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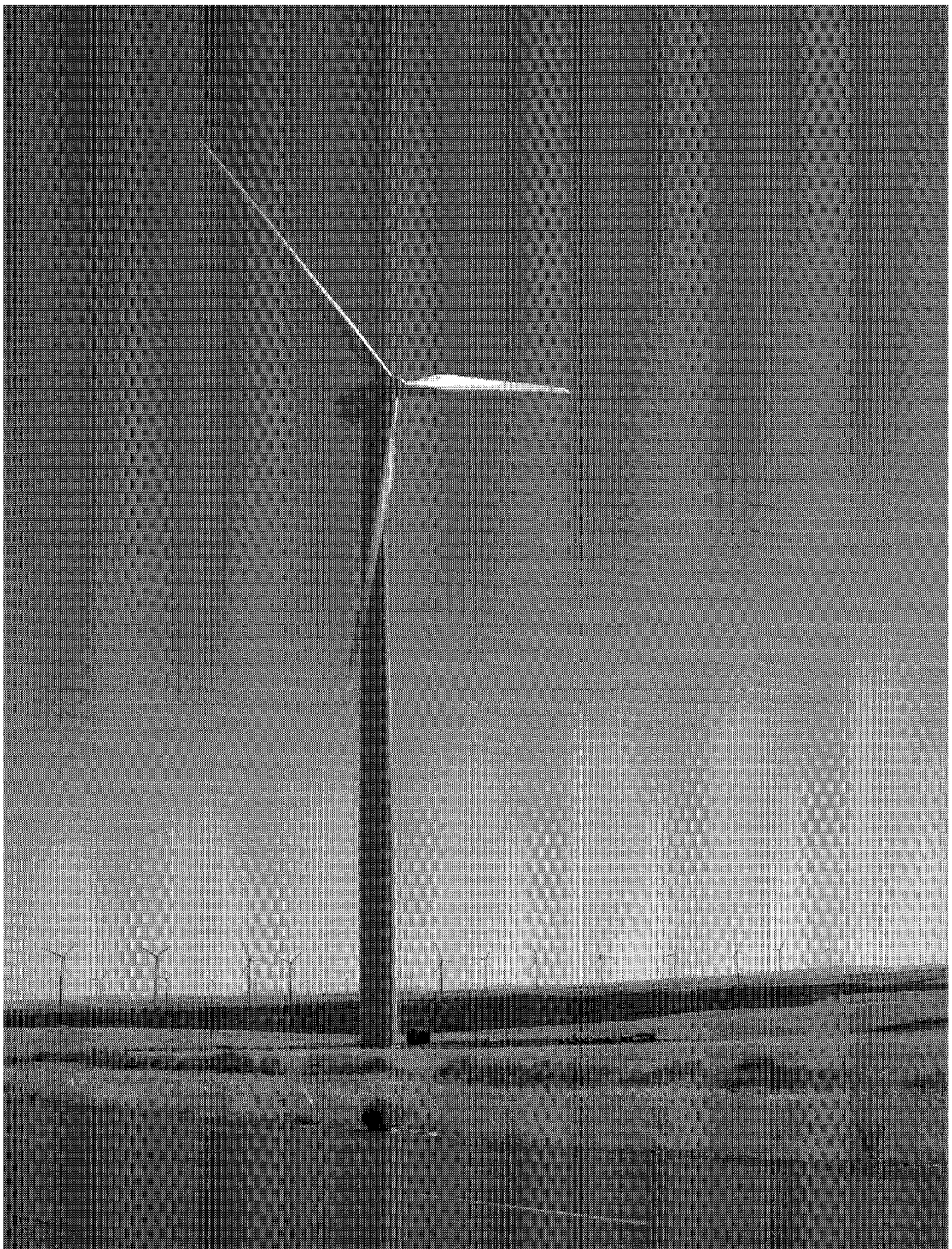
KLONDIKE III / BIGLOW CANYON WIND INTEGRATION PROJECT

Draft Environmental Impact Statement
DOE/EIS-0374



BONNEVILLE POWER ADMINISTRATION

Klondike III/Biglow Canyon Wind Integration Project

Responsible Agency: U.S. Department of Energy, Bonneville Power Administration (BPA)

Title of Proposed Project: Klondike III/Biglow Canyon Wind Integration Project

State Involved: Oregon

Abstract: BPA has been asked by PPM Energy, Inc. to interconnect 300 megawatts (MW) of electricity generated from the proposed Klondike III Wind Project to the Federal Columbia River Transmission System. Orion Energy LLC has also asked BPA to interconnect 400 MW of electricity from its proposed Biglow Canyon Wind Farm, located north and east of the proposed Klondike III Wind Project. To interconnect these projects, BPA would need to build and operate a 230-kV double-circuit transmission line about 12 miles long, expand one substation and build one new substation. The wind projects would require wind turbines, substation(s), access roads, and other facilities.

Two routes for the transmission line are being considered. Both begin at PPM's Klondike Schoolhouse Substation then travel north (Proposed Action) or north and westerly (Middle Alternative) to a new BPA 230-kV substation next to BPA's existing John Day 500-kV Substation.

BPA is also considering a No Action Alternative in which BPA would not build the transmission line and would not interconnect the wind projects.

The proposed BPA and wind projects would be located on private land, mainly used for agriculture. If BPA decides to interconnect the wind projects, construction of the BPA transmission line and substation(s) could commence as early as the winter of 2006-07. Both wind projects would operate for much of each year for at least 20 years.

The proposed projects would generally create no or low impacts. Wildlife resources and local visual resources are the only resources to receive an impact rating other than "none" or "low." The low to moderate impacts to wildlife are from the expected bird and bat mortality and the cumulative impact of this project on wildlife when combined with other proposed wind projects in the region. The low to high impacts to visual resources reflect the effect that the transmission line and the turbine strings from both wind projects would have on viewers in the local area, but this impact diminishes with distance from the project.

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For additional information on DOE NEPA activities, please contact Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance, EH-42, U.S. Department of Energy, 1000 Independence Avenue S.W., Washington D.C. 20585, phone: 1-800-472-2756 or visit the DOE NEPA Web site at www.eh.doe.gov/nepa.

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Bonneville Power Administration (***BPA***)[1], a federal agency, owns and operates more than 15,000 circuit miles of electric ***transmission lines***, including most of the ***high-voltage*** (115-***kilovolt*** [***kV***] and above) lines in the Pacific Northwest. BPA's transmission system, known as the Federal Columbia River Transmission System (FCRTS), is operated in part, to "integrate and transmit the electric power from existing or additional federal or non-federal generating units" that are developed in the region.[2] Depending on the location of a proposed power generation project being developed in the region, interconnection of the project to the FCRTS may be essential for effective delivery of power generated by the project to loads in the Pacific Northwest and elsewhere.

Two companies, PPM Energy, Inc. (PPM) and Orion Energy LLC, (Orion) have proposed the construction and operation of two separate wind farm projects to generate power in Sherman County, Oregon. PPM's proposed project is referred to as the Klondike III Wind Project, and Orion's proposed project is referred to as the Biglow Canyon Wind Farm. Both proposed projects are in the vicinity of existing BPA transmission lines running along the lower Columbia River that are part of the FCRTS. As part of their proposals, both PPM and Orion have requested that BPA integrate power produced from their respective projects into the FCRTS at BPA's existing John Day 500-kV ***Substation***.

1.1 BPA's Need for Action

BPA has adopted an Open Access Transmission Tariff for the FCRTS consistent with the Federal Energy Regulatory Commission's (FERC) *pro forma* open access tariff.[3]

[1] Words in bold and italics are defined in Chapter 9, Glossary and Acronyms.

[2] 16 U.S.C. 838b.

[3] Although BPA is not subject to FERC jurisdiction, BPA follows the open tariff as a matter of national policy. This course of action demonstrates BPA's commitment to non-discriminatory

Under BPA's tariff, BPA offers transmission interconnection to the FCRTS to all eligible customers on a first-come, first-served basis, with this offer subject to an environmental review, such as this ***environmental impact statement*** (EIS), under the National Environmental Policy Act (NEPA). BPA must also evaluate how any new interconnection services would maintain reliable service to existing and foreseeable future customers.

As discussed above, both PPM and Orion have submitted generation interconnection requests for their respective projects to BPA for interconnection with the FCRTS.[4] Consistent with its tariff, BPA needs to respond to PPM's and Orion's requests and decide if it will provide interconnection for their projects into the regional transmission grid. More specifically, BPA needs to decide if it will enter into Large Generator Interconnection Agreements (LGIAs) to interconnect the proposed power generation projects into the FCRTS. BPA also needs to decide if it will provide transmission services to these projects through transmission service agreements.

In addition, granting an interconnection of these projects to the FCRTS would require that BPA construct and operate a new 230-kV transmission line and ancillary facilities from the projects to BPA's John Day 500-kV Substation. Accordingly, BPA needs to decide whether and where to construct such a line and other facilities.

1.2 BPA's Purposes

The purposes in the "purpose and need" statement are goals to be pursued while meeting the need for the project. These goals are important factors used to compare and contrast the alternatives evaluated in detail in the EIS. BPA will use the following purposes to choose among the alternatives:

- Maintain transmission system reliability to industry standards;
- Act consistently with BPA's statutory obligations;
- Continue to meet BPA's contractual obligations;
- Minimize environmental impacts;
- Minimize costs; and
- Encourage development of renewable energy resources.

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access to its transmission system and ensures that BPA will receive non-discriminatory access to the transmission system of utilities that are subject to FERC jurisdiction.

[4] PPM's interconnection request, submitted to BPA in February 2004, is for up to 300 megawatts (MW) of the output from its proposed project; Orion's interconnection request, submitted to BPA in April 2002, is for up to 400 MW of the output from its proposed project.

1.3 Wind Project Siting Issues

The wind projects proposed by PPM and Orion would be in the state of Oregon. Because of the proposed generating ***capacity*** of each of the wind projects, both projects are under the jurisdiction of the Oregon Energy Facility Siting Council (EFSC), which has siting authority over the projects. Accordingly, PPM and Orion must each obtain a site certificate from Oregon EFSC before constructing or operating their respective projects.[5] As part of the site certificate approval process, Oregon EFSC must find that the proposed projects meet certain standards, including environmental standards, pursuant to Oregon Administrative Rule (OAR) Chapter 345, Division 21, Section 045. The following describes the Oregon EFSC siting process to date for each of the proposed wind projects.

1.3.1 Klondike III Wind Farm

PPM proposes to build and operate the Klondike III Wind Project near the town of Wasco, in Sherman County, Oregon, next to its existing Klondike I and II wind projects. PPM proposes the construction and operation of up to 165 wind turbines, all on privately-owned land, as part of this project. The facility would have an electric generating capacity of about 273 ***megawatts*** (MW).

PPM submitted an Application for Site Certificate (ASC) for its proposed wind project to Oregon EFSC on May 13, 2005. The ASC was deemed complete by Oregon EFSC on February 6, 2006. Review of the ASC for PPM's proposed project by involved state agencies is expected to occur concurrently with BPA's EIS review process.

1.3.2 Biglow Canyon Wind Farm

Orion Energy LLC proposes to build and operate the Biglow Canyon Wind Farm in Sherman County, Oregon. Orion proposes the construction and operation of up to 225 wind turbines, all on privately-owned land, as part of this project. The facility would have an electric generating capacity of about 400 MW.

Orion submitted an Application for Site Certificate for its proposed wind project to Oregon EFSC on October 12, 2005. The ASC was deemed complete by Oregon EFSC on February 24, 2006. Review of the ASC for Orion's proposed project by involved state agencies is expected to occur concurrently with BPA's EIS review process.

1.4 Scoping and Major Issues

Scoping refers to a time early in the development of an EIS when the public tells BPA what issues should be considered. On February 11, 2005, BPA published a ***Notice***

[5] While Oregon EFSC has siting jurisdiction over the proposed wind projects, it has no involvement in the siting, construction or operation of BPA's transmission lines and appurtenant facilities.

of Intent (NOI) in the Federal Register to prepare an EIS for BPA's proposed actions related to the proposed Klondike III Wind Project. This NOI also announced BPA's intent to hold a public scoping meeting on March 1, 2005 in Wasco, Oregon and set May 13, 2005 as the date for the close of the public scoping comment period. The NOI was posted on a BPA Web site created specifically for posting information and updates related to the EIS.

In addition to the NOI, three letters (dated February 11, 2005, February 24, 2005, and April 12, 2005) were mailed to people potentially interested in or affected by the proposal. These letters explained the proposal, the environmental impact statement process, and how to participate. A comment sheet was included so people could mail their comments to BPA.

BPA also purchased ads in local newspapers announcing the scoping meeting.

As indicated in the NOI, BPA held a public scoping meeting on March 1, 2005 in Wasco, Oregon to describe BPA's proposed action and accept any scoping comments. PPM representatives were also present at this meeting to discuss their proposed wind project. A second scoping meeting, also in Wasco, was held on April 27, 2005.

During the initial scoping period, BPA received comments suggesting that the Biglow Canyon Wind Farm be added to the EIS because it was planned to be built near the Klondike III Wind Project. Based on this public feedback and a request from Orion for interconnection, BPA decided to include interconnection of the Biglow Canyon Wind Farm in the EIS being developed for the interconnection of the Klondike III Wind Project. BPA then reopened and extended the scoping comment period for the EIS until January 5, 2006. BPA announced this extension by publishing a *Notice of Extension of Comment Period for an Environmental Impact Statement* in the Federal Register on December 6, 2005. BPA also mailed a letter on December 2, 2005 to people potentially interested in or affected by the proposal announcing the extended comment period, and posted notice of the extension on the BPA Web site for the EIS.

As a result of the scoping process, various written and verbal comments were collected. Comments covered many issues:

- Need for the project;
- Economic benefits and impacts;
- Adverse environmental impacts of a transmission line, including interruption of farming practices;
- Bird and bat collisions with the wind facilities;
- Visual impacts;
- Possible routes for the transmission line.
- Location of the substation facilities.

This is a partial list of issues identified from the comments received. All comments received were logged in, and forwarded to resource specialists to include in their environmental impact analyses for the EIS.

EFSC will also request public comments during its site certification processes for the two proposed wind projects. BPA staff will review these comments for any issues related to BPA's actions for the proposed wind projects.

1.5 Organization of the EIS

The remainder of this EIS is organized as follows:

- Chapter 2 describes the proposed action and alternatives, including taking no action. It summarizes the differences among alternatives, especially in potential environmental impacts.
- Chapter 3 describes the existing environment that could be affected by the project. The existing environment includes the social and natural environment.
- Chapter 4 describes the possible environmental consequences of the proposed action and alternatives. An assessment of the direct, indirect, and cumulative effects on geology, soil, and seismicity, ***hydrology*** and water quality, vegetation and wildlife, fish, traffic and circulation, air quality, visual quality and aesthetics, cultural resources, land use plans and policies, socioeconomics, public services and utilities, and health and safety, including noise, is provided. Impacts can range from no or low impact to high impact.
- Chapter 5 discusses the licenses, permits and other approvals that must be obtained in order to implement the proposed action.
- Chapters 6 through 9 list the individuals who helped prepare the EIS, the references used, the individuals, agencies, and groups the EIS was sent to, and provides a glossary.
- An index is included as Chapter 10.
- Supporting technical information is in appendices.

Chapter 2 - Proposed Action and Alternatives

In this Chapter:

- BPA's Proposed Action
- Alternatives to the Proposed Action Including No Action
- Alternatives Considered But Eliminated from Detailed Study
- Descriptions of the Proposed Wind Projects
- Comparison of Alternatives and Summary of Impacts

This chapter describes two action alternatives and the No Action Alternative BPA is evaluating in detail in this EIS, and other alternatives considered but eliminated from detailed study. Summaries of the proposed Klondike III Wind Project and Biglow Canyon Wind Farm are also provided. The chapter concludes with comparative summaries of how each alternative addresses the purposes described in Chapter 1 of this EIS, as well as the potential environmental impacts of each alternative based on the analysis contained in Chapter 4 of this EIS.

2.1 BPA's Proposed Action

BPA's Proposed Action is to: (1) enter into interconnection agreements with PPM and Orion for their proposed wind projects; and (2) construct and operate a new ***double-circuit*** 230-kV transmission line and ancillary facilities from the proposed wind projects to BPA's John Day 500-kV Substation. These actions would allow the proposed wind projects to be interconnected with the FCRTS. The preferred route for the new BPA transmission line is the North Alternative (see Map 1). The 12-mile long line would generally extend north from PPM's Klondike Schoolhouse Substation for about 5.3 miles, and then west for the remaining 6.7 miles to the John Day Substation.

PPM's Klondike III project would be tied into the new line at Klondike Schoolhouse Substation. The Biglow Canyon Wind Farm would connect to the line at a new substation built by Orion located in between Klondike and the new John Day 230-kV Substation. The line would be constructed to carry up to 600 MW of capacity in each circuit to allow for additional capacity in the future.

To connect the new 230-kV transmission line to the FCRTS at the existing John Day 500-kV Substation, BPA would both expand the existing substation and construct a new 230-kV substation immediately adjacent to the existing substation. BPA would construct a new ***bay*** at the existing John Day 500-kV Substation and add two ***circuit breakers*** and associated disconnect ***switches***. BPA would also extend the substation's existing south fence on existing BPA property to add a ***dead end*** tower to connect to the new 230-kV substation. The expanded area would be about 0.1 acre.

The new 230-kV substation would be directly south of the existing John Day 500-kV Substation. The new substation would occupy about 5 acres, and would include a 500/230-kV ***transformer***, ring bus and other typical substation equipment. BPA would purchase 15 acres in fee for the proposed John Day 230-kV Substation.

The remainder of this section describes the proposed transmission line and ancillary facilities in more detail.

2.1.1 Proposed Double-Circuit 230-kV Transmission Line

BPA proposes to build a double-circuit 230-kV transmission line (see Map 1). Double circuit means carrying two transmission lines on one ***structure***. For this project, a 230-kV line would be on each side of either a steel tube or a ***lattice steel*** tower. The preferred route for this line is the North Alternative, which is about 12 miles long.

2.1.2 Transmission Structures

Steel tubes and lattice steel towers would be used to suspend the 230-kV transmission line in the air (see Figure 1). Steel tubes would be used for ***tangent*** and small angle structures. Steel tubes average about 125 feet tall, with the average span 900 to 1,000 feet (see Figure 1). Steel tubes are usually preferred in agricultural areas because they do not disrupt farming practices as much as other types of structures.

BPA would use lattice steel towers for the ***dead-end*** structures needed for the lines. Dead-end structures equalize tension of the ***conductors*** between two segments of transmission line where the line makes a turn. The last transmission structures on lines entering a substation are also dead-end towers. These towers are built with extra strength to reduce conductor tension on ***substation dead-ends*** and to provide added reliability to the substation.

Lattice steel towers would be used for dead-end towers because they are more cost effective than steel tubes. Lattice steel towers average about 120 feet tall, with the average span 1,000 to 1,200 feet (see Figure 1).

The steel tubes would be embedded in the ground about 20 to 25 feet, in a hole about 5 feet in diameter. The lattice steel towers would be attached to the ground on ***plate or grillage footings***. Plate footings are 6 foot by 6 foot steel plates buried about 10 feet deep. Grillage footings are a 10 foot by 10 foot assembly of steel I-beams that have been welded together and buried 10 to 12 feet deep.

A track hoe would be used to excavate an area for the footings. The excavation sidewalls would be sloped or shored to prevent collapse. All the soil and rock materials removed would be used to backfill the excavated area once the footings are installed.

Transmission structures would normally be assembled in sections at a structure site and lifted into place by a large crane (30 to 100 ton capacity). The construction of a tower and its footings could disturb an area of about an acre (200 feet by 200 feet) using plate and grillage footings.

2.1.3 Conductors and Insulators

The wires that carry electrical ***current*** in a transmission line are called ***conductors***. The conductor proposed for this project would be about 1.3 to 1.6 inches in diameter. Conductors are suspended from tubes and towers with ***insulators***. Insulators are made of nonconductive materials (rubber, porcelain or fiberglass) that prevent electric current from passing through the towers to the ground. Insulator strings of non-reflective material for BPA's line would be 10 inches in diameter and 7 feet long.

Conductors and insulators would be installed after the tubes and towers have been built. A pulling cable called a "sock line" would be placed in pulleys or travelers that are attached to the insulators on the structures. The sock line would be pulled through the pulleys, usually by helicopter. The end of the sock line would be attached to a conductor on large reels mounted on trucks equipped with a brake system that allows the conductor to be unwound under tension. The sock line would be used to pull the conductors through the series of pulleys mounted on the structures. Conductor tensioning sites would typically be located every 2 to 3 miles.

About 10 tensioning sites would be required for this project. Conductor tensioning sites would typically disturb an area of about 1 acre. Disturbance would be temporary. Any disturbed area would be restored to pre-construction conditions.

At the dead-end structures, there are two primary methods available to BPA to attach the conductor to the structure. The first method, hydraulic compression fittings, uses a large press and pump that closes a metal clamp or sleeve onto the conductor. This method requires heavy equipment and is time consuming. The second method, implosive fittings, uses explosives to compress the metal together. The implosive fittings do a better job of compressing the sleeve onto the conductor and actually weld the metals together. Implosive fittings do not require heavy equipment, but do create noise similar to a loud explosion when the primer is struck. BPA would to use implosive fittings on this project.

Two smaller wires, called ***ground wires***, would also be attached to the top of the transmission structures. Ground wires are used for lightning protection. There would also be a series of wires and/or grounding rods (called ***counterpoise***) buried in the ground at each structure. These wires are used to establish a low resistance path to earth, usually for lightning protection.

A ***fiber optic*** cable would also be strung on the structures. The fiber optic cable would have up to 36 fibers. The fibers would be used for communications as part of the power system. Fiber optic technology uses light pulses instead of radio or electrical signals to transmit messages. This communication system can gather information about the system (such as the transmission lines in service and the amount of power being carried, meter readings at interchange points, and status of equipment and alarms).

2.1.4 Right-of-Way

BPA would acquire ***easements*** to build, operate and maintain the transmission line across private properties. In general, the ***voltage*** of a transmission line is the primary factor in determining the necessary width of the ***right-of-way*** (ROW) required for the line for safety and other reasons. Because of the voltage of the proposed transmission line, a new 125-feet wide ROW would be required for the full 12-mile length of the line.

