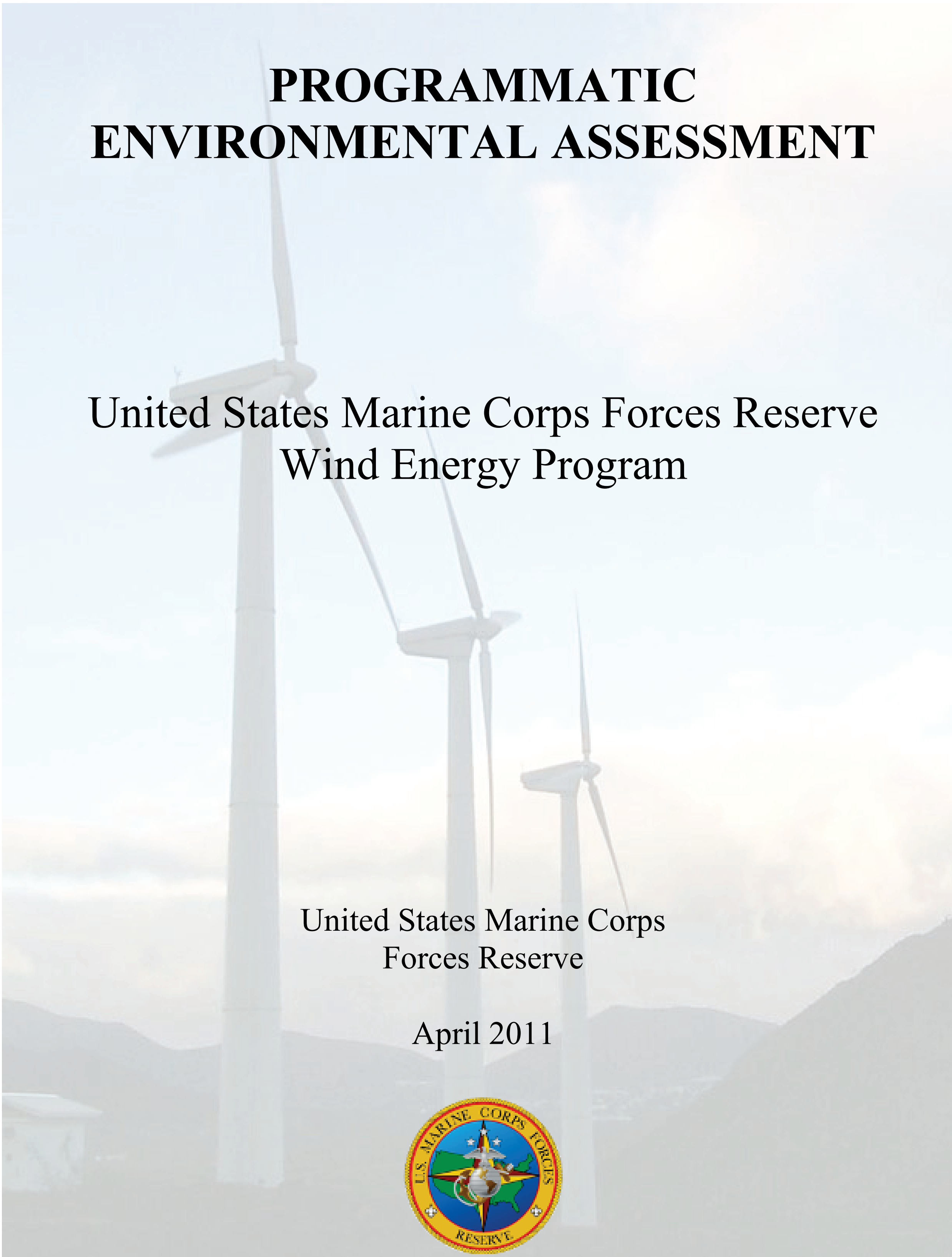
***Final***



# PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

## United States Marine Corps Forces Reserve Wind Energy Program

United States Marine Corps
Forces Reserve

April 2011

# Acronyms and Abbreviations

| | |
|---|---|
| ACP | Advanced Conservation Practice |
| AGL | above ground level |
| APE | Area of Potential Effect |
| AQCR | Air Quality Control Region |
| ARPA | Archeological Resource Protection Act |
| ASR | airport surveillance radar |
| ATC | air traffic control |
| BGEPA | Bald and Golden Eagle Protection Act |
| BLM | Bureau of Land Management |
| BMP | best management practice(s) |
| CAA | Clean Air Act |
| CEQ | Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| CGP | Construction General Permit |
| $CH_4$ | methane |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| $CO_2e$ | $CO_2$ equivalent |
| CWA | Clean Water Act |
| CZMA | Coastal Zone Management Act |
| dB | decibel |
| dBA | A-weighted decibel |
| DNH | Determination of No Hazard |
| DoD | Department of Defense |
| DOH | Determination of Hazard |
| DoN | Department of the Navy |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| EMI | electromagnetic interference |
| EO | Executive Order |
| EPAct | Energy Policy Act |
| ESA | Endangered Species Act |
| FAA | Federal Aviation Administration |
| FAR | Federal Aviation Regulations |
| FEMA | Federal Emergency Management Agency |
| FICON | Federal Interagency Committee on Noise |
| FICUN | Federal Interagency Committee on Urban Noise |
| FONSI | Finding of No Significant Impact |
| ft | foot (feet) |
| FY | fiscal year |
| GCM | general conservation measure |
| GHG | greenhouse gas |
| GPS | Global Positioning System |
| GWP | global warming potential |
| HUD | U.S. Department of Housing and Urban Development |
| Hz | hertz |
| IAP | International Airport |
| IBA | Important Bird Area |
| ICRMP | Integrated Cultural Resources Management Plan |
| IFR | Instrument Flight Rule(s) |
| INRMP | Integrated Natural Resources Management Plan |
| IRP | Installation Restoration Program |
| $L_{dn}$ | day-night average sound level |
| MARFORRES | U.S. Marine Corps Forces Reserve |
| MBTA | Migratory Bird Treaty Act |
| MCAS | Marine Corps Air Station |
| MCO | Marine Corps Order |
| MOU | Memorandum of Understanding |
| mph | miles per hour |
| MSL | mean sea level |
| MW | megawatt |
| MWh/yr | megawatt-hours per year |
| $N_2O$ | nitrous oxide |
| NAA | Nonattainment Area |
| NAAQS | National Ambient Air Quality Standards |
| NAS | National Academy of Sciences |
| NAVFAC ESC | Naval Facilities Engineering Service Center |
| NBII | National Biological Inventory Infrastructure |
| NEPA | National Environmental Policy Act |
| NEXRAD | Next-Generation Radar |
| NHPA | National Historic Preservation Act |
| NM | nautical mile |
| NMFS | National Marine Fisheries Service |
| $NO_2$ | nitrogen dioxide |
| NOI | Notice of Intent |
| $NO_2$ | nitrogen dioxide |
| $NO_x$ | oxides of nitrogen |
| NPDES | National Pollutant Discharge Elimination System |
| NPH | Notice of Presumed Hazard |
| NPL | National Priority List |
| NPS | National Park Service |
| NREL | National Renewable Energy Laboratory |
| NRHP | National Register of Historic Places |
| NWCC | National Wind Coordinating Collaborative |
| NWI | National Wetlands Inventory |
| $O_3$ | ozone |
| OIEED | Office of Indian Energy and Economic Development |
| Pb | lead |
| PEA | Programmatic Environmental Assessment |
| $PM_x$ | particulate matter less than (2.5 or 10) microns in diameter |
| PSD | Prevention of Significant Deterioration |
| RHA | Rivers and Harbors Appropriation Act |
| RONA | Record of Non-Applicability |
| rpm | revolutions per minute |
| SEL | sound exposure level |
| SHPO | State Historic Preservation Office |
| SIP | State Implementation Plan |
| $SO_2$ | sulfur dioxide |
| $SO_x$ | oxides of sulfur |
| SWPPP | Stormwater Pollution Prevention Plan |
| TCP | Traditional Cultural Property |
| THPO | Tribal Historic Preservation Office |
| U.S. | United States |
| USACE | U.S. Army Corps of Engineers |
| U.S.C. | U.S. Code |
| USCG | U.S. Coast Guard |
| USEPA | U.S. Environmental Protection Agency |
| USFS | U.S. Forest Service |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| USMC | U.S. Marine Corps |
| VAWT | vertical axis wind turbine |
| VFR | Visual Flight Rule(s) |
| VOC | volatile organic compound |
| WTGAC | Wind Turbine Guidelines Advisory Committee |
| WoUS | Waters of the United States |

**Final**
**PROGRAMMATIC ENVIRONMENTAL ASSESSMENT**

| | |
|---|---|
| **Lead Agency:** | United States Marine Corps Forces Reserve |
| **Title of Proposed Action:** | United States Marine Corps Forces Reserve Wind Energy Program |
| **Designation:** | Programmatic Environmental Assessment |


**Abstract**

The Department of the Navy (DoN) has prepared this Programmatic Environmental Assessment (PEA) for the United States Marine Corps (USMC) Forces Reserve (MARFORRES) in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code §§ 4321-4370h), as implemented by the Council on Environmental Quality (40 Code of Federal Regulations [CFR] Parts 1500-1508); DoN NEPA regulations (32 CFR Part 775); and U.S. Marine Corps NEPA directives (Marine Corps Order P5090.2A, change 2). The proposed action is to implement the wind energy program at MARFORRES facilities in the United States. Under the wind energy program, MARFORRES would site, design, construct, and operate small-scale wind energy projects at MARFORRES facilities. For the purpose of this action, MARFORRES facilities are defined as those facilities that are not aboard active-duty USMC installations such as the MARFORRES Center on USMC Base Camp Lejeune. The design of a small-scale wind energy project would include one to four wind turbines ranging in size from small to large (i.e., < 0.1 to 2.5 megawatts) for each project site. The proposed action includes siting and design criteria, best management practices, and general conservation measures that would potentially be implemented to avoid and/or eliminate potentially significant environmental impacts and ensure operational compatibility during implementation of the wind energy program. Site-specific, focused Environmental Assessments would be tiered from this PEA to evaluate site-specific impacts. The following resource areas have been analyzed: land use, noise, geological resources, water resources, biological resources, cultural resources, visual resources, socioeconomics, air quality, utilities, airspace, health and safety, hazardous materials, and transportation. Through application of siting and design criteria, best management practices, and general conservation measures, potentially significant impacts would be avoided and/or eliminated. Therefore, this PEA finds that the proposed programmatic approach to the wind energy program at MARFORRES facilities would not have a significant impact on the environment.



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**April 2011**

## EXECUTIVE SUMMARY

The Department of the Navy (DoN) has prepared this Programmatic Environmental Assessment (PEA) for the United States (U.S.) Marine Corps Forces Reserve (MARFORRES) in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code §§ 4321-4370h), as implemented by the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] Parts 1500-1508); DoN NEPA regulations (32 CFR Part 775); and U.S. Marine Corps NEPA directives (Marine Corps Order P5090.2A, change 2).

*Siting and design criteria, best management practices, and general conservation measures in this PEA will help screen potential wind energy sites for development to avoid and/or eliminate potential environmental impacts and ensure operational compatibility.*

### PURPOSE AND NEED FOR PROPOSED ACTION

The purpose of the proposed action is to reduce dependency on fossil fuels and increase energy security and efficiency through development of the wind energy program at MARFORRES facilities in the U.S. Because the proposed action is to facilitate the development of wind as an energy source, only MARFORRES facilities at which the wind resource is readily available and economically feasible to develop as a renewable energy source are considered.

The proposed action is needed to enable MARFORRES to achieve specific goals regarding energy production and usage while sustaining operational capabilities in support of mission training requirements. These energy production and usage goals have been set by Executive Orders, legislative acts, and agencies like the U.S. Environmental Protection Agency, the Department of Defense, and the DoN. These energy goals seek to increase the efficiency of energy production, delivery and usage, reduce greenhouse gas emissions, and expand the use of renewable energy.

### PROPOSED ACTION

The proposed action is to implement the wind energy program at MARFORRES facilities in the U.S. For the purpose of this action, MARFORRES facilities are defined as those facilities that are not aboard active-duty U.S. Marine Corps installations such as the MARFORRES Center on U.S. Marine Corps Base Camp Lejeune. Under the wind energy program, MARFORRES would site, design, construct, and operate wind energy projects at MARFORRES facilities. The design of a wind energy project would include the number, sizes, and locations of wind turbines for a project site. These parameters would be chosen based on, for example, the capital cost of the wind turbines, the area available for siting the wind turbine(s), a facility's power demand, the specific requirements of the local electricity distribution system, environmental siting and design criteria, compatibility with DoD air/ground operations and training requirements, avoidance of low altitude collision hazards, the ability to erect turbines below and/or beyond Air Traffic Control Radar system line of sight, or a combination of these factors. The turbines installed at any given project site would range from one to four turbines and the specified size range category of turbines defined in this document: small (<0.1 megawatt [MW]), medium (0.1 to <1 MW), and large (1 to 2.5 MW).

The proposed action includes siting and design criteria, best management practices (BMPs), and general conservation measures (GCMs) that would potentially be implemented to avoid and/or eliminate potentially significant environmental impacts and ensure operational compatibility of the wind energy program. These program elements would guide site-specific decisions on selection of appropriate locations, sizes, and numbers of turbines, and construction and post-construction conservation measures. Site-specific, focused Environmental Assessments (EAs) would be tiered from this PEA and, if projects are sited and designed using the criteria, BMPs, and GCMs provided, these analyses should result in Findings of No Significant Impact (FONSIs). The use of tiering, as defined by CEQ NEPA regulations, is described in Section 1.5.1.

**NO-ACTION ALTERNATIVE**

Under the no-action alternative, MARFORRES would not pursue the implementation of the wind energy program at MARFORRES facilities in the U.S. and would continue to rely on the electrical grid for purchase of all electricity needs. Although the no-action alternative is not considered a reasonable alternative because it does not meet the purpose of and need for the proposed action as required under CEQ regulations (40 CFR § 1502.14[d]), it does provide a measure of the baseline conditions against which the potential adverse impacts of the proposed action can be compared. As such, the no-action alternative is carried forward for analysis. The no-action alternative for this PEA represents the baseline conditions described in Chapter 3, *Affected Environment*.

**ENVIRONMENTAL CONSEQUENCES**

This PEA evaluates the potential environmental consequences on the following resource areas: land use, noise, geological resources, water resources, biological resources, cultural resources, visual resources, socioeconomics, air quality, utilities, airspace, health and safety, hazardous materials, and transportation. Table ES-1 summarizes environmental consequences of the alternatives described above.

Based on the analyses presented in this PEA, potential for impacts at any given site would generally increase with greater number and size of turbines. However, through application of programmatic siting and design criteria, BMPs, and GCMs that would be implemented under the proposed action, the number, size, location, and design of turbines at a site would be selected to avoid and/or eliminate potentially significant environmental impacts and ensure operational compatibility. Therefore, all potential environmental impacts associated with the proposed wind energy projects at MARFORRES facilities would be less than significant. It should be recognized that site-specific NEPA analysis may show that an adverse impact cannot feasibly be avoided and/or eliminated, in which case the location would be dropped from consideration. A site with a potentially adverse impact would not be pursued under this program.

The program would reduce each facility's need to draw upon the mix of energy resources provided by the local utility, and would lessen the indirect impacts associated with the use of those resources. The no-action alternative would continue the status quo at each MARFORRES facility.

**Table ES-1. Summary of Environmental Consequences**

| *Resource* | *Environmental Consequences* |
|---|---|
| Land Use | Projects would be compatible with military land use and would not have an adverse impact on adjacent non-DoD land uses. Coastal sites would require site-specific analysis to determine consistency with the Coastal Zone Management Act; however, if the site is selected using the siting and design criteria included within this PEA, the siting would be consistent with the provisions of that act. |
| Noise | Noise impacts would be minimized due to sufficient separation of turbine locations from sensitive noise receptors. |
| Geological Resources | Impacts including erosion, exposure to geologic hazards, and potential loss of unique/important geologic resources would be minimized through siting and design criteria and BMPs. |
| Water Resources | Impacts to water resources, including surface and ground waters and wetlands, would be minimized or avoided due to application of siting and design criteria, and BMPS and compliance with the Clean Water Act. |
| Biological Resources | Due to the small scale of projects, their location at MARFORRES facilities, and the application of siting and design criteria, BMPs and GCMs, and regulatory compliance with the Endangered Species Act, Bald and Golden Eagle Protection Act, and Migratory Bird Treaty Act, impacts on sensitive species and habitats would be avoided and/or minimized. |
| Cultural Resources | Ground disturbance and potential visual impacts to historic properties would be avoided or minimized through siting and design criteria and analysis to support compliance with Section 106. |
| Visual Resources | Potential visual impacts of individual projects would be avoided or minimized through siting and design criteria. |
| Socioeconomics | Socioeconomic impacts would include a small beneficial effect on employment but otherwise would be non-existent or minor. |
| Air Quality | Projects would have minor construction impacts and beneficial operational impacts (slight reduction in greenhouse gas and other emissions). |
| Utilities | Through close communication and implementation of an Interconnect Agreement with the utility line owners/operators, impacts would be minimized. |
| Airspace | Individual projects would be coordinated with Federal Aviation Administration (FAA), civilian and military radar operators as required to minimize impacts to aviation. Impacts would be avoided through flexibility in siting (location) and design (turbine height). |
| Health & Safety | No impacts on safety with implementation of safety plans and procedures, including setbacks. Greater sized turbines may require larger setbacks. |

| *Resource* | *Environmental Consequences* |
|---|---|
| Hazardous Materials | No adverse impacts with implementation of hazardous materials management plans and procedures. |
| Transportation | Transportation activities during construction would be coordinated with local jurisdictions to ensure that public uses are not disrupted. |

**FINAL**
**PROGRAMMATIC ENVIRONMENTAL ASSESSMENT**
**UNITED STATES MARINE CORPS FORCES RESERVE WIND ENERGY PROGRAM**

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# CHAPTER 1
# PURPOSE AND NEED FOR PROPOSED ACTION

## 1.1 INTRODUCTION

This Programmatic Environmental Assessment (PEA) has been prepared by the Department of the Navy (DoN) for the United States (U.S.) Marine Corps (USMC) Forces Reserve (MARFORRES) in accordance with the National Environmental Policy Act (NEPA) of 1969 and regulations implemented by the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] Parts 1500-1508), DoN NEPA regulations (32 CFR Part 775), and USMC NEPA directives (Marine Corps Order [MCO] P5090.2A, change 2). This PEA analyzes the potential environmental impacts of implementing the wind energy program at MARFORRES facilities in the U.S.

*Program elements are intended to guide the siting, design, construction, and operation of small-scale wind energy projects at MARFORRES facilities while avoiding and/or eliminating potentially significant environmental impacts and ensuring operational compatibility.*

Each wind energy project would consist of one to four small, medium, or large turbines (described in more detail in Section 2.3). The proposed action includes programmatic siting and design criteria, best management practices (BMPs), and general conservation measures (GCMs) that would be implemented to avoid and/or eliminate potentially significant environmental impacts and ensure operational compatibility. These program elements would guide decisions on selection of appropriate locations, sizes, and numbers of turbines, and construction and post-construction conservation measures that, if applied on a site-specific level, could support site-specific Findings of No Significant Impact (FONSIs). Site-specific Environmental Assessments (EAs) would be tiered (as defined by CEQ NEPA regulations and described in Section 1.5.1) from this PEA to evaluate site-specific impacts.

It is estimated that the initial implementation of the wind energy program (wind turbine projects at four to six MARFORRES facilities) would commence in fiscal year (FY) 2012. These could be followed by additional wind energy projects at the other MARFORRES facilities.

## 1.2 PROJECT BACKGROUND

Renewable energy sources have the potential to reduce dependence on fossil fuels and the emission of greenhouse gases. As concerns about energy security, climate change, and the depletion of fossil fuel resources heighten, the development of renewable energy resources has become a national priority. Total renewable electricity generation increased 22.6% within the U.S. between 2001 and 2007. Out of all the renewable energy resources available, wind resources have experienced the largest growth in recent years, increasing 411% from 2001 to 2007 and 30% from 2006 to 2007. Most of this growth in wind energy generation has come from large-scale wind energy development projects (National Renewable Energy Laboratory [NREL] 2009, 2010a).

The wind energy projects considered in this action range from one to four turbines with generating capacity ranging from under 0.1 megawatt (MW) to 2.5 MW per turbine; an example is shown in Figure 1-1. While economies of scale can increase the benefit-to-cost ratio for large-scale commercial wind farms, smaller-scale wind energy projects offer several potential advantages which make them an attractive option for federal facilities (NREL 2007). These advantages include:

**Figure 1-1. 0.9-MW Turbine at Ascension Island**

- Power produced directly at the site may be valued at or near the retail price of electricity because it displaces utility-provided power.
- A small project may be less likely to interfere with the multitude of land uses that are seen on federal lands, and may thereby avoid or lessen environmental impacts and regulatory permit requirements.
- On-site power generation can be integrated into the site's electrical system in ways that may reduce dependence on the utility grid and provide a measure of energy security.

The key prerequisites for an economically viable wind energy project include a reasonably windy site in an area with relatively high utility rates, good financial incentives for wind technologies, and a straightforward interconnection process to lower transaction costs (NREL 2007).

The Department of Defense (DoD) has set a goal to procure or produce renewable energy such that it accounts for 25% of the DoD's facility electricity consumption by FY 2025 (Office of the Deputy Under Secretary of Defense 2009). The DoD accounts for approximately 63% of the energy consumed by federal facilities and buildings. This makes DoD the single largest energy consumer in the U.S. Based on FY 2007 energy consumption levels, electricity represents approximately 45% of the energy consumed by the DoD facilities, followed by natural gas at 33%, fuel oil at 11%, and coal and liquefied petroleum gas at 11%. Renewable energy represents approximately 8.7% of facility electricity use (Congressional Research Service 2009).

Table 1-1 compares renewable electricity use to total electricity use for DoD from FY 2000 to FY 2008. When considering total electricity, 2.9% of DoD's electricity consumption in FY 2008 came from renewable energy sources, not quite reaching the goal of 3% set by the Energy Policy Act of 2005. This is a drop from the 5.5% reported in FY 2007, primarily due to the increased cost and resulting smaller purchase of Renewable Energy Certificates (Office of the Deputy Under Secretary of Defense 2009).

**Table 1-1. Renewable Electricity Use versus Total Electricity Use (megawatt-hours)**

| | *FY 2000* | *FY 2001* | *FY 2002* | *FY 2003* | *FY 2004* | *FY 2005* | *FY 2006* | *FY 2007* | *FY 2008* |
|---|---|---|---|---|---|---|---|---|---|
| Renewable Electricity | 164,076 | 252,972 | 321,592 | 431,000 | 504,223 | 1,425,151 | 1,238,282 | 1,639,924 | 874,558 |
| Total Electricity | 30,242,318 | 29,963,594 | 30,352,859 | 29,747,453 | 30,666,157 | 29,594,692 | 29,792,539 | 29,656,103 | 29,730,479 |
| Percent (%) | 0.5 | 0.8 | 1.0 | 1.4 | 1.6 | 4.8 | 4.1 | 5.5 | 2.9 |

*Source:* Congressional Research Service 2009; Office of the Deputy Under Secretary of Defense 2009.

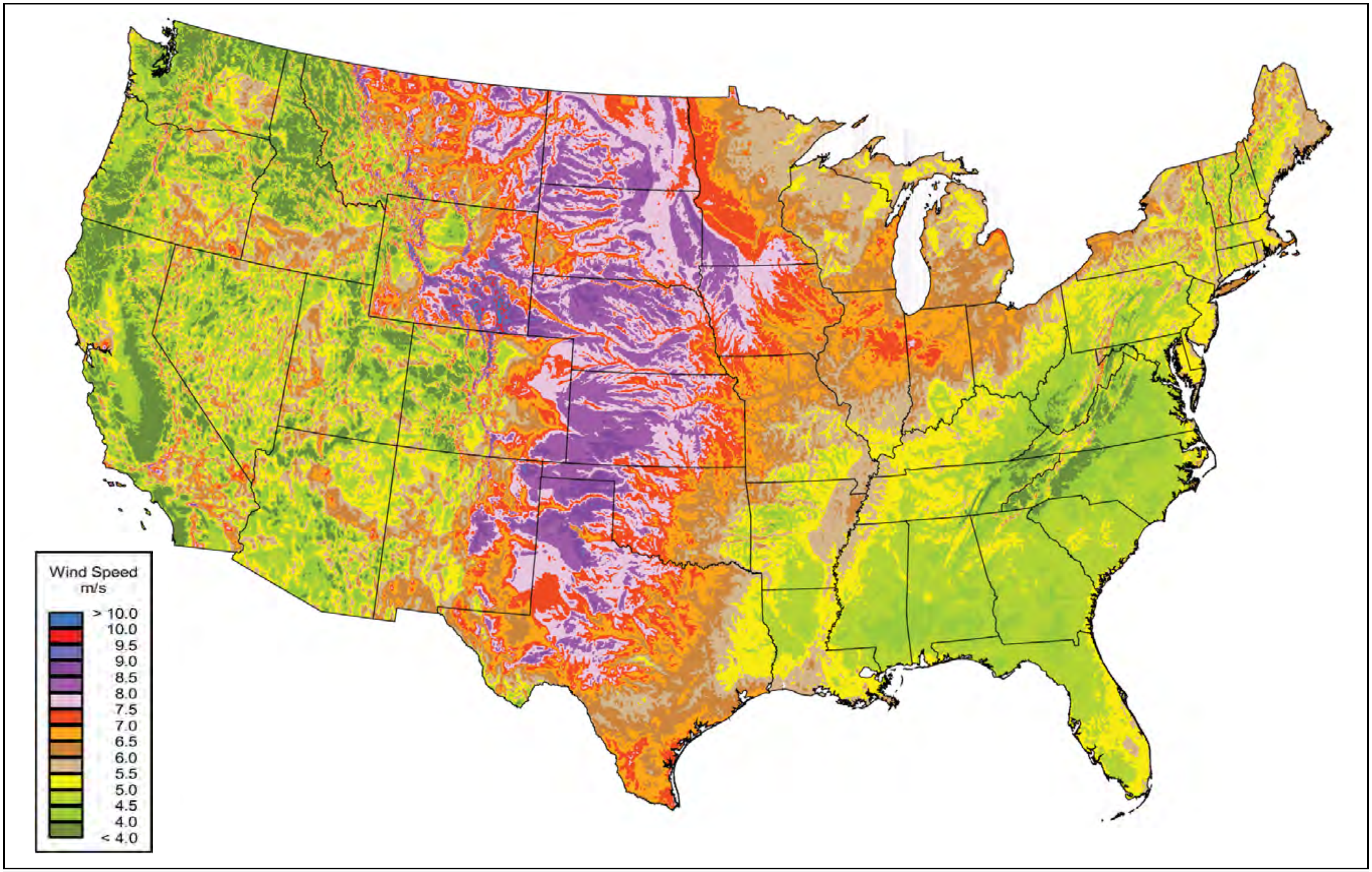
In 2005, DoD completed a renewable energy assessment to outline strategies to increase DoD's use of renewable energy (Office of the Secretary of Defense 2005). In this report, renewable energy resources on and near installations were analyzed, focusing on wind, geothermal, and solar energy. Regarding these specific technologies, the study found that where economical, DoD should pursue on-installation production of renewable energy because it provides energy savings, reduces U.S. dependence on foreign energy, and saves money, while increasing energy security. The proposed action will contribute to the realization of DoD renewable energy goals through the on-installation production of wind energy.

## 1.3 PROJECT LOCATIONS

The proposed action is to support the development of wind energy projects at MARFORRES facilities where (a) wind has been identified as a readily available and economically feasible source for renewable energy production; (b) the project is compatible with mission training requirements; and (c) potentially significant environmental impacts can be avoided. Average annual wind speeds, as shown for the U.S. as a whole in Figure 1-2, provide general indications as to where wind energy development may be most advantageous. Superimposed on these broad-scale patterns are important local differences, such as greater wind speeds at higher elevations and where prevailing winds blow down-slope or are funneled through a valley, mountain pass, or gap. Individual projects would be located in or near already developed areas associated with MARFORRES facilities, where the energy produced by wind would be used locally and directly reduce a facility's energy costs, and where the potential for significant environmental impacts is inherently low. There are approximately 179 MARFORES facilities in the U.S., many of which could be suitable and warrant investigation as to the feasibility of small-scale wind energy development. Most of the sites chosen for wind energy projects would be stand-alone MARFORRES facilities, but some could be on land shared with or owned by another federal agency.

## 1.4 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed action is to reduce dependency on fossil fuels and increase energy security and efficiency through development of the wind energy program at MARFORRES facilities in the U.S. Because the proposed action is to facilitate the development of wind as an energy source, only MARFORRES facilities at which the wind resource is readily available and economically feasible to develop as a renewable energy source are considered.




*Source*: U.S. Department of Energy 2010.
*Note*: Annual average wind speed at 260 ft.

**Figure 1-2**
**Annual Average Wind Speed in the United States**

The proposed action is needed to enable MARFORRES to achieve specific goals regarding energy production and usage while sustaining operational capabilities in support of mission training requirements. These energy production and usage goals have been set by Executive Orders (EOs), legislative acts, and agencies like the U.S. Environmental Protection Agency (USEPA), the DoD, and the DoN. These energy goals seek to increase the efficiency of energy production, delivery and usage, reduce greenhouse gas emissions, and expand the use of renewable energy. The following relevant energy policies have shaped the need for the proposed action.

*Energy Independence and Security Act of 2007.* The stated purpose of this act is to move the U.S. toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the federal government.

*Energy Policy Act (EPAct) of 2005.* Section 203 of the EPAct establishes renewable energy goals for the federal government. It states that no less than 5% of the total energy consumption should come from renewable sources in fiscal years 2010 through 2012 and no less than 7.5% in fiscal year 2013 and each fiscal year thereafter.

*EO 13423. Strengthening Federal Environmental, Energy, and Transportation Management.* EO 13423 establishes environmental, energy, and transportation management goals for federal agencies. Section 2(b) requires agencies to ensure that (i) at least half of the statutorily required renewable energy consumed by the agency in a fiscal year comes from new renewable sources, and (ii) to the extent feasible, renewable energy projects are implemented on agency property for agency use.

*EO 13514. Federal Leadership in Environmental, Energy, and Economic Performance.* EO 13514 requires federal agencies to conduct planning for sustainability performance, increased sustainability of facilities, and greenhouse gas management. Specifically, each federal agency must propose a target for the reduction of greenhouse gas emissions by 2020.

*DoN Response to EO 13514.* In response to the greenhouse gas planning requirement, the Secretary of the Navy announced a planned 50% reduction in greenhouse gas emissions from 2008 levels by 2020.

## 1.5 SUMMARY OF KEY ENVIRONMENTAL COMPLIANCE REQUIREMENTS

### 1.5.1 NEPA (42 U.S. Code [U.S.C.] §§ 4321-4370h)

NEPA requires federal agencies to take into consideration the potential environmental consequences of proposed actions in their decision-making processes. The CEQ was established under NEPA to ensure that federal agencies meet their obligations under the Act. *Regulations for Implementing Procedural Provisions of the NEPA* (40 CFR Parts 1500-1508) specify that an EA shall briefly provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a FONSI; aid in an agency's compliance with NEPA when no EIS is necessary; and facilitate the preparation of an EIS when one is necessary.

The CEQ NEPA regulations (40 CFR Parts 1500-1508) define tiering as the coverage of general matters in broader environmental documents (such as national program or policy statements) with subsequent narrower environmental analyses (such as regional or basinwide program statements or ultimately site-specific documents). It also states that "tiering is appropriate when the sequence of statements or analyses is (a) From a program, plan, or policy environmental impact statement to a program, plan, or policy statement or analysis of lesser scope or to a site-specific statement or analysis." Consistent with this guidance, this PEA will be used to support the tiering of site-specific EAs where required under NEPA for individual sites.

This document was prepared following DoN procedures for implementing NEPA (32 CFR § 775), which provide DoN policy for implementing the CEQ regulations and NEPA, and MCO P5090.2A, change 2, dated 21 May 2009*, Environmental Compliance and Protection Manual*, which establishes USMC procedures for implementing NEPA.

### 1.5.2 Endangered Species Act (ESA) (16 U.S.C. §§ 1531-1544)

The ESA of 1973 and subsequent amendments provide for the conservation of threatened and endangered species of animals and plants, and the habitats in which they are found. The ESA requires federal agencies to avoid jeopardizing endangered and threatened species or adversely modifying critical habitats essential to their survival. Section 7 of the ESA requires the proponent of a federal action to consult with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS) when any endangered or threatened species under their jurisdiction may be affected by a proposed action. Generally, the USFWS is responsible for land and freshwater or strictly estuarine species while NMFS is responsible for marine species and anadromous fishes such as salmon. However, the USFWS has responsibility for some marine animals such as nesting sea turtles, walruses, polar bears, sea otters, and manatees.

### 1.5.3 Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§ 703-712) and EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)

The MBTA of 1918 implements various treaties and conventions among the U.S. and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds is unlawful unless permitted by regulations. The Act provides that it is unlawful to pursue, hunt, take, capture, or kill; attempt to take, capture, or kill; possess, offer to or sell, barter, purchase, deliver, or cause to be shipped, exported, imported, transported, carried, or received any migratory bird, part, nest, egg, or product, manufactured or not.

The MBTA does not provide for the regulation of structures that pose a collision risk to migratory birds, and there is currently no defined permit or consultation requirement for wind turbines associated with the MBTA. However, EO 13186 provided more specific direction to federal agencies to conserve migratory birds and to assess the effects of their actions on migratory bird populations as part of NEPA compliance. The EO led to a Memorandum of Understanding (MOU) between the DoD and USFWS (2006), which includes the following commitments as related to energy development, including wind turbines:

> "*(4) Communications towers, utilities and energy development.* Increased communications demands, changes in technology and the development of alternative energy sources result in impacts on migratory birds. DoD will review wind turbine and powerline guidelines published by (US)FWS and the Avian Power Line Interaction Committee, respectively, and consult with (US)FWS as needed, in considering potential effects on migratory birds of proposals for locating communications towers, powerlines or wind turbines on military lands."

In compliance with the EO and MOU, MARFORRES and the USACE are coordinating with the USFWS (see also Section 1.6) regarding measures to avoid or minimize take of migratory birds, including the use of appropriate research protocols and best available technologies for mitigation and deterrence. It should be noted that the MBTA has no provision for unauthorized take, nor do its implementing regulations at 50 CFR Part 21 provide for permitting the incidental take, of migratory birds.

### 1.5.4 Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. §§ 668-668c)

The BGEPA of 1940 prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald or golden eagles, including their parts, nests, or eggs. The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." Among other actions, take includes disturbance to the degree that it substantially interferes with breeding, feeding, or sheltering behavior or results in injury. With the recovery and ESA delisting of the bald eagle in 2007, it is no longer protected under the ESA, and a new process for regulating take of both bald and golden eagles under the BGEPA has been developed by USFWS. A final rule for two new permit regulations became effective in November 2009. 50 CFR Part 22.26 would allow take of both species of eagles (including disturbance and limited "take resulting in mortality"), and 50 CFR Part 22.27 would allow the take of nests of both species for eagle and human health and safety reasons, and in other limited circumstances.

Under Part 22.26, the "take" of an eagle refers to the non-purposeful disturbance, wounding or killing of eagles, which is associated with but is not the purpose of an activity. "Take" can only be authorized when it is compatible with the preservation of bald and golden eagle populations.

Both regulations include provisions for "programmatic take," defined under 50 CFR Part 22.3 as "take that is recurring, is not caused solely by indirect effects, and that occurs over the long term or in a location or locations that cannot be specifically identified." Programmatic take permits under 22.26 and 22.27 may be issued only where take is unavoidable despite implementation of comprehensive measures called Advanced Conservation Practices (ACPs) developed in cooperation with the USFWS. ACPs are scientifically supportable measures approved by the USFWS that represent the best available techniques to reduce eagle disturbance and ongoing mortalities to a level where remaining take is unavoidable. The USFWS has created and staffed a set of teams to facilitate development of the tools necessary for programmatic permits and the development of ACPs. The USFWS Migratory Bird website will have the current details once they are released to the public.

All permit applicants must provide documentation that they have included all practicable avoidance and minimization measures in their planning. "Practicable" is defined in the regulations as "capable of being done after taking into consideration, relative to the magnitude of the impacts to eagles, the following 3 things: (1) the cost of remedy compared to proponent resources; (2) existing technology; and (3) logistics in light of overall project purposes." To qualify for programmatic permits, the standard for the permitees is "the maximum degree technically achievable," defined as "the standard at which any take that occurs is unavoidable, despite implementation of ACPs."

Because of concerns regarding populations of golden eagles — available data indicate potential population declines across the four large Bird Conservation Regions in the West — the USFWS will only consider golden eagle take permits for safety emergencies, programmatic permits, and any other permits that will result in a reduction of ongoing take or a net take of zero. The same standards apply to the bald eagle in the Sonoran Desert.

### 1.5.5 Coastal Zone Management Act (CZMA) (16 U.S.C. §§ 1451-1466)

The CZMA of 1972 requires that "any federal activity within or outside of the coastal zone that affects any land or water use or natural resource of the coastal zone" shall be "consistent to the maximum extent practicable with the enforceable policies" of a state's coastal zone management plan. Federal agencies, prior to carrying out activities, must comply with the "consistency" regulations of the CZMA promulgated by the Secretary of Commerce. These regulations set forth the procedures that federal agencies must follow to coordinate with coastal states prior to carrying out activities that are reasonably likely to affect coastal uses or resources within a state's coastal zone. The CZMA applies to the coastal regions of states bordering the Atlantic and Pacific Oceans, Gulf of Mexico, and Great Lakes.

### 1.5.6 Clean Air Act (CAA) (42 U.S.C. §§ 7401-7671q)

The CAA of 1970 is the law that defines USEPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer. The last major change in the law, the Clean Air Act Amendments of 1990, was enacted by Congress in 1990. Under the CAA, as amended, states are responsible for enforcing the established air quality regulations. The CAA Amendments of 1990 established new federal nonattainment classifications, new emission control requirements, and new compliance dates for nonattainment areas.

### 1.5.7 Clean Water Act (CWA), Sections 401, 402, and 404 (33 U.S.C. §§ 1251-1387) and EO 11990 (Protection of Wetlands)

The CWA of 1972 is the primary federal law that protects the nation's waters, including wetlands (as defined under 33 CFR 328.3). Section 402 of the CWA established the National Pollutant Discharge Elimination System (NPDES), under which a state regulates the discharge of non-point source pollution. Section 404 of the CWA requires a permit from the U.S. Army Corps of Engineers (USACE) for any discharge of excavated or fill material into waters of the U.S. (WoUS), defined to include navigable waters and their tributaries and adjacent wetlands that have a significant nexus (i.e., functional relationship) to the navigable water (USACE and USEPA 2008). Section 401 of the CWA requires a state Water Quality Certification for the issuance of a Section 404 permit, verifying that the discharge would meet state water quality protection requirements. EO 11990, Protection of Wetlands of 1977 requires federal agencies "to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands."

### 1.5.8 Rivers and Harbors Appropriation Act (RHA), Section 10 (33 U.S.C. 401 et seq.)

Section 10 of the RHA of 1899 requires a permit from the USACE for structures or work in or affecting navigable WoUS. Structures include any pier, wharf, bulkhead, etc. Work includes dredging, filling, excavating, or otherwise modifying navigable WoUS. The USACE has a single combined permit process for Section 10 of the RHA and Section 404 of the CWA where both statutes apply.

### 1.5.9 National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. §§ 470-470x-6) and Archeological Resource Protection Act (ARPA) of 1979 (16 U.S.C. §§ 470aa-470mm)

The NHPA established historic preservation as a national policy and defined historic preservation as the protection, rehabilitation, restoration, and reconstruction of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, or engineering. Section 106 of the Act requires federal agencies to take into account the effects of their undertakings on any district, site, building, monument, deposit, structure, or object, listed in or determined eligible for listing in the National Register of Historic Places (NRHP).

The U.S. passed the ARPA to regulate archaeological finds on federal and Indian lands and to prevent looting and destruction of archaeological resources. This Act protects the material remains of past human existence that are of archaeological interest and that are more than 100 years old. The legislation also includes procedures for issuing permits to lawfully excavate archaeological sites.

### 1.5.10 Federal Aviation Regulations (FAR) Part 77 – Obstructions Affecting Navigable Airspace

FAR Part 77 of 1977 establishes the federal criteria for use by local planning and land use jurisdictions to control the height of objects in the vicinity of airports in order to protect the airspace and approaches to runways from hazards that could affect the safe and efficient operation of airports. Federal law requires filing a Notice of Proposed Construction or Alteration (Form 7460-1) with the Federal Aviation Administration (FAA) for all structures over 200 feet (ft) above ground level (AGL), or lower if closer than 20,000 ft to a public use airport with a runway over 3,200 ft in length. In the latter case, the filing requirement is based on a 100 to 1 slope from the closest runway. The FAA conducts an initial study within the responsible FAA Region and issues either a Determination of No Hazard (DNH) to air navigation or a Notice of Presumed Hazard (NPH).

### 1.5.11 Sikes Act and Sikes Act Improvement Act (16 U.S.C. §§ 670a to 670o), Conservation Programs on Government Lands

The Sikes Act requires the preparation of Integrated Natural Resources Management Plans (INRMPs) for military installations with existing natural resources, and provides for cooperation by the Department of the Interior and DoD with state agencies in planning, development, and maintenance of fish and wildlife resources on military reservations throughout the U.S. At any installation with an approved INRMP, the siting, construction, and operation of small-scale wind energy projects would be done in a manner consistent with that INRMP.

## 1.6 AGENCY COORDINATION AND PUBLIC INVOLVEMENT

Consistent with the ESA, BGEPA, MBTA, and EO 13186, MARFORRES has had close coordination with the USFWS on the proposed wind energy program since the early stages of the NEPA process. This ensures that the environmental analysis of wind energy development projects reflects the best available science to minimize potential effects on threatened or endangered species, bald and golden eagles, and other migratory birds. Because the PEA may have nationwide applicability and be of widespread interest, a Notice of Availability for the Draft PEA has been published in the Federal Register, giving the public an opportunity to comment. A preliminary version of this Draft PEA was provided to the Advisory Council on Historic Preservation for their input pursuant to Section 106 of the NHPA (Appendix A).

As part of the site-specific NEPA process for each individual project, MARFORRES will coordinate or consult as required with state and federal agencies with jurisdiction over natural and cultural resources, and with local non-DoD jurisdictions regarding the use of public roads or other non-DoD lands. MARFORRES will provide information on each proposed project to the public and local stakeholders and will provide opportunities for their input, by way of Notices of Availability for site-specific Draft EAs and FONSIs published in local newspapers.

In a broader context, MARFORRES will continue coordination with the USFWS regarding further efforts to avoid or minimize take of protected migratory birds, to use the best and most current research protocols, and use the best available technologies for mitigation and deterrence.

