly, depending on such factors as type, model, size, and condition of the equipment; operation schedule; and condition of the area being worked. In addition to daily variations in activities, major construction projects are accomplished in several different stages. Each stage has a specific equipment mix, depending on the work to be accomplished. Most construction activities would occur during the day, when noise is tolerated better because of the masking effect of background noise. Nighttime noise levels probably would drop to the background levels of the project area. In general, construction activities would last for a short period (1 or 2 years at most) compared with operation of the wind turbines, and, accordingly, their potential impacts would be temporary and intermittent in nature.

5.5.2.1 Heavy Equipment

Average noise levels for typical construction equipment range from 74 dB(A) for a roller, to 85 dB(A) for a bulldozer, to 101 dB(A) at a pile driver (impact) (HMMH 1995). In general, the dominant noise source from most construction equipment is the diesel engine, which is continuously operating around a fixed location or with limited movement. This is particularly true if the diesel engine is poorly muffled. In a few cases, noise generated by pile driving or pavement breaking would dominate. Other sources of continuous noise would include field compressors, bulldozers, and backhoes.

Noise levels for typical construction equipment that would likely be used at a wind turbine project site are about in the 80 to 90 dB(A) range at a distance of 50 ft (15 m), as shown in Table 5.5.2-1. For a general assessment of construction impacts, it can be assumed that only two of the noisiest pieces of equipment would operate simultaneously. Assuming geometric spreading only (i.e., a decrease of about 6 dB per doubling of distance from a point source) and an 8-hour work day, on the basis of the noise levels presented in Table 5.5.2-1, it is estimated that with the two noisiest pieces of equipment operating simultaneously at peak load, noise levels would exceed the EPA guideline for residential L_{dn} noise [55 dB(A)] for a distance of about 1,640 ft (500 m) (EPA 1974). This distance would decrease if reasonable factors for noise attenuation (e.g., air absorption and ground effects due to terrain and vegetation) and operating loads were considered.

TABLE 5.5.2-1 Noise Levels at Various Distances from Typical Construction Equipment

	Noise Level $L_{eq(1\text{-}h)}$[a] at Distances [dB(A)]					
Construction Equipment	50 ft[b]	250 ft	500 ft	1,000 ft	2,500 ft	5,000 ft
Bulldozer	85	71	65	59	51	45
Concrete mixer	85	71	65	59	51	45
Concrete pump	82	68	62	56	48	42
Crane, derrick	88	74	68	62	54	48
Crane, mobile	83	69	63	57	49	43
Front-end loader	85	71	65	59	51	45
Generator	81	67	61	55	47	41
Grader	85	71	65	59	51	45
Shovel	82	72	62	56	48	42
Truck	88	74	68	62	54	48

[a] $L_{eq(1\text{-}h)}$ is the equivalent steady-state sound level that contains the same varying sound level during a 1-hour period.

[b] To convert feet to meters, multiply by 0.3048.

Source: HMMH (1995).

5.5.2.2 On-Road Vehicular Traffic

On-road vehicular traffic includes hauling of materials in and out of the construction site, movement of heavy equipment, and commuter and visitor traffic. The associated noise levels would increase and decrease rapidly. The number of truck trips associated with construction would vary, depending on the construction stage but, overall, the total traffic volume along local roads could be increased throughout the construction phase. Potential noise impacts would be greatest at the highest number of peak-hour trips and total heavy-duty truck trips. Commuter and visitor vehicular traffic, which would consist of mostly light-duty vehicles with lower-level noise sources (roughly 10 passenger cars equal 1 heavy truck on an L_{eq} basis), would be primarily limited to morning and afternoon rush hours. Other vehicular traffic, such as transport of heavy equipment, delivery of general construction materials, and a water truck for fugitive dust control, is anticipated; the noise contribution from these sources, however, would likely be short-lived.

To determine potential noise impacts from on-road vehicles associated with construction of a wind energy development project, noise levels at various distances from the road by hourly vehicle traffic were estimated. The peak pass-by noise level of a heavy truck operating at 50 mph (80 km/h) was estimated to be about 83 dB(A) (Menge et al. 1998), assuming an 8-hour daytime activity. Table 5.5.2-2 gives the noise levels at various distances and by hourly vehicle traffic. Except at receptor locations in close proximity to the road and/or heavy traffic volume, noise levels are below the EPA guideline of 55 dB(A) as L_{dn} for residential zones (EPA 1974).

5.5.2.3 Blasting

Depending on local geological conditions, explosive blasting for wind turbine foundations might be needed. Blasting would create a compressional wave in the air (air blast overpressure), the audible portion of which would be manifested as noise. In general, blasting activities between the hours of 7 a.m. and 10 p.m. are specifically exempt from noise regulation in some states (e.g., Washington). Depending on site conditions, it is anticipated that most wind turbine foundations would require one to two blasts. Potential impacts to the closest residential structure could be determined; however, residential structures probably would be located a considerable distance away from the site given the remote nature of most potential wind development locations on BLM-administered lands.

5.5.3 Site Operation

During operation, major noise sources would be mechanical and aerodynamic noise; transformer and switchgear noise from substations; corona noise from transmission lines; vehicular traffic noise, including commuter and visitor and material delivery; and noise from the operation and maintenance (O&M) facility. These noise sources are described below. Noise from infrequent diesel generator operations (e.g., 2 hours per month for mandatory testing) at the O&M facility and from traffic, ranging from light- to medium-duty vehicles, is expected to be negligible. Overall, the noise levels of continuous site operation would be lower than the noise levels associated with short-term construction activities.

TABLE 5.5.2-2 Noise Levels at Various Distances from Heavy Trucks[a]

	Noise Level $L_{eq(1-h)}$[b] at Distances [dB(A)]					
Hourly Vehicle Traffic	50 ft[c]	250 ft	500 ft	1,000 ft	2,500 ft	5,000 ft
1	50.7	43.8	40.7	37.7	33.8	30.7
10	60.7	53.8	50.7	47.7	43.8	40.7
50	67.7	60.7	57.7	54.7	50.7	47.7
100	70.7	63.8	60.7	57.7	53.8	50.7
	Noise Level L_{dn}[d] at Distances [dB(A)]					
Hourly Vehicle Traffic	50 ft	250 ft	500 ft	1,000 ft	2,500 ft	5,000 ft
1	46.0	39.0	36.0	33.0	29.0	26.0
10	56.0	49.0	46.0	43.0	39.0	36.0
50	63.0	56.0	53.0	50.0	46.0	43.0
100	66.0	59.0	56.0	53.0	49.0	46.0

[a] The EPA recommends an L_{dn} of 55 dB(A) for residential areas (EPA 1974).

[b] $L_{eq(1-h)}$ was estimated on the basis of an A-weighted peak pass-by noise level generated by a heavy truck operating at 50 mph (80 km/h) and traffic flow and distance adjustments.

[c] To convert feet to meters, multiply by 0.3048.

[d] L_{dn} was estimated by assuming an 8-hour daytime shift.

Source: Menge et al. (1998).

5.5.3.1 Wind Turbine Noise

Wind turbines produce two categories of noise: mechanical and aerodynamic. These categories are associated with four types of noise (tonal, broadband, impulsive, and low-frequency) (NWCC 1998). Recent improvements in the mechanical design of large wind turbines have resulted in significantly reduced mechanical noise. As a result, aerodynamic noise is the dominant source from modern wind turbines (Fégeant 1999). A brief discussion of each of these noise characteristics follows; a more detailed review is included in Wagner et al. (1996).

Mechanical noise, associated with the rotation of mechanical and electrical components, tends to be tonal, although a broadband component exists. It is primarily generated by the gearbox and other parts, such as generators, yaw drives, and cooling fans. However, the hub, rotor, and turbine may act as loudspeakers and transmit the mechanical noise over greater distances. Recent technological improvements have reduced mechanical noise. It can be further reduced through sound-proofing and noise insulation materials. Accordingly, mechanical noise must, to some extent, be viewed as an indication of poor design.

Aerodynamic noise from wind turbines originates mainly from the flow of air over and past the blades; therefore, the noise generally increases with tip speed. It is directly linked to the production of power and therefore inevitable, even though it could be reduced to some extent by altering the design of the blades (Wagner et al. 1996). The aerodynamic noise has a broadband character, often described as a “swishing” or “whooshing” sound, and is typically the dominant part of wind turbine noise today. The noise caused by this process is unavoidable. Inflow turbulent noise caused by the interaction of blades with atmospheric turbulence is a major contributor to broadband noise, but it has not yet been fully quantified (Wagner et al. 1996).

Although aerodynamic noise mostly has a broadband character, airfoil-related noise can also create a tonal component and there can be both impulsive and low-frequency components. Impulsive noise and low-frequency noise are primarily associated with older-model downwind turbines, the blades of which are on the downwind side of the tower; these types of noise are caused by the interaction of the blades with disturbed air flow around the tower. Impulsive noise is characterized by short acoustic impulses or thumping sounds that vary in amplitude (level) as a function of time. Low-frequency noise is a more steady sound in the range of 20 to 100 Hz. These types of noise can be avoided, however, with good engineering design.

There are many wind turbine designs. In general, upwind turbines are less noisy than downwind turbines and their lower rotational speed and pitch control results in lower noise generation. A variable speed wind turbine generates relatively lower noise emissions than a fixed speed turbine. A large variable speed wind turbine operates at slower speeds in low winds, resulting in much quieter operation in low winds than a comparable fixed speed wind turbine. As wind speed increases, the wind itself masks the increasing turbine noise.

To determine the potential noise impacts at nearby residences from wind turbine operations, sound level data would be needed. These data can be provided by the wind turbine manufacturer or vendor, obtained from field measurements, or from a literature survey. The sound power level from a single wind turbine is approximately 100 to 104 dB(A) for the rated power ranging from 1 to 1.4 MW (Rogers and Manwell 2002). Considering geometric spreading only, this results in a sound pressure level of 58 to 62 dB(A) at a distance of 50 m (164 ft) from the turbine, which is about the same level as conversational speech at a 1-m (3-ft) distance. At a receptor approximately 2,000 ft (600 m) away, the equivalent sound pressure level would be 36 to 40 dB(A) when the wind is blowing from the turbine toward the receptor. This level is typical of background levels of a rural environment (Section 4.5.2). To estimate combined noise levels from multiple turnbines, the sound pressure level from each turbine should be estimated and summed. Different arrangements of multiple wind turbines (e.g., in a line along a ridge versus in clusters) would result in different noise levels; however, the resultant noise levels would not vary by more than 10 dB.

On a clear night, temperature usually increases with height due to radiant cooling of the surface. Under this condition (called a temperature inversion), sound refracts or bends downward, which is a favorable condition for propagation (i.e., sound will travel farther). However, this condition would occur only at low wind speeds, approximately less than 9 ft/s (3 m/s), because stronger winds interfere with this effect. Modern-day wind turbines have a cut-in speed of about 8.2 to 13 ft/s (2.5 to 4 m/s) (see Appendix C, Table C-2); thus, increased noise propagation associated with temperature inversion would be minimal in most operations. The exception would be in sheltered valleys with relatively low ambient noise levels. In general, the effects of wind speed on noise propagation would generally dominate over those of temperature gradient.

Whether the turbine noise is intrusive or not depends not only on its distribution of amplitude and frequency but also on the background noise, which varies with the level of human and animal activities and meteorological conditions (primarily wind speed). In general, wind-generated background noise (i.e., noise caused by the interaction between wind and vegetation or structures) tends to increase more rapidly with wind speed than aerodynamic noise from wind turbines. Wind-generated noise would increase by about 2.5 dB(A) per each 3-ft/s (1-m/s) wind speed increase (Hau 2000); the noise level of a wind turbine, however, would increase only by about 1 dB(A) per 3-ft/s (1-m/s) increase. In general, if the background noise level exceeds the calculated noise level of a wind turbine by about 6 dB(A), the latter no longer contributes to a perceptible increase of noise. At a wind speed of about 33 ft/s (10 m/s), wind-generated noise is higher than aerodynamic noise. In addition, it is difficult to measure sound from modern wind turbines above a wind speed of 26 ft/s (8 m/s) because the background wind-generated noise masks the wind turbine noise at that speed (DWIA 2003). As a result, noise issues are more commonly a concern at lower wind speeds (Fégeant 1999).

5.5.3.2 Substation Noise

There are basically two sources of noise associated with substations: transformer noise and switchgear noise. Each has a characteristic noise spectrum and pattern of occurrence. A transformer produces a constant low-frequency humming noise primarily because of the vibration of its core. The core’s tonal noise should be uniform in all directions and continuous. The average A-weighted core sound level at a distance of 492 ft (150 m) from a transformer would be about 43 and 46 dB(A) for 100 and 200 million volt-amperes (MVA) (corresponding to about 80 and 160 MW), respectively (Wood 1992). These noise levels at a distance of 1,640 ft (500 m) would be 33 and 36 dB(A), which are typical of background levels in a rural environment (Section 4.5.2). Current transformer design trends have shown decreases in noise levels. The cooling fans and oil pumps at large transformers produce broadband noise only when additional cooling is required; in general, this noise is less noticeable than the tonal noise.

Switchgear noise is generated by the operation of circuit breakers used to break high-voltage connections at 132 kV and above. An arc formed between the separating contacts has to be "blown out" using a blast of high-pressure gas. The resultant noise is impulsive in character (i.e., loud and of very short duration). The industry is moving toward the use of more modern circuit breakers that use a dielectric gas to extinguish the arc and generate significantly less noise. Frequency of switchgear activities, such as regular testing, maintenance, and rerouting, is an operational issue unique to a specific utility company. During an electrical fault due to line overloads, the switch would open to isolate the fault and thereby protect the equipment. However, these operations would occur infrequently, and, accordingly, potential impacts of switchgear noise would be temporary and minor in nature.

5.5.3.3 Transmission Line Noise

Potential transmission line noise can result from corona discharge, which is the electrical breakdown of air into charged particles. Corona noise is composed of broadband noise, characterized as a crackling or hissing noise, and pure tones, characterized as a humming noise of about 120 Hz. Corona noise is primarily affected by weather and, to a lesser degree, by altitude and temperature. It is created during all types of weather when air ionizes near isolated irregularities (e.g., nicks, scrapes, and insects) on the conductor surface of operating transmission lines. Modern transmission lines are designed, constructed, and maintained so that during dry conditions the line will generate a minimum of corona-related noise. During dry weather conditions, noise from transmission lines is generally indistinguishable from background noise at locations beyond the edge of the transmission line ROW (50 ft [15 m] from the center of the tower) (BPA 1996). In wet conditions, however, water drops collecting on the lines provide favorable conditions for corona discharges. Occasional corona humming noise at 120 Hz and higher is easily identified and, therefore, may become the target of complaints from neighboring residents. During rainfall events, the noise level at the edge of the ROW of 230-kV transmission line towers would be less than 39 dB(A) (BPA 1996), which is typical of the noise level at a library. The noise level at a distance of 300 ft (91 m) would be about 31 dB(A), which is lost in the background noise typical of a rural environment at night (Section 4.5.2).

A preliminary study by Pearsons et al. (1979) indicated that because of its high-frequency components, corona noise may be judged to be as annoying as other environmental noises even when it is actually 10 dB(A) lower than those other noises However, corona noise tends to decrease faster with distance than other environmental noise because of its higher frequency components. In general, because of the arid climate in the study region and the remote location of most potential wind development sites on BLM-administered land, the impact of corona noise during the operations phase is not expected to be significant. Sites located at higher elevations or in more humid areas would generate some corona noise. Although corona noise could be an issue where transmission lines cross more populated areas, it would not likely cause a problem unless the residence is located next to the transmission line, say within 500 ft (152 m).

5.5.3.4 Noise Related to Maintenance Activities

Regular maintenance activities would include periodic site visits to wind turbines, communication cables, transmission lines, substations, and auxiliary structures. These activities would involve light- or medium-duty vehicle traffic with relatively low noise levels. Infrequent but noisy activities would be anticipated, such as road maintenance work with heavy equipment, or repair or replacement of old or inoperative wind turbines or auxiliary equipment. However, the anticipated level of noise impacts from maintenance activities would be far lower than that from construction activities.

5.5.4 Site Decommissioning

In general, noise impacts from decommissioning activities would be similar to but less than those associated with construction activities because the activity type and level would be similar but shorter in duration. As in the construction period, most of the decommissioning activities would occur during the day, when noise is tolerated better than at night because of the masking effect of background noise. Nighttime noise levels would drop to the background levels of a rural environment because decommissioning activities would cease at night. Like construction activities, decommissioning activities would last for a short period compared with wind turbine operation, and, accordingly, the potential impacts would be temporary and intermittent in nature.

5.5.5 Mitigation Measures

The following mitigation measures are recommended as ways to reduce potential noise impacts:

- Proponents of a wind energy development project should take measurements to assess the existing background noise levels at a given site and compare them with the anticipated noise levels associated with the proposed project (Section 4.5.2).

- Noisy construction activities (including blasting) should be limited to the least noise-sensitive times of day (daytime only between 7 a.m. and 10 p.m.) and weekdays.

- Whenever feasible, different noisy activities (e.g., blasting and earthmoving) should be scheduled to occur at the same time since additional sources of noise generally do not add a significant amount of noise. That is, less-frequent noisy activities would be less annoying than frequent less-noisy activities.

- All equipment should have sound-control devices no less effective than those provided on the original equipment. All construction equipment used should be adequately muffled and maintained.

- All stationary construction equipment (i.e., compressors and generators) should be located as far as practicable from nearby residences.

- If blasting or other noisy activities are required during the construction period, nearby residents should be notified in advance.

5.6 TRANSPORTATION IMPACTS

Transportation requirements for construction, operation, and decommissioning of a typical wind energy development project are discussed in Section 3.5. In general, the heavy equipment and materials needed for site access, site preparation, and foundation construction are typical of road construction projects and do not pose unique transportation considerations. However, depending on the design, some of the turbine components could be extremely long (e.g., blades) or heavy (e.g., the nacelle containing all drivetrain components except the rotor) and, therefore, require permitting as oversized loads. In addition, it is likely that the main cranes required for tower and turbine assembly would require a certain number of oversized and/or overweight shipments. Similar equipment and material would require transportation during site decommissioning.

5.6.1 Site Monitoring and Testing

During site monitoring and testing, transportation activities would be largely limited to very low volumes of heavy-duty all-wheel-drive pickup trucks, medium-duty trucks, or personal vehicles. It is likely that existing access roads would suffice, thus no special requirements or significant impacts are anticipated.

5.6.2 Site Construction

The movement of equipment and materials to the site during construction would cause a relatively short-term increase in the level of service of local roadways during the construction period. Most equipment (e.g., heavy earthmoving equipment and cranes) would remain at the site for the duration of construction activities. Shipments of materials, such as gravel, concrete, and water, would not be expected to significantly affect local primary and secondary road networks.

Shipments of overweight and/or oversized loads can be expected to cause temporary disruptions on the secondary and primary roads used to access a construction site. As noted in Section 3.1.2.1, it is possible that local roads might require fortification of bridges and removal of obstructions to accommodate overweight or oversized shipments. The need for such actions must be determined on a site-specific basis. Moreover, the wind energy development project access road must be constructed to accommodate such shipments. Because of the anticipated weight of the turbine components and electrical transformers that would be brought to the site, maximum grade becomes a critical road design parameter. While straight-line access roads would obviously minimize distance and cost, the combination of turning clearance requirements and maximum grade can be expected to result in access roads climbing a hill along a serpentine path. Visual impacts associated with road construction also would need to be considered (Section 5.11).

5.6.3 Site Operation

During operations, larger sites may be attended during business hours by a small maintenance crew of six individuals or fewer. Consequently, transportation activities would be limited to a small number of daily trips by pickup trucks, medium-duty vehicles, or personal vehicles. It is possible that large components may be required for equipment replacement in the event of a major mechanical breakdown. However, such shipments would be expected to be infrequent. Transportation activities during operations would not be expected to cause noticeable impacts to local road networks.

5.6.4 Site Decommissioning

With some exceptions, transportation activities during site decommissioning would be similar to those during site development and construction. Heavy equipment and cranes would be required for turbine and tower dismantlement, breaking up tower foundations, and regrading and recontouring the site to the original grade. With the possible exception of a main crane, oversized and/or overweight shipments are not expected during decommissioning activities because the major turbine components could be disassembled, segmented, or size-reduced prior to shipment. Thus, potential disruptions to local traffic during decommissioning would likely be fewer than those during original construction activities.

5.6.5 Mitigation Measures

Potential impacts from transportation activities related to site monitoring and testing, construction, operation, and decommissioning of typical wind energy development projects are expected to be low, provided appropriate planning and implementation actions are taken. The following measures to mitigate transportation impacts address the expected major activities associated with future wind energy development projects and general safety standards.

- Existing BLM standards regarding road design, construction, and maintenance are described in the BLM Manual 9113 (BLM 1985) and the Gold Book (RMRCC 1989). An access road siting and management plan should be prepared incorporating these standards, as appropriate. Generally, roads should be required to follow natural contours; be constructed in accordance with standards as described in BLM Manual 9113; and be reclaimed to BLM standards. As described in BLM Manual 9113, BLM roads should be designed to an appropriate standard no higher than necessary to accommodate their intended functions.

- Existing roads should be used to the maximum extent possible, but only if in safe and environmentally sound locations. If new access roads are necessary, they should be designed and constructed to the appropriate standard no higher than necessary to accommodate their intended functions (e.g., traffic volume and weight of vehicles). Abandoned roads and roads that are no longer needed should be recontoured and revegetated.

- A transportation plan should be developed, particularly for the transport of turbine components, main assembly cranes, and other large pieces of equipment. The plan should consider specific object sizes, weights, origin, destination, and unique handling requirements and should evaluate alternative transportation approaches (e.g., barge or rail). In addition, the process to be used to comply with unique state requirements and to obtain all necessary permits should be clearly identified.

- A traffic management plan should be prepared for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan should incorporate measures such as informational signs, flaggers when equipment may result in blocked throughways, and traffic cones to identify any necessary changes in temporary lane configuration. Signs should be placed along roads to identify speed limits, travel restrictions, and other standard traffic control information. To minimize impacts on local commuters, consideration should be given to limiting construction vehicles traveling on public roadways during the morning and late afternoon commute time.

- Project personnel and contractors should be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow.

- During construction and operation, traffic should be restricted to the roads developed for the project. Use of other unimproved roads should be restricted to emergency situations.

5.7 HAZARDOUS MATERIALS AND WASTE MANAGEMENT IMPACTS

The use, storage, and disposal of hazardous materials and waste associated with a typical wind energy project are discussed in Section 3.4. Potential adverse health and environmental impacts associated with improper management of these materials could be significant. In general, most potential impacts are associated with the release of these materials to the environment, which could occur if the materials are improperly used, stored, or disposed of. Direct impacts of such releases could include contamination of vegetation, soil, and water, which could result in indirect impacts to human and wildlife populations.

If appropriate management practices are implemented, the impacts associated with hazardous materials and wastes are expected to be minimal to nonexistent. Measures to mitigate or prevent environmental impacts associated with these materials are presented below. They were developed on the basis of the expected major activities associated with wind energy projects and standard industry practices.

The following mitigation measures are recommended for implementation during all activities associated with a wind energy project:

- The BLM should be provided with a comprehensive listing of the hazardous materials that would be used, stored, transported, or disposed of during activities associated with site monitoring and testing, construction, operation, and decommissioning of a wind energy project.

- Operators should develop a hazardous materials management plan addressing storage, use, transportation, and disposal of each hazardous material anticipated to be used at the site. The plan should identify all hazardous materials that would be used, stored, or transported at the site. It should establish inspection procedures, storage requirements, storage quantity limits, inventory control, nonhazardous product substitutes, and disposition of excess materials. The plan should also identify requirements for notices to federal and local emergency response authorities and include emergency response plans.

- Operators should develop a waste management plan identifying the waste streams that are expected to be generated at the site and addressing hazardous waste determination procedures, waste storage locations, waste-specific management and disposal requirements, inspection procedures, and waste minimization procedures. This plan should address all solid and liquid waste that may be generated at the site.

- Operators should develop a spill prevention and response plan identifying where hazardous materials and wastes are stored on site, spill prevention measures to be implemented, training requirements, appropriate spill response actions for each material or waste, the locations of spill response kits on site, a procedure for ensuring that the spill response kits are adequately stocked at all times, and procedures for making timely notifications to authorities.

- Operators should develop a storm water management plan for the site to ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion.

- If pesticides are to be used on the site, an integrated pest management plan should be developed to ensure that applications will be conducted within the framework of BLM and DOI policies and entail the use of only EPA-registered pesticides. Pesticide use should be limited to nonpersistent, immobile pesticides and should only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.

- Secondary containment should be provided for all on-site hazardous materials and waste storage, including fuel. In particular, fuel storage (for construction vehicles and equipment) should be a temporary activity occurring only for as long as is needed to support construction and decommissioning activities. Fuel storage facilities should be removed from the site after these activities are completed.

- Wastes should be properly containerized and removed periodically for disposal at appropriate off-site permitted disposal facilities.

- In the event of an accidental release to the environment, the operator should document the event, including a root cause analysis, appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts. Documentation of the event should be provided to the BLM authorized officer and other federal and state agencies, as required.

- Any wastewater generated in association with temporary, portable sanitary facilities should be periodically removed by a licensed hauler and introduced into an existing municipal sewage treatment facility. Temporary, portable sanitary facilities provided for construction crews should be adequate to support expected on-site personnel and should be removed at the completion of construction activities.

5.8 HEALTH AND SAFETY IMPACTS

Occupational and public health and safety considerations related to typical wind energy projects are discussed in Section 3.3. Potential impacts to the health and safety of workers and the public are discussed in the following sections. Potential mitigation measures are identified on the basis of the expected major activities, general safety standards, and research specific to wind power generation.

5.8.1 Occupational Safety

Potential occupational health and safety risks are very limited during the site monitoring and testing phase because of the limited extent of activities. Occupational hazards are greater during construction, operation, and decommissioning of a wind energy development project; they can be minimized, however, when workers adhere to safety standards and use appropriate protective equipment. Nevertheless, with the unique occupational hazards associated with wind energy, as well as hazards similar to those in heavy construction and the electric power industry, fatalities and injuries from on-the-job accidents can still occur. The following mitigation measures are recommended for implementation during all phases associated with a wind energy project:

- All construction, operation, and decommissioning activities should be conducted in compliance with applicable federal and state occupational safety and health standards (e.g., OSHA's Occupational Health and Safety Standards, 29 CFR Parts 1910 and 1926, respectively (DOL 2001, 2003).

- A safety assessment should be conducted to describe potential safety issues and the means that would be taken to mitigate them, including issues such as site access, construction, safe work practices, security, heavy equipment transportation, traffic management, emergency procedures, and fire control.

- A health and safety program should be developed to protect workers during construction, operation, and decommissioning of a wind energy project. The program should identify all applicable federal and state occupational safety standards, establish safe work practices for each task (e.g., requirements for personal protective equipment and safety harnesses; OSHA standard practices for safe use of explosives and blasting agents; and measures for reducing occupational EMF exposures), establish fire safety evacuation procedures, and define safety performance standards (e.g., electrical system standards and lighting protection standards). The program should include a training program to identify hazard training requirements for workers for each task and establish procedures for providing required training to all workers. Documentation of training and a mechanism for reporting serious accidents to appropriate agencies should be established.

- Electrical systems should be designed to meet all applicable safety standards (e.g., National Electrical Code [NEC] and IEC).

- For the mitigation of explosive hazards, workers should be required to comply with the OSHA standard (1910.109) for the safe use of explosives and blasting agents (DOL 1998).

- Measures should be considered to reduce occupational EMF exposures, such as backing the generator with iron to block EMF, shutting down the generator when working in the vicinity, and/or limiting exposure time while the generator is running (Robichaud 2004).

5.8.2 Public Safety

Potential public safety hazards during the site monitoring and testing phase are minimal. During construction, operation, and decommissioning of a wind energy development project, the hazards are greater but they can be effectively mitigated. These hazards include risks associated with major construction sites, rare tower failures, human-caused fire, EMF exposure, aviation safety interference, EMI, low-frequency sound, and shadow flicker. The following mitigation measures are recommended for implementation during all phases associated with a wind energy project:

- The project health and safety program should also address protection of public health and safety during construction, operation, and decommissioning of a wind energy project. The program should establish a safety zone or setback for wind turbine generators from residences and occupied buildings, roads, ROWs, and other public access areas that is sufficient to prevent accidents resulting from various hazards during the operation of wind turbine generators. It should identify requirements for temporary fencing around staging areas, storage yards, and excavations during construction or decommissioning activities. It should also identify measures to be taken during the operations phase to limit public access to facilities (e.g., permanent fencing should be installed around electrical substations, and turbine tower access doors should be locked to limit public access).

- Operators should consult with local planning authorities regarding increased traffic during the construction phase, including an assessment of the number of vehicles per day, their size, and type. Specific issues of concern (e.g., location of school bus routes and stops) should be identified and addressed in the traffic management plan.

- If operation of the wind turbines is expected to cause significant adverse impacts to nearby residences and occupied buildings from shadow flicker, low-frequency sound, or EMF, site-specific recommendations for addressing these concerns should be incorporated into the project design (e.g., establishing a sufficient setback from turbines).

- The project should be planned to minimize EMI (e.g., impacts to radar, microwave, television, and radio transmissions) and comply with FCC regulations. Signal strength studies should be conducted when proposed locations have the potential to impact transmissions. Potential interference with public safety communication systems (e.g., radio traffic related to emergency activities) should be avoided.

- In the event an installed wind energy development project results in EMI, the operator should work with the owner of the impacted communications system to resolve the problem. Potential mitigation may include realigning the existing antenna or installing relays to transmit the signal around the wind energy project. Additional warning information may also need to be conveyed to aircraft with onboard radar systems so that echoes from wind turbines can be quickly recognized.

- The project should be planned to comply with FAA regulations, including lighting requirements, and to avoid potential safety issues associated with proximity to airports, military bases or training areas, or landing strips.

- Operators should develop a fire management strategy to implement measures to minimize the potential for a human-caused fire.

5.9 ECOLOGICAL RESOURCES

This section describes the potential impacts to ecological resources on BLM-administered lands that could occur during each phase of development of a wind energy project; it also identifies potential mitigation measures for avoiding or mitigating these potential impacts. The descriptions focus primarily on potential impacts during the construction and operation of a wind energy project (Sections 5.9.2 and 5.9.3, respectively), because impacts resulting from these phases are considered to be greater. Impacts associated with site monitoring and testing activities and decommissioning are also discussed (Sections 5.9.1 and 5.9.4, respectively). Mitigation measures are recommended for all phases of development (Section 5.9.5).

The types of ecological resources that could be affected by wind energy development on BLM-administered lands depend on the specific location of the proposed project and its environmental setting. Ecological resources that could be affected include vegetation, fish, and wildlife, as well as their habitats. These biota include species that have been designated as threatened, endangered, or species of special concern by federal or state natural resource agencies (e.g., USFWS, BLM, and Wyoming Game and Fish Department [WGFD]) within the 11 western states where wind energy development projects may be implemented on BLM-administered lands.

Figure 5.9-1 shows the distribution of BLM-administered lands with a medium to high potential for wind energy development, relative to ecoregions that occur in the 11 western states. The types of plant communities and wildlife species that could be affected by wind energy development depend on the ecoregion in which the project is located and the type of plant community that is present at the project location within the ecoregion. The ecoregions with the greatest extent of areas with medium to high potential for wind energy development are the Wyoming Basin ecoregion in Wyoming; the Northwest Glaciated Plains and Northwest Great Plains ecoregions in Montana; the Northern Basin and Range ecoregion in California, Idaho, Nevada, Oregon, and Utah; and the Chihuahuan ecoregion in New Mexico (Figure 5.9-1). The vegetation communities in these ecoregions are largely arid and semiarid grass and shrub lands (Appendix F). Appendix F presents state-level maps showing the distribution of areas on BLM-administered lands with a medium to high potential for wind energy development across ecoregions of the 11 western states.

For the purposes of this assessment, impacts from wind energy development on biological resources were considered important if they would result in, or contribute to, any of the following:

- Reduction of the quality and/or quantity of habitat for fish, wildlife, or plants;
- A decrease in a plant or wildlife population to below self-sustaining levels;
- Establishment or increases of noxious weed populations;
- Elimination of a plant or animal community;

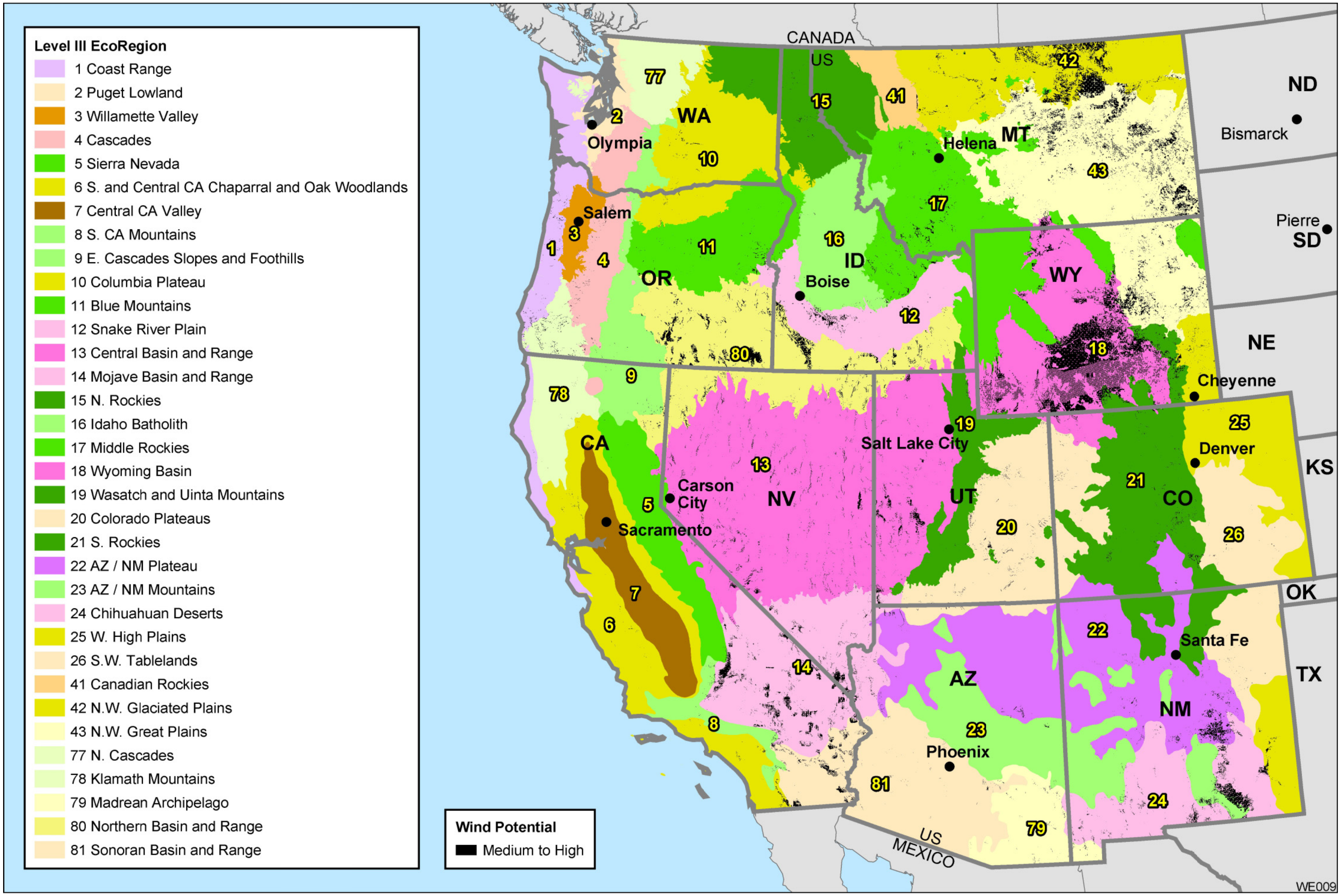

FIGURE 5.9-1 Distribution of BLM-Administered Lands with a Medium to High Potential for Wind Energy Development across Ecoregions of the 11 Western States

- Violations of the ESA, the BEPA, MBTA, or applicable state laws;
- A decline in bat, raptor, or migratory bird populations;
- Interference with the movement of any resident or migratory fish or wildlife species; or
- Conflicts with management strategies for BLM Special Management Areas.

The importance of these impacts can only be fully evaluated on a site-specific level, on the basis of a variety of factors, such as the status of native and invasive plant and animal populations; the types of habitats that would be disturbed and the nature of the disturbance; management activities and goals for plants, fish, and wildlife; results from monitoring area biota; and local, state, and federal criteria for area plants, fish, and wildlife. Furthermore, the changes in any of these conditions must be clearly linked to a wind energy project and not the result of some other, non-wind-energy-related activity.

The following sections discuss potential effects to ecological resources that may be incurred during the monitoring and testing of sites to determine their suitability for development, during the construction and operation of a wind energy development project, and during facility decommissioning. To evaluate the potential effects of wind energy development on ecological resources, it was assumed that all wind turbines might present a hazard to some vertebrate wildlife from an individual and/or population perspective and that some wind energy development sites would present less of a hazard than other sites.

5.9.1 Site Monitoring and Testing

During site monitoring and testing, impacts to vegetation, wildlife habitat, and aquatic habitats generally would be minimal. Monitoring and testing activities could lead to the introduction and spread of invasive vegetation. However, road construction and excavation would typically be very limited; some clearing or grading might be needed to install monitoring equipment or access a site. If more extensive road construction or excavation were needed, more extensive impacts could result (see Section 5.9.2 for impacts during construction).

5.9.2 Site Construction

During construction, adverse ecological effects could occur from (1) erosion and runoff; (2) fugitive dust; (3) noise; (4) the introduction and spread of invasive vegetation; (4) modification, fragmentation, and reduction of habitat; (5) mortality of biota; (6) exposure to contaminants; and (7) interference with behavioral activities. Site clearing and grading, along with construction of access roads, towers, support buildings, utility and transmission corridors, and other ancillary facilities, could reduce, fragment, or dramatically alter existing habitat in the disturbed portions of the project area. During construction, it is expected that ecological resources would be most affected by the disturbance of habitat in areas where turbines, support facilities, access roads, utility corridors, and transmission lines were being placed. Wildlife in surrounding habitats might also be affected if the construction activity (and associated noise) disturbs normal behaviors, such as feeding and reproduction.

The types of impacts from construction are expected to be similar to those that have occurred at other construction projects. The construction impacts of most concern with regard to ecological resources are those associated with the reduction, modification, and fragmentation of habitat.

5.9.2.1 Construction Effects on Vegetation

A number of construction-associated activities may adversely impact vegetation at a wind energy development site. These activities include the clearing and grading of vegetated areas in preparation of tower and infrastructure construction; clearing and grading of utility corridors and access roads; assembly of the turbines and towers; construction of transmission line towers that would connect the wind facility to existing electricity corridors; and refueling of construction equipment. Impacts associated with these activities may be of long- or short-term duration and would largely be localized to the immediate project area. The introduction of invasive vegetation into disturbed areas of the wind energy project site, and possibly into surrounding areas, could result in long-term impacts to the native plant community at the site, access routes, and transmission corridors, and in surrounding areas.

Regardless of the location of a wind energy development project, the nature of the construction impacts to vegetation (e.g., direct destruction from grading and clearing, loss of permanent habitat at turbines and support structures) would be similar in all ecoregions, while the extent of the impacts would depend on the size of the project. During construction of a wind energy project and its ancillary facilities (utility and transmission corridors, and access roads), vegetation may be adversely affected by (1) injury or mortality of vegetation, (2) fugitive dust, (3) exposure to contaminants, and (4) the introduction of invasive vegetation (Table 5.9.2-1). Generally, the significance of vegetation loss associated with a wind energy project depends on the amount of area disturbed, the types of plant communities (and the habitats they make up) that would be affected, the nature of the effect, the capacity for the disturbed habitat to recover (some habitat types may take a much longer time to recover than others), and whether listed or sensitive plants would be affected. These factors would determine whether the construction impacts to vegetation would be short or long term.

5.9.2.1.1 Direct Injury or Loss during Clearing, Grading, and Facility Construction. The various clearing, grading, and construction activities would result in direct injury to and/or loss of vegetation, thereby altering or eliminating the plant communities in the permanently disturbed portions of the project site (i.e., turbine and support facility footprints). These areas would represent no more than 5 to 10% of the entire project area. Direct impacts from trampling, crushing, or removal of vegetation could result in permanent habitat loss at the turbines, support buildings, substation, parking area, and access road locations. Impacts to

TABLE 5.9.2-1 Potential Wind Energy Construction Effects on Vegetation

Ecological Stressor	Associated Project Activity or Feature	Potential Effect	Effect Extent and Duration
Direct injury or mortality of vegetation	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Destruction and injury of vegetation, habitat reduction or degradation.	Long-term within construction footprints for turbines, support facilities, and access roads; short-term in areas adjacent to the construction area and other project locations if mowing was employed to remove surface vegetation.
Fugitive dust generation	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Damage to plant cuticle and thereby increased water loss; decreased carbon dioxide uptake, decreased photo-synthesis.	Short-term and localized.
Exposure to contaminants	Accidental spill during equipment refueling; accidental release of stored fuel or hazardous materials.	Exposure may affect plant survival, reproduction, development, or growth.	Short-term and localized to spill area.
Invasive vegetation	Site clearing and grading.	Establishment of invasive vegetation, decrease in native vegetation; decrease in wildlife habitat quality.	Long-term if established in areas where turbines, support facilities, and access roads would be situated, both on and off site.

vegetation along transmission lines and staging areas would be temporary, with vegetation expected to regenerate following completion of construction activities. Most vegetation in the direct construction footprint of the turbines, support facilities, and access roads would be permanently removed. Additional impacts on vegetation communities could occur from soil compaction, loss of topsoil, and removal of or reductions in the seed bank. Clearing of trees adjacent to a proposed wind energy project or within the transmission line ROW may also be required. The extent of clearing at the wind energy project would depend on the topography and wind characteristics at the site and on the relative height and placement of the turbines (NWCC 2002).

The temporary disturbance of vegetation in some project areas during facility construction may not be considered ecologically significant. Nevertheless, it could take several years for temporarily affected areas to recover (Erickson et al. 2003a), and some types of habitat may never fully recover from disturbance.

5.9.2.1.2 Fugitive Dust. Fugitive dust generated during clearing, grading, and construction activities may impact vegetation immediately surrounding the project area. Dust cover on leaves has been shown to increase leaf temperature, which is one of the major parameters controlling photosynthesis (Eller 1977; Hirano et al. 1995); increase water loss (Ricks and Williams 1974; Eveling and Bataille 1984); and decrease carbon dioxide (CO_2) uptake (Thompson et al. 1984; Hirano et al. 1995). Dust coating on leaves may also reduce photosynthesis through shading (Hirano et al. 1995; Thompson et al. 1984) and physically remove cuticular wax, which may lead to increased water loss and wilting (Eveling and Bataille 1984).