2.1.5 Right-of-Way Clearing

Most of the land along the ROW is in wheat production or has other low-growing vegetation compatible with transmission lines. Tall trees cannot be allowed to grow into or near the lines because electricity can arc, which can start a fire or injure or kill someone nearby. There are few tall trees along the proposed route and no trees would likely be removed.

2.1.6 Access Roads

BPA would use the existing road system as much as possible for construction. The proposed line currently parallels existing roads in the area, such as North Klondike Road and Herrin Road, for much of its length. However, some portions of the proposed line do not currently have road access, and access would be necessary for construction to each transmission structure site. BPA would purchase easements for ***access roads***. Any roads needed in farmed fields would be about 14 feet wide, would be designed to be temporary and would be removed after construction, unless requested to be left in place by the landowner. If construction were scheduled during the dry season, little or no rock is anticipated to be necessary on the roads. Access roads would be used by cranes, excavators, supply trucks, boom trucks, and line trucks for construction of the transmission line.

Ground disturbed for temporary roads would be restored to its pre-construction condition after the transmission lines would be built. If crop damage were to occur during construction or maintenance, landowners would be compensated. The location of temporary roads would generally fall within the transmission line ROW. BPA would purchase the rights to a permanent access road system. Access road locations would be coordinated with landowners, to the extent practical, to minimize impacts on property.

2.1.7 Gates

Some landowners/land managers have policies regarding public access to their properties. Locked gates are commonly used to restrict public access. BPA cooperates with landowners on a case-by-case basis on permanent access, gates and locks. At this time, the exact location of any locked gates that could be required is unknown.

2.1.8 Staging Areas

During transmission line construction, steel, electrical conductors, insulators and hardware are often stockpiled at a site called a staging area or material yard that is near the proposed line. BPA would secure temporary rights to establish a material storage yard and contractor staging area. BPA's storage yard/staging area would be about 5 to 10 acres. The location of this staging area would depend on the needs of the project and would be determined prior to construction. To facilitate construction efficiency, staging areas tend to be located next to highways and main roads. Staging areas are only used prior to and during construction. After construction, the staging areas would be removed, and the disturbed areas would be restored to their pre-construction conditions.

2.1.9 Substation Facilities

Substations contain electrical equipment that enables BPA to interconnect several different transmission lines, disconnect lines for maintenance or outage conditions, and regulate voltage. BPA proposes to expand its existing John Day 500-kV Substation, and to build a new John Day 230-kV Substation. The existing 500-KV substation would be expanded by about 0.1 acre on existing BPA property. The new 230-kV substation would occupy about 5 acres. The principal equipment that would be installed at these substations under the Proposed Action is described below.

Transformer — A transformer is a device for transferring electrical energy from one circuit to another by magnetic induction, usually between circuits of different voltages. BPA would install a new 500/230-kV transformer at the new 230-kV substation.

Power circuit breakers — A breaker is a switching device that can automatically interrupt power flow on a transmission line at the time of a fault, such as a lightning strike, trees or tree limbs falling on a line or other unusual event. New breakers would be installed at both the existing 500-kV substation and new 230-kV substation to redirect power as desired.

Switches — These devices are used to mechanically or electrically disconnect or isolate equipment. Switches are normally located on both sides of circuit breakers. Switches are planned on each side of the proposed dead-end tower at the 500-kV substation and 230-kV substation.

Bus tubing, bus pedestals — Power moves within the substation and between breakers and other equipment on rigid aluminum pipes called bus tubing. This tubing is supported and vertically elevated by pedestals called "bus pedestals."

Substation dead-end towers — These are the towers within the confines of the substation where incoming and outgoing transmission lines end. Dead-ends are typically the tallest structures in a substation. A substation dead-end structure would be installed inside both substations. The 230-kV lines would terminate on these towers.

Substation fence — A chain-link fence with barbed wire on top typically is placed around all BPA substations to provide security. The fence is placed to allow adequate spacing between the fence and substation electrical equipment to maneuver construction and maintenance vehicles. The existing fence at John Day 500-kV Substation would be extended to include the new equipment. The new 230-kV substation would also be fenced.

Substation rock surfacing — A 3-inch layer of rock selected for its insulating properties would be placed on the ground within the new 230-kV substation to protect operation and maintenance personnel from electrical danger during substation electrical failures. The expanded area of John Day 500-kV Substation would also be rocked.

2.1.10 Communication Facilities

Microwave communication sites and fiber-optic communication lines connect BPA's high-voltage substations to system control centers located in Vancouver and Spokane, Washington. Dispatchers within the control centers remotely monitor meters and gauges on electric power equipment within each substation and receive alarm signals if an emergency were to occur. Dispatchers have the ability to disconnect lines and electrical equipment when transmission failures do occur through breakers and switches remotely.

Communications between the wind farm collector facilities and the proposed new 230-kV substation would be accomplished with fiber optic cables. Redundant fiber optic cables with alternate routes would be installed between the new substation and the existing 500-kV substation to ensure that no single failure would disable communications. The circuits would be connected to the existing BPA communication system.

2.1.11 Cost Estimate

The estimated construction cost for the transmission line, the new 230-kV substation and the expansion at the existing John Day 500-kV Substation is about $40-45 million.

2.1.12 Maintenance

During the life of the project, BPA would perform routine, periodic maintenance and emergency repairs to the transmission line. Maintenance usually involves replacing insulators on an as-needed basis. Twice a year, a helicopter would fly over the line to look for hot spots (areas where electricity may not be flowing correctly) or other problems indicating that a repair may be needed.

Vegetation is also maintained along the line for safe operation and to allow access to the line. The area would need little vegetation maintenance because it is mostly farmed.

If vegetation maintenance is needed, BPA's vegetation management would be guided by its Transmission System Vegetation Management Program EIS (see Section 3.11.4 for more information). BPA uses an integrated vegetation management strategy for controlling vegetation along its transmission line rights-of-way. This strategy involves choosing the appropriate method for controlling the vegetation based on the type of vegetation and its density, the natural resources present at a particular site, landowner requests, regulations, and costs. BPA may use a number of different methods: manual (hand-pulling, chainsaws), mechanical (roller-choppers, brush-hogs), biological (insects or fungus for attacking noxious weeds), and herbicides.

Prior to controlling vegetation, BPA sends notices to landowners and requests information that might help in determining appropriate methods and ***mitigation*** measures (such as herbicide-free buffer zones around springs or wells). Noxious weed control is also part of BPA's vegetation maintenance program and BPA works with the county weed boards and landowners on area-wide plans for noxious weed control.

2.2 Middle Alternative

With the Middle Alternative, BPA would also: (1) enter into interconnection agreements with PPM and Orion for their proposed wind projects; and (2) construct and operate a new double-circuit 230-kV transmission line and ancillary facilities from the proposed wind projects to BPA's John Day 500-kV Substation. The transmission line for the Middle Alternative would originate from the same location as the Proposed Action, but would follow a different route to the new substation (see Map 1). This transmission line route would be about 12.5 miles long.

The Middle Alternative has all the components of the Proposed Action.

The estimated cost for the Middle Alternative is about $40-45 million, about the same as the Proposed Action.

2.3 No Action Alternative

The No Action Alternative is often called the no-build alternative. Under this alternative, BPA would not sign interconnection agreements with PPM and Orion, and would not construct a new BPA substation, expand the existing John Day 500-kV Substation, or construct a transmission line. The environmental impacts described for each of the BPA action alternatives would not occur. In addition, it is likely that both PPM's and Orion's proposed wind projects would not be built since there appears to be no feasible interconnection option for these projects other than the FCRTS.

2.4 Alternatives Considered but Eliminated from Detailed Study

In developing this EIS, BPA considered a wide range of potential alternatives. This range included alternatives developed by BPA based on its knowledge of transmission line design and possible environmental issues, as well as alternatives that either were suggested or responded to concerns raised during the scoping process for this EIS. For each potential alternative, BPA assessed whether the alternative was reasonable under

NEPA and merited detailed evaluation in this EIS, or was not reasonable and could be eliminated from detailed study.

BPA considered several factors in making this assessment of potential alternatives. BPA considered whether the potential alternative would meet the identified purposes and need for the proposed action (see Chapter 1). In addition, BPA considered whether the alternative would be practical and feasible from a technical and economic standpoint and using common sense, consistent with the Council of Environmental Quality Guidance on assessing the reasonableness of alternatives. Finally, BPA considered whether the alternative would have greater adverse environmental effects than the proposed action.

Alternatives deemed not to merit detailed evaluation in this EIS were those that did not meet the stated purpose and need for the proposed action, that were not practical or feasible, or that would have greater adverse environmental effects than the proposed action. This section summarizes the alternatives that were considered but have been eliminated from detailed study in this EIS.

2.4.1 Alternative Transmission Line Voltages

BPA considered other line voltages for a transmission line. A 115-kV line, (even if double-circuit), would not have the capacity for the amount of energy produced from the wind projects.

A 500-kV line would have more than enough capacity, but the cost would be prohibitive. A 500-kV line would also require larger towers and more ROW (150 feet) and would increase the impacts to visual resources and farming practices.

2.4.2 Underground Transmission Line Alternative

Underground transmission lines (cables), are highly complex in comparison to overhead lines. For 230-kV lines, underground cable may be 4 to 5 times as costly as overhead designs. Because of the cost, BPA uses underground cable in limited, special reliability, or routing situations, such as near nuclear power stations, at locations where high capacity lines must cross long bays, or in urban areas.

2.4.3 Alternative Transmission Line Routes

BPA considered several possible alternate routes for BPA's transmission line (see Map 2). The following were eliminated based on comments received at the March 1, and April 27, 2005 public meetings and during the scoping period, or because they could create greater impacts than other alternatives.

2.4.3.1 Alternative A

In this alternative, the transmission line would go northwest from the Klondike Schoolhouse Substation; across a field to Klondike Road; north along Klondike Road; west along Medler Road; then northwest to the new 230-kV substation. This alternative was modified to place transmission lines on edges of fields, not across fields, per landowner comments. Landowners preferred that structures be placed on field edges. Parts of this alternative are now included in the Middle Alternative and this alternative was eliminated from further consideration.

2.4.3.2 Alternative B

In this alternative, the transmission line would run northwest from the Klondike Schoolhouse Substation; across a field to Klondike Road; north along Klondike Road, west along Medler Road; due west across China Hollow to the existing BPA ROW; then north, adjacent to the existing ROW to the new 230-kV substation. This alternative was eliminated from consideration because there is a quarry where blasting occurs along the route. Also, China Hollow has one of the better riparian areas in the area and so this alternative was eliminated to avoid disturbing it.

2.4.3.3 Alternative C

This alternative ran northwest from the Klondike Schoolhouse Substation to the west end of Medler Road, then northwest to John Day Substation. This alternative was eliminated from consideration in response to landowners' concerns about disrupting farming practices. Landowners preferred to have structures on the edge of fields instead of in the middle of fields.

2.4.3.4 Alternative D

In this alternative the transmission line ran northwest from the Klondike Schoolhouse Substation to the west end of Medler Road; due west across China Hollow to the existing BPA ROW; then north, adjacent to the existing ROW to the new 230-kV substation. This alternative was eliminated from consideration for the same reasons as Alternative B, because of the existing quarry and China Hollow. In addition, there were concerns about conflicting with farming practices.

2.4.3.5 Alternative E

In this alternative the transmission line ran west along Klondike Road from Klondike Schoolhouse Substation passing south of the city of Wasco to the existing BPA ROW; then north, adjacent to the existing ROW to the new 230-kV substation. This alternative was eliminated from consideration in response to comments. This route would come close to a new home and is also close to the town of Wasco. It also would create impacts to farming operations. Parts of this alternative became the South Alternative.

2.4.3.6 South Alternative

The original South Alternative was modified during the scoping period by moving the east to west portion of the route approximately one-half mile farther south to run along existing property lines and minimize farmland and residential impacts. This route ran due south from the Klondike Schoolhouse Substation; then due west and parallel to Klondike Road, intersecting with an existing BPA ROW; then north, adjacent to the existing ROW to the new 230-kV substation. This alternative was eliminated from further consideration because transmission structures would interfere with farming practices though the structures would be on section lines. It was also the longest alternative, which increases costs.

Originally, a new substation site along the South Alternative also was proposed during scoping. It was eliminated from consideration because it was associated with the South Alternative that has been eliminated from detailed study in this EIS.

2.5 Proposed Wind Projects

A reasonably foreseeable consequence of implementing either of BPA's action alternatives is the construction and operation of the wind projects respectively proposed by PPM and Orion. This section describes these two projects.

2.5.1 Klondike Wind Project

The Klondike III Wind Project, proposed by PPM Energy, would consist of a wind generation project in northern Sherman County, Oregon that would produce about 273 MW. The proposed project is adjacent to PPM Energy's Klondike I (24 MW) and Klondike II (75 MW) wind projects. It would be connected to PPM's proposed Klondike West Substation (see Map 1).

All Klondike III facilities would be on private agricultural land. PPM has negotiated long-term wind energy leases with the landowners. The wind energy leases allow PPM to permit, construct, and operate wind energy facilities for a defined period. In exchange, the landowners receive compensation. The terms of the wind energy leases allow landowners to continue their farming operations in and around the wind turbine generators and other facilities where the farming activities would not impact operation and maintenance of the wind generation equipment.

Klondike III facilities would consist of up to 165 wind turbines and towers, about 19 miles of new roads, an operations and maintenance (O&M) facility, and two substations. Wind turbines and roads would be built within 900-foot-wide corridors. Project facilities would occupy about 64 acres of land. Construction would temporarily disturb about 97 acres.

2.5.1.2 Turbines and Towers

Wind turbines consist of two primary components: a tubular tower, and the nacelle, which rests on the tower. The nacelle houses equipment such as the gearbox and supports the turbine blades and hub. The turbines are interconnected with an underground power collection system and linked to the project substation.

The wind turbines would be grouped in linear strings, some would include aviation warning lights required by the Federal Aviation Administration (FAA). The number of turbines with lights and the lighting pattern of the turbines would be determined in consultation with the FAA.

One of two turbine types may be used for the project; PPM has not yet made a selection. However, both types would have similar environmental effects and power generation capabilities. The analysis in this DEIS is based on a “worst-case” situation; e.g., for the visual assessment, the taller of the two turbines was analyzed, and for the noise evaluation, the louder was analyzed.

The blade diameter of the turbines would range from 252 to 269 feet. The height at the hub would be up to 262 feet. The swept area of the rotor would be from 50,138 to 56,844 square feet, and the rotor speed would be between 10 and 18 revolutions per minute (rpm).

The tower supporting each wind turbine would be a tapered monopole, roughly 262 feet tall. It would be supported by a spread footing concrete foundation. The underground footprint of each foundation would be about 2,000 square feet. The actual foundation design would be determined based on site-specific geotechnical information and structural loading requirements of the selected turbine model. The towers would be uniformly painted a neutral gray or white color. Each tower would have a locked entry door at ground level and an internal access ladder with safety platforms for access to the nacelle. A controller cabinet would be inside each tower at its base. Towers are typically fabricated in three sections that are assembled on-site, and they are designed to withstand the maximum wind speeds expected at the project – typically 134 miles per hour (mph) at hub height.

A generator step-up (GSU) transformer would be installed at the base of each wind turbine to increase the output voltage of the wind turbine to the voltage of the power collection system (typically 34.5-kV). Small concrete slab foundations would support the GSU transformers.

2.5.1.2 Power Collection System

A network of underground power lines would be installed within the prism of new and existing roads at the project to collect power generated by the individual wind turbines and route the power to a collector substation for delivery into the utility grid. The power collection system would operate at 34.5-kV. Where geotechnical conditions or other engineering considerations require, the collector system may be aboveground.

Power from the eastern section of the project would be routed to a collector substation near Webfoot (see Map 1). From that substation, aboveground power lines, hung on single wood or steel poles of a type similar to other power lines in the area, would carry the power about 3.5 miles to PPM's Klondike Schoolhouse Substation. The poles would be about 110 feet tall, and sunk 30 feet deep. They would be spaced about 500 to 700 feet apart. All poles would conform to raptor protection guidelines of the Avian Powerline Interaction Committee (1996).

2.5.1.3 Interconnection/Substations

A new substation, called the Klondike West Substation, would be constructed on about 4 acres near PPM's existing Klondike Schoolhouse Substation to accommodate and step up the additional power entering the grid. The additional substation would include foundations, circuit breakers, power transformer(s), bus and insulators, disconnect switches, relaying, battery and charger, surge arrestors, AC and DC supplies, control house, metering equipment, supervisory, control and data acquisition (SCADA) provision, grounding, fence, and associated control wiring. A collector substation near Webfoot called Klondike East Substation would be constructed on the parcel that will also contain the O&M facility (see Section 2.5.1.4 and Map 1). The substation facilities would conform to all applicable Oregon and BPA regulations and standards.

2.5.1.4 Operations and Maintenance Facility

An O&M building about 5,000 square feet would be built on the Klondike III site, on a 4-acre parcel near Webfoot. A water supply (on-site well of less than 5,000 gallons per day) and sanitary facilities would be constructed at the new O&M site to serve Klondike III. Power to the new O&M building would be supplied by Wasco Electric Cooperative and would be carried from the existing O&M building 1 mile east on the poles of the aboveground collection system.

2.5.1.5 SCADA System

A SCADA system to be installed at the project would collect operating and performance data from each wind turbine and the project as a whole, and provide remote operation of the wind turbines. The wind turbines would be linked to a central computer via a fiber optic network. The host computer is expected to be located in the O&M facility at the project site.

2.5.1.6 Meteorological Towers

Three permanent, un-guyed, meteorological towers to collect wind resource data would also be part of the facility.

2.5.1.7 Roads

About 19 miles of new roads would be constructed to access turbines. The roads would be 20 feet wide and constructed with crushed gravel. Existing roads near the project would be upgraded and widened, where necessary, to accommodate construction and O&M equipment. Temporary access roads may also be built during construction. They would be removed after construction.

2.5.1.8 Construction Laydown Areas

About 55 acres of temporary disturbance would occur in 19 laydown areas that would be used to stage construction and store supplies and equipment during construction. A 2-acre laydown area would be next to each proposed turbine string, and four 4-acre laydown areas would be located throughout the project site. The laydown areas would have a crushed gravel surface. After construction, the laydown areas would be removed, and the disturbed areas would be restored to their pre-construction conditions.

2.5.2 Biglow Canyon Wind Farm

The Biglow Canyon Wind Farm facility, proposed by Orion Energy, would produce up to 400 MW in northern Sherman County. It would be connected to BPA's transmission system at one of two alternative substations on the Biglow Canyon Wind Farm site. Orion Energy is responsible for selecting its substation alternative.

The project would be built on private land. Orion Energy has negotiated long-term wind energy leases with the landowners in which the energy facilities would be constructed and operated in exchange for compensation.

The Biglow Canyon Wind Farm would consist of up to 225 wind turbines and towers, about 40 miles of new roads, an O&M facility, and a substation. Wind turbines and roads would be built within 500-foot wide corridors. Project facilities would occupy about 170 acres of land.

2.5.2.1 Turbines and Towers

Generally, the turbines and towers for the Biglow Canyon Wind Farm would be similar to those described for Klondike III. As with Klondike III, the specific turbine type has not yet been selected. The blade diameter of the turbines would likely be up to 265 feet, and the tower height would be up to 279 feet. The analysis in this DEIS is based on a “worst-case” scenario, as described for Klondike III.

2.5.2.2 Power Collection System

A transformer would be placed next to each turbine tower to increase the output voltage to 34.5-kV. Each transformer would be placed on a concrete slab. From the transformer, power would be transmitted via electric cables, some of which would be buried. In areas where collector cables from several turbine strings follow the same alignment (e.g., near the facility substation), multiple sets of cables could be installed within a single trench. There would be about 132 miles of underground electric cables.

In some areas, collector lines may be installed aboveground on poles or towers. Aboveground lines would allow the collector lines to span terrain such as canyons, native grasslands, ***wetlands***, and ***intermittent*** streams, thereby reducing environmental impacts, or to span cultivated areas and reduce impacts to farming. Overhead structures would generally be between 23 and 28 feet tall.

2.5.2.3 Substation and Interconnection to BPA

The Biglow Canyon Wind Farm would be connected to BPA's transmission system at one of two alternative substations on the Biglow Canyon Wind Farm site. Orion Energy is responsible for selecting its substation alternative (see Map 1). With either alternative, the proposed substation site would be a graveled, fenced area of up to 6 acres, with transformer and switching equipment and a parking area. Transformers would be non-PCB (polychlorinated biphenyl), oil-filled types.

2.5.2.4 Operations and Maintenance Facility

A permanent O&M facility would include about 5,000 square feet of enclosed space, including office and workshop areas, control room, kitchen, bathroom, shower, utility sink, and other facilities. Water would come from a well that would be constructed on the site. Water use is not expected to exceed 1,000 gallons per day. Domestic wastewater would drain to an on-site septic system. A graveled parking area for employees, visitors, and equipment would be built in the vicinity of the building. The O&M facility may be built next to the proposed substation.

2.5.3.5 SCADA System

A SCADA system, similar to that described for Klondike III, would be installed and linked to a central computer in the O&M building.

2.5.3.6 Meteorological Towers

Up to 10 meteorological towers would be placed throughout the Biglow Canyon project. The towers, which would be up to 279 feet tall, would collect wind resource data.

2.5.3.7 Roads

Existing roads in the analysis area are typically 16 to 20 feet wide. Some existing roads would be widened — up to 35 feet for construction, and up to 16 or 18 feet wide for operation, including an additional 5 to 6 feet of shoulders. Roads would be improved, where necessary, by adding an all-weather surface.

New access roads would be constructed where there are no roads near proposed turbine strings. About 40 miles of new access roads would be built. They would be about 16 to 18 feet wide for operation, including an additional 5 to 6 feet of shoulders.

Temporary access roads may also be built during construction. They would be removed after construction.

2.5.2.8 Construction Laydown Areas

Up to six principal, temporary laydown areas for construction staging would be located on site. Each laydown area would be up to 5 acres and would be covered with gravel. After construction, the gravel would be removed and the area restored.

In addition to the principal laydown areas, temporary laydown areas would be located at each turbine location and at each turbine string. Each turbine laydown area would temporarily disturb about 4,000 square feet. Placement of blades in the laydown areas is expected to result in little or no soil disturbance.