## 1.7 DOCUMENT ORGANIZATION

The organization of this PEA is as follows: Chapter 1 defines the purpose of and need for the proposed action. Chapter 2 describes the programmatic approach, the proposed action, the no-action alternative, and alternatives considered but eliminated. Chapter 3 defines the relevant environmental resource and issue areas for the proposed small-scale wind energy projects, provides details for preparation of site investigations, and describes the expected range of environmental conditions that typically exist at

MARFORRES facilities. Chapter 4 analyzes the potential environmental impacts associated with the proposed action and the no-action alternative. Chapter 5 analyzes the potential cumulative environmental impacts associated with the proposed action. Chapter 6 addresses other considerations required by NEPA. Chapter 7 contains all references cited in the PEA. Chapter 8 provides agencies and persons contacted, and Chapter 9 provides the list of preparers. Appendix A contains correspondence and comments resulting from the public review of the Draft PEA.

# CHAPTER 2
# PROPOSED ACTION AND ALTERNATIVES

## 2.1 INTRODUCTION

**Key Elements of the Proposed Action**

- Implementation of the wind energy program at MARFORRES facilities.
- Individual projects would be adapted to site-specific circumstances and would consist of one to four turbines of varying sizes.
- A programmatic approach that, based on the implementation of siting and design criteria, BMPs, and GCMs, would avoid and/or eliminate potentially significant impacts and ensure operational compatibility.
- Site-specific, focused EAs will be tiered from this PEA, and, with the application of the siting and design criteria, BMPs, and GCMs provided herein, should result in FONSIs.
- Facilitation of public input and environmental analyses to identify favorable circumstances for small-scale wind energy projects.

This chapter describes the programmatic approach, proposed action, no-action alternative, and alternatives considered but eliminated from further analysis. The proposed action is to implement the wind energy program at MARFORRES facilities. Under the wind energy program, MARFORRES would site, design, construct, and operate one to four wind turbines ranging in size from small to large at suitable MARFORRES facilities. Most of the sites chosen for wind energy projects would be stand-alone MARFORRES facilities, but some could be on land shared with or owned by another federal agency. Site-specific, focused EAs will be tiered from this PEA, and, with the application of the siting and design criteria, BMPs, and GCMs provided herein, should result in FONSIs.

## 2.2 PROGRAMMATIC APPROACH

The programmatic approach developed in this PEA includes: (1) the application of siting and design criteria to identify an environmentally preferable number, size, location, and design of wind turbines and ensure operational compatibility for a particular project site; and (2) BMPs and GCMs to reduce the environmental impacts associated with constructing and operating the turbine(s). Through this programmatic approach, the siting and design of wind energy projects at individual MARFORRES facilities would use a "phased approach" in which potential sites and turbine designs are identified and then analyzed for potential environmental impacts. As potential impacts are identified, the siting and design criteria, BMPs, and GCMs would be implemented to modify the number, size, location and/or design of the wind turbines, as appropriate, to avoid and/or eliminate potentially significant environmental impacts and ensure operational compatibility. Subsequent phases would refine and build upon issues raised and efforts undertaken in previous phases. Together, this phased approach, including application of these siting and design criteria, BMPs, and GCMs, will enable MARFORRES to identify environmentally and operationally preferable locations and turbine designs for wind energy development projects at MARFORRES facilities that would result in a FONSI. This process is described further and developed in Chapters 3 and 4.

The programmatic approach used in this document has both a broad scope, encompassing a federal program that would conduct a similar action at multiple locations throughout the U.S., and supporting subsequent site-specific, focused EAs that would be tiered from this PEA. Site-specific EAs would include analysis of wind energy projects at specific sites to be identified for wind energy development in the near term. Therefore, this PEA has been developed in general terms, with environmental impact analysis that is based on the *Generalized Project Design* (Section 2.3.1) for the range of environmental conditions that may occur at MARFORRES facilities. Site-specific, focused EAs would be tiered from this PEA and, if projects are sited and designed using the criteria, BMPs, and GCMs provided, these analyses should result in FONSIs. Under this program, a proposed action at a particular facility would not be pursued if the site-specific NEPA analysis identifies a potentially significant impact that cannot be avoided or eliminated.

## 2.3 PROPOSED ACTION

The proposed action is to implement the wind energy program at MARFORRES facilities in the U.S. Under the wind energy program, MARFORRES would site, design, construct, and operate wind energy projects at MARFORRES facilities in suitable locations throughout the continental U.S. As defined under this action, a wind energy project comprises one to four wind turbines that could be small (< 0.1 MW), medium (0.1 MW to < 1 MW), or large (1 MW to 2.5 MW) in size and power output. Environmental analysis in this PEA will focus on impacts relative to a range of potential development scenarios (i.e., variations in number and size of turbines ranging from a single small turbine to four large turbines). The *Generalized Project Design* below provides design parameters, construction methods, and typical operation and maintenance activities. In site-specific EAs tiered from this PEA, action alternatives would be identified and analyzed and may include variations in number, size, design, and/or location for the range turbines described in this PEA.

### 2.3.1 Generalized Project Design

The design of a wind energy project would specify the number, sizes, and locations of wind turbines for a project site. These parameters would be chosen based on a combination of factors including the capital cost of the wind turbines, the area available for siting the wind turbine(s), a facility's power demand, the specific requirements of the local electricity distribution system, the avoidance of low altitude collision hazards, compatibility with DoD air/ground operations and training requirements, non- interference with civilian and military radars, and other environmental siting and design criteria. The number of turbines installed at any given project site would range from a single turbine to a grouping of two to four small, medium or large turbines. Table 2-1 lists the three size range categories of turbines that could be constructed.

**Table 2-1. Wind Turbine Size Ranges for Potential MARFORRES Projects**

| *Turbine Size Categories* | *Power Output (MW)* | *Tower Height (ft)* | *Rotor Diameter (ft)* | *Total Height (ft)* | *Temporary Footprint (acres)* | *Permanent Footprint (acres)*[1] |
|---|---|---|---|---|---|---|
| Small | < 0.1 | < 130 | < 100 | < 180 | 0.36 | 0.056 |
| Medium | 0.1 - < 1.0 | 100 - 260 | 70 - 200 | 135 - 360 | 0.36 | 0.056 |
| Large | 1.0 - 2.5 | 200 - 330 | 160 - 330 | 280 - 495 | 0.87 | 0.058 |

*Notes:* [1] *Not including a permanent gravel access road, which could be required at some sites.*
*Source*: Naval Facilities Engineering Service Center (NAVFAC ESC) 2010.

#### 2.3.1.1 Turbine Design

Turbines would be made of a sectional tubular tower, three rotor blades connected to a hub, and a nacelle mounted on top of the tower that houses the electrical generator components. The base of a small or medium turbine would be anchored in either a cylindrical concrete foundation or a spread foot foundation. The cylindrical foundation would be approximately 15 ft in diameter that would extend to a depth of 12 ft to 40 ft, depending on site conditions. The spread foot foundation would be an octagonal, concrete foundation 10 ft deep and fitting within a 57-ft by 57-ft square with most of the foundation buried and only the pedestal, to which the turbine base would be attached, being above ground. The base of a large turbine would be anchored in a cylindrical concrete foundation approximately 16 ft in diameter that would extend to a depth of 15 ft to 50 ft, depending on site conditions.

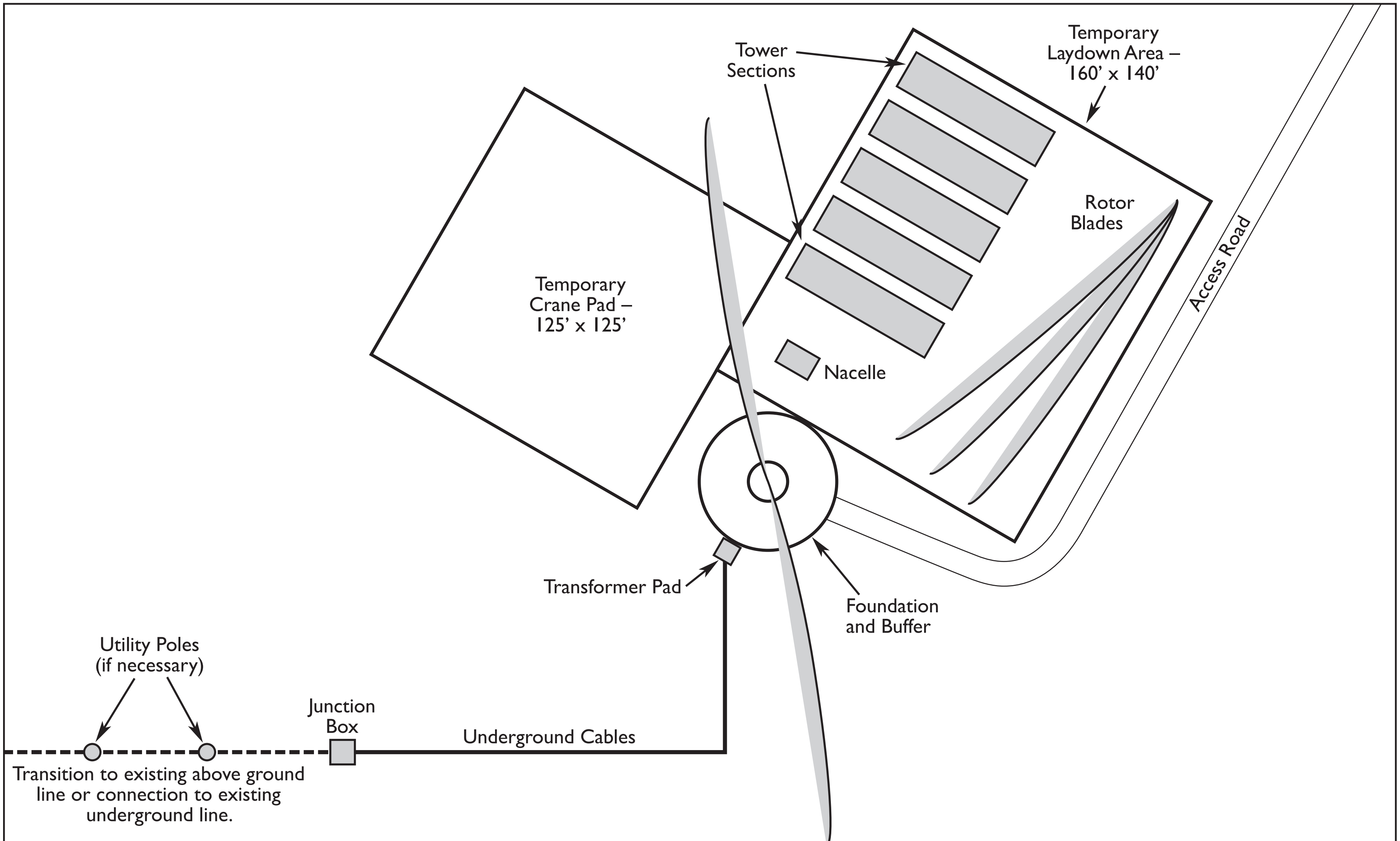
In addition to the concrete foundation, a 20-ft wide gravel area would surround the base of each turbine to provide access for maintenance vehicles. An electrical transformer would be placed adjacent to the gravel area of each turbine on an approximately 8-ft by 8-ft concrete pad. The gravel area and electrical transformer pad would have the same footprint size for all size categories of turbine. The total permanent footprint (foundation, gravel area, transformer) would be similar for all size categories of turbine, approximately 0.056 acre (2,440 square feet) for a small or medium turbine and 0.058 acre (2,530 square feet) for a large turbine. If existing roads or paved areas do not provide adequate site access, a new gravel road would be constructed to provide access to the turbine. The new gravel road would also have a permanent footprint depending on its length and width (to be determined during site-specific design). A summary of the turbine design parameters is provided in Table 2-1. Figure 2-1 provides a generalized plan view of a wind turbine facility.

In each of the turbine size categories there is a minimum wind speed, also called the "cut-in" speed, at which the wind turbine begins to generate usable power. This cut-in speed is approximately 7.8 miles per hour (mph) for the small and medium turbines and 6.7 mph for the large turbines. There is also a "cut-out" speed above which the turbine no longer produces useful power; this occurs at a wind speed of approximately 56 mph for all three size categories of turbine. The maximum rotational speed of the turbine blades is inversely proportional to their diameter and ranges from approximately 19 revolutions per minute (rpm) for a large turbine to 59 rpm for a small turbine (e.g., Gamesa 2009, Northwind Power Systems 2010).

#### 2.3.1.2 Site Preparation and Turbine Installation

The length of the construction phase of the proposed wind energy project varies. Construction could take from one to six months, depending on site conditions and number/size of turbine(s). Site preparation and construction of the turbine foundation would occur first. The wind turbine components would then be delivered to the project site by truck or by barge and the turbines would be erected by crane over an approximately two-month period.

For each turbine, the foundation would be excavated and poured. The methods of site excavation and the type of foundation used would depend on site-specific conditions. For example, coastal sites and other sites with a shallow groundwater table may require drilling and dewatering to excavate for a "mono-pile" foundation, which would be similar to a bridge footing. Non-native backfill material may be used at coastal sites for improved compaction and high-pressure grout may be used with a mono-pile foundation. If rock is encountered during excavation, large jackhammer attachments or blasting would be necessary if a rock anchor foundation is not used.




Note: This is a typical construction site for a 2.0 MW turbine; a construction site for small to medium turbine would require a 75' x 100' crane pad and a 80' x 100' laydown area.

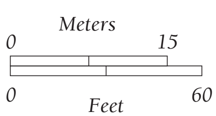



Figure 2-1
Typical Construction Site for Wind Turbine Installation

Adjacent to the turbine foundation, a temporary crane pad and staging/laydown area would be constructed in order to erect the turbine (see Figure 2-1). The crane pad would be a leveled area of well-compacted soil, approximately 125 ft by 125 ft for a large turbine and 75 ft by 100 ft for small and medium turbines. The staging/laydown areas would be approximately 160 ft by 140 ft for large turbines and 100 ft by 80 ft for small and medium turbines. Following installation, the crane pad and staging/laydown area would be returned to pre-construction conditions.

**Figure 2-2. Installation of Rotor Blades on a 2.0-MW Turbine at Warren Air Force Base, Wyoming (total height = 367 ft)**

A crane would be used to lift the turbine components into place. The sections of the tower would be installed, followed by the nacelle. The rotor blades would either be connected one at a time to the installed hub already mounted to the nacelle on the tower or connected to the hub on the ground and raised as a unit (Figure 2-2).

Following installation, the electrical transformer for each turbine would be installed and connected to the area's electricity distribution grid. However, an Interconnect Agreement would be formalized between the MARFORRES facility and electricity utility company prior to connection to the electricity distribution grid. The Interconnect Agreement would establish the necessary upgrades, modifications, or need for installation of additional power lines to accommodate project electricity generation. These upgrades or modifications would be implemented as part of the proposed action and analyzed in site-specific EAs tiered from this PEA. Connection to the existing electrical distribution system would be done via a new cable. Within 300 ft of the turbine base, the cable would be installed in an excavated trench approximately 2.5 ft wide and 4 ft deep. A "ditch-witch" (trenching machine) would be used to excavate the trench and no spoils piles are expected. If the existing electrical distribution system consists of above ground power poles, the new underground cable would transition to overhead power poles to enable direct tie-in to the existing overhead distribution system. This transition would typically require two to three new power poles.

#### 2.3.1.3 Turbine Operation and Maintenance

The amount of energy generated from the operation of a turbine is determined by the nominal power output (nameplate capacity) of the turbine and by the naturally varying wind conditions at the site. For small and medium size categories, energy generation is approximately 10 to 50% of the nameplate capacity of the turbines at annual wind speeds between 9 and 19 mph. At this capacity, energy output would range from 88 to 440 megawatt-hours per year (MWh/yr) for a small 0.1-MW turbine and 880 to 4,400 MWh/yr for a medium 1.0-MW turbine. For large size categories, energy generation is 30 to 37% of the nameplate capacity of a turbine at annual wind speeds between 13 and 19 mph. At this capacity, energy output would range from 5,300 to 6,500 MWh/yr for a large 2-MW turbine. The time it would take to recover the cost of a small-scale wind energy project is a function of the wind resource, wind turbine costs (purchase, installation, maintenance), and utility cost savings, all of which would vary between locations and alternative designs, and are subject to uncertainties in the future. Furthermore, a simple economic analysis does not capture the benefit to the local MARFORRES facility of reduced susceptibility to natural or manmade disruptions of electrical service. Nevertheless, it is estimated that each project carried forward under the MARFORRES program would pay for itself within 20 years.

Most repairs and maintenance activities (e.g., oil and fluid changes) would be conducted by operations and maintenance contractor crews. Crews would typically consist of two to three people who would visit the site approximately six times per year. Two of these would be semi-annual maintenance visits of one to two days in length. The other four visits would be for short duration repairs or resets that would take less than one day, generally only a few hours. Monitoring and maintenance would be conducted by on site engineering and maintenance personnel as needed or required.

### 2.3.2 Wind Energy Program Criteria

Wind energy program criteria include siting and design criteria, BMPs and GCMs. Siting and design criteria have been developed iteratively in conjunction with the impact analyses in Chapter 4 of this PEA. These criteria would be applied to select and evaluate alternative sites and designs (including number and size of turbine[s]) at each MARFORRES facility. BMPs are specific methods or techniques that provide effective and practical means of avoiding or reducing potential environmental impacts that would otherwise occur. GCMs are resource-specific measures that may be applicable, based on site-specific analysis, to ensure that impacts remain below a level of significance. If specific projects are sited and designed using these criteria, BMPs, and GCMs the site-specific analyses should result in FONSIs.

#### 2.3.2.1 Siting and Design Criteria

Siting and design criteria can be either exclusionary or evaluative. Exclusionary criteria define conditions that would exclude a site and/or design from further consideration because of an adverse impact. Evaluative criteria are based on desirable conditions that reduce potential impacts and favor the selection of one alternative over another.

Exclusionary Criteria

1. Site locations and designs whose impact on wetlands or WoUS would exceed the threshold or could not meet the terms and conditions for a Section 404 Nationwide Permit would be excluded.
2. Site locations that result in a turbine being placed within 500 ft of USFWS-recognized habitat for noise-sensitive wildlife species would be excluded unless consultation with USFWS confirms that the species and its habitat would not be adversely affected.
3. Site locations and designs that are *likely to adversely affect* an ESA-listed species or its critical habitat would be excluded unless all required terms and conditions and, to the extent feasible, recommended conservation measures that are specified in a Section 7 Biological Opinion are incorporated into the project.
4. Areas where wind turbine development has been restricted by another federal agency or by a state regulatory agency because of the proximity of sensitive bird or bat species (e.g., New Jersey Department of Environmental Protection 2009) would be excluded. Any corresponding species-specific buffer distances for sensitive species would be incorporated as siting and design criteria.
5. Site locations and designs that would alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish

the integrity of the property's location, design, setting, materials, workmanship, feeling, or association, would be excluded.

6. Site locations and designs for which predicted noise levels at sensitive non-DoD receptor locations (e.g., residences, parks) would exceed federal noise standards would be excluded.
7. Site locations and designs for which construction emissions would exceed *de minimis* thresholds, and for which a Conformity Determination indicates that the project would not conform to the applicable SIP would be excluded.
8. Site locations and designs must be compatible with DoD air/ground operations and training requirements.
9. Site locations and designs must meet FAA requirements to avoid height obstructions to aircraft. The FAA would be notified early in the planning process to identify siting and design requirements.
10. Site locations and designs for which turbine operations would be within line of sight, cause unavoidable electromagnetic interference (EMI), and substantially interfere with civilian or military radars would be excluded. Civilian and military radar operators in the general area of a turbine location would be contacted as necessary in the planning process to determine if radar interference may be a problem, in which case MARFORRES would coordinate with the operators to determine if there are feasible technological solutions.

Evaluative Criteria

1. As much as possible, projects would be located on previously disturbed or altered landscapes, avoiding less disturbed, relatively natural areas (*Note*: land with previous underground disturbance may not be suitable for wind turbine foundation installation).
2. Projects would consolidate infrastructure requirements (e.g., transmission lines or roads) and temporary construction areas (e.g., use the same crane pads or staging/laydown areas at a project site for multiple turbines) for efficient use of land.
3. Where there are potential noise, visual, shadow flicker, or safety concerns associated with the proximity of non-DoD lands to potential wind turbine locations, projects would consider reducing the number/size of wind turbines or relocating wind turbine sites further within the MARFORRES facility boundaries and/or away from the affected non-DoD areas.
4. Site locations and designs should (a) provide a minimum setback from any residence, public highway, or area of concentrated public use (such as a park or shopping area) outside of the MARFORRES facility that is consistent with local ordinances, plans, or policies regarding minimum setbacks of wind turbines from such areas; and (b) avoid conflicts with local ordinances, plans or policies regarding maximum heights of wind turbines.
5. Site locations and designs that *may affect* an ESA-listed species or its critical habitat would be less preferred unless, through informal consultation with USFWS, necessary and sufficient measures to ensure that the action is *not likely to adversely affect* the species or its designated critical habitat have been identified and incorporated into the action.
6. Locations and designs of small-scale wind energy projects should avoid overlap with, and, where practicable and effective in reducing potential impacts, maximize distance from, the following circumstances:

- Locations with valuable mineral deposits, paleontological resources, or within the viewshed of unique geological features.
- Wetlands and other WoUS.
- Areas within a 100-year floodplain or otherwise subject to flooding.
- Habitats that are protected under an installation's INRMP or that support ESA-listed species.
- Locations with federally or state-listed, or otherwise designated sensitive species, including migratory birds of conservation concern.
- Breeding and wintering bald or golden eagle use areas.
- Daily or seasonal flight patterns of migratory birds and bats.
- Areas near known bat hibernacula, breeding, and maternity/nursery colonies.
- Landscape features such as native (undisturbed) grasslands, scrub, woodlands, or wetlands that are known to be attractive to migratory birds.
- Scenic views associated with an NRHP-eligible historic property or recreation site, or where a turbine would alter the unique visual character of the landscape.
- Locations with soil contamination present in amounts and concentration levels of which make wind energy projects incompatible under prevailing governmental and industry standards.

Design Criteria

1. In order to minimize impacts to bird and bat populations, the following design features should be implemented:

   - Use tubular supports with pointed nacelle tops, rather than lattice supports, and avoid placing external ladders and platforms on tubular towers to minimize bird perching and nesting opportunities.
   - If turbines are taller than 200 ft (including the rotor swept area), use the minimum amount of pilot warning and obstruction avoidance lighting required by the FAA. All lights within the turbine facility should light synchronously. Use only the minimum number of strobe, strobe-like, or blinking red incandescent lights, with the minimum required intensity. Preferably install dual strobe lights per nacelle. No steady burning lights should be used on turbines or facility infrastructures.
   - Safety lighting on buildings or other infrastructure should be focused downward to reduce skyward illumination. Lights should also be equipped with motion detectors to reduce continuous illumination.
   - Where feasible, bury electric power lines or place insulated, shielded lines on the surface to avoid electrocution risks to birds.
   - Above-ground lines, transformers, and conductors should follow the Avian Power Line Interaction Committee 1994 and 2006 guidance. Aboveground lines should not be placed in wetlands or over canyons.
   - Reduce motion smear by using blades with staggered stripes or incorporating a black blade with two white blades to aid in reducing collisions.

2. Implement measures to reduce noise levels below noise guidelines for an affected land use. Measures could include, but are not limited to:

   - reduce number of wind turbines;
   - modify design (e.g., blade design, tower height, orientation) or operations (i.e., reduce or eliminate nighttime operations or change to a different sound level power curve, if available);

- provide vegetative (trees) or other screening in between wind turbines and sensitive receptors; or
- locate wind turbine sites sufficiently far away from sensitive receptors.

3. If initial analysis indicates a potential visual impact on a historic property or scenic view, the following should be implemented:

   - reduce the size of the turbine(s);
   - select a location that shield(s) the turbine(s) from view and minimizes contrast between the turbine(s) and the property or viewshed of concern; or
   - if feasible and approved by the FAA, modify the color or lighting of the turbine(s) to lessen contrast with the surrounding landscape.

2.3.2.2 Best Management Practices (BMPs)

This section contains BMPs to be used when constructing small-scale wind energy projects. These practices help minimize potential impacts to the environment and are applicable to all sites.

Construction BMPs

1. The local project proponent would coordinate with the responsible agencies regarding the use of any public roads or waterways during project construction to minimize any disruption of local traffic.
2. Current Wind Energy Standards of the International Electrotechnical Commission would be followed in the design, construction, and operation of each new wind energy project.
3. All mechanized clearing and grading, vehicle traffic, equipment staging, and the deposition of soil would be confined to the temporary and/or permanent project footprint or to other disturbed or developed land.
4. At least 7 days before project initiation, the project boundary (including temporary features such as staging/laydown areas and access roads) would be clearly marked with flagging, fencing, or signposts. All project-related activities would occur within the project boundary.
5. Heavy equipment and construction activities would be restricted to existing roads and disturbed areas to the maximum extent practicable. Staging/laydown areas would be located in disturbed habitats and would be delineated on the grading plans. Vehicle operation and staging/laydown areas would be defined by staking and flagging between stakes to prevent operations outside these areas.
6. Construction trucks would carry water and shovels or fire extinguishers in the field. The use of shields, protective mats, or other fire prevention equipment would be used during grinding and welding to prevent or minimize the potential for fire, and vehicles would not be driven or parked in areas where catalytic converters could ignite dry vegetation. No smoking or disposal of cigarette butts would take place within vegetated areas.
7. If required, the contractor would prepare a Stormwater Pollution Prevention Plan (SWPPP) in conjunction with the final design and would comply with all local permitting requirements. This plan would incorporate BMPs for erosion and sedimentation controls, including techniques to diffuse and slow the velocity of storm water runoff. SWPPP BMPs may include, but are not limited to, erosion, sedimentation, and stormwater control measures such as sandbags, silt fences, earthen berms, fiber rolls, sediment traps, erosion control blankets, check dams in medium-sized channels, or straw bale dikes in a smaller drain channels.

8. Onsite containment and cleanup capabilities would be provided, as necessary, to prevent the release of hazardous materials.
9. If evidence of contaminated soils is uncovered during construction, construction would be halted and cleanup procedures would be initiated, as required.
10. Grading during the rainy season would be avoided or minimized if practical. Where it is impractical to avoid grading during the rainy season, erosion and sedimentation controls would be installed immediately downslope of work areas. Erosion and sedimentation controls would be monitored and maintained during construction and for 12 months thereafter to ensure stabilization of the site.
11. No excavated or fill material would be placed in a jurisdictional wetland or WoUS except as authorized by a Section 404 Nationwide Permit from the USACE. The same thresholds and standards for minimization or mitigation that are contained the Nationwide Permits would be applied to non-jurisdictional isolated wetlands. Concreting operations would be conducted to ensure discharge water associated with these operations does not reach surrounding water bodies or pools unless specifically authorized in a CWA discharge permit.
12. All fill material brought to the construction site from off base would be checked to ensure that it is clean – specifically, that it is free from contaminants and does not contain any seeds or plant materials from non-native or invasive species.
13. Dust migration in or adjacent to riparian areas would be minimized by lightly spraying areas of exposed soil with water during excavation and grading activities when weather conditions require the use of dust control measures.
14. The action proponent, or their contractor, would ensure that construction and solid waste (including asphalt or concrete) resulting from construction activities is disposed of properly and not discarded onsite.
15. All trash would be disposed of properly. All food-related trash would be placed in sealed bins and removed from the site regularly. All equipment and waste would be removed from the site.
16. Disturbed soils would be re-contoured, stabilized and re-planted with native species that are consistent with pre-existing vegetation. The site would be restored to as near the original biological condition as possible once the project is completed.
17. The topsoil from native habitats within the proposed impact areas would be salvaged, stockpiled, and maintained in a manner that would facilitate survival of the mycorrhizal organisms and seed bank within the soil. This topsoil would be used as the surface horizon during the revegetation of native habitats.
18. No off-road construction vehicle operations would occur outside of the project boundary. To the maximum extent possible, off-road construction vehicle operations within the project boundary would avoid existing vegetation and use existing roads and disturbed areas to minimize the impact on vegetation, wildlife, and terrain.
19. If night work and consequent lighting are required, all nighttime construction activities would be monitored in and adjacent to sensitive habitat to avoid disturbance to listed species. Any night lighting used would be shielded and directed away from sensitive habitat.
20. Construction workers would use portable chemical toilets, with secondary containment basins to prevent spillage. Chemical toilets would not be placed within 100 ft of riparian habitat.

Operations BMPs

1. Avoid creating or maintaining habitat features that attract birds and bats. Examples include removing carrion, maintain vegetation to heights to reduce prey availability, minimize water ponding, and avoid creating situations where prey base would increase (e.g., rock piles or eroded turbine pads with openings underneath that are suitable for rodents will attract raptors, particularly golden eagles).
2. Minimize the number of required new roads, to the extent practicable, as roads can lead to habitat fragmentation and loss.
3. Pitch the blades of the turbine so they are parallel to the wind in low wind conditions (i.e., turbine feathering) to aid in reducing collisions.
4. Decommission all turbines that are permanently broken, of an out-of-date design, or otherwise non-operational to reduce collision threats. Remove the turbines, or at least the blades, as soon as possible.

2.3.2.3 General Conservation Measures (GCMs)

GCMs are resource-specific measures that may be applicable, based on site-specific analysis, to ensure that impacts remain minor. GCMs would generally require some degree of refinement at the site-specific level.

1. If valuable mineral resources or unique paleontological resources or geologic features are present, construction plans will, based on site-specific analysis, minimize grading in the areas of greatest concentration/abundance of the resource, leaving most of the resource intact. A qualified geologist will monitor grading to ensure compliance with this measure.
2. As warranted by data indicating high concentrations of birds or bats, or the presence of a species of concern in the vicinity of a project location, coordinate with the local USFWS office to develop a scientifically sound, post-construction monitoring program to document bird and bat fatalities by species, number, and season that are occurring at the turbine location. Based on monitoring results and continuing coordination with USFWS, MARFORRES would adaptively manage turbine operations to minimize bird and bat fatalities and potential population impacts by raising cut-in speeds and/or temporarily turning turbines off during high-use periods. Monitoring results would be shared with agencies and interest groups in support of broader action to reduce impacts to vulnerable species. Adjustments would be made as warranted by changes in the status and vulnerability of species (e.g., bat species impacted by white-nose syndrome), new information (e.g., previously undiscovered hibernacula), or climate-related changes in distribution or habitat use. MARFORRES will endeavor to implement new, cost-effective detection and deterrence technologies as they are developed and proven effective.
3. If an INRMP- or USFWS-recognized sensitive habitat is present on or near a proposed site, established avoidance, minimization, or compensation measures would be implemented as prescribed by the installation INRMP and/or USFWS policy to avoid impacting the resource.
4. If an ESA-listed, proposed, or candidate threatened or endangered species is present, such that it may be affected, necessary and sufficient measures to avoid the likelihood of take would be identified through consultation with USFWS, and incorporated into the project, to support a finding that the action is *not likely to adversely affect* the species.

5. If a bald or golden eagle nest, bald eagle winter roosting area, or important foraging habitat is within 3 miles or other threshold distance established under the BGEPA by the regional USFWS office, unless otherwise specified by USFWS (see below), the programmatic take permit process, including consultation to identify sufficient measures for incorporation into the project to minimize the likelihood of a lethal take, would be followed. In the Northeast Region, including the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia, that region's "Bald Eagle Management Guidelines and Conservation Measures" would be followed unless superseded by new regulations under the BGEPA.
6. If necessary to avoid adverse shadow flicker effects on residents, motorists, or sensitive views and land uses, turbine operation schedules would incorporate temporary shut downs.

## 2.4 NO-ACTION ALTERNATIVE

Under the no-action alternative, MARFORRES would not pursue the implementation of the wind energy program at MARFORRES facilities in the U.S. and would continue to rely on the electrical grid for purchase of all electricity needs. Although the no-action alternative is not considered a reasonable alternative because it does not meet the purpose of and need for the proposed action as required under CEQ regulations (40 CFR § 1502.14[d]), it does provide a measure of the baseline conditions against which the potential adverse impacts of the proposed action can be compared. As such, the no-action alternative is carried forward for analysis. The no-action alternative for this PEA represents the baseline conditions described in Chapter 3, *Affected Environment*.

## 2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED

### 2.5.1 Construction of Other Types of Renewable Energy Facilities

The purpose of the proposed action is to facilitate the development of wind as an energy source. The sites considered are those at which the wind resource is readily available and economically feasible for development as a renewable energy source. Therefore, development of other types of renewable energy facilities, such as solar and biomass, has been eliminated from further consideration in this PEA. MARFORRES facilities may develop other sources of renewable energy independently of this action; this development would be subject to requirements under NEPA, and appropriate impact analyses would be performed.

### 2.5.2 Alternative Tower Designs (Vertical Axis Wind Turbine [VAWT])

Use of VAWTs was considered in the initial planning stages of this project because VAWTs potentially have lower bird and bat collision fatality rates than conventional turbines in which the rotor spins on a horizontal axis. However, there have been no rigorous scientific studies comparing collision-fatality rates between the two types of turbines. Furthermore, VAWTs typically require supporting guy wires, which present an additional collision hazard to birds and bats that would tend to negate the presumed advantage of the vertical rotor. It was also found that the output levels of these types of wind turbines are not sufficient to make them economically viable to construct at MARFORRES facilities. In addition, the long blades on these turbines have natural resonance frequencies at some common frequencies of rotation. Therefore, the turbines have to be controlled to avoid certain rotational speeds. The vertical axis wind turbines are also subject to turbulent air at lower altitudes, thus they would be subject to greater material stresses and wear out faster than horizontal axis wind turbines. Therefore, vertical axis wind turbines are not considered a feasible alternative and have been eliminated from further consideration in this PEA.

### 2.5.3 Larger-scale Wind Farm Development

The development of larger-scale (i.e., > four wind turbines) wind farms was considered as an alternative to small-scale installation-based turbines. This alternative is not feasible for the proposed MARFORRES wind energy program and the MARFORRES facilities under consideration because of insufficient land available on small installations and conflicts with the training mission or other uses on larger installations.

# CHAPTER 3
# AFFECTED ENVIRONMENT

## 3.1 INTRODUCTION

This chapter describes the aspects of the affected environment for each resource that would be potentially affected by the proposed implementation of the MARFORRES wind energy program. These aspects (environmental features or circumstances), encompass existing conditions that may be expected to occur at any MARFORRES facility. Any individual site proposed for wind turbine construction under the MARFORRES wind energy program would be evaluated similarly with respect to these features and circumstances.

**Key Elements**

***Objectives:***

- Identify the aspects of the affected environment for each resource that are expected to be potentially affected by the proposed action.
- For each resource/issue area, identify the environmental features and circumstances relevant to the analysis of impacts at any proposed site.

***Resources analyzed:***

- Land use, noise, geology, water, biology, cultural, visual, socioeconomics, air quality, utilities, airspace, health and safety, hazardous materials, and transportation.

***Each resource/issue area includes:***

- Definition of resource
- Regulatory setting
  - ✓ Legal protection and requirements
- Existing conditions

Each section provides an introductory "Definition of Resource" which identifies the relevant aspects of the environment that could be taffected and hence need to be analyzed; a "Regulatory Setting" which identifies the legal protection and requirements applicable to that resource; and "Existing Conditions" which identifies aspects of the resource that are relevant to the proposed wind energy projects. For any proposed site, a site-specific NEPA analysis would include an "Existing Conditions" discussion of the baseline environmental conditions of potentially affected areas based on a detailed description of proposed and alternative site construction and operations plans for that particular site.

This basic "project description" is separate from the resource-specific descriptions that follow. Site plans would include but are not necessarily limited to:

- the location of each site and a general description of the site's recent historic use and condition, including the extent of development, disturbance, and any natural vegetation on the site;
- the ownership and uses of surrounding lands;
- the proposed (and alternative) number, size, and placement of the turbine(s);
- a detailed construction schedule, including the timing of use of existing transportation infrastructure for construction;
- land areas needed for temporary use during construction and long-term use during operation;
- any special construction requirements associated with soil and surface or groundwater conditions;

- an Interconnect Agreement with the local electricity utility on the means of connecting to the existing electrical grid and the identification of any additional infrastructure required to ensure safe operation of the turbine without disruption to other users; and
- any special siting, design, construction, or operation constraints that have been agreed to up front, either as adopted through this PEA or developed through local coordination and consultation.

Using the general impact analysis outlined in Chapter 4 and the program criteria identified in Section 2.3.2, the details provided in the site plan would be subject to site-specific NEPA analysis tiered from this PEA.

## 3.2 LAND USE

### 3.2.1 Definition of Resource

The attributes of land use considered in this analysis include general land use patterns, land ownership, special use areas, local ordinances regulating activities and types of development on non-DoD land adjacent to a facility, and land management plans that guide a region's growth. General land use patterns characterize the types of uses within a particular area and can include urban, agricultural, residential, scenic, natural, military, and recreational. Land ownership is a categorization of land according to type of owner. The major land ownership categories include private, federal, and state. Land management plans include those documents prepared by agencies to establish appropriate goals for future use and development. As part of this process, sensitive land use areas are often identified by agencies as being worthy of more rigorous or protective management. In an urban or suburban context, land use goals and controls are defined in General, Master, or Comprehensive Plans and are implemented through zoning or local ordinances.

### 3.2.2 Regulatory Setting

Individual project sites would be subject to the prevailing land use controls of the MARFORRES facility where they are located. Coastal sites would be subject to the CZMA and its requirements for consistency with the state's approved Coastal Zone Management Plan. The land use plans and policies of neighboring jurisdictions are not binding but should be considered as part of the NEPA process.

### 3.2.3 Existing Conditions

Aspects of land use that are relevant to the proposed wind energy projects include the following:

- *Current land use within and surrounding the proposed turbine location(s).* Any proposed location must be compatible with existing land uses within a MARFORRES facility. However, such uses must be described as part of the existing conditions so that changes to them are identified in the NEPA document.
- *Land ownership surrounding the facility.* Adjacent to each MARFORRES facility will be various landowners. These may be private, municipal, county, state, or other federal agencies.
- *Compatibility with neighboring land uses and land use plans.* Surrounding each MARFORRES facility are various land uses, some of which may be governed by municipal, county, regional, state, or federal plans. Land uses can include urban, agricultural, residential, scenic, natural, military, and recreational. Although a MARFORRES facility is not legally subject to the ordinances, plans, and policies of the adjacent local jurisdiction, consideration of relevant plans and policies, especially those that apply to the siting of wind turbines, is required under NEPA. In particular, local requirements limiting turbine heights or requiring setbacks to reduce noise or

safety concerns must be considered to the extent that potential impacts extend beyond the boundaries of the MARFORRES facility. For any proposed project affecting resources within a state coastal zone, the CZMA requires an evaluation of consistency with the local coastal plan.

- *Special use areas near the proposed site.* Sensitive land use areas, such as historic sites or sensitive natural areas, are often identified by agencies as being worthy of more rigorous or protective management.

## 3.3 NOISE

### 3.3.1 Definition of Resource

Noise is generally defined as any sound that interferes with communication, is intense enough to damage hearing, or is otherwise annoying (Federal Interagency Committee on Noise [FICON] 1992). Noise can be intermittent or continuous, steady or impulsive, as well as stationary or transient. Stationary noise sources are typically associated with specific land uses (e.g., schools or industrial facilities). Transient noise sources move through the environment, either along relatively established paths (e.g., highways, railroads, and aircraft flight tracks around airports) or randomly. There are a wide range of responses to noise depending on the type of noise and the characteristics of the sound source, as well as the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source and the receptor (e.g., a person or animal).

The physical characteristics of sound include intensity, frequency, and duration. The decibel (dB) is the unit of measure for the intensity of sound. Sound intensity varies widely (from a soft whisper to a jet engine) and is measured on a "logarithmic" scale to accommodate this wide range; thus, a 1-dB increase represents a ten-fold increase in noise. Under most conditions, a change of 5 dB is required for humans to perceive a change in the noise environment (USEPA 1974).

The frequency of sound is measured in cycles per second, or hertz (Hz). This measurement reflects the number of times per second the air vibrates from the acoustic energy. Low-frequency sounds are heard as rumbles or roars, and high-frequency sounds are heard as screeches. Sound measurement is further refined through the use of "A-weighting." The normal human ear can detect sounds that range in frequency from about 20 Hz to 15,000 Hz. However, all sounds throughout this range are not heard equally well. The human ear is most sensitive to frequencies in the 1,000 to 4,000 Hz range; sounds measured in these frequencies are termed "A-weighted" and are shown in terms of A-weighted decibels (dBA). Human hearing ranges from approximately 20 dBA (the threshold of hearing) to 120 dBA (the threshold of pain). Table 3.3-1 provides several examples of noise levels of various activities.

The sound exposure level (SEL) is a measure of the physical energy associated with a noise event, incorporating both the intensity and duration of the event. It is important to note that SEL does not directly represent the sound level heard at any given time, but rather provides a measure of the total exposure of the entire event. Its value represents all of the acoustic energy associated with the event as though it was present for one second. The SEL value is important because it is the value used to calculate other time-averaged noise metrics.

The day-night average sound level ($L_{dn}$) is the energy-averaged sound level of all SEL values within a 24-hour period, with a 10-dBA penalty assigned to noise events occurring between 10 p.m. and 7 a.m. to compensate for the annoyance associated with the occurrence of nighttime noise events. The $L_{dn}$ is the preferred noise metric of the U.S. Department of Housing and Urban Development (HUD), FAA, USEPA, and the DoD.

**Table 3.3-1. Representative Noise Levels**

| *Common Outdoor Activities* | *Noise Level (dBA)* | *Common Indoor Activities* |
|---|---|---|
| – | **110** | Rock band |
| Jet fly-over at 1,000 ft | **100** | – |
| Gas lawn mower at 3 ft | **90** | – |
| Diesel Truck at 50 mph, 50 ft | **80** | Food blender/ garbage disposal at 3 ft |
| Noisy urban area, daytime | **70** | Vacuum cleaner at 10 ft |
| Commercial area/ Heavy traffic at 300 ft | **60** | Normal speech at 3 ft |
| Quiet urban area, daytime | **50** | Large business office/ Dishwasher in next room |
| Quiet urban area, nighttime | **40** | Theater/large conference room |
| Quiet suburban area, nighttime | **30** | Library |
| Quiet rural area, nighttime | **20** | Bedroom at night/ Concert hall (background) |
| – | **10** | Broadcast/recording studio |
| Lowest threshold of human hearing | **0** | Lowest threshold of human hearing |

*Source*: California Department of Transportation 1998.

Most people are exposed to sound levels of 50-55 dBA ($L_{dn}$) or higher on a daily basis. Studies conducted to determine noise impacts on various human activities have revealed that sound levels below 65 dBA ($L_{dn}$) do not annoy approximately 87% of the population (FICON 1992). Figure 3.3-1 shows guidelines established by FICON commonly used to determine acceptable levels of noise exposure for various types of land uses. Public annoyance is the most common impact associated with exposure to elevated noise levels. When subjected to an $L_{dn}$ of 65 dBA, approximately 12% of persons so exposed will be “highly annoyed” by the noise. At levels below 55 dBA, the percentage of annoyance is correspondingly lower (less than 3%). The percentage of people annoyed by noise never drops to zero (some people are always annoyed), but at levels below 55 dBA it is reduced enough to be essentially negligible.