Fugitive dust generation may be relatively high at wind energy development sites located in the more arid ecoregions. However, the generation of fugitive dust during the construction phase of a wind energy project can be expected to be short term and localized to the immediate area of the wind project.

5.9.2.1.3 Exposure to Contaminants. During construction of a wind energy development project, construction equipment would need to be refueled and some hazardous materials or wastes (such as waste paints and degreasing agents) may be generated. Accidental fuel spills or releases of hazardous materials could result in the exposure of vegetation at the project site, and reestablishment of the vegetation may be impacted or delayed because of residual soil contamination. However, after expected hazardous materials handling and refueling requirements were met, only small spills or releases would be anticipated. (See Section 5.7 for a discussion of hazardous materials and waste management impacts and pertinent mitigation measures.)

5.9.2.1.4 Introduction of Invasive Vegetation. Plant seeds can be dispersed by a variety of mechanisms, including water or wind transportation, consumption and excretion by wildlife, and transport on the bodies of wildlife (Barbour et al. 1980). For example, Canada thistle is readily dispersed by wind or water, while seeds from the spotted knapweed (an exotic species) may be spread outward and downwind from the perimeter of existing stands by wind or over longer distances by wildlife and livestock (USDA 2003). Seeds may also become stuck in tire treads or in soil or mud on vehicles or other equipment and be transported to new, potentially suitable habitats (ISDA 2002). For example, seed transport on logging trucks, OHVs, and trail bikes has been reported to contribute greatly to the spread of spotted knapweed into new areas in British Columbia (USDA 2003).

The dispersal of invasive plant seeds by vehicles may affect native plant communities. In such cases, plant communities dominated by native vegetation may be replaced with ones dominated by invasive species. Other adverse impacts from the spread of invasive species may include:

- A decrease in biological diversity of ecosystems;

- A reduction in water quality and availability for wildlife species;

- A decrease in the quality of habitats for wildlife;
- Alterations in habitats needed by threatened and endangered species; and
- Health hazards, because some species are poisonous to humans, wildlife, and livestock.

Land that has been cleared at a wind energy project site may create an opportunity for invasive species. The magnitude and extent of invasive plant establishment at a wind energy site would be a function of the aggressiveness of the introduced plants, the number and frequency of seed introductions to a particular area, and the availability of suitable conditions (e.g., disturbed habitat) for colonization by the introduced seeds. The establishment of invasive vegetation may be limited by early detection and subsequent eradication of the plants. Seeds can be easily introduced into these areas via construction vehicles that have been in other areas where invasive species are present. Construction activities could introduce invasive species not only into the disturbed areas of the project site itself, but also into the surrounding vegetation communities. Invasive vegetation could also be introduced in the soils used to backfill and grade portions of a construction site. Depending on the source of the fill, it may contain seeds or other propagules of invasive plant species and thus provide an opportunity for introduction of invasive species.

5.9.2.2 Construction Effects on Wildlife

As with vegetation, wildlife may be affected during construction of a proposed wind energy development project and its ancillary facilities (i.e., access roads, utility corridors, and transmission corridors). The wildlife that could be affected would depend on the ecoregion in which the wind facility is planned (Figure 5.9-1) and the nature and extent of the habitats at the project area and surrounding vicinity. Construction activities may adversely affect wildlife through (1) habitat reduction, alteration, or fragmentation; (2) introduction of invasive vegetation; (3) injury or mortality of wildlife; (4) decrease in water quality from erosion and runoff; (5) fugitive dust; (6) noise; (7) exposure to contaminants; and (8) interference with behavioral activities. The location and timing of construction activities may also affect the migratory and other behavioral activities of some species. The overall impact of construction activities on wildlife populations at a wind energy site would depend on the type and amount of wildlife habitat that would be disturbed, the nature of the disturbance (e.g., complete, permanent reduction because of tower placement, or temporary disturbance in construction support areas), and the wildlife that occupy the project site and surrounding areas (Table 5.9.2-2).

5.9.2.2.1 Habitat Disturbance. The construction of a wind energy development project and its ancillary facilities may impact wildlife through the reduction, alteration, or fragmentation of habitat, which represents the greatest construction-related impact to on-site wildlife. All existing habitat within the construction footprints of turbines and support facilities, along new access road corridors, and within new utility ROWs would be disturbed. The amount of habitat that would be disturbed would be a function of the size of the proposed wind energy project

TABLE 5.9.2-2 Potential Wind Energy Construction Effects on Wildlife

Ecological Stressor	Associated Project Activity or Feature	Potential Effect	Effect Extent and Duration
Habitat disturbance	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Reduction or alteration of on-site habitat; all wildlife.	Long-term habitat reduction within tower, building, and access road footprints; long-term reduction in habitat quality in other site areas (utility and transmission corridors).
Invasive vegetation	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Reduced habitat quality; all wildlife.	Long-term if established in areas where turbines, support facilities, and access roads are situated.
Direct injury or mortality	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Destruction and injury of wildlife with limited mobility; amphibians, reptiles, birds, and mammals.	Permanent within construction footprints of turbines, support facilities, and access roads; short-term in areas adjacent to construction area.
Erosion and runoff	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Reduced reproductive success of amphibians using on-site surface waters; drinking water supplies may be affected.	Short-term; may extend beyond site boundaries.
Fugitive dust generation	Site clearing and grading; turbine and tower construction; access road and utility corridor construction.	Respiratory impairment; all wildlife.	Short-term.
Noise	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Disturbance of foraging and reproductive behaviors; habitat avoidance; birds and mammals.	Short-term.
Exposure to contaminants	Accidental spill during equipment refueling; accidental release of stored fuel or hazardous materials.	Exposure may affect survival, reproduction, development, or growth; all wildlife.	Short-term and localized to spill area.
Interference with behavioral activities	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Disturbance of migratory movements; avoidance of construction areas by migrating birds and mammals.	Short-term.
	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Disturbance of foraging and reproductive behaviors; birds and mammals.	Short-term for some species, long-term for other species that may completely abandon the disturbed habitats and adjacent areas.

(i.e., number of turbines), amount of associated infrastructure (such as access roads and utility corridors), and current degree of disturbance already present in the project site area. The construction of a wind energy project would not only result in the direct reduction or alteration of wildlife habitat within the project footprint but could also affect the diversity and abundance of area wildlife through the fragmentation of existing habitats (EFSEC 2003). The amount of habitat that would be physically disturbed by construction would be limited to the footprint of the turbines, support facilities, access roads, and utility corridors. These areas typically represent a small fraction (5 to 10%) of the entire wind energy development site.

Any effects of habitat reduction, disturbance, or fragmentation on wildlife would be related to the type and abundance of the habitats affected and to the wildlife that occur in those habitats. For example, on large sites (e.g., 1,000 acres [405 ha] or more), habitat effects could represent a significant impact to local wildlife, especially to species whose affected habitats are uncommon and not well represented in the surrounding landscape. In contrast, fewer impacts would be expected, in general, for wind projects located on previously disturbed lands that have not been adequately restored or reclaimed (e.g., open pit mining sites).

5.9.2.2.2 Introduction of Invasive Vegetation. Wildlife habitat could also be impacted if invasive vegetation becomes established in the construction-disturbed areas and adjacent off-site habitats. The establishment of invasive vegetation could reduce habitat quality for wildlife and locally affect wildlife occurrence and abundance.

5.9.2.2.3 Injury or Mortality. Clearing and grading activities would result in the direct injury or death of wildlife that are not mobile enough to avoid construction operations (e.g., reptiles, small mammals, and young), that utilize burrows (e.g., ground squirrels and burrowing owls), or that are defending nest sites (such as ground-nesting birds). Although more mobile species of wildlife, such as deer and adult birds, may avoid the initial clearing activity by moving into habitats in adjacent areas, it is conservatively assumed that adjacent habitats are at carrying capacity for the species that live there and could not support additional biota from the construction areas. The subsequent competition for resources in adjacent habitats would likely preclude the incorporation of the displaced individual into the resident populations.

The overall affect of construction-related injury or death on local wildlife populations would depend on a number of factors. The number and types of species present at the site that could be affected would be a function of the habitat that could be disturbed. The abundance of the affected species on the site and in surrounding areas would have a direct influence on population level effects. Impacts to common and abundant species may be expected to have less population-level effects than would the loss of individuals from a species that is uncommon. The greater the size of the project site, the greater the potential for more individual wildlife to be injured or killed. Finally, the timing of construction activities could directly affect the number of individual wildlife injured. For example, construction during the reproductive period of ground-nesting birds, such as sage-grouse, would have a greater potential to kill or injure birds than would construction at a different time.

5.9.2.2.4 Erosion and Runoff. Construction activities may result in increased erosion and runoff from freshly cleared and graded sites. This erosion and runoff could reduce water quality in on-site and surrounding water bodies that are used by amphibians, thereby affecting reproduction, growth, and survival. The potential for water quality impacts during construction would be short term, for the duration of construction activities and postconstruction soil stabilization (e.g., reestablishment of natural or man-made ground cover). Any impacts to amphibian populations would be localized to the surface waters receiving site runoff. Although the potential for runoff would be temporary, pending completion of construction activities and stabilization of disturbed areas with vegetative cover, erosion could result in significant impacts to local amphibian populations if an entire recruitment class is eliminated (e.g., complete recruitment failure for a given year because of siltation of eggs or mortality of aquatic larvae).

5.9.2.2.5 Fugitive Dust. Little information is available regarding the effects of fugitive dust on wildlife; however, if exposure is of sufficient magnitude and duration, the effects may be similar to the respiratory effects identified for humans. Those effects may include breathing and respiratory symptoms, damage to lung tissue, carcinogenesis, and premature death. Among humans, the major subgroups of the population that appear to be most sensitive to the effects of particulate matter include individuals with chronic obstructive pulmonary or cardiovascular disease or influenza, asthmatics, the elderly, and the young (EPA 2004c).

Fugitive dust generation during construction activities is expected to be short term and localized to the immediate area of the wind energy project and is not expected to result in any long-term individual or population-level effects.

5.9.2.2.6 Noise. Principal sources of noise during construction activities would include truck traffic, operation of heavy machinery, and foundation blasting (if necessary). The most adverse impacts associated with construction noise could occur if critical life-cycle activities were disrupted (e.g., mating and nesting) (NWCC 2002). If birds were disturbed sufficiently during the nesting season to cause displacement, then nest or brood abandonment might occur, and the eggs and young of displaced birds would be more susceptible to cold or predators.

On the basis of the types of construction equipment that would likely be employed (such as bulldozers and graders), the noise levels associated with the equipment would range from about 81 to 85 dB(A) within 50 ft (15 m) of the construction area and be at the mid-40-dB level approximately 5,000 ft (1,524 m) from the site (see Table 5.5.2-1). Construction noise levels associated with heavy-truck traffic (assuming that a heavy truck operates at 50 mph [80 kph]) would be in the range that the EPA recommends for residential areas: 55 dB(A) (see Table 5.5.2-2). These noise levels would be temporary.

Much of the research on wildlife-related noise effects to date has focused on birds. This research has shown that noise may affect territory selection, territorial defense, dispersal, foraging success, fledging success, and song learning (e.g., Reijnen and Foppen 1994; Foppen and Reijnen 1994; Larkin 1996). Several studies have examined the effects of continuous noise on bird populations, including the effects of traffic noise, coronal discharge along electric transmission lines, and gas compressors. Several studies (Reijnen and Foppen 1994, 1995; Foppen and Reijnen 1994; Reijnen et al. 1995, 1996, 1997) have shown reduced densities of some species in forest (26 of 43 species) and grassland (7 of 12 species) habitats adjacent to roads, with effects detectable from 66 to 11,581 ft (20 to 3,530 m) from the roads. On the basis of these studies, Reijnen et al. (1996) identified a threshold effect sound level of 47 dB(A) for all species combined and 42 dB(A) for the most sensitive species; the observed reductions in population density were attributed to a reduction in habitat quality caused by elevated noise levels. This threshold sound level of 42 to 47 dB(A) (which is somewhat below the EPA-recommended limit for residential areas) is at or below the sound levels generated by truck traffic that would likely occur at distances of 250 ft (76 m) or more from the construction area or access roads, or the levels generated by typical construction equipment at distances of 2,500 ft (762 m) or more from the construction site.

Blast noise (e.g., from military activities or construction blasting) has been found to illicit a variety of effects on wildlife (Manci et al. 1988; Larkin 1996). Brattstrom and Bondello (1983) reported that peak sound pressure levels reaching 95 dB resulted in a temporary shift in hearing sensitivity in kangaroo rats that required at least 3 weeks for the hearing thresholds to recover. The authors postulated that such hearing shifts could affect the ability of the kangaroo rat to avoid approaching predators. A variety of adverse effects of noise on raptors have been demonstrated, but in many cases, the effects were temporary, and the raptors became habituated to the noise (Andersen et al. 1989; Brown et al. 1999; Delaney et al. 1999).

5.9.2.2.7 Exposure to Contaminants. Accidental fuel spills or releases of hazardous materials could result in the exposure of wildlife at the project site. Potential impacts to wildlife would vary according to the material spilled, the volume of the spill, the location of the spill, and the species that could be exposed. Spills could contaminate soils and surface water and could affect wildlife associated with these media. A spill would be expected to have a population-level adverse impact only if the spill was very large or contaminated a crucial habitat area where a large number of individual animals were concentrated. The potential for either event is very unlikely. Because the amounts of fuels and hazardous materials are expected to be small, an uncontained spill would affect only a limited area (much less than 1.0 acre [0.4 ha]). In addition, wildlife use of the area during construction would be very minor or nonexistent, thus greatly reducing the potential for exposure.

5.9.2.2.8 Interference with Behavioral Activities. The construction of towers, support facilities, access roads, and transmission lines may affect local wildlife by disturbing normal behavioral activities such as foraging, mating, and nesting. Wildlife may avoid foraging, mating, or nesting or vacate active nest sites in areas where construction is occurring; some species may permanently abandon the disturbed areas and adjacent habitats. In addition, active construction may also affect movements of some birds and mammals; for example, they may avoid a localized migratory route because of ongoing construction.

5.9.2.3 Construction Effects on Wetland and Aquatic Biota

Wind energy development typically occurs on ridges and other elevated land where wetlands and surface bodies are not likely to occur; however, access roads and transmission lines may cross lands where these features may be more common. As a result, wetland and aquatic biota could be affected during construction of the wind energy project and its associated facilities. The types of aquatic biota and wetlands that could be affected would be a function of the ecoregion in which the facility is located (Figure 5.9-1) and of site-specific environmental conditions present at the facility location. Construction activities may adversely affect wetlands and aquatic biota through (1) habitat disturbance, (2) mortality or injury of biota, (3) erosion and runoff, (4) exposure to contaminants, and (5) interference with migratory movements. Except for the construction of stream crossings for access routes or the unavoidable location of a transmission line support tower in a wetland, construction within wetlands or other aquatic habitats would be largely prohibited. Thus, most potential impacts to wetlands and aquatic biota would be indirect.

The overall impact of construction activities on wetlands and aquatic resources would depend on the type and amount of aquatic habitat that would be disturbed, the nature of the disturbance (e.g., grading and filling, or erosion in construction support areas), and the aquatic biota that occupy the project site and surrounding areas (Table 5.9.2-3). The construction of stream crossings could directly impact aquatic habitat and biota within the crossing footprint. This impact would be long term, but of relatively small extent and magnitude.

5.9.2.3.1 Habitat Disturbance. Clearing, grading, and construction activities may result in direct disturbance or reduction of aquatic habitats that may be present within construction footprints and along any new access roads, utility corridors, and transmission corridors. Site clearing and grading (which could result in filling of aquatic habitats) would result in the reduction of aquatic habitats that could be present along access roads and transmission line corridors, and these activities could lead to the establishment of invasive wetland vegetation (such as tamarisk). Wetlands and other aquatic habitats could be injured if erosion from construction areas results in runoff and siltation into the aquatic habitat, thus decreasing water quality and silting-over of biota.

Compliance with the CWA and BLM restrictions regarding activities in wetlands on BLM-administered lands would limit the likelihood of construction occurring in wetland habitats.

5.9.2.3.2 Injury or Mortality. Wetland vegetation and aquatic biota could be impacted if construction of an access road or transmission line resulted in long-term disturbance of aquatic habitat. Temporary habitat disturbance (e.g., from construction equipment crossing streams, soil runoff) could injure or kill aquatic biota in the temporarily disturbed habitats; the nature and extent of the injury would depend on the biota present in the habitats and the nature of the disturbance.

TABLE 5.9.2-3 Potential Wind Energy Construction Effects on Aquatic Biota and Habitat

Ecological Stressor	Associated Project Activity or Feature	Potential Effect	Effect Extent and Duration
Habitat disturbance	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Reduction or alteration of on-site habitat, affecting all aquatic biota; establishment of invasive vegetation.	Long-term habitat reduction within tower, building, and access road footprints, possibly in other site areas (utility and transmission corridors).
Direct injury or mortality	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Destruction and injury of aquatic biota.	Long-term within construction footprints; short-term in areas adjacent to construction area.
Erosion and runoff	Site clearing and grading; turbine and tower construction; access road and utility corridor construction.	Decreased water quality, including increased turbidity and siltation, decreased light penetration, and decreased dissolved oxygen levels; siltation of eggs, larvae, and/or adults of aquatic invertebrates and vertebrates; decreased primary productivity; decreased wetland function.	Short-term and localized.
Exposure to contaminants	Accidental spill during equipment refueling; accidental release of stored fuel or hazardous materials.	Exposure may affect survival, reproduction, development, or growth of aquatic biota.	Acute effects short-term, chronic effects long-term; effects largely localized but may extend off site.
Facility construction activities	Site clearing and grading; turbine and tower construction; access road and utility corridor construction; construction equipment travel.	Interference with migratory behavior, avoidance or blockage of stream migration paths.	Short-term if interference is related to erosion and runoff; short- or long-term if related to contaminant exposure; long-term if related to habitat disturbance or reduction.

5.9.2.3.3 Erosion and Runoff. Water quality and aquatic habitat can be affected if wind energy project development increases runoff or erosion. Turbidity and sedimentation from erosion are part of the natural cycle of physical processes in water bodies, and most aquatic organisms tolerate short-term changes in these parameters. Generally, adverse impacts only occur if sediment loads are unusually high, last for extended periods of time, or occur at unusual times of the year. Increased sediment can decrease the feeding efficiency of aquatic biota; reduce plant, invertebrate, and fish abundance; and decrease fish spawning success by adversely affecting the survival of eggs and fry. Erosion and runoff could also affect wetland hydrology, function, and water quality (FPL Energy North Dakota Wind, LLC 2003). While any impacts to aquatic biota would be localized to the surface waters receiving site runoff, significant impacts to local populations could result if the magnitude and duration of the runoff were sufficiently high.

However, the amount of erosion and runoff into aquatic habitats at, and in the vicinity of, the site is expected to be very small; and impacts from erosion and runoff are expected to be localized and temporary. The potential for water quality impacts during construction would be short term (the duration of construction activities), and postconstruction soil stabilization activities (e.g., reestablishment of natural or man-made ground cover) would greatly reduce or eliminate further erosion and runoff from the site. As previously discussed, wind energy projects would be subject to the CWA, and if a project was expected to disturb 5 or more acres (20 or more ha) of wetland, a Storm Water Pollution Prevention Plan and NPDES compliance permit would be needed.

5.9.2.3.4 Exposure to Contaminants. Accidental fuel spills or releases of hazardous materials could result in the exposure of aquatic biota at or near the project site. By following hazardous material handling and refueling procedure requirements, accidental spills or releases would be small. However, any contaminant that did enter a stream could be transported off site. For a comparable spill volume, a water-based spill would be expected to have a more extensive potential impact than a land-based spill, because of the spatial extent of contamination within and the higher degree of difficulty to clean up a water spill. The effects of a spill on aquatic biota would primarily depend on the location of the spill relative to the aquatic habitat, the type of material spilled, the concentration of the contaminant, the life stage of the exposed biota (e.g., eggs, larvae, and juveniles are most sensitive), and duration of exposure.

Depending on the quantity of material spilled, a contaminant such as diesel fuel can affect aquatic organisms in several ways. Physically coating an aquatic organism and especially its respiratory surfaces (i.e., gills) can cause immobilization or suffocation. Acute exposure to high concentrations could result in the direct mortality of the exposed biota. Chronic exposures to lower concentrations may have sublethal effects, such as reduced growth, reduced reproduction, or altered behavior. The presence of a contaminant may also cause some fish to avoid areas traditionally used for reproduction, feeding, or migration.

5.9.2.4 Construction Effects on Threatened and Endangered Species

Construction activities could affect threatened, endangered, and sensitive species in the same manner that vegetation, wildlife, and aquatic resources could be affected (see previous sections). Threatened and endangered species (including federal and state listed species and BLM-designated sensitive species) could be affected as a result of (1) habitat disturbance, (2) the introduction of invasive vegetation, (3) injury or mortality, (4) erosion and runoff, (5) fugitive dust, (6) noise, (7) exposure to contaminants, and (8) interference with behavioral activities. Which species may be at risk to construction-related effects would depend on the ecoregion in which the wind energy project is located (Figure 5.9-1), and the specific habitat present at, and in the vicinity of, the project site.

Direct impacts on threatened, endangered, and sensitive wildlife species could include injury or mortality, while indirect effects could involve reduction or fragmentation of habitat, reduction or displacement of habitat features such as cover and forage, exposure to contaminants (e.g., diesel fuel) from a spill, and destruction of individual biota (e.g., from clearing and grubbing activities or from vehicle collisions).

Because of the regulatory requirements of the ESA and various state regulations, and the requirements specified in BLM Manual 6840 — Special Status Species Management (BLM 2001) and other resource-specific regulations and guidelines, appropriate survey, avoidance, and mitigation measures would be identified and implemented prior to any construction activities to avoid impacting any sensitive species or the habitats on which they rely.

5.9.3 Site Operation

During operation, adverse ecological effects could occur from (1) disturbance of wildlife by turbine noise and human activity; (2) site maintenance (e.g., mowing); (3) exposure of biota to contaminants; (4) mortality of biota from colliding with the turbines and meteorological towers, and (5) mortality of biota from electrocution or collision with transmission lines.

During operation of the wind facility, ecological resources may still be affected by the reduction in habitat quality associated with habitat fragmentation due to the presence of turbines, support facilities, access roads, and utility and transmission corridors. In addition, the presence of a wind energy development project and its associated access roads and transmission line ROWs may increase human use of surrounding areas, which in turn could impact ecological resources in the surrounding areas through the (1) introduction and spread of invasive vegetation, (2) disturbance of biota, and (3) increased potential for fire. The presence of a wind energy project (and its associated infrastructure) could also interfere with migratory and other behaviors of some wildlife.

Impacts of normal operations are expected to be similar in nature to those that have been observed at existing wind energy projects. The operational impacts of most concern to ecological resources are those associated with bird and bat strikes with turbines and associated infrastructure (e.g., transmission lines and meteorological towers) and, to a lesser extent, electrocution of birds. Potential impacts to gallinaceous birds from the operation of wind energy projects have also been identified as an issue of concern, with potential impacts related to habitat fragmentation, noise, presence of tall structures, and disturbance from human and vehicle activity. These same factors may affect other wildlife as well.

5.9.3.1 Operational Effects on Vegetation

A variety of operational activities could impact vegetation at, and in the vicinity of, a wind energy project. These activities include (1) site maintenance activities involving mowing and herbicide use and (2) the accidental releases of pesticides, fuels, or hazardous materials (Table 5.9.3-1). Increased use of surrounding BLM-administered lands, resulting from additional access corridors (via new access roads and utility and transmission corridors) could also affect vegetation through (1) direct injury to vegetation, (2) the legal and illegal take of plants, (3) the introduction of invasive vegetation, and (4) an increased potential for fire (Table 5.9.3-1).

5.9.3.1.1 Site Maintenance. During facility operation, routine site maintenance activities could include mowing around site buildings and turbine structures, along utility and transmission corridors, and possibly along access roads. Mowing in these areas would maintain plant communities in early successional stages of community development and may prevent reestablishment of desirable shrub species. Plant community succession would remain restricted over the lifetime of the facility. While mowing would not be expected to directly result in the establishment and spread of invasive vegetation, continued mowing could encourage the establishment of some invasive species.

Site maintenance activities may also include the licensed application of herbicides (i.e., pesticides) to control vegetation along access roads, utility and transmission corridors, and around support buildings and turbine towers. Herbicide use may be in addition to, or in lieu of, mowing. The accidental spill of herbicides may result in environmental concentrations exceeding licensed levels, and these herbicides could migrate off site and affect native vegetation in surrounding areas. Potential effects of such exposure are discussed in the following section.

5.9.3.1.2 Exposure to Contaminants. Operation of the wind energy project may require limited on-site storage and use of fuel (e.g., gasoline, diesel), pesticides, and hazardous materials. Very small quantities of hazardous wastes also may be generated (see Section 5.7 on hazardous materials and waste management). On-site storage of these materials is likely to be minimal (Table 3.4.1-1). The amount stored would depend on the size of the wind energy project and the nature of the vegetation maintenance program developed for the site (e.g., mowing only, mowing and herbicide use, herbicide use only).

TABLE 5.9.3-1 Potential Wind Energy Operation and Non-Facility-Related Human Activity Effects on Vegetation

Ecological Stressor	Activity	Potential Effect	Effect Extent and Duration
Wind Energy Operations			
Mowing	Mowing at support buildings and turbine locations, utility corridors, and transmission corridors.	Maintenance of plant communities in early successional stages; invasive plant invasion.	Short-term (duration of facility operation) for vegetation injury; long-term for invasive vegetation establishment.
Exposure to contaminants	Accidental spill or release of pesticides, fuel, or hazardous materials.	Exposure may affect plant survival, reproduction, development, or growth.	Short- or long-term, localized to spill locations.
Non-Facility-Related Human Activities			
Increased foot and vehicle traffic	Access to surrounding areas by visitors, including unauthorized vehicles, along facility access roads and utility and transmission corridors.	Trampling of vegetation by foot and vehicle traffic.	Short- or long-term, in areas adjacent to the wind energy project, access roads, utility corridors, and transmission corridors.
Legal and illegal take of vegetation	Access to surrounding areas.	Reduced abundance and/or distribution of some species.	Short- and long-term, depending on species affected and magnitude of take.
Invasive vegetation	Access to surrounding areas by visitors, including unauthorized vehicles, along facility access roads and utility and transmission corridors.	Establishment of invasive vegetation; exclusion of native vegetation; decrease in wildlife habitat quality.	Long-term, both on and off site.
Fire	Access to surrounding areas by visitors, including unauthorized vehicles, along facility access roads and utility and transmission corridors.	Loss of native vegetation; introduction and establishment of invasive vegetation; decrease in wildlife habitat quality.	Long-term.

Because of the relatively small amount of fuel and pesticides expected to be stored and used at a wind energy development project, an accidental release of these materials would be expected to impact only a small area of the site, and the vegetation at the spill locations would likely be vegetation regularly affected by mowing. Thus, impacts to vegetation from exposure to accidental fuel or pesticide releases are expected to be very localized and minor. Similarly, only relatively small amounts of hazardous wastes could be expected to be generated at a wind energy project, and any accidental releases would be small and affect vegetation primarily at the release location.

Exposure of vegetation in areas adjacent to the wind energy project would be minimal because of the limited amounts of fuels and hazardous materials that could be expected at the site, the relatively small amounts that might be accidentally released, and the implementation of spill response procedures designed to contain and clean up any such releases.

5.9.3.1.3 Direct Injury to Vegetation. The presence of a wind energy project on BLM-administered land may increase access to adjacent lands that previously had limited access, with a subsequent increase in the use of areas adjacent to the wind energy site. Impacts on vegetation at and adjacent to a wind energy project and its ancillary facilities could occur from increased use, unauthorized OHV use, illegal dumping, and illegal collection of plants from these areas (PBS&J 2002). Human activities, especially OHV use, could mechanically disturb cryptobiotic organisms (soil-dwelling microorganisms found in surface soils of the arid and semiarid west and critical to soil stability, nutrient cycling, nitrogen fixation, and plant growth) and decrease cryptobiotic cover, change species diversity and community composition, and alter soil nutrient dynamics (Belnap et al. 2001), which in turn could adversely affect plant productivity. Visitors and OHVs may crush or trample vegetation or destroy roots and other belowground plant structures (Payne et al. 1983; Cole 1995; Douglass et al. 1999).

5.9.3.1.4 Legal and Illegal Take of Plants. Increased access to adjacent BLM-administered lands could lead to an increase in the illegal take of some plant species, especially cacti. Depending on the species involved and the extent and magnitude of the illegal take, local populations of some species may be impacted. Most plant collecting has minimal impacts (e.g., seed collection for viability studies), but sometimes significant damage can occur, especially to species that are very sensitive to physical disturbance and population changes. Commercial collectors can impact plant populations through both the legal and illegal gathering of plants and plant products, such as endangered cacti or wild *Echinacea* species and other medicinal herbs. Collecting plants for herbarium specimens and collecting wildflower seeds for personal gardens generally have little impact on populations if conducted responsibly and in accordance with the terms of the collecting permit, if required.

5.9.3.1.5 Introduction of Invasive Vegetation. The increased access of OHVs and hiking onto previously less accessible areas may act to disperse seeds of invasive vegetation. Uncontrolled and largely unmanaged trail systems have been identified as ready corridors for weed dispersal (Douglass et al. 1999). Visitors may carry seeds on their clothing and equipment, and motorized vehicles can carry seeds on tires and in vehicle mud (Douglass et al. 1999; ISDA 2002; USDA 2003).

5.9.3.1.6 Fire. Increased human activity also increases the potential for fires. Wildland fires could be initiated by (1) poorly maintained and extinguished campfires associated with recreational activities, (2) contact with hot engine parts during OHV use, and (3) careless cigarette use. The potential for wildland fires would be greatest in the arid and semiarid ecoregions and would be expected to occur most often in summer and autumn, when native and invasive grasses have died back and fuel loads are at their greatest.

While fires have historically been a part of the Western landscape, and especially in shrub-steppe habitats (Knick 1999), an increase in fire frequency since the turn of the century throughout the arid West has enhanced the establishment of invasive vegetation such as cheatgrass (Young and Allen 1997; DOI 1996; USDA 2002a). Invasive grasses may especially benefit from fire, and once established, may promote recurrent fire to such an extent that native species decline and native plant communities are converted to invasive annual grasslands (Brooks and Pyke 2001).

Sagebrush is especially vulnerable to fires and may incur both short- and long-term effects (Quinney 2000). Big sagebrush plants are readily killed by fire, while native grasses and forbs are generally unharmed by fires (USDA 2002a). Frequently repeated fires reduce or prevent reestablishment of sagebrush seedlings from nearby unburned plants. Fires may kill some seeds of native grasses in upper soil layers, significantly reducing seedling emergence in burned areas (USDA 2002a). In contrast, fire may enhance the productivity of some native grasses (USDA 2002a).

5.9.3.2 Operational Effects on Wildlife

Wildlife may be affected by wind energy project operations through (1) electrocution from transmission lines; (2) noise; (3) the presence of, or collision with, turbines, meteorological towers, and transmission lines; (4) site maintenance activities; (5) exposure to contaminants; (6) disturbance associated with activities of the wind energy project workforce; (7) interference with migratory behavior; and (8) increased potential for fire (Table 5.9.3-2). Among these, the presence of, or collisions with, facility structures probably represent the greatest potential hazard to wildlife. In some instances, turbines, transmission lines, and other facility structures may interfere with behavioral activities, including migratory movements, and may provide additional perch sites for raptors, thereby increasing predatory levels on other wildlife (such as small mammals and birds).

Wildlife may be affected by human activities that are not directly associated with the wind energy project or its workforce but that are instead associated with the potentially increased access to BLM-administered lands that had previously received little use. The construction of new access roads or improvements to old access roads may lead to increased human access into the area. Potential impacts associated with increased access include (1) the disturbance of wildlife from human activities, including an increase in legal and illegal take and an increase of invasive vegetation, and (2) an increase in the incidence of fires (Table 5.9.3-2).

5.9.3.2.1 Electrocution. The electrocution of birds along electric transmission and distribution lines has been well documented (e.g., see Bevanger 1994). Thus, lines associated with the wind energy project may pose a risk to some birds. Birds reported to incur electrocution (and collisions with transmission lines) belong to 15 orders, 41 families, 129 genera, and 245 species; species belonging to the Ciconiformes (vultures), Falconiformes (falcons), Strigiformes (owls), Gruiformes (quail and grouse) and Passeriformes (passerines) are among the

TABLE 5.9.3-2 Potential Wind Energy Operation and Non-Facility-Related Human Activity Effects on Wildlife

Ecological Stressor	Activity	Potential Effect and Likely Wildlife Affected	Effect Extent and Duration
Wind Energy Operations			
Electrocutions	Electric transmission lines and electrical utility lines.	Mortality of birds.	On-site, low magnitude, but long-term.
Noise	Turbine operation, support machinery, motorized vehicles, and mowing equipment.	Disturbance of foraging and reproductive behaviors of birds and mammals; habitat avoidance.	Short- and long-term; greatest effect in highest noise areas.
Collision with turbines, towers, and transmission lines	Presence and operation of turbines; presence of transmission and meteorological towers and transmission lines.	Injury or mortality of birds and bats.	On-site, low magnitude but long-term for many species; population effects possible for other species.
Predation	Transmission and meteorological towers.	Increase in avian predators due to more perch sites for foraging; may decrease local prey populations.	Long-term; may be of high magnitude for some prey species.
Mowing	Mowing at support building and turbine locations.	Injury and/or mortality of less mobile wildlife; reptiles, small mammals, ground-nesting birds.	Short-term.
Exposure to contaminants	Accidental spill or release of pesticides, fuel, or hazardous materials.	Exposure may affect survival, reproduction, development, or growth; all wildlife.	Short- or long-term, localized to spill locations.
Workforce presence	Daily human and vehicle activities.	Disturbance of nearby wildlife and bird and mammal behavior; habitat avoidance.	Short- or long-term, localized and of low magnitude.
Decreased aquatic habitat quality	Erosion and runoff from poorly stabilized surface soils.	Reduced reproductive success of amphibians; wildlife drinking water supplies may be affected.	Short-or long-term, localized.
Interference with behavioral activities	Presence of wind facility and support structures.	Migratory mammals may avoid previously used migration routes, potentially affecting condition and survival.	Long-term, localized to populations directly affected by the presence of the facility.

TABLE 5.9.3-2 (Cont.)

Ecological Stressor	Activity	Potential Effect and Likely Wildlife Affected	Effect Extent and Duration
		Species may avoid areas surrounding the wind energy facility, including foraging and nesting habitats	Long-term for species that completely abandon adjacent areas; population-level effects possible for some species.
Non-Facility-Related Human Activity			
Disturbance of nearby biota	Access to surrounding areas by visitors, including unauthorized vehicles, along facility access roads and utility and transmission corridors.	Impacts to wildlife habitats by foot and vehicle traffic; disturbance of foraging and reproductive behaviors; all wildlife.	Short- or long-term, in areas adjacent to the wind facility, access roads, utility corridors, and transmission corridors.
Legal and illegal take of wildlife	Access to surrounding areas.	Reduced abundance and/or distribution of some wildlife.	Short- or long-term, depending on species affected and magnitude of take.
Invasive vegetation	Access to surrounding areas by visitors, including unauthorized vehicles, along facility access roads and utility and transmission corridors.	Establishment of invasive vegetation resulting in reduced wildlife habitat quality; all wildlife.	Long-term, off site.
Fire	Access to surrounding areas by visitors, including unauthorized vehicles, along facility access roads and utility and transmission corridors.	Some mortality of wildlife; reduction in habitat quality due to loss of native vegetation and introduction and establishment of invasive vegetation.	Long-term.

most frequently reported (Bevanger 1994). Large birds are occasionally electrocuted on distribution or transmission lines when they touch two electrical conductors or touch one conductor and a grounded wire (NWCC 2002).

The number of electrocutions that could occur depends on the types of birds present at the site, the location of the site with regard to migratory routes, and local weather conditions. For example, electrocutions have been a source of avian mortality at the Altamont Pass wind energy project; seasonal fog and rain coupled with wind have been suggested as contributing to higher electrocution risks (Stemer 2002).

Although electrocutions of birds from electric transmission lines have been widely reported, some species of birds regularly nest on electrical transmission line towers. Nesting success of raptors and common ravens using transmission towers has been reported to be similar to or higher than that of pairs nesting elsewhere, and modifications of tower design have been suggested to further attract birds and improve nesting success (Steenhof et al. 1993). The accidental electrocution of birds from contact with distribution or transmission lines is not expected to adversely affect bird populations in the vicinity of a wind energy development project.

While bird electrocutions have been widely reported, the electrocution of other wildlife from contact with electrical transmission lines is much less common. Reported nonavian wildlife include snakes, mice, squirrels, raccoons, bobcat, and black bear (Edison Electric Institute 1980; Williams 1990). Among the mammals, squirrels are among the most commonly reported species to be electrocuted because of their penchant for chewing on electrical wires. Because of the relatively rare nature of their electrocution, impacts on nonavian wildlife from electrocution is not expected to adversely impact populations of these wildlife in the vicinity of a wind energy development project.

5.9.3.2.2 Noise. The principal noise-generating activities associated with normal wind energy project operations include turbine noise, transmission line noise (corona), and truck and maintenance equipment noise. The magnitude and duration of noise associated with trucks and maintenance equipment (such as lawn-mowing equipment) is expected to result in only minor annoyance of wildlife at the site and not result in any long-term adverse effects. The primary noise concern for wildlife is the noise generated by operating turbines and the noise generated by wind passing over the turbine blades.

A study of the effect of wind turbines on grassland birds was conducted in southwestern Minnesota (Leddy et al. 1999). In that study, higher bird population densities were reported from control areas and areas that were 591 ft (180 m) away from turbines than in areas that were within 262 ft (80 m) of the turbines. While the authors could not determine the cause of the observed effect, they suggested that noise, the presence of an access road, and the physical movement of the turbines could have produced the effect. Bird population densities along transmission line ROWs in Oregon that exhibited noise levels of approximately 50 dB(A) were reported to be reduced up to 25% (Lee and Griffith 1978).

A study of the effects of gas well compressor noise on breeding bird populations in New Mexico found their response to noise to vary among species (LaGory et al. 2001). Lower numbers of some species were associated with noise levels greater than 40 dB(A). The greatest reductions were found in areas where the species were exposed to sound pressure levels of 50 dB(A) or greater (areas within 150 ft [46 m] of a compressor).

The results of these various studies suggest that the densities of bird populations in the vicinity of wind energy projects may be reduced near turbines, transmission lines, and other facility equipment if continuous noise levels are in the range of 40 dB(A) or higher.

However, birds may not be able to distinguish blade noise from ambient wind noise when the blade and wind noise levels are within 1.5 dB of each other. Overall noise levels measured during a moderate wind day at the Altamont Pass wind energy project were about 70 dB(A) (Dooling 2002), which is above the noise threshold reported by many researchers for disturbance effects on birds. The blade noise measured at the Altamont Pass wind energy project on a moderate wind day was spread relatively evenly across the spectrum of bird hearing (typically 1 to 5 kHz). Under reported wind conditions, blade noise from a normally operating turbine would simply add to the background noise fairly evenly across the sound spectrum and be inaudible to the bird at a distance of 82 ft (25 m) from the base of the turbine (Dooling 2002).

Wildlife in areas adjacent to a wind energy project may also be disturbed by increased noise levels associated with human activities. The greatest noise levels would be associated with vehicle use, while noise during activities such as hiking would be primarily associated with speech. In all cases, the noise levels would be temporary and would be present only during the time visitors were present.

5.9.3.2.3 Collisions with Turbines, Meteorological Towers, and Transmission Lines. Collisions with turbines, meteorological towers (and associated guy wires), and overhead distribution lines represent a potential collision hazard to birds and bats. Bird and bat deaths from collisions with wind energy project structures have received the major emphasis regarding adverse impacts to ecological resources associated with wind energy developments.

Avian Collisions. The number of turbines associated with a wind energy project has been identified as the major variable associated with potential avian mortality (EFSEC 2003). Erickson et al. (2001) provided a projected estimate of 33,000 bird fatalities per year from the estimated 15,000 operating wind turbines (by the end of 2001) in the United States.

Bird fatalities associated with wind turbines are composed of a variety of different groups, including raptors, passerines, waterfowl, and shorebirds (Erickson et al. 2001). The relative abundance of a bird species does not predict the relative frequency of fatalities per species (Thelander and Rugge 2000). Some species may become more susceptible to turbine collisions because postconstruction conditions at the wind energy project have increased prey abundance within the vicinity of turbines or ancillary facilities. Disturbed ground surface can be more suitable for burrowing animals, many of which are attractive prey for raptors (NWCC 2002). Where wind energy projects are located in grazing allotments, cattle often cluster around wind turbines (e.g., for shade). Cattle waste can attract insects that are prey items for some raptors (NWCC Wildlife Workgroup 2003).

Avian mortality estimates based on data collected from the various wind energy projects in the United States indicate an average of 2.19 avian fatalities per turbine per year for all species combined, and an average of 0.033 fatalities for raptors per turbine per year (Erickson et al. 2001). These estimates are based on survey methods that may or may not be equivalent between wind energy facilities, and may not accurately estimate actual mortality estimates. Excluding California, these averages are 1.83 total avian fatalities per turbine per year, and only 0.006 raptor fatalities per turbine per year. The number of bird fatalities per turbine per year from individual studies has ranged from 0 birds per turbine per year (at Searsburg, Vermont, and Algona, Iowa) to 4.45 birds per turbine per year (at Buffalo Ridge Phase III, Minnesota). Recent estimates of raptor mortality for the Altamont Pass Wind Resource Area (WRA) (Smallwood and Thelander 2004) ranged from 0.16 fatalities per turbine per year to 0.24 fatalities per turbine per year. The range of fatality rates reported for these facilities probably reflects differences in the habitats and bird communities among the sites, as well as differences in the designs of the mortality monitoring studies that generated the reported data. The monitoring study survey methods are not equivalent between facilities, and because of differences in searcher efficiency and study survey design may not accurately estimate mortality rates.

Table 5.9.3-3 summarizes avian fatality rates that have been reported at a number of wind energy projects. At the Foote Creek Rim wind energy project, each meteorological tower killed an estimated 8.1 birds per year compared with turbine estimates of 1.5 bird fatalities per year (Young et al. 2003a). Table 5.9.3-4 lists the number of bird species that have been observed as fatalities at wind energy projects; these data indicate that vulnerability to collisions with turbines is species- and habitat-specific (Erickson et al. 2001).