In total, construction activities (e.g., laydown areas and collector system trenches) would disturb about 387 acres.

2.6 Comparison of Alternatives and Summary of Impacts

Table 2-1 provides a comparison of the two action alternatives and the No Action Alternative to the purposes identified in Chapter 1 of this EIS. Table 2-2 provides a summary of the potential environmental impacts and mitigation for each alternative. Detailed analysis of potential impacts is contained in Chapter 4, **Environmental Consequences** and appendices.

Table 2-1 Comparison of Alternatives to Project Purposes

Purposes	BPA Proposed Action	BPA Middle Alternative	No Action Alternative
Maintain transmission system reliability to industry standards	Best achieves this purpose due to shorter line and resulting lower energy losses than the Middle Alternative.	Achieves this purpose, but slightly less well as the Proposed Action due to its longer length and resulting higher energy losses.	Transmission system would remain at the existing levels of reliability.
Act consistently with BPA's statutory obligations	Meets this purpose.	Meets this purpose.	Meets this purpose, but not as well as either of the two action alternatives.
Continue to meet BPA's contractual obligations	Meets this purpose.	Meets this purpose.	May not meet this purpose.
Minimize environmental impacts	Creates slightly fewer environmental impacts than Middle Alternative due to shorter distance and fewer temporary and permanent impacts from road construction, tower placement, etc. Route avoids disrupting farming operations and visual impacts as much as possible. Most impacts would be temporary and located in heavily disturbed agricultural fields. BMPs and site restoration of temporary impacts would be used to minimize environmental impacts.	Creates slightly more environmental impacts than the Proposed Action due to longer distance and slightly more temporary and permanent impacts from road construction, tower placement, etc. Route creates more impacts to farming operations. Most impacts would be temporary and located in heavily disturbed agricultural fields. BMPs and site restoration of temporary impacts would be used to minimize environmental impacts.	Creates no new environmental impacts.
Minimize costs	The Proposed Action is slightly shorter than the Middle Alternative, would cost slightly less, and would best meet this purpose of the two action alternatives. Costs have been minimized by selecting the shortest alignment given site constraints, and minimizing angle structures as much as possible.	The Middle Alternative is slightly longer than Proposed Action and would cost slightly more. Costs have been minimized by selecting the shortest alignment given site constraints, and minimizing angle structures as much as possible.	No costs are associated with this alternative.
Encourage development of renewable energy resources	The Proposed Action would meet this purpose by interconnecting the two wind projects.	The Middle Alternative meets this purpose by interconnecting the two wind projects.	The No Action Alternative would not meet this purpose.

Table 2-2 Summary of Impacts from Alternatives

Resource	Existing Conditions	BPA Proposed Action	BPA Middle Alternative	Klondike III Wind Farm	Biglow Canyon Wind Project	No Action Alternative
Land Use (See Sections 3.1, Land Use and 4.1, Land Use)	All land crossed by the alternatives and the wind projects are privately owned. Almost all of the land is in agricultural production, with several small areas of CRP land. Land is zoned F-1 Exclusive Farm Use.	Low impacts. Permanent removal of about 17 acres of farmland. Impacts to farming would be minimized by using steel pole towers. Landowners would be compensated for temporary crop damage.	Low impacts. Permanent removal of about 17 acres of farmland. Impacts to farming would be minimized by using steel pole towers. Landowners would be compensated for temporary crop damage.	Low impacts. Permanent removal of about 64 acres of farmland. Impacts to farming would be minimized by using steel pole towers. Landowners would be compensated for temporary crop damage.	Low impacts. Permanent removal of about 170 acres of farmland. Impacts to farming would be minimized by using steel pole towers. Landowners would be compensated for temporary crop damage.	No new impacts are expected.
Transportation (See Sections 3.2, Transportation, and 4.2, Transportation Facilities)	Project is served by Interstate 84, Highway 97, Highway 206, local collector roads and private roads. Roads currently function at high levels of service. Bridges on potential haul routes are structurally sound (although some are functionally obsolete)	Low impacts. Temporary delays on some local collectors during construction. Some local collectors improved to allow construction traffic. No long-term level of service reduction or degradation of road surfaces. Temporary roads constructed in agricultural lands to access tower sites will be removed following construction.	Low impacts. Temporary delays on some local collectors during construction. Some local collectors improved to allow construction traffic. No long-term level of service reduction or degradation of road surfaces. Temporary roads constructed in agricultural lands to access tower sites will be removed following construction.	Low impacts. Temporary delays on some local collectors during construction. Some local collectors improved to allow construction traffic. No long-term level of service reduction or degradation of road surfaces. Some new permanent roads will be constructed in agricultural land to serve tower sites.	Low impacts. Temporary delays on some local collectors during construction. Some local collectors improved to allow construction traffic. No long-term level of service reduction or degradation of road surfaces. Some new permanent roads will be constructed in agricultural land to serve tower sites.	No new impacts are expected.
Recreation (See Sections 3.3, Recreation, and 4.3, Recreation)	Recreation is limited to upland game hunting and sightseeing of historic trails. The John Day River Corridor, Journey Through Time Scenic Byway, and Barlow Road Cutoff Trail are important recreation facilities outside the project area.	No impacts. No impact to recreational opportunities. Some visual impacts may occur (see Visual Resources Section).	No impacts. No impact to recreational opportunities. Some visual impacts may occur (see Visual Resources Section).	No impacts. No impact to recreational opportunities. Some visual impacts may occur (see Visual Resources Section).	No impacts. No impact to recreational opportunities. Some visual impacts may occur (see Visual Resources Section).	No new impacts are expected.

Resource	Existing Conditions	BPA Proposed Action	BPA Middle Alternative	Klondike III Wind Farm	Biglow Canyon Wind Project	No Action Alternative
Geology and Soils (See Sections 3.4, Geology and Soils, and 4.4, Geology and Soils)	Terrain is gently rolling with several small canyon crossings. Slopes are stable. Surface soils are Walla Walla silt loam, which is mostly being intensively farmed for dryland wheat.	Low impacts. Temporary road construction and disturbance to soils. No increase in long-term erosion potential. Permanent impacts (low impact) to about 17 acres of Type II soils.	Low impacts. Temporary road construction and disturbance to soils. No increase in long-term erosion potential. Permanent impacts (low impact) to about 17 acres of Type II soils.	Low impacts. Temporary road construction and disturbance to soils. No increase in long-term erosion potential. Permanent impacts (low impact) to about 64 acres of Type II soils.	Low impacts Temporary road construction and disturbance to soils. No increase in long-term erosion potential. Permanent impacts (low impact) to about 170 acres of Type II soils.	No new impacts are expected.
Water Resources (See Section 3.5, Water Resources and 4.5 Water Resources)	Area is in an arid mostly upland area, with no perennial streams. Several jurisdictional waters (intermittent streams) and small wetlands are present.	No impacts. No wetlands are present, and the three intermittent drainages will be spanned.	No impacts. No wetlands are present, and the three intermittent drainages will be spanned.	No impacts. Underground power line will be bored underneath jurisdictional drainage and wetland will be avoided.	Low impact. One jurisdictional intermittent drainage will be trenched for underground powerlines. About 100 cubic yards of fill/removal required.	No new impacts are expected.
Fish and Wildlife (See Section 3.6, Fish and Wildlife, and 4.6, Fish and Wildlife)	There is no fish habitat in the analysis area. Agricultural lands form most of the wildlife habitat. Some former agricultural lands have been enrolled in the CRP program and are mostly in grasses. Small areas of upland tree habitat exists in some of the larger draws or near structures. Shrub-steppe habitat exists in small patches on steeper slopes. Federal and state threatened and endangered species are not in the analysis area, but bald eagles and peregrine falcons may be present near the Columbia and John	No to Moderate impacts. No impacts to upland tree, shrub-steppe, grassland, or CRP habitat. No impact to Threatened or Endangered Species. Low to moderate impacts to various wildlife species, low impacts to some bird species from collision with transmission line structures.	No to Moderate impacts. No impacts to upland tree, shrub-steppe, grassland, or CRP habitat. No impact to Threatened or Endangered Species. Low to moderate impacts to various wildlife species, low impacts to some bird species from collision with transmission line structures.	No to Moderate impacts. No impacts to Threatened or Endangered Species. Moderate impacts to bird species, especially raptors and passerines and bat species. Low impacts to waterfowl, common terrestrial species.	No to Moderate impacts. No impacts to Threatened or Endangered Species. Moderate impacts to bird species, especially raptors and passerines and bat species. Low impacts to waterfowl, common terrestrial species.	No new impacts are expected.

Resource	Existing Conditions	BPA Proposed Action	BPA Middle Alternative	Klondike III Wind Farm	Biglow Canyon Wind Project	No Action Alternative
	Day rivers. Common wildlife species such as deer, elk, coyote and a variety of bird species are present. Hawks are common and nest nearby.					
Vegetation (See Sections 3.7, Vegetation, and 4.7, Vegetation)	Dryland wheat crops dominate vegetation in analysis area. Upland trees, shrub-steppe, and CRP lands are also present. No rare plant species are documented in the analysis area. Noxious weeds are common in areas not under cultivation.	Low impacts. About 17 acres of permanent impacts to agricultural lands (low impact). About 160 acres of temporary impacts to agricultural lands (low impact).	Low impacts. About 17 acres of permanent impacts to agricultural lands (low impact). About 120 acres of temporary impacts to agricultural lands (low impact).	Low impacts. Permanent Impacts 0.8 ac Grassland 0.1 ac Shrub Steppe 6.5 ac CRP 56.4 ac Agricultural (low impact) Temporary Impacts: 3.6 ac Grassland 1.4 ac Shrub Steppe 10.4 ac CRP 81.7 ac Agricultural (low impact)	Low impacts. Permanent Impacts 1.1 ac Grassland 0.2 ac Shrub Steppe 11.2 ac CRP 157.3 ac Agricultural (low impact) Temporary Impacts: 1.0 ac Grassland 1.3 ac Shrub Steppe 15.5 ac CRP 386.9 ac Agricultural (low impact)	No new impacts are expected.
Visual Resources (See Sections 3.8, Visual Resources, and 4.7, Visual Resources)	Visual character of the area is open, rolling hills, with larger hills in the background and distant views of Cascade Mountains. Important visual resources nearby include Columbia River Gorge National Scenic Area, John Day River Canyon, five Oregon National Historic Trail sites, the Lower Deschutes River Canyon, the Lower Klickitat River Canyon, and the Journey Through Time Scenic Byway.	No to Moderate impacts. No impacts to John Day River Canyon, all five Oregon National Historic Trail sites, Lower Deschutes River Canyon and Lower Klickitat River Canyon. Low impacts to Columbia River Gorge Scenic Area, and Journey Through Time Scenic Byway. Moderate impacts in the	No to Moderate impacts. No impacts to John Day River Canyon, Oregon National Historic Trail sites, Lower Deschutes River Canyon and Lower Klickitat River Canyon. Low impacts to Columbia River Gorge Scenic Area, and Journey Through Time Scenic Byway. Moderate impacts in the	No to High impacts. No impacts to four Oregon National Historic Trail sites, Lower Deschutes River Canyon and Lower Klickitat River Canyon. Low impacts to Columbia River Gorge Scenic Area. Low to Moderate impacts to John Day River Canyon, Journey Through Time Scenic Byway,	No to High impacts. No impacts to all five Oregon National Historic Trail sites, Lower Klickitat River Canyon. Low impacts to Columbia River Gorge Scenic Area and Lower Deschutes River Canyon. Low to Moderate impacts to John Day River Canyon, Journey Through Time Scenic Byway.	No new impacts are expected.

Resource	Existing Conditions	BPA Proposed Action	BPA Middle Alternative	Klondike III Wind Farm	Biglow Canyon Wind Project	No Action Alternative
		immediate area.	immediate area.	and one Oregon National Historic Trail site. Moderate to High impacts in the immediate area.	Moderate to High impacts in the immediate area.	
Socioeconomics (See Sections 3.9, Socioeconomics, and 4.9, Socioeconomics)	Sherman County has four incorporated communities: Grass Valley, Moro, Rufus and Wasco. County population is 1,900 residents and decreasing. Vacancy rates are relatively high, between 12 and 21 percent. 750 hotel rooms are available within 30 miles. Unemployment is several percentage points higher than the State of Oregon.	Positive impact. Positive impacts due to influx of construction workers.	Positive impact. Positive impacts due to influx of construction workers.	Positive impact. Positive impacts due to influx of construction workers and long-term facility employees.	Positive impact. Positive impacts due to influx of construction workers and long-term facility employees.	No new impacts are expected.
Cultural Resources (See Section 3.10, Cultural Resources, and 4.10, Cultural Resources)	Four archeological resources were identified near the transmission line corridors, two on each alternative. Four archeological resources were found in the Klondike III area. One archeological resource and three historic resources were found in the Biglow Canyon area.	No impacts. Towers and temporary access roads will be placed to avoid the identified resources.	No impacts. Towers and temporary access roads will be placed to avoid the identified resources.	No impacts. Towers and temporary access roads will be placed to avoid the identified resources.	No impacts. Towers and temporary access roads will be placed to avoid the identified resources.	No new impacts are expected.
Noise, Public Health, and Safety (See Sections 3.11, Noise, Public Health and Safety, and 4.11 Noise, Public Health and Safety)	Ambient noise levels are low, about 26 dBA. Existing noise is from intermittent traffic and substation and agricultural operations. There are no public health or safety issues identified in the analysis area.	Low. Noise will be below EPA thresholds for nuisance. EMF below statutory thresholds No impacts to local health and safety infrastructure.	Low. Noise will be below EPA thresholds for nuisance. EMF below statutory thresholds No impacts to local health and safety infrastructure.	Low. Noise may exceed state standards. Noise easements will be purchased for turbine locations. Circuits would all be below ground; buried cables emit no	Low. Noise may exceed state standards. Noise easements will be purchased for turbine locations. Some circuits would be below ground; buried cables emit no electric	No new impacts are expected.

Resource	Existing Conditions	BPA Proposed Action	BPA Middle Alternative	Klondike III Wind Farm	Biglow Canyon Wind Project	No Action Alternative
				electric fields. The maximum magnetic field values for the underground circuits would be 41.1 mG. No impacts to local health and safety infrastructure.	fields. The maximum electric field under the overhead 34.5-kV distribution line would be less than 1 kV/m. The maximum magnetic field values for the underground circuits would be 62.9 mG. The maximum magnetic field values for the overhead circuits would be 144.6 mG. No impacts to local health and safety infrastructure.	
Air Quality (See Sections 3.12, Air Quality, and 4.12, Air Quality)	Air quality is good within the analysis area. Periodic fugitive dust emissions from agricultural operations occur, but the area has not been designated a ***non-attainment*** area.	No to Low impacts. Short-term reduction in air quality during active construction periods from fugitive dust emissions. No long-term impacts.	No to Low impacts. Short-term reduction in air quality during active construction periods from fugitive dust emissions. No long-term impacts.	No to Low impacts. Short-term reduction in air quality during active construction periods from fugitive dust emissions. No long-term impacts.	No to Low impacts. Short-term reduction in air quality during active construction periods from fugitive dust emissions. No long-term impacts.	No new impacts are expected.

Chapter 3 - Affected Environment

In this Chapter:

- Existing environment
- Protected resources

This Chapter describes existing conditions within the analysis area and general vicinity, as well as within the analysis area for each resource described. Analysis areas vary in extent, depending on the resource being studied for potential project impacts. For example, visual impacts of the projects would affect a larger area (i.e., the area from which the project could be seen) than soil impacts, which would be limited to the areas of ground disturbance. The analysis areas are briefly described under each resource.

3.1 Land Use

The analysis area includes the proposed BPA transmission routes and substation areas; about 22,000 acres for the proposed Klondike III facilities; and about 25,000 acres for the proposed Biglow Canyon facilities.

Nearly all of Sherman County is zoned F-1 (Exclusive Farm Use), as is the analysis area, except for some isolated nodes of commercial, industrial, and residential zoning designations in and around the city of Wasco. The F-1 zone restricts most development to preserve land for agriculture or resource extraction. Individual single-family dwellings are permitted if they meet criteria for dwellings in exclusive farm use areas. The area is sparsely populated, with only a few single-family residences spread out throughout the analysis area.

Most of the analysis area is under dryland wheat or barley production, with some areas in open range for cattle. In 2002, Sherman County had about 129,000 acres in wheat and barley production (2002 Agricultural Census, Sherman County Profile). Portions of the county are also enrolled in the ***Conservation Reserve Program*** (CRP), a voluntary federal program to assist private landowners to convert highly erodible and environmentally-sensitive cropland to permanent vegetative cover. Based on an analysis of soil types performed by Sherman County, no ground in the county is considered high-value farmland (see Section 3.4, Geology and Soils).

Most farming activities occur between March and October (David Evans and Associates, Inc. [DEA], 2005). Typical farm practices for dryland wheat farming in the area are spring land preparation, such as plowing, aerial fertilizing, planting seed and weeding. In the fall, farmers harvest spring and winter wheat, burn stubble, spread straw or crop residue, and reduce tall stubble by disking or harrowing. Winter wheat is planted in the late summer/early fall.

Sherman County has a Natural Hazards (NH) combining district, but BPA's proposed facilities, and the wind projects' proposed facilities are outside the district boundaries.

3.2 Transportation

The transportation analysis area encompasses northern Sherman County, Oregon.

The Sherman County Transportation System Plan (TSP) (Sherman County, 2003c) identifies all public rights-of-way within the County. The existing road system inventory includes all highways, arterial roadways, and collector roads within Sherman County. Roads in unincorporated or rural areas of Sherman County fall under either county or state jurisdiction.

3.2.1 Highway System

Highways within Sherman County are identified in Table 3-1 and shown on Map 3. As shown in Table 3-1, US 97 functions as a major arterial through the county and serves statewide and regional traffic demands. OR 206 (minor arterial) and OR 216 (major collector) serve regional and local traffic demands. The primary difference between the classifications of major collector and minor arterial is daily traffic volume.

I-84 is the main east-west highway through north central Oregon and the analysis area. US 97 is the primary transportation facility in Sherman County and is used to transport local products.

OR 206 (Wasco-Heppner Highway) begins at US 97 just west of Wasco and runs northwest/southeast to Condon and into Morrow County. OR 206 is a highway of regional importance and serves as the primary farm-to-market route between Sherman County and Condon. OR 206 (Celilo-Wasco Highway) is a highway of district importance. Beginning at I-84 at Celilo Village in Wasco County, OR 206 parallels I-84 across the Deschutes River into Sherman County.

3.2.2 County Roads

Although the state highway system forms the backbone of the roadway system in Sherman County, county roads are a vital part of the circulation system. Table 3-2 identifies local roads near the proposed transmission line and wind power projects. County roads are also shown on Map 3.

Table 3-1 Highways in Sherman County

State Route Number	Highway Name	ODOT Classification (ODOT Highway Number)	Sherman County Classification	Pavement Condition
I-84	Columbia River Highway	Interstate (2)	N/A	Good
US 97	Sherman Highway	Statewide (42)	Major Arterial	Fair
OR 206	Celilo-Wasco Highway	District (301)	Major Collector	Good/Fair
OR 206	Wasco-Heppner Highway	Regional (300)	Minor Arterial	Fair
OR 216	Sherars Bridge Highway	District (290)	Major Collector	Poor

ODOT = Oregon Department of Transportation; Source: Sherman County TSP, 2003c

Table 3-2 Local Roads near the Proposed Project

Road Name	Functional Classification	Pavement Type	Pavement Condition	Number of Lanes
Hildebrand Lane	Major Collector	Paved	Good	2
North Klondike Road	Major Collector	Paved	Good	2
Scott Canyon Road	Major Collector	Paved	Good	2
Herrin Lane	Minor Collector	Paved	Good	2
Klondike Lane	Minor Collector	Paved	Fair	2
Sandon Road	Minor Collector	Gravel	Fair	2
Beacon Road	Local	Dirt	Not rated	1 (>12 feet)
Biglow Road	Local	Gravel	Fair	1 (>12 feet)
China Hollow Road	Local	Paved/Gravel	Good	varies 1 to 2 lanes
Dehler Road	Local	Gravel	Poor	1 (>12 feet)
Egypt Road	Local	Dirt	Not rated	1
Emigrant Springs Lane	Local	Paved	Good	2
Gerking Road	Local	Gravel	Poor	1
Gosson Lane	Local	Gravel	Very poor	1
Greenberry Road	Local	Gravel	Fair	1
Helms Lane	Local	Paved	Good	2
Klondike Road	Local	Gravel	Fair	1
Macnab Lane	Local	Dirt	Not rated	1
Medler Lane	Local	Paved	Good	2
Oehman Road	Local	Gravel	Good	1
Tom Lane	Local	Paved	Good	2

Source: Sherman County TSP, 2003c

Near the proposed project, Sherman County maintains several collectors and local roads. All major collectors (Hildebrand Lane, North Klondike Road and Scott Canyon

Road) are two-lane paved roads in good condition. Minor collectors (Herrin Lane, Klondike Lane, and Sandon Road) are also paved two-lane facilities with the exception of Sandon Road, which is a two-lane gravel road. Both major and minor collectors are in fair to good condition and would be the primary access roads for the proposed projects.

Local roads that could be used for construction, operation and maintenance of the proposed projects vary in width and condition. Paved county roads with two lanes are generally 24 feet wide but can be as narrow as 16 feet with no shoulder. Medler Lane, located next to the BPA action alternatives and likely a primary access route, is a paved two-lane road in good condition. Gravel roads are generally 20 feet wide with no shoulders. There are several roads where the ROW is wider than 12 feet, but not wide enough to accommodate two lanes of traffic. Local roads are a mixture of paved, gravel, or dirt facilities; some roads alternate between gravel and paved surfaces. Most local roads near the projects are in fair to good condition, but Dehler and Gerking Roads, which would likely be used to access the proposed wind power projects during construction, and operation and maintenance, are rated in poor condition; Gosson Lane, near the proposed Klondike III facility, is in very poor condition. All three are gravel roads.

Sherman County primarily addresses roadway maintenance on an as-needed basis. It develops prioritized project lists each year through roadway inspection by maintenance crews and with the help of citizens who inform the County about maintenance needs, especially in rural areas not routinely traveled by maintenance personnel. Sherman County's maintenance department is responsible for all aspects of road maintenance including pavement rehabilitation, roadway signing and lighting needs, ditch and culvert clearing, and pavement marking.