Sensitive receptors associated with noise are generally people who occupy an area that can be substantially affected by noise. Examples of these types of areas include residential areas, schools, parks, libraries, and hospitals. Sensitive wildlife and their habitat can also be considered sensitive noise receptors.

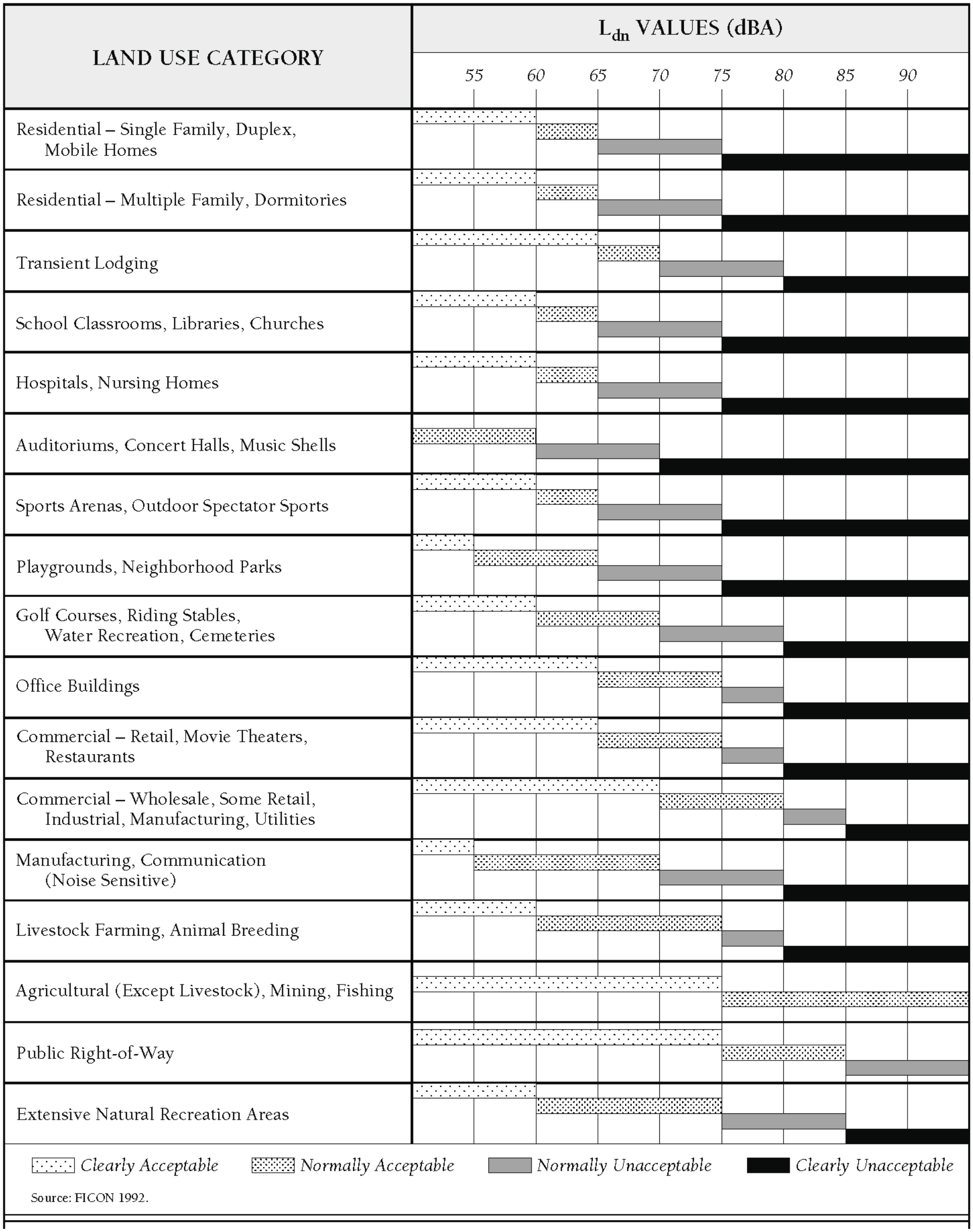



**Figure 3.3-1 $L_{dn}$-Based Noise Levels Acceptable for Various Types of Land Use**

### 3.3.2 Regulatory Setting

Noise standards and guidelines have been established at the federal, state, and local government levels to protect people from potential hearing damage as well as other impacts (i.e., annoyance) that can disrupt activities, alter quality of life, etc. MARFORRES facilities on federal/DoD lands are required to comply with federal noise standards and guidelines but are not subject to state and local noise ordinances. However, state and local noise ordinances may be considered when siting facilities and determining land uses on DoD installations in order to avoid or minimize impacts to surrounding land uses, including sensitive receptors.

The MARFORRES is subject to the requirements of the Noise Control Act of 1972, as amended (42 U.S.C. §§ 4901 *et seq.*), which was established by the USEPA to provide a framework for the coordination of federal noise control research, establishing noise emission standards, and providing information to the public. The Federal Interagency Committee on Urban Noise (FICUN) was formed to develop federal policy and guidance on noise. Federal agencies that comprise FICUN include DoD, USEPA, FAA, HUD, and Veterans Affairs. FICUN's efforts included the development of consolidated federal agency land use compatibility standards based on yearly $L_{dn}$.

A general characterization of $L_{dn}$ levels is summarized below:

- Based on numerous sociological surveys and recommendations of federal interagency councils, the most common noise-related benchmark referred to is an $L_{dn}$ of 65 dBA. This threshold is often used to determine residential land use compatibility around airports, highways, or other transportation facilities.
- An $L_{dn}$ of 55 dBA was identified by the USEPA as a level ". . . requisite to protect the public health and welfare with an adequate margin of safety" (USEPA 1974). Noise may be heard, but there is no risk to public health or welfare.
- An $L_{dn}$ of 75 dBA is a threshold above which effects other than annoyance may occur. It is 10 to 15 dBA below levels at which hearing damage is a known risk (Occupational Safety and Health Administration 1983). However, it is also a level above which some adverse health effects cannot be categorically discounted.

### 3.3.3 Existing Conditions

The characteristics of surrounding land uses and the existing noise environment influence the effect that the introduction of a new noise source would have on the area. Although noise measurements are not available for specific MARFORRES facilities where wind energy projects may be considered, inferences as to the potential for noise impacts can be drawn from the following:

- *Existing noise sources:* The existing noise sources and level of development surrounding each site strongly influence existing baseline noise levels. It is expected that all potential turbine locations would be in developed areas on MARFORRES facilities that are near well-traveled roads and/or waterways. Typical background noise sources would include automobiles and/or vessels, aircraft, the operation of machinery/equipment for construction, landscaping, or agriculture; and military training activities.
- *Sensitive noise receptors:* Sensitive noise receptors are those land uses that are particularly sensitive to noise and include residences, hospitals, schools, and parks (see Figure 3.3-1). These types of sensitive receptors would not be present within the immediate area of potential development, but could be present at varying distances. Both the distance and intervening

vegetation, topography, or development between a proposed turbine location and a sensitive noise receptor will affect the received noise levels.

## 3.4 Geological Resources

### 3.4.1 Definition of Resource

Geological resources are defined as the topography, geology, and geological hazards of a given area. Topography is typically described with respect to the elevation, slope, aspect, and surface features found within a given area. Long-term geological, seismic, erosional, and depositional processes typically influence the topographic relief of an area. The geology of an area includes bedrock materials, mineral deposits, soils, paleontological resources, and unique geological features. Bedrock refers to consolidated earthen materials that may be made up of either interlocking crystals (igneous and metamorphic rocks) or fragments of other rocks compressed and cemented together over time by pressure and dissolved minerals that have hardened in place (sedimentary rocks). Soil lies above bedrock and consists of weathered bedrock fragments and decomposed organic matter from plants, bacteria, fungi, and other living things. The value of soil as a geologic resource lies in its potential to support plant growth, especially agriculture. Mineral resources are metallic or non-metallic earth materials that can be extracted for a useful purpose, such as iron ore that can be refined to make steel, or gravel that can be used to build roads. Paleontological resources are the fossilized remains of plants and animals. Rarer fossils have major scientific value and often include vertebrate fossils or rarer invertebrate fossils. Unique geologic features are landforms such as a volcanic cinder cone, lava tube, rock tower, or other aspects of the landscape that owe their shapes to a particular combination of geologic processes such as weathering, erosion, and deposition. The principal geologic hazards influencing the stability of structures are soil stability and seismic properties.

### 3.4.2 Regulatory Setting

*Federal Soil Conservation Law* (16 USGS 590a). By Congressional policy, "provides permanently for the control and prevention of soil erosion by preventative measures, including, but not limited to, engineering operations, methods of cultivation, growing of vegetation, and changes to land use."

Although no laws specifically address paleontological resources, limited protection is offered through the Antiquities Act of 1906 to specimens of significant scientific value. ARPA 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 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 U.S.C. 1361]).

### 3.4.3 Existing Conditions

Aspects of geological resources that are relevant to the proposed wind energy projects include:

- *Topography and Soils.* The topography of a proposed project site can be determined with topographic maps published by the U.S. Geological Survey (USGS) or through GIS datasets available online. Project sites at MARFORRES facilities would typically be located adjacent to existing infrastructure and would be in areas with flat to low-sloped topography. The topography and soils at a project site would be characterized prior to construction to assess their suitability for construction and potential for erosion.

- *Mineral Deposits, Paleontological Resources, and Unique Geological Features*. Site conditions would be reviewed to determine if mineral deposits, paleontological resources, or unique geological features are present or expected. Because the proposed project sites would be located at existing MARFORRES facilities, the potential for the occurrence of mineral deposits, paleontological resources, and unique geological features should be known from previous construction projects. Additional sources of information about paleontological resources in a region may be found at a state repository of fossil finds.

- *Geologic Hazards*. Geologic hazards include landslides and seismic and faulting hazards. Potential hazards would be identified in a geotechnical study. The geotechnical study should provide design and construction recommendations that address all potential geological hazards at a site.

## 3.5 WATER RESOURCES

### 3.5.1 Definition of Resource

Water resources as defined in this PEA are sources of water available for use by humans, flora, or fauna, including surface water, groundwater, nearshore waters, wetlands, and floodplains. Surface water resources, including but not limited to stormwater, lakes, streams, rivers, and wetlands, are important for economic, ecological, recreational, and human health reasons. Groundwater is classified as any source of water beneath the ground surface and may be used for potable water, agricultural irrigation, and industrial applications. Nearshore waters can be directly affected by human activity, and are important for human recreation and subsistence. Wetlands are habitats that are subject to permanent or periodic inundation or prolonged soil saturation, and include marshes, swamps, and similar areas. Areas described and mapped as wetland communities may also contain small streams or shallow ponds, or pond or lake edges. Wetlands and WoUS that are potentially jurisdictional under the CWA are discussed in a regulatory context in this section. Water quality describes the chemical and physical composition of water as affected by natural conditions and human activities. Floodplains are relatively flat areas adjacent to rivers, streams, watercourses, bays, or other bodies of water subject to inundations during flood events.

### 3.5.2 Regulatory Setting

The CWA of 1972 is the primary federal law that protects the physical, chemical, and biological properties of the nation's waters, including all navigable waters, their tributaries, and Section 404 jurisdictional wetlands (as defined under 33 CFR 328.3). Section 404 of the CWA requires a permit from the USACE for any discharge of excavated or fill material into WoUS, defined to include navigable waters and their tributaries and adjacent wetlands that have a significant nexus (i.e., functional relationship) to the navigable water (USACE and USEPA 2008). Section 401 of the CWA requires a state Water Quality Certification for the issuance of a Section 404 permit, verifying that the discharge would meet USEPA or state water quality protection requirements. Section 402 of the CWA established the NPDES, under which the USEPA or an authorized state regulates the discharge of non-point source pollution. For construction or the placement of structures in navigable waters, a permit under Section 10 of the RHA is also required. Specific requirements that apply to the proposed action are detailed below.

*Construction General Permit*. Construction activities (which include soil disturbing activities such as clearing, grading, excavating, stockpiling, etc.) that disturb one or more acres, or smaller sites that are part of a larger common plan of development or sale, are regulated under the NPDES stormwater program. The USEPA has authorized most states to implement the NPDES permit program, including the stormwater program. The USEPA or authorized states regulate most construction activities under a Construction General Permit (CGP) that applies to the region or state. The CGP outlines a set of provisions that construction operators must follow to comply with the requirements of the NPDES stormwater regulations. Under the CGP, operators of regulated construction sites are required to develop

SWPPPs; to implement sediment, erosion, and pollution prevention control measures; and to obtain coverage under a USEPA or state NPDES permit. Construction operators must submit a Notice of Intent (NOI) to seek coverage under USEPA's or state's CGP.

*EO 11990*. This EO requires that governmental agencies, in carrying out their responsibilities, provide leadership and "take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands." Each agency is to consider factors relevant to a proposed project's effect on the survival and quality of wetlands. Among these factors is the maintenance of natural systems, including conservation and long-term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, and wildlife. If no practical alternative can be demonstrated, agencies are required to provide for early public review of any plans or proposals for new construction in wetlands.

*EO 11988 Floodplain Management*. This EO requires that federal agencies take action to reduce the risk of flood loss and restore and preserve the values of floodplains. To minimize the risk of damage associated with these areas, EO 11988 was issued to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practical alternative. EO 11988 outlines different requirements for federal projects located in 100-year and 500-year floodplains (i.e., that area which has a 1% or greater chance or 0.2% or greater chance, respectively, of flooding in any given year). Because the proposed action would not qualify as a "critical activity" under EO 11988, compliance with EO11988 for construction in a 500-year floodplain will not be required (Federal Emergency Management Agency [FEMA] 2010a).

### 3.5.3 Existing Conditions

The proposed projects would be located at MARFORRES facilities and in areas that have been previously disturbed. Surface water features include ponds/lakes, streams, rivers, and wetlands. Nearshore marine waters also occur at some sites. The primary concern would be impacts to surface and nearshore waters from stormwater runoff during both construction and operations. There is also potential for presence of jurisdictional wetlands and WoUS within the proposed project footprints.

Aspects of water resources that are particularly relevant to the proposed wind energy projects include:

- *Surface Water Quality.* Stormwater discharges from MARFORRES facilities are regulated under existing SWPPPs that include BMPs and Spill Prevention Plans. Under a SWPPP, BMP implementation includes performing frequent visual inspections and benchmark monitoring to determine BMP effectiveness. Monitoring results are then analyzed in relationship to the identified water quality objectives and if the benchmarks are not being reached, the BMPs would be modified.

  Specific regulatory and compliance requirements under NPDES are issued by the USEPA or authorized state agency, and therefore vary from state to state. Compliance with the appropriate CGP would need to be met for each site, as necessary.

- *Wetlands and WoUS*. If a formal wetland delineation has already been prepared for the MARFORRES facility or the proposed project area, this can be used to determine the occurrence of jurisdictional wetlands or WoUS within the footprint of the construction area. If no previous delineation has been performed, sources available on the internet can be used to determine if there is a potential for wetlands or WoUS to be located within the proposed project footprint. These sources include but are not limited to aerial photographs, USFWS National Wetlands Inventory

(NWI), and soil classifications developed by the U.S. Department of Agriculture, Natural Resources Conservation Services that can be used to identify the presence of hydric soils. Even if these sources do not provide evidence of potential wetlands, any previously undeveloped site should be inspected by a wetland biologist to determine if unmapped wetlands or WoUS are present. It is important to note that locations, sizes, and classes of NWI wetlands do not necessarily correspond to jurisdictional wetlands.

If any of these sources indicate that wetlands or WoUS may be located within the proposed project footprint, then a formal wetland delineation would need to be conducted according to the USACE (1987) *Wetlands Delineation Manual* and any appropriate regional supplements. These documents require that, under normal conditions, positive indicators of wetland hydrology, soil, and vegetation be present in order for an area to be deemed a jurisdictional wetland. A wetland delineation report would then be submitted to the USACE and the USACE would make a determination on whether or not a wetland is jurisdictional and therefore subject to Section 404 Nationwide Permit requirements.

- *Floodplains*. FEMA flood maps (FEMA 2010b) can be used to determine if the proposed project area is located within a FEMA-designated 100-year floodplain. If a project site is determined to be located within a 100-year floodplain, any federal development at that site is subject to EO 11988.

## 3.6 Biological Resources

### 3.6.1 Definition of Resource

Biological resources include native and naturalized plants and animals and their habitats. In this context, the focus of the analysis is on resources that could be affected by the installation and operation of one to four wind turbines at existing MARFORRES facilities. The impacts of greatest concern are (1) potential construction-related impacts on legally protected habitats or species (e.g., destruction of wetlands, endangered plant species habitat, or active nests of MBTA-protected bird species); and (2) potential injury or mortality to birds and bats, especially ESA-listed species and bald and golden eagles, from collision with rotating wind turbine blades. The potential for turbine operational noise impacts on wildlife in surrounding areas must also be considered.

Scientific names of the plants and animals referred to by common name in this section can be found in the Integrated Taxonomic Information System (www.itis.gov).

In the site-specific tiered EAs, potential impacts to other national-level, state-level, and local or regional level important biological resources will be considered and evaluated. These may include the 147 USFWS recognized "Birds of Conservation Concern" (USFWS 2008), bird or bat species listed as threatened or endangered under a state-level ESA regulation, or areas designated by local organizations to be of conservation importance, such as local parks, refuges, or Audubon-designated Important Bird Areas (IBAs). Finally, due to the prevalence of white-nose syndrome in bat colonies in many states, populations of many bat species are in extreme declines; therefore, the site-specific tiered EAs will need to take in to consideration impacts to some common bat species, as well as bat species that are already listed.

### 3.6.2 Regulatory Setting

The primary biological resource issues that require evaluation for the proposed wind energy projects at MARFORRES facilities include (1) any construction-related loss or degradation of habitat supporting ESA-listed species, migratory birds, or which is otherwise protected under an installation's INRMP or other statute (e.g., CWA wetlands and other WoUS as discussed in Section 3.5); and (2) potential incidental take via turbine collision of: (a) threatened and endangered avian and bat species listed under the federal ESA, (b) birds protected by the MBTA, or (c) bald or golden eagles protected by the BGEPA. The Sikes Act (16 U.S.C. 670a et seq.), as amended through 1998, provides the primary legal basis for the Secretary of Defense to carry out a program that provides for the conservation and rehabilitation of natural resources on military installations. Regarding the Sikes Act, more specifically, the Secretary of a military department shall cooperate with the Secretary of the Interior, acting through the Director of the USFWS, and the head of each appropriate state fish and wildlife agency for the state in which the military installation concerned is located [16 U.S.C. 670a (a)(2)].

As described in Chapter 1, the ESA requires federal agencies to avoid jeopardizing endangered and threatened species or adversely modifying designated critical habitat. Federally listed bird or bat species are known to occur at certain sites, or they may potentially occur based on the suitability of onsite or nearby habitats to support those species. In these cases, initiation of informal ESA Section 7 consultation with USFWS would be warranted, coupled with the review of existing conditions and information on the occurrence of those species. Additional field assessment may also be needed.

The MBTA requirements do not provide for the regulation of structures that pose a collision risk to migratory birds; hence, there is no MBTA permit or consultation requirement for wind turbines. However, in compliance with EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, which requires federal agencies to conserve and protect the nation's migratory bird resources, DoD and USFWS signed an MOU in 2006 (DoD and USFWS 2006). The MOU provides that military installations and commands are committed to review USFWS wind turbine and Avian Power Line Interaction Committee guidelines, and consult with USFWS, as needed, in considering potential effects of new towers, wind turbines, and transmission lines.

Under BGEPA, the presence of an active nest, wintering site, or foraging habitat for either species near a proposed wind turbine site necessitates the evaluation of potential impacts to individuals of those species. This evaluation may indicate the need for a programmatic take permit as described previously (refer to Section 1.5.4).

### 3.6.3 Existing Conditions

Aspects of biological resources that are especially relevant to the proposed wind energy projects and methods of assessment are described below. The approach here parallels the process recommended by the Wind Turbine Guidelines Advisory Committee (WTGAC) (WTGAC 2010).

- *Occurrence of sensitive plant or animal species or habitats on the proposed site.* The potential for sensitive species or habitats to be present onsite would be evaluated either in the field or through discussions with base personnel and local resource agency staff. Any available installation-level information would be reviewed, including INRMPs, prior Biological Assessments, or Biological Opinions, to determine what site-specific information may be available on the occurrence of ESA-listed species within the project area or vicinity. By reference to the USFWS website at http://ecos.fws.gove/ipac and through informal (ESA Section 7) consultation with the local USFWS Ecological Services office, including an evaluation of onsite conditions, as necessary, the presence of suitable habitat for any ESA-listed or proposed plant or animal species within the immediate vicinity of project construction would be determined. If suitable habitat for federally listed species is present, a survey would be conducted within the site (and surrounding buffer area as applicable) according to the approved species-specific protocol(s). Site conditions would be evaluated to determine whether there is a reasonable likelihood of nesting on the construction site by any MBTA-listed bird species. If so, a pre-construction survey would be conducted to confirm the presence/absence of nests in areas subject to construction.

When siting turbines, disturbance to sensitive plant or animal species or habitat would be avoided. Site development plans would also avoid placing supporting infrastructure, construction equipment/material, and access roads in these sensitive areas. Discussion of existing wetlands is covered in Section 3.5, *Water Resources*.

- *Occurrence of ESA-listed, proposed, or candidate birds and bats.* The presence of ESA-listed, proposed, or candidate avian or bat species at or near a project site would be of concern because of the risk of collisions with rotating wind turbine blades. Where ESA-listed species have a reasonable likelihood of occurrence in the "action area" affected by a project, an assessment must be made, supported by (informal) consultation with USFWS, of the potential for incidental take. Informal consultation with USFWS may identify sufficient measures to avoid take if implemented as part of the project. If not, the potential for incidental take of an ESA-listed or proposed bird or bat species in this manner would trigger the need for formal consultation with USFWS, which would likely require avoidance, minimization, or compensation measures to be implemented before the take could be authorized. Consideration of candidate species is encouraged under the ESA, although not legally required, because such species could be proposed for listing in the near future. This program would exclude from consideration any site/design that engendered the likely take of a listed or proposed species.
- *Occurrence of BGEPA-protected bald or golden eagles.* Raptors, golden eagles in particular, are known to be susceptible to mortality from collision with rotating wind turbine blades. The occurrence of bald or golden eagles in the vicinity of a project site would be of concern because both species are fully protected under BGEPA. The regional-level USFWS BGEPA point-of-contact would be contacted to determine the proximity of nesting/foraging locations or winter roost areas for either species. As described in Sections 1.5.4 and 2.3.2.3, compliance procedures established under the BGEPA would be followed.
- *Located in a known migration route or local high-use movement corridor for birds or bats.* If a project site is located in a high-use regional migration corridor/route for birds, or in an area near where bat roosts or hibernacula are known to exist, this raises the expected frequency of collision mortality. The majority of avian species are MBTA-protected, and a few bat species are federally or state-listed. As stated in Section 1.5.3, the MBTA has no provision for allowing unauthorized take of migratory birds. However, this issue would be addressed as follows:
  - Review available information on major migration routes from online sources such as www.npwrc.usgs.gov/resource/birds/migratio/routes.htm and www.birdnature.com/flyways.html.
  - For local knowledge of potential migration routes, consult with the nearest USFWS MBTA point-of-contact, and review online information at www.fws.gov/migratorybirds. Contact other local experts and interest groups for additional information.
  - For information on potential Important Bird Areas (IBAs) near the project site, see http://web4.audubon.org/bird/iba.

  - Contact field personnel of the local USFWS field office or state fish and wildlife office and review online information at www.batcon.org/index.php/allabout-bats/species-profiles.html to determine proximity of bat roosts or hibernacula.
  - Where existing information indicates substantial concentrations of migratory birds and bats in the general vicinity, other sources of information would be sought to determine whether a turbine location would intercept flight patterns. Such sources may include but are not limited to existing Next-Generation Radar (NEXRAD) data, and new data from radar, acoustic (for bats), or conventional surveys.

- *Occurrence of other bird or bat species of concern.* The occurrence of other bird or bat species of federal, state, or local concern in close proximity to a project site, particularly in large numbers, raises the likelihood of collision mortality to these species and warrants further analysis to assess potential population impacts. The state's natural heritage database (or equivalent) would be queried for location information. Web links to most of the state databases can be found at www.natureserve.org/visitLocal. Also, MARFORRES would consult with USFWS regarding the potential for adverse impacts to areas frequented by bird species of conservation concern.

## 3.7 CULTURAL RESOURCES

### 3.7.1 Definition of Resource

Cultural resources can be present within landscapes as districts, sites, buildings, structures, or objects (Little et al. 2000). Cultural resources also include Traditional Cultural Properties (TCPs), locations with enduring significance to the beliefs, customs, and/or practices of living communities. TCPs are considered eligible for nomination to the NRHP if they are associated with cultural practices or beliefs of a living community that are (a) rooted in the community's history and (b) important in maintaining the continuing cultural identity of the community (Parker and King 1998). Culturally sensitive locations called Areas of Native American Concern which may not be considered eligible for nomination to the NRHP may still be protected under the American Indian Religious Freedom Act.

Cultural resources that are currently listed in or have been determined eligible for listing in the NRHP are termed "historic properties." Historic properties can include both prehistoric (prior to European contact) and historic (post-European contact) objects, sites, buildings, structures, and districts as well as TCPs. All historic properties within a project area constitute the affected environment for cultural resources.

Impacts from the proposed wind energy development on historic properties can be of three types: (1) direct physical impacts to the property from ground disturbing activities or changes to or demolition of historic structures; (2) direct impacts to the setting of the property from changes to the visual environment; and (3) indirect impacts to the property from changes to its accessibility, use(s), economic viability, or other factors that are not immediate results of construction or operation of wind energy facilities.

Cultural resources that could be affected by the proposed wind turbines are most likely going to be historic buildings and structures. Visual impacts to a historic property would only be considered for properties where setting has been specifically identified as an important aspect of the property's integrity. This program will not consider sites or designs that would adversely affect cultural resources.

### 3.7.2 Regulatory Setting

The assessment of impacts and effects to cultural resources are established through two federal acts: Section 106 of the NHPA and ARPA. Section 106 of the NHPA requires the federal agency to take into account the direct and indirect effects of an undertaking on historic properties and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment. ARPA protects archaeological resources found on federal and tribal lands from disturbance and establishes standards for the issuance of permits to excavate archaeological sites. Of the federal statutes, Section 106 of the NHPA is of primary importance. Information developed while completing the Section 106 review is utilized for ascertaining and evaluating impacts to cultural resources under NEPA. ARPA is only triggered if artifacts are going to be collected from archaeological sites on federal or Tribal lands or if archaeological sites will be tested and/or excavated.

Depending on location of the historic property, State Historic Preservation Offices (SHPOs) or Tribal Historic Preservation Offices (THPOs) would be responsible for Section 106 review and consultation.

### 3.7.3 Existing Conditions

For the proposed action, the affected environment includes the Area of Potential Effect (APE) (area subject to direct ground disturbance or other construction activities) and the Visual Area of Potential Effect (Visual APE) (area within the viewshed of the proposed wind turbine[s]). For a wind energy development project, the APE is generally the footprint of the proposed turbine or turbine complex and the associated facilities (crane pads, staging/laydown areas, access roads, utility corridors, and any other associated areas of ground disturbance). APEs typically include a buffer around the permanent footprint of the turbines and the associated facilities where ground disturbing activities may occur during construction, maintenance, and operation of the facilities. The Visual APE is the area of the visual environment (landscape), or viewshed, that could be impacted by a proposed action. Some SHPOs have established standard Visual APEs specifically for wind energy development projects or wind farms (e.g., New York, Illinois, and Missouri), some follow similar guidelines that have been set for cellular towers in determining Visual APEs for wind turbines (e.g., Texas and Michigan), while others require the federal agency to define the Visual APE and provide justification for the Visual APE boundaries. The responsible federal agency determines the APE and Visual APE for a proposed wind energy development, often in consultation with the SHPO/THPO to establish an agreed-upon geographic area for impact evaluation.

The following steps would be followed to identify and characterize historic properties located within the APE and Visual APE:

1. Identification of historic properties may include a records and literature search, field survey, archaeological site testing, and evaluation of eligibility of properties for listing in the NRHP. A records and literature search is conducted to determine (1) if historic properties are known to exist within the APE or Visual APE and (2) whether previous investigations have been sufficient to determine the presence or absence of historic properties. The initial records and literature search would be coordinated with the installation to obtain any applicable Integrated Cultural Resource Management Plans (ICRMPs), other cultural resources management plans, and files and reports of cultural resources investigations at the installation.

   Other sources of information include the NRHP, State Historic Registers, SHPO or state repository databases, THPO or tribal repository databases, and other local or regional data repositories including museums, universities, and historical societies. General records searches for historic properties can be performed online through the SHPOs in New York, Texas, Missouri, Illinois, and Michigan, and locations of historic structures can generally be identified online. Access to specific information on archaeological sites is restricted, and this information must be obtained either directly from SHPOs/THPOs, state repositories, Bureau of Indian Affairs or online with permission from the SHPO or state historic preservation agency.

2. The potential for subsurface cultural resources within areas of potential ground disturbance would be assessed during the records and literature search. Some states (e.g., New York and Illinois) have online databases that depict areas of high archaeological sensitivity in the state, but in most states the SHPO/THPO should be consulted for appropriate references for this data.
3. Following compilation of data obtained in the records and literature search, MARFORRES would determine whether additional survey and evaluation is needed for properties within the APE. If additional survey and evaluation is not required, MARFORRES would submit a determination of no historic properties affected or no effect on historic properties and a request for Section 106 concurrence to the SHPO/THPO, and the SHPO/THPO would have 30 days to comment on the findings. Once a letter of concurrence is received from the SHPO/THPO, the Section 106 compliance process is complete.
4. If the project is located in an area with known historic properties or is located in an area that is designated as having a high sensitivity for archaeological sites, an intensive archaeological survey (usually referred to as a Phase I/Class III archaeological survey) of the entire APE would be recommended. In some cases, additional testing, referred to as a Phase II archaeological investigation, is necessary to assess potential eligibility to the NRHP. The assessment of eligibility to the NRHP is based upon the criteria established by 36 CFR 60.4 and follows the guidance provided by the U.S. Department of the Interior (1998).
5. Any archaeological sites identified would be documented, and a report presenting the results and findings of the survey would be submitted to the SHPO/THPO. The report would make recommendations for NRHP eligibility and site management if possible. The SHPO/THPO has up to 30 days to review and comment on the findings and recommendations.

## 3.8 VISUAL RESOURCES

### 3.8.1 Definition of Resource

Visual resources consist of the natural and cultural features that make up the visible landscape or "viewshed," as seen from a common or prominent vantage point. They include the land, water, vegetation, structures, and other features within the public's view. Visual impacts are the degree of change in the visual resources of a viewshed caused by a proposed action. Federal agencies have established processes for describing and analyzing the degree of impacts from a proposed action referred to as a Visual Impacts Assessment (U.S. Department of Transportation 1988).

The introduction of wind turbines as a new or more prominent feature of the landscape has the potential to impact visual resources, particularly where other similar structures are absent or relatively inconspicuous. The primary examples of visual resources that could be affected are scenic and highly-valued vistas or viewsheds, including those which contribute to the context or setting of cultural resources (refer to Section 3.7 for detailed discussion on cultural resources). Negative effects from wind turbines can also occur to recreational use areas if the viewsheds from those areas are highly valued by a large segment of the viewing public. Such recreational use areas would include national, state, and local parks located adjacent to the project area. One important aspect of the potential visual impacts to cultural resources and recreational use areas is the height of the wind turbines utilized. The large turbines standing up to 495 ft high will have a greater potential to visually impact these resources than the small turbines standing less than 180 ft tall (refer to Table 2-1).

The rotating blades of a wind turbine can also produce shadow flicker, which is the alternation of light and shadow caused by blade rotation when the turbine is in line of sight between the sun and another object or person. The potential effects of shadow flicker on individuals and land uses, as well as sensitive visual resources in affected areas need to be considered as part of the visual analysis.

### 3.8.2 Regulatory Setting

The visual resource assessment process is rooted in several federal laws including NEPA and NHPA. NEPA states that the federal government must "assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings." Visual impacts are included within NEPA under aesthetics. Aesthetics is the science or philosophy of the visual experience. Quality in NEPA refers to excellence or superiority in kind. Aesthetic assessments must describe the visual attributes of a proposed action and evaluate their effects on the relative excellence of the visual experience (U.S. Department of Transportation 1988). Visual effects regulated under Section 106 of the NHPA are discussed in Sections 3.7 and 4.7, *Cultural Resources*.

### 3.8.3 Existing Conditions

Visual resources are the natural and cultural features that make up the landscape of a viewer from a vantage point. Wind turbines have the potential to impact the visual environment by introducing a new and highly conspicuous feature to the landscape of a viewer from a vantage point. Two types of visual resources could be impacted by wind turbine development. These are:

- *Historic Properties*. Historic properties consist of cultural features on the landscape that are listed in, or have the potential to be listed in, the NRHP. These are presented in Section 3.7, *Cultural Resources*.

- *Recreational Use Areas*. Recreational use areas consist of national, state, and local parks, and other locations that contain landscapes and vistas which are highly valued by a large segment of the viewing public.

In addition to the above, neighboring land uses that could be sensitive to shadow flicker (e.g., residential areas, roadways) would be identified as part of the land use analysis (Section 3.2).

## 3.9 SOCIOECONOMICS

### 3.9.1 Definition of Resource

Socioeconomics is defined as the basic attributes and resources associated with the human environment, particularly population and economic activity. Economic activity typically encompasses employment, personal income and industrial growth. Impacts on these fundamental socioeconomic components can influence other issues such as housing availability, utility capabilities, and fire and police protection.

Disadvantaged groups within the study area are specifically considered in order to assess the potential for disproportionate occurrence of impacts. For the purposes of this analysis, disadvantaged groups are defined as follows:

- *Minority Population*: Persons of Hispanic origin of any race, Blacks, American Indians, Eskimos, Aleuts, Asians, or Pacific Islanders.

- *Low-Income Population*: Persons living below the poverty level, according to income data collected in U.S. Census 2000.
- *Youth Population*: Children under the age of 18 years.

### 3.9.2 Regulatory Setting

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was issued to focus attention of federal agencies on human health and environmental conditions in minority and low-income communities, and to ensure that disproportionately high and adverse human health or environmental effects on these communities are identified and addressed. To provide a thorough environmental justice evaluation, particular attention is given to the distribution of race and poverty status in areas potentially affected by implementation of the proposed action.

Children may suffer disproportionately from environmental health risks and safety risks. EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, was introduced in 1997 to prioritize the identification and assessment of environmental health risks and safety risks that may affect children, and to ensure that federal agency policy, programs, activities and standards address environmental risks and safety risks to children. This identifies the distribution of children and locations where the number of children in the affected area may be disproportionately high (e.g., schools, child care centers, etc.).

### 3.9.3 Existing Conditions

An initial demographic analysis should include a search of U.S. Census data from 2000 or if available American Community Survey data from 2006, 2008, or 2010. Federal, state, regional, county, and local plans or documents may also have relevant data. Income, age, and racial characteristics should be described for the area around the installation to determine whether environmental justice communities exist.

Aspects of socioeconomics and environmental justice that may be relevant to the proposed wind energy projects include the following:

- *Socioeconomic Conditions: population, employment, income, housing, and other local characteristics*. The area surrounding the proposed wind energy site is characterized by various socioeconomic attributes. Existing socioeconomic conditions should be determined through a search of U.S. Census data from 2000 or, if available, American Community Survey data from 2006, 2008, or 2010. Federal, state, regional, county, and local plans or documents may also have relevant data. Population, employment, income, housing, and other local characteristics should be described for the area around the installation.
- *Demographics: minority and low-income communities and children.* The area surrounding the proposed wind energy site is characterized by various demographic attributes of particular importance to environmental justice. Existing demographics should be determined through a search of U.S. Census data from 2000 or if available American Community Survey data from 2006, 2008, or 2010. Federal, state, regional, county, and local plans or documents may also have relevant data. Income, age, and racial characteristics should be described for the area around the installation to determine whether environmental justice communities exist.

## 3.10 AIR QUALITY

### 3.10.1 Definition of Resource

#### 3.10.1.1 Criteria Pollutants and Air Quality Standards

Air quality is defined by ambient air concentrations of specific pollutants determined by the USEPA to be of concern with respect to the health and welfare of the general public. Seven major pollutants of concern, called "criteria pollutants," are carbon monoxide (CO), sulfur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), ozone ($O_3$), suspended particulate matter less than or equal to 10 microns in diameter ($PM_{10}$), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). $SO_2$ and $NO_2$ are commonly referred to and reported as oxides of sulfur ($SO_x$) and oxides of nitrogen ($NO_x$), respectively. Volatile organic compounds (VOCs) and $NO_x$ do not have established ambient standards but are important as precursors to $O_3$. The USEPA has established National Ambient Air Quality Standards (NAAQS) for these pollutants. An area generally is in nonattainment for a pollutant if its NAAQS has been exceeded more than once per year. Former nonattainment areas that have attained the NAAQS are designated as maintenance areas. Some states have adopted ambient air quality standards that are slightly more stringent than the NAAQS.

#### 3.10.1.2 Greenhouse Gas Emissions

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere. These emissions occur from natural processes as well as human activities. The accumulation of GHGs in the atmosphere regulates, in part, the earth's temperature. Scientific evidence suggests a trend of increasing global temperature over the past century potentially due to an increase in GHG emissions from human activities. The most common GHGs emitted from natural processes and human activities include carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$). Each GHG is assigned a global warming potential (GWP). The GWP is the ability of a gas or aerosol to trap heat in the atmosphere. The GWP rating system is standardized to $CO_2$, which has a value of one. For example, $CH_4$ has a GWP of 21, which means that it has a global warming effect 21 times greater than $CO_2$ on an equal-mass basis. Total GHG emissions from a source are often reported as a $CO_2$ equivalent ($CO_2e$). The $CO_2e$ is calculated by multiplying the emission of each GHG by its GWP and adding the results together to produce a single, combined emission rate representing all GHGs.

#### 3.10.1.3 Prevention of Significant Deterioration Class I Areas

In the Clean Air Act Amendments of 1977, Congress specified the initial classification of lands for Prevention of Significant Deterioration (PSD) purposes. Certain lands, where existing air quality is "good" and is deemed to be of national importance, were designated as Class I and may not be reclassified. These mandatory Class I areas include all international parks, national memorial parks larger than 5,000 acres, and national parks larger than 6,000 acres that were in existence when the Amendments were passed. All other areas to which the PSD provisions apply were classified as Class II.

### 3.10.2 Regulatory Setting

#### 3.10.2.1 Criteria Pollutants and General Conformity Rule

Section 176(c) of the 1990 CAA Amendments contains the General Conformity Rule (40 CFR §§ 51.850-860 and 40 CFR §§ 93.150-160). The General Conformity Rule (updated March 24, 2010) requires any federal agency responsible for an action in a nonattainment or maintenance area to determine that the action conforms to the applicable State Implementation Plan (SIP) (USEPA 2010a). This means that federally supported or funded activities will not (1) cause or contribute to any new air quality standard violation, (2) increase the frequency or severity of any existing standard violation, or (3) delay the timely attainment of any standard, interim emission reduction, or other milestone. Emissions of attainment pollutants are exempt from conformity analyses. Actions would conform to a SIP if their annual direct and indirect emissions remain less than the applicable *de minimis* thresholds. Formal conformity determinations are required for any actions that exceed these thresholds.

#### 3.10.2.2 Greenhouse Gas Emissions

On a national scale, federal agencies are addressing emissions of GHGs by reductions mandated in federal laws and EOs. Most recently, EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management,* and EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance,* were enacted to address GHG in detail, including GHG emissions inventory, reduction, and reporting. Several states have promulgated laws as a means to reduce statewide levels of GHG emissions.

The potential effects of proposed GHG emissions are by nature global and cumulative impacts, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. Therefore, the impact of GHG emissions (associated with a proposed action) to global climate change is typically discussed in the context of cumulative impacts.

#### 3.10.2.3 Prevention of Significant Deterioration Regulations

As part of the PSD Regulation (40 CFR 52.21), the CAA set a long-term goal of improving visibility to achieve natural conditions in selected areas of the U.S. (National Parks greater than 6,000 acres or National Wilderness Areas greater than 5,000 acres). These areas are granted special air quality protections under Section 162(a) of the federal CAA. 40 CFR § 51.307 requires the operator of any new major stationary source or major modification located within 100 kilometers of a Class I area to contact the federal land managers for that area. In 1999, the USEPA promulgated a regional haze regulation that requires states to establish goals and emission reduction strategies to make initial improvements in visibility at their respective Class I areas.

### 3.10.3 Existing Conditions

The General Conformity Rule (updated March 24, 2010) requires any federal agency responsible for an action in a nonattainment or maintenance area to determine that the action conforms to the applicable SIP (USEPA 2010a). If the applicable air basin for the project site is in an attainment area, the General Conformity Rule does not apply and no further action is required. If the applicable air basin is in a nonattainment or maintenance area, then the applicable *de minimis* thresholds should be determined for the representative air basin. A CAA Conformity Determination is required for each pollutant where the total of direct and indirect emissions in a nonattainment or maintenance area caused by a federal action would equal or exceed any of the rates in Table 3.10-1.

Aspects of air quality that are relevant to the proposed wind energy projects include:

- *Affected Air Basin.* The affected air basin includes the Air Quality Control Region (AQCR) and county in which the site is located. An AQCR is defined as an interstate or intrastate area designated by the USEPA for the attainment and maintenance of NAAQS.
- *Attainment Status.* The USEPA classifies areas of the country where air pollution levels persistently exceed the NAAQS as nonattainment areas. Maintenance areas refer to those geographic areas that previously had a history of nonattainment, but are now consistently meeting the NAAQS. Attainment areas refer to geographic areas that meet or do better than the NAAQS.

**Table 3.10-1. Criteria Pollutant *de minimis* Thresholds (tons/year)**

| *Nonattainment Areas (NAAs)* | *Tons/Year* |
|---|---|
| **Ozone (VOCs or NOx)** | |
| Serious NAAs | 50 |
| Severe NAAs | 25 |
| Extreme NAAs | 10 |
| Other ozone NAAs outside an ozone transport region | 100 |
| Marginal/Moderate NAAs inside an ozone transport region | |
| VOC | 50 |
| NOx | 100 |
| **Carbon Monoxide (CO)** | |
| All NAAs | 100 |
| **$SO_2$ or $NO_2$** | |
| All NAAs | 100 |
| **$PM_{10}$** | |
| Moderate NAAs | 100 |
| Serious NAAs | 70 |
| **Pb** | |
| All NAAs | 25 |
| ***Maintenance (NAA)*** | ***Tons/Year*** |
| **Ozone (NOx, $SO_2$ or $NO_2$)** | |
| All Maintenance Areas | 100 |
| **Ozone (VOCs)** | |
| Maintenance areas inside an ozone transport region | 50 |
| Maintenance areas outside an ozone transport region | 100 |
| **Carbon Monoxide (CO)** | |
| All Maintenance Areas | 100 |
| **$PM_{10}$** | |
| All Maintenance Areas | 100 |
| **Pb** | |
| All Maintenance Areas | 25 |

*Note:* Thresholds provided in 40 CFR 51.853(b).