A comparison of the numbers of species, by order, observed as fatalities in six western states (Tables 5.9.3-4) with the number of species, by order, reported to occur in those same states (Table 4.6.2-2) further indicates that relatively few species actually die as a result of collisions with wind energy facilities. For example, only one species of waterfowl (the Anseriformes: duck, swans, and geese) has been observed as incurring fatalities at wind energy developments in Oregon, Washington, and Wyoming. In comparison, between 37 and 44 waterfowl species have been reported to occur in these states. This difference in numbers probably reflects site-specific differences in the distribution of waterfowl at wind facility locations and their distribution in their habitats in those states. In contrast, seven or more species of raptors (the Falconinformes: kites, eagles, hawks, and osprey) have been observed as fatalities at wind energy developments in California. This number of species represents almost one-third of the raptor species reported to occur in California, with the majority of the fatalities occurring at the Altamont facility. These results further emphasize the importance of species-specific, habitat-specific, and facility-location-specific considerations of bird vulnerability to collisions with turbines. Because they tend to fly at relatively high altitudes, birds conducting long-range migrations may not be likely to be impacted by turbines except during weather conditions that induce them to fly low (Hanowski and Hawrot 2000). Resident birds may have a higher probability of colliding with turbines than migrants, given that residents tend to fly lower and spend more time in the area (Janss 2000).

Some additional information is available for bird casualties at a few other wind energy projects in the United States. The following information is a general summary of bird fatalities recorded for each site:

- Madison, New York — seven turbines located on farmland, four bird fatalities recorded over a period of 1 year;

- St. Mary’s, Kansas — two turbines located in grassland prairie, no bird fatalities recorded in three migration seasons; and

TABLE 5.9.3-3 Avian Fatality Rates Observed at Some Wind Energy Projects[a]

Wind Resource Area	State	No. of Turbines	No. of Bird Fatalities per Turbine per Year[b]	No of Bird Fatalities per 100,000 m^2 of RSA per year[b]	No. of Raptor Fatalities per Turbine per Year[b]	No. of Raptor Fatalities per 100,000 m^2 of RSA per year[b]
Altamont Pass	California	5,400 (in 2001), 7,340 (in early 1990s)	0.33 to 0.87, 0.05 to 0.1, 0.19	NA	0.16 to 0.24, 0.007 to 0.1, 0.048, 0.1	9.0 to 22.0, 1.0 to 2.0[c]
Buffalo Ridge (all phases)	Minnesota	354	2.8	161.0	NA	NA
Buffalo Ridge Phase 1	Minnesota	73	0.33 to 0.66, 0.98	NA	0.01	NA
Buffalo Ridge Phase 2	Minnesota	143	2.27	NA	0.0	NA
Buffalo Ridge Phase 3	Minnesota	138	4.45	NA	0.0	NA
Foote Creek Rim	Wyoming	69	1.5, 1.75	108.0	0.03, 0.036	3.0, 0.3[c]
Green Mountain (Searsburg)	Vermont	11	0.0	0.0	0.0	0.0
IDWGP (Algona)	Iowa	3	0.0	0.0	0.0	0.0
Klondike	Oregon	16	1.42	NA	0.0	NA
Montezuma Hills	California	600	NA	NA	0.48	NA
Mountaineer Wind Energy Center	West Virginia	44	4.04	NA	0.33	NA
Nine Canyon Wind Energy Project	Washington	37	3.59	119.8	0.08	2.6
Princeton	Massachusetts	8	0.0	0.0	0.0	0.0
San Gorgonio	California	2,900	2.31	NA	0.01	NA
Somerset County	Pennsylvania	8	0.0	0.0	0.0	0.0
Stateline	Oregon/ Washington	454	1.7	96.6	0.05	NA
Vansycle	Oregon	38	0.63	38.0	0.0	0.0
Wisconsin	Wisconsin	31	2.83	73.3	0.02	NA

[a] Abbreviations: IDWGP = Iowa Distributed Wind Generation Project; NA = not applicable (not calculated or appropriate); RSA = rotor-swept area.

[b] Multiple values are included if there were results from more than one study.

[c] Golden eagles only.

Sources: Curry and Kerlinger (2004a,b); Erickson et al. (2001, 2002, 2003a,b); Johnson et al. (2002, 2003a); Kerns and Kerlinger (2004); Osborn et al. (2000); Smallwood and Thelander 2004; Strickland et al. (2001a,b); Thelander and Rugge (2001); Young et al. 2003a.

TABLE 5.9.3-4 Number of Bird Species, by Order, Observed as Fatalities at Wind Energy Developments in Various Western States

	State				
Order	CA	CO	OR	WA[a]	WY
Gaviformes – Loons	–[b]	–	–	–	–
Podicipediformes – Grebes	1	–	–	–	1
Procellariiformes – Albatrosses, Fulmars, Shearwaters, Petrels, and Storm-Pertrels	–	–	–	–	–
Pelicaniformes – Tropic Birds, Boobies, Gannets, Pelicans, Cormorants, Anhingas, and Frigate Birds	1	–	–	–	–
Ciconiiformes – Bitterns, Herons, Egrets, Ibises, Spoonbills, and Storks	1+[c]	–	1	1	–
Ciconiiformes – Vultures	–	–	1	–	–
Anseriformes – Swans, Geese, and Ducks	1+	1+	1	1	1
Falconiformes – Kites, Eagles, Hawks, and Osprey	7+	–	2	2	1
Falconiformes – Caracaras and Falcons	2	–	1	1	1
Galliformes – Chachalacas, Pheasants, Grouse, Ptarmigan, Turkeys, and Quail	3	–	3+	3	–
Gruiformes – Rails, Gallinules, Coots, Limpkins, and Cranes	2	–	–	1	–
Charadriiformes – Plovers, Oystercatchers, Stilts, Avocets, Jacanas, Sandpipers, and Phalaropes	–	–	–	–	–
Charadriiformes – Jaegers, Gulls, Skuas, Terns, and Skimmers	1+	1	–	–	–
Charadriiformes – Auks and Murres	–	–	–	–	–
Columbiformes – Pigeons and Doves	2	–	–	–	1
Psittaciformes – Parrots	–	–	–	–	–
Cuculiformes – Cuckoos, Roadrunners, and Anis	1	–	–	–	–
Strigiformes – Owls	5+	–	–	–	1
Caprimulgiformes – Nighthawks and Nightjars	–	–	–	–	2
Apodiformes – Swifts	1	2	1	–	–
Apodiformes – Hummingbirds	–	–	–	–	–
Trogoniformes – Trogans	–	–	–	–	–
Coraciiformes – Kingfishers	–	–	–	–	–
Piciformes – Woodpeckers	1	1	2	–	–
Passeriformes – Flycatchers, Kingbirds, and Phoebes	–	1	–	–	–
Passeriformes – Shrikes	1	–	–	–	–
Passeriformes – Vireos	–	–	–	–	1
Passeriformes – Jays and Crows	2	–	1	1	–
Passeriformes – Larks	1	1	1	1	1
Passeriformes – Swallows	2	2	–	–	2+
Passeriformes – Chickadees and Titmice	–	–	–	–	–
Passeriformes – Verdin, Bushtits, and Wrentits	–	–	–	–	–
Passeriformes – Nuthatches and Creepers	–	–	–	1	1
Passeriformes – Wrens	1	–	2	2	2
Passeriformes – Dippers	–	–	–	–	–
Passeriformes – Kinglets, Old World Warblers, and Gnatcatchers	–	1	2	3	1

TABLE 5.9.3-4 (Cont.)

Order	State				
	CA	CO	OR	WA[a]	WY
Passeriformes – Thrushes and Bluebirds	4	–	1	1	3+
Passeriformes – Mockingbirds and Thrashers	–	–	–	4	1
Passeriformes – Starlings and Accentors	1	1	1	1	–
Passeriformes – Wagtails and Pipits	1	–	–	–	1
Passeriformes – Waxwings	–	–	–	–	–
Passeriformes – Silky Flycatchers	–	–	–	–	–
Passeriformes – Wood Warblers	1	–	2	2	5+
Passeriformes – Tanagers	1	–	–	–	1
Passeriformes – Towhees, Sparrows, and Longspurs	3+	4	6+	7	9
Passeriformes – Cardinals, Grosbeaks, Bunting, and Dickcissel	–	–	–	–	–
Passeriformes – Blackbirds and Orioles	4+	1	2	3	1+
Passeriformes – Finches	1	1	1	1	–
Passeriformes – House Sparrow	–	–	–	–	–

[a] Partially duplicative of Oregon, as data include the Stateline Wind Project that is located at the Oregon/Washington border.

[b] A dash indicates not observed.

[c] + = includes unidentified specimens that may or may not be additional species.

Sources: Erickson et al. (2001, 2003a,b); Strickland et al. (2001a,b); Thelander and Rugge (2001); Thelander et al. (2003); Young et al. (2003a).

- Door County, Wisconsin — 31 turbines located on farmland, 21 bird fatalities (mostly passerines) recorded from 1999 to 2000 (Curry and Kerlinger 2004a,b).

Many of the reported bird fatalities involved common, yearlong resident species such as horned lark, house sparrows, starlings, gulls, and rock doves (Erickson et al. 2001, 2003a). The composition of species that could collide with wind energy facility structures will be a function of the habitat type and quality that is present at and in the vicinity of the facility.

Factors Potentially Contributing to Avian Collisions. As is the case with other tall structures, reduced visibility because of fog, clouds, rain, and darkness may be a contributing factor in collisions of birds with wind turbines. As many as 51 of the 55 collision fatalities (93%) at the Buffalo Ridge Wind Resource Area (WRA) may have occurred in association with inclement weather such as thunderstorms, fog, and gusty winds (Johnson et al. 2002). Aviation marker lights installed on turbines (and meteorological towers) more than 200 ft (60 m) tall may also be a factor in bird fatalities (NWCC 2002). Observed fatality rates of passerines for lit turbines at the Nine Canyon Wind Power Project were higher than for unlit turbines, although differences were not statistically significant (Erickson et al. 2003b). Birds seem most sensitive to red light and appear to be attracted to that color. Blinking red marker lights in poor visibility conditions appear to disorient birds and simulate stars as navigation cues. Quickly flashing white strobes appear to be less attractive to birds (Ugoretz 2001). The presence of lighting on some turbines might attract birds to the area and increase the potential for collision mortality at both the lit and unlit turbines (Johnson et al. 2002). Substations and ancillary facilities that are lit for security purposes may also contribute to this problem, particularly if they are located in close proximity to turbines (Kerlinger and Kerns 2003; NWCC Wildlife Workgroup 2003). The FAA would evaluate proposed wind energy development projects and make recommendations regarding possible airway marking, lighting, and other safety requirements that would become part of the project. Under current (June 2003) FAA regulations, navigation lights would need to be mounted on the first and last turbine of each string and every 1,000 to 1,400 ft (30 to 427 m) in between (EFSEC 2003).

In comparison with early-generation turbines, the new-generation turbines have a larger rotor diameter and, therefore, a larger rotor-swept area (RSA). For example, it would take three to eight average Altamont Pass turbines (150 kW) to make up the same RSA of a single new-generation wind turbine (600 kW to 1.5 MW; Erickson et al. 2002). Bird collision metrics are often provided as fatalities per 100,000 m^2 (1,076,391 ft^2) of RSA in addition to fatalities per turbine. Yearly raptor fatalities at Foote Creek Rim are 0.04 per turbine, which is at the upper range of raptor fatality rates for new-generation wind energy projects. This fatality rate equates to three raptor fatalities per 100,000 m^2 (1,076,391 ft^2) RSA, which is about three to seven times lower than at the Altamont Pass WRA (9 to 22 raptor fatalities per 100,000 m^2 [1,076,391 ft^2] of RSA) (Erickson et al. 2002).

Other factors that may contribute to the variation in bird strikes at different wind energy projects include the spatial arrangement of turbines (including turbine spacing), tower types (e.g., lattice versus tubular), and tower height (e.g., blades rotate closer to the ground on shorter turbines). Also, birds may not be able to see the blade tips of rapidly rotating wind turbine rotors because motion smear makes them seem transparent (Stemer 2002; Hodos 2003). Birds may also not hear the turbine well, especially in noisy (windy) conditions. A human with normal hearing can probably hear a turbine blade twice as far away as the average bird (Dooling 2002).

Raptors. Fatalities of raptors are of special concern because of their generally low numbers and protected status. Except at the Altamont Pass WRA, the number of raptors killed at any facility is small (see Table 5.9.3-3; NWCC 2002). At Foote Creek Rim Construction Unit I, 92% of avian fatalities were passerines, with a little over half of these being nocturnal migrants. Raptor casualties (0.03 bird per turbine per year) were considered low on the basis of high raptor use for the site. The yearly casualty rate for all birds was estimated at 1.5 birds per turbine per year (Young et al. 2003a). Depending on the species involved and its population size, the number of fatalities may or may not result in population-level effects to the affected raptors. To date, no studies have shown population-level effects in raptor populations associated with wind energy projects. The text box beginning on the next page provides additional information about the compatibility of wind energy development and raptors, including information about possible measures to mitigate raptor fatalities.

Passerines. Passerines (both resident and migratory species) are the most common group of birds killed at new wind energy projects, making up more than 80% of reported fatalities (Erickson et al. 2001). About half of the passerine mortalities involve nocturnal migrants, although no large episodic mortality (as has been documented for bird strikes with communication towers) has been known to occur. The largest single incident reported was 14 migrants found at two turbines (Erickson et al. 2002). At Foote Creek Rim WRA, guyed meteorological towers had an estimated per-structure passerine fatality rate four to five times higher than the rate for wind turbines (Young et al. 2003a).

On the basis of mortality estimates at existing wind energy projects, the mid-range expected for passerine mortality would be approximately 1.2 to 1.8 birds per turbine per year. This level of mortality may not have any population-level consequences for individual species, because of the expected low fatality rates for most species and the high population sizes of the common species, such as European starling, American robin, horned lark, and western meadowlark (Young and Erickson 2003). However, population effects may be possible for some species, although no studies to date have documented such effects. Researchers estimated that 6,800 birds are killed annually at the San Gorgonio Pass WRA, while 69 million birds pass through the Coachella Valley annually; therefore, the calculated mortality (approximately 1 in 10,000) from the wind energy project was concluded not to be biologically significant (Erickson et al. 2002). Impacts of the Stateline WRA on grassland nesting passerines may have been largely due to the direct reduction of habitat from turbine pads and roads and the temporary disturbance of habitat between turbines and road shoulders, rather than to collisions with turbines (Erickson et al. 2003a).

Waterfowl. Waterfowl mortality at wind energy projects is relatively minor. Wind energy projects with significant sources of open water near turbines (San Gorgonio, California, and Buffalo Ridge, Minnesota) have the highest documented waterfowl mortality, with 10 to 20% of all fatalities consisting of waterfowl and shorebirds. Some sites with agricultural landscapes are occasionally observed to have large flocks of Canada geese during winter. However, only one Canada goose fatality has been documented (Erickson et al. 2002).

Bat Collisions. There are 45 bat species in the United States, 32 of which have been reported from the 11 western states (see Section 4.6.2.3). To date, only 9 species (6 species in the western states) have been recorded as fatalities at wind farms (Erickson et al. 2002; Johnson and Strickland 2004). Table 5.9.3-5 lists bat species that have been observed as fatalities at wind energy projects. Hoary bats (*Lasiurus cinereus*) and eastern red bats (*L. borealis*) made up most of the bat fatalities in the Midwest and eastern United States, while hoary bats and silver-haired bats (*Lasionycteris noctivagans*) were most commonly observed in the 11 western states. Table 5.9.3-6 summarizes bat fatality rates that have been estimated for several wind energy projects. The estimates are based on survey methods that may or may not be equivalent between individual WRAs, and may not accurately estimate actual mortality levels.

Compatibility of a Wind Energy Development Project and Raptors

Continuing concerns about the effects of wind energy development projects on ecological resources have focused on collisions of birds with turbines. Primary attention has focused on raptor species because of early observations of golden eagle, red-tailed hawk, and American kestrel fatalities at the Altamont Pass and Tehachapi wind energy projects (Erickson et al. 2001). Avian studies have focused on raptors because:

- There is a relatively high proportion of raptors killed at some wind energy projects;
- Raptors have a high public profile;
- Some raptor species have relatively small populations or slow breeding rates; and
- Raptors often fly at heights within the blade sweep area (Kingsley and Whittam 2003).

Other raptor fatalities at wind energy development projects include ferruginous hawk, northern harrier, prairie falcon, Swainson's hawk, white-tailed kite, turkey vulture, barn owl, burrowing owl, flamulated owl, short-eared owl, long-eared owl, and great horned owl (Erickson et al. 2001; Thelander et al. 2003).

Thelander et al. (2003) evaluated bird fatalities from 1998 through 2000 and provided a yearly mortality estimate of 24 golden eagles, 244 red-tailed hawks, 56 American kestrels, and 93 burrowing owls at the Altamont Pass WRA. Smallwood and Thelander (2003) estimated that there were 400 to 800 golden eagle, 2,980 to 5,960 red-tailed hawk, and 2,700 to 5,400 burrowing owl fatalities at the Altamont Pass WRA from 1983 to 2003. Altamont Pass is unusual in its intensive use by raptors, relative to most wind farms, and all fatalities at wind farms are not due to collisions with turbines. During a 7-year study of radio-tagged golden eagles at the Altamont Pass WRA, Hunt (2002) recorded deaths from turbine collisions, electrocutions, wire strikes, vehicle strikes, poisoning, and other causes.

The golden eagle hunts mainly small mammals while soaring or from perches, and may hunt cooperatively (NatureServe 2004). The majority of the golden eagle turbine-strike mortalities at the Altamont Pass WRA occur to subadults and floaters. A reserve of floaters exists (Hunt et al. 1998; Hunt 2002); therefore, collisions of golden eagles with wind farm structures have not resulted in detectable population level effects to this species within the region of the Altamont Pass WRA (Hunt 2002).

The American kestrel is one of the more commonly observed raptor species at most wind projects and is among the most commonly observed raptors killed at Altamont Pass (California), Tehachapi Pass (California), San Gorgonio (California), and Foote Rim Creek (Wyoming). No bald eagle mortalities have been reported at any WRA in the United States. Red-tailed hawk fatalities are also commonly observed at the Altamont WRA. This hawk's relatively motionless flight within an updraft may increase its risk of turbine-related collisions. Scavenger species (e.g., common raven and turkey vulture) are common at many wind farms but are not apparently susceptible to collision (Erickson et al. 2001, 2002; Hoover 2002).

The factors that contribute to a high number of raptor fatalities in California include unusually high raptor densities, topography, and, possibly, older turbine technology (Kingsley and Whittam 2003). Generally, raptors are able to avoid wind turbines (Young et al. 2003b). There is little or no information related to how owl species react to turbines, but they generally fly within turbine height or lower, which puts them at risk of collision. The numbers of owls killed at a wind energy project varies, representing a proportion ranging from 0.0% up to 10 to 15% of the total number of birds killed (Kingsley and Whittam 2004).

When turbines are placed in areas where raptors spend a great deal of time, the incidence of collision increases up (Hoover 2002). However, the relative abundance of a raptor species does not predict the relative frequency of fatalities per species (Thelander and Rugge 2000). Some species may become more susceptible to turbine collisions because postconstruction conditions at the wind farm have increased prey abundance within the vicinity of turbines or ancillary facilities. For example, rock piles produced during construction are used by desert cottontails, which are prey for the eagles, and thus, the eagles are more likely to encounter the turbines while foraging around these rock piles. Thelander et al. (2003) reported a similar relationship between pocket gopher abundance around turbines and red-tailed hawk mortality. The pocket gophers were more abundant on steeper

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Compatibility of a Wind Energy Development Project and Raptors (Cont.)

slopes into which lay-down areas and access roads were cut. Where wind farms are located in grazing allotments, cattle often cluster around wind turbines and their waste can attract insects that are prey items for raptors such as American kestrels and burrowing owls (NWCC Wildlife Workgroup 2003).

Few raptor species targeted during nest surveys have been observed as fatalities at newer wind plants. Correlations are very low between fatalities and overall raptor nest density (Johnson et al. 2003b).

Among the 841 avian fatalities reported from California studies, 42% were diurnal raptors and 11% were owls. Of the 192 avian fatalities reported from outside of California, 2.7% were diurnal raptors and 0.5% were owls. U.S. average raptor fatalities were estimated at 0.033 per turbine per year, which would equate to 495 raptor fatalities for the projected 15,000 operational turbines by the end of 2001. Excluding California, raptor fatalities were estimated at 0.006 per turbine per year, which would equate to 21 raptor fatalities for the 3,500 operational turbines in the United States (excluding California) by the end of 2001 (Erickson et al. 2001).

The reported differences in raptor (and all avian) mortality may be based on differences in turbine characteristics, tower design, and turbine placement (Erickson et al. 2002; Smallwood and Thelander 2004). For example, a 5-year study evaluating bird mortality at the Altamont Pass WRA (Smallwood and Thelander 2004) recovered 1,189 bird carcasses (including 481 raptor carcasses) during the study period. Most of the recovered birds (approximately 70%) were associated with 2 of the 10 turbine/tower combinations present at the facility; more than 45% of all recovered carcasses were associated with lattice-towered turbines. Most of the recovered birds were also found in summer and winter, and at two elevation levels, 115 to 225 m (377 to 738 ft) and 280 to 350 m (918 to 1,148 ft) above sea level. These data also suggest that other environmental factors may contribute to the reported differences in avian mortality at wind facilities.

At the Mountaineer Wind Energy Center, West Virginia, 1 red-tailed hawk and 2 turkey vultures were among the 24 bird carcasses (24 species) found between April 4 and November 11, 2003. The estimated raptor mortality rate is 0.33 per turbine (0.11 per turbine for the red-tailed hawk and 0.22 per turbine for the turkey vulture). This estimate is based on bird fatalities that exclude the fatalities from the May 23, 2003, event where 33 dead birds (no raptors) were observed near three turbines and the substation (Kerns and Kerlinger 2004).

Mitigation measures that could minimize raptor fatalities at wind energy development projects include:

- Raptor use of the project area should be evaluated, and the project should be designed to minimize or mitigate the potential for raptor strikes. Scientifically rigorous raptor surveys should be conducted; the amount and extent of baseline data required should be determined on a project-specific basis.
- Areas with a high incidence of fog, mist, low cloud ceilings, and low visibility should be avoided.
- Turbine locations should be configured in order to avoid landscape features (including prairie dog colonies and other high-prey potential sites) known to attract raptors.
- Turbine arrays should be configured to minimize avian mortality (e.g., orient rows of turbines parallel to known bird movements).
- Underground or raptor-safe transmission lines should be used to reduce collision and electrocution potential.
- A habitat restoration plan should be developed that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species (e.g., avoid the establishment of habitat that attracts high densities of prey animals used by raptors).
- Road cuts, which are favored by pocket gophers and ground squirrels, should be minimized.
- Either no vegetation or native plant species that do not attract small mammals should be maintained around the turbines.

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Compatibility of a Wind Energy Development Project and Raptors (Cont.)

- Tubular supports rather than lattice supports should be used, with no external ladders and platforms.
- The minimum amount of pilot warning and obstruction avoidance lighting specified by the FAA should be used, and the FAA should be consulted.
- Operators should determine if active raptor nests (i.e., raptor nests used during the breeding season) are present. Buffers should be provided to avoid disturbance of nesting raptors.
- Areas with high bird use should be avoided through micrositing alternatives (e.g., at the Foote Creek Rim project, turbines were located slightly away from the rim edge of a flat top mesa [Strickland et al. 2001a]).

With proper design and siting of wind projects (e.g., turbine arrangement and design and land management), raptor mortality can generally be reduced (Defenders of Wildlife 2004; Ling and Linehan 2003). Mitigation measures should be evaluated objectively on a site-specific basis before they are implemented at new wind energy development projects (Strickland et al. 2001a).

Reported bat mortality rates ranged from 0.74 bat per turbine at the Vansycle Ridge Wind Project in Oregon to 3.21 bats per turbine at the Nine Canyon Wind Energy Project in Washington (Erickson et al. 2003b). Using an approximate range of estimates from existing wind energy projects in the West and Midwest, it appears that approximately 1 to 2 bat fatalities occur per turbine per year. Actual levels of mortality could vary, depending on regional migratory patterns, patterns of local movements through the area, and the response of bats to turbines, individually and collectively (Young and Erickson 2003).

Comparative estimates of bat mortalities between wind energy projects and other structures are lacking. However, there are reports of bat strikes with other structures (e.g., television and communication towers, lighthouses, buildings, and powerlines; see Erickson et al. 2002). There are also reports of bats being impaled on barbed-wire fences (DeBlase and Cope 1967).

Preliminary data from the Buffalo Ridge WRA suggest that while a number of bats may be susceptible to turbine collisions, the observed mortality is not sufficient to cause population declines in the vicinity of the facility. This is based on relatively stable fatality rates over time. The effect on migrant bat populations from sustained collision mortality over an extended period of years, however, is not known (Erickson et al. 2002). If the species that were killed were uncommon, impacts could result in population-level effects, while impacts from killing small numbers of common bat species would not be expected to result in population-level effects. The text box beginning on the next page provides additional information about bats and wind energy development projects, including information about possible measures to mitigate bat fatalities.

5.9.3.2.4 Site Maintenance. During the operational period, grass mowing and brush cutting may be required once every few years. These activities would result in minor impacts to

TABLE 5.9.3-5 Bat Species Observed as Fatalities at WRAs in the United States

	Western States					Eastern and Midwestern States				
Species	CA	CO	OR	WA[a]	WY	MN	PA	TN	WI	WV
Big brown bat (*Eptesicus fuscus*)	–[b]	–	X	X	X	X	–	X	X	X
Hoary bat (*Lasiurus cinereus*)	X	X	X	X	X	X	–	X	X	X
Long-eared myotis (*Myotis evotis*)	–	–	–	–	–	–	–	–	–	X
Silver-haired bat (*Lasionycteris noctivagans*)	–	–	X	X	X	X	–	X	X	X
Eastern red bat (*Lasiurus borealis*)	–	–	–	–	–	X	–	X	X	X
Western red bat (*Lasiurus blossevillii*)	X	–	–	–	–	–	–	–	–	–
Little brown bat (*Myotis lucifugus*)	–	–	X	X	X	X	X		–	X
Eastern pipistrelle (*Pipistrellus subflavus*)	–	–	–	–	–	X	–	X	–	X
Myotis sp.	–	–	–	–	–	–	–	–	–	X
Unidentified	X	X	X	X	X	X	–	–	–	X

[a] Duplicative of Oregon, as data are for the Stateline Wind Project that is located at the Oregon/Washington border.

[b] A dash indicates not observed; X indicates observed.

Sources: Erickson et al. (2002, 2003a,b); Johnson and Strickland (2004); Johnson et al. (2003b); Kern and Kerlinger (2004); Strickland et al. (2001a,b); Young et al. (2003a,b).

TABLE 5.9.3-6 Bat Fatality Rates Observed at Wind Energy Projects

Wind Resource Area	State	No. of Turbines	Estimated No. of Bat Fatalities per Turbine per Year[a]	Estimated No. of Bat Fatalities per 100,000 m^2 of RSA per year[b]
Buffalo Mountain	Tennessee	3	10.0	NA[c]
Buffalo Ridge	Minnesota	354	2.3	164.0
Buffalo Ridge Phase 1	Minnesota	73	0.07, 0.26, 2.02	NA
Buffalo Ridge Phase 2	Minnesota	143	1.78, 2.02	NA
Buffalo Ridge Phase 3	Minnesota	138	2.04, 2.32	NA
Foote Creek Rim	Wyoming	69	1.04, 1.34	97.0
Klondike	Oregon	16		33.3
Nine Canyon	Washington	37	3.21	106.6
Stateline	Oregon/ Washington	454	0.95	53.3
Vansycle	Oregon	38	0.74	45.0
Wisconsin	Wisconsin	31	1.1	246.4

[a] Multiple values were included if there were results from more than one study.

[b] RSA = rotor-swept area.

[c] NA = not applicable (not calculated or appropriate).

Sources: Erickson et al. (2002, 2003a,b); Johnson et al. (2003a); Strickland et al. (2001a,b); Young et al. (2003a,b).

wildlife. Mobile animals would be displaced to adjacent undisturbed habitats. Less mobile wildlife could be killed or injured during mowing and cutting; however, the overall significance of such impacts on local wildlife populations would likely be minor, because of the likely limited quality and carrying capacity of the maintained habitats.

The licensed use of pesticides and herbicides at a wind energy project would not be expected to adversely affect local wildlife. Applications of these materials would be conducted by following label directions and in accordance with applicable permits and licenses. However, accidental spills or releases of these materials could impact exposed wildlife. Potential effects of such exposures are discussed below.

5.9.3.2.5 Exposure to Contaminants. During operation of a wind energy project, wildlife may be exposed to accidental spills or releases of pesticides, fuel, or hazardous materials. Exposures to these materials could affect reproduction, growth, development, or survival of exposed individuals. If the magnitude and extent of the spill and subsequent exposure are sufficient, population level effects may be incurred. However, such exposures are not expected under normal facility operations. Only small amounts of these materials would be expected to be present at any facility, and spill response plans would be in place to address any accidental spills or releases. Furthermore, given the small area potentially affected by a spill (much less than 1.0 acre [0.4 ha]), a land-based spill would affect relatively few individual animals and a relatively limited portion of the habitat or food resources for large-ranging mammal species (e.g., deer or elk).

5.9.3.2.6 Disturbance of Wildlife. During wind energy project operations, wildlife both on and off site could be disturbed by vehicles, workers, and project machinery. The response of wildlife to such disturbance is highly variable and depends on species; distance; and type, intensity, and duration of disturbance. Some species may become readily habituated to daily site activities; others may temporarily move from the area; still others may permanently move from the area; and, finally, some species (e.g., raccoons and coyote) may be drawn to the wind energy project areas, particularly if garbage is allowed to accumulate or is improperly managed. Wildlife permanently moving from the area may incur high mortality levels if the surrounding habitats are at or near carrying capacity, or have little similar habitat capable of supporting the displaced individuals.

The presence of new (or improved) access roads and utility and transmission line corridors to the wind energy development site could result in increased access. Increased foot traffic from hikers fording streams, OHVs crossing streams or driving along stream beds, and increased fishing activities could result in impacts to shoreline and shallow water vegetation, increased erosion from shoreline areas disturbed by foot and vehicle traffic, disruption of stream bottoms that support invertebrate and fish populations, and increased fishing pressure. The magnitude and extent of such impacts would be a function of the types of aquatic resources present in the wind energy project area, the proximity of those habitats to access roads and utility and transmission line corridors, and the current level and type of activities that occur on BLM-administered lands in the project area.

While no information was found regarding the injury or mortality of wildlife from human activities, wildlife may incur injury or death through collision with vehicles, particularly OHVs. While occasional wildlife may be injured or killed by a vehicle, most can be expected to respond to the noise of an oncoming vehicle by temporarily fleeing the area or by seeking shelter in a burrow or under rocks. Wildlife may also be impacted if increased access leads to an increase in the legal and illegal take of biota, which could impact local populations of some species.

Increased use of surrounding areas may increase the potential for the introduction and establishment of invasive vegetation and fish (introduced as released bait fish). Establishment of such species could reduce habitat quality and wetland function and alter the biotic community.

The text box beginning on the next page provides information about gallinaceous birds (e.g., sage-grouse) and wind energy development, including information about possible measures to mitigate impacts.

Compatibility of a Wind Energy Development Project and Bats

Much of the research concerning the impacts of wind energy development projects on wildlife has concentrated on avian mortality. However, bat mortality can also be expected at wind farms (Erickson et al. 2002). This concern has gained increased attention ever since the observations of a comparatively large number of bat fatalities at the Mountaineer Wind Energy Center in West Virginia (Johnson and Strickland 2004; Kerns and Kerlinger 2004). However, relatively low numbers of bat fatalities are generally observed at most wind energy development projects, especially in the West.

Only 5 of the 32 bat species reported from the 11 western states have been observed as fatalities at wind farms (Table 5.9.3-5); hoary bat (*Lasiurus cinereus*) and silver-haired bat (*Lasionycteris noctivagans*) fatalities were most commonly observed. The big brown bat (*Eptesicus fuscus*), western red bat (*Lasiurus blossevillii*), and little brown bat (*Myotis lucifugus*) have also been documented as fatalities at some wind energy developments in the western states.

The hoary bat is the most widespread North American bat (CDFG 2004b). It occurs throughout the United States, including all 11 western states. The hoary bat has a dispersed population and is basically solitary except for the mother-young association and during migration when groups of up to hundreds of individuals may form. In summer, adult males are distributed mainly in the western half of North America while the females predominantly occur in eastern North America (NatureServe 2004). The hoary bat occurs in forests and woodlands, usually roosting in tree foliage 3 to 5 m (10 to 16 ft) above ground with dense foliage above and open flying room below (NatureServe 2004). It feeds chiefly on large moths over clearings and may forage around lights in nonurban situations. The hoary bat may forage more than 1.6 km (1.0 mi) from its diurnal roost site, often along streams or lake edges (NatureServe 2004). It may migrate long distances between summer and winter ranges. During spring and fall migrations, large groups are sometimes encountered. Hoary bats that winter in colder climates hibernate (CDFG 2004b). On the basis of the ecology and life history of the hoary bat, fatalities at wind energy development projects would be minimal during summer and minimal to nonexistent during winter.

The silver-haired bat occurs throughout much of the United States, including all 11 western states. Maternity colonies are small. The silver-haired bat usually roosts singly, but occasionally it roosts in groups of up to six individuals. It generally migrates south for the winter and is usually found only during spring and fall migration over most of its range (NatureServe 2004). It prefers forested areas adjacent to lakes, ponds, and streams. The silver-haired bat will sometimes occur in xeric areas during migration. Summer roosts and nursery sites include tree foliage, cavities, or under loose bark; sometimes in buildings (NatureServe 2004). It forages less than 6 m (20 ft) over forest streams, ponds, and open brushy areas (CDFG 2004b). On the basis of the ecology and life history of the silver-haired bat, fatalities at wind energy development projects would be minimal during summer and winter.

Among the 11 western states, the eastern red bat (*Lasiurus borealis)* only occurs within Montana and Colorado, which are at the western limits of its distribution. The western red bat occurs within western Washington, western Oregon, California, western and southern Nevada, Utah, and scattered locations in Arizona and New Mexico (NatureServe 2004). The eastern red bat winters mainly in the southeastern United States. In some nonurban situations, it often forages around lights (NatureServe 2004). The western red bat has a similar life history to that of the eastern red bat (NatureServe 2004). Overall, both the eastern red bat and the western red bat would have a minimal susceptibility to wind turbine fatalities during summer and winter.

The little brown bat occurs throughout the 11 western states except for Arizona (NatureServe 2004). It uses human-made structures, caves, and hollow trees for nesting and maternity sites. It generally forages in woodlands near water and feeds low over water margins of lakes, streams, and ponds as well as along forest edges. On the basis of the ecology and life history of the little brown bat, fatalities at wind energy development projects would be minimal during summer and essentially nonexistent in winter.

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Compatibility of a Wind Energy Development Project and Bats (Cont.)

The big brown bat occurs throughout the United States, including all 11 western states. The big brown bat occurs in wooded and semiopen habitats, including cities, and forages over land or water, clearings and lake edges, and around lights in rural areas. On the basis of the ecology and life history of the big brown bat, fatalities at wind energy development projects would be minimal during summer and essentially nonexistent in winter (Nature Serve 2004; CDFG 2004b).

Between April 4 and November 11, 2003, a total of 475 bat carcasses representing seven species were detected at the Mountaineer Wind Energy Center in West Virginia. It was estimated that 2,092 bat fatalities actually occurred during this period, representing a fatality rate of 47.53 bats per turbine. Most carcasses were found between August 18 and September 30 (92.5%) (Kerns and Kerlinger 2004). Bat fatalities at a three-turbine wind farm on Buffalo Mountain in Tennessee have been studied over a period of 3 years. During this period, 119 dead bats have been documented (Johnson and Strickland 2004). The estimated bat mortality rate for this site was 28.5 bats per turbine per year (Kerns and Kerlinger 2004). Data from the Mountaineer wind energy project support previous conclusions that migrating bats are at most risk of turbine collision and that resident, breeding, or foraging bats have a low risk of collision mortality (Erickson et al. 2002; Johnson and Strickland 2004).

Generally, bat fatality rates are much lower than those observed at the Mountaineer and Buffalo Mountain sites. On the basis of the 184 bat fatalities documented from 1996 to 1999 at the 354-turbine Buffalo Ridge wind energy project in Minnesota, the estimated bat mortality rate was 1.53 bats per turbine per year (Johnson et al. 2003b). No significant difference was noted between bat mortalities at lit and unlit turbines (Johnson et al. 2003b). This lack of difference has also been noted at the Klondike Phase I Wind Project in Oregon, the Buffalo Ridge site in Minnesota, and at the Nine Canyon Wind Power Project in Washington (Erickson et al. 2002, 2003b; Johnson et al. 2003b).

Other reported bat mortality rates range from 0.74 bats per turbine per year at the Vansycle Ridge Wind Project in Oregon, to 3.21 bats per turbine per year at the Nine Canyon Wind Energy Project in Washington (Erickson et al. 2003b). Using an approximate range of estimates from existing wind farms in the West and Midwest, it appears that approximately 1 to 2 bat fatalities occur per turbine per year. Actual levels of mortality could vary depending on regional migratory patterns; patterns of local movements through the area; and the response of bats to turbines, individually and collectively (Young and Erickson 2003).

At the 16-turbine Klondike Phase I Wind Project in Sherman County, Oregon, the estimated total bat mortality over the 1-year study period was 19 or 1.16 bats per turbine per year. Six bats were actually found during the study — during months when this species is generally migrating.

Johnson and Strickland (2004) summarized bat fatality studies that have been conducted at several other eastern U.S. wind facilities. No bat fatalities were found at four facilities: two in farmland habitats and two in forested areas. One little brown bat fatality was found at a facility in a forested area. The number of turbines at these facilities ranged from 2 to 11.

Major trends in bat mortality at wind farms are (1) the majority of bat mortalities tend to be tree-dwelling vesper bats, and (2) most mortality involves migrant or dispersing bats rather than resident breeding bats (Johnson and Strickland 2004; Johnson et al. 2003b; Keeley 2001).

Mitigation measures that could minimize bat fatalities at wind energy development projects include:

- Turbines should not be located near known bat hibernation, breeding, and maternity/nursery colonies, in migration corridors, or in flight paths between colonies and feeding areas.
- Bat use of the project area should be evaluated, and the project should be designed to minimize or mitigate the potential for bat strikes. Both macro- and micro-siting options can be considered to minimize impacts to bats.

With proper design and siting of wind projects (e.g., turbine arrangement and design and land management), bat mortality can be greatly reduced and population-level effects avoided (Defenders of Wildlife 2004; Ling and Linehan 2003).

5.9.3.2.7 Interference with Migratory Behavior. Wildlife may also be affected if a wind energy project and/or its ancillary facilities interfere with migratory movements, while migrating birds and bats are expected to simply fly around individual structures or around or over the facility site and continue their migratory movement. (Impacts to migratory birds and bats from collisions with facility structures are addressed in Section 5.9.3.2.3.) The presence of a wind energy project could disrupt movements of terrestrial wildlife, particularly during migration. Herd animals, such as elk, deer, and pronghorn antelope, could potentially be affected if rows of turbines are placed along migration paths between winter and summer ranges or in calving areas (NWCC 2002). However, studies conducted at Foote Creek Rim in Wyoming have not demonstrated any displacement effects on pronghorn antelope, and antelope use of the area has not declined since construction of the wind energy project (Johnson et al. 2000). The wind energy development project and associated transmission lines and access roads would be maintained as areas of low vegetation that may hinder or prevent movements of some wildlife species.

5.9.3.2.8 Fire. Increased human activity also increases the potential for fires (see Section 5.9.3.1.6). Fire may affect wildlife through (1) direct mortality, (2) reduction of habitat, or (3) a reduction in habitat quality. In general, short-term and long-term fire effects on wildlife are related to fire impacts on vegetation, which in turn affect habitat quality and quantity, including the availability of forage shelter (Groves and Steenhof 1988; Sharpe and Van Horne 1998; Lyon et al. 2000b; USDA 2002a,b; Hedlund and Rickard 1981; Groves and Steenhof 1988; Knick and Dyer 1996; Watts and Knick 1996; Schooley et al. 1996; USDA 2002b,c).

Wildlife may survive fires by either seeking underground or aboveground refuge within the fire or by moving away from it (Ford et al. 1999; Lyon et al. 2000a). While individuals caught in a fire could incur increased mortality, depending on how quickly the fire spreads, most wildlife would be expected to escape by either outrunning the fire or seeking safety in burrows. Some mortality of burrowing mammals from asphyxiation in their burrows during fire has been reported (Erwin and Stasiak 1979). Burrowing kangaroo rats were reported as the only rodents to survive a chaparral fire, probably because the burrows protected them from the fire (Lyon et al. 2000b).

In the absence of long-term vegetation changes, rodents in grasslands usually show a decrease in density after a fire, but they often recover to achieve densities similar to or greater than preburn levels (Beck and Vogel 1972; Lyon et al. 2000b; USDA 2002d). Long-term changes in vegetation from a fire (such as loss of sagebrush or the invasion or increase of nonnative annual grasses) may affect food availability and quality and habitat availability for wildlife; the changes could also increase the risk from predation for some species (Hedlund and Rickard 1981; Groves and Steenhof 1988; Knick and Dyer 1997; Watts and Knick 1996; Schooley et al. 1996; Lyon et al. 2000b; USDA 2002b,c).

Compatibility of a Wind Energy Development Project and Gallinaceous Birds

Most concerns about the effects of wind energy development projects on ecological resources have focused on collisions of birds and bats with turbines. However, increasing attention is being paid to the potential impacts associated with reduction, fragmentation, and modification of grassland and shrubland habitats by wind energy projects and their associated infrastructure (Manes et al. 2002). The lesser prairie-chicken, sharp-tailed grouse, and sage-grouse (both Gunnison and greater sage-grouse) are of particular concern relative to reduction and fragmentation of sagebrush habitat within the 11 western states.

Depending on the population of sage-grouse, which varies from nonmigratory to migratory, a population may occupy an area that exceeds 1,040 mi^2 (2,700 km^2) on an annual basis. The distance between leks and nesting sites can exceed 12.4 mi (20 km) (Connelly et al. 2000). However, sage-grouse have a high fidelity to a seasonal range (Connelly et al. 2000).

Among the gallinaceous bird species, the sage-grouse is especially of concern to the BLM because about half of the remaining sage-grouse habitat occurs in areas that are under BLM jurisdiction. Therefore, the BLM has an important role in the conservation of sage-grouse and other sagebrush-dependent wildlife species. Sage-grouse need contiguous, undisturbed areas of high-quality habitat during their four distinct seasonal periods: (1) breeding, (2) summer-late brooding and rearing, (3) fall, and (4) winter (Connelly et al. 2000).