The County does not normally pave new roads, mainly due to budget constraints. Generally, maintaining paved roads requires filling potholes and asphalt overlays. Gravel roads in Sherman County receive the most routine maintenance. Most gravel roads are bladed twice annually: once in the spring and once in the fall. All dirt roads are generally only graded to a minimal width to provide access to adjacent properties. The County approaches maintenance of dirt roads without a formal routine or preventive maintenance plan. The County also provides road maintenance services to the cities of Rufus, Wasco, Moro and Grass Valley. The County maintains some city streets and provides some snow removal service during the winter months for the roads that are heavily traveled, such as bus routes, or are needed for emergency service access.

3.2.3 Bridges

The Oregon Department of Transportation (ODOT) has jurisdiction over and maintains 77 bridges on state highways in both rural and urban Sherman County. There are 16 bridges located on I-84, 28 bridges on US 97, 16 bridges on OR 206 (Wasco-Heppner Highway), 15 bridges on OR 206 (Celilo-Wasco Highway) and spur, and three bridges on OR 216. Four state-owned bridges are functionally obsolete: two of the bridges are on I-84 east of Rufus; another is on US 97 as it crosses over I-84; and the fourth is located on OR 206 (Celilo-Wasco Highway) in Fulton Canyon. The bridges on I-

84 and US 97 would be on primary haul routes for the proposed projects. The bridge on US 206 is west of the analysis area and is not anticipated to be a primary haul route because truck traffic would use US 97 as a more direct connection to the proposed projects. While the three bridges on I-84 and US 97 are functionally obsolete, none are structurally deficient or have weight restrictions that would limit trucks and heavy equipment (ODOT, 2005).

Sherman County owns and maintains 10 bridges, one of which is identified as structurally deficient. The deficient bridge spans Mud Hollow Canyon and is on Mud Hollow Road west of US 97, is outside the analysis area, and would not be used for any of the projects.

3.2.4 Roadway Operations

Roadway operations are measured in level of service (LOS), where LOS is a function of both average travel speed and percent of time following the vehicle ahead. Six standards are used to identify LOS, from LOS A in which traffic is relatively free flowing, to LOS F, in which the system is saturated with traffic and movement is substantially slowed.

Traffic conditions along I-84 in Sherman County for average and peak summer traffic conditions was LOS A, where traffic is free flowing even at the height of summer conditions (Sherman County, 2003c). All other highways in the county also operate at LOS A (Sherman County, 2003c).

Even under projected worst case conditions in 2019 (TSP planning horizon), freeway, two-lane rural highway, and unsignalized intersection operations in Sherman County are expected to continue to operate at LOS A or B (Sherman County, 2003c). There are no identified capacity constraints within the county.

3.3 Recreation

The BPA Proposed Action and Middle Alternative lie entirely within the analysis area for the proposed wind projects.

All recreational facilities within 5 miles of the proposed Klondike III Wind Project and Biglow Canyon Wind Farm were identified as part of their respective *Applications for Site Certificates* (ASCs) (DEA, 2005; CH2MHill, 2005). Using the two ASC inventories, recreational uses and areas were identified from about 4 miles north of the Columbia River in Klickitat County to areas south of the community of Moro, and recreational facilities from the west of US 97 to east of the John Day River. Recreation facilities are shown on Map 4.

3.3.1 Recreation Facilities

In general, recreational activities in the county include camping, hiking, upland bird and big game hunting, rafting, boating, fishing, sightseeing (including observational astronomy), nature and wildlife photography, and bicycling. Water-based recreation activities occur on the nearby John Day River. Recreational opportunities in the area are generally limited to “access by permission only” e.g., upland bird/big game hunting and observational astronomy and some viewing of historic trail alignments from county roads.

No important recreational facilities or opportunities exist along the proposed transmission line routes, substation sites, or within the two proposed wind projects’ site boundaries except those mentioned above (DEA, 2005, CH2MHill, 2005).

Three important recreational facilities are within the vicinity of the proposed projects, but are outside the immediate project boundaries: the John Day River Corridor, the Journey Through Time Scenic Byway, and the Historic Oregon Trail and Barlow Road Cutoff Trail alignments.

3.3.2 John Day River

The John Day River system includes more than 500 river miles and is one of the longest free-flowing river systems in the continental United States. The main stem of the river between about river miles 0 and 26 runs through the proposed wind power facility analysis areas (for Biglow Canyon from river mile 0 to 20, for Klondike III from river mile 5 to 26). This segment is a designated Federal Wild and Scenic River and is classified as *Recreational*, meaning that at the time of designation, the segment was readily accessible by road or railroad, may have some shoreline development, and may have undergone some impoundment or diversion in the past. Outstanding remarkable values include the following: scenic, recreation, fish, wildlife, geological, paleontological, and archaeological. Botanical and ecological values are also deemed important (DEA, 2005; CH2MHill, 2005).

The segment is also designated as a State Scenic Waterway. The Scenic Waterway designation included the river itself and the lands that lie within 0.25 mile of its high water line. Scenic River Areas are administered to preserve their undeveloped character, maintain or enhance their high scenic quality, recreation, fish, and wildlife values, while allowing continued agricultural use. The guideline for new utility facilities in Scenic River Areas is that they share existing utility corridors, minimize ground and vegetation disturbance, and make use of non-visible alternatives when reasonably possible (DEA, 2005; CH2MHill, 2005).

The State of Oregon also established the John Day Wildlife Refuge in 1933, which includes the river segment in the analysis area. The primary purpose of the refuge is to protect wintering and nesting waterfowl (DEA, 2005; CH2MHill, 2005).

The primary recreational uses along this section of the John Day River include boating, rafting, and fishing. Secondary uses may include upland bird hunting, sightseeing, and nature/wildlife photography (DEA, 2005; CH2MHill, 2005). The US Department of the Interior, Bureau of Land Management (BLM) has developed the Oregon Trail Interpretive Site near the John Day River Crossing (a.k.a. McDonald Ferry) and the Rock Creek facility, both day use areas that provide boating access to the John

Day River. The interpretive site near McDonald Ferry also provides historical information about the Oregon Trail. Wheel ruts and scars are visible on the hillside from the interpretive site. There are no developed or undeveloped camping sites along this section of the river.

3.3.3 Journey Through Time Scenic Byway

The Journey Through Time Scenic Byway runs south from Biggs along US 97 through the analysis area to Shaniko, where it turns east, and eventually travels to Baker City. "Off the Beaten Path: A Guide to Oregon's Scenic Byways," published online by the Oregon Tourism Commission, characterizes this byway as celebrating 50 million years of Oregon history by providing a route through an area with abundant fossils, pioneer trails, ghost towns, and other remnants of the old West (Oregon Tourism Commission, 2006). The guide mentions these features along the segment of the scenic byway in the analysis area: Biggs, which is characterized as a traditional Native American salmon harvesting site; Wasco, with its original Columbia Southern Railroad depot; and Moro, home of the Sherman County Historical Museum.

Primary recreational uses include sightseeing and road touring. There are no developed scenic overlooks or waysides along the byway in the analysis area. Bicyclists tend to avoid US 97 due to the relatively heavy traffic volumes (DEA, 2005) including commercial traffic.

3.3.4 Historic Oregon Trail and Barlow Road Cutoff Trail Alignments

Although the historic Oregon Trail and Barlow Road Cutoff trail alignments technically meet the criteria of being important recreational opportunities, agricultural practices and other development activities have destroyed nearly all evidence of the trails in the analysis area. The only accessible, intact segment that has been identified near the proposed projects occurs near McDonald Ferry on the John Day River. The Oregon Trail is also described in Section 3.10, Cultural Resources.

Historic trail crossings at county and state roads are signed to some degree, but many signs are dilapidated or missing. Further, the surrounding landscape is primarily private land cultivated for wheat, so the recreational opportunity is limited to visiting and viewing the approximate historic alignments from county roads.

3.3.5 Federal and Local Management Plans for Recreational Resources

Section 3.8, Visual Resources, describes the applicable management plans for recreation, which focus on scenic and aesthetic values within the analysis area that may apply.

3.4 Geology and Soils

The analysis area for geology is northern Sherman County; the analysis area for soils encompasses the areas in which ground disturbance may occur for the BPA action alternatives, the Klondike III Wind Project, and the Biglow Canyon Wind Farm.

Geology and soils characteristics for those portions of the proposed transmission line routes outside the wind farm analysis areas are similar to those within them (DEA 2005; GRI 2005; and CH2MHill 2005).

3.4.1 Topography

Topography within the area is typified by gently rolling to level ground located along a high plateau south of the Columbia River. Areas of steep slopes are confined to portions of the Deschutes River Canyon to the west and John Day River Canyon to the east, including several unnamed intermittent tributaries. Elevations range from 185 feet above sea level along the Columbia River to 3,600 feet on the highlands in southern Sherman County (CH2MHill, 2005). Elevations along the plateau, within the analysis area, range from about 950 to 1,500 feet.

The proposed transmission line would begin in the western portion of the analysis area, at about elevation 1,500 feet near the existing Klondike Schoolhouse Substation. The line would extend northwesterly toward the existing John Day Substation at about elevation 950 feet. With both action alternatives, the line would traverse a series of low, east-west-trending ridges, where slopes are typically in the range of 3 to 8 percent (GRI, 2005). The proposed Klondike III turbines would be on a relatively flat topographic plateau between 1,250 to 1,500 feet in elevation. Slopes in the turbine locations are typically less than 3 percent. Tower locations would not encroach on steeper areas to the south along Grass Valley Canyon. Topographic conditions are similar in the area of the proposed Biglow Canyon Wind Farm (CH2MHill, 2005).

3.4.2 Geology

The analysis area is in the Deschutes-Columbia Plateau ***physiographic*** province, a north-sloping, volcanic plateau that covers over 60,000 square miles in Oregon, Washington, and Idaho. Volcanic rocks mapped as Columbia River Basalt Group underlie nearly the entire province. Most of the area is mantled by brown, fine-grained, silty soils, referred to as loess. The thickness of loess observed in road cuts is typically 4 to 6 feet.

No landslide deposits are mapped within the project boundary (Bela, 1982; scale 1:250,000). The transmission line route alternatives would not cross areas mapped with the potential for slope stability, flooding, or erosion-related geologic hazards (GRI, 2005). No obvious surface evidence of large-scale, deep-seated slope instability, or evidence of faulting or ground rupture, along the eastern two-thirds of the alignment or the area around the line terminus was observed (GRI 2005). Review of aerial photography did not reveal evidence of slope instability, faulting, or ground rupture in the project vicinity.

The Klondike III project area is underlain by a surface layer of silt (loess) 4 to 6 feet thick, overlying basalt (GRI 2005). Review of aerial photography did not reveal evidence of slope instability, faulting, or ground rupture (GRI, 2005).

The Biglow Canyon project area is also underlain by a surface layer of silt (loess) overlying basalt. No obvious surface evidence of large-scale, deep-seated slope instability, or evidence of faulting or ground rupture was observed; and aerial photography did not reveal evidence of slope instability, faulting, or ground rupture (CH2MHill, 2005).

3.4.3 Geologic Structure

The analysis area lies between the Deschutes and John Day rivers, between the Columbia Hills Anticline to the north (Newcomb, 1966) and the Gordon Ridge Anticline and Grass Valley Syncline to the south (Bela, 1982). The analysis area lies about 180 miles inland from the surface expression of the Cascadia Subduction Zone. The subduction zone is a broad, eastward-dipping zone of contact between the upper portion of the subducting slabs of the Gorda and Juan de Fuca plates, and the over-riding North America Plate (GRI, 2005).

3.4.4 Soils

The near surface soils in the project vicinity were identified using the US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Soil Survey of Sherman County, Oregon (Macdonald et al., 1999). The soils in the area are grouped into five General Soil Units – Wato-Anders, Walla Walla-Anderly, Wrentham-Lickskillet-Rock Outcrop, Lickskillet-Nansene, and Mikkalo-Ritzville. Each general soil unit is composed of several soil series units, which are delineated at a greater level of detail, but share relatively similar spatial coverage and engineering properties as the general units. Table 3-3 provides a listing of these detailed soil units, including their drainage class and erosion potential. Soils in the area are shown on Map 5.

Area soils are susceptible to accelerated erosion caused by disturbance of natural conditions through burning, excessive grazing, or tillage (NRCS, 1964). These disturbances increase the potential for erosion by wind and water. Wind typically presents the greatest source of erosion due to the arid climate. Water erosion is typically less serious because much of the precipitation comes in the form of gentle rain. However, localized rain of high intensity, prolong duration, rain on frozen ground, and rapid snowmelt events can cause considerable runoff, and soil losses on unprotected soils are then high (NRCS, 1964).

The analysis area is dominated by Walla Walla silt loam. The NRCS Soil Survey of Sherman County (1999) identifies Walla Walla silt loam, deep and very deep, as being well suited for wheat and moderately well suited for barley. The State of Oregon and NRCS have identified seven soil map units as farmland of statewide importance and seven soil map units as prime farmland only if irrigated, although none of these soil units are currently irrigated in the analysis area. Only one small section of land next to the

John Day Substation is irrigated and its soil type is within the Kuhl soil complex, which is not considered prime farmland if irrigated. Based on additional analysis of soil types performed by Sherman County, the analysis area does not contain high-value farmland (Macnab, 2005).

Table 3-3 Detailed Soil Map Units Present in Analysis Area

Soil Series	Drainage Class	Erosion Potential	Farmland Classification
Anderly silt loam, 1 to 7 percent slopes	Well drained	High	Prime, if irrigated
Anderly silt loam, 7 to 15 percent slopes	Well drained	High	Statewide importance
Anderly silt loam, 15 to 35 percent south slopes	Well drained	High	Statewide importance
Endersby fine sandy loam, 0 to 3 percent slopes	Somewhat excessively drained	Not high	Prime, if irrigated
Endersby-Hermiston complex, 0 to 3 percent slopes	Well drained	Not high	Prime, if irrigated
Kuhl very stony very fine sandy loam, 3 to 20 percent slopes	Well drained	High	
Lickskillet-Rock outcrop complex, 40 to 70 percent south slopes	Well drained	Not high	
Lickskillet very stony loam, 7 to 40 percent south slopes	Well drained	Not high	
Lickskillet-Bakeoven complex, 2 to 20 percent slopes	Well drained	Not high	
Mikkalo silt loam, 2 to 7 percent slopes	Well drained	High	Prime, if irrigated
Mikkalo silt loam, 7 to 15 percent slopes	Well drained	High	Statewide importance
Nansene-Rock outcrop complex, 35 to 70 percent north slopes	Well drained	Not high	
Ritzville silt loam, 2 to 7 percent slopes	Well drained	Not high	Prime, if irrigated
Ritzville silt loam, 7 to 15 percent slopes	Well drained	Not high	Statewide importance
Rock outcrop-Rubble land-Lickskillet complex, 50 to 80 percent south slopes	Well drained	Not high	
Walla Walla silt loam, 1 to 7 percent slopes	Well drained	Not high	Prime, if irrigated
Walla Walla silt loam, 7 to 15 percent slopes	Well drained	Not high	Statewide importance
Walla Walla silt loam, 15 to 35 percent north slopes	Well drained	Not high	Statewide importance
Wato very fine sandy loam, 3 to 7 percent slopes	Well drained	Not high	Prime, if irrigated
Wato very fine sandy loam, 7 to 15 percent slopes	Well drained	Not high	Statewide importance

3.4.5 Regional Seismological Setting

Potential seismic sources that may affect the projects can be grouped into three independent categories: *subduction zone events*, *subcrustal events*, and *local crustal events*. Subduction zone events and subcrustal events have not occurred in the Pacific Northwest in post-settlement times, and are generally widely spaced in geologic time, they may occur during the life of the projects. Sudden crustal movements along relatively shallow, local faults in the Columbia-Deschutes Plateau area are rare, but have been responsible for local earthquakes.

3.5 Water Resources

The analysis area includes the proposed BPA transmission routes and substation areas; about 22,000 acres for the proposed Klondike III facilities; and about 25,000 acres for the proposed Biglow Canyon facilities.

3.5.1 Precipitation

Located on the eastern side of the Cascade Mountains, the area predominantly exhibits the continental climate of the Intermountain Region – extreme temperatures and low rainfall. However, the Columbia River Gorge provides a passageway for the normal eastward migration of ocean-conditioned air masses from the Pacific. Most of the annual rainfall in Sherman County occurs between November and February, reflecting the strong influence of the marine air masses entering from the Pacific Ocean. Mean monthly rainfall (measured 1971 to 2000 at Moro, Oregon) ranges from 0.31 inch in July to 1.57 inches in January. Between 1910 and 1995, average total annual precipitation was 11.76 inches in Wasco, Oregon (Oregon Climate Service, 2005).

3.5.2 Floodplains

There are no ***floodplains*** mapped by the Federal Emergency Management Agency (FEMA) within the analysis areas (FEMA, 1984).

3.5.3 Groundwater

The analysis area lies within the Columbia Plateau regional aquifer system. Groundwater resides in the cracks, fractures, and loose materials associated with the upper and lower boundaries of the numerous basalt (i.e., lava) flows associated with the basin. Groundwater can also be found in layers of unconsolidated-deposits that overlie the basalt flows (US Geological Survey [USGS], 2006).

In Sherman County, the basaltic rock aquifers tend to be the most productive; however, both basaltic rock and unconsolidated-deposits are present. Typical well depths range from 125 to 710 feet below ground surface and have yields ranging from less than 20 up to 2,000 gallons per minute. The principal ground water uses in the county are for public supply, domestic and commercial, agriculture, and industrial (USGS, 2006).

The analysis area is not in a State of Oregon Groundwater Management Area (Oregon Department of Environmental Quality [DEQ], 2005a).

3.5.4 Wetlands and Surface Water

Project wetland specialists conducted a site visit and wetland delineation on November 18, 2005, for the Klondike III/ Biglow Canyon Wind Integration Project. They also reviewed recent documents from the Biglow Canyon Wind Farm ASC (CH2M HILL, 2005) and the Klondike III Wind Project ASC (DEA 2005) and field-verified the findings of these documents.

Wetland specialists used the U.S. Army Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) to complete the wetland delineation. This manual requires that all three wetland parameters –hydrology, hydrophytic (water-loving) plants, and hydric soils – be present for an area to be considered a wetland.

Wetland specialists reviewed reference materials prior to the field investigation to provide information regarding the possible presence of wetlands, water features, hydric soils, wetland hydrology and site topography. The materials reviewed included precipitation data for Pendleton, Oregon (Oregon Climate Service, 2005); US Geological Survey (USGS) 7.5-minute Quadrangle maps; National Wetlands Inventory (NWI) maps; and the on-line Soil Survey of Sherman County Area, Oregon (USDA, 2005).

Most of the analysis area is in dry land wheat production. Few areas of native plant communities remain, occurring only in small patches along stream channels. (See Section 3.7, Vegetation, for further discussion on plant communities.)

Soils are relatively homogeneous throughout the wetland analysis area. The typical soil profile consisted of dark brown silt loam from 0 to 16 inches deep, with no mottles or other indicators of hydric soils present. This profile was observed throughout most of the wetland analysis area and was determined to be non-hydric (DEA, 2005; CH2MHill, 2005).

Within the entire analysis area, two jurisdictional wetlands and six jurisdictional drainage crossings were identified (see Map 6 and Table 3-4). A jurisdictional wetland or drainage is one that is considered a water of the state and regulated by the Oregon Department of State Lands and/or the Army Corps of Engineers. Many other non-jurisdictional drainages were identified in the analysis area, however these drainages are not regulated and most have been affected by agricultural practices such as plowing and no channels exist. They are not considered further in the analysis.

Table 3-4 Wetlands and Jurisdictional Drainages

Water Resource	Description*	Project Area
Wetland W1	POWHX in non-jurisdictional drainage in Emigrant Canyon	Biglow Canyon
Wetland W2	PEMIC in non-jurisdictional drainage	Klondike III
Drainage A	Jurisdictional drainage in Gerking Canyon	BPA Proposed Action
Drainage B	Jurisdictional drainage in Scott Canyon	BPA Proposed Action
Drainage C	Jurisdictional drainage in tributary to Helm Canyon	BPA Proposed Action
Drainage D	Jurisdictional drainage in Gerking Canyon (south of A)	Middle Alternative
Drainage E	Jurisdictional drainage in Gerking Canyon (south of A, D)	Middle Alternative
Drainage F	Jurisdictional drainage in tributary to China Hollow	Middle Alternative

* POWHX = Palustrine open water permanently flooded excavated wetland; PEM1C = Palustrine emergent persistent seasonal wetland.

3.5.4.1 BPA Proposed Action

BPA's Proposed Action crosses three drainages and no wetlands (see Map 6):

- Crossing A: A jurisdictional drainage was identified in Gerking Canyon about 1 mile west of the existing John Day Substation. This drainage runs north and is an unnamed intermittent tributary of the Columbia River. No water was observed, but a channel with bed and bank characteristics about 8 feet wide and 5 feet deep was present. Upland herbaceous ***species*** dominated the channel banks during the site visit.

- Crossing B: A jurisdictional drainage was identified just west of Scott Canyon Road and south of Herrin Lane. This drainage runs northwest and is an unnamed intermittent tributary of the Columbia River. No water was observed, but a channel with bed and bank characteristics about 5 feet wide and 3 feet deep was present. Upland herbaceous species dominated the channel during a site visit.

- Crossing C: A jurisdictional drainage was identified west of Helm Canyon, along Herrin Lane. This drainage runs north and is an unnamed intermittent tributary of Helm Canyon, which is an intermittent tributary of the Columbia River. No water was observed, but a channel with bed and bank characteristics about 2 feet wide and 2 feet deep was present. Upland herbaceous species dominated the channel during the site visit.

3.5.4.2 Middle Alternative

The Middle Alternative crosses three drainages and no wetlands:

- Crossing D: A jurisdictional drainage was identified about 3 miles southeast of the existing John Day Substation, just west of Scott Canyon Road. This drainage runs northwest and is the upstream portion of the drainage in Gerking Canyon described under Crossing A, above. No water was seen, but a channel with bed and bank characteristics about 5 feet wide and 3 feet deep was present. Upland herbaceous species dominated the channel during a site visit.