- *Applicable de minimis thresholds. de minimis* thresholds apply to nonattainment and maintenance areas and their maximum values vary depending on the severity of the nonattainment or maintenance area. A CAA Conformity Determination is required for each pollutant where the total of direct and indirect emissions in a nonattainment or maintenance area caused by a federal action would equal or exceed *de minimis* thresholds.

## 3.11 UTILITIES

### 3.11.1 Definition of Resource

Utilities are defined as services such as electricity, natural gas, telephone, potable water, and sewage systems, which are typically provided by either public or private service companies (i.e., electricity, natural gas, and telephone) or municipalities (i.e., water and sewer systems). Each type of utility has its own associated infrastructure, such as pipelines, cables, conduits, electrical substations, and pumping stations, which allow for the provision of services to a specific location. Most MARFORRES facilities receive utilities from a variety of local and regional service providers. These include utilities for various activities, such as electricity for powering buildings and equipment; natural gas for heating buildings and water; telephone and internet service for purposes of communication; and water for drinking and washing equipment.

### 3.11.2 Regulatory Setting

The Federal Energy Regulatory Commission has jurisdiction over interstate utilities, such as interstate electricity sales, wholesale electric rates, hydroelectric licensing, natural gas pricing, and oil pipeline rates. Federal Energy Regulatory Commission is an independent regulatory agency within the U.S. Department of Energy. In addition, each state regulates intrastate utilities through the state public utilities commission. The regulated intrastate utilities include electricity, gas pipelines, natural gas, telecommunications, steam, and water.

### 3.11.3 Existing Conditions

Aspects of the existing utilities that are relevant to the proposed wind energy projects include:

- *Location of existing utilities*. Overhead and buried utility lines are present at MARFORRES facilities.
- *Existing utility capacity*. The capacity of existing electricity lines would be determined through information provided by the companies or government agencies that own and/or operate the electrical utilities.

## 3.12 AIRSPACE

### 3.12.1 Definition of Resource

The nation's airspace is designed and managed by the FAA to meet both the individual and common needs of all military, commercial, and general aviation interests. Navigable airspace is categorized as either regulatory or nonregulatory. Within those two categories are four types of airspace: Controlled, Special Use, Uncontrolled, and Other. Airspace is further defined in terms of classifications according to the operating and flight rules that apply to each airspace area. The manner in which airspace is classified depends on (1) the complexity or density of aircraft operations within an airspace area; (2) the nature of those operations; (3) the level of safety required; and (4) national and public interest. Detailed descriptions of the different airspace types and classifications along with a graphic that illustrates each type/classification and their relationship to each other are defined below.

Definitions for navigable airspace are presented below.

- Controlled airspace is that airspace within which all aircraft operators are subject to certain pilot qualifications, operating rules, and equipment requirements outlined in FAA's "General Operating and Flight Rules" (14 CFR Part 91). Controlled airspace is defined in FAA Order 7400.2 as being "airspace of defined dimensions within which air traffic control (ATC) service is provided to Instrument Flight Rule (IFR) flights and to Visual Flight Rule (VFR) flights in accordance with the airspace classification." Controlled airspace is designated as **Class A, B, C, D,** and **E,** as described below**.**
- Uncontrolled airspace is outside the parameters of controlled airspace. Uncontrolled airspace is designated as **Class G**, as described below. Limits of uncontrolled airspace typically extend from the surface to 700 ft AGL in urban areas, and from the surface to 1,200 ft AGL in rural areas. ATC does not have authority to exercise control over aircraft operations within uncontrolled airspace. Primary users of uncontrolled airspace are general aviation aircraft.

**Class A** airspace, generally, is that airspace from 18,000 ft above mean sea level (MSL) up to and including 60,000 ft or Flight Level 600.

**Class B** airspace, generally, is that airspace from the surface to 10,000 ft MSL around the nation's busiest airports. Class B airspace is typically associated with major airport complexes.

**Class C** airspace, generally, is that airspace from the surface to 4,000 ft above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and that have a certain number of IFR operations or passenger enplanements. Although the actual configuration of Class C airspace is individually tailored, it usually consists of a surface area with a 5-nautical mile (NM) radius, and an outer circle with a 10-NM radius that extends from 1,200 ft to 4,000 ft above the airport elevation.

**Class D** airspace, generally, is that airspace from the surface to 2,500 ft above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. Arrival extensions for instrument approach procedures may be designated as Class D or Class E airspace.

**Class E** airspace may range from ground level at non-towered airfields up to 18,000 ft MSL. The majority of Class E airspace is where more stringent airspace control has not been established.

- **Surface Area Designated for an Airport.** When so designated, the airspace will be configured to contain all instrument procedures.
- **Extension to a Surface Area.** These airspace areas serve as extensions to Class B, C, and D surface areas designated for an airport. This airspace provides controlled airspace to contain standard instrument approach procedures without imposing a communications requirement on pilots operating under VFR.
- **Airspace Used for Transition.** These areas begin at either 700 or 1,200 ft AGL for use in transitioning aircraft to/from the terminal or enroute environment.

**Class G** airspace is considered uncontrolled airspace in which ATC does not have authority over aircraft operations. This airspace follows the contours of the earth's surface with vertical altitude limits up to 700 ft AGL, 1,200 AGL, or 14,500 MSL, as applicable. VFR general aviation pilots are the primary users of this airspace. Figure 3.12-1 provides graphic representation of the different airspace classifications (FAA 2010a).

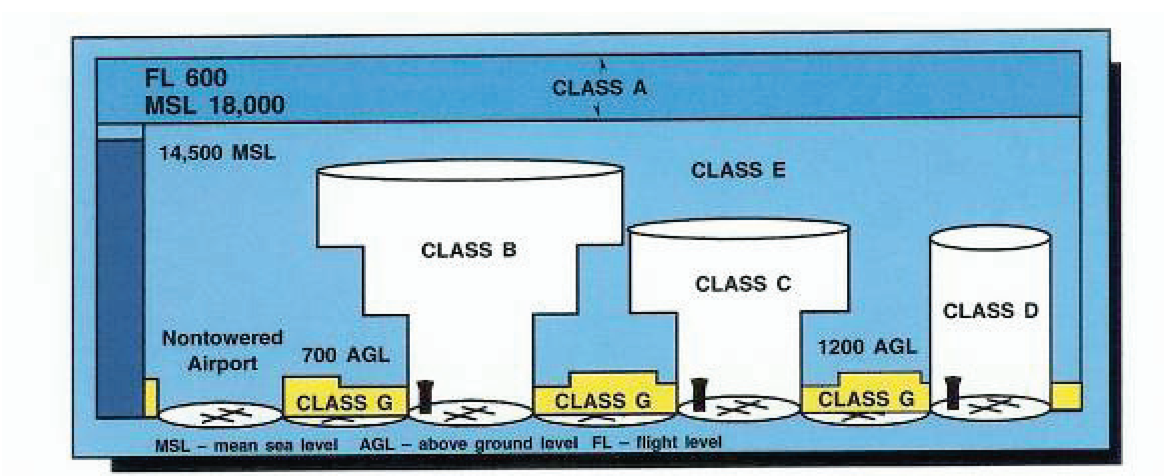



**Figure 3.12-1. Controlled and Uncontrolled Airspace Depictions.**

Civilian and military radars used in support of ATC or military operations or (in coastal regions), maritime safety, as well as weather (Doppler) radars, comprise other elements of airspace relevant to wind turbine siting and operations.

### 3.12.2 Regulatory Setting

The FAA has oversight of any object that could have an impact on the navigable airspace or communications/navigation technology of aviation (commercial or military) or DoD operations. FAA Order JO 7400.2G, *Procedures for Handling Airspace Matters*, establishes standards for determining obstructions to air navigation. Paragraph 2, *Scope*, of Section 3, *Identifying/Evaluating Aeronautical Effect*, of Chapter 6, *Aeronautical Studies*, states, "Part 77 establishes standards for determining obstructions for air navigation. A structure that exceeds one or more of these standards is presumed to be a hazard to air navigation unless the obstruction evaluation study determines otherwise."

FAR Part 77, *Objects Affecting Navigable Airspace* identifies the filing requirement to notify the FAA prior to construction commencement objects that may affect the navigable airspace. The filing requirement set forth in FAR Part 77 applies to most new wind energy development projects since any structure, no matter where it is located within the U.S. and its territories, requires filing of Notice of Construction to the FAA if it exceeds 200 ft AGL. If a structure is less than 200 ft AGL and closer than 20,000 ft to public-use airport runways over 3,200 ft in length, the filing requirement is based on a 100 to 1 slope from the closest runway.

For any filed project, the FAA undertakes an initial aeronautical study within the relevant FAA region, and issues either a Determination of No Hazard (DNH) to air navigation or a Notice of Presumed Hazard (NPH). If an NPH is issued, the FAA will then initiate an in-depth technical analysis (commonly called an extended study which may also include a public comment period). The study will explain the cause of the NPH and evaluate impacts on air operations. If an operational impact is identified, the FAA will try to negotiate an acceptable height for a project that has received a NPH. If no agreement can be reached, FAA will issue a Determination of Hazard (DOH). A DOH can be appealed to FAA Washington Headquarters. If the appeal does not secure a DNH, the proponent's main recourse is to bring the issue before a federal court (14 CFR Part 77).

### 3.12.3 Existing Conditions

Aspects of airspace use that are relevant to the proposed wind energy projects include a determination of proposed wind structure as an obstruction to air navigation after a Notice of Construction is submitted to the FAA. Any object that could be an obstruction to air navigation will be evaluated by the FAA who would make a DNH or a NPH.

- *Imaginary surface penetration height.* Height exceeds 500 ft AGL or a height that is 200 ft AGL above an established airport elevation, whichever is higher, within 3 NM, or is closer than 20,000 ft to a public-use airport with a runway more than 3,200 ft long.
- *Operational Impacts.* This includes impacts to VFR Operations (Routes, and Traffic Patterns), IFR Operations (Departures, Arrivals, and Enroute).
- *EMI (Radar, Television Interference, FM Radio Interference, Cellular Phone, Satellite Services*). Wind turbines can degrade performance of ATC. The phenomenon can include sudden or intermittent appearance of radar contacts at the location of the wind turbine because of blade motion or rotation of the turbine to face the wind. The effect is principally on analog technology trying to pull television signals from 30-60 miles away through the wind farm.

## 3.13 HEALTH AND SAFETY

### 3.13.1 Definition of Resource

Any aspect of the project that creates a potential risk to human health and safety requires consideration under NEPA. This includes occupational hazards to workers as well as the exposure of the general public to conditions creating the risk of immediate injury or long-term health hazards. The latter may include indirect effects related to noise, utilities, airspace, and hazardous materials, respectively, which are addressed in separate sections of this chapter.

### 3.13.2 Regulatory Setting

The primary statute addressing occupational hazards is the Occupational Health and Safety Act (29 U.S.C. 651 *et seq*.). Consideration of any impacts to public safety is a general requirement under NEPA. Under EO 13045, *Protection of Children from Environmental Health Risks and Safety Risk*, projects are required to assess and avoid risks to children.

### 3.13.3 Existing Conditions

Aspects of health and safety that are relevant to the proposed wind energy projects include the following:

- *Existing land use.* The existing land use (with regard to level of development and human presence) at each site provides a means to estimate baseline conditions.

- *Nearest residential and public use areas.* Because sites would be located on MARFORRES facilities, security measures at each site would restrict or limit public access to wind turbines and associated equipment. Wind turbines would generally be sited within fenced and monitored locations. As such, the existing health and safety environment is defined by where the nearest public access areas are located. The proximity of residential and public use areas (e.g., parks) would increase potential health and safety issues, especially if these involve children.

## 3.14 HAZARDOUS MATERIALS

### 3.14.1 Definition of Resource

This section addresses the use, generation, or inadvertent release of hazardous materials by the proposed action. Hazardous materials include all chemicals listed by the USEPA under the Superfund Amendments and Reauthorization Act of 1986 (40 C.F.R. §355 *et seq*.).

### 3.14.2 Regulatory Setting

The generation, transportation, treatment, storage, and disposal of hazardous wastes are regulated under the Resource Conservation and Recovery Act of 1976 (42 U.S.C. §6901 *et seq*.).

### 3.14.3 Existing Conditions

The aspects that are relevant to hazardous materials at the project sites include the following:

- *Existing hazardous materials use and previous contamination sites.* Because sites would be located on MARFORRES facilities, storage, use, and disposal of hazardous materials in support of military operations is likely to occur at proposed sites. Hazardous materials use can contribute to the degradation of the project sites, and the presence of known or potential contamination sites must be considered. Because the proposed turbine sites are located on MARFORRES installations, it is possible that Installation Restoration Program (IRP) sites are present. This would include sites where live munitions and ordnance have been used.

## 3.15 TRANSPORTATION

### 3.15.1 Definition of Resource

Transportation refers to the use of roads or waterways as affected by the proposed action. The only potential impacts are associated with the transport of equipment to and from the site for construction.

### 3.15.2 Regulatory Setting

The transportation of large pieces of equipment is subject to Department of Transportation requirements and to federal, state, and local regulation of vehicle lengths and weights on public roads. Transportation over navigable waterways necessitates coordination with the USCG.

### 3.15.3 Existing Conditions

The aspects that are relevant to the transportation resources at the project sites include the following:

- *Nearest public roadways.* The nearest public roadways would most likely be used in transporting wind turbine components to project sites. As such, use of these routes could result in conflict with other users.
- *Public waterways.* If sites are located adjacent to waterways, these would be used instead of, or in conjunction with, public roadways in transporting wind turbine components to project sites.

# CHAPTER 4
# ENVIRONMENTAL CONSEQUENCES

## 4.1 INTRODUCTION

This chapter evaluates the potential environmental consequences of the proposed action. A general impact analysis for the proposed action has been prepared to examine the range of potential impacts that may occur for each resource. The analysis determines whether the application of siting and design criteria, BMPs, and GCMs to any given site would successfully avoid and/or eliminate potentially significant impacts and ensure operational compatibility.

**Key Elements**

***Objectives:***

- Provide analysis of general impacts (programmatic approach) for each resource/issue area
- Provide correlation between siting and design criteria, BMPs, GCMs, and impact analysis

***Resources analyzed:***

- Land use, noise, geology, water, biology, cultural, visual, socioeconomics, air quality, utilities, airspace, health and safety, hazardous materials, and transportation

***Key components:***

- Analysis of general impacts for the proposed action and no-action alternative.

This general impact analysis provides a framework from which site-specific NEPA analyses would be tiered. Under each resource, the impact analysis is organized under one or more *Analysis Items*, which are in the form of a question identifying a pertinent resource concern. Each *Analysis Item* is followed by a general impact analysis that (1) outlines the expected range of environmental impacts that could occur under the proposed wind energy program, (2) identifies conditions where additional site-specific analysis would be tiered from this PEA, and (3) identifies the process by which environmental impacts would be avoided and/or eliminated. Site-specific EAs tiered from this PEA would identify the number, size, design, and location of turbine(s) for an individual MARFORRES facility and provide analysis focused on the unique circumstances that characterize each proposed project.

Consistent with the range of options provided under the proposed action, the proposed project at each individual MARFORRES facility could have more than one action alternative involving variations in number, size, design, and/or location for the turbine(s). An important means of preventing a potential impact would be to simply avoid construction at a location where that impact cannot feasibly be prevented otherwise. This could be accomplished either by choosing an alternative location where the impact is less, or by removing that location from consideration such that the overall project at that location comprises fewer turbines. These types of alternatives would be considered to reduce impacts at the site-specific level. A turbine would not be constructed under any circumstance in which a potentially significant impact cannot be avoided and/or minimized through changes in design, location, construction, or operations.

Evaluation of the no-action alternative is presented in Section 4.16 at the end of this chapter. Cumulative impacts are discussed in Chapter 5.

## 4.2 LAND USE

- *Analysis Item LU-1: Would construction or operations result in adverse impacts to land use on the installation?*

Within the MARFORRES facility, only locations that are compatible with the mission of that facility would be considered. Any potential conflicts with training, operations, or long-range plans would be resolved at the local installation level during the siting and design process. MARFORRES facilities would be selected based on their suitability for wind energy and MARFORRES's interest in developing wind energy on-site. Turbines would be sited in appropriate areas according to permitted land uses on the installations. Therefore, the proposed action would not impact (i.e., be incompatible with a military land use designation) or would only negligibly impact land use on the installation if the facility has other designated land uses within its boundaries.

- *Analysis Item LU-2: Would the siting, design, construction or operation of the turbine(s) be in conflict with adjacent land uses, local zoning, or land use planning?*

Ownership of lands surrounding each facility varies. Although a MARFORRES facility is not required to comply with local planning and zoning for adjacent non-MARFORRES property, a conflict with height or setback requirements would require reconsideration of the project location or design. While small turbines would likely be visually non-intrusive, non-disruptive as far as noise, and in accordance with any existing land use planning as related to height restrictions and setbacks, the greater height and noise associated with medium and large turbines increases the potential for conflicts with adjacent uses, zoning, and planning. However, as indicated in Section 2.3.2.1, *Siting and Design Criteria*, turbines would be sited with appropriate buffers and setbacks and designed (e.g., reduced number and/or size of turbine[s]) to minimize effects on adjacent non-DoD properties and land uses. Site-specific analysis would be prepared, as necessary, to (1) examine the compatibility of the proposed project with local planning and zoning on property outside of the MARFORRES facility; (2) address potential effects to nearby sensitive land uses (e.g., residential areas); and (3) identify necessary and sufficient measures to ensure that a project does not interfere with neighboring land uses. Therefore, through application of siting and design criteria, impacts to land use would be minor.

For MARFORRES facilities located within the coastal zone or sufficiently close to affect coastal zone resources or uses, the project would be subject to the CZMA, and therefore would be sited and designed to meet the CZMA's requirements for consistency with the state's approved Coastal Zone Management Plan. With increased number and/or size of turbines, the potential increases for adverse effects on coastal resources, including recreational uses and wildlife. A site-specific analysis would be prepared of the specific resources that could be affected, using the same approaches specified for those resources/uses in this PEA. Therefore, through compliance with the CZMA and incorporation of the programmatic approach to coastal zone resources, impacts to the coastal zone would be minor.

## 4.3 NOISE

Noise impacts associated with the proposed wind energy projects would include: short-term noise generated by construction activities associated with site clearing and installation of facilities; and long-term noise due to operation of the wind turbine(s). The proposed project site would be reconsidered or excluded from consideration if Normally Unacceptable noise levels occur or are exceeded (as indicated in Figure 3.3-1) for surrounding land uses and sensitive receptors. In some cases, it may be possible to conclude that noise impacts would not occur due to the lack of sensitive land uses or receptors (e.g., residences, parks, libraries, sensitive wildlife areas, and hospitals) in close proximity (e.g., within 1 mile) or other project or site-specific factors (e.g., size of proposed turbines in combination with distance to receptors and screening by topography, trees, etc.).

- *Analysis Item N-1: Would construction activities result in noise impacts to surrounding land uses or sensitive receptors?*

Construction of wind turbines under the proposed action has the potential to increase noise levels in the vicinity of construction activities. Noise associated with construction of wind turbines at each site would be intermittent and of relatively limited duration. Construction would typically consist of delivery of materials (e.g., construction equipment and turbine components) to the project site, site preparation (potentially involving heavy equipment or blasting) to excavate/construct the foundation, and then erecting and assembling the turbine(s). The construction phase would take from 1 to 6 months, depending on specific site characteristics. When sensitive receptors are nearby, construction would occur only during daytime hours, when noise impacts are generally less severe than at night. As such, these impacts would be short-term and minor.

- *Analysis Item N-2: Would operations result in noise impacts to surrounding land uses or sensitive receptors?*

Noise generated by wind turbines would be dependent mainly on the number and size of turbines installed. Both the noise generated by wind turbines and ambient wind noise levels are functions of wind speed. Sound levels from modern wind turbines operating at a constant speed (set by the operator) tend to increase more slowly with increasing wind speed than ambient wind-generated sound. One study has shown that wind speeds above approximately 18 mph typically mask the noise generated by wind turbines (Danish Wind Turbine Manufactures Association 2002 *cited in* Rogers et al. 2006). Therefore, wind turbine noise is generally more of a concern at lower wind speeds than higher wind speeds.

According to Gipe (1995), the operation of an individual small, medium, or large wind turbine (roughly similar to those described in Chapter 2) produces a maximum sound power level at the source of approximately 96 dBA, 106 dBA, or 116 dBA, respectively (Table 4.3-1). More modern turbines would, if anything, be quieter through advances in engineering and sound insulation (NREL 2008a), making these estimates a conservative worst-case for the proposed action. Using these sound power levels to estimate the amount of noise that is heard, or the sound pressure level, the estimated sound pressure level for a single small, medium, or large wind turbine at 130 ft is provided in Table 4.3-1. The operation of a second turbine of the same size, at the same distance from the receptor, would add approximately 3 dBA to the sound pressure level; doubling the number of turbines to four would add another 3 dBA. Generally, noise attenuates at a rate of 6 dB for a doubling of distance from the source, and noise levels drop off quickly as distance increases, then level out over greater distances. However, some research suggests that nighttime noise produced by wind turbines can be higher than predicted from daytime measurements under certain atmospheric conditions (van den Berg 2004).

A conservative estimate of noise level for operation of one to four small, medium, or large wind turbines at a distance of 0.1 mile and 0.5 mile is provided in Table 4.3-1. As indicated in Table 4.3-1, the noise generated from the operation of larger turbines would be greater than small wind turbines. A recent study estimated similar, although slightly lower, noise levels for large turbines (i.e., 1.5 MW) (Kaliski 2009) Actual noise levels would likely be lower due to factors at each project site that would attenuate (e.g., vegetation) or mask (e.g., other noise sources such as aircraft or vehicle operations) noise generated by wind turbines, including ambient, or existing baseline, environmental noise levels at MARFORRES facilities. These calculations indicate that normally acceptable noise levels for sensitive land use categories, as shown in Figure 3.3-1, would not be exceeded by projects consisting of one to four small or medium-sized turbines located on DoD land at least 0.1 mile away from "sensitive noise receptors," and in general, such projects would not have adverse noise impacts. For large turbines, additional setbacks may be required for sensitive noise receptors, depending on the proximity of the proposed turbine location(s). In the regulatory context of this project, sensitive noise receptors would include both humans and wildlife that might find additional noise, at a given location and once it reaches a certain level, both annoying and disruptive, or even loud enough to cause displacement and relocation to quieter areas.

**Table 4.3-1. Estimated Noise Levels under the Proposed Action**

| *Proposed Action Scenario* | *Noise (dBA) at Various Distances* | | | |
|---|---|---|---|---|
| | **At source (0 ft)** | **130 ft** | **0.1 mile** | **0.5 mile** |
| One Small Turbine | 96 | 55 | 46 | 32 |
| Four Small Turbines | NA | 61 | 52 | 38 |
| One Medium Turbine | 106 | 65 | 56 | 42 |
| Four Medium Turbines | NA | 71 | 62 | 48 |
| One Large Turbine | 116 | 75 | 66 | 52 |
| Four Large Turbines | NA | 81 | 72 | 58 |

*Notes*: NA = Not Applicable.
*Source*: Gipe 1995.

The majority of the sensitive noise receptors adjacent to a typical site are expected to be residential areas. For these types of sites, the noise produced by the wind turbines would likely become indistinguishable from other background noise sources at a distance. In an urbanized or industrial area, background noise levels may be such that introduction of a new noise source (i.e., construction or wind turbine[s]) would not increase existing noise levels or be noticeable outside the immediate vicinity. However, in an urbanized area any potential increase in noise would potentially affect more receptors than in a less developed area. In a rural area, introduction of a new noise source would typically be more noticeable than in an urbanized or industrial area, although whether this increase in noise would be noticeable depends on the distance to the closest noise receptor(s).

The location of the proposed sites at MARFORRES facilities is likely to provide some separation from potentially sensitive receptors, and other noise sources, especially aircraft and automobiles, are likely to be present and would tend to mask noise from the construction and operation of the turbines. However, an assessment of ambient noise conditions and the proximity of sensitive receptors at proposed sites will be necessary. As indicated in Section 2.3.2.1, *Siting and Design Criteria*, turbines would be sited with appropriate buffers and setbacks and designed (e.g., reduced number or size of turbine[s]) to minimize noise impacts to sensitive receptors, both human and non-human, and land uses. Therefore, noise impacts would be minor.

## 4.4 GEOLOGICAL RESOURCES

### 4.4.1 Topography and Soils

- *Analysis Item GR-1: Would site development result in a substantial alteration of topography or increase in erosion?*

The construction of one to four wind turbines under the proposed action would include permanent footprints (i.e., wind turbine foundation, access pad and road, and utility cables) and temporary footprints (i.e., crane pad and staging/laydown area). If existing disturbed/graded areas can be utilized for permanent footprints and/or temporary footprints, grading would be minimal or not required. Wind turbines would typically be located adjacent to existing infrastructure and project sites would be in areas with flat to low sloped topography that would need minimal grading. Therefore, while the proposed construction activities would require limited excavation, grading, and placement of fill material, no prominent topographic features would be affected.

Potential impacts resulting from erosion during grading and construction activities would be controlled through the use of appropriate erosion control BMPs such as sandbags, silt fences, earthen berms, fiber rolls, sediment traps, erosion control blankets, check dams in medium-sized channels, or straw bale dikes in a smaller drain channels. In addition, soil conservation regulations require that appropriate BMPs be utilized to minimize/eliminate site-specific erosion concerns. For project sites involving construction activities that disturb one or more acres, filing of an NOI in compliance with a USEPA or state issued CGP would be required. A NOI would be filed and the CGP requirements would be followed, including preparation and implementation of a SWPPP. The SWPPP would identify appropriate BMPs to control and minimize erosion at the construction site and post-construction BMPs to stabilize soils when construction is complete. Through compliance with NPDES requirements construction activities would generally minimize impacts to soils. However, if a project qualifies for a CGP, appropriate site-specific analysis should be prepared. The site-specific analysis should account for all applicable USEPA and state NPDES requirements.

Project sites would be excluded from consideration if the proposed construction activities were to result in substantial alteration to topography or substantially increase the potential for erosion. Sites located in existing disturbed areas or requiring little grading would have minimal impacts to topography or soils. A site-specific analysis should be prepared for sites with varied topography requiring considerable grading to ensure the appropriate and sufficient application of BMPs. There would be no impact during operation because there would be no ground disturbance following construction.

### 4.4.2 Mineral Deposits, Paleontological Resources, and Unique Geological Features

- *Analysis Item GR-2: Would construction result in the destruction of valuable mineral deposits, paleontological resources, or unique geological features?*

A project site would be excluded from consideration if construction would destroy important (economically or scientifically valuable) mineral deposits, rare fossils or fossils directly associated with archaeological resources, or unique geological features. However, MARFORRES facilities are typically located in developed areas that have been previously disturbed. As a result, it is unlikely that significant mineral deposits, paleontological resources, or unique geological features would be located at these sites. Nevertheless, the potential occurrence and significance of these resources on a proposed project site would be outlined in a site-specific analysis and assessed for potential impacts. If mineral deposits, paleontological resources, or unique geological features are identified at a project site, siting and design criteria and GCM #1 (Section 2.3.2) would be followed to ensure that effects are minimized and that most of the resource remains intact. Therefore, there would be no adverse impacts to mineral deposits, paleontological resources, or unique geological features.

### 4.4.3 Geological Hazards

- *Analysis Item GR-3: What potential impacts from geological hazards would exclude the project from consideration?*

As discussed under *Topography and Soils*, project sites are typically located in areas with flat or low sloped topography. These types of sites would not be susceptible to landslides due to the relatively level topography in the project area. In addition, seismic and faulting hazards are classified as minor for many areas. Regardless, construction in areas with relatively level topography and/or classified as having minor seismic and faulting hazards would comply with applicable federal and state building codes.

Geological hazards can result in adverse impacts if applicable federal and state building codes are not followed. However, in areas with steep topography or potential seismic hazards, a geotechnical study would be performed before final design of the wind turbine facility to identify site-specific geologic conditions and potential geologic hazards. The geotechnical study would be prepared by licensed civil or geotechnical engineers or engineering geologists and would provide design and construction recommendations based on all applicable federal and state building codes for a specific project location. The project would incorporate the recommendations identified by the geotechnical study to minimize potential slope-failure and to design wind turbines to withstand the maximum credible earthquake for a specific area. Therefore, there would be no impacts from geological hazards under the proposed action.

## 4.5 WATER RESOURCES

### 4.5.1 Surface Water Quality

- *Analysis Item WR-1: Would construction or operations substantially degrade surface water quality?*

During construction activities, pollutants that could potentially impact water quality include sediment from ground disturbance and potential spills or leaks from construction equipment. During the operations phase, increased runoff from increases in impervious area and spills and leaks from maintenance activities could potentially impact water quality. A project site would be excluded from consideration if construction activities or operations were to substantially degrade and thereby impact the designated beneficial uses of surface waters on, adjacent to, or downstream of the MARFORRES facility.

Under the proposed action, one to four wind turbines would be constructed at a MARFORRES facility. The disturbance area for a wind energy project would include areas of both temporary and permanent footprints for all proposed turbines at an individual MARFORRES facility. Based on footprint sizes indicated in Table 2-1, estimates for typical construction footprint (i.e., both temporary and permanent footprints) would range from approximately 0.41 acre for a single small or medium wind turbine to 3.72 acres for four large turbines. However, disturbed area for each potential project site would vary based on a number of factors including but not limited to: number and size of turbines; potential for sharing access roads, temporary staging/laydown areas, or crane pads with other turbines; and use of existing or previously disturbed areas for access roads, temporary staging/laydown areas, or crane pads.

For project sites involving construction activities that disturb one or more acres, filing of an NOI in compliance with a USEPA or state issued CGP would be required. A NOI would be filed and the CGP requirements would be followed, including preparation and implementation of a SWPPP. The SWPPP would identify construction-specific BMPs that would be implemented at the construction site as part of the proposed action to minimize increased runoff and erosion and subsequent impacts to surface water quality. However, for projects disturbing less than one acre and not requiring compliance with a CGP, appropriate BMPs would be implemented at the construction site as part of the proposed action to minimize increased runoff and erosion and subsequent impacts to surface water quality. For project sites requiring permitting under various NPDES requirements a site-specific analysis would determine the nature of any impacts to surface water quality and account for all applicable USEPA and state NPDES requirements.

During construction, potential indirect effects to adjacent or down-gradient wetland areas could potentially occur due to project related pollutants entering a wetland or WoUS. However, through implementation of the SWPPP and associated BMPs and the spill prevention plan, pollutants entering a wetland or WoUS would be minimal, resulting in no loss of functionality.

For coastal sites and other sites with a shallow groundwater table, dewatering of the foundation excavation may be required. Dewatering activities at construction sites are often covered under the CGP and discharges to municipal storm drain, surface waters, or dry channels are allowed if the groundwater is determined to be uncontaminated (i.e., there is no groundwater contamination within 1,000 ft of the excavation site). Because the depth of a turbine's foundation can extend from 15 to 50 ft, a geotechnical investigation would be conducted to determine if groundwater would be encountered during excavation of the foundation. If a site assessment of groundwater quality determines that the groundwater is contaminated, the groundwater would not be discharged to the environment.

During operations under the proposed action, there is potential to affect surface water quality due to increased runoff associated with impervious areas and from spills or leaks of contaminants associated with routine maintenance of the small wind turbines. The permanent project footprint would be small (i.e., 0.056 to 0.23 acre), resulting in only minor increases in storm runoff. A MARFORRES facility's existing SWPPP and spill prevention plan regulate stormwater discharges from the installation and minimize potential impacts from contaminant spills, respectively. If the existing SWPPP and spill prevention plan do not cover the new infrastructure and maintenance requirements associated with the proposed action during the operations phase, the SWPPP and spill prevention plan would be updated to accommodate the new operations.

Therefore, there would be no adverse impacts to surface water quality under the proposed action.

### 4.5.2 Wetlands and WoUS

- *Analysis Item WR-2: Would construction result in a substantial loss of the acreage or functionality of wetlands or WoUS?*

Impacts to CWA jurisdictional wetlands and other WoUS are regulated under Section 404 of the CWA and (in the case of navigable waters) Section 10 of the RHA, whereas EO 11990 directs federal agencies to minimize the loss of all types of wetlands, including non-jurisdictional isolated wetlands. Consequently, the presence of a wetland or other body of water in an area subject to construction would necessitate a delineation of the overlap of wetland and/or jurisdictional area by the construction footprint. Depending on the results, a Section 404 Permit may be required.

Under the proposed action, for sites where the proposed project footprint does not overlap potential wetlands or WoUS, then there would be no fill-related impacts to wetlands and WoUS. Indirect effects due to runoff are considered under Section 4.5.1, *Surface Water Quality*.

A substantial loss of wetland area or functionality (i.e., water quality, flood control, migratory bird support, or other habitat functions), defined here as exceeding any of the applicable thresholds for a Section 404 Nationwide Permit, would generally be considered an impact that would exclude a project site from consideration under this program. Activities with minor impacts to wetlands or WoUS that could be authorized under a Section 404 Nationwide Permit would be acceptable, provided the terms and conditions of the Nationwide Permit are satisfied. For project sites that are located in or have the potential to impact wetlands or WoUS, a wetland delineation would be performed and a site-specific analysis prepared of the potential impact.

If wetlands or WoUS are determined to be located within a proposed project footprint, MARFORRES would first attempt to minimize and, if possible, avoid impacts by relocating or realigning the project footprint. As described in Section 2.3.2.1, *Siting and Design Criteria*, any anticipated excavation or fill associated with a proposed project would not exceed thresholds established by the Section 404 Nationwide Permit program; otherwise the site would not be used. If avoidance of a jurisdictional wetland or other WoUS is not possible, MARFORRES would be required to obtain a Section 404 Nationwide Permit from the USACE to fill the wetlands and to comply with the terms and conditions of the permit. The same standards and thresholds would be applied to avoid and minimize an impact to a non-jurisdictional (isolated) wetland or water body. Therefore, construction activities associated with the proposed action would result in minor impacts to wetlands and WoUS.

### 4.5.3 Floodplains

- *Analysis Item WR-3: Would the project be in compliance with EO 11988?*

Projects located within a FEMA-designated 100-year floodplain must be in compliance with EO 11988 to avoid impacts to floodplains. Under the proposed action, if a proposed site is not located within a FEMA-designated 100-year floodplain, then the project would be in compliance with EO 11988. However, if a proposed site is located within a 100-year floodplain, then a site-specific analysis would be prepared to ensure compliance with EO 11988.

## 4.6 Biological Resources

- *Analysis Item BR-1: Would the project destroy or substantially degrade a legally or INRMP-protected habitat or resource (including protected species)?*

Potential construction related impacts would include vegetation removal, soil disturbance, and loss of habitat, both short-term and long-term. Construction of turbines is anticipated to take approximately one to six months. During that time, construction activity and the increase of people and machinery in the project area would eliminate the smaller, more sedentary wildlife species, and displace others into adjacent habitat. After construction is completed, some wildlife species may move back into the area and resume use.

The permanent footprint would range from 0.056 to 0.23 acre for one to four turbines, respectively, not including any new access road which, if needed, would increase the impact. Any applicable regulatory or INRMP conservation requirements would be identified and followed; these requirements may in turn require that the project incorporate specific impact avoidance, minimization, and/or compensation measures. In addition, application of siting and design criteria, BMPs, and GCMs identified in Section 2.3.2 would ensure that turbines are not sited in areas that contain habitat for sensitive species or result in fragmentation of contiguous wildlife habitat. This also would ensure that established avoidance, minimization, and compensation measures would be implemented to avoid impacts on sensitive habitats. Due to the overall small footprint of the individual turbines and the total area that would be potentially disturbed, construction impacts to habitat are anticipated to be negligible. Additionally, most of the proposed sites would be placed within disturbed or already developed areas of each facility, such that no important habitat would be directly impacted.

The operation of wind turbines has the potential to indirectly affect the use of surrounding habitats by wildlife through several mechanisms. Noise from the turbine(s) may interfere with communication signals or reduce the "alerting distance" at which biologically important sounds can be perceived (Dooling and Popper 2007; Barber et al. 2010). The turbine(s) could result in diminished use of surrounding areas by wildlife if wildlife avoid the turbine location(s) or the turbine site reduces accessibility or increases the cost, i.e. energetics or predation risk, of the use of adjacent areas.

For large wind farms, the infrastructure (roads and utility lines) associated with the wind turbines compounds potential adverse effects on wildlife habitat (Brennan et al. 2008). The proposed MARFORRES projects would not have these types of infrastructure requirements or related effects.

A number studies have sought to separate the effects of noise from other factors by comparing bird populations in similar habitats adjacent to oil and gas well pads with noise-generating compressor stations versus those without noise-generating compressor stations. The compressors operate continuously and produce noise similar to highway vehicles. One study in the boreal forest of western Canada revealed reduced reproductive success in ovenbirds adjacent to noise-generating compressor stations, presumably because of interference with communication (Habib et al. 2006). In another study, the abundance and diversity of boreal forest birds was found to be lower near compressor stations (Bayne et al. 2008). Finally, a study in pinyon-juniper habitat found that some species were more abundant, but others less so, near well pads with compressors. The more abundant, presumed noise-tolerant species apparently benefitted from a reduction in the effects of noise-sensitive predators (Francis et al. 2009). These studies illustrate the potential for noise effects on bird populations, but it should be noted that the compressors are louder than wind turbines, and that they are in remote locations surrounded by habitat that is largely intact.

Where construction or military training activities must occur near endangered species' habitats, buffer distances have been typically established through consultations with USFWS to avoid incidental take by disturbance of ESA-listed bird species. Such distances are indicative of the potential for disturbance by other types of projects, including the construction and operation of wind turbines. For example, at Marine Corps Air Station (MCAS) Miramar, a separation of 500 ft from active least Bell's vireo and coastal California gnatcatcher nests is required to minimize impacts from construction noise (MCAS Miramar INRMP 2006). At Marine Corps Base (MCB) Camp Pendleton, a separation of 250 to 500 ft from occupied least Bell's vireo, coastal California gnatcatcher, and southwestern willow flycatcher habitat is required for construction activities (USFWS 2004, 2009b). A 1,320-ft separation between construction activity and marbled murrelet habitat is required in Monterey, San Benito, San Luis Obispo, and Santa Cruz Counties in California (USFWS 2010d). For the Tehachapi Renewable Transmission Project in Angeles National Forest, California, a 500-ft buffer between construction noise and least Bell's vireo territories and a 300 ft buffer between coastal California gnatcatcher territories and construction noise has been required, unless the noise is less than 60 dBA (USFWS 2010e). No construction activity is allowed within 1.5 miles (7,920 ft) of a nesting California condor. To protect cavity trees used by red-cockaded woodpeckers, a 200 ft buffer is established (USFWS 2003). The 200-ft buffer is also used to minimize noise impacts to the woodpeckers, specifically from military training. Limited training activities are allowed within the 200-ft buffer.

The foregoing indicates there are established avoidance buffers for various species. As indicated by GCMs 7 and 8, applicable buffers will be established for individual projects based on the location and proximity to sensitive resources. Noise from wind turbines is more consistent and quieter than typical construction, road/highway, or aircraft noise, and, most of the time, would lack the associated human activity. Because of the consistent noise from the wind turbines, wildlife would likely become habituated/accustomed to the noise.

Hunsaker and Rice (2006 a,b) completed field trials of military noise disturbance and its effects on sensitive wildlife receptors; specifically they studied the potential effects of increased noise from proposed increased training operations on California gnatcatchers at MCAS Miramar, and on least Bell's vireo at MCAS/MCB Camp Pendleton. At MCAS Miramar, field studies were conducted on the effects of helicopter overflight noise on the habitat occupancy rates and reproductive success of the federally listed threatened California gnatcatcher (Hunsaker and Rice, 2006a). Their overall conclusion was that this species will find and inhabit suitable nesting habitat, in spite of the noise environment. In fact, habitat quality proved to be a more important variable affecting reproductive success, more so than any of the noise metrics tested; California gnatcatchers compensated for lower quality habitat and noisier environments by producing larger clutch sizes and re-nesting when necessary. At MCAS/MCB Camp Pendleton, noise metrics versus least Bell's vireo reproductive success was studied because of a concern that adding additional helicopter squadrons would lead to increased training noise and a lowering of the species productivity (Hunsaker and Rice 2006b). As with the gnatcatchers at Miramar, the vireos at Camp Pendleton were compensating in lower quality, noisier areas of the base by producing more successful fledges per nest, and by re-nesting, so that overall productivity of the species at Camp Pendleton remained unchanged after additional helicopter training noise was introduced. These recent field studies on the affects military training noise at DoD installations indicate that most wildlife species at existing installations have already adapted to baseline noise conditions, and that the additional noise generated by introducing new fighting platforms, or by increased "military readiness" training, seems to have little discernible effect on habitat occupancy or reproductive success.

Evidence that wildlife abundance or diversity is reduced in the vicinity of wind turbines is somewhat equivocal, and no studies have been done on small projects comparable to those proposed under the MARFORRES program. Leddy et al. (1999) found grassland bird densities were greatly reduced within 260 ft of wind turbines at a Minnesota wind farm, but found no effects at a distance of 590 ft. A comprehensive study conducted in the United Kingdom found no major effects of proximity to wind farms on wildlife populations (Devereux et al. 2008). However, a second study conducted in less-developed locations, reported that 7 out of 12 species' population sizes as sampled across similar habitats were negatively correlated with distance from wind farms (Pearce-Higgins et al. 2009); evidence of reduced abundance was primarily from distances less than 660-820 ft from the wind farms.

The foregoing suggests that the potential for indirect effects on wildlife habitats and populations increases as a function of proximity to a wind turbine location. The mechanisms underlying such effects are uncertain but could involve noise, human activity, habitat fragmentation, or avoidance of the turbines themselves. The evidence suggests that at distances beyond about 500 ft, the potential for such indirect effects is very low and would have only minor effects on wildlife habitats or populations. With the application of siting and design criteria and GCMs (Section 2.3.2), no adverse impacts would occur.

- *Analysis Item BR-2: Would the project result in take of an ESA-listed, proposed, or candidate bird or bat species?*

Of particular concern with wind energy projects is the potential for ESA-listed bird and bat collisions with turbines. Due to the relatively low impact of each of the projects (one to four turbines), impacts to bird and bat species would be correspondingly minor. If properly sited, the potential for these types of impacts would be limited and of lesser magnitude than from large wind farms, which are typically built in large areas of open space or range land containing native habitat. Compared with other anthropogenic sources of mortality, wind energy sites result in relatively few deaths. Nevertheless, any project site that would potentially result in incidental take would be excluded from consideration.