The breeding and nesting characteristics of the lesser prairie-chicken and sharp-tailed grouse are similar to those of the sage-grouse. However, their habitats and general food types vary somewhat from those of the sage-grouse; both species are less dependent upon sagebrush as habitat and, especially, as a winter food source (NAGP 2004; NatureServe 2004).

Loud, unusual sounds and noise from construction and human activities disturb gallinaceous birds, cause birds to avoid traditional use areas, and reduce sage-grouse use of leks (Young 2003). Disturbance at leks appears to limit reproductive opportunities and may result in regional population declines. Most observed nest abandonment is related to human activity (NatureServe 2004). Thus, site construction, turbine operation, and site-maintenance activities could be a source of auditory and visual disturbance to sage-grouse.

Transmission lines, turbines, and access roads may adversely affect habitats important to gallinaceous birds by causing fragmentation, reducing habitat value, or reducing the amount of habitat available (Braun 1998). Transmission lines, turbines, and other structures can also provide perches and nesting areas for raptors and ravens that may prey upon gallinaceous birds.

Measures that have been suggested for management of sage-grouse and their habitats (e.g., Paige and Ritter 1999; Connelly et al. 2000; Montana Sage-Grouse Work Group 2003) that have pertinence to wind energy development projects include:

- Identify and avoid both local (daily) and seasonal migration routes.
- Consider sage-grouse and sage habitat when designing, constructing, and utilizing project access roads and trails.
- Avoid, when possible, siting energy developments in breeding habitats.
- Adjust the timing of activities to minimize disturbance to sage-grouse during critical periods.
- When possible, locate energy-related facilities away from active leks or near sage-grouse habitat.
- When possible, restrict noise levels to 10 dB above background noise levels at the lek sites.
- Minimize nearby human activities when birds are near or on leks.
- As practicable, do not conduct surface-use activities within crucial sage-grouse wintering areas from December 1 through March 15.
- Maintain sagebrush communities on a landscape scale.

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Compatibility of a Wind Energy Development Project and Gallinaceous Birds (Cont.)

- Provide compensatory habitat restoration for impacted sagebrush habitat.
- Avoid the use of pesticides at grouse breeding habitat during the brood-rearing season.
- Develop and implement appropriate measures to prevent the introduction or dispersal of noxious weeds.
- Avoid creating attractions for raptors and mammalian predators in sage-grouse habitat.
- Consider measures to mitigate impacts at off-site locations to offset unavoidable sage-grouse habitat alteration and reduction at the project site.

The BLM manages more sage-grouse habitat than any other entity; therefore it has developed a National Sage-Grouse Habitat Conservation Strategy for BLM-administered public lands to manage public lands in a manner that will maintain, enhance, and restore sage-grouse habitat while providing for multiple uses of BLM-administered public lands (BLM 2004g). The strategy was issued in November 2004 and is consistent with the individual state sage-grouse conservation planning efforts. The purpose of this strategy is to set goals and objectives, assemble guidance and resource materials, and provide more uniform management directions for the BLM's contributions to the multistate sage-grouse conservation effort being led by state wildlife agencies (BLM 2004g). The BLM (2004g) strategy includes guidance for (1) addressing sagebrush habitat conservation in BLM land use plans, and (2) managing of sagebrush plant communities for sage-grouse conservation. This guidance is designed to support and promote the rangewide conservation of sagebrush habitats for sage-grouse and other sagebrush-obligate wildlife species on public lands administered by the BLM, and presents a number of suggested management practices (SMPs). These SMPs include management or restoration activities, restrictions, or treatments that are designed to enhance or restore sagebrush habitats. The SMPs are divided into two categories: (1) those that will help maintain sagebrush habitats (e.g., practices or treatments to minimize unwanted disturbances while maintaining the integrity of the sagebrush communities), and (2) those that will enhance sagebrush habitat components that have been reduced or altered (BLM 2004g).

SMPs that are or may be pertinent to wind energy development projects include:

- Development of monitoring programs and adaptive management strategies,
- Control of invasive species,
- Prohibition or restriction of OHV activity,
- Consideration of sage-grouse habitat needs when developing restoration plans,
- Avoidance of placing facilities in or next to sensitive habitats such as leks and wintering habitat,
- Location or construction of facilities so that facility noise does not disturb grouse activities or leks,
- Consolidation of facilities as much as possible (use existing ROWs),
- Initiation of restoration practices as quickly as possible following land disturbance,
- Installation of antiperching devices on existing or new power lines in occupied sage-grouse habitat, and
- Design of wind energy facilities to reduce habitat fragmentations and mortality to sage grouse.

Raptor populations generally are unaffected by, or respond favorably to, burned habitat (Lyon et al. 2000b). Fires may benefit raptors by reducing cover and exposing prey; raptors may also benefit if prey species increase in response to post-fire increases in forage (Lyon et al. 2000b; USDA 2002d). Direct mortality of raptors from fire is rare (Lehmen and Allendorf 1989), although fire-related mortality of burrowing owls has been documented (USDA 2002d). Most adult birds can be expected to escape fire, while fire during nesting (prior to fledging) may kill young birds, especially of ground-nesting species (USDA 2002d).

5.9.3.3 Operational Effects on Wetlands and Aquatic Resources

Potential operational impacts to wetlands and aquatic resources may be expected to be of lesser magnitude than impacts that could be incurred during construction of the wind energy project (see Section 5.9.2.3). Wetlands and aquatic resources could be affected by (1) site maintenance activities that involve mowing or cutting of wetland and riparian vegetation, (2) exposure to contaminants, and (3) decreased water quality due to surface runoff from the site (Table 5.9.3-7). Wetlands and aquatic resources could also be affected by human activities not related to wind energy project operations but rather associated with increased access to BLM-administered lands in the immediate vicinity of the wind energy project site. Potential impacts from increased access may include (1) disturbance of biota in wetland and aquatic habitats, (2) the introduction of invasive fish and vegetation, and (3) the illegal take of fish or other aquatic biota (Table 5.9.3-7).

5.9.3.4 Operational Effects on Threatened and Endangered Species

If present, threatened and endangered species (including federal and state listed species and BLM-designated sensitive species) could be affected by the same operational stressors and in the same manner as identified for vegetation, wildlife, and aquatic resources. Primary operational concerns would be associated with disturbance of species-specific behaviors (reproductive and foraging); electrocution from contact with transmission lines; collision with turbines, meteorological towers, and transmission lines; exposures to accidental releases of hazardous materials; decreased water quality; and interference with migratory movements.

The potential for operational impacts may be considered low for a variety of reasons. First, consistent with the requirements of the ESA and other applicable laws, regulations, policies, program guidance, and management plans (e.g., FLPMA), it is unlikely that a wind energy development project would be sited in a location known to have one or more federal listed species. Second, the siting and design of a wind energy project would be conducted in a manner to avoid or minimize, to the maximum extent possible, impacting threatened or endangered species. Third, the siting, construction, and subsequent operation of a wind energy project on BLM-administered lands would be conducted in compliance with BLM Manual 6840 — Special Status Species Management (BLM 2001), which provides policy and guidance, consistent with appropriate laws, for the conservation of special status species of

TABLE 5.9.3-7 Potential Wind Energy Operation Effects on Aquatic Biota and Habitat

Ecological Stressor	Associated Project Activity or Feature	Potential Effect	Effect Extent and Duration
Wind Energy Facility Operations			
Injury from mowing	Mowing at support buildings and turbine locations, utility corridors, and transmission corridors.	Maintenance of plant communities in early successional stages; invasive plants; decrease in habitat quality.	Short-term (duration of facility operation) for vegetation injury; long-term for invasive vegetation establishment; short- or long-term habitat quality impacts; localized to mowed areas.
Exposure to contaminants	Accidental spill or release of pesticides, fuel, or hazardous materials.	Exposure may affect survival, reproduction, development, or growth of aquatic biota.	Short- or long-term; largely localized to spill locations.
Decreased water quality	No specific operations-related activity; increased erosion and runoff from bare ground areas, such as access roads and parking areas, and from site locations disturbed during construction and poorly stabilized.	Decreased survival or habitat avoidance of invertebrates and fish due to decreased levels of dissolved oxygen; reduced photosynthesis and productivity of algae and aquatic macrophytes due to increased turbidity and decreased light penetration; decreased egg and larvae survival due to siltation.	Long-and short-term, depending on type of aquatic habitat and associated biota; short-term impacts episodic, associated with precipitation events.
Non-Facility-Related Human Activities			
Disturbance of nearby biota	Increased access to surrounding areas by visitors, including unauthorized vehicles, along facility access roads and utility and transmission corridors.	Impacts to shoreline habitats from foot and vehicle traffic; disruption of stream bottoms from foot and vehicle traffic fording streams and from vehicle travel along stream beds; increased fishing pressure.	Short- or long-term in areas adjacent to the wind facility, access roads, utility corridors, and transmission corridors; long-term at areas that become commonly used.
Introduction and establishment of invasive species	Increased access to surrounding areas by visitors, including unauthorized vehicles, along facility access roads and utility and transmission corridors.	Introduction of invasive bait fish, resulting in community-level changes on resident fishes. Establishment of invasive vegetation, resulting in reduced wetland habitat quality and functions and a reduced number of fish, waterfowl, and/or riparian wildlife.	Long-term, off-site.
Legal and illegal take of aquatic biota	Increased access to surrounding areas.	Increased fishing pressure; reduced abundance and/or distribution of some biota.	Short- or long-term, depending on species affected and magnitude of take.

plant and animals and the ecosystems on which they depend. Finally, the use of mitigation measures would further act to avoid or minimize the potential for affecting threatened or endangered species.

Potential impacts to threatened or endangered species (if present) from non-facility-related human activity would also be similar to those identified for vegetation, wildlife, and aquatic resources. These potential impacts would be unrelated to facility operations and out of the control of the facility and its operators.

Impacts may include the dispersal of invasive plant species into quality native plant habitats, which in turn could affect the availability of forage and habitat for wildlife and thus impact wildlife population levels.

5.9.4 Site Decommissioning

Impacts to biological resources from decommissioning activities would be similar in nature to the impacts that occur during construction, but of a reduced magnitude. There would be a temporary increase in noise and visual disturbance associated with the removal of wind energy project facilities and site restoration. Negligible to no reduction in wildlife habitat would be expected, and injury and mortality rates of vegetation and wildlife would be much lower than they would be during construction. Removal of turbines, meteorological towers, and overhead transmission components would eliminate the impacts associated with wildlife interactions with wind facility structures. Following site restoration, the biological resources at the project site could return to preproject conditions.

5.9.5 Mitigation Measures

The previous evaluations identified a number of potential impacts that could be incurred during the construction, operation, and decommissioning of a wind energy facility. A variety of mitigation measures may be implemented at wind energy projects to reduce potential ecological impacts, and these are described in the following sections. In addition, monitoring during the various phases of wind energy development can be utilized to identify potential concerns and direct actions to address those concerns. Monitoring data can be used to track the condition of ecological resources, to identify the onset of impacts, and to direct appropriate site management responses to address those impacts.

The following sections identify measures that may be appropriate for mitigating impacts that could be associated with new wind energy projects. In addition to these measures, a variety of federal and state agencies and environmental organizations have identified measures for mitigating the ecological impacts of other human activities. BLM guidance documents also identify measures for mitigating ecological impacts associated with other approved activities on BLM-administered lands, and these mitigation measures may be applicable to wind energy projects (see Section 3.6.2).

5.9.5.1 Mitigation during Site Monitoring and Testing

Site monitoring and testing would generally result in only minimal impacts to ecological resources. The following mitigation measures may ensure that ecological impacts during this stage of the project would be minimal:

- Existing roads should be used to the maximum extent feasible to access a proposed project area.
- If new access roads are necessary, they should be designed and constructed to the appropriate standard.
- Existing or new roads should be maintained to the condition needed for facility use.
- The area disturbed during the installation of meteorological towers (i.e., the tower footprint and its associated lay-down area) should be kept to a minimum.
- Individual meteorological towers should not be located in or near sensitive habitats or in areas where ecological resources known to be sensitive to human activities are present.
- Installation of meteorological towers should be scheduled to avoid disruption of wildlife reproductive activities or other important behaviors (e.g., during periods of sage-grouse nesting).

5.9.5.2 Mitigation during Plan of Development Preparation and Project Design

Mitigation measures may be considered during preparation of the POD and project design to ensure that the siting of the overall wind energy development project and of individual facility structures, as well as various aspects of the design of individual facility structures, do not result in unacceptable impacts to ecological resources. The following measures should be incorporated into the development of the POD and siting of the wind development project:

- Operators should identify important, sensitive, or unique habitat and biota in the project vicinity and site, and design the project to avoid (if possible), minimize, or mitigate potential impacts to these resources. The design and siting of the facility should follow appropriate guidance and requirements from the BLM and other resource agencies, as available and applicable.
- The BLM and operators should contact appropriate agencies early in the planning process to identify potentially sensitive ecological resources that may be present in the area of the wind energy development.

- The operators should conduct surveys for federal- and state-protected species and other species of concern within the project area.

- Operators should evaluate avian and bat use (including the locations of active nest sites, colonies, roosts, and migration corridors) of the project area by using scientifically rigorous survey methods (e.g., see NWCC 1999).

- The project should be planned to avoid (if possible), minimize, or mitigate impacts to wildlife and habitat.

- Discussion should be held with the appropriate BLM Field Office staff regarding the occurrence of sensitive species or other valued ecological resources in the proposed project area.

- Existing information on species and habitats in the project area should be reviewed.

The amount and extent of necessary preproject data would be determined on a project-by-project basis, based in part on the environmental setting of the proposed project location. Methods for collecting such data may be found in NWCC (1999).

5.9.5.2.1 Mitigating Habitat Impacts. The following measures may be incorporated into the POD and considered during project siting to minimize potential habitat disturbance:

- If survey results indicate the presence of important, sensitive, or unique habitats (such as wetlands and sagebrush habitat) in the project vicinity, facility design should locate turbines, roads, and support facilities in areas least likely to impact those habitats.

- Habitat disturbance should be minimized by locating facilities (such as utility corridors and access roads) in previously disturbed areas (i.e., locate transmission lines within or adjacent to existing power line corridors).

- Existing roads and utility corridors should be utilized to the maximum extent feasible.

- New access roads and utility corridors should be configured to avoid high quality habitats and minimize habitat fragmentation.

- Site access roads and utility corridors should minimize stream crossings.

- A habitat restoration management plan should be developed that identifies vegetation, soil stabilization, and erosion reduction measures and requires that restoration activities be implemented as soon as possible following facility construction activities.

- Individual project facilities should be located to maintain existing stands of quality habitat and continuity between stands.

- The creation of, or increase in, the amount of edge habitat between natural habitats and disturbed lands should be minimized.

- To minimize impacts to aquatic habitats from increased erosion, the use of fill ramps rather than stream bank cutting should be designated for all stream crossings by access roads.

- Stream crossings should be designed to provide in-stream conditions that allow for and maintain uninterrupted movement and safe passage of fish.

5.9.5.2.2 Mitigating Site/Wildlife Interactions. To reduce the potential use of site facilities by perching birds, to reduce the potential for collisions with project facilities, and to reduce the potential for electrocution, the following measures should be considered during the development of the POD and design of individual facility structures:

- Locations that are heavily utilized by migratory birds and bats should be avoided.

- Permanent meteorological towers, transmission towers, and other facility structures should be designed to discourage their use by birds for perching or nesting.

- The use of guy wires on permanent meteorological towers should be avoided or minimized.

- Electrical supply lines should be buried in a manner that minimizes additional surface disturbance. Overhead lines should be used in cases where the burial of lines would result in further habitat disturbance.

- Power lines should be configured to minimize the potential for electrocution of birds, by following established guidelines (e.g., APLIC [1996], APLIC and USFWS [2005]).

- Operators should consider incorporating measures to reduce raptor use of the project site into the design of the facility layout (e.g., minimize road cuts and maintain nonattractive vegetation around turbines).

- Turbines and other project facilities should not be located in areas with known high bird usage; in known bird and/or bat migration corridors or known flight paths; near raptor nest sites; and in areas used by bats as colonial hibernation, breeding, and maternity/nursery colonies, if site studies show that they would pose a high risk to species of concern.

- Wind energy projects should not be located in areas with a high incidence of fog and mist.

- To reduce attraction of migratory birds to turbines and towers, the need for or use of sodium vapor lights at site facilities should be minimized or avoided.

- Turbines should be configured to avoid landscape features known to attract raptors, if site studies show that placing turbines there would pose a significant risk to raptors.

5.9.5.3 Mitigation during Construction

Construction of a wind energy project may impact ecological resources. A variety of measures may be implemented to minimize the potential for these impacts. In addition to general engineering practices, existing BLM program-specific guidance documents (see Section 3.6.2) identify other mitigation measures for activities on program-specific BLM-administered lands that may be applicable to wind energy development projects.

5.9.5.3.1 Mitigating Habitat Disturbance. To mitigate habitat reduction or alternation during construction, the following measures may be implemented:

- The size of all disturbed areas should be minimized.

- Where applicable, the extent of habitat disturbance should be reduced by keeping vehicles on access roads and minimizing foot and vehicle traffic through undisturbed areas.

- Habitat restoration activities should be initiated as soon as possible after construction activities are completed.

5.9.5.3.2 Mitigating Disturbance and Injury of Vegetation and Wildlife. These measures may be applicable to mitigate the disturbance or injury of biota during construction:

- In consultation with staff from the BLM and other appropriate natural resource agencies, construction activities should be scheduled to avoid important periods of wildlife courtship, breeding, nesting, lambing, or calving.

- All construction employees should be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship, nesting) seasons. In addition, any pets should not be permitted on site during construction.

- Buffer zones should be established around raptor nests, bat roosts, and biota and habitats of concern, if site studies show that proposed facilities would pose a significant risk to avian or bat species of concern.

- Noise-reduction devices (e.g., mufflers) should be maintained in good working order on vehicles and construction equipment.

- Explosives should be used only within specified times and at specified distances from sensitive wildlife or surface waters as established by the BLM or other federal and state agencies.

- The use of guy wires on permanent meteorological towers should be avoided.

5.9.5.3.3 Mitigating Erosion and Fugitive Dust Generation. Measures to minimize disturbance of ecological resources from erosion and fugitive dust may include:

- Erosion controls that comply with county, state, and federal standards should be applied. Practices such as jute netting, silt fences, and check dams should be applied near disturbed areas.

- All areas of disturbed soil should be reclaimed using weed-free native grasses, forbs, and shrubs. Reclamation activities should be undertaken as early as possible on disturbed areas.

- Dust abatement techniques should be used on unpaved, unvegetated surfaces to minimize airborne dust.

- Construction materials and stockpiled soil should be covered if they are a source of fugitive dust.

- Erosion and fugitive dust control measures should be inspected and maintained regularly.

5.9.5.3.4 Mitigating Fuel Spills. To minimize potential impacts to ecological resources from accidental fuel spills, the following mitigation measures may be implemented:

- All refueling should occur in a designated fueling area that includes a temporary berm to limit the spread of any spill.

- Drip pans should be used during refueling to contain accidental releases.

- Drip pans should be used under fuel pump and valve mechanisms of any bulk fueling vehicles parked at the construction site.

- Spills should be immediately addressed per the appropriate spill management plan, and soil cleanup and soil removal initiated if needed.

5.9.5.3.5 Mitigating Establishment of Invasive Vegetation. The following measures may be implemented to minimize the potential establishment of invasive vegetation at the site and its associated facilities:

- Operators should develop a plan for control of noxious weeds and invasive plants, which could occur as a result of new surface disturbance activities at the site. The plan should address monitoring, weed identification, the manner in which weeds spread, and methods for treating infestations. The use of certified weed-free mulching should be required.

- If trucks and construction equipment are arriving from locations with known invasive vegetation problems, a controlled inspection and cleaning area should be established to visually inspect construction equipment arriving at the project area and to remove and collect seeds that may be adhering to tires and other equipment surfaces.

- Access roads and newly established utility and transmission line corridors should be monitored regularly for invasive species establishment, and weed control measures should be initiated immediately upon evidence of invasive species introduction.

- Fill materials that originate from areas with known invasive vegetation problems should not be used.

- Certified weed-free mulch should be used when stabilizing areas of disturbed soil.

- Habitat restoration activities and invasive vegetation monitoring and control activities should be initiated as soon as possible after construction activities are completed.

- All areas of disturbed soil should be reclaimed using weed-free native shrubs, grasses, and forbs.

- Pesticide use should be limited to nonpersistent, immobile pesticides and should only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.

5.9.5.4 Mitigation during Operation

5.9.5.4.1 Mitigating Fuel Spills and Exposure to Site-Related Chemicals. The following measures may be implemented to minimize the potential for exposure of biota to accidental spills:

- Drip pans should be used during refueling to contain accidental releases.
- Pesticide use should be limited to nonpersistent, immobile pesticides and herbicides and should only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- Spills should be immediately addressed per the appropriate spill management plan, and soil cleanup and removal initiated, if needed.

5.9.5.4.2 Mitigating Establishment of Invasive Vegetation. The following measure may be implemented to minimize the potential establishment of invasive vegetation at the site and its associated facilities:

- Access roads, utility and transmission line corridors, and tower site areas should be monitored regularly for invasive species establishment, and weed control measures should be initiated immediately upon evidence of invasive species introduction.

5.9.5.4.3 Mitigating Site/Wildlife Interactions. Measures to mitigate these interactions were previously addressed by the measures identified for inclusion in development of the POD and facility siting and design. The following measures may further reduce the potential for bird collisions, primarily through reducing the attractiveness of the facility to birds:

- Higher-height vegetation (i.e., shrub species) should be encouraged along transmission corridors to minimize foraging in these areas by raptors to the extent local conditions will support this vegetation.
- Areas around turbines, meteorological towers, and other facility structures should be maintained in an unvegetated state (e.g., crushed gravel), or only vegetation that does not support wildlife use should be planted.
- All unnecessary lighting should be turned off at night to limit attracting migratory birds.
- Employees, contractors, and site visitors should be instructed to avoid harassment and disturbance of wildlife, especially during reproductive

(e.g., courtship and nesting) seasons. In addition, pets should be controlled to avoid harassment and disturbance of wildlife.

- Observations of potential wildlife problems, including wildlife mortality, should be reported to the BLM authorized officer immediately.

5.9.5.5 Mitigation during Decommissioning

The measures identified to mitigate construction impacts are applicable to decommissioning activities and may include:

- All turbines and ancillary structures should be removed from the site.

- Topsoil from all decommissioning activities should be salvaged and reapplied during final reclamation.

- All areas of disturbed soil should be reclaimed using weed-free native shrubs, grasses, and forbs.

- The vegetation cover, composition, and diversity should be restored to values commensurate with the ecological setting.

Following removal of the project facilities, implementation of appropriate habitat restoration activities could restore disturbed areas to preproject conditions.

5.9.5.6 Mitigation for Threatened, Endangered, and Sensitive Species

If federal listed species are present in the project vicinity, the BLM will consult with the USFWS as required by Section 7 of the ESA. A Biological Assessment could be required, in addition to the assessment of impacts in the site-specific NEPA document for the project. Subsequently, formal consultation may be required that would result in a Biological Opinion issued by the USFWS. The Biological Opinion would specify reasonable and prudent measures and conservation recommendations to minimize impacts on the federal listed species at the site.

A variety of site-specific and species-specific measures may be required to mitigate potential impacts to special status species if present in the project area. Such measures may include:

- Field surveys should be conducted to verify the absence or presence of the species in the project area and especially within individual project footprints.

- Project facilities or lay-down areas should not be placed in areas documented to contain or provide important habitat for those species.

5.10 LAND USE

The construction and operation of a wind energy development project would have an impact on land use if there were:

- Conflict with existing land use plans and community goals;
- Conflict with existing recreational, educational, religious, scientific, or other uses of the area; or
- A conversion of the existing commercial land use of the area (e.g., mineral extraction) (PBS&J 2002).

5.10.1 Potential Impacts to BLM-Administered Lands

Generally, all public lands unless otherwise classified, segregated, or withdrawn are available at the BLM's discretion for ROW authorization for wind energy development under the FLMPA. As stated in Section 2.2.1, all lands that compose the BLM's NLCS would be excluded from consideration for authorization for wind energy development, with the exception of the California Desert Conservation Area (CDCA). The CDCA was authorized by Section 601 of the FLPMA. The Secretary of the Interior was directed by Section 601(d) to prepare and implement a comprehensive long-range plan for the management, use, development, and protection of the public lands within the CDCA. The *California Desert Conservation Area Plan*, *as Amended* (BLM 1999), identifies wind energy development as an authorization of the public lands, consistent with the Plan and NEPA. Consequently, public lands located in the CDCA are not off-limits for wind energy development.

Similarly, ACECs would also be excluded from consideration (Section 2.2.1). ACECs are considered land use authorization avoidance areas because they are known to contain resource values that could result in denial of applications for land uses that cannot be designed to be compatible with the management objectives and prescriptions for the ACEC (BLM 2003l). Adverse impacts to natural, cultural, and visual resources would be largely minimized by excluding the NLCS lands and ACECs from wind resource development authorization.

Site monitoring and testing would generally result in temporary, localized impacts to existing land uses associated with the meteorological towers and minimum-specification access roads (if required). Meteorological data would be collected for 1 to 3 years (Section 3.1.1) and would require the installation of meteorological towers to characterize the wind regime at a potential WRA. Since a meteorological tower would occupy only a few square feet, only a negligible impact to most existing land uses would be expected. However, the presence of the towers and possible access roads may impact more remote recreational experiences.

Construction activities would generally result in temporary impacts to existing land uses. For example, if the area was used for grazing, livestock might need to be removed from the areas where blasting or heavy equipment operations were taking place (EFSEC 2003). Permanent land use impacts are based on the amount of land that would be displaced by a proposed project and by the compatibility of the proposed use with existing, adjacent uses (PBS&J 2002). A significant permanent land use impact would occur from an uncompensated loss of the current productive use of the site or foreclosure of future land uses (FPL Energy North Dakota Wind, LLC 2003). However, permanently converted acreage would usually compose only a small portion of that available within a project area. For example, at the proposed Kittitas Valley Wind Power Project in Washington, a maximum of only 118 out of 7,000 acres (48 out of 2,833 ha) of rangeland within the project area, or only 118 out of 445,000 acres (48 out of 180,085 ha) of pasture or unimproved grazing lands within Kittitas County, would be permanently converted to energy production (EFSEC 2003). Given the overall footprints of wind turbine towers and ancillary structures, the amount of acreage required for most wind energy development projects should be a small fraction of the leased area.

Generally, wind turbines need to be separated by a distance equivalent to at least several tower heights in order to allow wind strength to reform and for the turbulence created by one rotor not to harm another turbine downwind. Therefore, only a small percentage of land area is taken out of use by the turbines, access roads, and other associated infrastructure. Depending on the location, size, and design of a wind energy development project, wind development is compatible with a wide variety of land uses and generally would not preclude recreational, wildlife habitat conservation, military, livestock grazing, oil and gas leasing, or other activities that currently occur within the proposed project area. The opportunity may also exist for wind development on reclaimed mine lands. A review of existing land use plans, zoning designations, and policies would need to be conducted in order to provide appropriate, up-front guidance to developers on where and how to locate wind energy projects so that they would be as consistent as reasonably possible with existing land uses and the environment (NWCC 2002).

Overall, the establishment of a wind energy development project and its ancillary structures (e.g., transmission lines and access road) would modify the existing land cover), particularly if the wind energy development project was located within existing forests and shrublands.

Indirect land use impacts would not be expected, because it is anticipated that a wind energy development project would not substantially induce or reduce regional growth to the extent that it would change off-site land uses or use of off-site resource-based recreation areas (EFSEC 2003).

Upon decommissioning, land use impacts from facility construction and operation would be mostly reversible. No permanent land use impacts would occur from decommissioning (EFSEC 2003). The BLM could decide to continue the use of, and maintain, access roads.

5.10.2 Potential Impacts to Aviation

The FAA requires a notice of proposed construction for a project so that it can determine whether it would adversely affect commercial, military, or personal air navigation safety (FAA 2000). One of the triggering criteria is whether the project would be located within

20,000 ft (6,096 m) or less of an existing public or military airport (depending upon the type of airport or heliport, see Sections 4.7.2 and 4.7.3). If the potential site for a wind energy development project is known, an Internet database can be searched online to obtain this information (AirNav.com 2004). Inputting the geographic coordinates allows identification of public, private, and military airports; balloon ports; glider ports; heliports; seaplane bases; short takeoff and landing airports (STOLports); and ultralight flight parks within a minimum radius of 6 mi (10 km) to a maximum of 200 mi (322 km). Another FAA criterion triggering the notice of proposed construction is any construction or alteration of more than 200 ft (61 m) in height above ground level. This criterion applies regardless of the distance from the proposed project to an airport (FAA 2000). Because a wind energy development project would have to meet appropriate FAA criteria, no adverse impacts to aviation would be expected.

5.10.3 Potential Impacts to Military Operations

A proposed WRA could be in conflict with existing or proposed military testing and training operations. Military testing and training exercises involve the use of aircraft, ground troops, and weapons (including guided missiles). Much of this testing and training requires extensive areas of highly secured air space such as the 20,000 mi^2 (51,800 km^2) of restricted air space in south-central California that is used by Edwards Air Force Base, China Lake Naval Weapons Center, and Fort Irwin Military Reservation. Restricted air space allows for real-world maneuvering room for high-speed military aircraft, while providing large buffer zones surrounding the test ground to ensure public safety (Feiste 2003). However, military test ranges are being challenged by encroachments such as population growth, urban expansion, growing air space congestion, and, even as a result of the unintended consequences of environmental laws that reduce the flexibility of military training (Feiste 2003). The presence of turbines, permanent meteorological towers, and aboveground transmission lines associated with wind energy projects could add additional constraints to military testing and training operations that may occur at low altitudes (e.g., helicopter low-altitude tactical navigation areas, military operations areas, and military training routes). These structures may also be a source of ground-based and, more importantly, aircraft radar interference. The aforementioned constraints to military testing and training operations could be the basis for denial of a ROW authorization should there be no available mitigation alternatives. Therefore, developers should conduct preapplication consultations with the BLM and appropriate military representatives.

5.10.4 Potential Impacts to Recreational Areas

Impacts on recreational resources would be considered significant if they occurred in a high-density, concentrated, developed recreation site or facility, or included (1) noise impacts; (2) dust or air quality impacts; or (3) visual impacts, particularly if such impacts occurred in remote settings and landscapes (PBS&J 2002). During construction, noise, dust, traffic, and the presence of a construction force would temporarily affect the rural to primitive character of the area. People engaged in hiking, camping, birding, and hunting would be affected the most by construction activities. Some parks and campsites may experience increased use by transient workers who seek temporary accommodations during project construction. This could displace recreational users, particularly on weekdays. No significant adverse impacts on recreational users would be expected from operations as the operating workforce would be limited.

In the long-term, improved accessibility to the area could increase recreational opportunities; although at the same time, this could alter the experience for people wanting a backcountry setting. However, development of a wind energy project could modify the ROS class (Section 4.7.5) within which the proposed project would be located. For example, the area could be modified from either a semiprimitive nonmotorized or motorized class to a roaded natural or rural class. Most long-term effects would relate to visual disturbances and are discussed in Section 5.11.

In summary, development of a wind energy project would have both positive and negative effects on the opportunities for dispersed recreational activities in the project area. It is possible that at least some portions of the access road or transmission line ROW could be integrated with local trail and road systems and used for hiking, OHVs, and additional access to hunting and fishing areas. Therefore, the wind energy project could enhance public access to some previously difficult or inaccessible areas. Alternately, hunting and fishing pressures could increase in some areas, and some private landowners might experience an increased level of intrusion on their property. In addition, persons who may otherwise use the area for a remote and undisturbed recreational experience may decide to go elsewhere.

5.10.5 Mitigation Measures

The previous evaluations identified potential land use impacts that could be incurred during the construction, operation, and decommissioning of a wind energy facility. The nature, extent, and magnitude of these potential impacts would vary on a site-specific basis and on the specific phase of the project (e.g., construction or operation). The greatest potential for land use impacts would occur as a result of decisions made during the design and siting of the wind energy project. A variety of mitigation measures may be incorporated, as stipulations, into the design and development of the POD and the design of a wind energy project to reduce potential land use impacts. These measures include:

- Wind energy projects should be planned to mitigate or minimize impacts to other land uses;

- Federal and state agencies, property owners, and other stakeholders should be contacted as early as possible in the planning process to identify potentially sensitive land uses and issues, rules that govern wind energy development locally, and land use concepts specific to the region;

- The DoD should be consulted regarding the potential impact of a proposed wind energy project on military operations in order to identify and address any DoD concerns;

- The FAA-required notice of proposed construction should be made as early as possible to identify any air safety measures that would be required;
- When feasible, a wind energy project should be sited on already altered landscapes;
- To plan for efficient land use, necessary infrastructure requirements should be consolidated whenever possible, and current transmission and market access should be evaluated; and
- Restoration plans should be developed to ensure that all temporary use areas are restored.

5.11 VISUAL RESOURCES

In the simplest terms, adverse visual impacts can be defined as unwelcome visual intrusions — or the creation of visual contrasts — that affect the quality of a landscape. The perception of adverse visual impacts reflects the belief that the use and development of lands and waters should not significantly detract from recognized scenic resources and scenic views and the conviction that conditions should be imposed on development to control unreasonable or unnecessary adverse effects on scenic resources (Smardon and Karp 1993).

It is widely acknowledged that aesthetic impacts are among the most important impacts associated with wind energy development and operations. However, it is difficult to determine the relative significance of aesthetic impacts (Hau 2000; Bisbee 2003). Visual impacts are intangible, highly subjective, and dynamic, and because they cannot be completely avoided, they are one of the greatest sources of objection to wind energy development projects (Bisbee 2003). Because of the subjective and experiential nature of visual resources, the human response to those changes and the significance of the impacts cannot be quantified, even though the visual impact of a proposed development can be described specifically (Hankinson 1999). This raises the challenge of making widely accepted, collective decisions about the relative worth and disposition of individual visual resource "experiences" relative to competing resource demands. Fortunately, there is also some commonality in individuals' experiences of visual resources. While it may not be possible to objectively assess subjective experience and values, it is possible to systematically examine and characterize visual values and to reach consensus about visual impacts and their trade-offs. VRM procedures provide the means to evaluate, mediate, and mitigate the subjective nature of relative impacts on visual resources, and they are a critical part of decision making to evaluate any modification of the BLM landscapes for wind energy development.

Adverse visual impacts have in the past been referred to as "visual pollution." In a review of EISs considering visual quality, Smardon and Karp (1993) found three major types of adverse visual impacts: unnatural intrusions of man-made appearance or disfigurement; partial degradation, reduction, or impairment of the existing level of visual quality; and complete loss of the visual resource. The BLM's VRM system defines visual impact as the contrast perceived by observers between existing landscapes and proposed projects and activities (Section 4.8.1). The degree to which an activity intrudes on, degrades, or reduces the visual quality of a landscape depends on the amount of visual contrast it introduces. Visual changes or modifications that do not harmonize with landscapes often look out of place, and the resulting contrast may be unpleasant and undesirable. Environmental design concepts and techniques can be applied to minimize visual contrast, and thus visual impacts (see Section 5.11.6 regarding mitigation measures).

Visual contrasts are produced through a range of direct and indirect actions or activities. The BLM administers lands — and landscapes — that have valuable aesthetic or scenic qualities; these lands are also used for multiple activities that have the potential to disturb the surface of the landscape and impact scenic values. These activities, such as recreation, mining, timber harvest, livestock grazing, road development, wind power, and others, may also interact or synergize in complex ways. These interactions among impacting activities may be contemporaneous or they may represent more incremental and cumulative changes occurring over longer, possibly historic periods of time (see Section 6.4.1.11 regarding cumulative impacts). The following presents potential impacts on visual resources during each phase of a wind energy development project. Several sources were consulted during development of this list of impacts (AusWEA 2002; EECA 1995; EFSEC 2003; Gipe 1998, 2002; NWCC 2002; PBS&J 2002; and WDFW 2003a).

5.11.1 Site Monitoring and Testing

Possible sources of impacts to visual resources during site monitoring and testing include occasional, short-duration road traffic and parking, and associated dust; the erection and presence of meteorological towers; the presence of solar panels, if used, and the possibility of associated reflections producing sun glint; and the presence of idle or dismantled equipment, if allowed to remain on the site.

5.11.2 Site Construction

During construction, there are several possible sources of visual impacts. Road development (new roads or expansion of existing roads) may introduce strong visual contrasts in the landscape, depending on the route relative to surface contours, and the width, length, and surface treatment of the roads. Conspicuous and frequent small-vehicle traffic for worker access and frequent large-equipment (trucks, graders, excavators, and cranes) traffic for road construction, site preparation, and turbine installation are expected. Both would produce visible activity and dust in dry soils. Suspension and visibility of dust would be influenced by vehicle speeds and road surface materials. Temporary parking for worker's vehicles would be needed within staging areas or on adjacent surfaces. Unplanned and unmonitored parking could likely expand these areas, producing visual contrast by suspended dust and loss of vegetation in portions of the site. Site development may be progressive, persisting over a significant period of time. It may also be intermittent, staged, or phased, giving the appearance that work starts and stops. Repeated visual experiences may provoke perceptions of lost benefit and productivity, like that alleged for idle equipment. Timing and duration concerns may result. There would be a temporary presence of large cranes or a self-erection apparatus to assemble and mount towers, nacelles, and rotors. Duration may be short, depending on the number of turbines. All such equipment would produce emissions while operational and may thus create visible exhaust plumes. There may also be a temporary presence of support facilities and fencing associated with the construction work site.

Ground disturbance would result in visual impacts that produce contrasts of color, form, texture, and line. Excavating for turbine foundations and ancillary structures; trenching to bury electrical distribution systems; grading and surfacing roads; clearing and leveling staging areas; and stockpiling soil and spoils (if not removed) would (1) damage or remove vegetation, (2) expose bare soil, and (3) suspend dust. Destruction and removal of vegetation due to clearing, compaction, and dust are expected. Soil scars and exposed slope faces would result from excavation, leveling, and equipment movement. Invasive species may colonize disturbed and stockpiled soils and compacted areas. These species may be introduced naturally or in seeds, plants, or soils introduced for intermediate restoration, or by vehicles. The land area or footprint of installed equipment would be typically small, as little as 5 to 10% of the site, but could be susceptible to broader disturbance and alteration over longer periods of time. Site restoration activities would reduce many of these impacts.

5.11.3 Site Operation

Wind energy development projects on BLM-administered lands would be highly visible because of the introduction of turbines into typically rural or natural landscapes, many of which have few other comparable structures. Figures 5.11-1 through 5.11-3 show views of existing wind energy projects in Wyoming from different vantage points, distances, and perspectives. They illustrate the visual resource contrast elements from wind energy operations on the landscape. The artificial appearance of wind turbines may have visually incongruous “industrial” associations for some, particularly in a predominantly natural landscape. Visual evidence of wind turbines cannot be avoided, reduced, or concealed, owing to their size and exposed location; therefore, effective mitigation could be limited.

Daily and seasonal low sunlight conditions striking ridgelines and towers would tend to make them more visible and more prominent. Given the typical pale color of turbines, their color contrast with surroundings would likely be the least in the winter season, with less greening and more snowcover. In regions with variable terrain, wind developments along ridgelines would be most visible, particularly when viewed from other similar or lower elevations, owing partly to silhouetting against the sky. Much higher viewing points would reduce silhouetting. Valley alignment with wind energy projects may allow greater visibility (Burton 1997; EFSEC 2003; Owens 2003; and WDFW 2003a). Interposition of turbines between observers and the sun, particularly in the early and late hours of the day and during the winter season when sun angles are low, could produce a strobe-like effect from flickering shadows cast by the moving rotors onto the ground and objects. At its most severe, shadow flicker would be temporary and limited to daylight hours; it may be significant, however, because of its motion and frequency. A related

FIGURE 5.11-1 View of the Wyoming Wind Project near Arlington, Wyoming (Source: NREL 2004d. Photo #06584. Photo credit: Tom Hall.)

FIGURE 5.11-2 View of a Wind Energy Development Project near Evanston, Wyoming

FIGURE 5.11-3 Another View of a Wind Energy Development Project near Evanston, Wyoming

but less severe effect would be a sun-dial-like effect, also increased at low sun angles, as the shadows of very tall turbines sweep great distances over the landscape. Interposition of turbines between observers and the sun may also produce a strobe-like effect caused by the regular reflection of the sun off rotating turbine blades. Unlike shadow flicker, perception of blade glint would depend on the orientation of the nacelle, angle of the rotor, and the location of the observer relative to the position of the sun. Blade glint would also be influenced by the color, reflectivity, and age of the blades. This effect may be noticeable at distances of about 6.2 to 9.3 mi (10 to 15 km) and may be especially pronounced when aligned with roadways or other viewing corridors.

All aboveground ancillary structures (including fences around substations) would potentially produce visual contrasts by virtue of their design attributes (form, color, line, and texture) and by virtue of the reflectivity of their surfaces and resulting glare. If security and safety lighting are used, even if they are downwardly focused, visibility of the site would increase, particularly in dark nighttime sky conditions typical of rural areas. It would also contribute to sky glow resulting from ambient artificial lighting. Any degree of lighting would produce off-site “light trespass”; it would be most abbreviated, however, if the lighting was limited to just the substation and controlled by motion sensors.

FAA rules would require lights mounted on nacelles that flash white during the day and twilight (20,000 candela) and red at night (2,000 candela). White lights would be less obtrusive in daylight, but red lights would likely be conspicuous at great distances against dark skies

(Gipe 2002). Typically, the FAA requires warning lights on the first and last turbines in a string and every 1,000 to 1,400 ft (305 to 427 m) in between. Although these beacons would concentrate light in the horizontal plane, they would increase visibility of the turbines, particularly in dark nighttime sky conditions typical of rural areas. Beacons would likely not contribute (because of intermittent operation) to sky glow resulting from artificial lighting. The emission of light to off-site areas could be considerable.

Towers, nacelles, and rotors may need to be upgraded or replaced, thereby repeating initial visual impacts of construction and assembly. Opportunity and pressures to break uniformity between turbines and among components (different sizes, styles, and mixes) may be greater than during initial construction, thus potentially increasing visual contrast and visual "clutter." Additional construction and installation of monitoring equipment may be required to optimize measurements (change locations) or to replace or upgrade equipment. Repeated visual evidence of disturbance would result. Infrequent outages, disassembly, and repair of equipment may occur. These may produce the appearance of idle or missing rotors, "headless" towers (when nacelles are removed), and lowered towers. Negative visual perceptions of "lost benefits" (e.g., loss of wind power) and "bone yards" (for storage) may result.

Similar to other phases of development, occasional small-vehicle traffic for testing, commissioning, monitoring, maintenance, and repair, and infrequent large-equipment traffic for turbine replacements and upgrades can be expected. Both would produce apparent activity and dust in dry soils. Suspension and visibility of dust would be influenced by vehicle speeds and road surface materials.