- Crossing E: The same unnamed jurisdictional drainage identified as Crossing D is re-crossed less than 1 mile upstream and retains the same character as Crossing D.

- Crossing F: A jurisdictional drainage exists along Medler Road, east of Scott Canyon Road. This drainage runs northwest and through a culvert under Medler Lane. The drainage is an unnamed intermittent tributary of China Hollow, which is an intermittent tributary of the Columbia River. No water was observed, but a channel with bed and bank characteristics about 5 feet wide and 2 feet deep was present. Upland herbaceous species dominated the channel during the site visit.

3.5.4.3 Wind Projects

According to the wetland delineation results from the Biglow Canyon Wind Farm ASC (Western EcoSystems Technology, Inc. [WEST], 2005), one wetland (W1) exists within the project boundary. The small wetland (0.06 acres) is identified as a palustrine open water permanently flooded excavated wetland (POWHX) and is in the eastern section of the analysis area, just north of Emigrant Springs Lane and between Weir Road and Rayburn Road (see Map 6). The wetland is associated with a non-jurisdictional drainage at the top of Emigrant Canyon and was likely formed when the small drainage was dammed near a residence.

One small wetland was identified within the Klondike III proposed site boundary (W2). This wetland was classified as palustrine emergent persistent seasonal wetland (PEM1C) and is associated with a discontinuous ephemeral or intermittent drainage that runs from west to east within the vicinity of Klondike Lane, eventually running underneath Klondike Lane via a bridge crossing near Webfoot. This drainage is not a state jurisdictional water since it does not directly connect to a fish-bearing stream (Oregon Department of State Lands [DSL], 2005). However, the wetland associated with the drainage is a state jurisdictional wetland (DSL, 2005).

3.6 Fish and Wildlife

The fish and wildlife analysis area consists of a 300-foot wide corridor centered on the proposed BPA ROW and substation facilities, a 300-foot wide corridor centered on Klondike III facilities, and a 500-foot wide corridor centered on Biglow Canyon facilities. Diurnal walking surveys as well as nighttime surveys for sensitive status species were conducted for Klondike III and Biglow Canyon.

The wildlife specialist reviewed reference materials prior to the field investigation to obtain information about the type, size and location of vegetative and wildlife resources within the project corridor. The materials reviewed included USGS 7.5-minute quadrangle maps; aerial photography at various scales, the Applications for Site Certificate for the Biglow Canyon Wind Farm (WEST, 2005), and the Klondike III Wind Project (DEA, 2005). The U.S. Fish and Wildlife Service (USFWS) and the Oregon Natural Heritage Information Center (ORNHIC) were queried for information on listed and sensitive species within the 5-mile data search area. The Oregon Department of Agriculture (ODA) was contacted for information about plant distribution, protection and conservation programs. The Oregon Department of Fish and Wildlife (ODFW) was contacted for information on fish and wildlife habitat requirements and distribution. On November 18, 2005, project wildlife specialists conducted a site visit to assess habitat conditions.

3.6.1 Fish Species and Fish Habitat

The analysis area contains no habitat for fish species. Only intermittent streams are present (see Section 3.6.2.6).

3.6.2 Wildlife Habitats within the Analysis Area

The following habitats are found within the analysis area.

3.6.2.1 Upland Trees

Upland tree areas included small native trees, typically black locust, usually found within or near dry washes or draws, or next to abandoned structures. Upland trees are rare in the analysis area. Sensitive species, such as loggerhead shrike and Swainson's hawk, nest and forage in this habitat, as well as more common species such as red-tailed hawk.

3.6.2.2 Shrub-Steppe

Shrub-steppe habitat within the analysis area occurs on slopes next to canyons and intermittent streams. It consists of an overstory of sagebrush and/or various native ***forbs*** and both rubber rabbitbrush and yellow rabbitbrush. The understory includes native grasses such as bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue, generally with a large percent cover of invasive grasses such as cheatgrass and bulbous bluegrass. Although the habitat is often weedy in places, it can provide some degree of structure and habitat for wildlife. Loggerhead shrike forage and nest in these areas, and the shrub structure provides habitat for white-tailed jackrabbit and other prey species for raptors.

3.6.2.3 Grassland

Grassland habitat within the analysis area consists mainly of invasive species such as cheatgrass, bulbous bluegrass, and tumblemustard. Native bunchgrasses remain in small patches, typically including species such as bluebunch wheatgrass and Sandberg's bluegrass. Native forbs such as rabbitbrush are present in small patches or in draws. White-tailed jackrabbit, burrowing owl, and long-billed curlew can use this habitat for foraging and nesting.

3.6.2.4 Conservation Reserve Program

CRP lands are found on the western end of the analysis area, near the John Day Substation and between Gerking Canyon and Scott Canyon, and within both wind analysis areas. Within the CRP areas, weed cover is generally low to moderate with scattered cheatgrass and bulbous bluegrass in the spaces between robust intermediate wheatgrass and crested wheatgrass. White-tailed jackrabbit, burrowing owl, and long-billed curlew can use this habitat for foraging and nesting.

3.6.2.5 Agricultural

Agricultural areas dominate the landscape and provide little habitat for wildlife other than for small mammals and forage for ungulates and raptors. Cultivated wheat is found in monoculture on these lands, with weedy forbs occasionally found on field perimeters. Raptors such as ferruginous hawk and rough-legged hawk could use this habitat for foraging.

3.6.2.6 Intermittent Streams

Three intermittent drainages were found within the analysis area: a jurisdictional drainage in Gerking Canyon about 1 mile west of the existing John Day Substation, a jurisdictional drainage just west of Scott Canyon Road more than 2 miles west of the substation, and a jurisdictional drainage 5 miles west of the substation south of and along Herrin Road west of Helm Canyon. No water was observed in any of these, but a channel with bed and bank characteristics of varying widths and depths was present. Western toad and other amphibians could use portions of these channels. Numerous other types of wildlife require access to water sources, which could be intermittently provided by this habitat type.

3.6.3 Species Analyzed

3.6.3.1 Threatened and Endangered Species

A number of federal and state ESA-listed and candidate wildlife species have the potential to exist within the analysis area: bald eagle, peregrine falcon, yellow-billed cuckoo, and Washington ground squirrel (USFWS, 2005 and ORNHIC, 2005). The yellow-billed cuckoo has likely been extirpated from Oregon (NatureServe, 2006), and is a riparian-dependent species, with no suitable breeding or foraging habitat present in the analysis area. The Washington ground squirrel does not occur in the analysis area, as their historical range is limited to areas east of the John Day River (USFWS, 2004).

Bald Eagle

The bald eagle is a federal and state-listed threatened species. Critical habitat has not been designated for the bald eagle. No suitable nesting or foraging sites are present in the analysis area. The closest bald eagle nest is on Browns Island on the Columbia River, west of the mouth of the Deschutes River (Isaacs, 2005), which is outside the study area for the proposed projects. Wintering bald eagles do not use the upland areas within and/or near the analysis area (Kohl, 2005).

Peregrine Falcon

The peregrine falcon is a State of Oregon endangered species. It has no status under the federal ESA because it was removed from the federal list of endangered and threatened wildlife on August 25, 1999 (USFWS, 1999). Peregrine falcons are limited to areas that contain suitable nesting ledges. Cliffs and bluffs typically found along rivers and other large bodies of water can provide habitat for nesting peregrines. Falcons prefer to nest where the concentration of prey, generally smaller birds, is high and where habitat characteristics may increase prey vulnerability.

Peregrine falcons may occur in the analysis area year-round. There are three peregrine falcon nest sites in the vicinity of the project; however, none are located within the analysis area.

3.6.3.2 Sensitive/Special Status Species

Table 3-5 lists the sensitive and special status wildlife species that may occur in the analysis area, whether suitable habitat is present, and whether the species has been observed in or near the analysis area.

3.6.3.3 Common Wildlife Species

Elk, mule deer, bighorn sheep, pronghorn and common species such as coyote and badger occur in the analysis area. Many common avian species such as horned lark and meadowlark are also regularly found within the analysis area.

Table 3-5 Special Status/Sensitive Species with the Potential To Occur within the Analysis Area

Species ***(Scientific Name)***	**Federal Status**	**State Status**	**Observed/Documented in Klondike III Analysis Area**	**Occurrence/Habitat in Biglow Canyon Analysis Area**	**Occurrence/Habitat in BPA Analysis Area**
Birds					
Bald eagle *(Haliaeetus leucocephalus)*	T/EA	T	No foraging or nesting habitat present. May use John Day and Columbia River canyons.	No foraging or nesting habitat present. May use John Day and Columbia River canyons.	No foraging or nesting habitat present. May use John Day and Columbia River Canyons.
Peregrine falcon *(Falco peregrinus anatum)*	--	E	Potential foraging habitat present. No nesting habitat present.	Potential foraging habitat present. No nesting habitat present.	Potential foraging habitat present. No nesting habitat present.
Golden eagle (*Aquila chrysaetos*)	EA	--	One nest documented in the project vicinity during 2001-2003 Klondike I and II surveys. Also documented in 2004-2005 avian baseline surveys.	Observed near John Day River rock outcrops during raptor nest survey.	Potential foraging habitat present; no nesting habitat present.
Swainson's hawk (*Buteo swainsoni*)	--	SV	11 nests documented in the project vicinity during 2001-2003 Klondike I and II surveys. 3 nests were documented in the project vicinity in 2004-2005 avian baseline surveys	18 observations from all surveys.	Potential foraging habitat present; nesting habitat present in upland trees.
Rough-legged hawk (*Buteo lagopus*)	--	--	Individuals documented within 2001-2003 Klondike I and II surveys as well as 2004-2005 avian baseline surveys.	Potential foraging habitat present; potential nesting habitat present in upland trees.	Potential foraging habitat present; potential nesting habitat present in upland trees.
Red-tailed hawk (*Buteo jamaicensis*)	--	--	18 nests documented in the project vicinity during 2001-2003 Klondike I and II surveys, and seen within the analysis area during 2005 sensitive species surveys.	Potential foraging habitat present; nesting habitat present.	Potential foraging habitat present; nesting habitat present.
Ferruginous hawk (*Buteo regalis*)	SoC	SC	Documented within 2001-2003 Klondike I and II surveys. None observed during 2004-2005 Klondike III surveys.	One observation, rare.	Potential foraging habitat present; potential nesting habitat present.
Long-billed curlew (*Numenius americanus*)	--	SV	Documented within 2001-2003 Klondike I and II surveys. Observed during Klondike III avian baseline surveys in eastern portion of the analysis area. No nests observed.	Observed south of proposed facility; ORNHIC lists use along John Day River up to Drapper Canyon mouth, historical nesting sites of broad county canyons.	Potential foraging habitat present; potential nesting habitat present in grasslands.
Bank swallow (*Riparia riparia*)	--	SU	None observed, probably migrant through analysis area.	None observed, probably migrant through analysis area.	None observed, probably migrant through analysis area.

Species **(*Scientific Name*)**	**Federal Status**	**State Status**	**Observed/Documented in Klondike III Analysis Area**	**Occurrence/Habitat in Biglow Canyon Analysis Area**	**Occurrence/Habitat in BPA Analysis Area**
Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*)	SoC	--	Historical county record, no observations in ORNHIC query.	Historical county record, no observations in ORNHIC query.	Historical county record, no observations in ORNHIC query.
Western greater sage grouse (*Centrocercus urophasianus*)	SoC	SV	Regionally extirpated	Regionally extirpated	Regionally extirpated
Common nighthawk (*Chordeiles minor*)	--	SC	County record; possible, especially near riparian areas.	County record; possible, especially near riparian areas.	County record; possible, especially near riparian areas.
Eastern Oregon willow flycatcher (*Empidonax traillii adastus*)	SoC	SU	None observed	None observed, Biglow Canyon habitat possible.	None observed
Western burrowing owl (*Athene cunicularia hypugaea*)	SoC	SC	None observed. Suitable habitat may exist within grassland areas.	Historical county record; no observations in ORNHIC query.	Potential foraging habitat present; potential nesting habitat may exist within grassland areas.
Grasshopper sparrow (*Ammodramus savannarum*)	--	SV/SP	Common in non-agricultural habitat.	Common in non-agricultural habitat.	Common in non-agricultural habitat.
Lewis' woodpecker (*Melanerpes lewis*)	SoC	SC	No observations, probably migrant through facility area.	No observations, probably migrant through facility area.	No observations, probably migrant through facility area.
Western bluebird (*Sialia mexicana*)	--	SV	None observed, possible use of facility tree lots and/or barns	None observed, possible use of facility tree lots and/or barns.	None observed, possible use of facility tree lots and/or barns
Western meadowlark (*Sturnella neglecta*)	--	SC	Abundant.	Abundant.	Abundant.
Yellow-breasted chat (*Icteria virens*)	SoC	Soc	Habitat lacking; irregular migrant potentially through analysis area.	Habitat lacking; irregular migrant potentially through analysis area.	Habitat lacking; irregular migrant potentially through analysis area.
Loggerhead shrike (*Lanius ludovicianus*)	--	SV	Documented within 2001-2003 Klondike I and II surveys. Observed once during the winter avian baseline surveys. Documented in one location within the analysis area and two locations outside of the analysis area during 2005 sensitive species surveys.	Uncommon. Potential foraging habitat present; potential nesting habitat may exist within upland tree areas.	Potential foraging habitat present; potential nesting habitat may exist within upland tree areas.

Species *(Scientific Name)*	Federal Status	State Status	Observed/Documented in Klondike III Analysis Area	Occurrence/Habitat in Biglow Canyon Analysis Area	Occurrence/Habitat in BPA Analysis Area
Mammals					
California bighorn sheep (*Ovis canadensis californiana*)	SoC	--	Unlikely to Occur	Observed east of John Day on south rim of Columbia River; might use river canyon slopes north and east of analysis area.	Observed east of John Day on south rim of Columbia River; might use river canyon slopes north and east of analysis area.
White-tailed jackrabbit (*Lepus townsendii*)	--	SU	Five individuals documented within 2001-2003 Klondike I and II surveys. At least one individual documented outside the analysis area during 2005 sensitive species surveys.	Observed, uncommon.	Potential foraging habitat present; species seen along project corridor during Biglow Canyon Wind Farm surveys in grasslands
Hoary bat (*Lasiurus cinereus*)			Probably migrant through analysis area.	Probably migrant through analysis area.	Probably migrant through analysis area.
Long-eared myotis (*Myotis evotis*)	SoC	SU	Unknown	Unknown	Unknown
Long-legged myotis (*Myotis volans*)	SoC	SU	Unknown	Unknown	Unknown
Pale western big-eared bat (*Corynorhinus townsendii pallescens*)	SoC	SC	Unknown	Unknown	Unknown
Pallid bat (*Antrozous pallidus pallidus*)	--	SV	Unknown	Unknown	Unknown
Silver-haired bat (*Lasionycteris noctivagans*)	SoC	SU	Probably migrant through analysis area.	Probably migrant through analysis area.	Probably migrant through analysis area.
Western small-footed myotis (*Myotis ciliolabrum*)	SoC	SU	Unknown	Unknown	Unknown
Yuma myotis (*Myotis yumanensis*)	SoC	--	Unknown	Unknown	Unknown
Amphibians and Reptiles					
Northern leopard frog (*Rana pretiosa*)	--	SC	None observed, not likely to occur.	None observed; habitat possible at pond near Emigrant Springs Road.	None observed, not likely to occur.
Western Toad *Bufo boreas*	--	SV	None observed, habitat possible in larger ravines.	Observed in upper Biglow Canyon.	None observed, habitat possible in larger ravines.
Painted turtle (*Chrysemys picta*)	--	SC		None observed; habitat possible at pond near Emigrant Springs Road.	
Western rattlesnake (*Crotalus viridis; C.v. oregonus*)	--	SV	Likely common in native shrub-steppe and ravine habitat.	Observed; likely common in native shrub-steppe and ravine habitat.	Likely common in native shrub-steppe and ravine habitat.

***EA** – Bald and Golden Eagle Protection Act; **E** – Endangered; **T** – Threatened; **SoC** – Species of Concern; **SC** – State Sensitive-Critical; **SV** – State Sensitive-Vulnerable; **SU** – State Sensitive-Undetermined Status.*

3.7 Vegetation

The analysis area for vegetation consists of the area within 300 feet of the proposed BPA facilities (including centerlines of the two alternative transmission line routes), within 300 feet of the proposed Klondike III Wind Project facilities, and within 500 feet of the proposed Biglow Canyon Wind Farm project facilities, including wind turbine corridor boundaries. On November 18, 2005, project vegetation specialists conducted a site visit to assess vegetation conditions.

Vegetation communities found in the analysis area include the following: upland trees, shrub-steppe, CRP, and agriculture. These communities, their representative species, and typical location in the landscape are described in Section 3.6.2.

3.7.1 Special-Status Plant Species (Federal and State)

No threatened or endangered plant species were identified as present in the analysis area (Oregon Natural Heritage Information Center, 2005). The following rare or special status species may occur in the project vicinity; however, there are no records of any of these species within the analysis area and none were found during field visits (DEA, 2005; CH2MHill, 2005).

- Henderson's needlegrass (*Achnatherum hendersonii*)
- Dwarf suncup (*Camissonia pygmaea*)
- Vernal pool mousetail (*Myosurus sessilis*)
- Whitehead navarretia (*Navarretia leucocephala*)
- Laurence's milkvetch (*Astragalus collinus* var. *laurentii*)
- Disappearing monkeyflower (*Mimulus evanescens*)
- Liverwort monkeyflower (*Mimulus jungermannioides*)
- Northern wormwood (*Atemisia campestris* v. *wormskioldii*)
- Henderson's ricegrass (*Achnatherum collinus* v. *laurentii*)
- Robinson's onion (*Allium robinsonii*)

3.7.2 Weeds and Undesirable Vegetation

3.7.2.1 Agricultural Lands

Agricultural lands within the analysis area are plowed, seeded, and harvested annually, mainly with wheat species. Herbicide spraying is common, widespread, and takes place at several stages during the year. The adjacent edge habitat is dominated by weeds typically found in these margins, mainly cheatgrass, Russian thistle, and ryegrass.

3.7.2.2 Other Lands

Native vegetation communities, such as upland trees, shrub-steppe, and grasslands within the analysis area have a large proportion of non-native and invasive weed species such as cheatgrass, bulbous bluegrass, and tumblemustard. Generally, no weed control is conducted within these communities. Within CRP lands, weed cover is generally low to moderate with scattered cheatgrass and bulbous bluegrass. Weed control in CRP lands is required, and would generally include spraying for broadleaf weeds. This herbicide control is most intensive in the early period of CRP establishment, and is not usually continued after full establishment of CRP has taken place. Burning is a seldom-used control method for weeds due to expense and fire danger.

3.8 Visual Resources

The analysis area for visual resources is the area within 30 miles of the Klondike III Wind Project and the Biglow Canyon Wind Farm. This area includes BPA's action alternatives.

The general landscape character features rolling hills in dry land winter wheat production or grasses dedicated to conservation easements through the CRP administered by the NRCS. Most of the analysis area is in wheat production. Very little acreage of native plant communities remains, occurring in small patches along tributaries and unnamed drainages to the Columbia, John Day, and Deschutes rivers.

The Deschutes River Canyon and John Day River Canyon are important features draining to the Columbia River. Basalt cliffs and rock outcrops are typical within the river canyons and are important visual elements. Where vegetation is not in agricultural production or conservation, it is characterized by shrub-steppe habitat typical to Central Oregon. Trees are very sparse, usually occurring in ravines or near the few home sites as shelter belts. The Cascade Mountains, including Mount Hood and other peaks and ridgelines, are visible in the distant background during clear conditions when not blocked by local topography.

Multiple transmission and distribution lines cross the analysis area as well as transportation corridors including the Columbia River, I-84, U.S. 97, SR-206, and SR-14. Existing wind turbines and substation facilities are also visible.

Several important visual resources have been identified in the analysis area (see Table 3-6 and Map 7). Summaries of these resources are provided in this section.

Table 3-6 Important Visual Resources within the Analysis Area

Visual Resource	Direction/Distance (miles) from		
	BPA Action Alternatives	**Klondike III Wind Project**	**Biglow Canyon Wind Farm**
Columbia River Gorge National Scenic Area	West, 9	Northwest, 12.2	West, 10
John Day River Canyon	East, 2.5	East, 0.8	West, 23
Oregon National Historic Trail High Potential Sites:			
Fourmile Canyon	East, 25	East, 20	East, 23
John Day River Crossing (a.k.a. McDonald Ferry)	Southeast, 4	East, 2	Southeast, 6
Biggs Junction	West, 7	Northwest, 11	West, 8
Deschutes River Crossing	West, 10	Northwest, 13.5	West, 11
The Dalles Complex	West, 24	West, 28	West, 25
Lower Deschutes River Canyon	West, 9	West, 8	West, 10
Lower Klickitat River Canyon	West, 25	Northwest, 27.5	West, 26
Journey Through Time Scenic Byway	Southwest, 1.5	West, 0.5	West, 2

3.8.1 Columbia River Gorge National Scenic Area

The Columbia River Gorge National Scenic Area (CRGNSA) is managed for an "unparalleled combination of scenery, geology, plants, wildlife, and multicultural history" (Columbia River Gorge Commission and USDA Forest Service [USFS], 1992). The exceptional beauty of this region is largely derived from its diverse character. Key Viewing Areas (KVAs) are important viewpoints open to the public offering opportunities to view the Gorge. KVAs within the analysis area include the Historic Columbia River Highway, I-84, Washington SR-14, the Columbia River, and Rowena Plateau (i.e., Tom McCall Preserve). Designated Scenic Travel Corridors in the analysis area include the Historic Columbia River Highway, I-84, SR-14, U.S. 97 and SR-142.

3.8.2 John Day River Canyon

The John Day River landscape within the analysis area features high desert communities of sagebrush and juniper with intermingled private ranches adding visual interest along the river (BLM, 2000). The John Day River Canyon (i.e., the area from rim to rim) is identified as an "area of high visual quality" (BLM, 1986). The BLM manages its lands in this area as a Visual Resource Management (VRM) Class II resource, meaning management activities resulting in changes to the existing character of the landscape may be allowed, provided they do not attract the attention of the casual observer (BLM, 2000).