The proposed action would involve the siting, construction, and operation of one to four small, medium, or large sized turbines at MARFORRES facilities. Using the largest potential size for each size category of turbine (i.e., rotor radius of: small = 50 ft, medium = 100 ft, and large = 165 ft), each turbine would have a rotor sweep area of 7,850 square feet, 31,400 square feet, and 85,487 square feet, respectively.

With greater number and size of turbines at a project site, total rotor sweep area for multiple turbines would increase up to a maximum of 341,946 square feet for four large turbines. The total rotor sweep area would represent the danger area for birds and bats where collisions could occur. At a given location, a reasonable presumption is that the rate of mortality would be proportional to the rotor sweep area, and that mortality rates would therefore increase proportionately with increasing numbers or the size of turbines.

Bird deaths at wind energy sites are extremely variable depending on a number of factors, with two important factors being the level of bird use at the site and the behavior of birds at the site (National Wind Coordinating Collaborative [NWCC] 2010). The rate of mortality is often defined by number of birds per MW per year (birds/MW/year), but the wide variety of number and size of turbines at various wind energy sites makes standardized observation across sites difficult. This method of measuring mortality also attempts to take into account variety of possible configurations of different sites to generate electricity (e.g., several small turbines versus fewer larger turbines). Estimates of bird deaths range from approximately 0.95 to 14 birds/MW/year with an average range of 1 to 4 birds/MW/year (Erickson et al. 2005, National Academy of Sciences [NAS] 2007, NWCC 2010). At these rates, population-level impacts are not expected (NAS 2007, Kingsley and Whittam 2007). However, USFWS is concerned that these mortality rates have been substantially underestimated, possibly by an order of magnitude (USFWS 2010c; comment in Appendix A).

Table 4.6-1 presents estimates of the average number of bird deaths per year at a variety of wind energy sites throughout the U.S. The species that are most abundant and whose flight patterns tend to cross turbine locations are expected to incur most of the mortality, and for locally common species, the anticipated collision mortality (several individuals per year) would be a minor impact. However, any potential take of an ESA-listed species would require formal consultation with USFWS. The data suggest an average death rate of 3.5 birds/MW/year across projects. The wide variation and lack of a clear correlation between the size of the turbines and the rate of mortality suggests the overriding importance of habitat. Accordingly, it would be inappropriate to predict fatality rates across a range of sites and project scales solely on the basis of MW. Within a particular location, it is still to be expected that an increase in the number or size of turbines would increase bird mortality rates, and that the reverse would also be true – there should be less mortality with fewer or smaller turbines.

There appears to have been only one rigorous study of bird mortality at a small (10 kilowatts) wind turbine. This was conducted on the Eastern Neck National Wildlife Refuge on the Chesapeake Bay, a location with a diverse avifauna of waterfowl, shorebirds, raptors, and resident and migratory songbirds (Willis, undated). Based on 3.5 years of data for a single 60-ft tall turbine with a rotor diameter of 23 ft, a bird mortality rate of slightly less than 3 migratory birds/year was documented; all were songbirds. Starlings, a nuisance species (not MBTA-protected) that nested in the lattice of the tower, were excluded from the analysis.

Relatively high incidences of collision mortality to birds and bats have been documented at a wind energy facility monitored by the New Jersey Audubon Society (2008). The facility has 5 large (1.5 MW) turbines surrounded by coastal marsh habitat near the shoreline. Data show the greatest number of fatalities to hoary and red bats - which are migratory tree bats. Avian fatalities have included raptors shorebirds, songbirds, and gulls. During an initial 5-month monitoring period, documented collision mortality amounted to 31 bats and 9 birds, including one osprey and one peregrine falcon. Additional fatalities probably occurred but were not detected. These results reinforce the importance of siting and show the potential for high fatality rates in coastal areas where birds and bats are abundant.

Various theories exist as to why birds, especially raptors, fatally collide with seemingly slow-moving wind turbines despite their keen eyes. One theory suggests that the bird's attention is too focused on its prey. Unlike human eyes, however, the physiology of a raptor's eyes allows it to see everything in its periphery just as easily as its prey. A more likely explanation is "motion smear," in which a bird (or a human) cannot see moving objects (such as a fan) because they are moving too quickly and become blurred. Motion smear is exacerbated by increased speed and proximity, which explains why a wind turbine may appear to be moving slowly to humans viewing from a distance while being invisible to a raptor within a dangerously close proximity (Hodos 2003). In this regard, the blade of a large turbine can have similar velocity at its tip as a small turbine spinning at much higher rpm.

Night-flying migrants are unlikely to collide with small wind turbines because the rotors are below the heights at which most migrants fly (Cooper 2004; Smithsonian Migratory Bird Center 2010). However, medium and large turbines cover a greater vertical range, correspondingly increasing the possibility of collisions with nocturnal migrants. In addition, migrants may fly lower in response to weather conditions or as they arrive or depart from local staging or stopover areas. Mass mortality to nocturnal migrants colliding with lighted tall buildings and communications towers (especially those with guy wires) has been extensively documented (Manville 2009). However, there is no evidence of comparable mortalities due to collisions with wind turbines (Kerlinger et al. 2010).

Dooling (2002) suggests that when ambient wind noise increases to within 1.5 dB of turbine blade noise, a bird cannot hear the blade. This may be especially problematic when a flying bird approaches the moving blades under high wind conditions and is unable to hear or see the blades. Other research from scientists studying night-time mortality in birds and bats from collision with tall structures suggests that the type and amount of exterior lighting on these structures is the greater problem. In 2005, USFWS offered a number of exterior lighting recommendations (Manville 2005) to reduce bird collisions at night, including: avoid powerful solid spot lights, ceilometers, intense bright lights which attract and "trap" birds in lighted areas – especially during spring and fall songbird migrations, and most especially during inclement weather at night. After studying bird mortality at 30 wind farms across the country, Kerlinger et al. (2010) found that multi-bird fatality events (defined as >3 birds killed in 1 night at 1 turbine) were rare, recorded at <0.02% (n=4) of approximately 25,000 turbine searches. Kerlinger et al. also noted that, although flashing red lights (L-864, recommended by the FAA) were not involved in the multi-bird fatality incidents, a statistical analysis revealed that there was no significant difference, at any individual wind farm, between fatality rates at turbines with FAA lights versus those without.

**Table 4.6-1. Estimated Bird Mortalities at Several Wind Energy Sites**

| | *Project Size* | | *Turbine Characteristics* | | | *Raptor Mortality* | | *All Bird Mortality* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Project* | *Number of Turbines* | *Number of MW* | *Rotor Diameter (M)* | *Sweep Area ($M^2$)* | *MW* | *#/Turbine/Year* | *#/MW/Year* | *#/Turbine/Year* | *#/MW/Year* | *Source* |
| Stateline OR/WA | 454 | 300 | 47 | 1735 | 0.66 | 0.06 | 0.09 | 1.93 | 2.92 | Erickson et al. 2004 |
| Vansycle, OR | 38 | 25 | 47 | 1735 | 0.66 | 0.00 | 0.00 | 0.63 | 0.95 | Erickson et al. 2000 |
| Combine Hills, OR | 41 | 41 | 61 | 2961 | 1.00 | 0.00 | 0.00 | 2.56 | 2.56 | Young et al. 2005 |
| Klondike, OR | 16 | 24 | 65 | 3318 | 1.50 | 0.00 | 0.00 | 1.42 | 0.95 | Johnson et al. 2003 |
| Nine Canyon, WA | 37 | 48 | 62 | 3019 | 1.30 | 0.07 | 0.05 | 3.59 | 2.76 | Erickson et al. 2003a |
| Foote Creek Rim, WY I | 72 | 43 | 42 | 1385 | 0.60 | 0.03 | 0.05 | 1.50 | 2.50 | Young et al. 2001 |
| Foote Creek Rim, WY II | 33 | 25 | 44 | 1521 | 0.75 | 0.04 | 0.06 | 1.49 | 1.99 | Young et al. 2003 |
| Wisconsin | 31 | 20 | 47 | 1735 | 0.66 | 0.01 | 0.00 | 1.30 | 1.97 | Howe et al. 2002 |
| Buffalo Ridge, MN I | 73 | 22 | 33 | 855 | 0.30 | 0.01 | 0.04 | 0.98 | 3.2 | Johnson et al. 2002 |
| Buffalo Ridge, MN I | 173 | 107 | 48 | 1810 | 0.75 | 0.00 | 0.00 | 2.27 | 3.03 | Johnson et al. 2002 |
| Buffalo Ridge, MN II | 139 | 104 | 48 | 1810 | 0.75 | 0.00 | 0.00 | 4.45 | 5.93 | Johnson et al. 2002 |
| Top of Iowa | 89 | 80 | 52 | 2124 | 0.90 | 0.01 | 0.01 | 1.29 | 1.44 | Koford et al. 2004 |
| Buffalo Mountain, TN | 3 | 2 | 47 | 1735 | 0.66 | 0.00 | 0.00 | 7.70 | 11.67 | Nicholson 2003 |
| Mountaineer, WV | 44 | 66 | 72 | 4072 | 1.50 | 0.03 | 0.02 | 4.04 | 2.69 | Kerns and Kerlinger 2004 |
| Klondike III, OR | 122 | 217 | 82.5-101 | 5346-8012 | 1.50-2.30 | 0.11 | 0.06 | 6.30 | 3.55 | Gritski et al. 2009 |
| Blue Sky, WI | 88 | 145 | 82 | 5281 | 1.65 | 0.01 | 0.01 | 11.83 | 7.17 | Gruver et al. 2009 |

*Sources:* NAS 2007; Gritski et al. 2009; Gruver et al. 2009.

**Table 4.6-2. Estimate Bat Mortality at Several Wind Energy Sites**

| *Facility* | *Landscape* | *Estimated Deaths/MW/Year* | *Search Efficiency (%)* | *Reference* |
|---|---|---|---|---|
| Klondike, OR | Cropland, grazed pasture/grassland | 0.8 | 75 | Johnson et al. 2003 |
| Stateline OR/WA | Shrubland, cropland | 1.7 | 42 | Erickson et al. 2003b |
| Vansycle, OR | Cropland, grazed pasture/grassland | 1.1 | 50 | Erickson et al. 2000 |
| Nine Canyon, WA | Grazed pasture/grassland, shrubland, cropland | 2.5 | 44 | Erickson et al. 2003a |
| High Winds, WA | Grazed pasture/grassland, cropland | 2.0 | 50 | Kerlinger et al. 2006 |
| Foote Creek Rim, WY | Shortgrass prairie | 2.0 | 63 | Young et al. 2003; Gruver 2002 |
| Oklahoma Wind Energy Center, OK | Cropland, shrubland, grazed pasture/grassland | 0.8 | 67 | Piorkowski 2006 |
| Buffalo Ridge, MN-I | Cropland, grassland, grazed pasture/grassland | 0.8 | 29 | Johnson et al. 2003, 2004 |
| Buffalo Ridge, MN-II (1996-1999) | Cropland, grassland, grazed pasture/grassland | 2.5 | 29 | Johnson et al. 2003 |
| Buffalo Ridge, MN-II (2001-2002) | Cropland, grassland, grazed pasture/grassland | 2.9 | 53.4 | Johnson et al. 2004 |
| Lincoln, WI | Cropland | 6.5 | 70 | Howe et al. 2002 |
| Top of Iowa, IA | Cropland | 8.6 | 72 | Jain 2005 |
| Meyersdale, PA | Deciduous forested ridge | 15.3 | 25 | Kerns et al. 2005 |
| Mountaineer, WV (2003) | Deciduous forested ridge | 32.0 | 28 | Kerns and Kerlinger 2004 |
| Mountaineer, WV (2004) | Deciduous forested ridge | 25.3 | 42 | Kerns et al. 2005 |
| Buffalo Mountain, TN-I | Deciduous forested ridge | 31.5 | 37 | Fiedler 2004 |
| Buffalo Mountain, TN-II | Deciduous forested ridge | 41.1 | 41 | Fiedler et al. 2007 |
| Klondike III, OR | Shrub-steppe/agricultural | 1.3 | 42-82 | Gritski et al. 2009 |
| Blue Sky, WI | Agriculture/wooded areas | 24.6 | 52 | Gruver et al. 2009 |

*Sources:* NAS 2007; Gritski et al. 2009; Gruver et al. 2009.

Also of concern are bat fatalities, which generally exceed bird fatalities at wind energy sites. Some common species appear to be especially vulnerable and are experiencing high rates of mortality at wind farms, raising concerns that they could become endangered in the future. Bats may not be able to detect rotating wind turbine blades because the high speed of the blades produces a Doppler shift in their rebounding echolocation sonar, making them imperceptible to some bat species. The angle of approach can greatly affect this phenomenon (Electric Power Research Institute 2003). The most common species of bats killed at wind energy sites are hoary bats (41.1%), eastern red bats (23.3%), eastern pipistrelle (10.5%), and silver haired bats (8.4%) (NAS 2007). The other 16.7% of bat deaths are made up of numerous other species. These four bat species are all tree roosting species that make long-distance migrations, which put them at higher risk of collisions with wind turbines (NWCC 2010). When determining potential impacts to bat species, the habitat type at project sites plays an important role, with higher rates of mortality occurring in forested habitats than in other habitat types. Table 4.6-2 shows estimated mortality rates at several wind turbine locations in the U.S. Mortality estimates range from 0.8 to 41.1 bats/MW/year and average 10.7 bats/MW/year. As mentioned previously, there are concerns that these mortality rates have been greatly underestimated (USFWS 2010c; comments in Appendix A).

The mechanisms underlying high bat mortality at wind turbines are an active subject of research (Cryan 2006; Cryan and Barclay 2009). Greater bat fatality rates have been clearly linked to taller turbines (Barclay et al. 2007). Bat fatalities result from both collisions and barotraumas (internal injuries caused by a sudden drop in pressure that a bat encounters when flying near the rotating blade). The reasons why migratory tree bats are especially vulnerable could involve their attraction to turbines as mating sites (Cryan 2008) or feeding locations, which is plausible because insects may also be attracted to wind turbines in calm weather. Episodes of bat mortality at wind turbines have been linked to low wind speeds during migration periods when bats are actively foraging, and by increasing cut-in speeds during these times, bat fatalities have been reduced at minimal cost to power generation (Arnett et al. 2009). Under the proposed MARFORRES program, cut-in speeds would be increased at times and locations when/where bats are known to be abundant.

As discussed above, with greater number and size of turbines, rotor sweep area and height correspondingly increase, resulting in a greater possibility of impacts to ESA-listed species. Further investigation to evaluate habitat suitability and local species movements would be warranted if: (a) it is determined that there is a moderate to high potential for an ESA-listed, proposed, or candidate threatened or endangered avian or bat species to be present on or near the installation, and (b) if it is a species known to suffer from turbine collision mortality. However, through application of programmatic siting and design criteria, BMPs, and GCMs identified in Section 2.3.2, the number, size, and location of turbines at a site would be selected to avoid/minimize potential impacts to ESA-listed species. The effectiveness of these measures would then be analyzed to determine through informal consultation (with USFWS concurrence), if a determination that the action is not likely to adversely affect the species can be supported, in which case the project site would still be considered viable. If this results in a determination that an adverse effect (take) would be likely to occur, the impact would require formal ESA Section 7 consultation with USFWS. While the likelihood of an adverse effect to a listed species is less likely to occur through application of programmatic siting and design criteria, BMPs, and GCMs, if a listed species is present, site-specific analysis and consultation with the USFWS would be undertaken to ensure that the action is not likely to result in a take.

- *Analysis Item BR-3: Is the project likely to result in injury or mortality to a bald or golden eagle?*

Bald and golden eagles are protected under the BGEPA, and any incidental mortality would exclude a proposed site from further consideration. The risk of collision with a turbine resulting in injury or mortality needs to be considered in areas where these species are present and their foraging areas and/or flight patterns carry them near a turbine location. Total raptor deaths at wind turbine sites are relatively low compared to other species of birds. While there have been a few wind turbine sites with rates of over 0.5 raptor deaths/MW/year, most are below 0.2 deaths/MW/year and several had no raptor mortality at all (NWCC 2010). Table 4.6-1 shows a range of 0 to 0.09 raptor deaths/MW/year with an average of 0.02 raptor deaths/MW/year for 14 locations.

The observance of a 3-mile threshold (i.e., as applicable to projects within 3 miles of a bald or golden eagle nest, bald eagle winter roosting area, or important foraging habitat) for seeking a programmatic take permit, or other distance threshold if established by a state or regional USFWS office under the BGEPA ensures that either (a) projects will be sufficiently far from eagle use areas to conclude that take would not occur; or (b) the consultation procedures of the BGEPA would be followed, leading to the incorporation of sufficient avoidance, minimization, and compensation measures to ensure that collision mortality is unlikely to occur and that there is no cumulatively adverse impact on the eagle population.

If the site-specific analysis indicates that bald or golden eagle flight patterns are likely to intersect the height and location of a proposed turbine, the risk of collision would require a permit for programmatic take under the BGEPA. The permit for programmatic take could only be issued conditional upon the incorporation of measures identified through consultation with USFWS to minimize the likelihood of collisions, such as the modification of turbine height or location. Post-construction monitoring of eagle habitat use is likely to be required as a condition of the eagle permit (e.g., http://www.fws.gov/midwest/eagle/protect/fnlpermitregs_qas.html). A project that incorporated necessary and sufficient measures to qualify for a programmatic take permit would be considered unlikely to cause injury or mortality and, therefore, would not exclude the project from further consideration.

As discussed previously under *Analysis Item BR-2*, with greater number and size of turbines, rotor sweep area and height correspondingly increase, resulting in a greater possibility of impacts to bald and golden eagles. However, if bald or golden eagles use the area surrounding a project site, the number, size, and location of turbines at a site would be selected through application of siting and design criteria, BMPs, and GCMs identified in Section 2.3.2 so as to avoid/minimize potential impacts to bald or golden eagles. Therefore, impacts to bald and golden eagles would be minor.

- *Analysis Item BR-4: Is the project site in a known high-use regional migratory flyway for birds, or within a local bird and/or bat high-use movement corridor, breeding, roosting, wintering, hibernacula, or "stop-over" site, resulting in a high likelihood and frequency of collisions?*

Concerns over the impact of small-scale wind energy projects on biological resources are primarily related to the effects of collision mortality on bird and bat populations. Although the numbers are relatively small as discussed previously, they should be viewed in the context of bird and bat populations many of which are already vulnerable due to a variety of anthropogenic stressors, including other sources of collision mortality (Manville 2009).

An article entitled *Putting Wind Power's Effect on Birds in Perspective* (Sagrillo 2003) cited estimates of avian mortality in the hundreds of millions of birds annually from a variety of (non-hunting) anthropogenic sources including collisions with buildings (and windows), communications towers, utility transmission and distribution lines (and related electrocutions), and motor vehicles; as well from poisoning and cat predation (USFWS 2002; Erickson et al. 2001; Coleman et al. 1997).

The USFWS estimated in 2009 that, among the 23,000 land-based wind turbines operating in the U.S., approximately 440,000 birds are killed each year, in total from collision with wind turbine rotors (Manville 2009). This estimate is more than an order of magnitude larger than the earlier estimates of Erickson et al. (2005). With the continuing growth of wind energy and some 155,000 turbines projected to be operational by 2020, USFWS has expressed concern over the magnitude of potential impacts to bird (and bat) populations (Manville 2009). While wind turbines contribute what may seem to be a negligible amount to overall mortality, the background of impacts from other sources raises concerns over even small amounts of additional mortality that would not otherwise occur. As noted previously, there is still the potential for bird and bat mortality at even a small-scale wind turbine project (NWCC 2010).

Construction of wind turbines near any high use flyway or movement corridor for birds or bats would have the potential to result in increased bird or bat collisions with the wind turbines. Different groups of birds may be at higher risk of mortality from turbines as well. Most of the bird deaths at turbines are songbirds (e.g., passerines) (Erickson et al. 2001, Johnson et al. 2002), while other species generally avoid turbine sites (NAS 2007, Erickson et al. 2002). Waterfowl (e.g., geese and ducks) have been shown to avoid off-shore wind farms with only a small amount (1%) typically approaching turbines (Desholm and Kahlert 2005). Approximately 74% of all bird deaths recorded at wind turbines in the U.S. are passerines, 11% are gamebirds, 6% are raptors/vultures, and the remaining 9% are various other types of birds (NAS 2007).

As discussed previously under *Analysis Item BR-2*, the possibility of collision impacts to birds and bats at a given site would increase with a greater number and/or size (rotor sweep area and height) of turbines. Through application of siting and design criteria, BMPs, and GCMs identified in Section 2.3.2, the number, size, location, and operation of turbines at a site would be selected to minimize potential collision impacts to birds and bats. Areas of high bird and bat concentrations would be avoided or have smaller scale projects and be subject to operational modifications (raised cut-in speeds, shut downs during peak migration periods). GCM number 2 (Section 2.3.2.3) provides for adjustments to be made if warranted by changing conditions or new information on the sensitivity and occurrence of bird and bat species. Therefore, impacts to birds and bats would be minor.

- *Analysis Item BR-5: Would the project result in collisions and mortality to a bird of conservation concern or state species of concern?*

Where birds of conservation concern or state-listed species are present and forage in or fly across a proposed turbine location, individuals of these species may be at risk from collision with the turbines. Observations of bird behavior and habitat use at the times of year when they are most vulnerable would be needed to assess the probability of collisions and any potential population-level impacts. These impacts may warrant discussion with the USFWS and state wildlife agencies or local experts to identify modifications to project design that would reduce collision risks. Modifications could include modifying turbine/blade appearance to increase visibility, changing location or height to lessen overlap with flight patterns, or changing operations. As previously mentioned, mortality to birds from other anthropogenic sources is more likely to have a much higher impact on birds and bats than from wind turbines. However, this does not completely discount the potential impacts wind turbines would have on bird species of conservation concern or state listed species.

For most of the potential impacts mentioned previously, site-specific analysis will be required to assess the occurrence of resources of concern and their vulnerability. Input from state and local agencies or nongovernmental organizations (i.e., Audubon) would be sought as part of the site-specific analysis for each location. Through application of siting and design criteria, BMPs, and GCMs identified in Section 2.3.2, the number, size, location, and operation of turbines at a site would be selected to avoid/minimize potential impacts to bird species of conservation concern or state listed species. Therefore, impacts to bird species of conservation concern or state-listed species would be minor.

## 4.7 CULTURAL RESOURCES

- *Analysis Item CR-1- Would construction or operations result in adverse effects to a historic property?*

Impacts to cultural resources can be direct or indirect and affect the integrity of the historic property and can adversely affect those characteristics that cause a property to be listed, or eligible for listing, on the NRHP. Direct impacts include physical impacts to all types of historic properties. They also include visual impacts to the setting of historic districts, buildings, structures, TCPs, and objects where setting is an important aspect of their integrity. Indirect impacts are those that change the accessibility, usage, or economic viability of the historic property.

Physical impacts include the partial or complete demolition or destruction of the historic property. Visual impacts to historic properties occur when the setting of the property is severely affected by the proposed action to the extent that its historical importance is no longer able to be conveyed. Impacts to accessibility can occur when access to historic properties is either enhanced or restricted. Enhanced access can lead to a greater degree of direct impact to the historic property by creating more opportunities for destruction (i.e., looting of archaeological sites or destruction of historic buildings and structures). Restrictions on the access to historic properties can indirectly impact the communities to which they are important for their cultural identity (i.e., limiting access by Native American communities to TCPs, limiting access to churches or other historic buildings of importance to the identity of local communities). Restrictions on access can also indirectly impact the usage and economic viability of historic buildings and structures that can lead to their destruction or demolition.

The primary criterion for determining the significance of the potential impacts from the proposed action is whether or not there are "adverse effects" on historic properties. If a historic property will not be impacted by a proposed action, it is determined to have "no effect." Impacts to historic properties that do not affect those aspects of integrity that cause a historic property to be listed in, or considered eligible for listing in, the NRHP are said to have "no adverse effects." Adverse effects occur when a proposed action has a negative impact on those qualities (characteristics) that make a property eligible for listing on the NRHP. Adverse effects on historic properties are generally caused by impacts to its integrity. They include physical destruction or damage to all or part of the property; removal from its historic location; change in the contributing features of setting that contribute to its historic significance; and introduction of visual, atmospheric, or noise elements that diminish integrity. If the proposed action causes a change in the setting of a historic property, adverse visual impacts could potentially occur to historic properties where setting has been specifically identified as an important aspect of the property's integrity. The setting of a historic property would be most likely an important aspect of integrity for a property that is located within or adjacent to a National Register Historic District.

The primary potential adverse effects from a wind energy project would be physical damage or destruction to a historic property during construction and/or the introduction of visual elements that diminish a historic property's integrity. The small turbines under the proposed action would have less potential to impact historic properties than medium or large turbines given the shorter height. In general, with increased size and number of turbines at a project site, the size of the physical APE increases resulting in greater potential for direct disturbance of historic properties during construction activities.

Similarly, with increased height and number of turbines at a project site, the size of the Visual APE increases resulting in potential for a greater number of historic properties to be located within it and therefore the greater the potential for a visual impact to a historic property to occur.

The proposed action could have a direct adverse effect on the physical integrity or the integrity of the setting of a historic property located within the project's physical APE or Visual APE, respectively. However, through application of siting and design criteria identified in Section 2.3.2, the number, size, and location of turbines at a site would be selected so that a determination of no effect or no adverse effect could be made. This program will not consider sites or designs that that would result in an adverse effect to cultural resources.

## 4.8 VISUAL RESOURCES

Visual resource assessment units can be landforms, landscapes, major viewer groups, or viewsheds. For historic properties, the pertinent SHPO policy on defining a Visual APE for the proposed wind turbines has been outlined in Section 3.7 and impact analysis provided in Section 4.7, *Cultural Resources*. For recreational sites, federal and local government agencies would be consulted to identify important or valued landscapes, viewsheds, and major viewer groups within the viewshed of the proposed turbine(s).

The visual environment is composed of four aspects or issues. These are the visual character, the visual quality, the viewer exposure, and the viewer sensitivity. All four aspects are evaluated in a visual impact assessment. The visual character and the visual quality refer to the visual resources in the landscape. The visual character consists of the vistas and viewsheds in the landscape. Visual quality is the appeal of those vistas and viewsheds. Viewer exposure is the how much a viewer would be exposed to the visual resource. Viewer sensitivity is the level of concern viewers would have to the changes in the visual character. The viewer exposure and the viewer sensitivity are use to determine the viewer response to the visual resources in the landscape.

Several federal agencies, such as the Federal Highway Administration, the U.S. Department of Interior, Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) have each developed their own visual resource management analysis guides to meet their own needs with regard to visual resources (U.S. Department of Transportation 1988; U.S. Department of the Interior 1986a,b). Common to all agencies, the primary criteria in determining adverse effects to visual resources consists of describing the visual character and the visual quality of the existing setting and the hypothetical setting of the proposed action. The visual character of a setting can be defined as the landscape formed by the order of the patterns which compose it. The patterns are described in terms of the forms, lines, colors and textures of the landscape's visual resources. Visual quality can be defined as the visual appeal of a landscape to a viewer. It is defined in terms of vividness, intactness, and unity.

- *Analysis Item VR-1: Would the wind turbines result in impacts to visual resources?*

Visual impacts occur when a conspicuous new feature is added to the visual environment that contrasts with that which already exists. The impacts to visual resources are evaluated by the degree of contrast in the visual environment caused by the introduction of the new feature. The degree of contrast is subjectively evaluated by the viewer(s) and would be measured using the BLM Visual Contrast Rating system as outlined in the *BLM Visual Contrast Rating Manual* (U.S. Department of Interior 1986a). In most cases, the changes to land/water and vegetation would not apply, and only changes in the structures within the Visual APE or viewshed of the recreational area would be evaluated. There are four levels of contrast that are defined for visual resources. These are: (1) None - element is not visible or perceived (2) Weak - element contrast can be seen but does not attract attention (3) Moderate - element contrast begins to attract attention and begins to dominate the characteristic landscape and (4) Strong - element contrast demands attention, will not be overlooked, is dominant in the landscape. The contrast ratings depend upon a variety of factors. These variables include distance, angle of observation, length of time the project is in view, the relative size and scale, season of use, light conditions, spatial relationships, atmospheric conditions, and motion.

The visual impacts of a proposed action are measured by comparing the current visual environment and viewer response to it with visual environment that would exist after implementation of the proposed action and the viewer response to it. The existing impacts to the visual environment can be both positive and negative. Positive impacts to the quality of the visual experience would require no further work. High degrees of contrast between the existing visual environment and the post-action visual environment, and strong negative viewer responses to the change are considered adverse impacts. Low or moderate degrees of contrast between the existing visual environment and the post proposed action visual environment and weak or moderate negative viewer responses to the change are considered minor impacts.

If no recreation use areas or other sensitive visual resources are identified within the viewshed of the proposed wind energy project, then no site-specific analysis would be needed. However, if recreational use areas or other sensitive visual resources are identified within the viewshed of the proposed wind energy project, potential visual impacts should be evaluated in a site-specific analysis. Under a visual impact analysis, contrast ratings ranging from None to Strong would be assigned and viewer responses (exposure and sensitivity) would be ascertained in consultation with the administrators (i.e., NPS, USFS, State and City Parks and Recreation Departments, etc.) of the recreational use areas. Generally, as the degree of contrast in the landscape rises at high use observation points, the greater the level of concern by the viewers. However, high contrasts in urban settings are less likely to generate greater levels of concern among viewers than high contrasts in natural settings. In addition, the public perception of a wind turbine being beneficial to the environment

A majority of the project locations would be in urban areas that are unlikely to have any exceptional vistas or viewsheds with a high level of appeal. For project sites in urban settings, viewer exposure would most often be from high frequency use locations within local parks and recreation areas. In addition, viewer sensitivity is low in urban settings and therefore the level of concern for viewers of the landscape is low. However, some proposed wind turbine locations could affect natural environments (e.g., wildlife refuges or Scenic Roadways) where the level of concern of viewers is high.

As discussed under cultural resources, with increased height and number of turbines at a project site, the size of the affected viewshed increases resulting in potential for a greater number of visual resources to be located within it and therefore the greater the potential for a visual impact to a recreational use area or other sensitive visual resource. However, through application of siting and design criteria identified in Section 2.3.2.1, the number, size, location, and design of turbines at a site would be selected to avoid/minimize impacts to visual resources. Therefore, the proposed project would result in no impact or minor impacts to visual resources.

- *Analysis Item VR-2: Would shadow flicker result in impacts to nearby residential or office buildings?*

The proposed action has the potential to affect nearby sensitive areas due to shadow flicker. Shadow flicker would be a nuisance to occupied structures, roadways, and recreational areas and has the potential to adversely affect cultural resources. It can be difficult to work in residential or office buildings if there is shadow flicker on a window. In addition to light intensity from shadow flicker, frequency is also a concern. The rotation speed of the blades determines the frequency of the shadow flicker; however, a wind turbine's frequency typically ranges from 0.6-1.0 Hz, which is harmless to humans (frequencies above 10 Hz are likely to cause epileptic seizures) (NAS 2007). For wind turbines located near roadways, shadow flicker can distract motorists at certain times of day.

Because the continental United States is in mid-latitudes, shadow flicker has less potential to be a nuisance than for areas at higher latitude where shadow flicker can be a greater problem of concern with the lower angle of the sun, especially in winter (NAS 2007). However, if sensitive resources are located within ten rotor diameters of a turbine, then a flicker analysis would be performed. The flicker analysis would determine the hours per year under which a specific location (of a sensitive resource) is affected by shadow flicker. Although there are no federal regulatory guidelines, many state regulations require that shadow flicker affecting a sensitive resource be limited to no more than 20 to 30 hours per year (Lampeter 2011).

With increased rotor diameter, height, and number of turbines at a project site, the size of the area potentially affected by shadow flicker increases resulting in potential for a greater number of sensitive resources to be affected. However, through application of siting and design criteria identified in Section 2.3.2.1, the number, size, location, and design of turbines at a site would be selected to avoid/minimize impacts from shadow flicker. In addition, as indicated under GCMs (Section 2.3.2.3), if shadow flicker adversely effects residents, motorists, or sensitive views and land uses, then turbine operation schedules would incorporate temporary shut downs. Therefore, the proposed project would result in no impact or minor impacts from shadow flicker.

## 4.9 SOCIOECONOMICS

Socioeconomic impacts should be described in terms of their locality, duration, intensity, and whether they would be beneficial or adverse. Construction impacts would likely be local, short-term, negligible, and beneficial to the local economy as the turbines are installed at an installation. Long-term operational effects to socioeconomics would be similar given the very small nature of the wind farms being proposed.

The economic effects of a wind energy project can be positive effects of increases in employment and local revenue where few, if any, mitigation measures would be necessary (Tribal Energy and Environmental Information Clearinghouse, Office of Indian Energy and Economic Development [OIEED] 2010). With large wind energy projects, there could be situations in which existing infrastructure and social services are inadequate to meet the needs of large workforces that are not local to the area, in which case mitigation measures would be warranted (OIEED 2010). However, these are not applicable to the proposed wind energy projects.

Impact threshold definitions for socioeconomics and environmental justice used in this document are as follows:

- *Negligible*: Socioeconomics or environmental justice would not be affected, or impacts would not depart measurably from the baseline conditions.
- *Minor*: Impacts to socioeconomics would be detectable, but would have a negligible effect on children, population, income, and/or employment, would not have a disproportionate adverse effect on low-income or minority populations, and would not warrant mitigation.
- *Moderate to Severe*: Impacts to socioeconomics or environmental justice would be readily apparent and could affect children or result in an increase or decrease in population, income, and/or employment, particularly one which would disproportionately affect a minority or low-income population. Such impacts would warrant mitigation. For the proposed small-scale wind

energy projects, this level of adverse impact would exclude a proposed project from further consideration.

- *Analysis Item SO-1: Would a proposed action result in a moderate to severe adverse impact to socioeconomics?*

The proposed action would not impact or would only negligibly impact socioeconomic conditions, and impacts would be beneficial such as short-term construction jobs (the construction phase typically is from one to six months) and long-term maintenance needs (the life of the project). Most repairs and maintenance activities would be conducted by operations and maintenance contractor crews which would contribute to income, employment, and possibly housing in the area. Some monitoring and maintenance would be conducted by on-site engineering and maintenance personnel. The project would result in less power purchased from local utilities; however, this is not expected to be a major revenue loss given the small total output of the turbines (< 2.5 million MWh/yr).

- *Analysis Item SO-2: Would a proposed action adversely affect children or have a disproportionate adverse effect on a low income or minority community?*

Because of the location of proposed wind turbines within MARFORRES facilities, the proposed action would not impact or would only negligibly impact low-income or minority communities and children, and impacts would be beneficial such as short-term construction jobs (the construction phase typically is from one to six months) and long-term maintenance needs (the life of the project). Therefore, impacts on socioeconomics would be minor.

### 4.10 AIR QUALITY

- *Analysis Item AQ-1: Would construction or operational emissions exceed applicable de minimis thresholds, requiring a Conformity Determination, and if so, would emissions fail to conform to the applicable SIP?*

If net annual emissions from a proposed project remain below applicable *de minimis* thresholds, a CAA Conformity Determination is not required. In this case, preparation of a Record of Non-Applicability (RONA) for CAA Conformity would demonstrate General Conformity Rule compliance and no further action would be required. If project emissions of one or more of the criteria pollutants were to exceed applicable *de minimis* thresholds, a CAA Conformity Determination would be required, and further analysis would be required to determine if emissions conform to the approved SIP.

For project sites in nonattainment or maintenance areas, a site-specific analysis would be required to determine if *de minimis* thresholds would be exceeded requiring a Conformity Determination. Failure to conform to the SIP would exclude a proposed project site from further consideration.

However, recent government studies and utility grid operator data indicate that emission savings from adding wind energy to the utility grid reduce carbon dioxide and other harmful air pollutants by replacing or reducing the use of fossil fuel powered plants with more efficient and flexible types of power generation (American Wind Energy Association 2010). As a result, project emissions would be potentially off-set or reduced by the emission reductions associated with wind energy projects, representing a net beneficial impact to air quality.

Construction Impacts

Under the proposed action, one to four wind turbines would be constructed at a MARFORRES facility. As indicated in Table 2-1, this would result in a construction footprint (i.e., both temporary and permanent footprints) ranging from approximately 0.41 acre for a single small or medium turbine to 3.72 acres for four large wind turbines. For the purposes of this general analysis, it was assumed that the construction duration for installation of each small, medium, or large turbine would be approximately 1, 2, or 4 months, respectively. Table 4.10-1 presents a summary of the estimated construction emissions that would occur under a range of proposed action scenarios. Detailed calculations are provided in Appendix B.

**Table 4.10-1. Estimated Construction Emissions under the Proposed Action**

| *Proposed Action Scenario* | *Construction Duration* | *Air Pollutant Emissions (tons)* | | | | | |
|---|---|---|---|---|---|---|---|
| | | *CO* | *VOC* | *NOx* | *$SO_x$* | *$PM_{10}$* | *$PM_{2.5}$* |
| One Small Turbine | 1 month | 0.53 | 0.13 | 1.14 | 0.00 | 0.09 | 0.06 |
| Four Small Turbines | 4 months | 2.11 | 0.52 | 4.54 | 0.00 | 0.38 | 0.23 |
| One Medium Turbine | 2 months | 1.06 | 0.26 | 2.27 | 0.00 | 0.19 | 0.11 |
| Four Medium Turbines | 8 months | 4.22 | 1.05 | 9.09 | 0.01 | 0.76 | 0.46 |
| One Large Turbine | 4 months | 2.11 | 0.52 | 4.54 | 0.00 | 0.38 | 0.23 |
| Four Large Turbines | 16 months | 8.45 | 2.09 | 18.18 | 0.02 | 1.51 | 0.92 |

These data show that construction emissions would be below *de minimis* thresholds for nonattainment or maintenance areas, regardless of the severity of the affected air basin. Therefore, construction activities associated with the proposed action would result in minor impacts to air quality.

Operational Impacts

Operations and maintenance of the turbines would typically consist of two to three people who would visit the sites approximately six times per year. These visits would consist of maintenance personnel driving a vehicle to and around the site. Emissions associated with these activities would be minimal and short-term and would not result in a major increase in air emissions.

One of the most important benefits of wind energy is that the production of electricity from wind power involves zero direct emissions of air pollutants. In contrast, fossil fuel-powered electric generation from coal, oil, or natural gas results in substantial direct emissions of air pollutants. The U.S. electricity sector accounts for approximately 39% of $CO_2$ emissions, 22% of NOx emissions, 69% of $SO_2$ emissions, and 40% of mercury emissions in the U.S (NREL 2008a).

The specific types of fossil fuel-powered plants that would be displaced by wind generation vary greatly among states and regions of the county. Some states and regions rely on coal plants for a majority of their power generation while other states and regions rely more heavily on natural gas-powered plants. Consequently the displaced emissions of $CO_2$, NOx, $SO_2$, and mercury would generally be greater in areas with large amounts of coal-fired generation and lower in areas where natural gas is the dominate fuel type. The emissions reduction level would also be influenced by the age of the existing fossil-fuel powered plants as well as their relative levels of efficiency and pollution control devices (NREL 2008b).

It is however clear that the energy output generated from wind turbines, with zero emissions of air pollutants, would displace roughly the same energy output that would otherwise be generated by a fossil fuel-powered plant, which generates GHGs and other harmful air pollutants. As discussed in Section 2.3.1.3, energy output would vary depending on annual wind speeds at a specific site. Table 4.10-2 includes the typical energy output under a range proposed action scenarios. This table shows the amount of electricity savings per year that would no longer need to be generated by a fossil fuel-powered plant (coal, oil, or natural gas).

**Table 4.10-2. Range of Energy Output under the Proposed Action**

| *Proposed Action Scenario* | *Energy Output (MWh/yr)* |
|---|---|
| One Small Turbine | 88 – 440 |
| Four Small Turbines | 352 – 1,760 |
| One Medium Turbine | 880 – 4,400 |
| Four Medium Turbines | 3,520 – 17,600 |
| One Large Turbine | 516,000 – 648,000 |
| Four Large Turbines | 2,064,000 – 2,592,000 |

Therefore, operational activities associated with the proposed action would result in beneficial impacts to air quality by adding wind energy to the utility grid and replacing or reducing the use of fossil fuel-powered plants with more efficient and flexible types of power generation.

- *Analysis Item AQ-2: Would the proposed action contribute to global climate change?*

Currently, there are no formally adopted or published NEPA thresholds for GHG emissions. On 18 February 2010, the CEQ released draft guidance for addressing climate change in NEPA documents (CEQ 2010). The draft guidance recommends quantification of GHG emissions; however, the guidance is being substantively revised in light of comments and will be issued for a second comment period in 2011. Therefore, formulating significance criteria for GHG emissions is problematic, as it is difficult to determine what level of proposed emissions would substantially contribute to global climate change. In the case of wind energy projects, GHG emissions associated with construction would be expected to be somewhat off-set or reduced by the beneficial effects of adding wind energy to the utility grid; therefore, the wind energy project would likely contribute to an overall beneficial impact to global climate change in the region.

<u>Construction Impacts</u>

Estimated GHG emissions associated with construction activities under a range of proposed action scenarios are shown in Table 4.10-3.

**Table 4.10-3. Estimated GHG Emissions under the Proposed Action**

| *Proposed Action Scenario* | *Metric Tons*[1] | | | |
|---|---|---|---|---|
| | *$CO_2$* | *$CH_4$* | *$N_2O$* | *$CO_2e$* |
| One Small Turbine | 103.33 | 0.01 | 0.10 | 134 |
| Four Small Turbines | 413.33 | 0.04 | 0.39 | 536 |
| One Medium Turbine | 206.67 | 0.02 | 0.20 | 268 |
| Four Medium Turbines | 826.67 | 0.08 | 0.78 | 1,071 |
| One Large Turbines | 413.33 | 0.04 | 0.39 | 536 |
| Four Large Turbines | 1,653.34 | 0.16 | 1.57 | 2,142 |

*Notes:* [1]$CO_2e = (CO_2 * 1) + (CH_4 * 21) + (N_2O * 310)$
*Source:* [2]CEQ 2010.

GHG emissions associated with construction of the proposed action would range from 134 metric tons of $CO_2e$ level for a single small turbine to 2,142 metric tons of $CO_2e$ level for four large turbines. Based on an estimated 7,054 million metric tons of GHG emissions from all construction in the U.S. in 2006 (USEPA 2008) construction associated with the proposed action would account for less than 0.000030%

of total annual $CO_2e$ emissions generated by the U.S. Therefore, construction activities associated with the proposed action would minimally contribute to global climate change.

Operational Impacts

Operational impacts would be the same as those discussed under *Analysis Item AQ-1*. Operation of the wind turbines proposed under the proposed action would result in a reduction in GHG emissions and other harmful air pollutants. Therefore, the proposed action would minimally contribute to global climate change and beneficial impacts to air quality would occur.