5.11.4 Site Decommissioning

During decommissioning, impacts on visual resources would be similar to those encountered during construction. These impacts are related to road redevelopment, temporary fencing of the work site, intermittent or phased activity persisting over extended periods of time, removal of buried structures and equipment, and the presence of idle or dismantled equipment, if allowed to remain on site. Visual deconstruction impacts of heavy equipment, support facilities, and lighting would be substantially the same as those in the construction phase. Restoring a decommissioned site to preproject conditions would entail recontouring, grading, scarifying, seeding and planting, and perhaps stabilizing disturbed surfaces. Newly disturbed soils would create a visual contrast that would persist at least several seasons before revegetation would begin to disguise past activity. Restoration to preproject conditions may take much longer. Invasive species may colonize newly and recently reclaimed areas. These species may be introduced naturally or in seeds, plants, or soils introduced for intermediate restoration, or by vehicles. Nonnative plants that are not locally adapted would likely produce contrasts of color, form, texture, and line.

5.11.5 Synergistic Effects

The subjective quality of aesthetic impacts, including visual and auditory impacts, introduces the opportunity for multisensory responses to wind energy development and for the interaction of impacts in the perception of those exposed. Because soundscape and landscape are terms that may describe two simultaneous and overlapping qualities of the same environment, visual and aural signals may also interact in complex ways within the subjective experience of those who are viewing and listening.

Research finds that visual perception (in landscapes) is not neutral but is influenced by auditory impressions (Viollon 2003). More specifically, research specific to combined sensory reactions to wind turbines documents that noise annoyance is correlated to visual factors, such as a respondent's opinion of wind turbines' (visual) impact on the landscape (Pedersen and Waye 2003). Shadows, or "light shade," of turbines and their vanes in rotation are beginning to be investigated in relation to visual judgment of landscapes to better understand interactions between noise annoyance and visual disturbance (Pedersen and Waye 2003; Maffei and Lembo 2003). That visual and audible factors may be related, and that their impacts can interact, are accepted. An example may be seen in the finding that auditory "expectations" may be induced by visual "information" (Viollon 2003). Much research is now beginning to focus on how such synergisms work.

5.11.6 Mitigation Measures

Mitigation measures are a means of reducing visual impacts on public aesthetic resources. The BLM and USFS have established mitigation measures pertaining to visual impacts of energy production on federal lands of the western United States (BLM 1984, 1986a,b, 2004a-d; RMRCC 1989).

Additional mitigation measures have been derived from experiences with wind energy on several continents, particularly North America, Europe, and Australia. Useful lessons drawn from less-than-best practices in early California wind energy developments have enriched mitigation practices on other continents. North American experience in Texas and mountainous areas of the Appalachian region play a lesser role, although limited experience in Vermont, with its strong landscape protection tradition, offers informed perspective on visual impacts and mitigation. Europe offers the longest and most pervasive experience with contemporary (and ancient) wind energy development, especially with recent development in highly populated areas and with intensive social and aesthetic impacts. Australia might offer the best analog to development in the rural/remote, arid, range, and mountain lands of the western United States, but its literature does not yet provide sufficient information. Many sources were consulted in developing the following list of recommended mitigation measures for addressing visual impacts on BLM-administered lands (NWCC 2002; AusWEA 2002; Gipe 1998, 2002; NYSDEC 2000).

- Existing mitigation measures developed by the BLM regarding VRM should be followed.

- The public should be involved and informed about the visual site design elements of the proposed wind energy projects. Possible approaches include conducting public forums for disseminating information regarding wind energy development, such as design, operations, and productivity; offering organized tours of operating wind energy development projects (Gipe 2002); using computer simulation and visualization techniques in public presentations; and conducting surveys regarding public perceptions and attitudes about wind energy development.

- Turbine arrays and the turbine design should be integrated with the surrounding landscape. To accomplish this integration, several elements of design need to be incorporated.

  – The operator should provide visual order and unity among clusters of turbines (visual units) to avoid visual disruptions and perceived “disorder, disarray, or clutter” (Gipe 2002).

  – To the extent possible given the terrain of a site, the operator should create clusters or groupings of wind turbines when placed in large numbers; avoid a cluttering effect by separating otherwise overly long lines of turbines, or large arrays; and insert breaks or open zones to create distinct visual units or groups of turbines.

  – The operator should create visual uniformity in the shape, color, and size of rotor blades, nacelles, and towers (Gipe 1998).

  – The use of tubular towers is recommended. Truss or lattice-style wind turbine towers with lacework, pyramidal, or prism shapes should be avoided. Tubular towers present a simpler profile and less complex surface characteristics and reflective/shading properties.

  – Components should be in proper proportion to one another. Nacelles and towers should be planned to form an aesthetic unit and should be combined with particular sizes and shapes in mind to achieve an aesthetic balance between the rotor, nacelle, and tower (Gipe 1998).

  – Color selections for turbines should be made to reduce visual impact (Gipe 2002) and should be applied uniformly to tower, nacelle, and rotor, unless gradient or other patterned color schemes are used.

  – The operator should use nonreflective paints and coatings to reduce reflection and glare. Turbines, visible ancillary structures, and other equipment should be painted before or immediately after installation. Uncoated galvanized metallic surfaces should be avoided because they would create a stronger visual contrast, particularly as they oxidize and darken.

- Commercial messages on turbines and towers should be prohibited (Gipe 2002).

- The site design should be integrated with the surrounding landscape.

  - To the extent practicable, the operator should avoid placing substations or large operations buildings on high land features and along "skylines" that are visible from nearby sensitive view points. The presence of these structures should be concealed or made less conspicuous. Conspicuous structures should be designed and constructed to harmonize with desirable or acceptable characteristics of the surrounding environment (Gipe 2002).

  - The operator should bury power collection cables or lines on the site in a manner that minimizes additional surface disturbance.

  - Commercial symbols (such as logos), trademarks, and messages should not appear on sites or ancillary structures of wind energy projects. Similarly, billboards and advertising messages should also be prohibited (Gipe 1998, 2002).

  - Site design should be accomplished to make security lights nonessential. Such lights increase the contrast between a wind energy project and the night sky, especially in rural/remote environments, where turbines would typically be installed. Where they are necessary, security lights should be extinguished except when activated by motion detectors (e.g., only around the substation) (Gipe 1998).

- Operators should minimize disturbance and control erosion by avoiding steep slopes (Gipe 1998) and by minimizing the amount of construction and ground clearing needed for roads, staging areas, and crane pads. Dust suppression techniques should be employed in arid environments to minimize impacts of vehicular and pedestrian traffic, construction, and wind on exposed surface soils. Disturbed surfaces should be restored as closely as possible to their original contour and revegetated immediately after, or contemporaneously with construction. Action should be prompt to limit erosion and to accelerate restoring the preconstruction color and texture of the landscape.

- The wind development site should be maintained during operation. Inoperative or incomplete turbines cause the misperception in viewers that "wind power does not work" or that it is unreliable. Inoperative turbines should be completely repaired, replaced, or removed. Nacelle covers and rotor nose cones should always be in place and undamaged (Gipe 1998). Wind energy projects should evidence environmental care, which would also reinforce the expectation and impression of good management for benign or clean power. Nacelles and towers should also be cleaned regularly (yearly, at minimum) to remove spilled or leaking fluids and the dirt and dust that would accumulate, especially in seeping lubricants. Facilities and off-site surrounding areas should be kept clean of debris, “fugitive” trash or waste, and graffiti. Scrap heaps and materials dumps should be prohibited and prevented. Materials storage yards, even if thought to be orderly, should be kept to an absolute minimum. Surplus, broken, disused materials and equipment of any size should not be allowed to accumulate (Gipe 2002).

- Aesthetic offsets should be considered as a mitigative option in situations where visual impacts are unavoidable, or where alternative mitigation options are only partially effective or uneconomical (NYSDEC 2000, BLM 2005a). An aesthetic offset is a correction or remediation of an existing condition located in the same viewshed of the proposed development that has been determined to have a negative visual or aesthetic impact. For example, aesthetic offsets could include reclamation of unnecessary roads in the area, removal of abandoned buildings, cleanup of illegal dumps or trash, or the rehabilitation of existing erosion or disturbed areas (BLM 2005a).

- A decommissioning plan should be developed, and it should include the removal of all turbines and ancillary structures and restoration/reclamation of the site.

5.12 CULTURAL RESOURCES

While impacts to cultural resources are determined on a site-specific basis, certain activities associated with wind energy development have a greater potential for adversely affecting cultural resources than others, assuming such resources are present in the project area. Earthmoving activities (e.g., grading and digging) have the highest potential for disturbing or destroying significant cultural resources; however, pedestrian and vehicular traffic and indirect impacts of earthmoving activities, such as soil erosion, may also have an effect. Visual impacts on significant cultural resources, such as sacred landscapes, historic trails, and viewsheds from other types of historic properties (e.g., homes and bridges) may also occur. In this section, the activities that could potentially affect cultural resources are described for each stage of wind energy development, and relevant mitigation measures are presented.

5.12.1 Site Monitoring and Testing

The potential exists for impacts on cultural resources to occur during site monitoring and testing; however, the causes of possible impacts would be limited to minor ground-disturbing activities and activities that result in the potential for unauthorized collection of artifacts and acts of vandalism. Typically, excavation activities and road construction to provide access to the project area would be very limited. Some clearing or grading might be needed in order to install monitoring towers and equipment enclosures. If more extensive excavation or road construction was needed during this phase, more extensive impacts would be possible (see Section 5.12.2 for a discussion of impacts during construction).

Vehicular traffic and ground clearing (such as the removal of vegetative cover) might directly affect cultural resources if they are present in the project area by compacting soils, potentially crushing artifacts, disturbing historic features (e.g., trails), and displacing cultural material from its original context. These activities might also impact areas of interest to Native Americans, such as sacred areas or areas used for harvesting traditional resources, such as medicinal plants. Indirect effects on cultural resources might occur through an increased potential for soil erosion as a result of these activities. The collection of artifacts by workers or amateur collectors accessing areas that may have been previously inaccessible to the public would be another possible impact. Increased access might also increase the potential for vandalism. Although the activities that occur during the monitoring and testing phase are characterized as temporary actions, cultural resources are mostly nonrenewable and, once impacted (i.e., removed or damaged), are not likely to be recovered or returned to their proper context.

5.12.2 Site Construction

The construction of the infrastructure necessary for wind energy development has the greatest potential to impact cultural resources because of the increased ground disturbance during this phase. The amount of area disturbed could be considerable and would destroy cultural resources if they were present in that area. An indirect effect of this ground disturbance would be soil erosion, which could also impact cultural resources outside the construction footprint.

The development of a wind energy project and its associated access roads would provide access to areas that might have been previously inaccessible. Any increase in the presence of humans in an uncontrolled and unmonitored environment containing significant cultural resources increases the potential for adverse impacts caused by looting (unauthorized collection of artifacts), vandalism, and inadvertent destruction to unrecognized resources.

In addition, visual impacts on cultural resources could occur during the construction phase (see also Section 5.11). Large areas of exposed ground surface, increases in dust, and the presence of large-scale machinery, equipment, and vehicles could contribute to an adverse impact on cultural resources (e.g., those with a landscape component that contributes to their significance, such as a historic trail or sacred landscape).

5.12.3 Site Operation

Fewer impacts on cultural resources are likely from the operation of a wind development project than from its construction. Impacts associated with operation are possible, however, because of the improved access to the area and the presence of workers and the public. As stated above, human presence potentially increases the likelihood of unauthorized collection of artifacts and vandalism, as well as inadvertent destruction of unrecognized resources. In addition, there may be visual impacts on the resource (Section 5.11), since the visible wind turbines may be perceived as an intrusion on a sacred or historical landscape. If the development site would need to be expanded during operation, the impacts would be similar to those associated with construction.

5.12.4 Site Decommissioning

Very few impacts on cultural resources would be expected from decommissioning. Ground disturbance during decommissioning would be confined primarily to areas that were originally disturbed during construction. Most cultural resources are nonrenewable and would either have been removed professionally prior to construction or would have been already disturbed or destroyed by prior activities. However, visual impacts on cultural resources would be mostly removed after decommissioning, as long as the site was restored to its preconstruction state. Despite the physical removal of equipment and the institution of site restoration practices, the impact of a scarred environment in an area sacred to Native Americans would likely remain. If access roads were left in place, the potential for looting and vandalism would also remain and might even increase, since the area would no longer be periodically monitored by the operator. If additional work areas were needed beyond those disturbed during construction, there would be the potential for new impacts similar to those that would occur during construction.

5.12.5 Mitigation Measures

- The BLM should consult with Native American governments early in the planning process to identify issues and areas of concern regarding the proposed wind energy development. Aside from the fact that consultation is required under the NHPA, consultation is necessary to establish whether the project is likely to disturb traditional cultural properties, affect access rights to particular locations, disrupt traditional cultural practices, and/or visually impact areas important to the Tribe(s). Under the conditions of the nationwide BLM PA, the state BLM offices should already have established a relationship with local Tribal governments. A list of the federally recognized Tribes for the 11-state region is available in Chapter 7.

- The presence of archaeological sites and historic properties in the area of potential effect should be determined on the basis of a records search of recorded sites and properties in the area and/or an archaeological survey. The SHPO is the primary repository for cultural resource information, and most BLM Field Offices also maintain this information for lands under their jurisdiction.

- Archaeological sites and historic properties present in the area of potential effect should be reviewed to determine whether they meet the criteria of eligibility for listing on the NRHP. Cultural resources listed on or eligible for listing on the NRHP are considered “significant” resources.

- When any ROW application includes remnants of a National Historic Trail, is located within the viewshed of a National Historic Trail's designed centerline, or includes or is within the viewshed of a trail eligible for listing on the NRHP, the operator should evaluate the potential visual impacts to the trail associated with the proposed project and identify appropriate mitigation measures for inclusion as stipulations in the POD.

- If cultural resources are present at the site, or if areas with a high potential to contain cultural material have been identified, a CRMP should be developed. This plan should address mitigation activities to be implemented for cultural resources found at the site. Avoidance of the area is always the preferred mitigation option. Other mitigation options include archaeological survey and excavation (as warranted) and monitoring. If an area exhibits a high potential, but no artifacts are observed during an archaeological survey, monitoring by a qualified archaeologist could be required during all excavation and earthmoving in the high-potential area. A report should be prepared documenting these activities. The CRMP also should (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of artifacts and destruction of property on public land.

- Periodic monitoring of significant cultural resources in the vicinity of development projects may help curtail potential looting/vandalism and erosion impacts. If impacts are recognized early, additional actions can be taken before the resource is destroyed.

- Unexpected discovery of cultural resources during construction should be brought to the attention of the responsible BLM authorized officer immediately. Work should be halted in the vicinity of the find to avoid further disturbance to the resources while they are being evaluated and appropriate mitigation measures are being developed.

5.13 ECONOMICS

The economic impact of wind energy development projects on BLM-administered lands was assessed at the state level for each of the 11 western states. Impacts were measured in terms of employment, income, GSP and tax revenues (sales and state income), and ROW rental receipts to the federal government. The impact of wind energy development projects on property values was also assessed.

To calculate impacts, representative data from a range of recent wind energy development projects in the western United States were used (PBS&J 2002; Cox 2004; ECONorthwest 2002; Northwest Economic Associates 2003; Goldberg et al. 2004). These data include material and labor costs and employment for project construction and operation, and fiscal data used to estimate sales and income tax revenues. These data were used to calculate the direct economic and fiscal impacts of a representative wind energy development project. IMPLAN economic data were then used to calculate the indirect impacts associated with wind energy development project wage and salary spending, material procurement spending, and expenditures of tax revenues (Minnesota IMPLAN Group 2004).

Impact estimates were based on projections of potential wind development on BLM-administered land taken from the WinDS model calculations generated by NREL (see Table 5.13-1 and Appendix B). The WinDS model takes into account project location, power generation capital costs, fossil fuel prices, and transmission system issues in determining maximum market potential for wind power for each state. As discussed in Appendix B and reflected in Table 5.13-1, the WinDS model was used to calculate total potential wind energy supply over the next 20 years in each state of the study area; additional analyses were conducted to estimate which portion of that state total would be located on BLM-administered lands. The WinDS model relies heavily on the assumptions and results from the reference case in DOE (2004a), as developed by the DOE Energy Information Administration, for input data on electricity demand, fossil fuel prices, generator costs, and other driving factors. While this reference case is a reasonable projection of the future U.S. energy situation, it is always possible that unforeseen factors might change those projected economic circumstances. For example, a major recession in the United States could dampen future electricity demand; or natural gas resources might prove to be more plentiful, which would decrease gas prices and increase the demand for gas-fired generation. Wind supply projections from the WinDS model that form the basis of the economic impact analysis for this PEIS include the PTC but exclude renewable energy portfolio standards.

5.13.1 Summary of Economic Impacts

Except in California and Nevada, the WinDS model predicts only relatively small amounts of wind energy development during the period 2005 to 2015. By 2025, all states would have wind energy development, but the majority would be concentrated in California, Nevada, and Utah (Figure 5.13.1-1).

The economic impacts of construction and operation activities associated with wind energy development projects on BLM-administered lands as projected by the WinDS model are shown in Tables 5.13.1-1 through 5.13.1-3 for the three years 2005, 2015, and 2025. Impacts include both the direct and indirect effects of project construction and operation. Direct impacts would include the creation of new jobs for workers at wind energy development projects and the associated income and taxes paid. Indirect impacts are those impacts that would occur as a result of the new economic development and would include things such as new jobs at businesses that support the expanded workforce or that provide project materials, and associated income and taxes. Impacts of construction presented in the three tables represent the total impacts of all wind energy projects on BLM-administered land for each year, rather than the impacts of new energy projects completed in each year. Impacts of operation correspond to the annual impact of operating wind developments in each year.

TABLE 5.13-1 Projected Wind Power Development by State, Landholding, and Year (MW)[a,b]

State	Landholding	2005	2015	2025
Arizona	Non-BLM	19	37	192
	BLM	1	2	31
	Total	20	40	223
California	Non-BLM	2,830	5,395	7,651
	BLM	784	1,323	1,462
	Total	3,614	6,718	9,113
Colorado	Non-BLM	225	622	1,848
	BLM	33	67	85
	Total	258	688	1,933
Idaho	Non-BLM	75	156	916
	BLM	52	105	185
	Total	127	261	1,101
Montana	Non-BLM	121	397	1,287
	BLM	10	27	37
	Total	131	424	1,325
Nevada	Non-BLM	417	545	604
	BLM	388	574	701
	Total	805	1,119	1,305
New Mexico	Non-BLM	476	952	1,344
	BLM	54	108	199
	Total	530	1,060	1,543
Oregon	Non-BLM	452	743	1,562
	BLM	92	144	196
	Total	543	887	1,758
Utah	Non-BLM	162	467	485
	BLM	89	248	256
	Total	251	716	741
Washington	Non-BLM	246	630	1,314
	BLM	3	6	12
	Total	249	636	1,326
Wyoming	Non-BLM	105	211	357
	BLM	12	24	75
	Total	117	234	433
Total	Non-BLM	5,128	10,154	17,561
	BLM	1,517	2,628	3,240
	Total	6,645	12,782	20,801

[a] Totals may be off due to rounding. Projections include additional new capacity on private and BLM-administered lands; existing capacity is excluded.

[b] According to the AWEA (2004), 1 MW of wind-generated power creates enough electricity to supply about 240 to 300 households per year.

Source: WinDS Model (Appendix B).

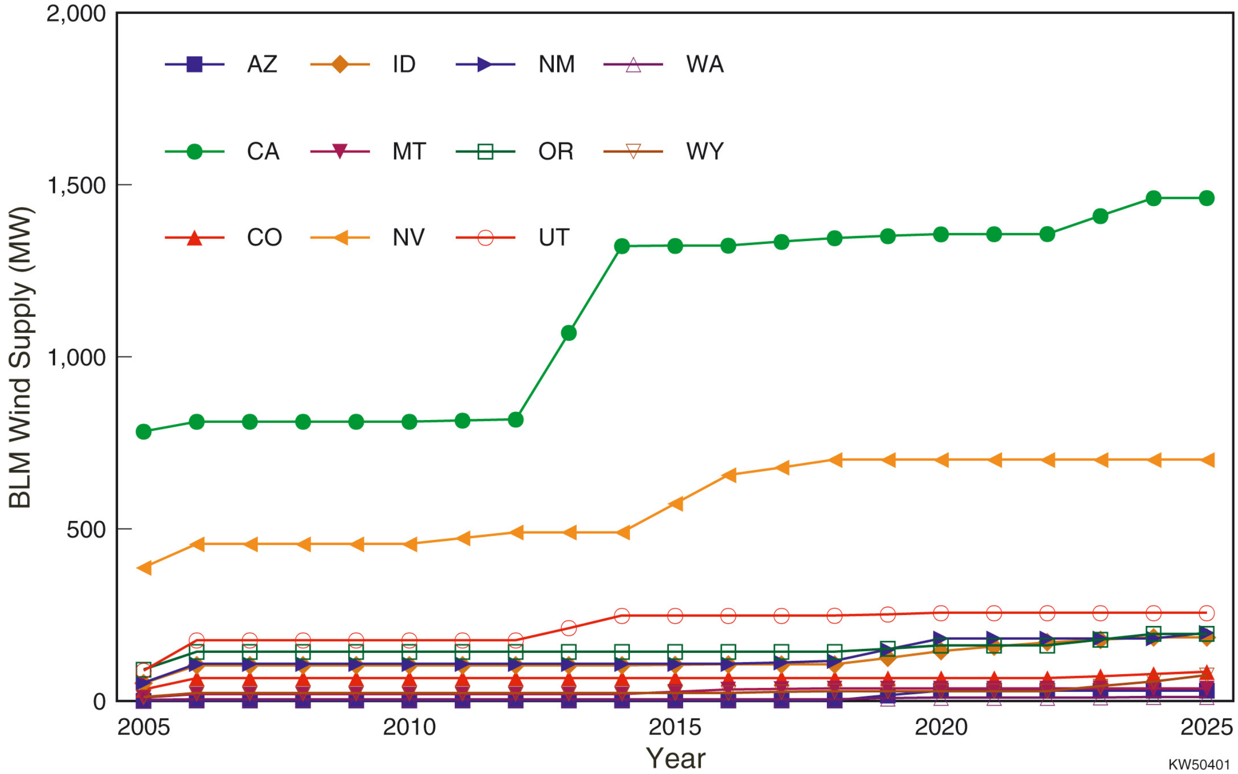

FIGURE 5.13.1-1 Projected Wind Power Development on BLM-Administered Lands by State and Year

The WinDS model predicts that all states in the study area would have wind energy development on BLM-administered lands by 2005. In Arizona and Washington, the level of development on BLM-administered lands would be very low (i.e., less than 5 MW), and most of the development would be in California (784 MW) and Nevada (388 MW). Construction activities associated with these projects would generate 560 direct and 1,590 overall jobs in California, $71 million in income, and $252 million in GSP (Table 5.13.1-1). The state would collect $17 million in sales taxes, and $4.5 million in income taxes would be generated. Impacts in Nevada in 2005 would be slightly smaller than those in California, with 280 direct and 700 total jobs created, $29 million in income, and $112 million in GSP generated. The State of Nevada would collect $7.9 million in sales taxes.

Operational activities on BLM-administered lands by 2005 would generate 210 direct and 270 total jobs in California, $11 million in income, $25 million in GSP, $2.6 million in sales taxes, and $4.6 million in income taxes (Table 5.13.1-1). Under the rental rates defined in the BLM Interim Wind Energy Policy (BLM 2002a) (Appendix A), wind energy operations in California would also produce $1.9 million in ROW rental receipts to the federal government. In Nevada, wind energy project operation would create 110 direct and 120 total jobs, $4.5 million in income, and $11 million in GSP. Sales taxes generated would amount to $1.2 million. ROW rental receipts in Nevada would amount to $0.9 million.

TABLE 5.13.1-1 Economic Impacts of Projected Wind Power Development on BLM-Administered Lands in 2005 ($ millions 2003, except employment)[a]

Economic Indicator	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming
Construction											
Employment											
Direct	0	560	20	40	10	280	40	70	60	0	10
Total	0	1,590	70	110	20	700	130	90	210	10	20
Income											
Direct	0	18.2	0.8	1.2	0.2	9.0	1.3	2.1	2.1	0.1	0.3
Total	0.1	71.4	3.0	4.0	0.7	29.3	4.4	7.3	7.4	0.2	0.8
Gross state product	0.3	252.0	10.7	15.5	2.9	111.8	17.0	27.7	28.0	0.9	3.5
Taxes											
Sales	0	17.3	0.7	1.1	0.2	7.9	1.2	1.9	1.9	0.1	0.2
Income	0	4.5	0.2	0.3	0	0.0	0.3	0.5	0.5	0	0.0
Operations											
Employment											
Direct	0	210	10	10	0	110	20	30	20	0	0
Total	0	270	10	20	0	120	20	40	40	0	10
Income											
Direct	0	6.0	0.3	0.4	0.1	3.0	0.4	0.7	0.7	0	0.1
Total	0	10.7	0.4	0.6	0.1	4.5	0.6	1.2	1.1	0	0.1
Gross state product	0	25.1	1.0	1.5	0.3	10.8	1.6	2.8	2.8	0.1	0.3
Taxes											
Sales	0	2.6	0.1	0.2	0	1.2	0.2	0.3	0.3	0	0
Income	0	4.6	0.2	0.3	0	0.0	0.3	0.5	0.5	0	0.0
ROW rental receipts[b]	0	1.9	0.1	0.1	0	0.9	0.1	0.2	0.2	0	0

[a] Employment = number of jobs. Impacts are the result of projected, new capacity on private and BLM-administered lands; impacts from existing capacity are excluded.

[b] ROW rental receipts to the federal government include annual minimum rent only, as based on installed capacity (in MW). The BLM may also charge additional production rents, depending on electricity production. These additional rents are not included since the projected electricity output from wind development is uncertain.

TABLE 5.13.1-2 Economic Impacts of Projected Wind Power Development on BLM-Administered Lands in 2015 ($ millions 2003, except employment)[a]

Economic Indicator	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming
Construction											
Employment											
Direct	0	940	50	80	20	410	80	100	180	0	20
Total	10	2,690	140	230	60	1,040	260	300	590	10	50
Income											
Direct	0.1	30.8	1.5	2.4	0.6	13.3	2.5	3.3	5.8	0.1	0.6
Total	0.2	120.6	6.0	8.0	1.9	43.4	8.8	11.5	20.9	0.5	1.7
Gross state product	0.7	425.5	21.4	31.3	7.9	165.4	34.0	43.4	78.7	1.8	6.9
Taxes											
Sales	0	29.2	1.5	2.2	0.6	11.7	2.3	3.0	5.4	0.1	0.5
Income	0	7.6	0.4	0.5	0.1	0.0	0.6	0.7	1.3	0	0.0
Operations											
Employment											
Direct	0	360	20	30	10	160	30	40	70	0	10
Total	0	450	20	50	10	170	40	60	110	0	10
Income											
Direct	0	10.1	0.5	0.8	0.2	4.4	0.8	1.1	1.9	0	0.2
Total	0	18.1	0.9	1.2	0.3	6.7	1.3	1.9	3.2	0.1	0.3
Gross state product	0.1	42.5	2.1	3.1	0.8	16.0	3.2	4.4	7.8	0.2	0.6
Taxes											
Sales	0	4.3	0.2	0.3	0.1	1.8	0.3	0.5	0.8	0	0.1
Income	0	7.8	0.4	0.6	0.2	0.0	0.6	0.8	1.4	0	0.0
ROW rental receipts[b]	0	3.1	0.2	0.2	0.1	1.4	0.3	0.3	0.6	0	0.1

[a] Employment = number of jobs. Impacts are the result of projected, new capacity on private and BLM-administered lands; impacts from existing capacity are excluded.

[b] ROW rental receipts to the federal government include annual minimum rent only, as based on installed capacity (in MW). The BLM may also charge additional production rents, depending on electricity production. These additional rents are not included since the projected electricity output from wind development is uncertain.

TABLE 5.13.1-3 Economic Impacts of Projected Wind Power Development on BLM-Administered Lands in 2025 ($ millions 2003, except employment)[a]

Economic Indicator	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming
Construction											
Employment											
Direct	20	1,040	60	130	30	500	140	140	180	10	50
Total	60	2,980	180	400	80	1,270	480	410	610	20	160
Income											
Direct	0.7	34.0	2.0	4.3	0.9	16.3	4.6	4.6	6.0	0.3	1.8
Total	2.6	133.3	7.6	14.1	2.7	53.0	16.2	15.7	21.5	0.9	5.3
Gross state product	9.6	470.2	27.4	55.1	10.9	202.1	62.6	59.3	81.2	3.6	22.1
Taxes											
Sales	0.6	32.3	1.9	3.9	0.8	14.3	4.3	4.1	5.6	0.3	1.6
Income	0.2	8.4	0.5	0.9	0.2	0.0	1.0	1.0	1.4	0.0	0.0
Operations											
Employment											
Direct	10	400	20	50	10	190	50	50	70	0	20
Total	10	500	30	80	20	210	80	80	110	0	30
Income											
Direct	0.2	11.2	0.7	1.4	0.3	5.4	1.5	1.5	2.0	0.1	0.6
Total	0.4	20.0	1.1	2.2	0.4	8.1	2.4	2.5	3.3	0.2	0.8
Gross state product	0.9	46.9	2.6	5.4	1.0	19.5	5.8	6.0	8.1	0.4	2.0
Taxes											
Sales	0.1	4.8	0.3	0.6	0.1	2.2	0.6	0.6	0.8	0.0	0.2
Income	0.2	8.6	0.5	1.1	0.2	0.0	1.1	1.1	1.5	0.0	0.0
ROW rental receipts[b]	0.1	3.5	0.2	0.4	0.1	1.7	0.5	0.5	0.6	0.1	0.2

[a] Employment = number of jobs. Impacts are the result of projected, new capacity on private and BLM-administered lands; impacts from existing capacity are excluded.

[b] ROW rental receipts to the federal government include annual minimum rent only, as based on installed capacity (in MW). The BLM may also charge additional production rents, depending on electricity production. These additional rents are not included since the projected electricity output from wind development is uncertain.

By 2015, wind energy development on BLM-administered lands would have increased in all states, although production in Arizona and Washington would still be quite low (2 MW and 6 MW, respectively), and continuing development in California (1,323 MW) and Nevada (574 MW) would still be greatest. In California, construction activities would produce 2,690 jobs, $121 million in income, and $426 million in GSP. Sales taxes and income taxes generated would amount to $29 million and $7.6 million, respectively (Table 5.13.1-2). Smaller impacts would occur in Nevada, with 1,040 jobs created, $43 million in income, and $165 million in GSP. The state would collect $12 million in sales taxes. Jobs would also be created in Utah (590), Oregon (300), New Mexico (260), Idaho (230), and Colorado (140).

By 2015, wind energy operations on BLM-administered lands in California would produce 450 jobs, $18 million in income, and $43 million in GSP (Table 5.13.1-2). Sales taxes and income taxes generated would amount to $4.3 million and $7.8 million, respectively. Wind power operations in California would also produce $3.1 million in ROW rental receipts to the federal government. Smaller impacts would occur in Nevada, with 170 jobs created, $6.7 million in income, and $16 million in GSP. Sales taxes generated would amount to $1.8 million. Wind energy operations in Nevada would also generate $1.4 million in ROW rental receipts to the federal government. Jobs would also be created in Utah (110), Oregon (60), Idaho (50), and New Mexico (40).

By 2025, wind energy development on BLM-administered land would have increased in all states, although production in Washington would remain around 12 MW. While continuing development would still be greatest in California (1,462 MW) and Nevada (701 MW), development in Utah (256 MW), Oregon (196 MW), New Mexico (199 MW), and Idaho (185 MW) would reach appreciable levels. In California, construction activities would produce 2,980 jobs, $133 million in income, and $470 million in GSP (Table 5.13.1-3). Sales taxes and income taxes generated would amount to $32 million and $8.4 million, respectively. Smaller impacts would occur in Nevada, with 1,270 jobs created, $53 million in income, and $202 million in GSP; $14 million in sales taxes would also be generated. Jobs would also be created in Utah (610), New Mexico (480), Oregon (410), Idaho (400), and the other five states.

By 2025, wind energy operations on BLM-administered lands in California would generate 500 jobs, $20 million in income, and $47 million in GSP (Table 5.13.1-3); $4.8 million in sales taxes and $8.6 million in income taxes would also be generated. Wind power operations in California would also produce $3.5 million in ROW rental receipts to the federal government. Smaller impacts would occur in Nevada, with 210 jobs created, $8.1 million in income, and $19.5 million in GSP; $2.2 million in sales taxes would also be generated. Wind power operations in Nevada would also produce $1.7 million in ROW rental receipts to the federal government. Smaller impacts would occur in Utah (110 jobs created), Idaho (80 jobs), New Mexico (80 jobs), Oregon (80 jobs), and the other five states.

5.13.2 Property Value Impacts

The potential impact of wind energy development projects on residential property values has often been a concern in the vicinity of locations selected for wind power. Although this PEIS does not directly assess the potential impacts of wind power on property values, a review of two studies that examined potential property value impacts of wind power facilities suggests that there would not be any measurable negative impacts.

ECONorthwest (2002) interviewed county tax assessors in 13 locations that had recently experienced multiple-turbine wind energy developments. While not all the locations chosen had wind turbines that were visible from residential areas, and some development projects had been constructed too recently for their full impact to be properly assessed, the study found no evidence that wind turbines decreased property values. Indeed, in one area examined, it was found that designation of land parcels for wind development actually increased property values.

Sterzinger et al. (2003) analyzed the effects of 10 wind energy development projects built during the period 1998 to 2001 on housing sale prices. The study used a hedonic statistical framework that attempted to account for all influences on changes in property value; its data came from sales of 25,000 properties, both within view of recent wind energy developments and in a comparable region with no wind energy projects, before and after project construction. The results of the study indicate that there were no negative impacts on property values. For the majority of the wind energy projects considered, property values actually increased within the viewshed of each project. Property values also tended to increase faster in areas with a view of the wind turbines than in areas with no wind projects.

5.14 ENVIRONMENTAL JUSTICE

The analysis of environmental justice issues associated with the development of wind energy projects on BLM-administered lands considered impacts at the state level in 11 western states. Site monitoring and testing, construction, operation, and decommissioning of wind energy development projects on BLM-administered lands in the 11 western states could impact environmental justice if any adverse health and environmental impacts resulting from any phase of wind development were significantly high, and if these impacts would disproportionately affect minority and low-income populations. If the analysis determined that health and environmental impacts would not be significant, there would not be any disproportionate impacts to minority and low-income populations. In the event that impacts were significant, disproportionality would be determined by comparing the proximity of high and adverse impacts to the location of low-income and minority populations.

Section 4.11 describes the distribution of low-income and minority populations in the 11-state study area. Data presented at the state level only provide a general indication of the potential for environmental justice concerns on BLM-administered lands in each state. The analysis undertaken for specific wind energy development projects would need to consider the potential impact on environmental justice at a more local level, where the relative concentration of minority and low-income populations could be significantly different from that at the state level.

5.14.1 Site Monitoring and Testing

Activities associated with site monitoring and testing activities would be relatively limited and typically would result in little change to the landscape. Unless extensive access road construction is involved, it is unlikely that there would be any significantly high adverse impacts associated with this phase of wind energy development on BLM-administered lands. Therefore, it is unlikely that there would be an environmental justice issue associated with these activities.

5.14.2 Site Construction

Noise and dust impacts during construction of wind towers and related transmission and other facilities would likely be minimal given the small amount of land typically disturbed and the relative remoteness of sites usually chosen for wind energy development projects. Mitigation can be applied to keep dust impacts to a minimum. A more significant issue may be impacts from access roads required during construction for the delivery of equipment and materials to wind energy development project sites. Associated visual impacts also could be a concern. Depending on the terrain across which these roads would be constructed, access road length, the length of time they would be used for construction traffic, the volume of traffic, and the proximity to minority and low-income populations, there could be environmental justice issues associated with wind energy project construction on BLM-administered lands.

5.14.3 Site Operation

A major potential environmental justice impact of wind energy development project operation on BLM-administered lands could be the visual impact of wind towers and associated transmission infrastructure. Although the MPDS and the BLM's policies exclude development on BLM-administered lands that are designated as being of scenic quality or interest, wind energy development projects could potentially alter the scenic quality in areas of traditional or cultural significance to minority and low-income populations.

Impacts from project operation could also create an environmental justice issue if noise impacts from wind turbine operation are significant. The extent to which noise is an issue would depend on the number of towers in any specific wind energy development project, and the proximity to minority and low-income populations. Additional potential areas of environmental justice concern during operations would be electromagnetic exposure and shadow flicker. Although a range of mitigation measures could be implemented to ensure that the risk to the human population would be minimal (Section 5.8), there may be some health and safety risks with respect to these hazards. The extent to which these hazards create an environmental justice concern would depend on the precise location of low-income and minority populations in relation to specific wind energy development projects. Full analysis of the potential impacts of specific projects on low-income and minority populations would be undertaken as part of site-specific NEPA reviews of each proposed wind energy development site.

5.14.4 Site Decommissioning

Activities occurring during decommissioning would be largely the same as those that occur during construction, only in reverse. As a result, the potential for significantly high adverse impacts to disproportionately affect minority and low-income populations should be about the same during both phases, assuming population demographics remain stable over the life of the wind energy development project.

5.15 EVALUATION AND IDENTIFICATION OF PROGRAMMATIC BMPs

The PEIS analysis of the potential impacts of wind energy development and relevant mitigation measures presented in Sections 5.1 through 5.14 was used to identify the programmatic BMPs to be included in the proposed Wind Energy Development Program (Section 2.2.3.2). The process for evaluating and identifying the programmatic BMPs is discussed below. An assessment of the effectiveness of the programmatic BMPs at mitigating potential impacts, along with an assessment of other aspects of the proposed Wind Energy Development Program, is presented in Chapter 6. The management alternatives to the proposed action also are assessed in Chapter 6.

One objective of the proposed program is to establish programmatic BMPs that would be applicable to all wind energy development projects on BLM-administered lands. As a result, the mitigation measures discussed in this chapter were reviewed to determine whether they are applicable to all wind energy development projects**.** Certain mitigation measures address issues that are likely to occur in a limited number of locations (e.g., efforts needed to minimize impacts to the movement and safe passage of fish) or only for specific species (e.g., mitigations for impacts to sage-grouse or golden eagles). These mitigation measures would be relevant to wind energy development on BLM-administered lands at specific locations and, in accordance with a policy included in the proposed Wind Energy Development Program, they would be incorporated into the project-specific POD and the ROW authorization stipulations, as needed, to address site-specific and species-specific issues. However, because these types of mitigation measures are not applicable to all projects, they are not included in the proposed programmatic BMPs.

Additional mitigation measures presented in Sections 5.1 through 5.14 are not included in the programmatic BMPs because they provide relatively detailed guidance regarding issues that are common to a variety of activities other than wind energy development on BLM-administered lands (e.g., road construction and maintenance, wildlife management, hazardous materials and waste management, cultural resource management, pesticide use, and integrated pest management). The proposed Wind Energy Development Program includes a policy stating that the requirements of other, existing and relevant BLM mitigation guidance will be incorporated into project PODs, as appropriate.

6 ANALYSIS OF THE PROPOSED ACTION AND ITS ALTERNATIVES

Through this PEIS, the BLM is evaluating the proposed action to implement a Wind Energy Development Program specific to BLM-administered lands. The proposed action, discussed in Section 2.2, would establish programmatic policies and BMPs providing guidance on how to mitigate the potential impacts of wind energy development. The alternatives to the proposed action present options for the management of this development activity. Under the no action alternative, discussed in Section 2.3, the BLM would continue to develop wind energy resources under the terms and conditions of the Interim Wind Energy Development Policy (BLM 2002a) (Appendix A), but would not establish programmatic mitigation guidance. Under the limited wind energy development alternative, discussed in Section 2.4, the BLM would restrict wind energy development to a few specific locations and would establish mitigation measures for those locations on a project-by-project basis only.

Chapter 5 presents an evaluation of the potential impacts of wind energy development on BLM-administered lands under the MPDS and discusses relevant measures that could be implemented to mitigate those impacts. In this chapter, the effectiveness of the different management options (i.e., the proposed action and its alternatives) at mitigating these potential impacts is evaluated. In addition, how well each management option would support or facilitate wind energy development on BLM-administered lands is analyzed. This discussion addresses the question of whether the proposed action presents the best management approach for the BLM to adopt (Section 2.4).

Sections 6.1 through 6.3 discuss the potential impacts of each of the management alternatives being evaluated. Section 6.4 discusses the cumulative impacts of the proposed action. Cumulative impacts include those effects that could result from incremental impacts of development in accordance with the terms and conditions of the proposed Wind Energy Development Program when added to other past, present, and reasonably foreseeable future actions. Section 6.5 discusses other NEPA considerations related to the proposed action, including unavoidable adverse impacts, short-term uses of the environment and long-term productivity, irreversible and irretrievable commitment of resources, and mitigation of adverse impacts.

6.1 IMPACTS OF THE PROPOSED ACTION

As discussed in Section 2.2, under the proposed action, the BLM is seeking to develop a Wind Energy Development Program that would establish comprehensive policies and BMPs addressing wind energy development on BLM-administered lands in 11 western states, excluding Alaska. The magnitude of potential development under the proposed action is defined by the MPDS and WinDS model results (Section 2.2.1). The proposed program includes policies and BMPs addressing the administration of wind energy development ROW authorizations and establishing programmatic level mitigation guidance (Section 2.2.3). The proposed action also includes the amendment of many BLM land use plans (Section 2.2.4).

Chapter 5 presents an analysis of the potential impacts associated with wind energy development on BLM-administered lands under the MPDS. It also presents information about relevant mitigation measures that could be applied to reduce those impacts. As discussed in Section 5.15, the BLM reviewed the impact analysis and mitigation measures to identify appropriate policies and BMPs that could be applied to all wind energy development projects on BLM-administered lands. Site-specific and species-specific mitigation measures are not included in the programmatic policies and BMPs. Rather, as required by the proposed policies and BMPs, the site-specific and species-specific issues would be addressed at the project level to ensure that potential impacts of a project would be minimized. These types of project-specific mitigation measures would be incorporated into the POD and ROW authorization stipulations. Information presented in Chapter 5 may be useful for identifying appropriate project-specific mitigation requirements.

The following sections discuss the impacts of the proposed action on the pace of wind energy development, the environment, and the economy. Cumulative impacts and other NEPA considerations of the proposed action are discussed in Sections 6.4 and 6.5, respectively.

6.1.1 Pace and Cost of Wind Energy Development on BLM-Administered Lands

Implementation of the proposed Wind Energy Development Program, including the establishment of programmatic policies and BMPs and amendment of land use plans, would be expected to minimize some of the delays that currently occur for wind energy development projects and reduce costs.[1] In addition, the proposed program would ensure consistency in the way ROW applications and grants for wind energy development are managed.