Beginning at Tumwater Falls near river mile 10 upstream through the analysis area, the river is a designated Federal Wild and Scenic River and classified as Recreational. Outstanding remarkable values in this segment include "scenic, recreation, fish, wildlife, geological, paleontological, and archaeological" values. The segment is designated as a

State Scenic Waterway pursuant to the Oregon State Scenic Waterways Act, ORS 390.805-390.925.

The Two Rivers Resource Management Plan Record of Decision (BLM, 1986) identifies two Special Management Areas relevant to this project: the Oregon Trail Historic Sites at Fourmile Canyon and McDonald Ferry, and the John Day River Canyon. For the trail sites, "the unusual qualities of these sites will be maintained and protected" (BLM, 1986). For the canyon, "areas of high visual and natural quality will continue to be protected while allowing other compatible uses in the same area" (BLM, 1986).

3.8.3 Oregon National Historic Trail

In 1978, Congress authorized the Oregon National Historic Trail Committee to commemorate the historic Oregon Trail and to promote its preservation, interpretation, public use, and appreciation. The National Park Service produced *The Management and Use Plan Update Final Environmental Impact Statement Oregon National Historic Trail and Mormon Pioneer National Historic Trail* (USDI National Park Service [NPS], 1999), to coordinate broad-based policies, guidelines, and standards for administering the trail to guide its protection, interpretation, and continued use.

Within the analysis area, the plan identifies five High-Potential Sites based on "historic significance, the presence of visible historic remnants, scenic quality, and relative freedom from intrusion" (NPS, 1999). These sites include Fourmile Canyon, John Day River Crossing (a.k.a. McDonald Ferry), Biggs Junction, Deschutes River Crossing, and The Dalles Complex. The plan does not identify specific scenic or aesthetic values in the analysis area beyond these five sites. Intact segments or other visual evidence (e.g., wagon ruts, scars) of the trail are not known to exist within the analysis area. Nearly all evidence of the trail within the analysis area has been obliterated through agricultural practices over the years.

3.8.4 Lower Deschutes River Canyon

The Lower Deschutes River is a designated Federal Wild and Scenic River and Oregon State Scenic Waterway. The Lower Deschutes Canyon "contains a diversity of landforms, vegetation and color" (BLM, 2001) where the river has carved a dramatic canyon through rugged Columbia River basalt flows. Riparian vegetation provides stark contrast against the broken reddish brown canyon walls. Transportation corridors (roads and railroad), and rural development occur in several areas throughout the canyon.

3.8.5 Lower Klickitat River Canyon

The lower 10 miles of the Klickitat River from its confluence with Wheeler Creek, near the town of Pitt, to its confluence with the Columbia River is designated a Federal Wild and Scenic River with a Recreational classification. Outstandingly remarkable resources include the river's free-flowing nature, resident and anadromous fish and their habitats, Native American dip-net fishing, and the geology of the lower gorge (USFS, 1991).

3.8.6 Journey Through Time Scenic Byway

The Journey Through Time Scenic Byway is administered through the ODOT Scenic Byway Program. The portion of the scenic byway within the analysis area is US 97 in Oregon.

The Journey Through Time Management Plan speaks to the rural heritage and history of the 286-mile route through north central Oregon. The plan establishes four goals: create jobs; maintain rural lifestyles (i.e., support traditional industries of agriculture and timber); protect important values (e.g., historical attractions); and build identity for the north central Oregon region. The plan identifies the communities of Wasco, Moro, and Grass Valley, the Historic Oregon Trail and Barlow Road, and the Sherman County Museum as points of interest within the analysis area.

3.9 Socioeconomics

This analysis uses U.S. Census Bureau information from the 1990 and 2000 decennial censuses but, where appropriate, also includes data from state and local agencies. Sherman County, its incorporated communities, and block groups (BG) are the census areas used for determining the effects to the socioeconomic characteristics in the analysis area. Because only one census tract (9501) covers the entire county, county and census tract demographic information are the same, and because of the low population of the analysis area, block groups are quite large and include some geographic areas that would not likely be affected by the proposed project.

There are two BGs within the analysis area. Block Group 1 covers the eastern portion of the county, including the town of Rufus, from US 97 north of Wasco and OR 206, south of Wasco to the eastern county boundary. Wasco is not part of BG 1. Block Group 2 includes the town of Wasco and all land west of US 97 and OR 206 from the Columbia River to the western county boundary and down to just north of the community of Moro. The southern boundary is generally Monkland Lane.

3.9.1 Population

The analysis area is entirely within Sherman County, which has four incorporated communities: Grass Valley, Moro, Rufus and Wasco. Rufus and Wasco are near the proposed project; Moro (county seat) and Grass Valley are in the southern portion of the county. The estimated 2003 population for Sherman County is 1,900 residents. Wasco is the largest community in the county with an estimated 380 residents.

Between 1990 and 2003, Sherman County population decreased slightly by 18 residents, or about one percent of its total population. Rufus has lost residents, declining by about 9 percent since 1990, while Wasco grew slightly, adding a handful of residents for the same period (Population Research Center, 2005).

According to census data, population in Sherman County rural areas appears to be more stable than local communities. Population increases in rural areas countered losses in incorporated communities in BG 1. Overall, BG 1 lost 15 residents between 1990 and 2000, but Rufus (included in BG population), actually lost 27 residents, which means that rural portions of the BG appear to have added 12 residents, reducing the overall loss of population in the entire BG to less than what was lost in Rufus. BG 2 grew between 1990 and 2000, increasing its population by about 7 percent (39 residents). Most of this growth also appears to have occurred in rural areas because Wasco, the block group's population center, grew by only seven residents.

3.9.2 Housing

The most recent housing data for Sherman County and its communities are from the 2000 decennial census. Because population has generally remained stable or declined in the county, current vacancy rates are assumed to be similar to those reported in the 2000 Census. The 2000 census reported that there were 935 housing units in Sherman County, as shown in Table 3-7. Of those, 523 are within BG 1 and 2.

Vacancy rates are shown in Table 3-7. In 2000, housing vacancy rates in the county area were relatively high, with the highest vacancy rates found in Rufus at 21 percent.

Table 3-7 Housing Supply and Availability in Sherman County and Project Vicinity, 2000

Census Geographic Area	Housing Units			
	Total	Occupied	Vacant	Percent Vacant
Sherman County	935	797	138	14.8%
Rufus	162	128	34	21.0%
Wasco	199	171	28	14.1%
Census Tract 9501	935	797	138	14.8%
CT 9501, BG 1	230	192	38	16.5%
CT 9501, BG 2	293	256	37	12.6%

Source: US Census Bureau SF-3

3.9.3 Lodging

Several lodging options are available near the proposed projects and have been used in the past during construction of the Klondike I and II Wind Projects. During construction of the first two phases, construction workers were housed in motels in the communities of Moro and Biggs Junction, and in a recreational vehicle (RV) park in Wasco. There are also several motels located in The Dalles in Wasco County west of Sherman County.

As a part of the Biglow Canyon Wind Farm ASC (CH2MHill, 2005), Orion identified over 750 hotel and motel rooms within a 30-mile range of the proposed Biglow Canyon Wind Farm. Additional rooms could also be available in establishments not identified as a part of the application. Other lodging could be found in Goldendale, Washington, and in overnight facilities at Oregon state parks and private RV campgrounds. Memaloose and Deschutes state parks together have nearly 100 sites that can accommodate RVs. Additional sites are also available for tents at both parks.

3.9.4 Social Characteristics

3.9.4.1 Age

The analysis area and Sherman County as a whole have a higher percentage of residents 50 years or older than the state as a whole. The population within the analysis area is generally similar to the state in the percentage of residents younger than 19 years old, but the percentage of county residents between 20 and 29 years old accounts for a much smaller portion of the population compared to other age cohorts and the state. The drop in residents within that age cohort could be attributed to young people leaving the county after high school and lack of local employment or college education opportunities in the county. The percentage of the county population between 30 and 39 years is within 4 percent of the state's overall population for that age group. For all age groups over 40, the county percentage (as well as that of Rufus, Wasco, and BG 2) exceeds that of the state as a whole.

3.9.4.2 Poverty

According to the 2000 census, the percentage of individuals and families living in poverty in Oregon was 11.6 percent and 7.9 percent, respectively, which was lower than Sherman County where the percentage of individuals and families in poverty was 14.6 percent and 12.3 percent, respectively. BG 1 has a slightly lower percentage of individuals in poverty, but has a higher percentage of families in poverty than the county as a whole. BG 2 is just the opposite, with a higher number of individuals in poverty at 15 percent and about 10 percent of families in poverty. Wasco has a lower poverty rate for individuals and families than the county. In all geographies, residents between 18 and 64 years old accounted for the highest percentage of individuals in poverty.

3.9.4.3 Race and Ethnicity

Minorities within Sherman County account for just 3 percent of the total population, compared to the state where about 16.5 percent of the total population is within a minority group. In general, minorities account for between 3 to 5 percent of the population in the analysis area.

3.9.5 Unemployment

Since 2000 Sherman County has had higher unemployment levels than the state. Sherman County's unemployment rate climbed from a relatively low 5.9 percent in 2000 to 11.9 percent in 2003. The increase was due to the loss of a single industry, aluminum manufacturing, which relied on low power costs to provide a comparative advantage. When aluminum production slowed in 2001, unemployment in the county increased rapidly. While unemployment rates have fallen recently because people have moved out of the county, travel outside the county for work, or because some unemployed may no longer be seeking work, the county still has an unemployment rate much higher than the state as a whole. In 2004, the county unemployment rate was nearly 10 percent, more than 2 percent higher than Oregon's. While some seasonal employment in the county is available, income from seasonal positions is generally lower than what the aluminum plants paid and the employment is generally less stable (Oregon Employment Department, 2005).

3.10 Cultural Resources

Cultural resources field inventories were conducted within the proposed alternative BPA transmission line routes and substation areas, within a 300-foot corridor around the proposed Klondike III Wind Project facilities, and within a 500-foot corridor around the proposed Biglow Canyon Wind Farm facilities. A portion of BPA's Middle Alternative was not surveyed because BPA could not obtain permission from current landowners to conduct the field inventory.

The field inventories identified historic properties and cultural resources. Methods of investigation included a literature review and records search (including records of the Oregon State Historic Preservation Office [SHPO]), as well as field investigations. The fieldwork consisted of the systematic pedestrian survey of the proposed turbine string alignments, laydown areas, new roads, overhead and underground utility lines, substations, meteorological towers, improvements to existing roads, and a wildlife mitigation area.

3.10.1 Resources near the Proposed Transmission Line Routes

The archaeological survey examined about 473 acres and identified four archaeological resources within the analysis area (Archaeological Investigations Northwest, Inc. [AINW], 2005a, 2005b). Two of the resources are located within the Proposed Action corridor, and the remaining two resources are within the proposed Middle Alternative corridor. The four resources consist of two prehistoric isolates (fewer than 10 artifacts), one historic-period isolate, and one historic-period site. No historic or archeological resources were identified near the proposed substation site.

A projectile point fragment was found on a gently-rolling high point overlooking Biglow and Emigrant canyons. One colorless machine-made glass bottle neck and two fragments of a colorless square glass bottle were also found within 16 feet of the projectile point. These bottle fragments had no identifying marks but likely date to the early or mid-1900s.

Scattered historic-period artifacts and the remains of a demolished structure were found north of Klondike Lane. Within the proposed transmission line corridor, AINW found one brick fragment, one piece of window glass, and four pieces of whiteware ceramics. The structural remains are located outside the current analysis area. The second school in Sherman County, Jacks School, was established in the 1880s (AINW, 2005a).

Artifacts found near Wasco-Rufus Road included one aqua glass machine-made bottle base that had no marks, one aqua glass machine-made bottle neck, one insulator fragment, and one colorless glass bottle base. It is likely that these artifacts are roadside debris rather than evidence of more extensive deposits.

A single tan cryptocrystalline silicate flake was found at the bottom of Gerking Canyon. No other artifacts were found within the analysis area at this location, and the context of this find suggests that this flake is a secondary deposit.

Most of the proposed BPA action alternatives' routes are within lands that were under wheat cultivation at the time of the survey. These fields varied between recently-planted winter wheat that was up to 4 inches tall, harvested wheat (stubble and debris left on the ground), and plowed fields (no debris or new growth). Ground surface visibility within recently-planted fields ranged between 20 and 80 percent, depending upon how recently the ground was seeded. Wheat fields that had been harvested had highly variable ground surface visibility (between 5 and 95 percent). Portions of the analysis area were also left fallow or used as range land, resulting in a ground cover of tall grass and virtually no ground surface visibility.

Modern debris was found scattered sporadically along most of the roadside portions of the analysis area, and especially alongside major connector roads (such as Wasco-Rufus Road) . Very few developments, modern or historic-period, are within the proposed route corridors. One complex of historic-period buildings is located on the north side of Medler Lane. These buildings were used by the Medler family, one of the early and important residents of Sherman County (AINW, 2005a).

Both the Proposed Action and Middle Alternative cross portions of the Oregon Trail (known at the time as the Emigrant Road) through what are today cultivated fields. While the portion of the Oregon Trail crossed by the Middle Alternative was not surveyed, no evidence of the trail was observed during the pedestrian survey of the Proposed Action. One fossilized large mammal limb bone was observed in a road cut on the north side of Gerking Canyon Road.

There are no historic resources listed on or eligible for listing on the National Register of Historic Places (NRHP).

3.10.2 Klondike III Wind Project

As part of the ASC process, field surveys identified four archaeological resources (DEA, 2005). Three of these resources are prehistoric archaeological isolates (each represents the find of a single artifact) and the fourth is a small assemblage of historic-period refuse (also recorded as an archaeological isolate).

A number of historic-period resources within the analysis area were also identified. Most of these resources are buildings and structures associated with private ranching operations. Most of these resources have been altered or modified from their original design or lack any distinguishing characteristics.

The Oregon Trail alignment through the Klondike III Wind Project area is a designated historic trail under both federal and Oregon statutes. The alignment of the trail, as best it can be reconstructed, crosses the northeastern portion of the Klondike III Wind Project area. No physical evidence of the trail was observed at any of these locations or anywhere else in the field survey. All of the reported locations of intact trail segments were agricultural fields, and farming activity is likely to have obliterated most—if not all—physical traces of the trail.

There are no historic properties in the area of the Klondike III Wind Project listed on or eligible for listing on the NRHP.

3.10.3 Biglow Canyon Wind Farm

There are no historic properties in the area of the Biglow Canyon Wind Farm listed on the NRHP. Field surveys identified three historic sites and one historic archaeological site that were recorded with the SHPO. Homestead A was a wheat farm and cattle ranch operation. Homestead B is an abandoned Victorian farmhouse with associated outbuildings and cached older farm equipment which does not likely meet criteria for listing on the NRHP.

The historic building is an isolated garage building presently used for storage. This building is architecturally undistinguished and it is not known to be associated with events that have made a major contribution to the broad patterns of our history, nor is it associated with the lives of persons significant in our past. The building does not likely meet NRHP eligibility criteria.

The archaeological site is a small historic period surface dump feature. This site is small, lacks appreciable depth, and (it or its artifact contents) cannot be clearly associated with any particular person in the historic record. This archaeological site is believed to be ineligible for listing in the NRHP.

3.11 Noise, Public Health and Safety

Transmission facilities and wind projects provide electricity for heating, lighting and other services essential for public health and safety. These same facilities can potentially harm humans. Contact with transmission lines or turbines can kill or injure people and damage aircraft. This section describes public health and safety concerns such as electric shock, fires, and ***electric and magnetic fields*** related to transmission facilities, wind projects or construction activities.

Potential hazards include fire (both natural and human-caused), and interference with aircraft.

The Federal Aviation Administration establishes requirements for towers and other tall structures such as wind turbines that could potentially interfere with aircraft safety. Structures taller than 200 feet may require a flashing warning light for aircraft safety.

Transmission lines, like all electric devices and equipment, produce electric and magnetic fields, most commonly referred to as EMF. Current, the flow of electric charge in a wire, produces the magnetic fields. Voltage, the force that drives the current, is the force of the electric field. The strength of electric and magnetic fields depends on the design of the line and on the distance from the line. Field strength decreases rapidly with distance.

3.11.1 Noise

Audible noise (AN), as defined here, represents an unwanted sound, as from a transmission line, transformer, airport, or vehicular traffic. Sound is a pressure wave caused by a sound source vibrating or displacing air. The ear converts the pressure fluctuations into auditory sensations. AN from a source is superimposed on the background or ambient noise that is present before the source is introduced.

Environmental noise, including transmission line noise, is usually measured in ***decibels*** on the A-weighted scale (dBA). This scale models sound as it corresponds to human perception. Table 3-8 shows typical noise levels for common sources expressed in dBA.

Table 3-8 Common Noise Levels

Sound Level dBA	Noise Source or Effect
110	Rock and roll band
80	Truck at 50 feet
70	Gas lawnmower at 100 feet
60	Normal conversation indoors
50	Moderate rain falling on foliage
40	Refrigerators
26	Ambient noise in analysis area
25	Woods during calm breeze

3.11.1.1 Transmission Line Noise

Corona is the partial electrical breakdown of the insulating properties of air around the conductors of a transmission line. In a small volume near the surface of the conductors, energy and heat are dissipated. Part of this energy is in the form of small local pressure changes that result in audible noise. Corona-generated audible noise can be characterized as a hissing, crackling sound that, under certain conditions, is accompanied by a 120-Hz hum. Corona-generated audible noise is of concern primarily for contemporary lines operating at voltages of 345-kV or higher and generally during foul weather.

The conductors of high-voltage transmission lines, i.e., those of 230-kV and above, are designed to be corona-free under ideal conditions. However, protrusions on the conductor surface, particularly water droplets on or dripping off the conductors, cause electrical fields near the conductor surface to exceed corona onset levels, and corona occurs. Therefore, audible noise from transmission lines is generally a foul-weather (wet conductor) phenomenon. Wet conductors can occur during periods of rain, fog, snow or icing. Based on the meteorological records near the routes of the proposed transmission lines, such conditions are expected to occur about 6 percent of the time during the year in the Wasco area.

For a few months after the line would be built, residual grease or oil on the conductors could cause water to bead up on the surface. This would result in more corona sources and a slightly higher level of audible noise and electromagnetic interference in the line. However, as new conductors “age” in the first few months, the level of corona activity decreases to the predicted equilibrium value. During fair weather, insects and dust can also collect on conductors and serve as a source of corona.

The area where the two transmission line alternatives would be located has an ambient noise level of about 26 dBA (CH2MHill, 2005).

3.11.1.2 BPA Substation Noise

Audible noise from substations is generated predominantly by equipment such as transformers, reactors and other wire-wound equipment. It is characterized by a 120 Hz hum that is associated with magnetic-field caused vibrations in the equipment. Noise from such equipment varies by voltage and other operating conditions. The BPA design level for substation noise is 50 dBA at the substation property line for new construction (USDOE, 2006). The design level is met by obtaining equipment that meets specified noise limits and, for new substations, by securing a no–build buffer beyond the substation perimeter fence. The existing John Day 500-kV Substation has no noise-making equipment and has an ambient noise level of about 26 dBA (CH2MHill, 2005). Periodically, disconnect switches engage and emit a blast.

3.11.1.3 Wind Projects

The project area is rural, and ambient noise levels are low (about 26 dBA [CH2MHill]), with infrequent noise from agricultural activities. DEQ regulations at

OAR 340-035-0035 establish noise standards at sensitive receptors. At the proposed project sites, residences are the only noise sensitive properties identified. The noise level in the area where the two wind projects would be located has an ambient noise level of about 26 dBA (CH2MHill, 2005).

New noise sources on sites that have not previously been used for commercial or industrial purposes have a limit on the allowable increase over existing ambient noise levels. Generally, sources on new sites may not increase the noise levels by more than 10 dBA unless the person who owns the noise sensitive property executes a legally effective easement or real covenant that benefits the property on which the wind energy facility is located. This effectively allows for a noise level of no more than 36 dBA (26 dBA background + 10 dBA increase) at noise sensitive properties.

Wind turbines and transformers can cause noise that may exceed the noise limit and would require mitigation.

3.11.2 Electric and Magnetic Fields (EMF)

Electric and magnetic fields are found around any electrical wiring, including household wiring and electrical appliances and equipment. Throughout a home, the electric field strength from wiring and appliances is typically less than 0.01 kilovolts per meter (kV/m). However, fields of 0.1 kV/m and higher can be found very close to electrical appliances.

3.11.2.1 Electric Fields

There are no national guidelines or standards in the Unities States for electrical fields from transmission lines. Oregon has adopted a maximum of 9-kV/m in areas that are accessible by the public and applies only to transmission lines of 230-kV or above longer than 16 km (10 miles) and crossing more than one city or county in the state. It is basically a safety standard to reduce risks of electric shocks and burns.

BPA designs new transmission lines to meet its electric-field guideline of 9-kV/m maximum strength on the ROW and maximum field strength of 5-kV/m at the edge of the ROW.

3.11.2.2 Magnetic Fields

Average magnetic field strength in most homes (away from electrical appliances and home wiring) is typically less than 2 ***milligauss*** (mG). Very close to appliances with high current, fields of tens or hundreds of mG are present. Typical magnetic field strengths for some common electrical appliances are given in Table 3-9. Unlike electric fields, magnetic fields from outside power lines are not reduced in strength by trees or building materials. Transmission lines and distribution lines (the lines feeding a neighborhood and a home), can be a major source of magnetic field exposure throughout a home located close to the line.

There are no national standards or guidelines in the U.S. for magnetic fields. Oregon and Washington have no magnetic field limits and BPA does not have a guideline for magnetic fields exposures.

Table 3-9 Typical Magnetic Field Strengths

Appliance	Magnetic Field (mG) (One foot from a common appliance)
Coffee maker	1 – 1.5
Electric range	4 - 40
Hair dryer	0.1 to 70
Television	0.4 – 20
Vacuum cleaner	20-200
Electric Blanket	15-100

3.11.2.3 Electromagnetic Interference

Corona on transmission line conductors can generate electromagnetic noise in the frequency bands used for radio and television signals. The noise can cause radio and television interference (RI and TVI). In certain circumstances, corona-generated electromagnetic interference (EMI) can also affect radio reception in the AM broadcast band (535 to 1605 kilohertz [kHz]), communications systems and other sensitive receivers. FM radio reception is rarely affected. Generally only residences very near to transmission lines can be affected by RI.