- *Analysis Item AQ-3: Would the proposed action result in impacts to Class 1 areas?*

Determination of impacts on visibility within Class I areas usually focuses on stationary emission sources, as mobile sources are generally exempt from permit review by regulatory agencies. However, Section 169A of the CAA states the national goal of prevention of any further impairment of visibility within Class I areas from man-made sources of air pollution. In regard to the potential for project emissions to impact air quality within a nearby Class I area, a project site within a Class I area would be excluded from further consideration if project emissions would represent a substantial increase from existing emissions generated by the affected air basin or region. For project sites located within a Class I area, a site-specific analysis would need to demonstrate that new emissions emitted from a proposed major stationary source or major modification, in conjunction with other applicable emissions increases and decreases from existing sources, would not cause or contribute to a violation of any applicable NAAQS or PSD increment.

As shown in Tables 4.10-1, and 4.10-3, construction emissions would be minor and would not exceed *de minimis* thresholds of a nonattainment or maintenance area, regardless of the severity of the affected air basin. Furthermore, operations of the wind turbines would result in a reduction in GHG emissions and other harmful air pollutants. Therefore, the proposed action would not impact any Class 1 areas and beneficial impacts to air quality would occur.

## 4.11 UTILITIES

- *Analysis Item UT-1: Would installation of the wind turbine(s) and associated infrastructure (e.g., new power lines) conflict with existing utility systems (e.g., power lines or buried pipelines)?*

An important factor to consider in evaluating potential impacts of the proposed wind turbines is the location of each of the multiple buried and overhead utilities at the proposed turbine sites. Impacts could occur if new underground power lines are placed too close to existing natural gas pipelines, if equipment used in the construction of new underground electrical lines damages an existing utility line carrying natural gas, or if an overhead line is too close to an existing power line. However these types of impacts would be avoided through coordination with the appropriate utility companies that operate in the area prior to initiating any construction activity. The "One-Call Center" nearest to the proposed project site would be contacted to obtain detailed information on the location and depth of all utility lines in the project area. The applicable utility company would send a representative to the proposed project site to mark the location of existing lines with pin flags (Alliant Energy 2007).

If existing utilities are identified within the project footprint and would potentially be impacted by construction activities, the project footprint or any trenching/excavation activities would be realigned to avoid impacts to existing utilities. Therefore, with implementation of the procedures discussed above, only minor impacts to existing utilities infrastructure would occur.

➢ *Analysis Item UT-2: Would the additional power generated by the new wind turbine(s) require installation of additional power lines?*

Another important factor to consider is the capacity of the existing electrical lines. Adverse impacts to utilities would occur if existing power lines have insufficient capacity resulting in a strain on the existing electrical lines. Wind is kinetic energy, which is converted to electricity by an induction generator (American Wind Energy Association 2005), and the electricity generated is connected to an existing electrical line. However, electricity generated from wind is highly variable due to frequent changes in wind speeds. This intermittent generation of power has resulted in major challenges in maintaining stability of existing electrical grids (Claverton Energy.com 2010). This intermittent nature of wind speed could impact the proper functioning of the existing electrical grid, if appropriate controls are not installed and additional capacity is not built into the electrical grid system.

Excess electricity delivered to an existing electrical line from the wind turbines would strain the existing electrical system, so that the operation of the system becomes unstable (Barth et al. 2006). The strain on the system could be caused by insufficient generating capacity, insufficient transmission line capability, or increased load (City of Palo Alto 2010). The options available to address the problem would be to add capacity, reduce the load, or provide additional electrical lines.

The existing capacity and any necessary upgrades, modifications, or need for installation of additional power lines to accommodate project electricity generation would be established in an Interconnect Agreement between the MARFORRES facility and electricity utility company (refer to Section 2.3.1.2).

Under the proposed action, the power output at full generation capacity would range from less than 0.1 MW for a single small turbine to a project maximum of 10 MW for 4 large turbines. For a relatively small increase in electricity (i.e., 0.1 to 0.5 MW) existing electrical lines would typically have sufficient capacity; however, for larger increases up to 10 MW, existing capacity could be exceeded and place a strain on the existing electrical lines. However, prior to any connection to the existing power grid, an Interconnect Agreement would be established between the MARFORRES facility and applicable electricity utility company (refer to Section 2.3.1.2). If existing electrical lines do not have sufficient capacity built into the system that is capable of handling the power generated by the proposed turbines, then any necessary upgrades, modifications, or need for installation of additional power lines to accommodate project electricity generation would be outlined in the Interconnect Agreement and would be implemented as part of the proposed action prior to connection to the area's electricity distribution grid. Therefore, no impacts or minor impacts to electrical utility systems would occur with implementation of the proposed action.

## 4.12 AIRSPACE

New or proposed changes to land use may result in a need to modify the existing airspace structure. It is important to identify and examine the current baseline use of all airspace within the proposed small-scale wind energy development site's region of influence in determining any potential impacts the proposed action may have on air traffic management in this region. A 27 September 2006, DoD report titled *The Effect of Windmill Farms on Military Readiness* identifies similar conflicts with air defense radar, which can extend for tens of miles from the radar facility due to atmospheric refraction. In addition, interference with microwave transmissions is another form of EMI that is of concern because public safety radio systems typically use microwave-based technologies.

➢ *Analysis Item AS-1: Does the proposed project pose an operational problem for a particular airport resulting in a FAA issued DOH?*

FAR Part 77 contains a Subpart (c) titled *Obstruction Standards* (14 CFR Part 77). These standards define imaginary surfaces in the airspace around an airport that determine the acceptable height of proposed structures. If a proposed structure is higher than the imaginary surface, further study would be required to determine if the wind turbines would have an actual "Operational Impact" on flight activities. Most imaginary surface penetrations are not necessarily determined by FAA to be "Hazards" unless they pose an operational problem for a particular airport. If an imaginary surface is penetrated by a constructed object (e.g., a wind turbine), the FAA then does an extended study to determine whether the turbine poses an operational problem for the relevant airport or for a specific visual flight route between airports. If the penetration does not pose an operational impact it may be determined not to be a hazard.

The proposed action involves the design, construction, and operations of wind energy projects, which could pose an operational problem for a particular airport. As indicated in Table 2-1, turbine heights would range from less than 180 ft in height for a small turbine to up to 495 ft for a large turbine. As required under FAR Part 77, MARFORRES would file of Notice of Proposed Construction with the FAA for all proposed wind turbines over 200 ft AGL. A notice would also be required for turbines smaller than 200 ft AGL if they are closer than 20,000 ft to a public use airport with a runway over 3,200 ft in length. In this case, the filing requirement is based on a 100:1 slope from the closest runway.

If the FAA issues a DNH, then the project site can be carried forward for consideration. If an NPH is issued by the FAA, then MARFORRES would either negotiate with the FAA to determine an acceptable height for the proposed turbine or relocate the turbine to site for which a DNH has been issued. Once an acceptable height has been negotiated, the FAA would issue a DNH for the modified turbine. If an acceptable negotiated height cannot be reached, MARFORRES may request the FAA to develop a departure procedure to divert a flight away from an impacted area or increase a climb gradient to overcome the 40:1 slope. If no agreement can be reached, the FAA would issue a DOH and the proposed turbine installation would not be carried forward. Therefore, through compliance with FAR Part 77 and negotiation with the FAA, impacts to airspace management, aircraft safety, or use of airspace around an airport would be avoided or minimized.

➢ *Analysis Item AS-2: Does the proposed project effect VFR or IFR operations in the navigable airspace?*

The FAA requires that a Notice of Proposed Construction (Form 7460-1) be filed for any object that would extend more than 200 ft AGL. FAA also requires this notice for objects closer than 20,000 ft to a public-use airport with a runway more than 3,200 ft long (14 CFR Part 77). The criteria detailed in this section supplement those contained in FAR Part 77 and address those protected airspace areas that, if penetrated by proposed wind turbines, would produce an FAA Aeronautical Study Determination of Hazard to Air Navigation.

- VFR Operations (Routes and Traffic Patterns):
    - *VFR Routes:* Obstacle height and visibility are of paramount importance due to the randomness of VFR routes of flight. The FAA automatically considers an object with a height of over 499 ft AGL to be a hazard if it is within 2 statute miles of a known VFR route. Since most current turbine designs do not exceed 499 ft AGL, this particular criterion may not represent a serious limitation.

- *Traffic Patterns:* Structures in traffic patterns near an airfield may be obstructions or a distraction to pilots during a critical phase of flight. Most late generation wind turbines exceed a protective height level within traffic patterns. Turbine heights could be limited within a distance of 2 NM from Category A airports and 5 NM from Category D airports. There are some exceptions to these standards based on shielding (i.e., other nearby tall obstacles) or a site location on much higher ground than the airport.

- IFR Operations (Departures, Arrivals, and Enroute):
  - *Departures:* Most protected departure areas begin at the end of an airport runway at the runway elevation. Within the primary area of a departure path area, a 40:1 slope forms the base of protected airspace (FAA 1999); no obstacle can penetrate this surface. This could cover a distance of many miles if the departure point elevation is greatly lower than the site elevation of a proposed structure.
  - *Arrivals:* The length of an approach area for arrivals can range from 4 to 7 miles from the airfield. The usual protection angle for vertical navigation is a 34:1 slope starting at 200 ft from the end of the runway. Structure heights within these areas cannot be higher than this imaginary surface. Proposed wind turbine structures within these areas would almost never be approvable due to the shallow slope of the protected airspace.
  - *Enroute:* Minimum enroute altitudes are the lowest enroute altitude levels that can be assigned to aircraft. This minimum altitude ensures that a pilot can safely avoid obstacles and receive navigation aid reception throughout the assigned route (FAA 2010b,c). Vertical separation for obstacles along these routes varies; it can be a separation of 1,000 ft from the obstacle to the lowest usable altitude in non-mountainous areas, or a separation of 2,000 ft in mountainous areas.

The proposed action involves the design, construction, and operations of wind energy projects, which could result in impacts to VFR and IFR operations. MARFORRES would file of Notice of Proposed Construction with the FAA for projects as required under FAR Part 77. An NPH or DOH could be issued for possible impacts to arrival and departure flight paths at sites in close proximity to the airfields, but impacts to enroute VFR and IFR flight traffic would not be expected. However, if negotiations with the FAA cannot result in a DNH, then the proposed turbine installation would not be carried forward. Therefore, through compliance through FAR Part 77 and negotiation with the FAA, impacts to VFR or IFR operations in the navigable airspace would be avoided or minimized.

Site-specific studies and coordination with the FAA, airspace managers, range managers and users would occur for each potential project site. Application of siting and design criteria would ensure compatibility with air/ground operations and training requirements and that turbines are placed beyond and/or below Air Traffic Control Radar systems line of sight; would avoid creating collision hazards for low flying aircraft; and would not interfere with weapons firing. As a result, there would be no significant impact on airspace.

- *Analysis Item AS-3: Does the Proposed Project Result in EMI (Radar, Television Interference, FM Radio Interference, Cellular Phone, Satellite Services):*

EMI includes interference with radar; television and FM radio signals; and cellular phone and satellite services as outlined below:

- *Radar*: Wind turbines can degrade performance of ATC or air defense radar, as well as other navigational and Doppler (weather) radars. This includes sudden or intermittent appearance of radar contacts at the location of the wind turbine either because of blade motion or because of rotation of the turbine to face the wind. Radar interference is generally limited to wind turbines that are within line of sight. Studies indicate that this problem may be minimal for turbines more than 5 NM from the radar.
- *Television Interference*: Wind turbines can affect television signals. This type of interference is generally characterized by video distortion (i.e., jittering of picture that's synchronized with the wind turbine blade rotation). The effect is principally on analog technology trying to pull television signals from 30 to 60 miles away through a wind farm. Most satellite television services are not susceptible to this issue. However, this particular EMI issue may worsen as the country switches to high definition television because that signal is a synchronized computer bit stream that is even more vulnerable to this kind of interference.
- *FM Radio Interference*: EMI effects on FM broadcast have been observed in laboratory simulations. This type of effect appears in the form of a background "hiss" superimposed upon the FM sound. The research conducted for wind turbines concluded that the effects of wind turbine EMI on FM reception was negligible except possibly within a few tens of meters from the turbine.
- *Interference with cellular phones*: Since cellular radio is designed to operate in a mobile environment, it is thought to be comparatively insensitive to EMI effects from wind turbines.
- *Interference with satellite services*: Satellite services using a geostationary orbit are not likely to be affected because of the elevation angle in most latitudes and the antenna gain.

The proposed action involves the design, construction, and operation of wind energy projects, which could result in EMI. There are still unanswered questions concerning whether wind turbine frequencies could generate EMI and the extent of these effects. Therefore, EMI impacts could occur at sites in close proximity to the airfield radar and residential housing. Proposed sites more than 5 NM from an airport run the least risk of the FAA issuing an NPH or DOH on radar concerns. For project sites with potential EMI concerns, siting and design criteria identified in Sections 2.3.2.1 would be used to avoid/minimize EMI-related impacts to airspace. Therefore, EMI-related impacts to airspace would be minor.

## 4.13 HEALTH AND SAFETY

Given adherence to International Electrotechnical Commission standards for wind turbines and to federal and state requirements for worker safety at each wind energy site, the primary health and safety concern is the exposure of members of the public to accidents during construction or operation of the turbine(s).

- *Analysis Item HS-1: Would construction or operation of the wind turbine(s) expose members of the general public, especially children, to health and safety hazards?*

Construction hazards would be similar to those existing at a typical construction site and would be related to the operation of large vehicles and pieces of equipment. With the implementation of measures in Section 2.3.2, appropriate security measures and setbacks would be incorporated to minimize risks to the public.

Implementation of existing military installation security measures at each site would restrict or limit public access to wind turbines and associated equipment. Wind turbines would generally be sited within fenced and monitored locations, and where necessary, additional fencing or security measures could be implemented to further limit access near land uses such as schools or parks frequented by children. A potential safety concern includes the use of aboveground electrical transmission lines. During project planning and construction, existing buried utility lines should be identified and new transmission infrastructure should be sited in compliance with established setback distances from other transmission lines, telephone lines, etc. Implementation of a project health and safety plan during construction would further limit potential safety issues.

The project would be excluded from further consideration if it exposed members of the public, especially children, to hazards. Even a very unlikely accident would potentially exclude a project when the consequences involve serious harm to an individual. The most common type of accident which would pose a hazard to the public involves blades, pieces of blades, or ice breaking and being thrown from the turbine (e.g., see Caithness Windfarm Information Forum 2010). Failure rates of this type for modern wind turbines have been estimated at 1 in 100 to 1 in 1,000 per year (Larwood 2005, Rhode Island Department of Environmental Management 2009). The distance that a thrown turbine blade or piece thereof would travel has been measured empirically in numerous cases, and mathematically modeled (Larwood 2005). In general, areas directly under the turbine are the most likely to be impacted, and the probability of a blade or fragment hitting the ground diminishes exponentially with distance from the base of the turbine.

To provide for public safety, several counties in California, as well as other planning agencies, have recommended or required minimum safety setbacks for public use areas of 1.5 times the total height of the proposed wind turbine. These recommendations, however, are not based on actual data documenting risks to the public (Rhode Island Department of Environmental Management 2009, Larwood 2005). The potential distance that a wind turbine could throw a blade, or part of a blade, depends upon the blade tip speed, which tends to remain constant or marginally decrease as turbine heights increase, because of a corollary decrease in rpm. Maximum potential distances estimated for blade or blade fragment throw range from one to several times the turbine's height (Larwood 2005), the ratio being larger for smaller turbines. These are maximum potential distances, for which the probability of occurrence is remote.

The safety risks of an operational accident as described above in general are likely to be minor, being much less than 0.1%, given the separation of the turbine location from general public as well as from military personnel working at the facility. However, this warrants site-specific analysis in all cases.

### 4.14 HAZARDOUS MATERIALS

- *Analysis Item HM-1: Is there a potential for uncontrolled release of hazardous materials into the environment?*

Construction, operation, and maintenance of wind turbines, as described in Section 2.3.1, would involve the use of small quantities of hazardous materials (e.g., fuel, oil, solvents, hydraulic fluid, antifreeze, lubricant, paints) and generation of hazardous wastes. Any differences in the quantities of hazardous materials used based on construction of various numbers or sizes of wind turbines at a site would be negligible. Appropriate procedures for the handling, storage, and disposal of hazardous materials and wastes would be implemented at each site in accordance with Resource Conservation and Recovery Act and other applicable federal, state, and local regulations. These would include preparation of a site-specific SWPPP for construction activities to include BMPs for spill prevention. In addition, each MARFORRES facility would be required to update its Spill Prevention Control and Countermeasures plan and Hazardous Waste Management Plan. Given the small amounts of hazardous materials used and hazardous wastes generated, impacts would be minor.

➢ *Analysis Item HM-2: Is there pre-existing contamination on the project site?*

For all proposed turbine sites, available data would be reviewed to determine whether IRP sites are known to occur or have the potential to occur. NREL and the USEPA are encouraging renewable energy development on current and formerly contaminated land as these areas often have limited use for other types of development (NREL 2010b, USEPA 2010b). However, as indicated in siting and design criteria identified in Section 2.3.2, locations would be avoided where soil contamination is present in amounts and concentration levels of which make wind energy projects incompatible under prevailing governmental and industry standards. Proper procedures would be implemented for each site, as necessary, to ensure that any contamination is properly identified, evaluated, and remediated to acceptable levels prior to the start of construction activities. During construction, procedures would be established in the event that previously unidentified contamination is encountered. These procedures would include immediately stopping construction activities in the generally vicinity and contacting the installation hazardous materials point of contact. Therefore, impacts from hazardous materials would be minor.

## 4.15 TRANSPORTATION

➢ *Analysis Item TR-1: Would the proposed action result in conflict with public use of roads or waterways?*

Installation of wind turbines at each site would involve the transport of construction equipment and wind turbine components during the construction phase. Typically these materials would be transported to the project site via public roads, including interstate highways, state highways, arterials, and local and collector roads. Impacts from the transport of large equipment or components, particularly turbine tower sections and nacelles, could lead to traffic delays and increase the potential for accidents. Large equipment associated with each turbine would require transport by several heavy trucks traveling at slow speeds (i.e., less than typical traffic flow and often lower than established speed limits). For each additional turbine installed at a particular site or for larger turbines, the higher the number of trips would be required to transport large equipment, so traffic impacts would increase correspondingly. This equipment often also constitutes wide loads which further affect traffic. In some cases, temporary road closures may be necessary to ensure the safe transport of equipment. These impacts would be higher on roads where traffic operates at or near designed capacity, such as urbanized areas.

Some sites may utilize local waterways. However, equipment and components transported by waterway would not likely have a substantial effect on boat traffic since the equipment size is well within the capacity of standard water commerce.

For both road and water transport, coordination with appropriate federal, state, and local agencies (i.e., state departments of transportation, highway patrol, city and county department of transportation, etc.) would be conducted to minimize traffic impacts and potential safety issues. This would include obtaining necessary permits and authorizations. If transportation of turbine components necessitates exclusive use of a public road or waterway, peak use periods would be avoided. Therefore, impacts to transportation during the construction phase would be minor. No impacts to transportation are anticipated during operation of wind turbines.

## 4.16 NO-ACTION ALTERNATIVE

Under the no-action alternative, MARFORRES would not pursue implementation of the wind energy program at MARFORRES facilities in the U.S. and would continue to rely on the electrical grid for purchase of all electricity needs. The no-action alternative for this PEA represents the baseline conditions described in Chapter 3, *Affected Environment*. Therefore, for all resources except air quality, implementation of the no-action alternative would result in no impact to environmental resources. As indicated in Section 4.10, *Air Quality*, implementation of the proposed action would result in beneficial impacts to air quality by reducing GHG emissions through production of electricity from wind power versus fossil fuel-powered electric generation. Therefore, implementation of the no-action alternative would eliminate the potential for beneficial impacts to air quality. However, reduction in GHG emissions associated with the proposed action accounts for only a miniscule portion of total GHG in the U.S.; therefore only minor impacts to air quality would occur with implementation of the no-action alternative.

# CHAPTER 5
# CUMULATIVE IMPACTS

## 5.1 INTRODUCTION

Cumulative impacts refer to the incremental effects of a project when combined with the similar effects of past, present, and future actions. For the proposed action, the potential for cumulative impacts needs to be considered on two levels. First, the effects of the proposed program at multiple MARFORRES facilities throughout the U.S. need to be considered in the context of expanding wind energy development to lessen reliance on non-renewable energy sources nationwide. Specifically, would the proposed action contribute to cumulative impacts on a national scale? Second, would a proposed project site contribute to cumulative impacts on the local scale?

**Key Elements**

***Objectives:***

- Address impacts of the proposed action in combination with the effects of other past, present, and future actions, for each resource/issue area

***Analysis:***

- Cumulative impacts are assessed at two scales:
  - ✓ On a national scale, the proposed action represents a small fraction of the anticipated growth in numbers of wind turbines. Nationally, there are both positive and negative cumulative impacts associated with expanding wind energy development; in either case, the proposed action's contribution would be extremely small.
  - ✓ On the local scale, the effects of each project at a MARFORRES facility would typically be minor, especially with the implementation of siting and design criteria, BMPs, and GCMs as warranted, but the potential cumulative impact would still need to be considered on a resource and site-specific level.

On a national scale, the proposed action represents a very small contribution to the amount of wind energy development that is forecast to occur in the U.S. The proposed action could be implemented at various locations across the continental U.S. The number of turbines associated with the proposed action (up to four per location) would be minimal in comparison to the 23,000 turbines operating today, and 155,000 by 2020 (Section 4.6). The proposed action would represent a small fraction of the total anticipated growth in wind turbine numbers nationwide. In terms of power generation, the project's contribution would be of the same order of magnitude. In combination with other wind energy development, the project would contribute to the overall beneficial cumulative impact associated with reduced reliance on the importation and extraction of non-renewable energy sources, and reduction of GHG emissions. Otherwise, given the project's very small incremental contribution to national wind energy development, contributions to cumulative impacts on any resource are expected to be minor at the national level.

On the local scale, the effects of each project at a MARFORRES facility would typically be minor, especially with the implementation of siting and design criteria, BMPs, and GCMs, as warranted, but the residual impact could still have a cumulative effect when combined with effects of other past, present, and future actions affecting a particular resource and location. This needs to be considered on a resource- and site-specific level as described below.

## 5.2 LAND USE

On the local scale, each proposed wind energy site would impact a relatively small area of land (roughly 0.4 to 2 acres) within the boundaries of a military facility. The siting process within each facility would ensure that the development of a site does not adversely impact the facility's mission and essential activities. Application of siting and design criteria identified in this document would ensure that adjacent public or private lands and activities would not be adversely impacted, resulting in negligible residual impacts to adjacent land uses. In the case of a project that may affect the resources of a state's coastal zone, the avoidance of potential cumulative impacts is an integral part of state and local coastal plans and would be addressed through compliance with federal CZMA coastal consistency requirements. As a result there would be no potential cumulative impacts for land use.

## 5.3 NOISE

Cumulative noise impacts could in theory result if a proposed wind energy development site were to combine with other noise sources and add to local noise levels experienced by sensitive receptors near the site. However, noise levels associated with wind turbines would be inaudible in a relatively noisy environment (e.g., near a busy road [Section 4.3]); hence cumulative impacts would not occur in these types of areas. Where a small-scale wind energy project represents a new source of noise, application of siting and design criteria identified in this document would ensure that potential noise impacts on sensitive receptors would be minimized. The analysis of noise impacts at the site-specific level would consider the proximity of sensitive receptors and ambient noise conditions that might lead to cumulative effects, and would apply the same criteria described in Section 4.3 and application of siting and design criteria identified in Section 2.3.2.1. As a result contributions from the proposed action to cumulative effects for noise are expected to be minor.

## 5.4 GEOLOGY AND SOILS

Impacts on geology and soils would be localized to the immediate area of a site, and where potential impacts arise, they would be controlled through application of BMPs and siting and design criteria identified in this document. As a result, the effect on local geological resources outside of the project site footprint would be negligible or minor, and there would be no potential for cumulative impacts.

## 5.5 WATER RESOURCES

Similar to the situation for geology and soils, any impact on water resources would be localized to the immediate area of a site, and where potential impacts arise, they would be controlled through the application of BMPs and siting and design criteria identified in this document. In particular, if site development were to necessitate placing fill in a drainage or wetland, the project would obtain a Section 404 Nationwide Permit which, by its terms and conditions, would ensure no net loss of functions and values or cumulative degradation of the nation's waters. Compliance with local and regional NPDES requirements would inherently minimize potential cumulative impacts on local water resources. As a result, the effect on local water resources would be negligible or minor, with minor cumulative impacts.

## 5.6 BIOLOGICAL RESOURCES

As discussed in Sections 3.6 and 4.6, potential impacts on biological resources are of two types: impacts on the ground and habitat at the site of wind turbine installation and collision mortality to birds and bats. Ground-based impacts would be localized to the relatively small area of each site, which would be on previously disturbed land within a military reservation and unlikely to contain any protected or important biological resources. Site development impacts would be minimized through application of siting and design criteria, BMPs, and GCMs identified in this document. The potential for cumulative impacts on habitats of concern would be identified through the site-specific evaluation of the rarity and sensitivity of the affected habitat. Requirements for habitat avoidance or mitigation as established in INRMPs or other relevant planning documents reflect a conservation response to previous and potential future impacts on that resource. As such, following these requirements ensures that contributions from the proposed action to cumulative effects on habitats of concern are expected to be minor.

Cumulative effects of collisions with structures on bird and bat populations are an important concern (Manville 2009). Collision-related mortality involving all types of structures can, for many species, affect their overall numbers, use of habitats, ecological relationships, and ultimately their vulnerability to extinction. Circumstances indicating the potential for a cumulative impact at the local level overlap those that indicate a potential impact at the project-specific level and include the presence and vulnerability of bird or bat species to collisions with proposed new turbines, in combination with past, present, and future sources of collision risk that affect the same populations. Of particular concern are the same resource categories identified in Sections 3.6 and 4.6:

- Threatened and endangered bird and bat species;
- Bald and golden eagles;
- Other species of conservation concern; and
- Bird and bat concentration areas associated with migratory flyways or heavily used habitats.

The application of siting and design criteria, BMPs, and GCMs specified in this document will ensure that project locations avoid or minimize the overlap of these sensitive resources, and reduce potential impacts where there is overlap. A key part of each site-specific assessment will be to evaluate the occurrence of these resources with respect to proposed turbine locations and other features in the environment, whether manmade or natural. This will include coordination with local experts, interest groups, and USFWS biologists as appropriate. As such, the assessment would consider and, as appropriate, adjust number, size, and location of turbine(s) to avoid/minimize potential cumulative effects at the local level. Where warranted by concerns over bird and bat fatalities, post-construction monitoring would be conducted to identify the species affected and their number. This information would be used to adjust operational parameters, and it would be shared with local and regional agencies, researchers, and interest groups in support of broader action to reduce impacts to vulnerable species. In addition, GCM number 2 (Section 2.3.2.3) provides for turbine operations to be adaptively managed, and adjustments to be made if warranted by new technology, changing conditions, or new information on the sensitivity and occurrence of bird and bat species. As a result, there is little potential for cumulative impacts.

## 5.7 CULTURAL RESOURCES

Cumulative impacts to cultural resources may accrue from direct or indirect impacts and include visual impacts to historic properties. Potential cumulative impacts of small-scale wind energy development projects must be considered in context with other past and reasonably foreseeable future actions that may or may not be directly associated with proposed projects. Application of siting and design criteria identified in this document, and consultation with the SHPO will ensure potential adverse effects on an historic property would be avoided/minimized. This process ensures that historic properties are not adversely affected. As a result, incrementally minor, adverse effects are not allowed to occur without mitigation that is approved by the state office. Each assessment must consider the condition of the resource and context of the effect, which includes any cumulative effects of other actions. Therefore, any potential cumulative effects would be addressed and minimized through Section 106 compliance.

## 5.8 VISUAL RESOURCES

Two types of visual resources have been considered in this document, views of or from historic properties (discussed in Section 5.7, *Cultural Resources*) and recreational views. In analyzing recreational views, the policies of the affected jurisdiction (e.g., state highway system, park district, national forest, etc.) would be referenced to determine significance. For potential visual impacts on sensitive viewpoints, the site-specific analysis evaluates the effect of adding the proposed turbine(s) to the field of view. Existing natural and manmade features are part of the analysis, including the sensitivity of the view and the degree to which a new project alters it. Where a wind energy project would affect the viewshed of a recreational use area, application of siting and design criteria identified in this document would ensure that potential visual impacts on the viewshed be avoided and/or minimized. As a result there is little potential for cumulative impacts to visual resources.

## 5.9 SOCIOECONOMICS

The socioeconomic impacts of small-scale wind energy projects would be small, but beneficial in terms of local employment. No adverse socioeconomic impacts on disadvantaged groups, neighborhoods, or children are anticipated. As a result, no cumulative socioeconomic impacts would occur.

## 5.10 AIR QUALITY

Potential cumulative impacts on air quality would be beneficial as net GHG emissions would be reduced. Cumulative air quality benefits include reducing the rate of climate change and reducing the emissions associated with the extraction, importation, and burning of fossil fuels for power generation.

## 5.11 UTILITIES

Potential cumulative impacts on utilities would be addressed through site planning and the required permits and authorizations for installing new connections to the electrical grid. Potential effects of electricity generation by wind turbines on the grid are addressed in consultation with the responsible utility on the design and safety requirements for the new connection(s). While the electricity generation associated with the turbine(s) would have a net beneficial effect, varying wind speeds would result in surges in electricity generation that need to be accommodated through the grid without interrupting service for other users (Section 4.11). Utilities may require additional fees or establish rates that allow them to upgrade infrastructure, as necessary, to accommodate variations in power supply from local wind energy producers. Coordination with the local utility and implementation of its requirements for new wind power connections to the grid would ensure that adverse cumulative impacts do not occur.

## 5.12 AIRSPACE

The project review process with FAA and other stakeholders for airspace and radar use ensures that any potential cumulative effects associated with height obstruction or radar interference would be identified and avoided. Coordination with local military installations, USCG, and National Doppler Radar Sites as applicable would similarly identify and avoid potential conflicts. As a result, cumulative impacts would not occur.

## 5.13 HEALTH AND SAFETY

The proposed small-scale wind energy projects would not adversely affect health and safety. As a result, no cumulative impacts would occur.

## 5.14 HAZARDOUS MATERIALS

Construction, operation, and maintenance of wind turbines would involve the use of small quantities of hazardous materials and generation of hazardous wastes. However, appropriate procedures for the handling, storage, and disposal of hazardous materials and wastes would be implemented at each site in accordance with Resource Conservation and Recovery Act and other applicable federal, state, and local regulations. As a result, the impacts from hazardous materials would be negligible or minor at each site and there is little potential cumulative impacts.

## 5.15 TRANSPORTATION

Transportation impacts would be minimal and temporary, limited to the use of road, rail, or waterways to transport equipment to a site for construction. By following the protocols identified in this document, potential conflicts with other users of transportation systems would be avoided during construction. As a result, cumulative impacts would not occur.

# CHAPTER 6
# OTHER CONSIDERATIONS REQUIRED BY NEPA

**Key Elements**

***Objectives:***

- Address additional requirements for NEPA analysis

***Issues addressed:***

- The proposed action would involve a relatively small commitment of natural and/or finite resources to small-scale wind energy projects
- Small-scale wind energy projects would not impede long-term natural resource productivity at individual sites or collectively
- This PEA proposes measures that would avoid all potentially significant impacts.

## 6.1 Irreversible Or Irretrievable Commitment Of Natural Or Finite Resources

Resources that are irreversibly or irretrievably committed to a project are those that are used on a long-term or permanent basis. This includes the use of non-renewable resources such as minerals and fossil fuels. These resources are irretrievable in that they would be used for a project when they could have been used for other purposes. Human labor is also considered an irretrievable resource. In addition, the unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment is also considered an irreversible commitment of resources. Finally, the unavoidable destruction of prehistoric cultural resources is considered irreversible as these are nonrenewable resources that are finite.

The proposed action involves a relatively small commitment of natural and/or finite resources at any individual site or collectively to all sites.

## 6.2 Relationship Between Local Short-Term Use Of The Human Environment And Maintenance And Enhancement Of Long-Term Natural Resource Productivity

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development option reduces future flexibility in pursuing other options, or that giving over a parcel of land or other resource to a certain use often eliminates the possibility of other uses being performed at that site. Because of the small scale and locations of the proposed wind energy projects, the proposed action would have negligible effects on long-term productivity at any site or collectively for all sites.

## 6.3 Means To Mitigate and/or Monitor Adverse Environmental Impacts

With the implementation of siting and design criteria, BMPs, and GCMs, as presented in Section 2.3.2, under the MARFORRES winder energy program, wind energy projects at individual sites would be sited and design so as to avoid and/or eliminate significant environmental impacts. Monitoring of avian and bat collisions with turbines may be developed for individual sites, pending consultation with USFWS.

# CHAPTER 7
# REFERENCES

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# APPENDIX A
# CORRESPONDENCE AND PUBLIC COMMENTS

Attachment

**U.S. Fish and Wildlife Service Comments on the Previous (November 2010) U.S. Marine Corps Draft Programmatic Environmental Assessment for Small-Scale Wind Energy Projects**

## <u>General Comments</u>

The Service recommends adding a section on post-construction monitoring and a section on an
adaptive management plan. These sections could be inserted in Section 2.3, Proposed Action. 1
Post-construction monitoring is necessary to evaluate the accuracy of pre-construction biological effects analyses and for detecting and reporting any fatalities. An adaptive management plan will provide USMC with options that may be used if biological effects are greater than expected. The Department of the Interior's Adaptive Management Technical Guide would be useful in developing such a plan: http://www.doi.gov/initiatives/AdaptiveManagement/index.html

Please note also that in some cases, the local USFWS Field Office has already coordinated with 2
U.S. Marine Corps (USMC) staff and their contractors to review existing information, discuss wildlife issues, and plan pre- and post-construction studies for individual projects.

The PEA focuses on impacts to bird and bat species, specifically on migratory birds, raptors, and
listed bat species. Due to the high rates of bat fatalities at wind facilities, in combination with 3
other cumulative impacts (e.g., white-nose syndrome, habitat loss), the USFWS is also concerned about potential impacts to non-listed bat species. It is possible that several bat species may be listed in the future because of the many new stressors on bat populations. For these reasons, we recommend that the USMC consider the effects of its proposed actions on non-listed bat species.

<u>Riverton, Utah Site</u>:

The proposed Riverton, Utah, site on the east side of the Camp Williams National Guard
training installation is located between Utah Lake and the Great Salt Lake and is an 4
important and active migratory bird flyway. Camp Williams identifies in its Integrated Natural Resources Management Plan sightings of 18 species of waterfowl, shorebirds, and wading birds; 12 species of hawks and owls; three bat species; and the presence of many raptor nests, including four golden eagle nests on the installation. The EA does not identify the exact location planned for the turbines, although it is likely they would be co-located with the two existing turbines operated by Camp Williams. This location is in proximity to a golden eagle nest as well as a perennial stream and high value riparian corridor. American white pelicans, a State sensitive species, are frequently seen flying this corridor, and the area is documented to have a high diversity of neotropical migratory bird species.

We recommend the Marine Corps conduct a site-specific evaluation of impacts to these resources. This assessment should include a cumulative effects analysis given the existing wind turbines and other local impacts (e.g., new transit, roadway, residential and other development). We recommend the Marine Corps work with the Camp Williams natural resource staff and the USFWS Utah Ecological Services Field Office to identify appropriate mitigation measures as necessary. 4 continued

**Purpose and Need for Proposed Action (Chapter 1)**

Section 1.5.3, Migratory Bird Treaty Act (MBTA) and E.O. 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) 5

Section 1.5 provided a summary of environmental laws that the proposed action would have to comply with. Section 1.5.3 notes that, "the MBTA does not provide for the regulation of structures that pose a collision risk to migratory birds; hence there is no permit or consultation requirement for wind turbines associated with the MBTA." This section goes on to state that EO 13186 provided more specific direction to federal agencies to conserve migratory birds.

This section should be amended to note that the MBTA has no provision for allowing unauthorized take of migratory birds. Unlike the Endangered Species Act, neither the MBTA nor its implementing regulations at 50 CFR Part 21, provide for permitting of "incidental take" of migratory birds. The Service's Office of Law Enforcement could hold individuals, companies, or agencies responsible for the unauthorized take of migratory birds.

**Proposed Action and Alternatives (Chapter 2)**

We recommend that consideration be given to off-site alternatives. While it is understood that the USMC prefers to develop turbines on their own property, if substantial fish and wildlife impacts are predicted at any of the sites currently under consideration, it may be feasible to site turbines on adjacent properties through partnerships, lease agreements, or acquiring development rights. We suggest the USMC explore this option. 6

**Affected Environment (Chapter 3)**

Sections 3.3 and 4.3 – Noise

The noise standards cited are related to human perception and effects. Because wildlife species often use different portions of the auditory spectrum, and often for purposes we are just now beginning to understand, the effects of noise to wildlife receptors should also be considered. 7

Section 3.3.3 – Existing Conditions

Page 3-9, Line 10 – "The Jamaica Bay National Wildlife Refuge (operated by the USFWS)…" 8

Please note that the correct name is the Jamaica Bay Wildlife Refuge and that it is administered by the National Park Service.

Section 3.6.2, Regulatory Setting – As previously noted, this section should note that the 9
MBTA does not have a provision that allows for unauthorized take.

Section 3.6.3, Existing Conditions – We note that the PEA refers to the USFWS's link for the Information, Planning, and Conservation (IPaC) system for section 7 consultation. Although
the online system is up and running, it is not yet fully operational. 10

To address potential impacts to federally listed species, we recommend that USMC initiate the section 7 process by obtaining an official species list and following the online application at http://www.fws.gov/midwest/Endangered. Through internal review and analysis, USMC can make a determination(s) regarding whether listed species would be impacted by the project. The USMC should review the Standard Operating Procedures to assist in completing the section 7 process and making a determination(s): http://www.fws.gov/midwest/Chicago/documents/Section%207%20Standard%20Operating%20Procedure.pdf.

For additional guidance on the critical habitat for the Great Lakes piping plover population, USMC should refer to the following:
http://www.fws.gov/midwest/Chicago/documents/Piping%20Plover%20CH%20guidance.pdf 11
http://www.fws.gov/midwest/Chicago/documents/Piping%20Plover%20CH%20guidance%20table.pdf.

Sections 3.6. and 4.6 – Biological Resources

The analyses of potential biological effects discussed in the draft PEA are largely focused on 12
avian or bat collision mortality/injury. Effects to habitat and behavior should also be considered, including the potential for displacement of individuals due to habitat loss, modification, or fragmentation, or habitat avoidance because of the presence of wind turbines.

Considering the resources listed on Table 3.6-1, "Biological Resources at Priority Sites," 13
many proposed sites contain at least one of the exclusionary criteria for project siting mentioned in Section 2.3.2.1. Federal and state listed species are found on these sites.

Table 3.6-1 – Biological Resources at Priority Sites – This table indicates that for the Great 14
Lakes, IL site, Lake County is known to support populations of the federally endangered Indiana bat. To our knowledge this statement is not accurate and according to our records, there are no known occurrences of Indiana bat in Lake County, IL.

Table 3.6 also notes that the coastal wetlands and nearshore waters near the Great Lakes, IL site are known to be used by over 10,000 ducks and geese as breeding habitat and as a stop-over area during migration. While it is true that waterfowl use the coastal wetlands and nearshore waters for breeding and during migration, numerous other birds besides waterfowl use the Lake Michigan coastline as an important migratory pathway as well and should be recognized. These other species will be discussed below.

Table 3.6 does not currently acknowledge the migratory birds from the Service's Region 3 Fish and Wildlife Resource Conservation Priorities (RCP) list or the Service's 2008 Birds of Conservation Concern (BCC) list for the Great Lakes, IL site, under the Other Species of Concern column. We recommend that the birds from these lists that could be in the vicinity of the Great Lakes site be included. The birds from these lists will be discussed below. 14 continued

Section 3.6.3.4, Great Lakes, IL – This section mentions one Important Bird Area (IBA) near the proposed site, Illinois Beach State Park (IBSP), as well as the federally endangered piping plover (and its critical habitat) and state listed bird species in the county. We believe that the information provided in this section does not fully represent the importance of the Lake Michigan shoreline as a migratory route for birds.

The eastern alternative for the Great Lakes site would be on the Lake Michigan shoreline while the interior alternative would only be two miles west of the Lake Michigan shoreline. The Great Lakes provide major migratory flyways for migratory birds and migration flights. Migration flights are generally concentrated along the shorelines, where birds may stop and rest during inclement weather. The Service is developing a policy statement regarding avoidance of wind power development within a protective buffer along Great Lakes shorelines.

There is a great deal of evidence that shows that heavy concentrations of migrating birds move along the Lake Michigan shoreline. These birds include raptors, waterfowl, shorebirds, and multiple songbird species. Falcon migration down the western shore of Lake Michigan is the largest known inland flight path (Robert Russell, USFWS, personal communication). Greenberg (2004) notes that falcon migration (fall) is "virtually confined to the Lake Michigan shore."

The merlin migration along the lakeshore is the largest known migration pathway away from the Atlantic coast. Online data from HawkCount, the Hawk Migration Association of North America website that tracks and reports raptor migrations, show that the maximum daily count for the merlin migration was 708 (October 9, 2007) at IBSP. The peregrine falcon migration along the lakeshore is the largest known inland movement away from the coasts and has numbered as many as 85 in a single day (October 9, 2007). HawkCount data from IBSP also shows that hawk migration numbers can also reach high maximum daily counts, with broad-winged hawk numbers as high as 3,193 (September 24, 2003).

Other bird experts from the Midwest have also recognized the importance of the Lake Michigan shoreline and have identified some attributes of migration and stopover sites along the western and southern shores of the lake:

- The Great Lakes are large geographical barriers to migration (Diehl et al. 2003; Bonter et al. 2009).
- The Lake Michigan coastline is important as a fall-out area for migrating birds (Brawn and Stotz 2001; Diehl et al. 2003; Greenberg 2004).
- More land birds migrate over land than the Great Lakes, especially in spring. Birds migrating over the Great Lakes exhibit "dawn ascent" and reorient to the nearest shore if within 28 km of the coast (Diehl et al. 2003).
- Some migrants seem to be concentrated on the lakefront (white-throated sparrow,

*Empidonax* flycatchers, ruby-crowned kinglet, common yellowthroat, Cape May warbler, Wilson's warbler) and others inland (vireos, great crested flycatcher, Eastern wood pewee, rose-breasted grosbeak, Baltimore Oriole, chestnut-sided warbler, black-throated green warbler, bay-breasted warbler) (Brawn and Stotz 2001; Brock 1992). 14 continued

- Higher average number of migrants along the lakeshore but less variation in numbers at inland sites, at least during spring migration. Largest number of migrants on the lakeshore with southwest winds, lowest numbers with onshore winds (Brawn and Stotz 2001).

The above information highlights the importance of the Lake Michigan shoreline for spring and fall migrations. The proposed locations for the Great Lakes, IL site could result in potentially large numbers of avian fatalities based on the evidence of birds that migrate along the Lake Michigan shoreline.