The proposed programmatic policies and BMPs would not eliminate the need for detailed analyses at the project level; they would, however, bring focus to the efforts. Decisions and debate regarding what actions must be undertaken at the project level and what mitigation measures must be addressed in the POD would be resolved by the programmatic policies and BMPs. The universe of issues that must be evaluated in detail at the project level would be reduced to site-specific and species-specific issues and concerns.

Proposed wind energy development activities must be reviewed and approved in accordance with local land use plan requirements. Such review and approval would be better supported by land use plans that specifically address wind energy development. The proposed amendment of selected BLM land use plans through this PEIS would facilitate specific project review and approval. Additional land use plans for those areas where developable wind energy resources would be located are expected to be amended or revised in the future to address wind energy development.

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[1] A number of other factors also would affect the pace of wind energy development within the region, including (1) the presence or absence and structure of national PTCs and national and state RPSs; (2) access to and the cost of electricity transmission; (3) the cost of other fuels for electricity supply, including natural gas and coal; and (4) public support or opposition to wind power development. Because these factors are beyond the influence or control of the BLM, they are not considered in the PEIS analysis.

As a result of the proposed action, the time necessary to obtain BLM approval of a ROW authorization application could be reduced, along with the associated costs to both the BLM and industry, without compromising the level of protection to natural and cultural resources. To the extent that decisions about future wind energy projects could be tiered off of the analyses in this PEIS or decisions in the resultant ROD, there would be even further time and cost savings. In summary, the proposed action would facilitate wind energy development on BLM-administered lands while ensuring that the adverse environmental, sociocultural, and economic impacts would be minimized.

6.1.2 Environmental Impacts

The proposed Wind Energy Development Program would incorporate policies and BMPs that establish mitigation requirements for all projects. The proposed policies identify specific lands on which wind energy development would not be allowed; establish requirements for public involvement, consultation with other federal and state agencies, and government-to-government consultation; define the need for project-level environmental review; establish requirements for the scope and content of the project POD; and incorporate adaptive management strategies. The proposed BMPs would establish environmentally sound and economically feasible mechanisms to protect and enhance natural and cultural resources. They would identify the issues and concerns that must be addressed by project-specific plans, programs, and stipulations during each phase of development. Specifically, they would address issues associated with the project location, project footprint and area of disturbance, sensitive or critical habitats, habitat fragmentation, threatened and endangered and other protected species, avian and bat impacts, habitat restoration, environmental monitoring and adaptive management strategies, visual resources, road construction and maintenance, transportation planning and traffic management, air emissions, noise, noxious weeds, pesticide use, cultural and paleontological resources, hazardous materials and waste management, storm water management and erosion control, and human health and safety. The land use plan amendments are being proposed to (1) adopt the programmatic policies and BMPs and (2) exclude specific areas from development. These proposed amendments would further ensure that potential impacts would be mitigated to the maximum extent possible.

Implementation of the proposed policies and BMPs would ensure that potential adverse impacts to most of the natural and cultural resources present at wind energy development sites, except wildlife and visual resources, would be minimal to negligible. This would include potential impacts to soils and geologic resources, paleontological resources, water resources, air quality, noise, land use, and cultural resources not having a visual component. The proposed policies and BMPs would require that mitigation measures protecting these resources be incorporated into project PODs; this would include the incorporation of specific programmatic BMPs as well as the incorporation of additional mitigation measures contained in other existing and relevant BLM guidance (Section 3.6.2) or developed to address site-specific or species-specific concerns. Information presented in Chapter 5 may be useful for identifying appropriate project-specific mitigation requirements.

The proposed policies and BMPs would considerably reduce potential impacts to wildlife by requiring that these issues be addressed comprehensively and by providing some minimum standards for mitigation. For example, under the proposed program, operators would be required to collect and review information regarding protected species and sensitive habitats at the project site and to design the project to avoid (if possible), minimize, or mitigate impacts to these resources. The specific measures needed to address these site-specific and species-specific issues, however, would be addressed at the project level. While it is possible that adverse impacts to wildlife could occur at some of the future wind energy development sites, the magnitude of these impacts and the degree to which they could be successfully mitigated would vary from site to site.

Similarly, the proposed policies and BMPs would reduce potential impacts to visual resources, although the degree to which this could be achieved would be site-specific. These resources would include cultural resources that have a visual component (e.g., sacred landscapes). The proposed program would require that the public be involved in and informed about potential visual impacts of a specific project during the project approval process. Minimum requirements regarding project design (e.g., BMPs regarding commercial logos and lighting) would be incorporated into individual project plans. Ultimately, determinations regarding the magnitude of potential visual impacts would be made by local stakeholders.

The proposed program would require the BLM and operators to adopt adaptive management strategies regarding wind energy development, which would further ensure that potential environmental impacts were kept to a minimum. Programmatic policies and BMPs would be reviewed and revised to strengthen mitigation measures as new data regarding the impacts of wind energy projects become available. At the project level, operators would be required to develop monitoring programs to evaluate the environmental conditions at the site through all phases of development, to establish metrics against which monitoring observations could be measured, to identify potential mitigation measures, and to establish protocols for incorporating monitoring observations and new mitigation measures into standard operating procedures and project-specific BMPs.

6.1.3 Economic Impacts

The potential economic impacts of the proposed action, which are discussed in detail in Section 5.13, would generally be beneficial to local and regional economies. The projected development defined by the WinDS model would result in new jobs and increased income, GSP, sales tax, and income tax in each of the 11 states during both construction and operation. These economic benefits would be realized to varying degrees in each state by the year 2005 and would increase over the 20-year study period.

The proposed policy to exclude certain lands from wind energy development (Section 2.2.3.1), as well as the corresponding land use plan amendments to exclude certain lands, would limit potential economic benefits to local communities. However, the economic impact of these exclusions at a regional level would likely be minimal.

The BLM would incur costs associated with developing, implementing, and managing wind energy development on BLM-administered lands. However, under the BLM's ROW program, which is a cost-recovery program, a substantial portion of the costs for processing ROW applications, including NEPA requirements, would be paid by industry. In addition, by the year 2025, the federal government is projected to earn as much as $7.9 million per year in ROW rental receipts for new wind energy development over what it currently earns from existing wind projects (Table 5.13.1-3).

6.2 IMPACTS OF THE NO ACTION ALTERNATIVE

As described in Section 2.3, under the no action alternative wind energy development would continue on BLM-administered lands in accordance with the terms and conditions of the Interim Wind Energy Development Policy (BLM 2002a) (Appendix A). Under the no action alternative, the BLM would not establish a Wind Energy Development Program to provide guidance to industry and BLM field staff in the 11-state study area. The policies, BMPs, and land use plan amendments of the proposed Wind Energy Development Program would not be implemented. Future wind energy projects and land use plan amendments would continue to be evaluated solely on an individual, case-by-case basis, and there would be no comprehensive program for moving the projects forward and ensuring consistency.

The MPDS developed for the proposed action (see Section 2.2.1 and Appendix B) is assumed to also represent the development scenario for the no action alternative and to define the extent and distribution of BLM-administered lands that would be potentially subject to wind energy development over the next 20 years. However, it is acknowledged that the absence of a BLM Wind Energy Development Program would be likely to adversely impact the pace at which wind energy resources would be developed on public lands and the cost of future projects (discussed below). An assessment of the potential impacts associated with the no action alternative on the pace of development, the environment, and the economy is described in the following sections.

6.2.1 Pace and Cost of Wind Energy Development on BLM-Administered Lands

The absence of a BLM Wind Energy Development Program would likely cause wind energy development on BLM-administered lands to occur at a slower pace than under the proposed action. The anticipated benefits of the proposed Wind Energy Development Program (Section 2.2), in terms of land use plan amendments, tiered NEPA analyses, and the availability of comprehensive BMP guidance, would not be realized under the no action alternative. One can predict that without these benefits, the length of time needed to review, process, and approve ROW applications for wind energy projects would increase. This would be particularly true for commercial project applications but would also likely be true for site monitoring and testing applications.

Extended time lines for application and approval processes usually translate into increased costs, and the cost per unit of wind energy developed would likely be greater under the no action alternative than under the proposed action. This could result in delays in establishing necessary project financing and power market contracts. Furthermore, developers could elect to avoid delay and uncertainty by shifting their projects to state, Tribal, and private land with potentially less federal environmental oversight (Section 6.2.2). If this shift were to occur, resulting in less development of wind energy on BLM-administered lands, this outcome would be in conflict with the intent of the National Energy Policy recommendation that encourages the development of renewable energy resources on public lands, and with the requirements of E.O. 13212 to expedite energy-related projects (U.S. President 2001a).

6.2.2 Environmental Impacts

The potential adverse impacts to natural and cultural resources on BLM-administered lands associated with the no action alternative could be greater than those described in Section 6.1 for the proposed action if effective mitigation measures are not applied to individual projects. In all likelihood, however, effective mitigation measures would be developed for individual wind energy projects by virtue of the environmental analyses required by the Interim Wind Energy Development Policy (BLM 2002a) (Appendix A). In that event, potential adverse impacts to natural and cultural resources would be similar to those of the proposed action. The absence of a Wind Energy Development Program, however, could result in inconsistencies in the type and degree of mitigation required for individual projects.

Although it is beyond the scope of the BLM’s jurisdiction or responsibility, it is important to note that potential adverse impacts to natural and cultural resources on non-BLM-administered lands under the no action alternative could increase. If the absence of a BLM Wind Energy Development Program were to result in delays in processing wind project applications on BLM-administered lands or increases in the cost of developing wind power on BLM-administered lands, developers could respond by focusing their wind energy development efforts on state-owned, Tribal, and private lands. While wind energy development on nonfederal lands is subject to a wide array of environmental reviews and approvals by virtue of state and local permitting processes (see Appendix E), it may not be subject to NEPA requirements if federal funding or permitting is not required for the project.

6.2.3 Economic Impacts

Because it is difficult to estimate the degree to which the absence of the Wind Energy Development Program would impact the pace and amount of development, it is difficult to estimate the extent to which economic impacts under the no action alternative would vary from those estimated for the proposed action (Section 5.13). While the economic impact of specific projects on BLM-administered lands in a host state would likely be similar regardless of whether a Wind Energy Development Program is in place, uncertainties surrounding the time required for permitting and the consequent impact on project cost would likely delay the development of any given project. The consequent postponement of the various economic (employment, income and output) and fiscal (taxes and ROW rental receipts) benefits of specific projects would hinder the economic development of the region. Many of the potential host locations do not have other potential sources of economic growth.

In addition, even though it can be assumed that there would be an increased demand for wind energy as wind generation technology becomes more economically viable, it is difficult to predict where this development would occur. Although there is the potential for wind energy development to shift to nonfederal lands, as discussed in Section 6.2.1, it is also possible that economic factors would stifle development elsewhere. For example, sites on non-BLM-administered land within the 11 states may not necessarily be chosen for development if wind availability at these sites is inferior to that of sites on BLM-administered land, and if higher land costs undermine the economic viability of wind energy development. Consequently, the overall level of wind development in these states might be less in the absence of a BLM Wind Energy Development Program. Whether the focus for wind energy development would shift to potential locations outside the 11-state area is unknown. Given the remote location of much of the BLM-administered land and rural nature of surrounding communities, it is likely that the economic development prospects of communities located near potential wind development projects on BLM-administered land would be poorer than elsewhere in the 11-state area. The absence of a BLM Wind Energy Development Program may represent a lost economic development opportunity for rural communities.

The BLM would incur costs associated with developing, implementing, and managing wind energy development on BLM-administered lands. However, under the BLM's ROW program, which is a cost-recovery program, a substantial portion of the costs for processing ROWs, including NEPA requirements, would be paid by industry. In addition, the federal government earns money from ROW rental receipts.

6.3 IMPACTS OF THE LIMITED WIND ENERGY DEVELOPMENT ALTERNATIVE

As discussed in Section 2.4, under the limited wind energy development alternative, additional future wind energy development on BLM-administered lands would be limited to those locations where it currently exists (including future expansion at those facilities), is under review, or has been approved for development at the time the ROD for this PEIS is published. For the purposes of establishing an upper bound on the potential impacts of this alternative, it was assumed that all proposed wind energy projects on BLM-administered lands currently under review would be approved for development by the time the ROD is published. If this is not the case, there would be fewer environmental and economic impacts than described in this section. Under these limitations, the assumption used in the preparation of this PEIS is that wind energy development would be restricted to six locations:

- Existing wind energy development
    1. Palm Springs, California
    2. Ridgecrest, California
    3. Wyoming Wind Project, Arlington, Wyoming

- Proposed wind energy projects currently under review
    4. Table Mountain Wind Generating Facility, Nevada
    5. Cotterel Mountain Wind Farm Project, Idaho
    6. Walker Ridge, California

Under this alternative, wind energy development would be managed in accordance with the terms and conditions of the Interim Wind Energy Development Policy (BLM 2002a) (Appendix A).

6.3.1 Environmental Impacts

Environmental analyses for future expansions at existing wind projects would be conducted under the direction of the relevant BLM Field Office at such time that applications for expansion or repowering are submitted. The appropriate level of analysis would be determined on the basis of the nature and scale of the proposed activity, in accordance with NEPA requirements. Of the three proposed wind project applications currently being processed, an EIS has been completed for the Table Mountain Project in Nevada (PBS&J 2002), and EISs are being prepared at this time for the Cotterel Mountain Wind Farm Project and the proposed development at Walker Ridge.

Detailed project-specific analyses are not within the scope of this PEIS and would be redundant to on-going evaluations. As a result, site-specific environmental analyses associated with the limited wind energy development alternative have not been prepared for this PEIS. It can be concluded, however, that under this alternative, potential environmental impacts to BLM-administered lands associated with wind energy development would be less on a regional level than those discussed in the proposed action and the no action alternative because development would be restricted. Environmental impacts would occur at the local level and would need to be mitigated through project-specific stipulations. In turn, it might also be concluded that the decreased opportunities for wind energy development effected by limiting development on BLM-administered lands could result in the need to develop other traditional sources of electricity, such as natural gas or coal, which could translate into greater environmental impacts regionally. A multitude of factors would determine the balance between wind energy development on other federal, state, and private lands and increased development of fossil fuel sources, the analysis of which is beyond the scope of this PEIS. The limited wind energy development alternative could also cause increased development on state, Tribal, and private lands with potentially less federal environmental oversight.

6.3.2 Economic Impacts

Under the limited wind energy development alternative, only three new wind energy projects would be developed on BLM-administered land, and expansion of capacity would occur at two existing sites over the period 2005 to 2015.[2] The time line for development of the new wind energy projects, if they are approved, is expected to be 2 years (i.e., by 2007); the time line for expansion of capacity at the two existing sites is expected to be 10 years (i.e., by 2015). The projected capacity varies by project: Walker Ridge (120 MW), Ridgecrest (150 MW), and Palm Springs (40 MW), all in California; Cotterel Mountain, Idaho (200 MW); and Table Mountain, Nevada (205 MW). The impacts in the host state of constructing and operating these projects in 2015 are shown in Table 6.3.2-1. The year 2015 was selected for analysis because by that time, all new capacity projected under this alternative is expected to be developed.

Construction activities associated with these projects would produce 360 direct and 1,040 overall jobs in California, $46.5 million in income, and $164.0 million in GSP. The state would collect $11.3 million in sales taxes and $2.9 million in income taxes. Impacts in Idaho in 2015 would be slightly less than those in California, with 430 jobs created, $15.2 million in income, and almost $60 million in GSP generated. The state would collect $4.2 million in sales taxes and $1.0 million in income taxes. Impacts would also occur in Nevada, with 370 jobs created, producing almost $16 million in income.

Operational activities in 2015 would produce 140 direct and 180 total jobs in California, $7.0 million in income, $16.4 million in GSP, $1.7 million in sales taxes, and $3.0 million in income taxes (Table 6.3.2-1). Wind operations in California would also generate $1.2 million in ROW rental receipts to the federal government. In Idaho, wind project operation would create 50 direct and 90 total jobs, $2.4 million in income and $5.8 million in GSP. Sales taxes in the amount of $0.6 million would be generated, together with $1.2 million in income taxes. ROW rental receipts to the federal government would amount to $0.5 million in Idaho. Impacts would also occur in Nevada, with 60 jobs created, $2.4 million in income generated, and $0.5 million in ROW rental receipts to the federal government.

While the BLM incurs costs associated with managing wind energy development on these BLM-administered lands, the BLM’s ROW program is a cost-recovery program, and a substantial portion of the costs for processing ROW applications, including NEPA requirements, is paid by industry. In addition, the federal government earns money from ROW rental receipts.

6.4 CUMULATIVE IMPACTS

The purpose of this cumulative impact assessment is to determine how the environmental, sociocultural, and economic conditions within the 11-state study area may be incrementally impacted over the next 20 years by wind energy development that would occur on BLM-administered lands in accordance with the proposed Wind Energy Development Program. The CEQ, in its regulations (CEQ 1997a) implementing the procedural provisions of NEPA (40 CFR 1500-1508), defines cumulative effects as follows:

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2 As discussed in Section 2.4.1, expansion of production capacity is not anticipated at the Wyoming Wind Project located on BLM-administered lands in Arlington, Wyoming.

TABLE 6.3.2-1 Economic Impacts of the Limited Wind Energy Development Alternative in 2015 ($ millions 2003, except jobs)[a]

Impact Area	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming
Construction											
Employment											
Direct	0.0	360	0.0	140	0.0	150	0.0	0.0	0.0	0.0	0.0
Total	0.0	1,040	0.0	430	0.0	370	0.0	0.0	0.0	0.0	0.0
Income											
Direct	0.0	11.9	0.0	4.7	0.0	4.8	0.0	0.0	0.0	0.0	0.0
Total	0.0	46.5	0.0	15.2	0.0	15.5	0.0	0.0	0.0	0.0	0.0
Gross state product	0.0	164.0	0.0	59.6	0.0	59.1	0.0	0.0	0.0	0.0	0.0
Taxes											
Sales	0.0	11.3	0.0	4.2	0.0	4.2	0.0	0.0	0.0	0.0	0.0
Income	0.0	2.9	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operations											
Employment											
Direct	0.0	140	0.0	50	0.0	50	0.0	0.0	0.0	0.0	0.0
Total	0.0	180	0.0	90	0.0	60	0.0	0.0	0.0	0.0	0.0
Income											
Direct	0.0	3.9	0.0	1.5	0.0	1.6	0.0	0.0	0.0	0.0	0.0
Total	0.0	7.0	0.0	2.4	0.0	2.4	0.0	0.0	0.0	0.0	0.0
Gross state product	0.0	16.4	0.0	5.8	0.0	5.7	0.0	0.0	0.0	0.0	0.0
Taxes											
Sales	0.0	1.7	0.0	0.6	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Income	0.0	3.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROW rental receipts[b]	0.0	1.2	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0

Footnotes on next page.

TABLE 6.3.2-1 (Cont.)

[a] The estimated impacts presented in this table cannot be compared with the impacts presented in Table 5.13.1-2 for this same time period under the proposed action. The estimates in that table were made on the basis of projections generated by the WinDS model, and, therefore, were constrained by the model's assumptions about development (see Section 2.2.1 and Appendix B).

[b] ROW rental receipts to the federal government include annual minimum rent only, as based on installed capacity (in MW). The BLM may also charge additional production rents, depending on electricity production. These are not included, given the uncertainty over projected electricity output from wind developments.

> "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7).

The discussion of cumulative impacts in this programmatic analysis describes the impacts of wind energy development in the context of other activities that also could impact environmental resources. Specifically, the analysis considers the impacts of wind energy development on BLM-administered lands in the context of the impacts of (1) other commercial uses of BLM-administered lands, and (2) wind energy development on non-BLM-administered lands.

Section 6.4.1 presents the cumulative impact analysis for the proposed action. The analysis encompasses the same resources analyzed in Chapter 5 and considers the impacts that could occur as a result of wind energy development under the terms and conditions of the proposed Wind Energy Development Program, assuming that the proposed policies and BMPs are adopted (Section 2.2.3). In particular, it is assumed that the requirements for adaptive management incorporated into the proposed policies and BMPs would be met. These proposed policies and BMPs would require comprehensive, on-going environmental monitoring programs to evaluate environmental conditions and adjust impact mitigation requirements, as necessary. As a result, the proposed Wind Energy Development Program would continue to provide needed impact mitigation over time.

The scope of the cumulative impact analysis in this PEIS includes wind energy projects that are consistent with the pace of development projected for the next 20 years in the MPDS and the WinDS models (Table 2.2.1-1), projects that are consistent with the policies and BMPs contained in the proposed action, and projects that are proposed where land use plans have been amended to incorporate considerations of wind energy development. Individual site-specific wind energy projects on BLM-administered lands that are within the scope of this cumulative analysis and in accordance with the Wind Energy Development Program as described under the proposed action are considered to have been adequately addressed by this PEIS. These individual wind energy projects provide an incremental continuation to the overall scope of the cumulative analysis of wind energy development on BLM-administered lands.

Section 6.4.2 presents a comparison of the impacts associated with the development of wind energy versus other sources of electric power, including natural gas, coal, nuclear, solar, and geothermal energy. This comparison considers land area disturbance, air quality impacts, water use, and waste generation. Section 6.4.3 presents a discussion of considerations related to transmission line construction as a separate but related activity.

6.4.1 Cumulative Impacts of Wind Energy Development under the Proposed Action

To address the contributions of wind energy development to cumulative impacts, an understanding and knowledge of existing and reasonably foreseeable future activities are essential. For planning purposes, this PEIS assumes that activities on BLM-administered lands would continue into the future at current levels. Commercial activities include livestock grazing; forestry; mining; oil and gas development; construction of new gas, electric, and communication transmission lines; road construction; and outdoor recreation. Wind energy development on BLM-administered lands as described under the proposed action and analyzed in this PEIS would be in addition to those activities.

To support the cumulative impact assessment, the magnitude of wind energy development on BLM-administered lands under the proposed action was compared with other commercial uses of BLM-administered lands and with wind energy development on non-BLM-administered lands. Table 6.4.1-1 shows the amount of BLM-administered lands considered to be economically developable for wind energy over the next 20 years compared with total BLM-administered lands involved in various other commercial activities as of 2002 (data for 2003 on commercial uses of BLM-administered land were not available in time for incorporation into this PEIS). This comparison shows that the amount of BLM-administered land with economically developable wind resources is generally much smaller than lands involved in other commercial uses in each of the 11 states except California.

Table 6.4.1-2 shows the amount of BLM-administered lands considered to be economically developable over the next 20 years compared with all lands in each state (including BLM-administered lands and all other lands) expected to be involved in wind energy development over the same time period. In most states, the percentage of development expected to occur on BLM-administered lands compared with all lands is less than 20%, and in three of these states, it is less than 5%. In Utah and Nevada, the percentage of development on BLM-administered lands compared with all lands is higher, at 35% and 54%, respectively.

Tables 6.4.1-1 and 6.4.1-2, in combination with Table 2.2.2-1, show that the potential for wind energy development on BLM-administered lands is relatively small when compared with the total amount of BLM-administered lands and when compared with other uses of BLM-administered lands. To the extent that wind energy development projects on BLM-administered lands occur at the rates and in the amounts projected, as well as to the extent that the policies and BMPs described under the proposed action are applied, the impacts attributable to wind energy development would be marginal when compared with other anticipated ongoing activities.

6.4.1.1 Physiography, Geology, Soils, Sands, Gravel, and Seismicity

Cumulative impacts to geologic resources or seismic characteristics from wind energy projects are not expected to be significant. The proposed program includes many BMPs to mitigate impacts from blasting, excavation, or earthmoving activities. Any impacts that might occur would be minimal and largely limited to the project site.

The construction of new access roads, improvements to existing roads and bridges, and installation of turbines and ancillary structures at a project site would involve cut and fill operations. If large amounts of fill material would be necessary, increased demands could occur

TABLE 6.4.1-1 Comparison of Amount of BLM-Administered Lands with Projected Economically Developable Wind Resources Compared with Amount of BLM-Administered Lands Involved in Other Commercial Uses

State	BLM-Administered Lands with Economically Developable Wind Resources (acres)[a,b]	BLM-Administered Lands with Other Commercial Uses (acres)[c,d]	Percentage Wind versus Other Commercial Uses
Arizona	1,500	315,500	0.5
California	72,300	338,600	21.4
Colorado	4,200	1,616,000	0.3
Idaho	9,100	330,300	2.8
Montana	1,800	1,326,200	0.1
Nevada	34,700	658,400	5.3
New Mexico	9,800	4,659,700	0.2
Oregon/Washington[e]	10,300	2,528,700	0.4
Utah	12,700	1,495,300	0.8
Wyoming	3,700	4,172,800	0.1
Total	160,100	17,441,600	0.9

[a] To convert acres to hectares, multiply by 0.4047.

[b] Acreage estimates generated by the WinDS model. Projections include additional new capacity; existing capacity is excluded.

[c] Sources: Stamm (2004); (see Section 4.7 and Table 4.7.1-2). Other commercial uses include timber sales; oil and gas, geothermal, and coal production; nonenergy leasables; and ROW authorizations.

[d] Acres do not include existing wind energy projects, livestock grazing use, or mining activities. Grazing is a designated use that encompasses nearly all BLM-administered lands in the 11 western states. Data describing acreage involved in mining activities were not available.

[e] The acreage data describing other commercial uses in these two states were combined because Oregon and Washington are managed as a single administrative unit.

to off-site supplies of sand, gravel, and crushed rock. If multiple construction projects were developed within a single area, local supplies of required fill material, particularly gravel or crushed rock, could be reduced to the point of impacting the needs of roadways and other construction projects. For example, the Kittitas Valley Wind Project in Washington State is projected to require 145,000 yd^3 (110,860 m^3) of off-site gravel resources to support improvements to 7 mi (11 km) of existing roads; to construct 19 mi (30 km) of new road; and to build two substations, nine permanent meteorological towers, an operations center building, and

TABLE 6.4.1-2 Comparison of Amount of BLM-Administered Lands with Projected Economically Developable Wind Resources Compared with Amount of Total Lands with Projected Economically Developable Wind Resources

State	BLM-Administered Lands with Economically Developable Wind Resources (acres)[a,b]	Total Lands in State with Economically Developable Wind Resources (acres)[a,b]	Percentage BLM-Administered Wind
Arizona	1,500	11,000	14
California	72,300	450,400	16
Colorado	4,200	95,600	4
Idaho	9,100	54,400	17
Montana	1,800	65,500	3
Nevada	34,700	64,500	54
New Mexico	9,800	76,300	13
Oregon	9,700	86,900	11
Utah	12,700	36,600	35
Washington	600	65,500	1
Wyoming	3,700	21,400	17
Total	160,100	1,028,100	16

[a] To convert acres to hectares, multiply by 0.4047.

[b] Acreage estimates generated by the WinDS model. Projections include additional new capacity; existing capacity is excluded.

150 turbines (EFSEC 2003). This demand could impact resource availability for other local or regional projects.

6.4.1.2 Paleontology

Disturbances from wind energy development, combined with other surface-disturbing development activities, could uncover or destroy fossils on BLM-administered land. However, the proposed programmatic BMPs addressing paleontological resources and the proposed policy for excluding NLCS lands and ACECs from wind energy development would limit the potential impacts at a wind energy project site so that any cumulative impacts would be negligible.

6.4.1.3 Water Resources

Cumulative impacts to water resources are not expected to be significant. The proposed program includes many BMPs to mitigate impacts to both surface water and groundwater quality. On-site mixing of concrete during construction would require water as would some of the dust abatement activities, but these uses would be temporary. Operation of a wind energy project would use very small amounts of water and would not result in discharges to surface water.

6.4.1.4 Land Use

Appropriate planning and evaluation to address cumulative impacts of all permitted activities on BLM-administered lands would be needed at the Field Office level to ensure that proposed wind energy development projects are compatible with ongoing activities and land uses in the project region. The contribution to cumulative impacts of wind energy projects on BLM-administered lands likely would be small or negligible unless a significant permanent, uncompensated loss of the current productive use of a site occurred, or if future uses were precluded. However, wind energy development would generally be compatible with many other land uses, including livestock grazing; recreation; wildlife habitat conservation; and oil, gas, and geothermal production activities. The small number of workers at a wind energy project at any given time (e.g., about 150 during the peak construction period for a 180-MW capacity facility with about 150 turbines, and 10 to 20 workers during operations) would not likely add to cumulative impacts to land use or land disturbance that are occurring or have occurred from ongoing and past activities.

6.4.1.5 Air Quality

Wind energy development on BLM-administered lands would be unlikely to result in air pollutant concentrations that would exceed NAAQS. Multiple construction projects at the same time could contribute to regional pollutant emission loads from construction and worker vehicle exhaust emissions. Localized incidences of fugitive dust emissions along unpaved roads could occur if multiple construction projects occurred simultaneously. For example, transportation of the projected 145,000 yd^3 (110,860 m^3) of off-site gravel needed for the Kittitas Valley Wind Project in Washington State would require about 7,380 round-trips by medium-sized dump trucks (i.e., 23-ton [21-t] capacity per truck), or 5,300 round-trips by larger dump trucks of 32-ton (29-ton) capacity. Fugitive dust emissions from this volume of truck traffic, together with other sources of particulate emissions, would cause particulate concentrations to increase substantially above normal background levels, causing localized dust problems. However, the proposed programmatic BMPs include mitigation measures to reduce airborne dust at the project site. Dust emissions would not contribute to cumulative impacts to regional air quality because they would be localized and temporary. Air emissions from vehicles involved in operational activities at wind energy projects would be minimal because of the small number of employees needed on site at any one time. The small number of employees and associated trips during project operations would not have a noticeable effect on cumulative regional air quality. The use of wind-generated electrical power would avoid cumulative pollutant emissions from fossil-fired facilities that would be necessary to generate equivalent amounts of power (Section 6.4.2).

6.4.1.6 Noise

Noise levels generated by construction equipment would be variable and depend on the type, size, and condition of equipment used and the equipment operating schedule. Most locations of wind energy projects on BLM-administered land would likely be at distances far enough away from receptors that noise levels would not increase above existing background levels at the receptor location. Construction equipment at a wind turbine site could generate noise levels of 80 to 90 dB(A) at a distance of about 50 ft (15 m), as shown in Table 5.5.2-1. Because the estimated noise level of the two noisiest pieces of equipment operating simultaneously would not exceed the EPA noise guideline level of 55 dB(A) at a distance of about 1,640 ft (500 m) from the source, cumulative impacts would not be expected to occur to local residents living near BLM-administered land. Local residents near construction roads and turbine sites could experience intermittent noise from construction vehicles during the daytime period. Noise generated by turbines, substations, transmission lines, and maintenance activities during the operational phase would approach typical background levels for rural areas at distances of 2,000 ft (600 m) or less and, therefore, would not be expected to result in cumulative impacts to local residents.

6.4.1.7 Transportation

Localized impacts to traffic volume could occur on roads during construction and decommissioning, especially during peak periods; however, these impacts would be temporary. Multiple construction projects on the same or overlapping schedules could collectively contribute to congestion on local roads and highways. The vehicles of 100 to 150 workers and vehicles used to transport construction equipment, turbine components, and fill material to the respective wind energy projects would add to traffic volumes if common roads are used. Once wind energy projects were constructed, traffic volumes on nearby roads could increase by tourists wanting to drive by the turbines or visit the operations center.

6.4.1.8 Hazardous Materials and Waste Management

All wind energy projects would require shipment, storage, use, and disposal of hazardous materials and generation of solid and hazardous wastes; however, the proposed programmatic BMPs addressing these activities would effectively mitigate potential impacts. Waste volumes would likely be limited compared with other wastes generated regionally, particularly, if wastes generated during decommissioning of turbines and ancillary structures were recycled for other uses. As a result, cumulative impacts resulting from hazardous material use and waste generation would be negligible.

6.4.1.9 Human Health and Safety

Increased risk to human health and safety could occur during wind energy development and operation on the basis of the inherent hazards associated with construction activities and maintenance of turbines; however, these risks would be minimized by the proposed programmatic BMPs requiring a safety assessment, development of a comprehensive health and safety program and fire management strategy, safety setbacks to nearest residences, mitigation for EMI, and compliance with FAA regulations. In addition, EMF from transmission lines would decrease to background levels at distances of about 200 to 300 ft (60 to 90 m) from the edge of the ROW of a 115-kV and 230-kV line (BPA 1993). Cumulative impacts to human health and safety, therefore, would be negligible.

6.4.1.10 Ecological Resources

Ecological resources would be impacted by wind energy development as a result of vegetation clearing, wildlife habitat modification (e.g., reduction or fragmentation), increased noise levels generated during construction, and human intrusion into previously undisturbed areas. In addition, some biota may permanently abandon areas adjacent to the wind energy facility and could experience population-level effects. New access roads could create indirect impacts to vegetation and wildlife from increased use of previously remote areas. Off-road vehicle use, hunting intensity, and other activities would likely increase in the proximity of new wind energy projects where new access roads are built.

The number of bird collisions at wind energy projects is relatively small, when compared with collisions with other human-made structures. The effects of bird collisions on local populations would be a function of the number of animals killed relative to the size of the total population of the species in the region (NWCC 2002). It has been estimated that from 100 million to well over 1 billion birds are killed annually in the United States due to collisions with man-made structures (Erickson et al. 2001). These estimates include 60 million to 80 million birds from highway vehicle collisions, 28,500 birds from aircraft collisions, up to 174 million birds from power line collisions, 4 million to 50 million from collisions with communication towers, and 98 million to 980 million birds from colliding with buildings. In addition, an estimated 67 million birds die annually from exposures to agricultural pesticides, 1 million to 2 million birds from oil and gas extraction operations, and more than 100 million birds from legal hunting harvests (Curry and Kerlinger 2004a,b; Dunn 1993: Erickson et al. 2001; Klem 1990).

Other sources of avian mortality for which estimates are lacking include barbed-wire fences, commercial fishing (e.g., from being caught in nets), land development, oil spills, oil and gas open pits, logging, collisions with trains, strip mining, stock tank drowning, and exposure to mercury pollution from power plants (Allen and Ramirez 1990; Curry and Kerlinger 2004a,b; Erickson et al. 2001; Kleekamp 2004). Cats probably kill hundreds of millions of birds yearly (Kleekamp 2004). In Wisconsin alone, cats may kill as many as 217 million birds per year (Coleman and Temple 1996). Avian collision deaths for all existing wind energy projects are estimated at 10,000 to 40,000 each year (Erickson et al. 2001). Even as the number of wind turbines in the United States increases, wind turbine-related bird fatalities would still cause no more than a few percent of all collision deaths related to other non-wind-power related structures (Erickson et al. 2001). However, depending on the species involved, population-level effects could be increased as a result of such collisions.

Noise during construction would likely result in temporary impacts to wildlife at a wind energy site. Cumulative impacts to wildlife populations would be negligible for more mobile species, or species with relatively large home ranges. Operating wind energy projects could generate turbine noise levels that would adversely impact wildlife.

Depending on the turbine height, type, and location, and the locations of meteorological towers at existing wind energy projects or areas being monitored in pilot studies for future development, songbird mortality could occur from collisions with structures during migration. On the basis of bird and bat monitoring studies at existing wind energy projects, the contribution of wind projects to cumulative impacts on birds and bats would likely be minimal in comparison with population declines from other causes (e.g., habitat loss or fragmentation). However, some species could incur population-level effects.

Vegetation losses or disturbance would occur from wind energy project construction. The small amount of vegetation clearing at each turbine site would not be significant when compared with the amount of available similar habitat on large wind energy sites that cover several hundred acres.

6.4.1.11 Visual Resources

Visual resources could be impacted by wind energy projects. The heights, type, and color of turbines, together with their placement with respect to local topography (i.e., on a ridge or mesa), are factors that would contribute to visual intrusion on the landscape. Also, the need for additional transmission lines to connect wind energy projects to the regional power grid could contribute to cumulative impacts. The level of public acceptance of visual impacts may vary considerably from project to project.

Flexibility in locating turbines to avoid cumulative impacts to important (e.g., VRM Class I or II) viewsheds should be considered both by the wind energy developer and by the BLM on a project-specific basis. Depending on the number and height of turbines and transmission line towers in these viewsheds, wind farms could result in cumulative impacts on visual resources.

6.4.1.12 Cultural Resources

Disturbances from wind energy development, combined with other surface-disturbing development activities, could uncover or destroy cultural resources on BLM-administered land. However, the proposed programmatic BMPs addressing cultural resources and the proposed policy for excluding NLCS lands and ACECs would limit the potential impacts at a wind energy project site. The proposed programmatic policies and BMPs also require consultation under Section 106 of the NHPA, which includes consultation with SHPOs and with Native American governments as early in the planning process as appropriate to identify issues and concerns. Cumulative impacts to some cultural resources, predominantly archaeological sites, would, therefore, be negligible. However, cumulative impacts to cultural resources with a visual component (i.e., sacred landscapes) could occur.

6.4.1.13 Economics

Wind power developments on BLM-administered lands could potentially produce adverse cumulative impacts on other commercial uses of these lands and adjacent lands, including agriculture, forestry, mining, oil and gas development, electric power generation and transmission line facilities, recreation, and residential development. Quantification of these impacts requires specific information about the location and economic variables (e.g., the price of renewable [forest products] and nonrenewable [fossil energy] natural resources) and policy variables, such as federal and state legislation of natural resources. In general, however, the relatively small amount of land required for wind energy projects and their typically isolated locations means that the cumulative impact on other commercial uses of BLM-administered lands would likely be small. Consequently, potential conflicts with other traditional uses of BLM-administered lands, such as mining, oil and gas development, and agriculture, would likely be minimized. In addition, many of the activities associated with traditional uses of BLM-administered lands have either existed for long periods of time, or the location of any potential new developments would be predictable given the distribution of natural resources and areas of scenic beauty. Conflicts with forestry and recreation could therefore also be minimized.

Beneficial cumulative impacts associated with wind energy development on BLM-administered lands would be likely (Section 5.13). These benefits would include the creation of new jobs and increased regional income, GSP, sales and income tax revenues, and ROW authorization income to the federal government.

6.4.1.14 Environmental Justice

Potential cumulative impacts on environmental justice as a result of wind development could occur if wind energy projects produced environmental and health impacts similar to those that result from other activities on BLM-administered lands and adjacent lands in the project vicinity. If these combined impacts were to result in impacts that would be high and adverse, environmental justice issues would arise if minority and low-income populations were affected disproportionately. Proposed programmatic policies and BMPs, however, should ensure that adverse impacts to populations are minimized. Therefore, cumulative impacts on environmental justice issues should be negligible.

6.4.2 Impacts of Wind Energy Development versus Other Sources of Energy

This section provides a comparison of the environmental impacts of wind energy development with impacts associated with other energy sources. This comparison considers the amount of land area disturbed, air emissions, water use, and waste generation for the entire fuel cycle of different energy technologies.

6.4.2.1 Land Area Disturbance

Wind energy projects vary in land area requirements, depending on wind project size, terrain, turbine size, and the type of turbine array (e.g., linear pattern along a ridge line or grid-type distribution). Lease arrangements between the developer and landowner are also variable and depend on specific agreements between the parties. For example, the Nine Canyon Wind Project, a 69-MW capacity wind project located southeast of Kennewick, Washington, consists of 49 turbines that require 47 acres (19 ha) for towers, access roads, and maintenance buildings (Energy-Northwest 2004) over a leased area of 5,120 acres (2,073 ha). Similarly, the proposed Wild Horse Wind Project in Washington, a 312-MW wind energy project, would involve disturbance of 165 acres (67 ha) for 158 turbines and associated access roads on a leased area of 8,600 acres (3,482 ha) (EFSEC 2004). Land disturbance at these two projects is equal to about 1 acre per turbine or 0.52 and 0.68 acres per MW of installed capacity; at both projects, less than 2% of the total leased area is disturbed.

Land area disturbance for wind energy facilities is minimal compared with the amount of land disturbed by a coal surface mine or a new oil or gas field to produce an equivalent amount of electrical power by a conventional fossil-fueled power plant. For example, mining and disposal of waste from a 1,000-MW coal-fired power plant over its operational life is estimated to disturb 22,000 acres (8,900 ha) of land (NRC 1996). The coal-fired plant itself would require 1,300 to 1,700 acres of land (526 to 688 ha) (DOE/BPA 2003; NRC 1996). As another example, photovoltaic cells and solar thermal conversion power systems also disturb large land areas. Construction of a solar thermal generating station with a capacity of 1,000 MW would disturb about 5,000 acres (2,000 ha) of land in one or more locations (Sargent & Lundy LLC 2003), and thus affect land use and wildlife habitat in a relatively large area compared with land disturbed by an equivalent-sized wind energy project. Table 6.4.2-1 gives a comparison of land area disturbance for a 1,000-MW generation facility using different fuel sources. No information was available on the energy consumption and associated land disturbance to produce raw materials (i.e., the front-end fuel cycle) needed to make turbines, solar collectors, or piping and other hardware for geothermal facilities.

6.4.2.2 Air Quality

Air emissions from alternative energy sources are often compared when evaluating the advantages and disadvantages of new power generation capacity. Energy offsets from renewable energy sources, such as photovoltaic systems, wind energy, and solar thermal plants, are

TABLE 6.4.2-1 Land Disturbance for 1,000-MW Power Generation from Alternative Energy Sources

	Disturbed Land Area (acres)	
Energy Type	Front-End Fuel Cycle	Generation Facility
Wind	Unknown	520 to 680[a]
Solar thermal	Unknown	5,000[b]
Photovoltaic cell	Unknown	2,000[c]
Geothermal	Unknown	7,000[d]
Hydroelectric	Variable	Variable
Coal	22,000[b]	1,700[d], 1,300[e]
Oil	1,600[b]	120[d]
Natural gas	3,600[b]	110[d]
Nuclear	1,000[b]	500–1,000[d]

Sources: [a]EFSEC (2004) and Energy Northwest (2004), [b]Sargent & Lundy (2003), [c]Hansen (2003), [d]NRC (1996), and [e]DOE/BPA (2003).

compared with coal-, oil- or natural-gas-fired power plants both with respect to homes served and emissions generated. Gipe (1995) examines energy offsets for wind energy that includes both power generation and the fuel cycle for nuclear-, coal-, oil-, and natural-gas-fired plants. Table 6.4.2-2 gives a comparison of emissions from different generation technologies during facility operations.