Interference with electromagnetic signals by corona-generated noise is generally associated with lines operating at voltages of 345-kV and above. This is especially true of interference with television signals.

Corona-caused TVI occurs during foul weather and is generally of concern for transmission lines with voltages of 345-kV and higher, and only for conventional receivers within about 600 feet of such a line.

No state in the U.S. has limits for RI or TVI. Electromagnetic interference from power lines is governed by the Federal Trade Communication Commission (FCC).

3.11.2.4 Wind Projects

The wind projects would use 34.5-kV collectors to collect power from the wind turbines. Klondike III's circuits would all be below ground; Biglow Canyon would use above ground and below ground collectors. Above ground circuits emit electric fields and are measurable at the ground; however, buried cables, buried at a depth of 4 feet, emit no electric fields since the electric field is contained within the buried cables.

Maximum magnetic fields are measured at 1 meter above the ground. Both buried cables and overhead conductors emit magnetic fields.

3.11.3 Toxic and Hazardous Substances

3.11.3.1 BPA Operations

Minimal amounts of hazardous waste result from routine maintenance procedures performed on substation equipment and transmission lines. Kinds and volumes of waste such as oily rags, minor leaks from vehicles, etc., depend on the maintenance procedure.

3.11.3.2 BPA Substation Equipment

The two circuit breakers and associated disconnect switches BPA proposes to add at the existing John Day 500-kV Substation would not contain oil. The proposed John Day 230-kV Substation would have an oil containment system for the new transformers. The new transformers would not contain PCBs. BPA has a Spill Prevention Control and Countermeasure Plan that puts in place protocols and procedures for response in case a spill occurs.

3.11.3.3 Wind Projects Operations

Hazardous materials that would be used on the projects would include lubricating oils, cleaners and pesticides that would be used primarily during operations, but potentially during construction as well. These materials would be properly stored at the O&M facilities for both projects.

3.11.4 BPA Right-of-Way Vegetation Management

Vegetation is maintained for safe operation and to allow access to the towers. The vegetation would be managed as guided by BPA's Transmission System Vegetation Management Program Environmental Impact Statement (EIS) (DOE/EIS-0285), which is incorporated by reference, and with landowners' management practices.

3.11.5 Fire and Fire Protection

Fires on or near the ROW can jeopardize safe and reliable operation of transmission lines. Besides physical damage from heat and flames, smoke and hot gases from a fire can cause arcing between lines, between lines and a tower, or between lines and the ground. Such occurrences can pose a threat to the safety of personnel in the area, such as firefighters, and can result in line outages. To prevent fires and other hazards, safe clearances are maintained between the ground and the lines. BPA also prohibits storage of flammable materials on its ROWs. Transmission towers are tall structures that may be struck by lightning. Because the towers are electrically grounded, the current from the lightning strike passes directly into the ground, with minimal risk of starting a fire.

The proposed wind projects and transmission line alternatives are in the North Sherman Fire Protection District based in Wasco. The District provides fire protection and has trained EMT volunteers, although the District does not provide ambulance service. The District contracts with the Moro Rural Fire Protection District to provide ambulance service. The North Sherman Rural Fire Protection District has one volunteer trained in high angle rescue, specifically for potential accidents occurring on wind generation towers or aboveground collector lines. No incidents at existing wind power facilities within the district have occurred that would require this service. Local farmers also provide fire suppression and are often the first to respond because of the large service areas. Local service providers state that farmers often have their own fire equipment and also often respond to emergencies.

3.11.6 Sheriff Services

The Sherman County Sheriff's Department provides police service for all of Sherman County, including the proposed transmission line alternatives and wind projects. Other sheriff's departments within the analysis area include the Gilliam County Sheriff's Department and the Wasco County Sheriff's Department. The Wasco County Sheriff's Department is the largest of the three Oregon departments, with 17 full-time deputies, due to the much larger population it serves. Sherman and Gilliam counties employ four to five full-time deputies. All three departments have agreements to provide backup service for each other if needed.

According to the Sherman County Sheriff, no events have occurred at the existing wind facilities that required law enforcement services.

3.11.7 Health Care

The Mid-Columbia Medical Center, located in The Dalles, is the only full service medical facility located within the analysis area. The center provides emergency services as well as surgery. If an accident were to occur at the site, ambulance service from the Moro Rural Fire Protection District would transport patients to the hospital. Evacuation via helicopter is also available, if needed.

3.12 Air Quality

The Clean Air Act of 1970 empowered the U.S. Environmental Protection Agency (EPA) to establish air quality standards for six criteria air pollutants: ozone, carbon monoxide (CO), lead, nitrogen dioxide, particulate matter (PM-2.5, PM-10), and sulfur dioxide. The EPA uses these six criteria pollutants as indicators of air quality. For each of these pollutants, the EPA has determined a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are called National Ambient Air Quality Standards (NAAQS), and it is when an area exceeds these standards that it is designated as a nonattainment area. Pollution control measures are mandated for federal actions in nonattainment areas.

A nonattainment area can be listed for any one, or more, of the criteria pollutants. An area that was once a nonattainment area, but has since improved its air quality enough so that it now meets the EPA established air quality standards, is up-graded to a **maintenance area** designation. Maintenance areas also have pollution controls imposed on them, but because the air quality is not as poor as in nonattainment areas, the control standards are not as strict in maintenance areas. All other areas not listed by the EPA for air quality degradation are considered **attainment areas**.

Sherman County is classified as an attainment area. In fact, Sherman County has the lowest total emissions of any county in Oregon. The most recent EPA air emission data available for the criteria pollutants is from 2001 and is provided for: carbon monoxide (CO), nitrogen oxides (NOx), volatile organic compounds (VOC), sulfur dioxide (SO_2), particulate matter (PM 10 and PM 2.5), and ammonia. In 2001, Sherman County's total emissions were 13,806 tons. Table 3-10 shows Sherman County's air emissions data for 2001 and how the county ranked, compared to other counties in Oregon (EPA, 2006).

Table 3-10 Emission Amounts in Sherman County, Oregon

Pollutant	Amount of Emissions (in tons)	Rank Compared to Other Oregon Counties
Carbon Monoxide (CO)	7,259	Lowest in OR
Nitrogen Oxides (NOx)	1,434	3rd lowest after adjacent Wheeler County and Wallowa County
Volatile Organic Compounds (VOCs)	813	Lowest in OR
Sulfur Dioxide (SO_2)	109	Lowest in OR
Particulate Matter (PM 2.5)	837	Lowest in OR
Particulate Matter (PM 10)	3,064	Second lowest after adjacent Wheeler County
Ammonia	1,127	Average, near the median

According to the 2000 U.S. Census data, the economy of Sherman County is driven by agriculture. Sherman County has a total of 531,200 acres; 304,138 acres of this land is tillable. Barley, wheat, and cattle make up a large percentage of the agricultural base. A crop is raised only once every two years; land lies fallow during the off years. Beef cattle graze about 223,000 acres (Oregon Department of Environmental Quality and Oregon Department of Agriculture, 2006).

Agriculture provides the economic base of not only Sherman County, but of the state of Oregon as well. Oregon's farmers and ranchers recognize the importance of being responsible environmental stewards to sustain the natural resource base (Oregon Department of Environmental Quality and Oregon Department of Agriculture, 2006). Environmentally, air pollution can: damage soils, water, crops, vegetation, manmade materials, property, animals and wildlife, impair visibility, affect climate and weather, and create transportation hazards (Washington State Department of Ecology, 2003). Large concentrated cattle/animal operations emit pollutants such as ammonia and methane and agricultural fields are a source of particulate matter. Evidence would suggest that these activities contribute significantly to Sherman County's total nonpoint emissions (Oregon Department of Environmental Quality and Oregon Department of Agriculture, 2006).

Chapter 4 - Environmental Consequences

In this Chapter:

- Specific impacts from BPA's alternatives
- Specific impacts from the proposed wind projects
- Proposed mitigation
- Cumulative impacts
- Comparison of alternatives

This chapter discusses the potential impacts of BPA's alternatives and the proposed wind projects on the environment. To analyze potential impacts from construction, operation and maintenance activities, resource specialists analyzed actions using a scale with four impact levels: **high**, **moderate**, **low** and **no** impact. Definitions of the impact levels vary for each resource. Most impact definitions are given in the first part of each resource discussion. The level of detail for each affected resource depends on the character of that resource, the importance of the issue, and the scale of analysis most relevant for the affected resource. Additional detail and maps can be found in appendices.

Specialists considered direct and indirect impacts in the short and long term. Direct impacts are caused by the action and occur at the same time and place. Indirect impacts are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Impacts can be beneficial or adverse. The impact discussion lists ***mitigation*** that could reduce impacts.

This chapter also includes the potential ***cumulative impacts*** of the alternatives under each of the resources evaluated in this chapter. Cumulative impacts are the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions. Foreseeable future actions can be undertaken by federal or non-federal entities. Cumulative impacts also can result from individually minor but collectively significant actions taking place over a period of time. The following describes the various actions considered in the cumulative impact analyses in this chapter.

Although much of the project vicinity has remained as undeveloped rangeland, agricultural and other rural development has occurred in the area in the past two centuries. Typical past development includes large grain farms, irrigated row crop farms, specialty crop enterprises such as orchards and vineyards, and small rural communities. Various types of roads and utility infrastructure also have been developed in the area. This type of development continues in present times and likely will continue into the future. A more recent type of development to occur in the area has been wind farms. Examples include the Klondike I and II wind farms, as well as the Condon wind farm.

Due to its rural nature, there is limited current or proposed future development activity in the general project area of the proposed projects. Typical activity includes road construction, housing development, and some commercial and industrial expansion. However, most of the current or future development expected to occur involves wind farms that are already under construction, are approved but not yet constructed, or are proposed and currently undergoing some type of permitting process. Table 4-1 identifies these reasonably foreseeable future actions. Past experience with proposed wind projects has shown that it is likely that not all of these wind farms will ultimately be developed, but full development is nonetheless assumed for purposes of the cumulative impact analyses in this chapter.

No other major projects or actions are known to be underway or planned in Sherman, Wasco, Gilliam, and Klickitat (Washington) counties (Mcnab, 2006b; Baird, 2006; Anderson, 2006; Dreyer, 2006; Deal, 2006).

In Morrow County, Oregon, proposed development other than wind farms includes a 1,500-acre NASCAR facility proposed for north-central Morrow County near Tower Road; a new potato processing facility; a 120-acre methane digester to burn methane and produce 10 MW of electricity; and two new ethanol plants (McLane, 2006).

Table 4-1 Existing, Planned and Reasonably Foreseeable Wind Projects in the Project Vicinity

Wind Projects		
Regional Projects	**MW**	**Oregon County (unless noted)**
Seven Mile Hill	70	Wasco
Windy Point	250	Klickitat, Washington
Klondike I	24	Sherman
Klondike II	75	Sherman
Klondike III	300	Sherman
Biglow Canyon	400	Sherman
Oregon Trail	15	Sherman
Goodnoe Hills	150	Klickitat, Washington
Big Horn	200	Klickitat, Washington
White Creek	200	Klickitat, Washington
Condon	50	Gilliam
Leaning Juniper	200	Gilliam
Arlington CEP	100	Gilliam
Orion South	200	Sherman
Shepherds Flat	750	Gilliam and Morrow
Willow Creek	150	Gilliam and Morrow
Total	**3,134**	

4.1 Land Use

4.1.1 Impact Levels

Impacts would be considered **high** where actions would:

- Involve acquisition of new land or land easements for facilities that would preclude existing or planned use of land in an area not previously directly affected by the presence of utility facilities.
- Convert active and productive farmlands to a non-farm land use in excess of 3 percent of agricultural land in the county.
- Displace residents by causing in excess of five homes to be removed.

Impacts would be considered **moderate** where actions would:

- Involve acquisition of new land or land easements for facilities that would preclude existing or planned use of land in an area already affected by the presence of utility facilities.
- Adversely affect existing farmlands from 2 to 3 percent of agricultural lands county-wide.
- Displace some households (five or less) and residents who choose to move because of land use changes.

Impacts would be considered **low** where actions would:

- Involve acquisition of new land or land easements for utility facilities that would result in an adjustment of established or planned use of land.
- Convert active and productive farmlands to non-farm use in less than 1 percent of the agricultural lands within the county.
- Create short-term disturbances (such as crop damage during construction), but still allow the continued use of the land according to existing farm practices.
- Displace no residents.

No impact would occur when land uses would not change.

4.1.2 BPA Proposed Action

4.1.2.1 Impacts

The Proposed Action would be located entirely within land zoned F-1 (Exclusive Farm Use). BPA would acquire 125-foot wide easements to build, operate and maintain the transmission line from the proposed John Day 230-kV Substation to PPM's existing Klondike Schoolhouse Substation. BPA would purchase 15 acres in fee for the proposed John Day 230-kV Substation. BPA would also purchase easements for access roads.

Permanent Impacts

The proposed transmission line is about 12 miles long. Transmission line towers would be placed about 900 feet apart, requiring about 71 towers (61 steel tubes, 10 steel lattice). Each steel tube tower would require 225 square feet (15 feet by 15 feet) while each lattice tower would require about 5,000 square feet (about 70 feet by 70 feet) of land per tower. Because steel lattice towers require more land, their use would have a greater adverse impact to farming practices. They are also more expensive to construct. As a result, steel tube towers would be used wherever possible. Steel lattice towers would only be used for angle points or dead ends.

All rock and soil materials used for excavating the area for footings would be later used to backfill the excavated area once the footings are installed. Land within the 125-foot wide easement unaffected by constructing the towers and substation would remain open and available for farming. No residences would be removed or permanently affected by the Proposed Action. Wherever feasible, the transmission lines would be placed along the margins of cultivated areas to reduce the potential for conflict with farm operations. Overall, the towers would permanently affect about 1.5 acres.

Expansion of the John Day Substation would permanently affect about 0.1 acre of land classified as F-1 farmland. This land is not being farmed. The proposed 230-kV John Day Substation would require about 15 acres of F-1 farmland (see Table 4-2).

Table 4-2 Land Use Impacts

Type of Disturbance	BPA Proposed Action	BPA Middle Alternative	BPA No Action Alternative	Klondike III Wind Project	Biglow Canyon Wind Farm
Temporary Impacts (acres)					
Roads/Staging	51.00	52.0	0.00	42.20	106.47
Towers/Turbines	65.19	67.95	0.00	46.90	274.47
Substations/O&M Facilities	0.00	0.00	0.00	8.00	6.00
Total	**116.19**	**119.95**	**0.00**	**97.10**	**386.94**
Permanent Impacts (acres)					
Roads/Staging	0.00	0.00	0.00	46.00	144.15
Towers/Turbines	1.46	1.53	0.00	9.80	14.58
Substations/O&M Facilities	15.10	15.10	0.00	8.00	11.11
Total	**16.56**	**16.63**	**0.00**	**63.80**	**169.84**

No permanent roads would be constructed as part of the Proposed Action.

During the life of the proposed project, BPA would perform routine, periodic maintenance and emergency repairs to the transmission line. Little vegetation maintenance is anticipated because the analysis area is mostly farmed. If necessary, BPA would coordinate with local farmers to reduce the risk of impacts to farming practices along its transmission rights-of-way prior to any vegetation maintenance. Vegetation maintenance is described in Section 2.1.13, Maintenance.

Permanent impacts to land use from the Proposed Action would total about 16.6 acres. This would be a low impact because total acreage taken out of production would account for less than 1 percent of total farmland within Sherman County.

Temporary Impacts

Temporary construction-related impacts would include disturbance to areas surrounding tower and substation construction sites and temporary road construction.

Constructing each tower would disturb an area about 40,000 square feet (200 feet by 200 feet), temporarily affecting about 65.2 acres. This land would be restored to pre-project conditions when construction is completed.

BPA would use the existing road system as much as possible for construction, although temporary access would be necessary for construction at each tower site. Most of the access roads would be within the transmission line ROW. About 50.7 acres would be temporarily disturbed for construction of temporary roads and a staging area (about 10 acres). The location for the staging area would be determined prior to construction and it would likely be located next to a highway or main road, and would only be used prior to and during construction. If construction were to occur during the dry season, little or no gravel would be required for temporary access roads. Any construction access roads needed would be about 14 feet wide and would be removed after construction. Ground disturbed for temporary roads would be restored to its pre-construction condition after construction is completed.

If crop damage were to occur during construction or during periodic maintenance, landowners would be compensated for damaged or lost crops. Access road locations would be coordinated with landowners and ODOT or Sherman County (depending on the road) to the extent practicable, to minimize impacts on traffic, property and existing uses.

In the short term, farm revenues could be adversely affected to the extent that disruptions could cause delays in harvesting, more time needed to move equipment, and interruptions to harvesting patterns. These impacts would be temporary and farmers would be compensated for the loss of revenue from land affected by construction.

Overall, temporary land use impacts from the Proposed Action would total about 116 acres and represent a low impact.

4.1.2.2 Mitigation Measures

BPA would compensate landowners through perpetual easements for the transmission line ROW and access roads, and purchase the land in fee for the substation site. BPA would compensate landowners for any crop damage that occurs during construction, and operation and maintenance.

4.1.3 BPA Middle Alternative

4.1.3.1 Impacts

The Middle Alternative would be about 12.5 miles long and except for the different route, would have similar components to the Proposed Action and similar impacts.

Permanent Impacts

As with the Proposed Action, the Middle Alternative would be entirely located on land zoned F-1 (Exclusive Farm Use) (EFU) and would require a 125-foot wide easement. Transmission line towers would be placed about 1,000 feet apart, which would require about 74 towers (64 steel tube, 10 steel lattice). Overall, construction of the transmission line would permanently affect about 1.5 acres, similar to the Proposed Action. Unlike the Proposed Action, the Middle Alternative would cross some fields and could affect harvesting patterns around the towers, although land within the 125-foot wide easement unaffected by constructing the towers and substations would remain open for farming. No residences would be removed or permanently affected by the Middle Alternative. Wherever feasible, the transmission lines would be placed along the margins of cultivated areas to reduce the potential for conflict with farm operations. Expansion of the John Day Substation would affect about 0.30 acre of F-1 farmland, though this land is not now being farmed. The proposed 230-kV John Day Substation would require about 10 acres of F-1 farmland. The substations would permanently affect about 15 acres, the same as the Proposed Action.

Similar to the Proposed Action, no permanent roads would be constructed.

Permanent impacts to land use from the Middle Alternative would total about 16.6 acres, similar to the Proposed Action. This would be a low impact because total acreage taken out of production would account for less than 1 percent of total farmland within Sherman County.

Temporary Impacts

Constructing each tower would disturb an area about 40,000 square feet (200 feet by 200 feet), temporarily affecting about 68 acres, although this land would be restored to pre-project conditions when construction is completed.

BPA would use the existing road system as much as possible for construction, although temporary access would be necessary for construction at each tower site. About 120 acres of land would be temporarily disturbed for construction of temporary roads and staging areas. As with the Proposed Action, temporary construction-related impacts would include a 10-acre staging area needed for transmission line construction and the stockpiling of materials.

As with the Proposed Action, adverse short-term impacts to farm revenues could occur to the extent that disruptions could cause delays in harvesting, more time could be needed to move equipment and could cause temporary interruptions to harvesting patterns. These impacts would be temporary and farmers would be compensated for the loss of revenue from land affected by construction.

Overall, temporary land use impacts from the Middle Alternative would total about 120 acres, slightly more than the Proposed Action, and represent a low impact.

4.1.3.2 Mitigation Measures

BPA would compensate landowners through perpetual easements for the transmission line ROW and access roads, and purchase the land in fee for the substation site. BPA would compensate landowners for any crop damage that occurs during construction, and operation and maintenance.

4.1.4 BPA No Action Alternative

The No Action Alternative would have no impact to land use because no new substation, substation expansion or transmission line would be constructed. Existing land uses would remain the same as today.

4.1.5 Klondike III Wind Project

4.1.5.1 Impacts

Permanent Impacts

Permanent land use impacts would consist of replacing farmed land with the utility use (including roads to access the turbine strings) and forced changes in harvesting patterns to avoid the turbine strings. If the turbine strings are long and would bisect a parcel, they would convert the site into two parcels for farming practices, primarily for moving and manipulating equipment and vehicles to, across, and around the property. The project would require about 64 acres of land to be permanently removed from farm use (see Table 4-2). About 129,000 acres are farmed within Sherman County area, so the amount permanently removed from production would be less than 0.1 percent. Permanent impacts from the Klondike III Wind Project would have a low impact to land use.

Temporary Impacts

Temporary impacts would consist of delays in access to roads or property by construction traffic and temporary displacement of crops by construction activities. Several local roads currently used by farm owners or operators would be improved, which would cause temporary delays, but when completed would improve the functionality of the roads for transporting farm equipment and vehicles. Roadway improvement would be completed on Gosson, Sandon, Smith, and local roads within the analysis area. Construction-related delays could occur on Emigrant Springs, Rayburn, Webfoot, McDonald Ferry, and Dehler roads. The proposed facility would slightly increase traffic volumes from trips by operational staff, but would not cause a reduction in LOS, therefore no effect would occur. About 97 acres of farmland would be temporarily affected by construction, a low impact (DEA 2005) (see Table 4-2).

4.1.5.2 Mitigation Measures

PPM Energy would compensate affected landowners through long-term leases for construction and operation of the wind power facilities.

4.1.6 Biglow Canyon Wind Farm

4.1.6.1 Impacts

Permanent Impacts

The project would be co-located and compatible with existing and ongoing agricultural activities. The land adjacent to the sites where the turbines, access roads, and construction areas would be located is devoted to the production of wheat and barley crops. Although the presence of the turbine pads and turbines would have an impact on the use of adjacent land, the Biglow Canyon Wind Farm would not seriously interfere with farm practices. The proposed facility would be located on land tracts where its footprint is small in comparison to the total farmed acreage in the tract and thus there is negligible likelihood that the facility would change the pattern of land use by causing certain tracts to go out of farm use. The Biglow Canyon Wind Farm would have a low impact to farm uses. Where necessary, roads would be improved to accommodate construction equipment. Permanent road improvements would benefit the local transportation system.

The project would require that about 170 acres be permanently removed from farm use (CH2MHill, 2005). This would account for less than 0.1 percent of existing acreage in barley and wheat production. The Biglow Canyon Wind Farm would have a low impact to land uses.