Besides the birds listed in this section of the PEA, other species listed above such as the Service's RCP and BCC lists should be included in the PEA as well. Both lists include bird species that are listed due to their rare or declining status (e.g., state listed species) and therefore, have a need for special conservation attention. The RCP list also includes species that are listed due to their recreational value (e.g., waterfowl). The PEA mentions some birds that are on both lists, such as the bald eagle and several of the state listed birds. However, there are several species that are on both lists that are not mentioned in the PEA. 15

The PEA should also indentify other IBAs in close proximity to or along the Lake Michigan shoreline where birds could be impacted. Other IBAs include: the Naval Station Great Lakes (for common tern), the Chicago Lakefront (for migrating landbirds), and the Lake Calumet.

This section mentions the piping plover and its critical habitat as it relates to federally listed species. Guidance has been provided for USMC to address potential impacts to federally listed species. It should be noted that the federally endangered Kirtland's warbler has been observed several times during migration at Whiting Lakeshore Park, located at the southern shoreline of Lake Michigan, and may migrate along the western side of Lake Michigan to reach breeding grounds in central or northwest Wisconsin. The piping plover and Kirtland's warbler have the potential to move through the area during migration. Additionally, a pair of piping plovers nested near IBSP in 2009. Stopover use by piping plovers has been observed several times along the Lake Michigan shoreline in Cook and Lake Counties over the last few years (including another plover documented near IBSP on May 6, 2010). Therefore, there is the potential for both listed bird species to be found in the project area. 16

As mentioned above, raptor migration is extensive along the western shore of Lake Michigan. Raptor migration includes the migration of both the bald and golden eagles. Both species are known to migrate in the vicinity of the proposed action area. Section 1.5.4. provides detail about the Bald and Golden Eagle Protection Act and notes that the Service is in the process of developing regulations that would provide more specific requirements for bald and golden eagle protection. Although the Service has issued permits for nesting bald and golden eagles, it is unlikely that the Service would issue a permit for the take of a bald or golden eagle in a migration corridor.

16 continued

Finally, as mentioned above, the Indiana bat has not been found in Lake County, IL. However, due to the high rates of bat fatalities at wind facilities, in combination with other cumulative impacts (e.g., white-nose syndrome, habitat loss), we are concerned about possible impacts to other bat species. Furthermore, we are concerned about other bats that are not currently listed and the possibility that these other bat species could be listed in the near future.

<u>Sections 3.13 and 4.13 – Health and Safety</u>

Please consider the potential for "ice-throw" from turbine blades. 17

**<u>Environmental Consequences (Chapter 4)</u>**

<u>Section 4.6, Biological Resources</u> – The USMC provides information about the protocols and criteria for each of the three alternatives. The PEA indicates that the impacts of the corresponding alternatives are unlikely to be significant (provided the proposed protocols are followed, the criteria are used to assess significance, and potential mitigation measures are implemented where the need is indicated) but that site specific analyses would be required, according to the protocols. The PEA does note that site-specific NEPA analysis, including review of potential mitigation measures, may show that an impact cannot feasibly be mitigated, in which case the location would be dropped from consideration. A site with a significant impact, indicating the need to prepare an environmental impact statement, would not be pursued under this program. 18

Due to the aforementioned importance of the Lake Michigan shoreline, we do not concur with USMC findings regarding the Great Lakes, IL site. USFWS concurrence of USMC findings would require section 7 consultation and appropriate avian and bat studies.

The protocols and criteria considered: 1) destruction or degradation of habitat; 2) the presence of federally listed species; 3) the presence of bald and golden eagles; 4) determination if a site is within a regional migratory flyway; and 5) the presence of bird species of conservation concern. Based on the location of the Great Lakes, IL site (both alternatives) and the information provided, all of the categories need to be considered for all three alternatives, except for the destruction or degradation of habitat.

Due to the evidence that piping plover has stopped at various locations along the western Lake Michigan shoreline, that piping plover critical habitat is approximately four miles north of the Great Lakes, IL site, and the high number and diversity of birds that migrate along the Lake Michigan shoreline, we could not conclude that impacts would not be significant for any of the three alternatives.

Bat information for this section shows a range that goes up to 41.1 for bat mortality at wind energy developments. More recent studies for wind facilities in Wisconsin have shown that 19 bat fatality per turbine per year numbers could be even higher. The estimated bat fatality per turbine per study period for these studies was 40.54 for Blue Sky Green Field (2008-2009), 50.5 for Cedar Ridge (2009), and 70.7 for forward Energy (2008). These higher numbers should be noted in the PEA. 19 continued

<u>Section 4.6.3, Alternative 1 – Small Turbines</u> –

**Page 4-29, Line 33:** *"Due to the relatively small scale of each of the projects (one to four small turbines), impacts to bird and bat species would be correspondingly small. The potential for these types of impacts would be limited and of much smaller magnitude than from large wind farms, which are typically built in large areas of open space or range land containing native habitat."* 20

This statement is not necessarily true. A poorly sited small project may have the potential to cause very significant biological effects. We recommend rephrasing this statement to indicate that the risk of impacts to wildlife is firstly dependent on siting.

**Page 4-30, Line 23 –** *"Accordingly, it would be inappropriate to use this average mortality rate to predict mortality across a range of sites and project scales solely on the basis of MW output."* 21

Please note that turbine MW rating (or "nameplate rating") is not the same as turbine megawatt-hour (MWh) output. Most studies of collision mortality use a MW rating. A MW rating provides no information about the actual electrical output (MWh), which is an indication of the degree that the blades were turning during the study period.

**Page 4-31, Line 1 –** *"Night-flying migrants are unlikely to collide with small wind turbines because the rotors are below the heights at which most migrants fly."* 22

It is important to note that episodic collision events are possible with small wind turbines, especially during nights with low visibility (e.g., fog, low cloud cover) or when birds are ascending after take-off or descending to land. An example of a small wind turbine with an increased risk of bird mortality would be placing turbines in migration stopover areas where birds fly at lower altitudes to access roosting and feeding habitat.

**Pages 4-32 and 4-33 –** We note that the bird and bat mortality data found in Tables 4.6-1 and 4.6-2 is limited to studies conducted prior to 2007. This information should be updated with more recent studies. 23

<u>Section 4.6.4, Alternative 2 – Medium Turbines</u> –

**Page 4-37, Line 26 (and elsewhere) –** *"Because of the greater height (roughly twice as high, depending on design) and sweep area (roughly four times as large, depending on design) of turbines for this alternative, the potential impacts are correspondingly greater than for Alternative 1."* 24

This is contradicted by the statement on Page 430, Line 20, *"However, it should be noted that there is no significant correlation between the size of the turbines and the rate of mortality."* 24 continued

USFWS emphasizes that turbine location, not necessarily size, may be more directly related to biological effects.

Section 4.6.6, Potential Mitigation Measures –

**Page 4-42, Potential Mitigation Measure BR-8 – "***Turbine feathering, or pitching the blades of the turbine so they are parallel to the wind in low wind conditions, would aid in reducing collisions."* 25

This technique is proving very useful for reducing bat mortality at wind facilities. We support the implementation of blade curtailment protocols at wind projects where bats occur.

**Page 4-42, Potential Mitigation Measure BR-9 – "***Consider temporarily turning turbines off in areas with high concentrations of migrating raptors, passerines, and bats, and areas of high concentrations of over-wintering raptors or during peak raptor use periods."* 26

We also support the temporary shut-down of turbines during specific periods when wildlife concentrations are high. The draft PEA should indicate a commitment for close coordination with the USFWS regarding the development and implementation of turbine operational adjustments.

**Cumulative Impacts (Chapter 5)**

The USMC acknowledges that cumulative effects of bird and bat collisions with anthropogenic structures would occur. However, USMC notes that due to the proposed mitigation strategies, significant cumulative impacts would not occur. Based on the information already provided in the PEA regarding bird and bat impacts with other anthropogenic structures, it is unclear how the conclusion of no significant impacts was reached. Information would have to be analyzed for each site in order to make such a determination. The PEA would benefit from a discussion of how the USMC will conduct its cumulative impacts analyses on a site-by-site basis. 27

**Literature Cited**

BHE Environmental. 2010. Post-construction bird and bat mortality study Cedar Ridge wind farm Fond du Lac County, Wisconsin. Interim Report prepared for Wisconsin Power and Light and submitted to Wisconsin Public Service Commission. 28

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Brawn, J.D. and D.F. Stotz. 2001. The importance of the Chicago region and the "Chicago Wilderness" initiative for avian conservation. Pp. 509-522. *In* Avian Ecology and Conservation in an urbanizing world (eds. J.M. Marzluff, R. Bowman and R. Donnelly). Kluwer Academic Publishers, Boston.

Brock, K.J. 1992. Fall warblers at the migrant trap, Hammond, Indiana. Indiana Audubon Quart. 70:154-162.

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Drake, D., J. Garvin, S. Grodsky, and M. Watt. 2010. Post-construction bird and bat monitoring at the Forward Energy Center Second Interim Report. Interim Report prepared for Forward Energy LLC and submitted to the Wisconsin Public Service Commission.

Greenberg, J. 2004 A natural history of the Chicago region. University of Chicago Press, Chicago.

Gruver, J., M. Sonnenburg, K. Bay, and W. Erickson. 2009. Post-construction bat and bird fatality study at the Blue Sky Green Field Wind Energy Center, Fond du Lac County, Wisconsin. Final Report submitted to the Wisconsin Public Service Commission by WEST, Inc.

**Responses to U.S. Fish and Wildlife Service Comments on the Previous (November 2010) U.S. Marine Corps Draft Programmatic Environmental Assessment for Small-Scale Wind Energy Projects**

1. See General Conservation Measure #2 in Section 2.3.2.3, which discusses the potential need for developing a post-construction monitoring program if warranted by data indicating high concentrations of birds or bats at a specific site. Also note that this GCM includes a provision for adaptive management and continued coordination with USFWS based on monitoring results.

2. The results of these efforts will be incorporated into the site-specific EAs, as applicable.

3. The comment's concerns are reflected in revised sections 3.6 and 4.6.

4. This information will be incorporated into the site-specific EA as applicable.

5. Additional text on the MBTA has been incorporated into Section 1.5.3.

6. This would not be consistent with the purpose and need of the proposed action and would not fall under the USMC program. Off-site options could be pursued independently, but substantial fish and wildlife impacts would be avoided in any case.

7. Section 4.6 has been expanded to address potential wind turbine noise impacts on wildlife in response to USFWS DMBM Headquarters comments.

8. This information will be incorporated into the site-specific EA as applicable.

9. This has been added to the revised PEA.

10. Understood, IPaC will be used with an awareness of any limitations. The remainder of the comment is pertinent to the Midwest Region and corresponding site-specific EAs.

11. This information will be considered when preparing the site-specific EA for the Great Lakes site.

12. Effects to habitat and behavior, including loss of habitat and displacement of species are addressed in revised sections 3.6 and 4.6.

13. Siting criteria have been refined in Section 2.3.2. This information will be incorporated into the site-specific EAs as applicable.

14. This information will be incorporated into the site-specific EA as applicable.

15. This information will be incorporated into the site-specific EA as applicable.

16. This information will be incorporated into the site-specific EA as applicable.

17. The potential for ice throw has been added to the Health and Safety section.

18. This information will be incorporated into the site-specific EA as applicable.

19. This information has been cited in the revised PEA.

20. "If properly sited,…" has been added to the beginning of this statement.

21. The distinction between MWh and the nameplate rating in MW is understood. The text in question has been reworded to clarify.

22. The possibility that birds would be flying lower due to weather or habitat features is recognized and has been added to the discussion.

23. Data from two more recent references, both of which provide rigorous fatality estimates, have been added to each table.

24. The text in question has been revised to clarify. We agree with the importance of location, and view turbine size as a secondary factor that can influence mortality rates, all else being equal.

25. USMC concurs, previous mitigation measures have been moved to Section 2.3.2.

26. Same as response to comment 25.

27. As discussed in the updated Section 5.6, a key part of each site-specific EA will be to evaluate the occurrence of biological resources with respect to proposed turbine locations and other features in the environment, whether manmade or natural. This will include coordination with local experts, interest groups, and USFWS biologists as appropriate. As such, the assessment would consider and, as appropriate, adjust number, size, and location of turbine(s) to avoid/minimize potential cumulative effects at the local level. Furthermore, where warranted by concerns over bird and bat fatalities, post-construction monitoring would be conducted to identify the species affected and their number. This information would be used to adjust operational parameters, and it would be shared with local and regional agencies, researchers, and interest groups in support of broader action to reduce impacts to vulnerable species. As a result, we conclude that significant cumulative impacts would not occur.

28. This information will be incorporated into the site-specific EAs as applicable.

# United States Department of the Interior

NATIONAL PARK SERVICE
Geologic Resources Division
P.O. Box 25287
Denver, CO 80225


TRANSMITTED VIA ELECTRONIC MAIL - NO HARDCOPY TO FOLLOW

L2360

December 21, 2010

MARFORRES
Attn: Alain Flexer
4400 Dauphine Street
New Orleans, LA 70146-5400

Re: Draft Programmatic Environmental Assessment for the Development and Operation of Small Scale Wind Energy Projects at United States Marine Corps Facilities Throughout the United States.

Dear Mr. Flexer:

The National Park Service (NPS) has reviewed the Draft Programmatic Environmental Assessment for the Development and Operation of Small Scale Wind Energy Projects at United States Marine Corps Facilities throughout the United States and offers the following brief comments:

We understand that these comments are arriving well after the comment due date of December 4, 2010, but we believe that through the project-specific planning process, NPS suggestions can easily be incorporated into the siting, construction and operational phases of small scale wind energy projects at United States Marine Corps facilities that may be planned for areas located adjacent to units of the National Park System or other affiliated areas. 1

It is important to note that the NPS Organic Act (16 U.S.C. §1) states that "[t]he National Park Service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments and reservations hereinafter specified . . ., by such means and measures as conform to the fundamental purposes of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wildlife therin and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The NPS also holds similar responsibilities for other "affiliated areas" such as National Trails, National Heritage Areas, National Historic Landmarks, and Wild and Scenic Rivers.

With the above referenced mandates in mind, we encourage the Department of the Navy to consider and consult with the NPS in an effort to reduce or eliminate potential impacts to these sensitive resources if small scale wind energy projects at United States Marine Corps facilities are planned adjacent to units of the National Park System or other affiliated areas. NPS resource specialists are available to work with the Department of the Navy to help achieve the goal of providing wind power to United States Marine Corps facilities while protecting important natural, historical, and cultural resources.

1 continued

We appreciate the opportunity to provide comments on the draft programmatic environmental assessment. If you have any questions or if we can be of any further assistance, please contact Mr. Kerry Moss of my staff at 303-969-2334.

Sincerely,

/s/

Carol McCoy
Chief, Planning, Evaluation and Permits Branch,
Geologic Resources Division

**Responses to National Park Service Comments on the U.S. Marine Corps Draft Programmatic Environmental Assessment for Small-Scale Wind Energy Projects**

1. Information noted. The USMC will work with the NPS on any applicable site-specific issues.

**Memorandum**

To: Alain D. Flexer, Energy Manager <alain.flexer@usmc.mil>
Marine Forces Reserve Facilities
4400 Dauphine Street Building 601, Room 5B411
New Orleans, LA 70146-5400

From: Albert M. Manville, II, Ph.D., C.W.B., Senior Wildlife Biologist
Division of Migratory Bird Management, U.S. Fish and Wildlife Service, 4401 N. Fairfax Dr. – MBSP-4107, Arlington, VA 22203

Through: Marcia Pradines, Deputy Chief, Division of Migratory Bird Management (DMBM)

Subj: DMBM's Comments on the United States Marine Corps Small-Scale Wind Energy Projects, DRAFT Programmatic Environmental Assessment (DPEA)

Date: December 15, 2010

Via Email: alain.flexer@usmc.mil, Jeff Haskins

Cc: "Casey Barker" casey.barker@navy.mil

[Wind DMBM Comments USMC DPEA-Manville.doc]

The Division of Migratory Bird Management (DMBM), U.S. Fish and Wildlife Service (FWS or Service) is pleased to provide the following comments on the U.S. Marine Corp's (USMC or Corps) Draft Programmatic Environmental Assessment (DPEA), released for public review and comment in November 2010. Should you have additional questions or concerns about our comments, please feel free to contact Dr. Albert Manville at 703/358-1963, albert_manville@fws.gov.

## General Comments

It should be pointed out (e.g., as a preface to Table ES-1 on p. ES-4) that the potential impacts and consequences of "small wind" projects may not necessarily be small. The rotor swept area of a 1.0- 2.5 MW turbine may encompass over 3.0 acres of airspace, with blade tip speeds that 1
could exceed 170 mph under normal operating conditions. Wind wake turbulence and blade tip vortices may be significantly increased over comparable smaller turbines, increasing chances for blade smear, collisions, barotrauma and noise impacts. Under "perfect storm" conditions when,

for example, bird presence during migration, inclement weather, bird "fall out," and fully operating turbines coincide, even 1 turbine could result in a mass mortality event. Given the presence of even 1 "small" (< 1.0 MW) turbine in the Whooping Crane corridor (e.g., Amarillo and Galveston, TX), next to a Northern Sage-grouse lek, adjacent to a Golden Eagle nest site, or desert tortoise core habitat could prove deleterious to the species in question. Impacts to species and their habitats should be based on risk at each site. "Small scale wind energy projects" with even 1 turbine can still pose a high risk. These issues should be clarified in the Final PEA. 1 continued

The USMC should state up front on p. ES-2 their preferred alternative even though project size and turbine variability are different for each of the 10 priority projects being examined in this DPEA. A summary table would be helpful. 2

Much of the literature used and cited in this document is out of date, including sources cited from FWS. The information and references should reflect the most current information, such as the Service's current estimate for turbine-caused bird mortality based on 23,000 operating land-based turbines – i.e., 440,000 birds killed/yr (Manville 2009. Proceedings 4th Internatl. Partners in Flight Conference, McAllen, TX) not the 33,000 birds referenced in this DPEA (P. 4-34). 3

**Specific Comments**

**Page 1-13, Section 1.5.3, Migratory Bird Treaty Act and EO 13186**. While the Executive Order is mentioned, and specifically the Memorandum of Understanding between the Department of Defense and the Service (2006) is referenced, it might be helpful here and in Section 1.6 (p. 1-15, details of agency coordination) to mention USMC and Army Corps of Engineer coordination with the Service regarding further efforts to avoid or minimize take of protected migratory birds, to use the best and most current research protocols, and use the best available technologies for mitigation and deterrence. Collaboration is briefly suggested later in the document. 4

**Page 1-13, Section1.5.4, Bald and Golden Eagle Protection Act** (BGEPA). This section needs to be revamped and updated since, among other issues, no mention is made of the two new regulations regarding eagle "take" – i.e., 50 CFR Parts 22.26 and 22.27. The National Eagle Management Guidelines were intended to focus on Bald Eagles in the Northeast and they are considerably outdated. Among various other eagle issues, the Service intends to update them. We recommend that the USMC insert the following language regarding these 2 regulations in your final PEA. 5

*"With the recent recovery of the Bald Eagle, it was delisted from the Endangered Species Act (ESA) in 2007 throughout most of its range. While protected under the ESA, permits had allowed "take" of Bald Eagles. No longer regulated under ESA, "take" permits had to be developed under BGEPA. Because both species are protected under the BGEPA, the new permit regulations apply to Golden Eagles as well as Bald Eagles. In September 2009, a final rule for 2 new permit regulations was released, effective the following November. 50 CFR Part 22.26*

*would allow take of both species of eagles (including disturbance and limited "take resulting in mortality"), and 50 CFR Part 22.27 would allow the take of nests of both species for eagle and human health and safety reasons, and in other limited circumstances.* 5 continued

*Under Part 22.26, the "take" of an eagle refers to the non-purposeful disturbance, wounding or killing of eagles, which is associated with but is not the purpose of an activity, such as the construction and operation of a "small scale" wind facility on a USMC base. A Final Environmental Assessment (FEA) was also released with the 2 regulations outlining the science and rational behind the 2 new permit types. The FEA also analyzed the number of permits that could be issued, based on the overall goal of maintaining stable or increasing breeding populations of both species. "Take" can only be authorized when it is compatible with the preservation of Bald and Golden Eagle populations.*

*Both regulations include provisions for "programmatic take," defined under 50 CFR Part 22.3 as "take that is recurring, is not caused solely by indirect effects, and that occurs over the long term or in a location or locations that cannot be specifically identified." Programmatic take permits under 22.26 and 22.27 may be issued only where take is unavoidable despite implementation of comprehensive measures called Advanced Conservation Practices (ACPs) developed in cooperation with the Service. ACPs are scientifically-supportable measures that are approved by the Service and represent the best-available techniques to reduce eagle disturbance and ongoing mortalities to a level where remaining take is unavoidable.*

*Because of concerns regarding populations of Golden Eagles — available data indicate potential population declines across the 4 large Bird Conservation Regions in the West — the Service will only consider Golden Eagle take permits for safety emergencies, programmatic permits, and any other permits that will result in a reduction of ongoing take or a net take of zero. The same standards apply to the Bald Eagle in the Sonoran Desert.*

*All permit applicants must provide documentation that they have included all practicable avoidance and minimization measures in their planning. "Practicable" is defined in the regulations as "capable of being done after taking into consideration, relative to the magnitude of the impacts to eagles, the following 3 things: 1) the cost of remedy compared to proponent resources; 2) existing technology; and 3) logistics in light of overall project purposes." To qualify for programmatic permits, the standard for the permitees is "the maximum degree technically achievable," defined as "the standard at which any take that occurs is unavoidable, despite implementation of ACPs."*

*The Service has created and staffed a set of teams to facilitate development of the tools necessary for programmatic permits and the development of ACPs. Because these are ongoing efforts, please refer to the Service's Migratory Bird website for the current details once they are released to the public."*

**Page 2-2, Generalized Project Design, Line 29**. No mention is made here of the evaluation and
potential use of the vertical helix turbine, purported to be much more bird- and bat-friendly than 6
the standard, 3-bladed horizontal nacelle-mounted turbine design. The turbine option is briefly
mentioned on p. 2-9, **Section 2.6.2**, but is dismissed due to insufficient power output. With some
new and improved vertical helix turbines becoming commercially available, this option should
be further explored with a more detailed discussion of its viability in the Final PEA.

**Pages 3-4 - 3-6** (and beyond), **Section 3.3, Noise**. The noise issues discussed in this DPEA
focus on impacts to humans but fail to address known and potential impacts of noise to birds,
bats and other wildlife species. We recommend the inclusion of the following issues to better
address concerns about noise impacts to wildlife.

7

*Wind turbine noise standards developed by countries such as Sweden and New Zealand and
some specific site level standards implemented in the U.S. focus primarily on sleep disturbance
and annoyance to humans. Generally however, few noise standards exist for wildlife. Noise
impacts to wildlife should be included as a factor in wind turbine siting and operation, including
small wind projects being proposed by the USMC.*

*This includes an understanding of 1) how wind facilities affect background noise levels; 2) how
and what fragmentation, including acoustical fragmentation, occurs especially to species
sensitive to habitat fragmentation; 3) comparison of turbine noise levels at lower valley sites –
where it may be quieter – to turbines placed on ridge lines above rolling terrain where
significant topographic sound shadowing can occur having the potential to significantly elevate
sound levels above ambient conditions; and 4) correction of a 15 decibel (dB) underestimate
from daytime wind turbine noise readings used to estimate nighttime turbine noise levels (van
den Berg 2004, J. Barber Colorado State Univ. and National Park Service pers. comm., K.* 8
*Fristrap National Park Service pers. comm.).*

*Turbine blades at normal operating speeds can generate significant levels of noise. Based on a
propagation model of an industrial-scale 1.5 MW wind turbine at 263 ft hub height, positioned
approximately 1,000 ft apart from neighboring turbines, the following decibel levels were
determined. At a distance 300 ft from the blades, 45- 50 dBA were detected; at 2,000 ft, 40 dBA;
and at 1 mile, 30-35 dBA (Kaliski 2009). Noise or a bird's inability to detect it creates one of
several problems. For the average bird in a signal frequency of 2-3 kHz, noise must be 26- 28
dB above the spectrum level in order for a bird to detect it. Compare this to human hearing
where the average human can detect a sound at twice the distance of the typical bird (Dooling
2002:7-8, 17). Where turbine blade noise decreases to within 1.5 dB of the level of ambient wind* 9
*noise, a bird cannot hear the blade. This may be especially problematic as a flying bird
approaches a moving blade under high wind conditions, loses its ability to see the blade due to
motion smear, and may not hear the blade until it is very close – if it is able to hear it at all
(Dooling 2002:8, 13). Another issue for birds, bats, and probably other wildlife is the effect of
ambient noise on communication distance and an animal's ability to detect calls. For effects to*

*birds, this can mean 1) behavioral and/or physiological effects, 2) damage to hearing from acoustic over-exposure, and 3) masking of communication signals and other biologically* 10
*relevant sounds (Dooling and Popper 2007:48). Noise in the frequency region of avian vocalizations will be most effective in masking these vocalizations (Dooling 2007:45). While some birds are able to shift their vocalizations to reduce the masking effects of noise, when shifts don't occur or are insignificant, masking may prove detrimental to the health and survival of wildlife (Barber et al. 2010: 180, 182). Data suggest noise increases of 3 dB to 10 dB correspond to 30 to 90% reductions in alerting distances for wildlife, respectively (Barber et al. 2010:187).*

Noise Reference Citations:

Barber, J.R., K.R. Crooks, and K.M. Fristrup. 2010. The costs of chronic noise exposure for terrestrial organisms. Cell Press, doi:10.1016/j.tree.2009.08.002

Bayne et al. 2008. Impacts of Chronic Anthropogenic Noise from Energy-Sector Activity on Abundance of Songbirds in the Boreal Forest.

Dooling, R.J., and Popper A.N. 2007. The effects of highway noise on birds. Sacramento (CA): California Department of Transportation, Division of Environmental Analysis. 74p. 11

Dooling, R. 2002. Avian Hearing and the Avoidance of Wind Turbines. National Renewable Energy Laboratory Technical Report: NREL/TP-500-30844. June 2002.

Francis, C.D., C.P. Ortega and A. Cruz. 2009. Noise Pollution Changes Avian Communities and Species Interactions. Current Biology, in press, doi: 10.1016/j.cub.2009.06.052.

Habib, L, E.M. Bayne and S. Boutin. 2007. Chronic industrial noise affects pairing success and age structure of ovenbirds *Seiurus aurocapilla.* Journal of Applied Ecology 44: 176-184.

Kaliski, K. 2010. Calibrating sound propogation models fro wind power projects. Resource System Group, Inc. Washington, DC.

Lengagne, T. 2008. Traffic noise affects communication behaviour in a breeding anuran, *Hyla arborea.* Biological conservation 141: 2023-2031.

Lohr, B., T.F. Wright and R.J. Dooling. 2003. Detection and discrimination of natural calls in masking noise by birds: estimating the active space of a signal. Animal Behavior 65: 763-777.

Schuab, A, J.,Ostwald and B.M. Siemers. 2008. Foraging bats avoid noise. The Journal of Experimental Biology 211: 3174-3180.

Swaddle J.P. and L.C. Page. 2007. High levels of environmental noise erode pair preferences in zebra finches: implications for noise pollution. Animal Behavior 74:363-368

Van den Berg, G.P. 2004. Effects of the wind profile at night on wind turbine sound. Journal of Sound and Vibration 277: 955-970.

**Page 3-17, Section 3.6, Biological Resources**. The DPEA states that, "*the impacts of greatest concern are …impacts on legally protected species…* [e.g.] *active nests of MBTA-protected bird species … and injury or mortality to birds and bats, especially ESA-listed species, from collisions with rotating turbines.*" DMBM suggests that impacts to listed species only represent a small portion of the issues of overall concern from wind development , although potential impacts to Whooping Cranes are significant. While there are currently 92 Federally-listed bird species,some of which may be impacted by wind development, the MBTA currently protects 1,007 species, many of which are potentially at risk from wind development. Any [2008] Birds 12 of Conservation Concern that are or may be present at any of the 10 USMC sites should also be mentioned and assessed at each of the project sites. There are a total of 147 bird species that were designated in 2008 as Birds of Conservation Concern at the National scale. That was briefly discussed on pp. 3-21 – 3-22, but should be summarized in this section of the DPEA. The same should be summarized here regarding concerns over the presence of any State-listed and State species of conservation concern, including concerns about potential impacts to birds, bats and other trust species. Data currently indicate that bats are being taken far more frequently and in greater numbers than are birds at North American wind development projects where studies are being conducted. Where any of the USMC project turbines could pose risks to 13 migratory birds that are staging, resting, feeding, breeding, nesting, roosting or are concentrated during migration should also be mentioned here. These issues all represent potential risk factors to protected species. They are only briefly addressed later in the DPEA. Further discussion would be very helpful.

The cumulative effects of each of the Corps' proposed projects need to be addressed in relationship to other nearby commercial wind development projects, as well as impacts from other anthropocentric structures and human development that are impacting wildlife trust resources. Comparing estimated turbine blade mortality affecting migratory birds to other 14 sources of mortality (e.g., p. 4-34) is of little help and does not facilitate the Corps' attempt here to effectively 'make its case.' The overall anthropocentric issue must be about cumulative impacts.

**Page 3-18, Regulatory Setting**. Under the BGEPA discussion (line 27- ), 50 CFR Parts 22.26 and 22.27 need to be addressed here. The Service is unaware of any MOU being developed with DoD regarding take of eagles under BGEPA, specifically in regard to the following language: "*The MOU may lead to a programmatic permit to allow a limited take of bald and golden* 15 *eagles, with restrictions and within normal operating conditions. The details of the MOU should be forthcoming in late 2010*" [lines 31-33). Reference the earlier suggested discussion regarding programmatic permits. This is an ongoing issue. On p. 3-19, line 33, there are provisions for "incidental take" of eagles and their nests (i.e., Parts 22.26 and 22.27). While they are currently in force, they have yet to be implemented. .

**Page 3-21 – 3-22, Biological Resources at Priority Sites**.

The Corps has identified the potential presence of imperiled birds and/or bats at virtually all of the proposed project sites. For example, at the Brooklyn, NY, Jamaica Bay facility, Piping 16
Plover, Roseate Tern, Least Tern, Bald Eagle and other waterbirds are included on the list. At the Galveston, TX, site, the Whooping Crane, Piping Plover, Eskimo Curlew (a high probability this species is extinct since none have been seen for decades), Bald Eagle and other birds are designated as present. At the Great Lakes facility, an Indiana bat hibernaculum has been identified 7.5 miles from the project site. What is not discussed here nor on **p. 4-27, Biological Resources, 4.6.1 Protocols**, are the mitigation and deterrent "tools" that the Corps anticipates, is considering, and is willing to use to avoid or minimize take of birds and bats once turbines are 17
operating. Among these options, the Corps should consider blade "feathering"/idling, rolling or seasonal shutdowns, changes in blade cut-in speeds, any setbacks where appropriate, ultrasonic deterrents once refined, and possibly other measures under testing and development. DMBM would be glad to discuss these options and others under development.

**Page 4-30 – 4-32, Table 4.6-1-2, Estimates of Bird Mortality**. The estimates of bird mortality presented in this DPEA (i.e., 0.95 – 14 birds/MW/yr; average range 1-4 birds/MW/yr) are misleading and likely significantly underestimate the actual level of ongoing mortality in the United States. The more appropriate metric of "take" of migratory birds should focus on Birds of Conservation Concern and any listed species killed at turbines, imperiled bats (not just those Federally listed), and the cumulative impacts to all the birds and bats that are killed. Depending on the use of appropriate and robust bias correction factors for scavenging and searcher 18
efficiency, the mortality estimates cited in this DPEA may be serious underestimates (after M. Huso 2010). While admittedly "take" at "small" wind facilities should be lower than that at industrial scale wind developments, take at small facilities still represents a level of concern for all the reasons previously stated. For example, the Altamont Pass, CA, experience with small turbines continues to clearly illustrate bird impacts from "small" turbines (see Smallwood and Thelander 2004), including the estimated take of some 1,000 raptors/yr (including up 40-60 Golden Eagles/yr) and thousands of other bird species/yr.

**Draft Service Wind Guidance**. The Service is in the midst of finalizing draft land-based wind turbine guidelines, using a recommendation from the Wind Energy Federal Advisory Committee submitted to DOI in March 2010 as a framework for our draft. We recommend that the Corps 19
review these draft guidelines once they are released in the *Federal Register* for public review and comment sometime in early to mid 2011. They may provide some additional tools to better address risk at the 10 projects proposed in this DPEA. We also solicit comments from the Corps on these draft guidelines. Thank you for the opportunity to provide these comments.

**Responses to Albert M. Manville, Senior Wildlife Biologist, Division of Migratory Bird Management, U.S. Fish and Wildlife Service Comments on the U.S. Marine Corps Draft Programmatic Environmental Assessment for Small-Scale Wind Energy Projects**

1. We agree that depending on location and other circumstances, even a relatively small wind energy project can pose a significant risk of mortality to birds or bats. The revised Draft PEA reflects recognition of these potential impacts and the USMC's desire to avoid or minimize them.
2. The preferred program alternative is a range of turbine sizes and numbers that is adaptable to local conditions for individual projects.
3. The discussion of wind turbine-caused bird mortality has been updated with the reference provided. Other discussions have been updated with new references as well.
4. Additional language has been added to Sections 1.5.3 and 1.6 to reflect coordination with the USFWS.
5. The BGEPA discussion in Section 1.5.4 has been rewritten, incorporating the information provided in the comment.
6. The discussion of the vertical (helix) axis design in Section 2.5.2 has been expanded. These turbines are not as readily available or cost effective in terms of energy production; they are sufficiently new that their reliability is largely untested; and there is no hard evidence of reduced bird and bat fatalities or lesser environmental impacts otherwise relative to a conventional turbine with the same power rating.
7. Discussion has been added of potential noise impacts to wildlife. Based on the evidence discussed in Section 4.6 under BR-1, we feel that a 500-foot setback and other measures that are now part of Section 2.3.2 adequately protect against significant noise impacts to wildlife.
8. The information provided has been incorporated into the Noise section of the PEA.
9. This information has been added to the collision discussion in Section 4.6 under BR-2.
10. Noise impact discussion added under Section 4.6, BR-1. Re- last sentence of comment, Barber et al provide only a simple mathematical model (not empirical data) of how background noise of the same frequency can diminish the detectability of sound. Revised text does mention possible reductions in alerting distance as a function of increased background noise.
11. Several of the more relevant references have been added/discussed in the revised document.
12. This information is reflected in revised Section 3.6 and the discussion of "other" (not necessarily ESA-listed) special status species.
13. High rates of bat fatalities are recognized in the document, as is the importance of migratory bird concentration areas.
14. Potential cumulative effects are recognized and addressed in Chapter 5.
15. Addressed in the revised Section 1.5.4 with new USFWS suggested BGEPA permit language.

16. Site-specific comments will be used when developing the site-specific EAs.
17. These suggestions are incorporated into revised Section 2.3.2.
18. The likelihood that these are underestimates, possibly by an order of magnitude, is recognized in the document. USMC welcomes the USFWS' input to improve the accuracy of fatality estimates in conjunction with post-construction monitoring of at least some of the potential project sites. It is not necessary to dwell on the negative impacts of the Altamont Pass Wind Resource Area (APWRA), which includes now-obsolete (lattice) turbine designs and poor siting. Within the APWRA, older turbines and their annual take of raptors remains unusually high each year. However, in a 2008 report to the Alameda County Community Development Agency, ICF Jones & Stokes (2008) reported that in areas re-powered with modern turbines, total raptor mortality was reduced by 63% when compared to older turbines still operating in the APWRA during the 2005-2007 study period. The total annual take of raptors in the repowered area was 20 individuals/year, compared to the 2,792 estimated APWRA-wide annual takes, equating to an average annual mortality rate of 1.8 raptors/MW/year with the modern turbines, versus 4.8 raptors/MW/year with the older style turbines in the APWRA.
19. We look forward to the guidelines and will consider their application to program locations.

# United States Department of the Interior

U. S. GEOLOGICAL SURVEY

Reston, VA 20192

In Reply Refer To: December 14, 2010

Mail Stop 423
ER 10/1041

Mr. Alain D. Flexer 34
Energy Manager 35
Marine Forces Reserve, Facilities 36
4400 Dauphine Street 37
Bldg 601, Rm 5B411 38
New Orleans, LA 70146-5400 39

Subject: Draft Programmatic Environmental Assessment for the Development and Operation of Small-Scale Wind Energy Projects at U.S. Marine Corps Facilities, Throughout the United States

Dear Mr. Flexer:

As requested in your correspondence of December 2, 2010, the U.S. Geological Survey (USGS) has reviewed the subject draft programmatic environmental assessment (DPEA) and offers the following comments.

**COMMENTS**

**Chapter 4: Environmental Consequences, Section 4.6, Biological Resources**

The Draft PEA addresses the potential that threatened or endangered birds and bat species might be
impacted by the wind turbines, however, the document does not address mitigation. Suggest the Final 1
PEA discuss mitigation analysis, and potential mitigation actions to minimize adverse impacts to resident and migratory birds and bats. Suggested references for assessment and analysis are: Brennan et al. (2008), Cryan et al (2010), Cryan and Barclay (2009), Cryan (2008), Cryan and Brown (2007) and Cryan (2006).

**REFERENCES**


Brennan LA, Perez RM, Demasco SJ, Ballard BM, and Kuvlesky WP. 2008. "Potential impacts of wind farm energy development on upland game birds: Questions and concerns". Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics, pages 179–183. Available online: http://www.pwrc.usgs.gov/pif/pubs/McAllenProc/articles/PIF09_Anthropogenic%20Impacts/Brennan_1_PIF09.pdf

Cryan, P.M., J.W. Jameson, E.F. Baerwald, C.K.R. Willis, R.M.R. Barclay, E.A. Snider, and E.G. Crichton. 2010. Evidence of mating readiness in certain bats killed by wind turbines abs.. In: North American Symposium on Bat Research: 40th Annual Meeting – Denver, CO: North American Society for Bat Research. p. 16-17.

Cryan, P.M. and R.M.R. Barclay. 2009. Causes of bat fatalities at wind turbines: Hypotheses and predictions. Journal of Mammalogy 90(6): 1330-1340.

Cryan, P.M. 2008. Mating behavior as a possible cause of bat fatalities at wind turbines. Journal of Wildlife Management 72(3): 845-849.

Cryan, P.M. and A.C. Brown. 2007. Migration of bats past a remote island offers clues towards the problem of bat fatalities at wind turbines. Biological Conservation 139(1-2): 1-11.

Cryan, P. 2006. Bat fatalities at wind turbines: Investigating the causes and consequences. Available online: http://www.fort.usgs.gov//BatsWindmills/.

Thank you for the opportunity to review and comment on the DPEA. If you have any questions concerning our comments, please contact Gary LeCain, USGS Coordinator for Environmental Document Reviews, at (303) 236-1475 (x229) or at gdlecain@usgs.gov

Sincerely,

***/Signed/***

James F. Devine
Senior Advisor for Science Applications

Copy to: Office of Environmental Policy and Compliance

**Responses to U.S. Geological Survey Comments on the U.S. Marine Corps Draft Programmatic Environmental Assessment for Small-Scale Wind Energy Projects**

1. The updated Section 2.3.2, Wind Energy Program Criteria, discusses wind turbine siting, design, and exclusion criteria; construction and operations best management practices; and general conservation measures, all of which provide “mitigation” in the general sense. The cited references have been discussed and cited as applicable in the revised document, with the exception of Cryan et al. 2010, which is only an abstract and is a variation on the theme of Cryan 2008.

**UNITED STATES MARINE CORPS**
MARINE FORCES RESERVE
4400 DAUPHINE STREET
NEW ORLEANS, LOUISIANA 70146-5400

IN REPLY REFER TO
11011
FAC/adf
29 Nov 10

Louise Brodnitz
Advisory Council on Historic Preservation
Office of Federal Agency Programs, Federal Property Management Section
1100 Pennsylvania Avenue, NW, Suite 803
Old Post Office Building
Washington D.C. 20004

Dear Ms. Brodnitz:

The United States Marine Corps (USMC) Marine Forces Reserve Command (MARFORRESCOM) is proposing to design, construct, and operate a number of wind energy projects at several of its facilities across the United States (Proposed Action). The Proposed Action would allow the MARFORRESCOM to achieve specific goals set by President Obama's administration with regards to energy production and usage. The actual number of turbines that would be constructed will vary from a single turbine up to four turbines, and the actual design of the proposed facilities would vary from facility to facility depending on a number of factors.

A Programmatic Environmental Assessment (EA) has been written for the Proposed Action entitled, *Programmatic Environmental Assessment United States Marine Corps Small Scale Wind Energy Projects.* The Programmatic EA has been written in accordance with the National Environmental Policy Act of 1969 (NEPA) as implemented under the Council on Environmental Quality (CEQ) regulations (42 CFR 800 Parts 1500-1508); Department of the Navy (DoN) NEPA regulations (32 CFR Part 775); USMC NEPA directives (Marine Corps Order P5090.2A including changes 1 and 2). The document sets forth siting criteria, best management practices, and general conservation measures that will avoid or minimize impacts on the natural and human environment. Ten priority facilities with potential for wind energy development in the near term are identified and analyzed using the criteria developed in the Programmatic EA. Site-specific NEPA analyses will be completed for projects at facilities requiring additional analysis to address site-specific potential impacts or impacts that cannot be avoided or mitigated. Those will be tiered off of the Programmatic EA.

Under the protocols developed in the Programmatic EA, each specific wind energy project will undergo Section 106 consultation with the individual State Historic Preservation Offices (SHPOs) and other consulting parties as needed. MARFORRESCOM respectfully seeks the Advisory Council on Historic Preservation's input and comment on the siting criteria, best management practices, and general conservation measures presented in the Programmatic EA as they generally relate to avoidance or minimization of impacts on historic properties. Any necessary Section 106 consultations will be initiated during the site-specific NEPA analyses.

The MARFORRESCOM is also seeking input and comment on the Programmatic EA from various federal agencies and the public at large. A Notice of Availability (NOA) was published in the *Federal Register* on November 15. For additional information and to request a copy of the Programmatic EA, please contact MARFORRES, Attn: Alain Flexer, by telephone at 504-678-8489 or by e-mail at alain.flexer@usmc.mil. Please address any input or comments to Mr. Flexer as well.

Thank you for your time and consideration in this matter.

Sincerely,

E. J. MAGUIRE
Deputy AC/S Facilities

## Dungan, Mike

**From:** Flexer CTR Alain D [alain.flexer@usmc.mil]
**Sent:** Monday, January 03, 2011 1:29 PM
**To:** Barker, Casey CIV NAVFAC ESC, EV; Dungan, Mike
**Cc:** Goodfellow Dr Sue
**Subject:** FW: MARFORRESCOM Wind Energy Projects

Gentlemen:

Input from the Advisory Council on Historic Preservation.

Alain

-----Original Message-----
From: Louise Brodnitz [mailto:lbrodnitz@achp.gov]
Sent: Thursday, December 23, 2010 13:38
To: Flexer CTR Alain D
Subject: MARFORRESCOM Wind Energy Projects

Hello Mr. Flexer,

Thank you for contacting us regarding the referenced project. I've reviewed Mr. Maguire's letter, dated December 7, 2010. We note that this Programmatic EA will develop siting criteria, best management practices and general conservation measures for wind energy projects. In such case, we would suggest that a Programmatic Agreement be developed and incorporated within the final NEPA document so as to ensure that consulting parties with knowledge and interest in historic properties in the affected states may advise on criteria and procedures to ensure full consideration of alternatives to avoid adverse effects.