Emission factors for the fuel cycle have been prepared by DOE for conventional coal plants, and nuclear power and photovoltaic plants (Meridian Corporation 1989 as cited in Gipe 1995). The emissions during the fuel cycle of these three technologies are shown in Table 6.4.2-3. A portion of the emissions for the nuclear fuel cycle are probably based on open pit mining, a type of uranium mining replaced by in situ mining in the western United States during the past two decades, and are thus higher than actual levels that would occur from current mining practices. No information was found that compared the fuel cycle emissions attributable to production of raw material used to manufacture components for wind turbines, solar power, and geothermal power plants. Kaygusuz (2004) provided estimates of SO_2, NO_2, and CO_2 emissions (in kg/GWh) for the manufacture of wind turbines on the basis of wind speed classes (in m/s), as follows:

- Wind speed = 4.5 m/s: SO_2 = 18–32 kg/GWh, NO_2 = 26–43 kg/GWh, CO_2 = 19–34 kg/GWh
- Wind speed = 5.5 m/s: SO_2 = 13–20 kg/GWh, NO_2 = 18–27 kg/GWh, CO_2 = 13–22 kg/GWh
- Wind speed = 6.5 m/s: SO_2 = 10–16 kg/GWh, NO_2 = 14–22 kg/GWh, CO_2 = 10–17 kg/GWh

TABLE 6.4.2-2 Comparison of Annual Air Emissions from Wind Energy Generation with Different Generation Methods[a] per Average Megawatt

	Air Emissions (tons/MW)					
Type of Energy Generation	SO_2	NO_x	CO_2	Particulates	CO	PAHs[b]
Wind[c]	0	0	0	0	0	0
Solar	0	0	0	0	0	0
Geothermal	0.8	0	700.8[d]	0	0	0
Coal	8.6	21.6	8,843	1.3	1.5	+[e]
Natural gas combined-cycle	0.05	0.7	3,542–5,142	0.03[d]	0.7–3.8	+
Oil combined-cycle	2.4[f]	1.8[f]	6,220[e]	1.4[e]	NA[g]	+
Nuclear	0	0	0	0	0	0
Wood-fired	0.5	9.0	11,959	1.7	17	+
Solid-waste-fired	13.6	70.2	13,256	3.0	2.7	+

[a] Information modified from DOE/BPA (2003), unless otherwise noted.

[b] PAHs = polycyclic aromatic hydrocarbons.

[c] Minor amounts of particulates and NO_x emissions would occur at wind energy projects from construction equipment and vehicles, and during O&M activities.

[d] Source DOE/BPA (1993).

[e] Present in emissions from incomplete fuel combustion.

[f] Source Gipe (1995).

[g] NA = not available.

TABLE 6.4.2-3 Estimated Emissions (g/MWh) from the Fuel Cycle for Coal, Natural Gas, Nuclear, and Photovoltaic Power Plants[a]

Emission	Natural Gas (combined cycle)	Coal	Nuclear	Photovoltaics
NO_x	277	2,700	30	10
SO_x	4	2,700	30	20
CO_2	389,000	962,000	7,800	5,350
Particulates	10	1,500	2.7	20
Trace metals	NA[b]	110	0	0
Solid waste	NA	213,000	30	10

[a] Sources: Table modified from information presented in Gipe (1995) and NEI (2004).

[b] NA = not available.

The extraction of raw materials and manufacture of wind turbines would not be expected to generate as much particulate matter as would be generated by a large coal surface mine.

Offsets can be calculated with information on wind turbine size, wind speed, and emissions generated by a typical coal-fired power plant. A 25-m (87-ft) diameter turbine at a wind energy site with an average wind speed of 7 m/s (16 mph) capturing about 30% of the wind energy, would generate about 1,000 kWh/m^2 of rotor area. During 1 year, the wind turbine would generate 500,000 kWh and offset about 500,000 kg (1 million lb) of CO_2 emitted by a new coal-fired power plant (Gipe 1995). In a 1992 report, the California Energy Commission indicated that the average household in California consumed about 6,450 kWh based on 1989 data. The power consumed by about 80 homes (the equivalent of 500,000 kWh), if generated by wind turbines, would offset 500,000 kg (1 million lb) of CO_2 emissions.

Many factors influence how power from wind energy production will affect production at other power production facilities. It is reasonably certain that producing a kWh of wind energy might correspond to a reduction of less than a kWh at other power facilities. Recognizing this limitation, upper bound offsets for coal and natural gas combined-cycle plants are presented below. In the mid-1990s, the State of California generated about 2 TWh/yr of electricity from wind energy projects. If this amount of power had been offset by a reduction in power generated by coal-fired plants, emissions up to the following could have been prevented:

- SO_x 14 million kg (15,428 tons)
- NO_x 14 million kg (15,428 tons)
- CO_2 2,600 million kg (2,860,000 tons)
- Particulates 4 million kg (4,200 tons)
- Trace metals 300,000 kg (330 tons)
- Solid waste 580,000 kg (638 tons)

Had the power been offset by a reduction in power generated by natural gas combined-cycle plants, emissions up to the following could have been prevented:

- SO_x 1.2 million kg (1,300 tons)
- NO_x 0.021 million kg (23 tons)
- CO_2 1,100 million kg (1,200,000 tons)
- Particulates 0.027 million kg (29 tons)
- Trace metals not available
- Solid waste not available

For perspective, in 2000, the most recent data available (EPA 2004c) indicated that total nonrenewable power plant emissions in the United States for SO_2, NO_2, and CO_2 were 11,513,034, 5,644,354, and 2,652,901,442 tons (10,444,449, 5,120,472, and 2,406,671,701 t), respectively.

6.4.2.3 Water Use

Wind energy projects require far less water than do other energy technologies. During construction, water is required for mixing of concrete and dust control along access roads and other areas of temporary disturbance around the turbines. Once a wind energy project is operating, minimal quantities of water are needed. Coal and nuclear fuel cycles can use 30 to 40 times more water than needed for periodic washing of photovoltaic panels (Gipe 1995). Fuel cycle water use by coal is about 3.12 ac-ft (1.017 million gal)/GWh, compared with 4.12 ac-ft (1.343 million gal) for nuclear and 0.1 ac-ft (32,590 gal) for photovoltaics (washing) (Gipe 1995). Consumptive water use (i.e., water lost to evaporation) ranges from 1.5 to 3.0 ac-ft (488,850 gal to 977,700 gal)/GWh for coal, compared with 2.5 to 4.0 ac-ft (814,750 gal to 1.304 million gal) for nuclear.

6.4.2.4 Waste Generation

Wastes generated by the coal and nuclear fuel cycles are very large compared with wastes associated with wind energy. Small waste quantities would be produced by operating wind energy projects mainly in the form of sanitary waste, and wastes produced from periodic servicing of the wind turbines. Preparation of coal before combustion in western U.S. power plants typically generates wastes that are about 10% of the coal mined. On the basis of coal extraction data from the early 1980s (DOE 1983), about 970,000 tons (879,969 t) of solid waste was produced each year during coal preparation (crushing and washing) before combustion in power plants. Coal combustion produces additional solid waste in the form of boiler slag, fly ash, and scrubber sludge produced by SO_2 removal equipment, which requires land for appropriate disposal. Nuclear power also generates solid wastes during power plant operations that require storage in underground water pools or dry casks in aboveground facilities. Relative to coal or nuclear plants, oil combined-cycle, and natural-gas-fired power plants generate very small amounts of solid waste during operation.

Gipe (1995) estimated that a wind turbine 25 m (82 ft) in diameter, if it was producing power to replace the same quantity of power generated by coal, would have a reduction of 234,000 lb (106,5000 kg) of solid waste.

6.4.3 Related Transmission Line Construction

In some portions of BLM-administered lands within the 11 western states, new transmission lines would be constructed to meet future power demands. This constitutes a separate but related activity to wind energy development. Planning for new transmission would require interagency coordination and cooperation following the protocol established between federal agencies and members of the Western Governors' Association on the siting and permitting of interstate electric transmission lines in the western United States signed in 2002 (Western Governors' Association 2002). This protocol is intended to carry out the goals set forth in the *Memorandum of Understanding among the U.S. Department of Energy, U.S. Department of the Interior, U.S. Department of Agriculture, U.S. Environmental Protection Agency, Council* *on Environmental Quality, and the Members of the Western Governors' Association, Regarding Energy Development and Conservation in the Western United States,* signed in 2001.

The protocol calls for an efficient mechanism for information sharing among entities having jurisdiction in siting and permitting new transmission systems. Feeder lines to connect wind energy facilities to larger transmission lines would require assessments by the BLM Field Offices to determine where best to site new feeder lines. Decisions on where to site the lines would require a coordinated, multidisciplinary environmental review that takes into account the project-specific location and design of the proposed wind energy project, line length, tower types, heights, construction methods, and access roads needed for line construction and maintenance. In addition, the BLM should gather information from state energy offices and wind energy associations on a regular and ongoing basis to stay abreast of future plans for wind energy and other energy generation facilities that would require new transmission systems.

An ongoing information database of current and future activities in the vicinity of proposed wind energy development projects that could affect siting of feeder and transmission lines should be maintained by BLM Field Office staff. Proximity of feeder lines to designated utility corridors on BLM-administered lands and the possible use of these corridors for the feeder lines would reduce the potential for additional cumulative impacts to wildlife and prevent human access into areas that are remote or with limited access.

To mitigate potential cumulative impacts of building new transmission and feeder lines to connect wind power facilities to the electrical grid, the following concerns and issues should be addressed before approval of new line routes:

- *Local and regional power supply needs.* Evaluate future transmission capacity and power demands.

- *Current and future land use.* Consider effects of ongoing oil and gas activities, mining, livestock grazing, and important wildlife use areas; land uses on private parcels adjacent to BLM-administered lands should not be ignored when determining how transmission lines might affect land use.

- *Potential for visual effects.* Evaluate how lines would fit into the visual character of the landscape collectively with the wind turbines and other structures; transmission tower height, type, and color are important factors in evaluating visual effects to local residents or motorists having a view of the lines.

- *Impacts to federal- and state-protected species.* Consider impacts of tower construction and conductor stringing, and increased access by individuals using transmission line access roads; evaluate how other activities in the vicinity of the lines have fragmented habitat or reduced the number of protected species.

- *Effects of access roads on human access to remote areas*. Consider the use that may be affected by ongoing projects on BLM-administered lands that could be further impacted by new access roads for transmission line construction.

- *Habitat fragmentation.* Determine how biodiversity and habitat have been affected by other activities in the area; evaluate line routes requiring minimal vegetation clearing.

- *Cultural resources.* Consider what potential impacts could occur from transmission line access roads opening remote areas or areas of significant cultural use; determine the impacts of other activities on BLM-administered lands and adjacent lands that have altered Native American use and values in the project area.

6.4.3.1 Rules and Regulations Governing Wind Project Grid Interconnections

A wind energy development project needs an outlet for the wind energy through the transmission system grid. In July 2003, the Federal Energy Regulatory Commission (FERC) issued Order 2003, *Standardization of Generator Interconnection Agreements and Procedures*, to establish a set of procedures and agreements to govern the process of interconnecting generators (i.e., generating facilities capable of producing more than 20 MW of power) to a transmission provider's transmission system. (Revised Order 2003-A was issued in March 2004.) Order 2003 applies to any new wind energy development larger than 20 MW in capacity that wants to interconnect to a transmission system that has a FERC-approved transmission tariff. It applies to independent transmission providers, such as Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs), as well as nonindependent transmission providers that provide tariff service.

Order 2003 establishes standard interconnection procedures, including a standard application form and procedures for studies that would be conducted to assess the proposed interconnection's effect on the transmission system. It also establishes a standard interconnection agreement and sets out the legal rights and obligations of the parties, including cost responsibility, milestones for the project's completion, and a process for resolving disputes.

In Order 2003, FERC also clarifies who should pay for interconnection costs when the transmission provider is not independent. The wind developer will pay for facilities on its side of the point of interconnection to the transmission system. Initially, the wind developer also will cover the cost of upgrades to the transmission provider's transmission system required to accommodate the new generator and the delivery of the output over the transmission grid to the point of delivery. The transmission provider may give credits back to the developer to offset a portion of the facility costs of the interconnection and transmission system improvements that can be included in the provider’s tariff.

Also, on January 24, 2005, FERC proposed regulations that would remove barriers to wind-generated electricity while helping to ensure continued reliability of the national power grid. Wind-generated power is a growing source of electricity generation in the United States; however, unique technical characteristics may impede the interconnection of wind facilities with the nation's grid system. The proposed regulations would include certain technical requirements that transmission providers must apply to interconnection service for wind generation plants. Once enacted, these requirements would be applied in addition to the standard interconnection procedures adopted in Order 2003.

6.4.3.2 Transmission System Additions for Wind Development

Order 2003 and subsequent filings by public utilities have standardized the procedures by which transmission providers and wind developers assess the need for transmission system additions to support a wind developer's request for interconnection. The standardized procedures require the development and review of an Interconnection Feasibility Study, Interconnection System Impact Study, and Interconnection Facilities Study. Each study is funded by the interconnection requestor; follow-on studies may be required on the basis of the status of other interconnection requests and/or changes in the points of interconnection.

The Interconnection Feasibility Study preliminarily evaluates the feasibility of the proposed interconnection to the transmission system. The study should consist of a power flow and short-circuit analysis and provide a list of facilities, a nonbinding good-faith estimate of cost responsibility, and a nonbinding good-faith estimated time to construct.

The Interconnection System Impact Study evaluates the impact of the proposed interconnection on the reliability of the transmission system, and coordinates the Interconnection System Impact Study with any adjacent system that may be impacted by the project. The Interconnection System Impact Study should consist of a short-circuit analysis, a stability analysis, and a power flow analysis. It should state the assumptions upon which it is based, state the results of the analyses, and identify the requirements or potential impediments to providing the requested interconnection service, including a preliminary indication of the cost and length of time that would be necessary to correct any problems identified in those analyses and implement the interconnection.

The Interconnection Facilities Study should identify the work needed to implement the conclusions of the Interconnection System Impact. It should also identify the electrical switching configuration of the connection equipment and necessary network upgrades, and provide an estimate of the time required to complete the construction and installation of such facilities.

Upon completion of a final Interconnection Facility Study, and any operational studies requested by the wind developer, an interconnection agreement would be negotiated and executed. For interconnects with federal power marketing administrations (e.g., Western Area Power Administration and Bonneville Power Administration), the appropriate level of NEPA review would need to have been completed before the interconnection agreement could be executed. The environmental impacts, including cumulative effects, of site-specific interconnection facilities and network upgrades would be assessed under site-specific environmental reviews.

6.5 OTHER NEPA CONSIDERATIONS

6.5.1 Unavoidable Adverse Impacts

The impacts associated with the proposed action are discussed in Section 6.1.1. In general, with the exception of potential impacts to wildlife and visual resources, these impacts would be negligible because of the comprehensive approach to mitigation provided in the proposed programmatic policies and BMPs. Unavoidable adverse impacts to wildlife and visual resources would likely occur at some of the future wind energy development sites; however, the magnitude of these impacts and the degree to which they can be successfully mitigated would vary from site to site. These site-specific and species-specific issues would be addressed at the project level in order to maximize opportunities to mitigate impacts.

6.5.2 Relationship between Local Short-Term Uses of the Environment and Long-Term Productivity

Activities associated with wind energy development that could be considered to be short-term uses of the environment would include those limited activities that would occur during the site monitoring and testing phase and the short-term disturbance associated with construction and decommissioning activities (e.g., use of lay-down areas and parking lots). The impacts associated with short-term use of the environment during the site monitoring and testing phase would be negligible, provided new access roads are not constructed and surface disturbance activities are kept to a minimum. Environmental impacts during construction would be relatively short term (about 1 to 2 years) and would be largely mitigated by programmatic BMPs and stipulations, including requirements for habitat restoration. The impacts to the environment during operations would constitute a long-term use of the environment; however, it would not conflict with most other land uses. The impacts of short-term use during decommissioning also would be mitigated by required habitat restoration activities, thereby rendering the land suitable for other uses.

The proposed action would result in favorable short-term and long-term effects for the local and regional economies where wind energy projects are located (Section 5.13). These benefits include the creation of new jobs and increased regional income, GSP, sales and income tax revenues, and ROW rental receipts to the federal government.

6.5.3 Irreversible and Irretrievable Commitment of Resources

The development of wind energy projects on BLM-administered lands would result in the consumption of sands, gravels, and other geologic resources, as well as fuel, structural steel, and other materials. Upon decommissioning, some of these materials would be available for reuse. Water resources also would be consumed during the construction and, to a lesser extent, decommissioning phases. These would be temporary uses and would be largely limited to on-site mixing of concrete and dust abatement activities.

In general, the impact to biological resources would not constitute an irreversible and irretrievable commitment of resources. During construction, operation, and decommissioning, individual animals would be impacted. For most species, population-level effects would be unlikely; however, population-level effects are possible for some species. Site-specific and species-specific analyses conducted at the project level for all project phases would help ensure that the potential for such impacts would be minimized to the fullest extent possible. While habitat would be impacted during construction and decommissioning, the restoration of habitat required by the programmatic policies and BMPs would reduce these impacts over time.

Cultural and paleontological resources are nonrenewable. Impacts to these resources would constitute an irreversible and irretrievable commitment of resources; however, the programmatic policies and BMPs are designed to minimize the potential for these impacts to the extent possible.

Impacts to visual resources in specific locations could constitute an irreversible and irretrievable commitment of resources. Efforts to mitigate these impacts would be undertaken at the project level with stakeholder input.

6.5.4 Mitigation of Adverse Effects

The proposed Wind Energy Development Program would establish programmatic policies and BMPs to ensure that potential adverse effects resulting from wind energy development on BLM-administered lands would be mitigated to the fullest extent possible. Any potential adverse impacts that cannot be addressed at the programmatic level would be addressed at the project level where resolution of site-specific and species-specific concerns is more readily achievable.

The proposed program would require that the BLM adopt adaptive management strategies regarding wind energy development. Programmatic policies and BMPs would be reviewed and revised to strengthen mitigation measures as new data regarding the impacts of wind power projects become available. At the project level, operators would be required to develop monitoring programs to evaluate the environmental conditions at the site through all phases of development, to establish metrics against which monitoring observations can be measured, to identify potential mitigation measures, and to establish protocols for incorporating monitoring observations and new mitigation measures into standard operating procedures and project-specific BMPs.

7 CONSULTATION AND COORDINATION UNDERTAKEN TO SUPPORT PREPARATION OF THE PEIS

7.1 PUBLIC SCOPING

The BLM published the NOI to prepare a PEIS to evaluate wind energy development on western public lands administered by the BLM in the *Federal Register* (68 FR 201) on October 17, 2003. The NOI initiated the public scoping process and invited public comments on the content and issues that should be addressed in the PEIS. The BLM conducted scoping for a 60-day period from October 17, 2003, through December 19, 2003. During that period, the BLM invited the public and interested groups to provide information and guidance, suggest issues that should be examined, and express their concerns and opinions on resources in the western United States that wind energy development might impact.

During the scoping process, the public was given four means of submitting comments to the BLM on the PEIS:

- Open public meetings, which were held in Sacramento, California (November 3); Salt Lake City, Utah (November 5); Cheyenne, Wyoming (November 12); Las Vegas, Nevada (November 18); and Boise, Idaho (November 20);

- Traditional mail;

- Toll-free facsimile transmission; and

- Directly through a Web site on the Internet.

This variety of ways to communicate issues and submit comments was provided so as to encourage maximum participation. All comments, regardless of how they were submitted, received equal consideration.

It is estimated that as many as 5,000 people participated in the scoping process by attending public meetings, providing comments, requesting information, or visiting the Wind Energy Development PEIS Web site. Approximately 110 documents containing comments were received from individuals, organizations, and government agencies, in addition to the verbal comments provided at the public meetings. Comments were received from nine state agencies (within the States of California, Montana, New Mexico, Utah, Washington, and Wyoming), three federal agencies (USFWS, Western Area Power Administration, and U.S. Air Force), four local government organizations (Board of Fremont County Commissioners, White Pine County Public Works, the Elmore County Commissioner, and the Kern County Planning Department), and nearly 60 other organizations (including environmental and interest groups and industry). More than 850 individual comments were received. Comments received in writing, as opposed to those submitted verbally at the public meetings, were submitted in the following ways:

- 72% via the Wind Energy Development PEIS Web site,

- 7% by fax, and

- 21% by regular mail.

Comments originated from 24 states. Of those comments, 80% were from states within the study area, and 30% were from California alone. No comments were received from other countries. During the scoping period, more than 10,500 visits were made by more than 4,800 different visitors to the Wind Energy Development PEIS Web site.

The BLM published a scoping report (BLM 2004f) that summarizes and categorizes the major themes, issues, concerns, and comments expressed by private citizens, government agencies, private firms, and nongovernmental organizations. The BLM considered the comments in developing the alternatives and analytical issues that are contained in this PEIS. Copies of the individual letters, facsimiles, and electronic comments received during scoping are available on the BLM Wind Energy Development PEIS Web site (http://windeis.anl.gov).

7.2 PUBLIC COMMENT ON THE DRAFT PEIS

The EPA published the Notice of Availability (NOA) of the Draft PEIS in the *Federal Register* on September 10, 2004 (69 FR 175). Publication of the NOA began a 90-day public comment period on the Draft PEIS, which ended on December 10, 2004.

The Draft PEIS was posted in its entirety on the Wind Energy Development PEIS Web site. Printed copies of the document and CDs containing the electronic files for the document were mailed upon request. Comments on the document were received by two methods:

- An electronic comment form on the project Web site, and

- Traditional mail.

More than 120 people and organizations participated in the public comment process by providing Internet-based comments or letters. More than 60 recognized organizations (public and private) provided comments on the Draft PEIS. The breakdown of comment documents (sets of comments from an individual or organization) by mode of submittal was as follows:

- 77% via the project Web site, and

- 23% by regular mail.

All comments, regardless of how they were submitted, received equal consideration. On the basis of the documents received during the public comment period, comment categorization resulted in approximately 718 individual comments. The BLM reviewed all comments and made changes to the Final PEIS, as appropriate. Responses to comments are provided in Volume 3 of the Final PEIS. Volume 3 has not been printed for distribution but is provided on a compact disc in a pocket attached to the back cover of Volume 2.

7.3 GOVERNMENT-TO-GOVERNMENT CONSULTATION

The BLM works on a government-to-government basis with Native American Tribal entities. As a part of the government's Treaty and Trust responsibilities, the government-to-government relationship was formally recognized by the federal government on November 6, 2000, with E.O. 13175, "Consultation and Coordination with Indian Tribal Governments," (U.S. President 2000).

The BLM coordinates and consults with Tribal governments, Native communities, and Tribal individuals whose interests might be directly and substantially affected by activities on BLM-administered lands. It strives to provide the Tribal entities sufficient opportunities for productive participation in BLM planning and resource management decision making.

The BLM developed a process to offer specific consultation opportunities to "directly and substantially affected" Tribal entities, as required under the provisions of E.O. 13175. Starting in October 2003, Tribal entities located in or with interests in the 11-state study area were contacted by mail by the BLM State Directors. In September 2004, the same Tribal entities were contacted by mail by the BLM State Directors advising them of the availability of the Draft PEIS for review and comment. Table 7.2-1 at the end of this chapter lists the Tribal entities that were contacted by state. Through the course of the entire PEIS preparation process, only three Tribes — Lovelock Pauite, Taos Pueblo, and Pawnee Nation of Oklahoma — indicated an interest in consultation. The BLM will continue to work with these Tribes. In addition, the BLM will continue to implement government-to-government consultation on a case-by-case basis for site-specific wind energy development proposals.

7.4 COORDINATION OF BLM STATE AND FIELD OFFICES

This PEIS was prepared by the BLM Washington Office to evaluate a program that will have Bureauwide impacts. The BLM Washington Office created two working groups to ensure adequate coordination between the BLM State Offices and multiple Field Offices that (1) needed to be involved in preparation of the PEIS and (2) would be impacted by its outcome.

The first group that was formed included land and resources staff from each of the 10 State Offices located within the 11-state study area.[1] These staff members served as technical leads and were responsible for providing technical knowledge regarding wind energy development in their respective state and coordinating with Field Office staff.

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[1] Although there are 11 states within the study area, there are only 10 BLM State Offices involved. The State Office located in Portland, Oregon, has management authority over BLM-administered lands in both Oregon and Washington.

The second group that was formed included Public Affairs Office staff from each of the State Offices. These staff members were responsible for coordinating all public involvement activities related to the PEIS (e.g., public meetings, local public notifications, and advertisements); conducting the government-to-government consultation process with Tribes; notifying state governmental agencies of the PEIS; responding to any questions regarding the PEIS received from local parties; and forwarding, as appropriate, any questions or comments regarding the PEIS to Washington Office staff.

In addition, land use planners in the State and Field Offices were involved in the process of identifying which land use plans would be proposed for amendment in the PEIS. This included determining the proposed changes and rationale for each change.

Coordination with State Office and Field Office staff will continue on issues related to wind energy development on BLM-administered lands. BLM Washington Office staff will work with State and Field Office staff following the release of the ROD to support (1) implementation of the Wind Energy Development Program or other programmatic or policy direction; (2) review of individual wind energy project ROW applications; (3) determination of the level of NEPA review required for individual project applications; (4) amendment and revision of land use plans; and (5) ongoing evaluation of wind energy resources on BLM-administered lands, employing NREL researchers, as necessary.

7.5 AGENCY COOPERATION, CONSULTATION, AND COORDINATION

From the start of this PEIS process, the BLM consulted with several federal agencies regarding the purpose and need for the proposed action and the scope of the analysis. Agencies that were involved in early consultations include the USFWS, the U.S. Air Force, the DOE Office of Energy Efficiency and Renewable Energy, and agency representatives to the Federal Energy Resources Network (FERN) (DOE Office of Fossil Energy, EPA, NPS, USFS, Minerals Management Services, and DoD). Consultation activities included notification of the opening of the scoping period, informal meetings and discussions, participation in a PEIS workshop in February 2004, and review of the Draft PEIS. During the Draft PEIS comment period, the DOE's Western Area Power Administration (Western) expressed an interest in working with the BLM to incorporate additional information related to wind energy and transmission system interconnects and expansions. The BLM accepted Western's offer for assistance and incorporated new information regarding transmission system interconnects and related issues into Section 6.4.3. As discussed in Chapter 1, the DOE is now a cooperating agency on the PEIS.

In accordance with the Memorandum of Agreement between the BLM and the USFWS, the BLM is consulting with the USFWS regarding the proposed plan amendments discussed in Section 2.2.4 and Appendix C (Appendix G of BLM 2002b). These consultations will be conducted in accordance with the requirements of Section 7 of the ESA (16 USC 1536) and are expected to result in the issuance of a programmatic biological assessment and biological opinion.

In addition, the BLM initiated activities to coordinate and consult with the governors of each of the 11 states and with state agencies. Prior to the issuance of the ROD and the approval of proposed plan amendments, the governor of each state will be given the opportunity to identify any inconsistencies between the proposed plan amendments and state or local plans and to provide recommendations in writing (during the 60-day consistency review period).

7.6 POTENTIAL ADOPTION OF THE PEIS BY OTHER ORGANIZATIONS

The PEIS provides an analysis of the positive and negative environmental, social, and economic impacts associated with wind energy development on BLM-administered lands in the western United States. It identifies potential measures that may be undertaken to avoid, mitigate, or minimize potential impacts and proposes specific policies and BMPs to govern wind energy development. The information contained in the PEIS and the decisions represented in the proposed policies and BMPs may be relevant to wind energy development on other lands, including other federal, private, state-owned, and Tribal lands. They may also be relevant to decisions regarding other related activities, including development of new transmission lines, substations, and other facilities.

As a cooperating agency, the DOE may elect to adopt this PEIS, or a portion of this PEIS, at some time in the future. Other agencies may elect to adopt this PEIS as well. The CEQ regulations provide specific guidance on the process by which one agency can adopt another agency's final NEPA document even though it did not participate as a cooperating agency (40 CFR 1506.3). According to the CEQ in its March 23, 1981 "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," Question 30, "If the proposed action for which the EIS was prepared is substantially the same as the proposed action of the adopting agency, the EIS may be adopted as long as it is recirculated as a final EIS and the agency announces what it is doing. This would be followed by the 30-day review period and issuance of a Record of Decision by the adopting agency. If the proposed action by the adopting agency is not substantially the same as that in [46 FR 18036] the EIS (i.e., if an EIS on one action is being adapted for use in a decision on another action), the EIS would be treated as a draft and circulated for the normal public comment period and other procedures" (46 FR 55, 18026–18038).

Individual organizations should consider their own NEPA implementing regulations or comparable programmatic requirements to evaluate the potential benefits associated with implementation of all or portions of the BLM's Final PEIS.

TABLE 7.2-1 Government-to-Government Consultation Summary

BLM State Office	Consultation Invitation Letters Sent to the Tribal Organizations Listed Below
Arizona	Yavapai-Prescott Indian Tribe, Prescott, AZ Colorado River Indian Tribes, Parker, AZ Hopi Tribal Council, Kykotsmovi, AZ Hualapai Tribal Council, Peach Springs, AZ
California	Buena Vista Rancheria, Ione, CA Barona Band of Mission Indians, Lakeside, CA Pinoleville Rancheria, Ukiah, CA Jamul Indian Village, Jamul, CA Enterprise Rancheria, Oroville, CA Big Valley Rancheria, Lakeport, CA Mooretown Rancheria, Oroville, CA Augustine Band of Mission Indians, Coachella, CA San Manuel Band of Mission Indians, Patton, CA Yurok Tribe, Klamath, CA Chicken Ranch Rancheria, Jamestown, CA Cherokees of California, Yuba City, CA Resighini Rancheria, Klamath, CA Lytton Rancheria, Santa Rosa, CA Twenty Nine Palms Band of Mission Indians, Coachella, CA Agua Caliente Band of Cahuilla Indians, Palm Springs, CA Elk Valley Rancheria, Crescent City, CA Smith River Rancheria, Smith River, CA Laytonville Rancheria, Laytonville, CA Colusa Rancheria, Colusa, CA Big Lagoon Rancheria, Trinidad, CA Cahuilla Band of Mission Indians, Anza, CA Round Valley Reservation, Covelo, CA Manchester Point Arena Band of Pomo Indians, Point Arena, CA Inaja and Cosmit Reservation, Escondido, CA La Posta Band of Mission Indians, Boulevard, CA Cortina Rancheria, Williams, CA Quartz Valley Reservation, Fort Jones, CA Tule River Reservation, Porterville, CA Cold Springs Rancheria, Tollhouse, CA Viejas Group of Capitan Grande Band of, Alpine, CA Stewarts Point Rancheria, Santa Rosa, CA Ewiiapaayp Band of Kumeyaay Indians, Alpine, CA Pit River Tribal Council, Burney, CA Potter Valley Rancheria, Ukiah, CA Soboba Band of Mission Indians, San Jacinto, CA Bridgeport Indian Colony, Bridgeport, CA Guidiville Rancheria, Talmage, CA Mechoopda Indian Tribe of the Chico Rancheria, Chico, CA

TABLE 7.2-1 (Cont.)

BLM State Office	Consultation Invitation Letters Sent to the Tribal Organizations Listed Below
California (Cont.)	Federated Indians of Graton Rancheria, Novato, CA Los Coyotes Reservation, Warner Springs, CA Benton Paiute Reservation, Benton, CA Indian Canyon Mutsun Band of Coastanoan, Hollister, CA La Jolla Band of Luiseno Indians, Pauma Valley, CA Table Bluff Reservation, Loleta, CA Mesa Grande Band of Mission Indians, Santa Ysabel, CA Hopland Reservation, Hopland, CA Middletown Rancheria, Middletown, CA Chemehuevi Indian Tribe, Havasu Lake, CA Pala Band of Mission Indians, Pala, CA Fort Independence Reservation, Independence, CA Timbisha Shoshone Tribal Office, Bishop, CA United Auburn Indian Community, Newcastle, CA Elem Indian Colony, Clearlake Oaks, CA Torres-Martinez Desert Cahuilla Indians, Thermal, CA Sycuan Band of Mission Indians, El Cajon, CA Bishop Paiute Tribe, Bishop, CA Table Mountain Rancheria, Friant, CA Kern Valley Indian Community, Kernville, CA Robinson Rancheria, Nice, CA Sherwood Valley Rancheria, Willits, CA
Colorado	Apache Tribe of Oklahoma, Anadarko, OK Cheyenne and Arapaho Tribes of Oklahoma, Concho, OK Cheyenne River Lakota Tribe, Eagle Butte, SD Comanche Tribe of Oklahoma, Lawton, OK Crow Creek Lakota Tribal Council, Fort Thompson, SD Hopi Tribal Council, Kykotsmovi, AZ Hopi Cultural Preservation Office, Kykotsmovi, AZ Jicarilla Apache Tribal Council, Dulce, NM Kiowa Tribe of Oklahoma, Carnegie, OK Navajo Nation Tribal Council, Window Rock, AZ Navajo Nation Historic Preservation Office, Window Rock, AZ Northern Arapaho Business Council, Fort Washakie, WY Northern Cheyenne Tribe, Lame Deer, MT Uintah and Ouray Tribal Business Committee, Ft. Duchesne, UT Northern Ute Tribe, Ft. Duchesne, UT Oglala Lakota Tribe, Pine Ridge, SD Pawnee Nation of Oklahoma, Pawnee, OK Pueblo of Acoma, Acomita, NM Pueblo of Conchiti, Cochiti, NM Pueblo of Isleta, Isleta, NM Pueblo of Jemez, Jemez Pueblo, NM

TABLE 7.2-1 (Cont.)

BLM State Office	Consultation Invitation Letters Sent to the Tribal Organizations Listed Below
Colorado (Cont.)	Pueblo of Nambe, Santa Fe, NM Laguna Pueblo Tribal Council, Laguna Pueblo, NM Picuris Pueblo, Penasco, NM Pueblo of Pojoaque, Santa Fe, NM Pueblo of Sandia, Bernalillo, NM Pueblo of San Felipe, San Felipe, NM Pueblo of San Juan, San Juan Pueblo, NM San Ildefonso Pueblo, Santa Fe, NM Pueblo of Santa Ana, Bernalillo, NM Santa Clara Pueblo, Espanola, NM Pueblo of Santo Domingo, Santa Domingo, NM Pueblo of Taos, Taos, NM Pueblo of Tesuque, Santa Fe, NM Pueblo of Zia, Zia Pueblo, NM Pueblo of Zuni, Zuni, NM Zuni Cultural Resource Enterprise, Inc., Zuni, NM Rosebud Sioux Tribe, Rosebud, SD Rosebud Lakota Tribe, Mission, SD Shoshone Tribe, Fort Washakie, WY Southern Ute Indian Tribe, Ignacio, CO Standing Rock Lakota Tribe, Fort Yates, ND Ute Mountain Ute Tribe, Towoac, CO Ute Mountain Ute Farm and Ranch Enterprise, Towoac, CO
Idaho	Coeur d'Alene Tribe, Plummer, ID Kootenai Tribe of Idaho, Bonners Ferry, ID Nez Perce Tribal Executive Committee, Lapwai, ID Shoshone-Bannock Tribes, Fort Hall, ID Shoshone-Paiute Tribes, Owyhee, NV
Montana	Assiniboine and Sioux Tribes of Fort Peck, Poplar, MT Chippewa Cree Indians of Rocky Boy, Box Elder, MT Crow Tribe of Montana, Crow Agency, MT Northern Cheyenne Tribe, Lame Deer, MT Spirit Lake Sioux Tribe, Fort Totten, ND Turtle Mountain Band of Chippewa, Belcourt, ND Blackfeet Tribe, Browning, MT Confederated Salish and Kootenai Tribes of Flathead, Pablo, MT Fort Belknap Indian Community, Harlem, MT Three Affiliated Tribes of Fort Berthold, New Town, ND Standing Rock Sioux Tribe, Fort Yates, MT Cheyenne River Sioux Tribal Council, Eagle Butte, SD Crow Creek Sioux Tribe, Fort Thompson, SD Lower Brule Sioux Tribal Council, Lower Brule, SD Oglala Lakota Sioux Tribal Council, Pine Ridge, SD Rosebud Sioux Tribe, Rosebud, SD

TABLE 7.2-1 (Cont.)

BLM State Office	Consultation Invitation Letters Sent to the Tribal Organizations Listed Below
Montana (Cont.)	Sisseton Wahpeton Sioux Tribe of Lake Traverse, Agency Village Sisseton, SD Yankton Sioux Tribe, Marty, SD Blackfeet Tribe, Browning, MT Crow Tribe, St Xavier, MT Fort Peck Tribes, Poplar, MT Sioux Tribe, Lower Brule, SD Northern Cheyenne Tribe, Lame Deer, MT Sioux Tribe, Pine Ridge, SD Chippewa Cree Tribe, Box Elder, MT Sioux Tribe, Mission, SD Standing Rock Hunkpapas Yanktonai Tribe, Fort Yates, ND Three Affiliated Tribes, New Town, ND Fort Peck Tribe, Poplar, MT
Nevada	Duck Water Shoshone Tribe, Duckwater, NV Fallon Business Council, Fallon, NV Ely Shoshone Council, Ely, NV Fort McDermitt Paiute-Shoshone Tribe, McDermitt, NV Duck Valley Shoshone-Paiute Tribe, Owyhee, NV Summit lake Paiute Tribe, Winnemucca, NV Te-Moak Tribal Council, Elko, NV Battle Mountain Band Council, Battle Mountain, NV Las Vegas Paiute Tribe, Las Vegas, NV Moapa Business Council, Moapa, NV Pyramid Lake Paiute Tribe, Nixon, NV Reno-Sparks Indian Colony, Reno, NV Lovelock Paiute Tribe, Lovelock, NV Elko Band Council, Elko, NV Wells Band Council, Wells, NV South Fork Band Council, Spring Creek, NV Washoe Tribe of Nevada and California, Gardnerville, NV Yerington Tribal Council, Yerington, NV Yomba Shoshone Tribe, Austin, NV Winnemucca Colony Council, Winnemucca, NV Walker River Paiute Tribe, Schurz, NV Carson Community Council, Carson City, NV Woodfords Community Council, Markleeville, CA Dresslerville Community Council, Garderville, NV Stewart Community Council, Carson City, NV Goshute Business Council, Ibapah, UT Timbisha Shoshone Tribe, Death Valley, CA Fort Mojave Indian Tribe, Needles, CA

TABLE 7.2-1 (Cont.)

BLM State Office	Consultation Invitation Letters Sent to the Tribal Organizations Listed Below
New Mexico	Jicarilla Apache Tribe, Dulce, NM Navajo Nation, Window Rock, AZ Mescalero Apache Tribe, Mescalero, NM Pueblo of Acoma, Acoma, NM Pueblo of Cochiti, Cochiti, NM Pueblo of Isleta, Isleta, NM Pueblo of Jamez, Jemez Pueblo, NM Pueblo of Laguna, Laguna, NM Pueblo of Nambe, Santa Fe, NM Pueblo of Picuris, Penasco, NM Pueblo of Pojoaque, Santa Fe, NM Pueblo of San Felipe, San Felipe Pueblo, NM Pueblo of San Juan, San Juan Pueblo, NM Pueblo of Sandia, Bernalillo, NM Pueblo of Santa Ana, Santa Ana Pueblo, NM Pueblo of Santa Clara, Espanola, NM Ysleta del Sur Pueblo, El Paso, TX Pueblo of Santo Domingo, Santa Domingo Pueblo, NM Pueblo of Taos, Taos, NM Pueblo of Tesuque, Santa Fe, NM Pueblo of Zia, Zia Pueblo, NM Pueblo of Zuni, Zuni, NM Ramah Navajo Chapter, Ramah, NM
Oregon and Washington	Tribal Council Chair, Burns Paiute Tribe, Burns, OR Chair, Colville Confederated Tribes, Nespelem, WA Chairman, Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians, Coos Bay, OR Chairman, Coquille Indian Tribe, North Bend, OR Chairwoman, Cow Creek Band of Umpqua Indians, Roseburg, OR Chairwoman, Confederated Tribes of Grand Ronde Indians, Grand Ronde, OR Chairman, Kalispel Tribe, Usk, WA Chairman, Klamath Tribes, Chiloquin, OR Chairman, Puyallup Tribe, Tacoma, WA Chairperson, Samish Tribe of Indians, Anacortes, WA Chairwoman, Confederated Tribes of Siletz Indians, Siletz, OR Chairman, Spokane Tribe, Wellpinit, WA Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR Confederated Tribes of the Warm Springs Reservation, Warm Springs, OR Chairman, Yakama Nation, Toppenish, WA

TABLE 7.2-1 (Cont.)

BLM State Office	Consultation Invitation Letters Sent to the Tribal Organizations Listed Below
Utah	President, Navajo Nation, Window Rock, AZ Aneth Chapter Coordinator, Navajo Nation, Montezuma Creek, UT Mexican Water Chapter Coordinator, Navajo Nation, Teec Nos Pos, AZ Navajo Mountain Chapter Coordinator, Navajo Nation, Tonalea, AZ Oljato Chapter Coordinator, Navajo Nation, Monument Valley, UT Red Mesa Chapter Coordinator, Navajo Nation, Montezuma Creek, UT Teec Nos Pos Chapter Coordinator, Navajo Nation, Teec Nos Pos, AZ Dennehotso Chapter Coordinator, Navajo Nation, Dennehotso, AZ Director, Navajo Utah Commission, Montezuma Creek, UT Chair, Ute Mountain Ute Tribe, Towaoc, CO Chair, White Mesa Ute Council, Blanding, UT Chair, Uintah and Ouray Tribal Business, Fort Duchesne, UT Cultural Resources Director, Fort Duchesne, UT Chairwoman, Paiute Indian Tribe of Utah, Cedar City, UT Band Chair, Kanosh Band of Paiutes, Kanosh, UT Chair, Koosharem Band of Paiutes, Richfield, UT C.R., Paiute Indian Tribe of Utah, Cedar City, UT President, San Juan S. Paiute Council, Tuba City, AZ Chair, Goshute Indian Tribe, Ibapah, UT Chair, Skull Valley Band of Goshute Indians, Salt Lake City, UT Chair, NW Band of Shoshone Nation, Pocatello, ID Band Chair, Indian Peaks Band of Paiutes, Enoch, UT Band Chair, Shivwitz Band of Paiutes, St. George, UT Environmental Coordinator, Goshute Tribe, Ibapah, UT
Wyoming	Shoshone Cultural Office, Fort Washakie, WY Northern Cheyenne Tribal Council, Lame Deer, MT Olglala Sioux Tribal Council, Pine Ridge, SD Cheyenne River Sioux Tribal Council, Eagle Butte, SD Natural Resources Subcommittee Nex Perce Tribe, Lapwai, ID Crow Tribal Council, Crow Agency, MT Blackfeet Tribal Planning Department, Browning, MT Cultural Rights and Protection Ute Indian Tribe, Fort Duchesne, UT Shoshone Business Council, Fort Washakie, WY Arapaho Business Council, Fort Washakie, WY Northern Cheyenne Cultural Committee, Lame Dear, MT Rosebud Sioux Tribal Council, Rosebud, SD Cheyenne River Sioux Tribe, Eagle Butte, SD Shoshone-Bannock Tribes of Fort Hall Business Council, Fort Hall, ID Cultural Director, Crow Tribal Administration, Crow Agency, MT Salish and Kootenai Tribal Council, Pablo, MT Cultural Resource Coordinator, Rosebud Sioux Tribe, Mission, SD Natural Resources Subcommittee, Nez Perce Tribal Executive Committee, Lapwaii, ID Cultural Resource Coordinator, Shoshone-Bannock Tribes, Fort Hall, ID Blackfeet Tribal Business Council, Browning, MT Ute Tribal Council, Fort Duchesne, UT

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10 GLOSSARY

Active pitch control: Continuous adjustment of the orientation of a turbine blade's airfoil in order to achieve maximum efficiency or maintain the rotation speed within design limits.