Please provide a copy of the Programmatic EA for our use, electronic version preferred.

Thanks and happy holidays,

Louise

Louise Dunford Brodnitz, AIA AICP

Historic Preservation Specialist

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United States Department of the Interior

U. S. GEOLOGICAL SURVEY

Reston, VA 20192

In Reply Refer To:
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ER 11/102

March 1, 2011

Mr. Alain D. Flexer, Energy Manager
Marine Forces Reserve, Facilities
4400 Dauphine Street Bldg 601, Rm 5B411
New Orleans, LA 70146-5400

Subject: Draft Programmatic Environmental Assessment for the Development and Operation of Small-Scale Wind Energy Projects at U.S. Marine Corps Facilities, Throughout the United States

Dear Mr. Flexer:

As requested by the U.S. Department of the Interior, Office of Environmental Policy and Compliance, in their correspondence of February 4, 2011, the U.S. Geological Survey (USGS) has reviewed the subject draft programmatic environmental assessment (PEA) and offers the following comments.

**COMMENTS**

**Section 3.6, Biological Resources**

**Pg. 3-12:** The document includes provisions for the protection of birds and bats in known
migration routes or local high-use movement corridors, however, it does not address provisions
or requirements that might be implemented if currently unknown migration routes or bat 1
roosts/hibernacula are discovered near a project site. Suggest the Final PEA address these
possibilities and offer mitigation options to avoid or reduce wildlife impacts.

**General:** The bat populations in the northeastern U.S. are experiencing unprecedented mortality 2
due to a disease identified as “white-nose syndrome” (WNS). Suggest the Final PEA address
this additional stress factor when discussing impacts and mitigation options (Cryan, 2009).

<u>Cited reference:</u>

Cryan, P.M. 2009. White-nose Syndrome threatens the survival of hibernating bats in North America.

Thank you for the opportunity to review and comment on the DPEA. If you have any questions concerning our comments, please contact Gary LeCain, USGS Coordinator for Environmental Document Reviews, at (303) 236-5050 (x229) or at gdlecain@usgs.gov

Sincerely,

***/Signed/***

James F. Devine
Senior Advisor for Science Applications

Copy to: Office of Environmental Policy and Compliance

**Responses to U.S. Geological Survey Comments on the U.S. Marine Corps Draft Programmatic Environmental Assessment (February 2011) for Small-Scale Wind Energy Projects**

1. Text has been added to Section 2.3.2.3 (GCM #2) to clarify that turbine operations would be adaptively managed in the future to minimize impacts and that adjustments such as temporary shut downs would be implemented as warranted by new data or changes in status or distribution. This text is reflected in the impacts discussions in Chapters 4 and 5.

2. WNS is mentioned in Section 3.6.1 as a factor increasing the vulnerability of populations now and in the future. In conjunction with the revised GCM mentioned above, bat populations severely impacted by WNS such that they could become endangered in the foreseeable future would be considered sensitive, and design or operational measures to lessen potential impacts would be implemented.

# APPENDIX B
# AIR QUALITY EMISSIONS CALCULATIONS

## Emissions Summary

***SMALL TURBINE: CONSTRUCTION EMISSIONS SUMMARY***

| Emissions | Emissions (tons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CO | VOC | $NO_X$ | $SO_X$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | $CH_4$ |
| One Small Turbine | 0.53 | 0.13 | 1.14 | 0.00 | 0.09 | 0.06 | 113.91 | 0.01 |
| Four Small Turbines | 2.11 | 0.52 | 4.54 | 0.00 | 0.38 | 0.23 | 455.62 | 0.05 |

***SMALL TURBINE: GHG EMISSIONS SUMMARY***

| Emissions | Emissions (Metric tons/year) | | | |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_20$ | $CO_{2e}$ |
| One Small Turbine | 103.33 | 0.01 | 0.10 | 134 |
| Four Small Turbines | 413.33 | 0.04 | 0.39 | 536 |

***MEDIUM TURBINE: CONSTRUCTION EMISSIONS SUMMARY***

| Emissions | Emissions (tons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CO | VOC | $NO_X$ | $SO_X$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | $CH_4$ |
| One Medium Turbine | 1.06 | 0.26 | 2.27 | 0.00 | 0.19 | 0.11 | 227.81 | 0.02 |
| Four Medium Turbines | 4.22 | 1.05 | 9.09 | 0.01 | 0.76 | 0.46 | 911.25 | 0.09 |

***MEDIUM TURBINE: GHG EMISSIONS SUMMARY***

| Emissions | Emissions (Metric tons/year) | | | |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_20$ | $CO_{2e}$ |
| One Medium Turbine | 206.67 | 0.02 | 0.20 | 268 |
| Four Medium Turbines | 826.67 | 0.08 | 0.78 | 1071 |

***LARGE TURBINE: CONSTRUCTION EMISSIONS SUMMARY***

| Emissions | Emissions (tons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CO | VOC | $NO_X$ | $SO_X$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | $CH_4$ |
| One Large Turbine | 2.11 | 0.52 | 4.54 | 0.00 | 0.38 | 0.23 | 455.62 | 0.05 |
| Four Large Turbines | 8.45 | 2.09 | 18.18 | 0.02 | 1.51 | 0.92 | 1822.49 | 0.18 |

***LARGE TURBINE: GHG EMISSIONS SUMMARY***

| Emissions | Emissions (Metric tons/year) | | | |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_20$ | $CO_{2e}$ |
| One Large Turbine | 413.33 | 0.04 | 0.39 | 536 |
| Four Large Turbines | 1653.34 | 0.16 | 1.57 | 2142 |

***Notes:***

Conversion to Metrix Tons = 1 short ton = 0.90718474 metric tons

$N_20 = NOx * 0.095$

$CO_{2e} = (CO_2*1) + (CH_4*21) + (N_2O*310)$

## *Small Turbine*

Construction duration is assumed to be 1 month per small turbine

| Construction | Fuel | HP | Load Factor | Emission Factors, g/bhp-hr | | | | | | | | No of Equipment | Hrs/day | Months | Emissions, lbs/day | | | | | | | | Emissions, tons/year | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Equipment* | | | | CO | VOC | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 | | | | CO | VOC | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 | CO | VOC | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 |
| Tractor/Loader/Backhoe | Diesel | 108 | 55 | 4.07 | 1.19 | 7.16 | 0.007 | 0.654 | 0.58206 | 568.3 | 0.108 | 2 | 4 | 1 | 4.26 | 1.25 | 7.50 | 0.01 | 0.69 | 0.61 | 595.38 | 0.11 | 0.06 | 0.02 | 0.10 | 0.00 | 0.01 | 0.01 | 7.74 | 0.00 |
| Dump Truck | Diesel | 479 | 57 | 1.82 | 0.57 | 5.55 | 0.006 | 0.295 | 0.26255 | 568.3 | 0.051 | 1 | 4 | 1 | 4.38 | 1.37 | 13.36 | 0.01 | 0.71 | 0.63 | 1368.31 | 0.12 | 0.06 | 0.02 | 0.17 | 0.00 | 0.01 | 0.01 | 17.79 | 0.00 |
| Water Truck | Diesel | 250 | 50 | 1.82 | 0.57 | 5.55 | 0.006 | 0.295 | 0.26255 | 568.3 | 0.051 | 1 | 4 | 1 | 2.01 | 0.63 | 6.12 | 0.01 | 0.33 | 0.29 | 626.45 | 0.06 | 0.03 | 0.01 | 0.08 | 0.00 | 0.00 | 0.00 | 8.14 | 0.00 |
| Crane | Diesel | 399 | 43 | 2.44 | 0.63 | 6.27 | 0.006 | 0.243 | 0.21627 | 568.3 | 0.053 | 1 | 4 | 1 | 3.69 | 0.95 | 9.49 | 0.01 | 0.37 | 0.33 | 859.84 | 0.08 | 0.05 | 0.01 | 0.12 | 0.00 | 0.00 | 0.00 | 11.18 | 0.00 |
| Rough Terrain Forklift | Diesel | 93 | 60 | 4.14 | 1.28 | 7.55 | 0.007 | 0.69 | 0.6141 | 568.3 | 0.115 | 1 | 4 | 1 | 2.04 | 0.63 | 3.72 | 0.00 | 0.34 | 0.30 | 279.65 | 0.06 | 0.03 | 0.01 | 0.05 | 0.00 | 0.00 | 0.00 | 3.64 | 0.00 |
| Excavator | Diesel | 168 | 57 | 2.19 | 0.59 | 6.15 | 0.006 | 0.229 | 0.20381 | 568.3 | 0.053 | 1 | 4 | 1 | 1.85 | 0.50 | 5.19 | 0.01 | 0.19 | 0.17 | 479.91 | 0.04 | 0.02 | 0.01 | 0.07 | 0.00 | 0.00 | 0.00 | 6.24 | 0.00 |
| Crawler | Diesel | 157 | 57.5 | 2.19 | 0.59 | 6.15 | 0.006 | 0.229 | 0.20381 | 568.3 | 0.053 | 1 | 4 | 1 | 1.74 | 0.47 | 4.90 | 0.00 | 0.18 | 0.16 | 452.42 | 0.04 | 0.02 | 0.01 | 0.06 | 0.00 | 0.00 | 0.00 | 5.88 | 0.00 |
| Bobcat | Diesel | 44 | 55 | 6.07 | 2.25 | 5.68 | 0.007 | 0.578 | 0.51442 | 568.3 | 0.203 | 1 | 4 | 1 | 1.30 | 0.48 | 1.21 | 0.00 | 0.12 | 0.11 | 121.28 | 0.04 | 0.02 | 0.01 | 0.02 | 0.00 | 0.00 | 0.00 | 1.58 | 0.00 |
| Drill Rig | Diesel | 291 | 75 | 3.16 | 0.7 | 6.71 | 0.006 | 0.271 | 0.24119 | 568.3 | 0.063 | 1 | 4 | 1 | 6.08 | 1.35 | 12.91 | 0.01 | 0.52 | 0.46 | 1093.78 | 0.12 | 0.08 | 0.02 | 0.17 | 0.00 | 0.01 | 0.01 | 14.22 | 0.00 |
| Trencher | Diesel | 63 | 75 | 4.35 | 1.47 | 8.72 | 0.007 | 0.734 | 0.65326 | 568.3 | 0.133 | 1 | 2 | 1 | 0.91 | 0.31 | 1.82 | 0.00 | 0.15 | 0.14 | 118.40 | 0.03 | 0.01 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 1.54 | 0.00 |
| Compactor | Diesel | 8 | 43 | 3.47 | 0.68 | 4.33 | 0.009 | 0.274 | 0.24386 | 568.3 | 0.061 | 1 | 2 | 1 | 0.05 | 0.01 | 0.07 | 0.00 | 0.00 | 0.00 | 8.62 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| Compressor | Diesel | 106 | 48 | 4.08 | 1.32 | 7.76 | 0.007 | 0.686 | 0.61054 | 568.3 | 0.119 | 1 | 4 | 1 | 1.83 | 0.59 | 3.48 | 0.00 | 0.31 | 0.27 | 254.99 | 0.05 | 0.02 | 0.01 | 0.05 | 0.00 | 0.00 | 0.00 | 3.31 | 0.00 |
| Concrete Truck/Pump Truck | Diesel | 210 | 20 | 1.82 | 0.57 | 5.55 | 0.006 | 0.295 | 0.26255 | 568.3 | 0.051 | 1 | 4 | 1 | 0.67 | 0.21 | 2.06 | 0.00 | 0.11 | 0.10 | 210.49 | 0.02 | 0.01 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 2.74 | 0.00 |
| **TOTAL for 1 Small Turbine** | | | | | | | | | | | | | | | **30.81** | **8.75** | **71.82** | **0.07** | **4.02** | **3.58** | **6469.49** | **0.78** | **0.40** | **0.11** | **0.93** | **0.00** | **0.05** | **0.05** | **84.10** | **0.01** |
| **TOTAL for 2 Small Turbines** | | | | | | | | | | | | | | | **61.63** | **17.49** | **143.64** | **0.14** | **8.05** | **7.16** | **12938.98** | **1.56** | **0.80** | **0.23** | **1.87** | **0.00** | **0.10** | **0.09** | **168.21** | **0.02** |
| **TOTAL for 3 Small Turbines** | | | | | | | | | | | | | | | **92.44** | **26.24** | **215.46** | **0.21** | **12.07** | **10.74** | **19408.47** | **2.34** | **1.20** | **0.34** | **2.80** | **0.00** | **0.16** | **0.14** | **252.31** | **0.03** |
| **TOTAL for 4 Small Turbines** | | | | | | | | | | | | | | | **123.26** | **34.98** | **287.28** | **0.28** | **16.09** | **14.32** | **25877.97** | **3.13** | **1.60** | **0.45** | **3.73** | **0.00** | **0.21** | **0.19** | **336.41** | **0.04** |

## *Medium Turbine*

Construction duration is assumed to be 2 months per medium turbine

| Construction | Fuel | HP | Load Factor | Emission Factors, g/bhp-hr | | | | | | | | No of Equipment | Hrs/day | Months | Emissions, lbs/day | | | | | | | | Emissions, tons/year | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Equipment* | | | | CO | VOC | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 | | | | CO | VOC | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 | CO | VOC | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 |
| Tractor/Loader/Backhoe | Diesel | 108 | 55 | 4.07 | 1.19 | 7.16 | 0.007 | 0.654 | 0.58206 | 568.3 | 0.108 | 2 | 4 | 2 | 4.26 | 1.25 | 7.50 | 0.01 | 0.69 | 0.61 | 595.38 | 0.11 | 0.11 | 0.03 | 0.20 | 0.00 | 0.02 | 0.02 | 15.48 | 0.00 |
| Dump Truck | Diesel | 479 | 57 | 1.82 | 0.57 | 5.55 | 0.006 | 0.295 | 0.26255 | 568.3 | 0.051 | 1 | 4 | 2 | 4.38 | 1.37 | 13.36 | 0.01 | 0.71 | 0.63 | 1368.31 | 0.12 | 0.11 | 0.04 | 0.35 | 0.00 | 0.02 | 0.02 | 35.58 | 0.00 |
| Water Truck | Diesel | 250 | 50 | 1.82 | 0.57 | 5.55 | 0.006 | 0.295 | 0.26255 | 568.3 | 0.051 | 1 | 4 | 2 | 2.01 | 0.63 | 6.12 | 0.01 | 0.33 | 0.29 | 626.45 | 0.06 | 0.05 | 0.02 | 0.16 | 0.00 | 0.01 | 0.01 | 16.29 | 0.00 |
| Crane | Diesel | 399 | 43 | 2.44 | 0.63 | 6.27 | 0.006 | 0.243 | 0.21627 | 568.3 | 0.053 | 1 | 4 | 2 | 3.69 | 0.95 | 9.49 | 0.01 | 0.37 | 0.33 | 859.84 | 0.08 | 0.10 | 0.02 | 0.25 | 0.00 | 0.01 | 0.01 | 22.36 | 0.00 |
| Rough Terrain Forklift | Diesel | 93 | 60 | 4.14 | 1.28 | 7.55 | 0.007 | 0.69 | 0.6141 | 568.3 | 0.115 | 1 | 4 | 2 | 2.04 | 0.63 | 3.72 | 0.00 | 0.34 | 0.30 | 279.65 | 0.06 | 0.05 | 0.02 | 0.10 | 0.00 | 0.01 | 0.01 | 7.27 | 0.00 |
| Excavator | Diesel | 168 | 57 | 2.19 | 0.59 | 6.15 | 0.006 | 0.229 | 0.20381 | 568.3 | 0.053 | 1 | 4 | 2 | 1.85 | 0.50 | 5.19 | 0.01 | 0.19 | 0.17 | 479.91 | 0.04 | 0.05 | 0.01 | 0.14 | 0.00 | 0.01 | 0.00 | 12.48 | 0.00 |
| Crawler | Diesel | 157 | 57.5 | 2.19 | 0.59 | 6.15 | 0.006 | 0.229 | 0.20381 | 568.3 | 0.053 | 1 | 4 | 2 | 1.74 | 0.47 | 4.90 | 0.00 | 0.18 | 0.16 | 452.42 | 0.04 | 0.05 | 0.01 | 0.13 | 0.00 | 0.00 | 0.00 | 11.76 | 0.00 |
| Bobcat | Diesel | 44 | 55 | 6.07 | 2.25 | 5.68 | 0.007 | 0.578 | 0.51442 | 568.3 | 0.203 | 1 | 4 | 2 | 1.30 | 0.48 | 1.21 | 0.00 | 0.12 | 0.11 | 121.28 | 0.04 | 0.03 | 0.01 | 0.03 | 0.00 | 0.00 | 0.00 | 3.15 | 0.00 |
| Drill Rig | Diesel | 291 | 75 | 3.16 | 0.7 | 6.71 | 0.006 | 0.271 | 0.24119 | 568.3 | 0.063 | 1 | 4 | 2 | 6.08 | 1.35 | 12.91 | 0.01 | 0.52 | 0.46 | 1093.78 | 0.12 | 0.16 | 0.04 | 0.34 | 0.00 | 0.01 | 0.01 | 28.44 | 0.00 |
| Trencher | Diesel | 63 | 75 | 4.35 | 1.47 | 8.72 | 0.007 | 0.734 | 0.65326 | 568.3 | 0.133 | 1 | 2 | 2 | 0.91 | 0.31 | 1.82 | 0.00 | 0.15 | 0.14 | 118.40 | 0.03 | 0.02 | 0.01 | 0.05 | 0.00 | 0.00 | 0.00 | 3.08 | 0.00 |
| Compactor | Diesel | 8 | 43 | 3.47 | 0.68 | 4.33 | 0.009 | 0.274 | 0.24386 | 568.3 | 0.061 | 1 | 2 | 2 | 0.05 | 0.01 | 0.07 | 0.00 | 0.00 | 0.00 | 8.62 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 |
| Compressor | Diesel | 106 | 48 | 4.08 | 1.32 | 7.76 | 0.007 | 0.686 | 0.61054 | 568.3 | 0.119 | 1 | 4 | 2 | 1.83 | 0.59 | 3.48 | 0.00 | 0.31 | 0.27 | 254.99 | 0.05 | 0.05 | 0.02 | 0.09 | 0.00 | 0.01 | 0.01 | 6.63 | 0.00 |
| Concrete Truck/Pump Truck | Diesel | 210 | 20 | 1.82 | 0.57 | 5.55 | 0.006 | 0.295 | 0.26255 | 568.3 | 0.051 | 1 | 4 | 2 | 0.67 | 0.21 | 2.06 | 0.00 | 0.11 | 0.10 | 210.49 | 0.02 | 0.02 | 0.01 | 0.05 | 0.00 | 0.00 | 0.00 | 5.47 | 0.00 |
| **TOTAL for 1 Medium Turbine** | | | | | | | | | | | | | | | **30.81** | **8.75** | **71.82** | **0.07** | **4.02** | **3.58** | **6469.49** | **0.78** | **0.80** | **0.23** | **1.87** | **0.00** | **0.10** | **0.09** | **168.21** | **0.02** |
| **TOTAL for 2 Medium Turbines** | | | | | | | | | | | | | | | **61.63** | **17.49** | **143.64** | **0.14** | **8.05** | **7.16** | **12938.98** | **1.56** | **1.60** | **0.45** | **3.73** | **0.00** | **0.21** | **0.19** | **336.41** | **0.04** |
| **TOTAL for 3 Medium Turbines** | | | | | | | | | | | | | | | **92.44** | **26.24** | **215.46** | **0.21** | **12.07** | **10.74** | **19408.47** | **2.34** | **2.40** | **0.68** | **5.60** | **0.01** | **0.31** | **0.28** | **504.62** | **0.06** |
| **TOTAL for 4 Medium Turbines** | | | | | | | | | | | | | | | **123.26** | **34.98** | **287.28** | **0.28** | **16.09** | **14.32** | **25877.97** | **3.13** | **3.20** | **0.91** | **7.47** | **0.01** | **0.42** | **0.37** | **672.83** | **0.08** |

## *Large Turbine*

Construction duration is assumed to be 4 months per large turbine

| Construction | Fuel | HP | Load Factor | Emission Factors, g/bhp-hr | | | | | | | | No of Equipment | Hrs/day | Months | Emissions, lbs/day | | | | | | | | Emissions, tons/year | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Equipment* | | | | CO | VOC | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 | | | | CO | VOC | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 | CO | VOC | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 |
| Tractor/Loader/Backhoe | Diesel | 108 | 55 | 4.07 | 1.19 | 7.16 | 0.007 | 0.654 | 0.58206 | 568.3 | 0.108 | 2 | 4 | 4 | 4.26 | 1.25 | 7.50 | 0.01 | 0.69 | 0.61 | 595.38 | 0.11 | 0.22 | 0.06 | 0.39 | 0.00 | 0.04 | 0.03 | 30.96 | 0.01 |
| Dump Truck | Diesel | 479 | 57 | 1.82 | 0.57 | 5.55 | 0.006 | 0.295 | 0.26255 | 568.3 | 0.051 | 1 | 4 | 4 | 4.38 | 1.37 | 13.36 | 0.01 | 0.71 | 0.63 | 1368.31 | 0.12 | 0.23 | 0.07 | 0.69 | 0.00 | 0.04 | 0.03 | 71.15 | 0.01 |
| Water Truck | Diesel | 250 | 50 | 1.82 | 0.57 | 5.55 | 0.006 | 0.295 | 0.26255 | 568.3 | 0.051 | 1 | 4 | 4 | 2.01 | 0.63 | 6.12 | 0.01 | 0.33 | 0.29 | 626.45 | 0.06 | 0.10 | 0.03 | 0.32 | 0.00 | 0.02 | 0.02 | 32.58 | 0.00 |
| Crane | Diesel | 399 | 43 | 2.44 | 0.63 | 6.27 | 0.006 | 0.243 | 0.21627 | 568.3 | 0.053 | 1 | 4 | 4 | 3.69 | 0.95 | 9.49 | 0.01 | 0.37 | 0.33 | 859.84 | 0.08 | 0.19 | 0.05 | 0.49 | 0.00 | 0.02 | 0.02 | 44.71 | 0.00 |
| Rough Terrain Forklift | Diesel | 93 | 60 | 4.14 | 1.28 | 7.55 | 0.007 | 0.69 | 0.6141 | 568.3 | 0.115 | 1 | 4 | 4 | 2.04 | 0.63 | 3.72 | 0.00 | 0.34 | 0.30 | 279.65 | 0.06 | 0.11 | 0.03 | 0.19 | 0.00 | 0.02 | 0.02 | 14.54 | 0.00 |
| Excavator | Diesel | 168 | 57 | 2.19 | 0.59 | 6.15 | 0.006 | 0.229 | 0.20381 | 568.3 | 0.053 | 1 | 4 | 4 | 1.85 | 0.50 | 5.19 | 0.01 | 0.19 | 0.17 | 479.91 | 0.04 | 0.10 | 0.03 | 0.27 | 0.00 | 0.01 | 0.01 | 24.96 | 0.00 |
| Crawler | Diesel | 157 | 57.5 | 2.19 | 0.59 | 6.15 | 0.006 | 0.229 | 0.20381 | 568.3 | 0.053 | 1 | 4 | 4 | 1.74 | 0.47 | 4.90 | 0.00 | 0.18 | 0.16 | 452.42 | 0.04 | 0.09 | 0.02 | 0.25 | 0.00 | 0.01 | 0.01 | 23.53 | 0.00 |
| Bobcat | Diesel | 44 | 55 | 6.07 | 2.25 | 5.68 | 0.007 | 0.578 | 0.51442 | 568.3 | 0.203 | 1 | 4 | 4 | 1.30 | 0.48 | 1.21 | 0.00 | 0.12 | 0.11 | 121.28 | 0.04 | 0.07 | 0.02 | 0.06 | 0.00 | 0.01 | 0.01 | 6.31 | 0.00 |
| Drill Rig | Diesel | 291 | 75 | 3.16 | 0.7 | 6.71 | 0.006 | 0.271 | 0.24119 | 568.3 | 0.063 | 1 | 4 | 4 | 6.08 | 1.35 | 12.91 | 0.01 | 0.52 | 0.46 | 1093.78 | 0.12 | 0.32 | 0.07 | 0.67 | 0.00 | 0.03 | 0.02 | 56.88 | 0.01 |
| Trencher | Diesel | 63 | 75 | 4.35 | 1.47 | 8.72 | 0.007 | 0.734 | 0.65326 | 568.3 | 0.133 | 1 | 2 | 4 | 0.91 | 0.31 | 1.82 | 0.00 | 0.15 | 0.14 | 118.40 | 0.03 | 0.05 | 0.02 | 0.09 | 0.00 | 0.01 | 0.01 | 6.16 | 0.00 |
| Compactor | Diesel | 8 | 43 | 3.47 | 0.68 | 4.33 | 0.009 | 0.274 | 0.24386 | 568.3 | 0.061 | 1 | 2 | 4 | 0.05 | 0.01 | 0.07 | 0.00 | 0.00 | 0.00 | 8.62 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.45 | 0.00 |
| Compressor | Diesel | 106 | 48 | 4.08 | 1.32 | 7.76 | 0.007 | 0.686 | 0.61054 | 568.3 | 0.119 | 1 | 4 | 4 | 1.83 | 0.59 | 3.48 | 0.00 | 0.31 | 0.27 | 254.99 | 0.05 | 0.10 | 0.03 | 0.18 | 0.00 | 0.02 | 0.01 | 13.26 | 0.00 |
| Concrete Truck/Pump Truck | Diesel | 210 | 20 | 1.82 | 0.57 | 5.55 | 0.006 | 0.295 | 0.26255 | 568.3 | 0.051 | 1 | 4 | 4 | 0.67 | 0.21 | 2.06 | 0.00 | 0.11 | 0.10 | 210.49 | 0.02 | 0.04 | 0.01 | 0.11 | 0.00 | 0.01 | 0.01 | 10.95 | 0.00 |
| **TOTAL for 1 Large Turbine** | | | | | | | | | | | | | | | **30.81** | **8.75** | **71.82** | **0.07** | **4.02** | **3.58** | **6469.49** | **0.78** | **1.60** | **0.45** | **3.73** | **0.00** | **0.21** | **0.19** | **336.41** | **0.04** |
| **TOTAL for 2 Large Turbines** | | | | | | | | | | | | | | | **61.63** | **17.49** | **143.64** | **0.14** | **8.05** | **7.16** | **12938.98** | **1.56** | **3.20** | **0.91** | **7.47** | **0.01** | **0.42** | **0.37** | **672.83** | **0.08** |
| **TOTAL for 3 Large Turbines** | | | | | | | | | | | | | | | **92.44** | **26.24** | **215.46** | **0.21** | **12.07** | **10.74** | **19408.47** | **2.34** | **4.81** | **1.36** | **11.20** | **0.01** | **0.63** | **0.56** | **1009.24** | **0.12** |
| **TOTAL for 4 Large Turbines** | | | | | | | | | | | | | | | **123.26** | **34.98** | **287.28** | **0.28** | **16.09** | **14.32** | **25877.97** | **3.13** | **6.41** | **1.82** | **14.94** | **0.01** | **0.84** | **0.74** | **1345.65** | **0.16** |

# Construction Truck Emissions

## *Small Turbine*

| Proj. Construction Trucks | No. of Trucks | Speed (mph) | VMT (mi/vehicle-day) | CO Running Exhaust (g/mi) | $NO_X$ Running Exhaust (g/mi) | VOC Running Exhaust (g/mi) | SOx Running Exhaust (g/mi) | PM10 Running Exhaust (g/mi) | PM10 Tire Wear (g/mi) | PM10 Brake Wear (g/mi) | PM2.5 Running Exhaust (g/mi) | PM2.5 Tire Wear (g/mi) | PM2.5 Brake Wear (g/mi) | CO2 Running Exhaust (g/mi) | CH4 Running Exhaust (g/mi) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heavy-duty diesel trucks | 10 | 27 | 40 | 6.303 | 17.209 | 1.262 | 0.019 | 0.713 | 0.036 | 0.028 | 0.656 | 0.009 | 0.012 | 1992.669 | 0.059 |
| **Emissions, lbs/day** | | | | | | | | **Emissions, tons/year** | | | | | | | |
| CO | NOx | VOCs | SOx | PM10 | PM2.5 | CO2 | CH4 | CO | NOx | VOCs | SOx | PM10 | PM2.5 | CO2 | CH4 |
| **5.56** | **15.18** | **1.11** | **0.02** | **0.69** | **0.60** | **1757.24** | **0.05** | **0.07** | **0.20** | **0.01** | **0.00** | **0.01** | **0.01** | **22.84** | **0.00** |
| **Total 1 Small Turbine =** | | | | | | | | **0.07** | **0.20** | **0.01** | **0.00** | **0.01** | **0.01** | **22.84** | **0.00** |
| **Total 2 Small Turbines =** | | | | | | | | **0.14** | **0.39** | **0.03** | **0.00** | **0.02** | **0.02** | **45.69** | **0.00** |
| **Total 3 Small Turbines =** | | | | | | | | **0.22** | **0.59** | **0.04** | **0.00** | **0.03** | **0.02** | **68.53** | **0.00** |
| **Total 4 Small Turbines =** | | | | | | | | **0.29** | **0.79** | **0.06** | **0.00** | **0.04** | **0.03** | **91.38** | **0.00** |

| **Unpaved Road Emissions** | | **PM10** | **PM2.5** |
|---|---|---|---|
| E = k(s/12)^a(W/3)^b | k | 1.5 | 0.15 |
| Assume s = 8.5 | a | 0.9 | 0.9 |
| Assume W = 10 | b | 0.45 | 0.45 |
| Assume 5 miles of travel per vehicle per day | | | |
| Emission Factor | | 1.890604 | 0.18906 |
| Control Efficiency | | 61% | 61% |
| Emissions, lbs/day | | 2.526113 | 0.2201 |
| **1 Small Turbine (emissions, tons/year) =** | | **0.03** | **0.00** |
| **2 Small Turbines (emissions, tons/year) =** | | **0.07** | **0.01** |
| **3 Small Turbines (emissions, tons/year) =** | | **0.10** | **0.01** |
| **4 Small Turbines (emissions, tons/year) =** | | **0.13** | **0.01** |

## *Medium Turbine*

| Proj. Construction Trucks | No. of Trucks | Speed (mph) | VMT (mi/vehicle-day) | CO Running Exhaust (g/mi) | $NO_X$ Running Exhaust (g/mi) | VOC Running Exhaust (g/mi) | SOx Running Exhaust (g/mi) | PM10 Running Exhaust (g/mi) | PM10 Tire Wear (g/mi) | PM10 Brake Wear (g/mi) | PM2.5 Running Exhaust (g/mi) | PM2.5 Tire Wear (g/mi) | PM2.5 Brake Wear (g/mi) | CO2 Running Exhaust (g/mi) | CH4 Running Exhaust (g/mi) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heavy-duty diesel trucks | 10 | 27 | 40 | 6.303 | 17.209 | 1.262 | 0.019 | 0.713 | 0.036 | 0.028 | 0.656 | 0.009 | 0.012 | 1992.669 | 0.059 |
| **Emissions, lbs/day** | | | | | | | | **Emissions, tons/year** | | | | | | | |
| CO | NOx | VOCs | SOx | PM10 | PM2.5 | CO2 | CH4 | CO | NOx | VOCs | SOx | PM10 | PM2.5 | CO2 | CH4 |
| **5.56** | **15.18** | **1.11** | **0.02** | **0.69** | **0.60** | **1757.24** | **0.05** | **0.14** | **0.39** | **0.03** | **0.00** | **0.02** | **0.02** | **45.69** | **0.00** |
| **Total 1 Medium Turbine =** | | | | | | | | **0.14** | **0.39** | **0.03** | **0.00** | **0.02** | **0.02** | **45.69** | **0.00** |
| **Total 2 Medium Turbines =** | | | | | | | | **0.29** | **0.79** | **0.06** | **0.00** | **0.04** | **0.03** | **91.38** | **0.00** |
| **Total 3 Medium Turbines =** | | | | | | | | **0.43** | **1.18** | **0.09** | **0.00** | **0.05** | **0.05** | **137.06** | **0.00** |
| **Total 4 Medium Turbines =** | | | | | | | | **0.58** | **1.58** | **0.12** | **0.00** | **0.07** | **0.06** | **182.75** | **0.01** |

| **Unpaved Road Emissions** | | **PM10** | **PM2.5** |
|---|---|---|---|
| E = k(s/12)^a(W/3)^b | k | 1.5 | 0.15 |
| Assume s = 8.5 | a | 0.9 | 0.9 |
| Assume W = 10 | b | 0.45 | 0.45 |
| Assume 5 miles of travel per vehicle per day | | | |
| Emission Factor | | 1.890604 | 0.18906 |
| Control Efficiency | | 61% | 61% |
| Emissions, lbs/day | | 2.526113 | 0.2201 |
| **1 Medium Turbine (emissions, tons/year) =** | | **0.07** | **0.01** |
| **2 Medium Turbines (emissions, tons/year) =** | | **0.13** | **0.01** |
| **3 Medium Turbines (emissions, tons/year) =** | | **0.20** | **0.02** |
| **4 Medium Turbines (emissions, tons/year) =** | | **0.26** | **0.02** |

## *Large Turbine*

| Proj. Construction Trucks | No. of Trucks | Speed (mph) | VMT (mi/vehicle-day) | CO Running Exhaust (g/mi) | $NO_X$ Running Exhaust (g/mi) | VOC Running Exhaust (g/mi) | SOx Running Exhaust (g/mi) | PM10 Running Exhaust (g/mi) | PM10 Tire Wear (g/mi) | PM10 Brake Wear (g/mi) | PM2.5 Running Exhaust (g/mi) | PM2.5 Tire Wear (g/mi) | PM2.5 Brake Wear (g/mi) | CO2 Running Exhaust (g/mi) | CH4 Running Exhaust (g/mi) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heavy-duty diesel trucks | 10 | 27 | 40 | 6.303 | 17.209 | 1.262 | 0.019 | 0.713 | 0.036 | 0.028 | 0.656 | 0.009 | 0.012 | 1992.669 | 0.059 |
| **Emissions, lbs/day** | | | | | | | | **Emissions, tons/year** | | | | | | | |
| CO | NOx | VOCs | SOx | PM10 | PM2.5 | CO2 | CH4 | CO | NOx | VOCs | SOx | PM10 | PM2.5 | CO2 | CH4 |
| **5.56** | **15.18** | **1.11** | **0.02** | **0.69** | **0.60** | **1757.24** | **0.05** | **0.29** | **0.79** | **0.06** | **0.00** | **0.04** | **0.03** | **91.38** | **0.00** |
| **Total 1 Large Turbine =** | | | | | | | | **0.29** | **0.79** | **0.06** | **0.00** | **0.04** | **0.03** | **91.38** | **0.00** |
| **Total 2 Large Turbines =** | | | | | | | | **0.58** | **1.58** | **0.12** | **0.00** | **0.07** | **0.06** | **182.75** | **0.01** |
| **Total 3 Large Turbines =** | | | | | | | | **0.87** | **2.37** | **0.17** | **0.00** | **0.11** | **0.09** | **274.13** | **0.01** |
| **Total 4 Large Turbines =** | | | | | | | | **1.16** | **3.16** | **0.23** | **0.00** | **0.14** | **0.12** | **365.51** | **0.01** |

| **Unpaved Road Emissions** | | **PM10** | **PM2.5** |
|---|---|---|---|
| E = k(s/12)^a(W/3)^b | k | 1.5 | 0.15 |
| Assume s = 8.5 | a | 0.9 | 0.9 |
| Assume W = 10 | b | 0.45 | 0.45 |
| Assume 5 miles of travel per vehicle per day | | | |
| Emission Factor | | 1.890604 | 0.18906 |
| Control Efficiency | | 61% | 61% |
| Emissions, lbs/day | | 2.526113 | 0.2201 |
| **1 Large Turbine (emissions, tons/year) =** | | **0.13** | **0.01** |
| **2 Large Turbines (emissions, tons/year) =** | | **0.26** | **0.02** |
| **3 Large Turbines (emissions, tons/year) =** | | **0.39** | **0.03** |
| **4 Large Turbines (emissions, tons/year) =** | | **0.53** | **0.05** |

### *Small Turbine*

| Vehicle Class | No. POVs | Speed (mph) | VMT (mi/vehicle-day) | CO | | $NO_X$ | | VOCs | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Hot-Soak (g/trip) | Resting Loss (g/hr) | Running Evaporative (g/mi) | Diurnal Evaporative (g/hr) |
| Light-duty truck, catalyst | 15 | 33 | 40 | 2.924 | 11.289 | 0.284 | 0.56 | 0.055 | 0.816 | 0.183 | 0.024 | 0.047 | 0.054 |

| Vehicle Class | SOx | | PM10 | | | | PM2.5 | | | | CO2 | | CH4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Tire Wear (g/mi) | Brake Wear (g/mi) | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Tire Wear (g/mi) | Brake Wear (g/mi) | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] |
| Light-duty truck, catalyst | 0.004 | 0.002 | 0.013 | 0.016 | 0.008 | 0.013 | 0.011 | 0.014 | 0.002 | 0.005 | 399.538 | 203.967 | 0.027 | 0.046 |

| Emissions, lbs/day | | | | | | | | Emissions, tons/year | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **NOx** | **VOCs** | **SOx** | **PM10** | **PM2.5** | **CO2** | **CH4** | **CO** | **NOx** | **VOCs** | **SOx** | **PM10** | **PM2.5** | **CO2** | **CH4** |
| **4.24** | **0.39** | **0.20** | **0.01** | **0.05** | **0.02** | **535.2** | **0.04** | **0.06** | **0.01** | **0.00** | **0.00** | **0.00** | **0.00** | **6.96** | **0.00** |
| **Total 1 Small Turbine =** | | | | | | | | **0.06** | **0.01** | **0.00** | **0.00** | **0.00** | **0.00** | **6.96** | **0.00** |
| **Total 2 Small Turbines =** | | | | | | | | **0.11** | **0.01** | **0.01** | **0.00** | **0.00** | **0.00** | **13.92** | **0.00** |
| **Total 3 Small Turbines =** | | | | | | | | **0.17** | **0.02** | **0.01** | **0.00** | **0.00** | **0.00** | **20.87** | **0.00** |
| **Total 4 Small Turbines =** | | | | | | | | **0.22** | **0.02** | **0.01** | **0.00** | **0.00** | **0.00** | **27.83** | **0.00** |

### *Medium Turbine*

| Vehicle Class | No. POVs | Speed (mph) | VMT (mi/vehicle-day) | CO | | $NO_X$ | | VOCs | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Hot-Soak (g/trip) | Resting Loss (g/hr) | Running Evaporative (g/mi) | Diurnal Evaporative (g/hr) |
| Light-duty truck, catalyst | 15 | 33 | 40 | 2.924 | 11.289 | 0.284 | 0.56 | 0.055 | 0.816 | 0.183 | 0.024 | 0.047 | 0.054 |

| Vehicle Class | SOx | | PM10 | | | | PM2.5 | | | | CO2 | | CH4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Tire Wear (g/mi) | Brake Wear (g/mi) | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Tire Wear (g/mi) | Brake Wear (g/mi) | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] |
| Light-duty truck, catalyst | 0.004 | 0.002 | 0.013 | 0.016 | 0.008 | 0.013 | 0.011 | 0.014 | 0.002 | 0.005 | 399.538 | 203.967 | 0.027 | 0.046 |

| Emissions, lbs/day | | | | | | | | Emissions, tons/year | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **NOx** | **VOCs** | **SOx** | **PM10** | **PM2.5** | **CO2** | **CH4** | **CO** | **NOx** | **VOCs** | **SOx** | **PM10** | **PM2.5** | **CO2** | **CH4** |
| **4.24** | **0.39** | **0.20** | **0.01** | **0.05** | **0.02** | **535.2** | **0.04** | **0.11** | **0.01** | **0.01** | **0.00** | **0.00** | **0.00** | **13.92** | **0.00** |
| **Total 1 Large Turbine =** | | | | | | | | **0.11** | **0.01** | **0.01** | **0.00** | **0.00** | **0.00** | **13.92** | **0.00** |
| **Total 2 Medium Turbines =** | | | | | | | | **0.22** | **0.02** | **0.01** | **0.00** | **0.00** | **0.00** | **27.83** | **0.00** |
| **Total 3 Medium Turbines =** | | | | | | | | **0.33** | **0.03** | **0.02** | **0.00** | **0.00** | **0.00** | **41.75** | **0.00** |
| **Total 4 Medium Turbines =** | | | | | | | | **0.44** | **0.04** | **0.02** | **0.00** | **0.00** | **0.00** | **55.67** | **0.00** |

### *Large Turbine*

| Vehicle Class | No. POVs | Speed (mph) | VMT (mi/vehicle-day) | CO | | $NO_X$ | | VOCs | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Hot-Soak (g/trip) | Resting Loss (g/hr) | Running Evaporative (g/mi) | Diurnal Evaporative (g/hr) |
| Light-duty truck, catalyst | 15 | 33 | 40 | 2.924 | 11.289 | 0.284 | 0.56 | 0.055 | 0.816 | 0.183 | 0.024 | 0.047 | 0.054 |

| Vehicle Class | SOx | | PM10 | | | | PM2.5 | | | | CO2 | | CH4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Tire Wear (g/mi) | Brake Wear (g/mi) | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Tire Wear (g/mi) | Brake Wear (g/mi) | Running Exhaust (g/mi) | Start-Up (g/start)[a] | Running Exhaust (g/mi) | Start-Up (g/start)[a] |
| Light-duty truck, catalyst | 0.004 | 0.002 | 0.013 | 0.016 | 0.008 | 0.013 | 0.011 | 0.014 | 0.002 | 0.005 | 399.538 | 203.967 | 0.027 | 0.046 |

| Emissions, lbs/day | | | | | | | | Emissions, tons/year | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **NOx** | **VOCs** | **SOx** | **PM10** | **PM2.5** | **CO2** | **CH4** | **CO** | **NOx** | **VOCs** | **SOx** | **PM10** | **PM2.5** | **CO2** | **CH4** |
| **4.24** | **0.39** | **0.20** | **0.01** | **0.05** | **0.02** | **535.2** | **0.04** | **0.22** | **0.02** | **0.01** | **0.00** | **0.00** | **0.00** | **27.83** | **0.00** |
| **Total 1 Large Turbine =** | | | | | | | | **0.22** | **0.02** | **0.01** | **0.00** | **0.00** | **0.00** | **27.83** | **0.00** |
| **Total 2 Large Turbines =** | | | | | | | | **0.44** | **0.04** | **0.02** | **0.00** | **0.00** | **0.00** | **55.67** | **0.00** |
| **Total 3 Large Turbines =** | | | | | | | | **0.66** | **0.06** | **0.03** | **0.00** | **0.01** | **0.00** | **83.50** | **0.01** |
| **Total 4 Large Turbines =** | | | | | | | | **0.88** | **0.08** | **0.04** | **0.00** | **0.01** | **0.01** | **111.33** | **0.01** |