Adiabatic change: Change in the volume and pressure of a parcel of gas without an exchange of heat between the parcel of gas and its surroundings.

Adaptive management: A management system that is designed to make changes (i.e., to adapt) in response to new information and changing circumstances.

Aerodynamic noise: Aerodynamic noise is produced by the movement of an object through the air. For wind turbines, it is the noise caused by the rotor blades passing through the air, often described as a "swishing" sound. In general, the higher the rotational speed, the louder the sound.

Aerodynamics: The study of the forces exerted on and the flow around solid objects moving relative to a gas, especially the atmosphere.

Aerodynamic stall: A condition in which the wind's aerodynamic lifting force is approximately equal to its aerodynamic drag, resulting in the lowest wind power capture by the blade.

Aggregate: Mineral materials such as sand, gravel, crushed stone, or quarried rock used for construction purposes.

Air density: The weight of a given volume of air. Air is denser at a lower altitude, lower temperature, and lower humidity.

Air toxics: Substances that have adverse impacts on human health when present in ambient air.

Alluvial: Formed by the action of running water; of or related to river and stream deposits.

Alluvial fan: A gently sloping mass of unconsolidated material (e.g., clay, silt, sand, or gravel) deposited where a stream leaves a narrow canyon and enters a plain or valley floor. Viewed from above, it has the shape of an open fan. An alluvial fan can be thought of as the land counterpart of a delta.

Alternating current (ac): A flow of electrical current that increases to a maximum in one direction, decreases to zero, and then reverses direction and reaches maximum in the other direction. The cycle is repeated continuously. The number of such cycles per second is equal to the frequency, measured in Hertz (Hz). U.S. commercial power is 60 Hz.

American Antiquities Act of 1906: This act prohibits excavating, injuring, or destroying any historic or prehistoric ruin or monument or object of antiquity on federal land without the prior approval of the agency with jurisdiction over the land.

American Indian Religious Freedom Act of 1978: This act requires federal agencies to consult with Tribal officials to ensure protection of religious cultural rights and practices.

Anemometer: An instrument that measures wind speed or wind speed and direction.

Anthropogenic: Human made; produced as a result of human activities.

Aquifer: A permeable underground formation that yields usable amounts of water to a well or spring. The formation could be sand, gravel, limestone, and/or sandstone.

Archaeological and Historical Preservation Act of 1966, as Amended*:* This act directly addresses impacts to cultural resources resulting from federal activities that would significantly alter the landscape. The focus of the law is the creation of dams and the impacts resulting from flooding, creation of access roads, etc. Its requirements, however, are applicable to any federal action.

Archeological Resources Protection Act of 1979: This act requires a permit for excavation or removal of archeological resources from public or Native American lands.

Archaeological site: Any location where humans have altered the terrain or discarded artifacts during prehistoric or historic times.

Areas of Critical Environmental Concern (ACECs): These areas are managed by the Bureau of Land Management and are defined by the Federal Land Policy and Management Act of 1976 as having significant historical, cultural, and scenic values, habitat for fish and wildlife, and other public land resources, as identified through the Bureau of Land Management's (BLM's) land use planning process.

Array (turbine): The positioning and spatial arrangement of wind turbines relative to each other.

Attainment area: An area considered to have air quality as good as or better than the National Ambient Air Quality Standards for a given pollutant. An area may be in attainment for one pollutant and in nonattainment for others.

Attenuation: The reduction in level of sound.

Bald and Golden Eagle Protection Act of 1940: This act makes it unlawful to take, pursue, molest, or disturb bald and golden eagles, their nests, or their eggs. Permits must be obtained from the U.S. Department of the Interior in order to relocate nests that interfere with resource development or recovery.

Best management practices (BMPs): A practice (or combination of practices) that are determined to provide the most effective, environmentally sound, and economically feasible means of managing an activity and mitigating its impacts. Best management practices adopted as part of the proposed Wind Energy Development Program would identify for the BLM, industry, and stakeholders the best set of practices for developing wind energy and ensuring minimal impact to natural and cultural resources.

Betz limit: The maximum fraction of the power in the wind that can theoretically be extracted by a wind turbine, usually given as 16/27 (about 59%).

Biological assessment: A document prepared for the Endangered Species Act of 1973 Section 7 process to determine whether a proposed major construction activity under the authority of a federal action agency is likely to adversely affect listed species, proposed species, or designated critical habitat.

Biological opinion: A document resulting from formal consultation with the U.S. Fish and Wildlife Service. The document presents the opinion of the U.S. Fish and Wildlife Service as to whether or not a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

Biomass: Anything that is or has once been alive.

Biota: The living organisms in a given region.

Boiler slag: A noncombustible by-product collected from the bottom of furnaces that burn coal for the generation of steam. When molten boiler slag comes in contact with water it fragments into coarse, black, angular particles having a smooth, glassy appearance. These particles are used for blasting grit and roofing granules.

Borrow pit: A pit or excavation area used for gathering earth materials (borrow) such as sand or gravel.

Broadband noise: Broadband noise is noise that has a continuous spectrum (i.e., energy is present at all frequencies in a given range). This type of noise lacks a discernible pitch and is described as having a “swishing” or “whooshing” sound.

Bureau of Land Management (BLM): An agency of the U.S. Department of the Interior that is responsible for managing public lands.

Candela: The International System of Units standard unit of measurement of light intensity (formerly called the candle). The power of a light source is often expressed in candelas per square meter.

Candidate species: Candidate species are plant and animals for which the U.S. Fish and Wildlife Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a listing regulation is precluded by other higher priority listing activities.

Canopy: The upper forest layer of leaves consisting of tops of individual trees whose branches sometimes cross each other.

Capacity factor: The practically available power (usually expressed as a percentage) from a wind turbine. It is defined as the ratio of the annual energy output of a wind turbine to the turbine's rated power times the total number of hours in a year (8,760).

Carbon monoxide (CO): A colorless, odorless gas that is toxic if breathed in high concentrations over an extended period. Carbon monoxide is listed as a criteria air pollutant under Title I of the Clear Air Act.

Carrion: The dead, decomposing flesh of an animal.

Categorical Exclusion (CX): Under the National Environmental Policy Act, these are classes of actions that the U.S. Department of the Interior has determined do not individually or cumulatively have a significant effect on the human environment.

Chaparral: A plant community of shrubs and low trees adapted to annual drought and often extreme summer heat and also highly adapted to fires recurring every 5 to 20 years.

Clean Air Act (CAA): This act establishes national ambient air quality standards and requires facilities to comply with emission limits or reduction limits stipulated in State Implementation Plans. Under this act, construction and operating permits, as well as reviews of new stationary sources and major modifications to existing sources, are required. The act also prohibits the federal government from approving actions that do not conform to SIPs.

Clean Water Act (CWA): This act requires National Pollutant Discharge Elimination System permits for discharges of effluents to surface waters, permits for storm water discharges related to industrial activity, and notification of oil discharges to navigable waters of the United States.

Coal production (on BLM lands): The Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1976 requires competitive leasing of coal. These leases require payment of a royalty rate of 12.5% for surface-mined coal (8% for coal mined by underground methods), diligent development of commercial quantities of coal within 10 years of lease issuance, and stipulations to protect other resources within the lease. The BLM routinely inspects all coal to ensure accurate reporting of coal production and maximum economic recovery of the coal resource.

Code of Federal Regulations* (CFR)*: A compilation of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the United States. It is divided into 50 titles that represent broad areas subject to federal regulation. Each volume of the CFR is updated once each calendar year and is issued on a quarterly basis.

Conifers: Cone-bearing trees, mostly evergreens, that have needle-shaped or scale-like leaves.

Conterminous United States: The 48 mainland states, excluding Alaska and Hawaii.

Coriolis effect: The deflection sideways of free-moving air or water bodies (e.g., wind, ocean currents, airplanes, and missiles) relative to the solid earth beneath, as a result of the earth's eastward rotation. The Coriolis effect must be taken into account when projectile trajectories, terrestrial wind systems, and ocean currents are being evaluated.

Corona/corona noise: The electrical breakdown of air into charged particles. The phenomenon appears as a bluish-purple glow on the surface of and adjacent to a conductor when the voltage gradient exceeds a certain critical value, thereby producing light, audible noise (described as crackling or hissing), and ozone.

Council on Environmental Quality (CEQ): Established by the National Environmental Policy Act. Council on Environmental Quality regulations (40 CFR Parts 1500–1508) describe the process for implementing the National Environmental Policy Act, including preparation of environmental assessments and environmental impact statements, and the timing and extent of public participation.

Criteria air pollutants: Six common air pollutants for which National Ambient Air Quality Standards (NAAQS) have been established by the U.S. Environmental Protection Agency under Title I of the Clean Air Act. They are sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, particulate matter ($PM_{2.5}$ and PM_{10}), and lead. Standards were developed for these pollutants on the basis of scientific knowledge about their health effects.

Critical habitat: The specific area within the geographical area occupied by the species at the time it is listed as an endangered or threatened species. The area in which physical or biological features essential to the conservation of the species are found. These areas may require special management or protection.

Cryptobiotic organisms: Cryptobiotic organisms are soil-dwelling organisms, including cyanobacteria (blue-green bacteria), microfungi, mosses, lichens, and green algae found in surface soils of the arid and semiarid west. These organisms perform many important functions, including fixing nitrogen and carbon, maintaining soil surface stability, plant growth, and preventing erosion. They bind together with soil particles to create a crust.

Cultural resources: Archaeological sites, architectural structures or features, traditional-use areas, and Native American sacred sites or special-use areas that provide evidence of the prehistory and history of a community.

Culvert: A pipe or covered channel that directs surface water through a raised embankment or under a roadway from one side to the other.

Cumulative impacts: The impacts assessed in an environmental impact statement that could potentially result from incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal), private industry, or individual undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Cut-in speed: The wind speed below which a wind turbine cannot economically produce electricity. It is unique for each turbine.

Cut-out speed: The wind speed above which a wind turbine cannot economically produce electricity without also potentially suffering damage to its blades or other components.

Decibel (dB): A standard unit for measuring the loudness or intensity of sound. In general, a sound doubles in loudness with every increase of 10 decibels.

Decibel, A-weighted [dB(A)]: A measurement of sound approximating the sensitivity of the human ear and used to characterize the intensity or loudness of a sound.

Decommissioning: All activities necessary to take out of service and dispose of a facility after its useful life.

Demographics: Specific population characteristics such as age, gender, education, and income level.

Desert scrub: The desert scrub community is characterized by plants adapted to seasonally dry climate.

Dewater: To remove or drain water from an area.

Dielectric fluids: Fluids that do not conduct electricity.

Direct current (dc): Electric current that flows in one direction only.

Direct impact: An effect that results solely from the construction or operation of a proposed action without intermediate steps or processes. Examples include habitat destruction, soil disturbance, and water use.

Distributed energy systems: Interconnected wind turbines operating for the express purpose of generating electricity.

Downwind turbine: A turbine whose rotor and blades are oriented to the downwind side of the turbine's support structure. Downwind is the direction toward which the wind is blowing; with the wind.

Ecological refugium: See refugium.

Ecological resources: Fish, wildlife, plants, biota and their habitats, which may include land, air, and/or water.

Ecoregion: A geographically distinct area of land that is characterized by a distinctive climate, ecological features, and plant and animal communities.

Ecosystem: A group of organisms and their physical environment interacting as an ecological unit.

Electric and magnetic fields (EMF): The electric and magnetic fields that surround both big power lines that distribute power and the smaller electric lines in homes and appliances.

Electromagnetic fields: Electromagnetic fields are generated when charged particles (e.g., electrons) are accelerated. Charged particles in motion produce magnetic fields. Electromagnetic fields are typically generated by alternating current in electrical conductors. They are also referred to as EM fields.

Electromagnetic interference: Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electrical equipment. It is caused by the presence of electromagnetic radiation.

Emergency Planning and Community Right-to-Know Act (EPCRA): This act requires emergency release notification, hazardous chemical inventory reporting, and toxic chemical release inventory reporting by facilities, depending on the chemicals stored or used and their amounts.

Emissions: Substances that are discharged into the air from industrial processes, vehicles, and living organisms.

Empirical: Based on experimental data rather than theory.

Endangered species: Any species (plant or animal) that is in danger of extinction throughout all or a significant part of its range. Requirements for declaring a species endangered are found in the Endangered Species Act.

Endangered Species Act of 1973 (ESA): This act requires consultation with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service to determine if endangered or threatened species or their habitats will be impacted by a proposed activity and what, if any, mitigation measures are needed to address the impacts.

Endemic: Unique to a particular region.

Environmental assessment (EA): A concise public document that a federal agency prepares under the National Environmental Policy Act to provide sufficient evidence and analysis to determine whether a proposed action requires preparation of an environmental impact statement or whether a Finding of No Significant Impact can be issued. An environmental assessment must include brief discussions on the need for the proposal, the alternatives, and the environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted.

Environmental impact statement (EIS): A document required of federal agencies by the National Environmental Policy Act for major proposals or legislation that will or could significantly affect the environment.

Environmental justice: The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

Ephemeral: Lasting a very short time.

Exotic species: A plant or animal that is not native to the region where it is found.

Exploration and Mining Activity (on BLM land): Exploration refers to exploring for minerals by way of drilling, trenching, etc. Mining refers to the extraction and processing of minerals. Exploration and mining activities on BLM-managed lands are regulated under 43 CFR Part 3809, which provides for three levels of activity. The first, causal use, requires no contact with the BLM. The second, a notice, is filed for activities that disturb less than 5 acres (2 ha) unreclaimed per calendar year. The third, a plan of operations, is filed for activities that exceed 5 acres (2 ha) unreclaimed per calendar year. Plans of operation require BLM approval and are subject to the National Environmental Policy Act.

Extant: Currently existing.

Extensive Recreation Management Areas: All BLM-administered lands outside Special Recreation Management Areas. These areas may include developed and primitive recreation sites with minimal facilities.

Extremely low frequency (ELF): ELF refers to a band of frequencies from 30 to 300 Hz. Sometimes the band from 0 to 3,000 Hz is considered to be extremely low frequency. The 60 Hz power frequency is in this range.

Federal Cave Resources Protection Act of 1988: This act allows the collection and removal of resources from federal caves only when a permit has been authorized by the Secretary of Agriculture or the Secretary of the Interior.

Federal Land Policy and Management Act of 1976: This act requires the Secretary of the Interior to issue regulations to manage public lands and the property located on those lands for the long term.

Feeder lines: Power lines that travel out from substations to “feed” smaller distribution lines in a certain geographic area.

Fledging success: The average number of offspring fledged (i.e., raised until they leave the nest) per female.

Floaters: Nonbreeding adult and subadult birds that move and live within a breeding population.

Floodplain: Mostly level land along rivers and streams that may be submerged by floodwater.

Flora: Plants, especially, those of a specific region, considered as a group.

Fly ash: Small particles of airborne ash produced by burning fossil fuels. Fly ash is expelled as noncombustible airborne emissions or recovered as a by-product for commercial use (e.g., as a replacement for Portland cement used in concrete).

Flyway: A concentrated, predictable flight path of migratory bird species from their breeding ground to their wintering area.

Forbs: Nonwoody plants that are not grasses or grasslike.

Fragmentation of habitat: The breaking up of a single large habitat area such that the remaining habitat patches are smaller and farther apart from each other.

Frost heave: Expansion in soil volume due to the formation of ice. It is generally expressed as an upward movement of the ground surface.

Fugitive dust: The dust released from activities associated with construction, manufacturing, or transportation.

Gallinaceous birds: A term used for birds of the order Galliformes. They are heavy-bodied largely ground-feeding domestic or game birds, including chickens, pheasants, turkeys, grouse, partridges, and quail.

Geologic resources: Material of value to humans that is extracted (or is extractable) from solid earth, including minerals, rocks, and metals; energy resources; soil; and water.

Geology: The science that deals with the study of the materials, processes, environments, and history of the earth, including the rocks and their formation and structure.

Geostrophic wind: Horizontal wind in the upper atmosphere that moves parallel to isobars. It results from a balance between pressure gradient force and Coriolis force.

Geotechnical: Related to the use of scientific methods and engineering principles to analyze and predict the behavior of earth materials. Geotechnical engineers deal with soil and rock mechanics, foundation engineering, ground movement, deep excavation, and related work.

Geothermal energy: Energy that is generated by the heat of the earth's own internal temperature. Sources of geothermal energy include molten rock, hot springs, geysers, steam, and volcanoes.

Geothermal production: Electricity produced from the heat energy of the earth. This energy may be in the form of steam, hot water, or the thermal energy contained in rocks at great depths. The BLM leases geothermal rights to explore for and produce geothermal resources from federal lands or from subsurface mineral rights held by the government.

Grazing permits and leases (on BLM land): A grazing permit authorizing grazing of a specified number and class of livestock within a grazing district on a designated area of land during specified seasons each year. A grazing lease authorizes the grazing of livestock on public land outside grazing districts during a specified period of time. Grazing privileges are measured in terms of animal unit months.

Gross state product (GSP): The sum of value added in the production of all goods and services in the state in a year. It is a measure of the level of economic activity in the state.

Ground moraine: A deposit of glacial till released beneath the ice sheet as a glacier melts. An unsorted mixture of rocks, boulders, sand, silt, and clay deposited by glacial ice.

Groundwater: The supply of water found beneath the earth's surface, usually in porous rock formations (aquifers), which may supply wells and springs. Generally, it refers to all water contained in the ground.

Grubbing: Removal of stumps, roots, and vegetable matter from the ground surface after clearing and prior to excavation.

Guy wire: Wire or cable used to secure and stabilize wind turbines, meteorological towers, and other vertical objects in wind resource areas.

Habitat: The place, including physical and biotic conditions, where a plant or animal lives.

Hazardous air pollutants (HAPs): See air toxics.

Hazardous material: Any material that poses a threat to human health and/or the environment. Hazardous materials are typically toxic, corrosive, ignitable, explosive, or chemically reactive.

Hazardous material transportation law: The hazardous material transportation law (Title 49, Sections 5101–5127 of the *United States Code*) is the major transportation-related statute affecting transportation of hazardous cargoes. Regulations include The Hazardous Materials Table (49 CFR 172.101), which designates specific materials as hazardous for the purpose of transportation, and Hazardous Materials Transportation Regulations (49 CFR Parts 171–180), which establish packaging, labeling, placarding, documentation, operational, training, and emergency response requirements for the management of shipments of hazardous cargos by aircraft, vessel, vehicle, or rail.

Hedonic statistical framework: A method of assessing the impact of various structural (number of bedrooms, bathrooms, square footage, age, etc.) and locational attributes (local amenities, fiscal conditions, distance to workplace, etc.) on residential housing prices.

Herbaceous plants: Nonwoody plants.

Hertz (Hz): The unit of measurement of frequency, equivalent to one cycle per second.

Historic properties: Any prehistoric or historic districts, sites, buildings, structures, or objects included in, or eligible for inclusion in, the *National Register of Historic Places* maintained by the Secretary of the Interior. They include artifacts, records, and remains that are related to and located within such properties.

Historic site: The site of a significant event, prehistoric or historic activity, or structure or landscape (existing or vanished), where the site itself possesses historical, cultural, or archeological value apart from the value of any existing structure or landscape.

Hub: The central portion of the rotor to which the blades are attached.

Hydrology: The study of water that covers the occurrence, properties, distribution, circulation, and transport of water, including groundwater, surface water, and rainfall.

Indigenous: Native to an area.

Indirect impact: An effect that is related to but removed from a proposed action by an intermediate step or process. An example would be changes in surface-water quality resulting from soil erosion at construction sites.

Infrasound: Sound waves below the frequency range that can be heard by humans (about 1 to <20 Hz). Infrasound can often be felt, or sensed as a vibration, and can cause motion sickness and other disturbances.

Infrastructure: The basic facilities, services, and utilities needed for the functions of an industrial facility or site. Examples of infrastructure for wind farms are access roads, transmission lines, meteorological towers, etc.

Invasive species: Any species, including noxious and exotic species, that is an aggressive colonizer and can outcompete indigenous species.

Isochronal: Recurring at regular intervals; of equal time.

Lay-down area: An area that has been cleared for the temporary storage of equipment and supplies. To ensure accessibility and safe maneuverability for transport and off-loading of vehicles, lay-down areas are usually covered with rock and/or gravel.

L_{dn}: The day-night average sound level. It is the average A-weighted sound level over a 24-hour period that gives additional weight to noise that occurs during the night (10:00 p.m. to 7:00 a.m.).

Lead: A gray-white metal that is listed as a criteria air pollutant. Health effects from exposure to lead include brain and kidney damage and learning disabilities. Sources include leaded gasoline and metal refineries.

Lek: A traditional site that is used year after year by males of certain bird species for communal display as they compete for female mates.

L_{eq}: For sounds that vary with time, L_{eq} is the steady sound level that would contain the same total sound energy as the time-varying sound over a given time.

Listed species: Any species of fish, wildlife, or plant that has been determined, through the full, formal ESA listing process, to be either threatened or endangered.

Low-frequency sound: Sound waves with a frequency in the range of 20 to 80 Hz. The range of human hearing is approximately 20 to 20,000 Hz.

Marsh: A wetland where the dominant vegetation is nonwoody plants, such as grasses, as compared with a swamp where the dominant vegetation is woody plants, such as trees and shrubs.

Mechanical noise: Noise caused by the vibration or rubbing of mechanical parts. Sources of mechanical noise from wind turbines include the gearbox, the generator, yaw drives, cooling fans, etc.

Meteorological tower: A wind monitoring system that measures meteorological information such as wind speed, wind direction, and temperature at various heights above the ground. These data are used to evaluate the wind resource at a specific location.

Migratory Bird Treaty Act of 1918 (MBTA): This act requires that the USFWS be consulted to determine the effects of a proposed activity on migratory birds and requires that opportunities to minimize the effects be considered.

Mineral materials (salable): For BLM-managed land, these are defined as minerals such as common varieties of sand, gravel, pumice, and clay that are not obtainable under the mining or leasing law, but that can be obtained through purchase or free use permit under the Materials Act of 1947, as amended.

Mitigation: Actions taken to avoid, minimize, rectify, or compensate for any adverse environmental impact.

Mudflat: A flat sheet of mud between the high and low tide marks. Also, the flat bottoms of lakes, rivers, and ponds, largely filled with organic deposits, freshly exposed by a lowering of the water level.

Nacelle: The housing that protects the major components (e.g., generator and gear box) of a wind turbine.

Nameplate rating: The maximum amount of power that can be produced by a wind turbine under ideal conditions. It is usually expressed in watts or megawatts of electrical power.

National Ambient Air Quality Standards (NAAQS): Air quality standards established by the Clean Air Act, as amended. The primary National Ambient Air Quality Standards specify maximum outdoor air concentrations of criteria pollutants that would protect the public health within an adequate margin of safety. The secondary National Ambient Air Quality Standards specify maximum concentrations that would protect the public welfare from any known or anticipated adverse effects of a pollutant.

National Conservation Areas: Areas designated by Congress to provide for the conservation, use, enjoyment, and enhancement of certain natural, recreational, paleontological, and other resources, including fish and wildlife habitat.

National Environmental Policy Act of 1969 (NEPA): This act requires federal agencies to prepare a detailed statement on the environmental impacts of their proposed major actions significantly affecting the quality of the human environment.

National Historic Preservation Act of 1996, as Amended (NHPA): This act requires federal agencies to take into account the effects of their actions on historical and archaeological resources and consider opportunities to minimize their impacts.

National Historic Trails: These trails are designated by Congress under the National Trails System Act of 1968 and follow, as closely as possible, on federal land, the original trails or routes of travel with national historical significance.

National Landscape Conservation System (NLCS): The National Landscape Conservation System was created by the BLM in June 2000 to increase public awareness of BLM lands with scientific, cultural, educational, ecological, and other values. It consists of National Conservation Areas, National Monuments, Wilderness Areas, Wilderness Study Areas, Wild and Scenic Rivers, and National Historic and Scenic Trails.

National Monument: An area owned by the federal government and administered by the National Park Service, the BLM, and/or U.S. Forest Service for the purpose of preserving and making available to the public a resource of archaeological, scientific, or aesthetic interest. National monuments are designated by the President, under the authority of the American Antiquities Act of 1906, or by Congress through legislation.

National Natural Landmark: An area of national significance, designated by the Secretary of the Interior or the Secretary of Agriculture, that contains outstanding examples of the nation's natural heritage.

National Outstanding Natural Areas: Areas of public land that are either Congressionally or administratively designated on the basis of their exceptional, rare, or unusually natural characteristics.

National Parks: National Parks are public lands set aside by an act of Congress because of their unique physical and/or cultural value to the nation as a whole. They are administered by the National Park Service.

National Pollutant Discharge Elimination System (NPDES): A federal permitting system controlling the discharge of effluents to surface water and regulated through the Clean Water Act, as amended.

National Recreation Area: An area designated by Congress to conserve and enhance certain natural, scenic, historic, and recreational values.

National Recreation Trails: Trails designated by the Secretary of the Interior or the Secretary of Agriculture that are reasonably accessible to urban areas and meet criteria established in the National Trails System Act.

National Scenic Trails: These trails are designated by Congress and offer maximum outdoor recreation potential and provide enjoyment of the various qualities — scenic, historical, natural, and cultural — of the areas through which these trails pass.

National Wild and Scenic River: A river or river section designated by Congress or the Secretary of the Interior, under the authority of the Wild and Scenic Rivers Act of 1968, to protect outstanding scenic, recreational, and other values and to preserve the river or river section in its free-flowing condition.

National Wildlife Refuge: A designation for certain protected areas in the United States managed by the U.S. Fish and Wildlife Service. The National Wildlife Refuge System includes all lands, waters, and interests therein administered by the U.S. Fish and Wildlife Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish, wildlife, and plant resources.

Native American Graves Protection and Repatriation Act: This act established the priority for ownership or control of Native American cultural items excavated or discovered on federal or Tribal land after 1990 and the procedures for repatriation of items in federal possession. The act allows the intentional removal from or excavation of Native American cultural items from federal or Tribal lands only with a permit or upon consultation with the appropriate tribe.

Nitrogen dioxide (NO_2): A toxic reddish brown gas that is a strong oxidizing agent, produced by combustion (as of fossil fuels). It is the most abundant of the oxides of nitrogen in the atmosphere and plays a major role in the formation of ozone.

Nitrogen oxides (NO_x): Nitrogen oxides include various nitrogen compounds, primarily nitrogen dioxide and nitric oxide. They form when fossil fuels are burned at high temperatures and react with volatile organic compounds to form ozone, the main component of urban smog. They are also a precursor pollutant that contributes to the formation of acid rain. Nitrogen oxides are one of the six criteria air pollutants specified under Title I of the Clean Air Act.

Noise Control Act of 1972: This act requires that noise levels of facilities or operations not jeopardize public health and safety. States are authorized to establish their own noise levels.

Nominal (measurement): A design value, based on experience and generally reflecting accepted industry practice. A nominal value (e.g., depth of a tower foundation) may change depending on the conditions at a specific location.

Nonattainment area: The U.S. Environmental Protection Agency's designation for an air quality control region (or portion thereof) in which ambient air concentrations of one or more criteria pollutants exceed National Ambient Air Quality Standards.

Nonenergy leasables: All solid nonenergy mineral that private entities produce under leases issued by the BLM. These entities pay royalties to the federal government based on the value of the mineral they produce. Most of these minerals are used in industry and include sodium, bicarbonate, and potash.

Noxious plants/noxious weeds: Those plants regulated by law or those that are so difficult to control that early detection is important.

Occupational Safety and Health Administration (OSHA): Congress created the Occupational Safety and Health Administration under the Occupational Safety and Health Act on December 29, 1970. Its mission is to prevent work-related injuries, illnesses, and deaths.

Offsets: Reductions in emissions that are caused by an activity not directly related to the source creating the emissions. For example, a company that buys and uses wind-powered electricity has acquired an offset equal to the amount of fossil-fueled energy and carbon dioxide emissions it would have taken to produce the same amount of electricity. Offsets are used to stabilize total emissions in a particular area.

Oil and gas leasing (on BLM land): The BLM leases oil and gas rights to explore for and produce oil and gas resources from federal lands or mineral rights owned by the federal government. Federal oil and gas leases may be obtained and held by any adult citizen of the United States.

Operating range: The range of wind speeds over which a wind turbine is designed to operate and economically produce electricity. It includes all the wind speeds between the cut-in speed and the cut-out speed.

Operator: The party holding the right-of-way grant allowing either monitoring and testing of wind energy resources at a site, or commercial development of a wind energy project.

Outwash plain: A smooth plain covered by deposits from water flowing from glaciers.

Ozone (O_3): A strong-smelling, reactive toxic chemical gas consisting of three oxygen atoms chemically attached to each other. It is formed in the atmosphere by chemical reactions involving nitrogen oxide and volatile organic compounds. The reactions are energized by sunlight. Ozone is a criteria air pollutant under the Clean Air Act and is a major constituent of smog.

Paleontological resources: Any remains, trace, or imprint of a plant or animal that has been preserved in the earth's crust since some past geologic time.

Paleontology: The study of plant and animal life that existed in former geologic times, particularly through the study of fossils.

Particulate matter: Fine solid or liquid particles, such as dust, smoke, mist, fumes, or smog, found in air or emissions. The size of the particulates is measured in micrometers (μm). One micrometer is 1 millionth of a meter or 0.000039 inch. Particle size is important because the U.S. Environmental Protection Agency has set standards for $PM_{2.5}$ and PM_{10} particulates.

Passerines: Perching birds or songbirds.

Permissible exposure limit (PEL): The maximum amount or concentration of a chemical that a worker may be exposed to under Occupational Safety and Health Administration regulations.

Photovoltaic system: A system that converts light into electric current.

Physiography: The physical geography of an area or the description of its physical features.

Pitch: The orientation of a turbine blade relative to the direction of the wind.

Planetary boundary layer: The bottom layer of the atmosphere that is in contact with the surface of the earth. Within this layer, the effects of friction are significant. It is roughly the lowest 1 or 2 kilometers of the atmosphere.

Plateau: A large, flat area of land that is higher than the surrounding land.

Playa/playa lake: Playas form in arid basins where rivers merge but do not drain. They are flat areas that contain seasonal or year-to-year shallow lakes that often evaporate leaving minerals behind.

PM_{10}: Particulate matter with a mean aerodynamic diameter of 10 micrometers (0.0004 in.) or less. Particles less than this diameter are small enough to be deposited in the lungs. PM_{10} is one of the six criteria air pollutants specified under Title I of the Clean Air Act.

$PM_{2.5}$: Particulate matter with a mean aerodynamic diameter of 2.5 micrometers (0.0001 in.) or less.

Policy: A plan of action adopted by an organization. Policies adopted as part of the proposed Wind Energy Development Program would establish a system for the administration and management of wind energy development on BLM-administered lands.

Pollutant: Any material entering the environment that has undesired effects.

Polychlorinated biphenhyls (PCBs): A group of manufactured organic compounds made up of carbon, hydrogen, and chlorine. They were used in the manufacture of plastics and as insulating fluids for electrical equipment. Because they are very stable and fat-soluble, they accumulate in ever-higher concentrations as the move up the food chain. Their use was banned in the United States in 1979.

Population: A group of individuals of the same species occupying a defined locality during a given time that exhibit reproductive continuity from generation to generation.

Potable water: Water that can be used for human consumption.

Power coefficient or rotor power coefficient: The ratio of the rotor power density to the wind power density.

Power density or rotor power density: The mechanical power available at the rotor shaft divided by the swept area of the rotor.

Prevention of Significant Deterioration (PSD) Program: An air pollution-permitting program intended to ensure that air quality does not diminish in attainment areas.

Production Tax Credit (PTC): The Production Tax Credit was a federal policy that promoted the development of renewable energy (including wind energy). It provided qualifying facilities with an annual tax credit based on the amount of electricity that was generated. The Production Tax Credit expired December 31, 2003.

Programmatic Agreement: A document that records the terms and conditions agreed upon to resolve the potential adverse effects of a federal agency program, complex undertaking, or other situations in accordance with Section 800.14(b), "Programmatic Agreements," of 36 CFR Part 800, "Protection of Historic Properties."

Putrescible waste: Solid waste that contains organic matter that can rot or decompose.

Rain shadow: A region on the leeward (downwind) side of a mountain range where rainfall is noticeably less than the windy (windward) side of a mountain.

Raptor: Bird of prey.

Recharge: The addition of water to an aquifer by natural infiltration (e.g., rainfall that seeps in to the ground) or by artificial injection through wells.

Recreation Opportunity Spectrum (ROS) Class: A tool commonly used by federal land management agencies to determine the level of development, the types of facilities that are appropriate, and the type of recreational opportunities that one will experience. Six recreation opportunity classes have been developed: primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, rural, and urban. See Section 4.7.5 of the programmatic environmental impact statement for more information.

Refugium: An area where special environmental circumstances have enabled a species or a community of species to survive after extinction in surrounding areas.

Research Natural Areas: Areas designated or set aside by Congress or by a public or private agency to protect natural features or processes for scientific and educational purposes.

Resource Conservation and Recovery Act (RCRA): This act regulates the storage, treatment, and disposal of hazardous and nonhazardous wastes.

Right-of-way (ROW): Public land authorized to be used or occupied pursuant to a right-of-way grant. A right-of-way grant authorizes the use of a right-of-way over, upon, under, or through public lands for construction, operation, maintenance, and termination of a project.

Riparian: Relating to, living in, or located on the bank of a river, lake, or tidewater.

Rotational speed: The rate (in revolutions per minute) at which a turbine blade makes a complete revolution around its axis. Wind turbine speeds can be fixed or variable.

Rotor: The portion of a modern wind turbine that interacts with the wind. It is composed of the blades and the central hub to which the blades are attached.

Rotor diameter: The diameter of the circular area that is swept by the rotating tip of a wind-turbine blade. It is equal to twice the blade length.

Rotor-swept area: The circular area that is swept by the rotating blades. Doubling the length of the blades quadruples the blade-swept area.

Safe Drinking Water Act (SDWA): This act authorizes development of maximum contaminant levels for drinking water applicable to public water systems (i.e., systems that serve at least 25 people or have at least 15 connections).

Savannah: A flat grassland of tropical and subtropical regions usually having distinct periods of dry and wet weather.

Scrubbers: Any of several forms of chemical/physical devices that remove sulfur compounds formed during coal combustion.

Section 7 of the ESA: The section of the Endangered Species Act that requires all federal agencies, in “consultation” with the U.S. Fish and Wildlife Service, to ensure that their actions are not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of critical habitat.

Sedges: Perennial nonwoody plants that resemble grasses in that they have relatively narrow leaves. They are common to most freshwater wetlands.

Sediment: Materials that sink to the bottom of a body of water, or materials that are deposited by wind, water, or glaciers.

Sedimentary rock: Rock formed at or near the earth's surface from the consolidation of loose sediment that has accumulated in layers through deposition by water, wind, or ice, or deposited by organisms. Examples are sandstone and limestone.

Sedimentation: The removal, transport, and deposition of sediment particles by wind or water.

Seismic: Pertaining to any earth vibration, especially that of an earthquake.

Sensitive species: A plant or animal species listed by the state or federal government as threatened, endangered, or as a species of special concern.

Shadow flicker: The visual effect that occurs when the rotating blades of wind turbines cast shadows that cause a flickering effect.

Shake-down tests: Tests conducted to demonstrate that equipment is operational and meets performance requirements.

Shrub steppe: Habitat composed of various shrubs and grasses.

Silt: Sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

Siltation: The deposition or accumulation of silt.

Sludge: A dense, slushy, liquid-to-semifluid product that accumulates as an end result of an industrial or technological process designed to purify a substance.

Solid Waste Disposal Act: An act that regulates the treatment, storage, or disposal of solid hazardous and nonhazardous waste.

Sound pressure level: The level, in decibels, of acoustic pressure waves. Very loud sounds have high sound pressure levels; soft sounds have low sound pressure levels. A 3-dB increase in sound doubles the sound pressure level. Zero decibels is the threshold of human hearing. The maximum level of human hearing is around a 120-dB sound pressure level, which is the level where people begin to experience pain because of the high sound pressure levels.

Special areas: Areas of high public interest and containing outstanding natural features or values. BLM special areas include National Wild and Scenic Rivers, National Wildernesses, National Conservation Areas, National Scenic Areas, National Recreation Areas, National Monuments, National Outstanding Natural Areas, National Historic Landmarks, National Register of Historic Places, National Natural Landmarks, National Recreational Trails, National Scenic Trails, National Historic Trails, National Backcountry Byways, Areas of Critical

Environmental Concern, Research Natural Areas, Important Bird Areas, United Nations Biosphere Reserves, and World Heritage Sites.

Special Recreation Management Areas (SRMAs): An area where a commitment has been made to provide specific recreation activity and opportunities for recreational activities and experiences. These areas usually require a high level of recreation investment and/or management. They include recreation sites, but recreation sites alone do not constitute Special Recreation Management Areas.

Special status species: Special status species include both plant and animal species that are proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the Endangered Species Act; those listed by a state in a category such as threatened or endangered, implying potential endangerment or extinction; and those designated by each BLM State Director as sensitive.

Species of special concern: A species that may have a declining population, limited occurrence, or low numbers for any of a variety of reasons.

State Historic Preservation Officer (SHPO): The State officer charged with the identification and protection of prehistoric and historic resources in accordance with the National Historic Preservation Act.

Stipulation: A restriction that is insisted upon as a condition of agreement. Right-of-way grants issued by the BLM would include project-specific stipulations defining the conditions for wind energy development on BLM-administered lands. The policies and best management practices of the proposed Wind Energy Development Program would provide a baseline set of stipulations; additional stipulations would be developed, as needed, to address site-specific issues and concerns, on the basis of relevant land use plan requirements, other BLM mitigation guidance, and mitigation measures identified and discussed in Chapter 5 of this programmatic environmental impact statement.

Stratigraphy, subsurface: The arrangement (in layers) of different types of geologic materials located below the surface of an area.

Subalpine: The growing or living conditions in mountainous regions just below the timberline.

Substation: A substation consists of one or more transformers and their associated switchgear. It is used to switch generators, equipment, and circuits or lines in and out of a system. It is also used to change ac voltages from one level to another.

Sulfur dioxide (SO_2): A gas formed from burning fossil fuels. Sulfur dioxide is one of the six criteria air pollutants specified under Title I of the Clean Air Act.

Surface water: Water on the earth’s surface that is directly exposed to the atmosphere, as distinguished from water in the ground (groundwater).

Switchgear: A group of switches, relays, circuit breakers, etc. Used to control distribution of power to other distribution equipment and large loads.

Terrace: A step-like surface, bordering a valley floor or shoreline, that represents the former position of a floodplain, lake, or sea shore.

Threatened species: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Requirements for declaring a species threatened are contained in the Endangered Species Act.

Tip speed or rotor tip speed: The speed of the tip of a rotor blade as it travels along the circumference of the rotor-swept area.

Tip speed ratio: The ratio of the speed of the tip of a rotating blade to the speed of the wind.

Topography: The shape of the earth's surface; the relative position and elevations of natural and human-made features of an area.

Toxic Substances Control Act (TSCA): An act authorizing the U.S. Environmnetal Protection Agency to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment.

Transformer: A device for transferring electric power from one circuit to another in an alternating current system. Transformers are also used to change voltage from one level to another.

Transponder: A device that transmits and responds to radio waves.

Turbidity: A measure of the cloudiness or opaqueness of water. Typically, the higher the concentration of suspended material, the greater the turbidity.

Turbine: A device in which a stream of water or gas turns a bladed wheel, converting the kinetic energy of the fluid flow into mechanical energy available from the turbine shaft. Turbines are considered the most economical means of turning large electrical generators. They are typically driven by steam, fuel vapor, water, or wind.

Turbine spacing: The distance between wind turbines in a string. This distance is generally proportional to the rotor diameter.

Upwind turbine: A turbine whose rotor and blades are oriented to the upwind (the direction from which the wind is blowing) side of the turbine's support structure.

U.S. Environmental Protection Agency (EPA): The independent federal agency, established in 1970, that regulates federal environmental matters and oversees the implementation of federal environmental laws.

Viewshed: The total landscape seen or potentially seen from all or a logical part of a travel route, use area, or water body.

Visitor days: One visitor day equals 12 visitor hours at a site or area.

Visual Resource Management (VRM): The planning, design, and implementation of management objectives for maintaining scenic values and visual quality.

Visual resources: The composite of basic terrain, geologic features, hydrologic features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal that the unit may have.

Volatile organic compounds (VOCs)**:** A broad range of organic compounds that readily evaporate at normal temperatures and pressures. Sources include certain solvents, degreasers (benzene), and fuels. Volatile organic compounds react with other substances (primarily nitrogen oxides) to form ozone. They contribute significantly to photochemical smog production and certain health problems.

Voltage flicker: A noticeable dimming of a light source for a fraction of a second (flicker) caused by a sudden dip in voltage. Some people can detect dips as low as a third of a volt.

Watershed: An area from which water drains to a particular body of water. Watersheds range in size from a few acres to large areas of the country.

Wetlands: Areas that are soaked or flooded by surface or groundwater frequently enough or long enough to support plants, birds, animals, and aquatic life. Wetlands generally include swamps, marshes, bogs, estuaries, and other inland and coastal areas and are federally protected.

Wild horses and burros: These are unbranded and unclaimed horses or burros roaming free on public lands in the western United States and protected by the Wild Free-roaming Horse and Burro Act of 1971. They are descendants of animals turned loose by, or escaped from, ranchers, prospectors, Indian Tribes, and the U.S. cavalry form the late 1800s through the 1930s.

Wilderness Areas: Areas designated by Congress and defined by the Wilderness Act of 1964 as places "where the earth and its community are untrammeled by man, where man himself is a visitor who does not remain." Designation is aimed at ensuring that these lands are preserved and protected in their natural condition.

Wilderness Study Areas (WSAs): Areas designated by a federal land management agency as having wilderness characteristics, thus making them worthy of consideration by Congress for wilderness designation.

Wind farm: One or more wind turbines operating within a contiguous area for the purpose of generating electricity.

Wind resource areas (WRAs): Areas where wind energy is available for use based on historical wind data, topographic features, and other parameters.

Wind shear: The change, sometimes severe, in wind direction caused primarily by geographic features and obstructions near the land surface.

Wind shadow: The area behind an obstacle where air movement is not capable of moving material.

Windward slopes: Those slopes facing into the wind.

Xeric: Low in moisture.

Yaw: Side-to-side movement. For wind turbines, it refers to the angle between the axis of the rotor shaft and the wind direction. As this angle increases, the turbine's ability to capture the wind's energy decreases.