Temporary Impacts

Temporary construction-related impacts would be similar to those described for Klondike III, but would affect about 387 acres. Temporary impacts would be low.

4.1.6.2 Mitigation Measures

Orion Energy would compensate affected landowners through long-term leases for construction and operation of the wind power facilities.

4.1.7 Cumulative Impacts

Although potential land use impacts from BPA's Proposed Action and the wind projects would be low, these impacts would contribute incrementally to land use impacts that are already occurring due to present development and activities in the project vicinity, combined with impacts that could occur from the reasonably foreseeable future developments planned in the vicinity. BPA's Proposed Action and the wind projects would contribute to the cumulative conversion of undeveloped land to developed land in the area. Given the relatively small number of current and proposed cumulative projects that are dispersed over a large area, these projects are not expected to result in a significant change in land use in the area.

Most of the land in the project vicinity is zoned for agricultural use. Changes in the types of agricultural use would not create cumulative impacts to land use, but changes from agricultural to nonagricultural uses would take agricultural land out of production. The limited development that is expected in the project vicinity in the near future would not likely create negative cumulative impacts due to the large amount of agricultural land in the area.

Although the current and reasonably foreseeable cumulative wind projects in the project vicinity could convert agricultural land to non-agricultural uses, cumulative land use impacts from these projects would likely be low, because such projects typically do not require a large amount of farm land and allow farming activities to continue. Cumulative impacts would only be expected if nonagricultural development occurred rapidly over the next several years.

4.2 Transportation Facilities

4.2.1 Impact Levels

Impacts would be considered **high** where actions would:

- Preclude future expansion or realignment of the local transportation system.
- Cause permanent traffic increases, or disruption or rerouting of a transportation facility such that major transportation system upgrades would be required.

Impacts would be considered **moderate** where actions would:

- Create long-term disruption of traffic, or increases in traffic such that existing systems would need to be upgraded.

- Create short-term traffic disruptions so that the existing transportation systems could not carry the increased traffic and traffic flow is delayed.

Impacts would be considered **low** where actions would:

- Create short-term traffic disruptions where existing transportation systems could carry the increased traffic temporarily.

No impact would occur if the new facilities would be placed a sufficient distance from the transportation system so that future planned expansion would not be affected, no transportation system upgrades would be required, and any increases in traffic and/or traffic disruptions are short-term and temporary.

4.2.2 BPA Proposed Action

4.2.2.1 Impacts

The BPA Proposed Action would have no long-term impact to the local or regional transportation system. No transmission or substation facilities (including the future substation) would be placed within existing road rights-of-way. Construction equipment and supply vehicles would use the existing state highway system and county roads to reach the construction area. While portions of the transmission line would be next to North Klondike and Herrin roads, the transmission line would be outside of existing road ROW and would not hinder any future expansion of the road. As with the wind projects, some road improvements may be necessary to accommodate construction-related equipment or to repair sections of road damaged by heavy equipment and construction-related traffic. During construction, temporary, short-term disruption to traffic could occur, although the level of the impact is anticipated to be low because of existing low traffic volumes within the analysis area. Disruption of existing traffic patterns would likely be caused by construction traffic entering and leaving county roads to access construction areas.

All project construction would occur on BPA-owned property for the substations or on private property with ROW easements for the proposed transmission line. During operation, the Proposed Action would not increase existing traffic levels because no additional staff is anticipated to be needed to maintain the new transmission line, substations or expansion of the existing John Day Substation.

BPA would use the existing road system as much as possible for construction, although temporary access from the existing road system to the construction site would be needed to construct each structure located within the proposed easement for the transmission lines. Access roads from county roads to construction areas would be about 14 feet wide, would be temporary, and would be removed after construction. If construction were scheduled during the dry season, little or no rock would be necessary for temporary access roads.

Ground disturbed for temporary roads would be restored to its pre-construction condition after the transmission line is built. If crop damage were to occur or farmland be removed from production during construction or maintenance, landowners would be compensated for lost revenue. Access roads, where needed, would be constructed in locations with the most direct route and shortest distance from the public ROW to the construction site to minimize impacts to farmland. Temporary road construction would be coordinated with landowners, to the extent practical, to minimize impacts on property.

4.2.2.2 Mitigation Measures

When construction of the transmission line and substations is completed, the contractor responsible for construction would remove temporary access roads and staging areas used to access tower construction sites. The contractor would rehabilitate areas temporarily affected by construction to pre-construction conditions.

Roadways used for transporting equipment and materials to the project site would be inspected by Sherman County and BPA prior to beginning construction, to identify any potential safety concerns, such as large potholes or inadequate pavement conditions. During construction, transport routes would be periodically inspected by the County and BPA to determine if construction-related traffic is having an adverse impact on the roadway.

4.2.3 Middle Alternative

4.2.3.1 Impacts

The Middle Alternative would have similar impacts to the state and county road system as the Proposed Action.

4.2.3.2 Mitigation Measures

Mitigation measures would be the same as for the Proposed Action.

4.2.4 BPA No Action Alternative

Under the No Action Alternative, no impacts to the transportation system would occur and road improvements proposed by the wind power projects would not be completed. Roads would remain as they are today.

4.2.5 Klondike III Wind Project

4.2.5.1 Impacts

The proposed Klondike III Wind Project would be constructed on private property and would not interfere with any future improvement to the local transportation system.

Traffic related to the operation of the proposed Klondike III Wind Project would have little impact to the existing or projected LOS on the state highway or local transportation system. All transportation routes within the County are projected to operate with LOS A or B in 2019 (TSP planning horizon, see Section 3.2, Transportation) even during summer when traffic volumes are highest. Given that 15 to 20 employees would work at the facility, the increase in the number of trips on the road system would be minimal and would not affect the operation of the roadway system (DEA, 2005).

Construction-related traffic is anticipated to take I-84 to US 97 (at Biggs Junction) to the US 97/OR 206, then OR 206 to Wasco. Construction traffic could also approach the site from the south on US 97. Both US 97 and OR 206 are two-lane paved highways with poor to fair pavement condition. From Wasco, construction-related traffic would use a series of county roads to access private land where the construction staging areas and turbine strings would be located. Local roads are generally gravel rural roadways with little traffic other than local residential and farm traffic. Local roads that would be used include: Wasco Lane, North Klondike Road, Emigrant Springs Road, Rayburn Road, Dehler Lane, Dormaier Road, McDonald Ferry Lane, Gosson Lane, Egypt Road, and Smith Road. An unnamed road connecting Gosson Lane and Dormaier Road would also be used.

No physical impact is anticipated to occur on highways (I-84, US 97, and OR 206) because all are constructed to accommodate the heavy loads of trucks (estimated at up to 80,000 lbs) that would deliver the turbine components and other construction materials. Some of the local roadways would require improvements, which would generally be a 6-inch gravel layer placed on top of the existing road prior to project construction to accommodate the length and weight of vehicles that would deliver the turbine pieces and machinery necessary for construction. Large sections of local roads in poor condition would be completely reconstructed. Reconstructed roadways would be improved to accommodate two 8-foot travel lanes and would be constructed with 8 inches of crushed aggregate on top of a geotextile separation fabric (DEA, 2005). All improvements on local roads would be constructed within the public right-of-way. During roadway improvements or reconstruction, some short-term delays would likely occur. The proposed improvements would have a beneficial impact to the Sherman County Road Maintenance Department because it would not have to pay for the improved roads, although long-term maintenance would still be the County’s responsibility.

Construction-related traffic could have a low impact by causing short-term traffic delays when trucks deliver construction-related equipment and the turbines, but those delays would be temporary and are not anticipated to have an adverse impact on highways in the analysis area. Construction-related traffic delays on local roadways could occur but are anticipated to be limited due to low use of these local roadways. Several local roadways would be improved or completely reconstructed to accommodate construction-related traffic. Many of the existing local roads are in poor condition; the proposed improvements would have a beneficial long-term impact by improving the quality of the road for all users.

4.2.5.2 Mitigation Measures

When construction of the project facilities is completed, the contractor(s) responsible for construction would remove temporary access roads and staging/laydown areas used to access construction sites. The contractor(s) would rehabilitate areas temporarily affected by construction to pre-construction conditions.

Roadways used for transporting equipment and materials to the project site would be inspected by Sherman County and PPM Energy prior to beginning construction, to identify any potential safety concerns, such as large potholes or inadequate pavement conditions. During construction, transport routes would be periodically inspected by the County and PPM Energy to determine if construction-related traffic is having an adverse impact on the roadways. If inspections indicate damage from construction-related traffic, PPM Energy would be responsible for making the necessary improvements.

4.2.6 Biglow Canyon Wind Farm

4.2.6.1 Impacts

The proposed Biglow Canyon Wind Farm would be constructed on private property and would not interfere with any future improvement to the local transportation system.

As with the proposed Klondike III Wind Project, traffic related to the operation of the proposed Biglow Canyon Wind Farm would have no impact to the existing or projected LOS on the state highway or local transportation system. All transportation routes within the county currently operate at LOS A or B and are projected to maintain that high level of service, even during the summer. Given that only 15 to 20 employees would work at the facility, the increase in the number of trips on the road system would be minimal and would not affect the LOS of the roadway system (CH2MHill, 2005).

The primary route for construction-related traffic would carry the majority of heavy-duty and light-duty delivery vehicles as well as workforce traffic. The route would begin from either eastbound or westbound I-84, and continue south on US 97 (from Biggs Junction) to Wasco. From Wasco, construction-related traffic would travel east and then southeast on OR 206 before heading due east on either Klondike Road or Hilderbrand Lane. Vehicles would then progress north on North Klondike Road to various county roads to access individual turbine string roads. County roads used for construction access would include sections of Medler Lane, Emigrant Springs Road, Oehman Road, Biglow Road, Beacon Road, and Herrin Lane. It is assumed that all improvements on local roads would be constructed within the public right-of-way.

No physical impact is anticipated to occur to the state highway system. As with Klondike III, county and local roadways would likely require some improvement before construction would begin, including regrading and in some cases reconstructing county roadways to accommodate construction and delivery equipment (CH2MHill, 2005). During any roadway improvements or reconstruction, some short-term delays would likely occur. Any road improvements would be a beneficial impact to the County as improvements would remain in place after construction, though maintenance of the road would still be the County's responsibility.

Construction-related traffic would have a temporary low level of impact to state and county roadways from traffic increases as construction vehicles access the site. Because of the rural nature of the area, roadways currently accommodate very few trips and all routes in the county operate at LOS A. Additional construction traffic would temporarily increase the volume of vehicles on the roadway, but not to the point where traffic flow would be delayed.

4.2.6.2 Mitigation Measures

After construction of the project facilities, the contractor(s) responsible for construction would remove temporary access roads and staging/laydown areas used to access construction sites. The contractor(s) would rehabilitate areas temporarily affected by construction to pre-construction conditions.

Roadways used for transporting equipment and materials to the project site would be inspected by Sherman County and Orion Energy prior to beginning construction, to identify any potential safety concerns, such as large potholes or inadequate pavement conditions. During construction, transport routes would be periodically inspected by the County and Orion Energy to determine if construction-related traffic is having and adverse impact on the roadway. If inspections indicate damage from construction-related traffic, Orion Energy would be responsible for making the necessary improvements.

4.2.7 Cumulative Impacts

Construction, operations and maintenance of the proposed transmission facilities and wind projects and the projects listed in Table 4-1 have had or are expected to have a low impact on regional and local roads. The Biglow Canyon Wind Farm and Klondike Wind Project Phases I, II, and III) would employ 40 to 50 (15 to 20 people each at Biglow Canyon Wind Farm and Klondike III Wind Project, eight to 10 at Klondike I and II), generating about 100 daily trips on local county roads. Other wind projects would also add a small number of trips from employees, but given the small amount of existing and projected traffic in the county, additional trips generated by staff of all proposed projects would not negatively affect the LOS of existing roads in Sherman County.

A short-term cumulative impact could potentially occur if several projects were constructed at the same time. Truck traffic could increase on highways, but capacity along local and state roads would be adequate to accommodate the increased trips, and it is unlikely levels of safety or service on any major highways would be affected. Some short-term traffic delays could occur. No delays are anticipated after construction.

Construction of the proposed Klondike III and Biglow Canyon wind projects would have a cumulative beneficial impact to the local transportation system. Prior to constructing the facilities, several roads would need to be improved to accommodate construction vehicles for both projects. Road improvements would remain in place after wind power facilities are completed that would be used by local residents, and for moving farm equipment. Improving these roads would be a beneficial impact to Sherman County because the cost of roadway improvements would be paid for by the wind power facilities and improvements would remain in place after construction.

4.3 Recreation

4.3.1 Impact Levels

Impacts would be considered **high** where actions would:

- Preclude existing or planned ***dispersed recreational*** uses after construction;
- Alter or eliminate dedicated recreational activities after construction;
- Permanently negatively affect the recreational experience, of either a dedicated or dispersed recreational use, e.g., if a facility next to a hiking trail changed the rural hiking experience, or lights from wind turbines obliterated the night sky for astronomy clubs.

Impacts would be considered **moderate** where actions would:

- Temporarily preclude or limit dispersed or dedicated recreational uses during peak-use periods during construction;
- Temporarily affect the recreational experience, of either a dedicated or dispersed recreational use during peak-use periods, e.g., if a facility next to a hiking trail changed the rural hiking experience.

Impacts would be considered **low** where actions would:

- Temporarily preclude or limit dispersed or dedicated recreational uses during off-peak use during construction;
- Require minor relocation of dispersed recreational activities to an equal or better location after construction.
- Temporarily affect the recreational experience during off-peak use, of either a dedicated or dispersed recreational use, e.g., if a facility next to a hiking trail changed the rural hiking experience.

No impact would occur to recreation areas if there were no effect on the location or experience of recreational uses during or after construction.

4.3.2 BPA Action Alternatives, Klondike III Wind Project, and Biglow Canyon Wind Farm

4.3.2.1 Impacts

None of the recreational facilities described in Section 3.3 would be removed or relocated and no recreational activities would be precluded as a result of the proposed project. Likewise, there would be no impact to hunting on private land. However, visual impacts to recreational resources could occur, particularly in areas where the landscape is relatively flat and views are unobstructed by trees or natural features. Impacts to visual resources are also addressed in Section 4.8, Visual Resources.

Temporary, construction-related impacts such as short-term traffic delays on US 97 and local roads could affect access to recreational opportunities, although impacts to recreational uses are expected to be low because motorists could use existing passing lanes on US 97 to pass large, slower moving construction-related equipment. Short-term traffic delays would have no impact on the availability of recreation amenities. Local road improvements (see Section 4.2, Transportation Facilities) would enhance portions of the access route to the John Day River via McDonald Ferry Lane, and thus have some positive impact on ability to access the river. Visitor interest in the proposed wind farms could augment visits to existing recreational opportunities.

John Day River

The BLM manages the John Day River Corridor. BPA's action alternatives would be constructed on private land and BPA land (substation) and would not be under BLM jurisdiction. There would be no direct loss of recreational opportunity. Impacts to the John Day River would occur in isolated areas (up to about river mile 17) where turbines would be visible. BLM classifies all wild and scenic river segments as VRM Class II in which "management activities resulting in changes to the existing character of the landscape may be allowed, provided they do not attract the attention of the casual observer." Generally, where views would be altered, it would occur in limited areas and would have little effect on recreation activities. Few turbines or turbine blades would be visible from any single location. To the extent the turbines would be visible, they would be subordinate in view because portions of views of the John Day Canyon are already obstructed by existing transmission lines (DEA, 2006c; CH2MHill, 2005). The slight modification of views from the John Day River corridor would have no impact on the recreational experience in that area.

Above the river, portions of the proposed wind projects would be visible from some locations along the upper portions of the canyon walls. Because recreation access to the rim and canyon walls is very limited, towers would have no impact on the recreational experience.

Journey Through Time Scenic Byway

There would be no direct loss of recreational opportunity as a result of the proposed transmission line and wind projects. Temporary, construction-related impacts could occur to the Byway from increased traffic, but they would be of limited duration.

While portions of the proposed wind projects and transmission line would be visible from the Journey Through Time Scenic Byway, the proposed project would be compatible with the goals stated in the Journey Through Time Management Plans because it would do the following: 1) create jobs, 2) maintain rural lifestyles, 3) protect important values (i.e., historical attractions and artifacts), and 4) build identity for the North Central Region of Oregon (DEA, 2005). There are no scenic overlooks or vista points along the segment of highway near the proposed projects. BPA's action alternatives would have no impact because their effects do not meet the criteria for high, moderate, or low impacts, although turbines and transmission lines would be intermittently visible from the Byway. The action alternatives would not preclude the use of the road as a recreational amenity. The alternatives would also only be visible in limited areas because existing topography would screen much of the proposed project. Views of the turbine strings could have a beneficial recreation impact by attracting motorists to view the area.

Historic Oregon Trail and Barlow Road Cutoff Trail Alignments

The proposed transmission line, substations and wind projects would not be visible from the BLM Oregon Trail Interpretive Site near McDonald Ferry so there would be no visual impact to that recreational site. The project would be visible from many points along the historic Oregon Trail alignment, but not from known, accessible, intact segments.

There would be no direct or indirect loss of a recreational opportunity related to the Oregon Trail as a result of the proposed projects. All development would occur on private property on which no intact trail segments have been identified. Further, the project would not affect existing locations where the historic trail alignments cross county roads, nor would turbines be constructed over the historic alignments. Access roads would cross the historic alignments in a few locations, but would not impact intact segments because none exist at the proposed access road crossings.

4.3.2.2 Mitigation Measures

Because there are no identified recreational resources directly affected, no mitigation measures are proposed. Impacts related to visual resources of the proposed projects are described in Section 4.8.

4.3.3 BPA No Action Alternative

Under the No Action Alternative, no new substation, substation expansion or transmission line would be constructed; therefore, no impacts to recreation would occur.

4.3.4 Cumulative Impacts

Cumulative impacts to recreational resources would be primarily visual impacts and are addressed in Section 4.8.8. None of the cumulative projects are known to be proposed within identified recreational areas or resources in the project vicinity, so direct loss of recreational opportunities is not expected. It is expected that the cumulative effects to the dispersed recreation that occurs in the area such as hunting, fishing, etc., would be low because this type of recreation could continue after development.

4.4 Geology and Soils

4.4.1 Impact Levels

Impacts would be considered **high** where actions would:

- Require road or facility construction or clearing on sites that are prone to mass movement or have very high susceptibility to erosion.
- Occur on soils with soil properties so unfavorable or difficult that standard mitigation measures, including revegetation, would be ineffective.
- Cause long-term impacts from accelerated erosion, sedimentation, or disruption of unstable soils.

Impacts would be considered **moderate** where actions would:

- Create impacts that are primarily short term, with an increase in normal erosion rates for a few years following soil disturbance until erosion and drainage controls become effective.

Impacts would be considered **low** where actions would:

- Require road and facility construction on soils with low to moderate erosion hazard, and where the potential for successful mitigation would be good using standard erosion and runoff control practices.
- Occur where erosion levels could be held near normal during and following construction.

No impact would occur where soils remain unchanged and no erosion occurs.

4.4.2 BPA Action Alternatives

4.4.2.1 Impacts

Soils and geologic conditions are similar for the Proposed Action and Middle Alternative.

Geologic conditions along the proposed routes and at the proposed substation and substation expansion are relatively stable and suitable for the proposed activities. The alternatives would not affect geologic conditions and would have the same potential for exposure to geological hazards. Exposure would be low to none.

Most of the project site consists of agricultural fields where bare soils are often exposed to wind and water. Based on the soil types present, soil erosion potential ranges from highly erodible to not highly erodible (MacDonald et al., 1999). However, because the project would not appreciably increase the amount of exposed soils, impacts would be low. The land along the proposed routes is primarily plowed cropland, and to a lesser extent, other vegetation.

Permanent impacts would involve the removal of soil from about 16.6 acres of land for the Proposed Action and a similar amount for the Middle Alternative. Because the soil types to be removed are common throughout the analysis area, the removal of this small area of soil would be a low impact for either alternative.

Temporary impacts would include disturbance of about 116 acres of soil for the Proposed Action and about 120 acres of soil for the Middle Alternative. Temporary soil disturbance would occur during construction of the transmission towers, staging area, temporary access roads, and substation construction. Establishing the staging area would involve stripping and temporarily stockpiling the topsoil before placing gravel on the laydown areas. BPA would try to minimize the need for such disturbance by finding areas already graveled or paved if possible. Because stockpiling would occur during the time of year when rainfall is lowest, very little erosion would result from precipitation. After the staging area is no longer needed, the site would be brought back to its original contours, topsoil would be spread on the site, and normal cropping or revegetation would occur.

While the project would use existing roads to the extent practical, temporary access roads would be needed. These roads would be 14 feet wide. Specific locations of temporary access roads have not been determined and would be coordinated with landowners to minimize impacts. As needed, water trucks would be used to keep wind erosion losses to a minimum. Any disturbed CRP and other non-cropped vegetated areas would be ***revegetated*** with appropriate species. Construction would require the use of heavy equipment and haul trucks to deliver aggregate, water, and other materials. The repeated traffic of heavy machinery could cause localized soil compaction. To minimize compaction, truck traffic would be limited to designated existing and improved road surfaces, whenever feasible. Any compacted soils outside of the permanent project footprint would be restored.

Erosion control ***best management practices*** (BMPs) would be used to manage wind and water erosion. Areas of temporary disturbance would be revegetated as appropriate. The BPA action alternatives would result in a low impact to soils because erosion control measures are expected to keep erosion levels near normal during and after construction.

Overall temporary impacts to soils would be similar to impacts resulting from existing farm uses (e.g., regular disturbance from crop production). All soils temporarily disturbed by construction would be returned to pre-construction contours and condition. Therefore, temporary impacts to soils are expected to be low.

4.4.2.2 Mitigation Measures

Because impacts would be low and appropriate erosion control measures are included in the Proposed Action, additional mitigation measures are not proposed.

4.4.3 Klondike III and Biglow Canyon Wind Projects

4.4.3.1 Impacts

Geologic and soil conditions are similar to those described for the BPA action alternatives. Permanent impacts would include removing soil from about 234 acres of land (about 64 acres from Klondike III and about 170 acres from Biglow Canyon). The potential for exposure to geological hazards would be low. Topsoil removed for construction of project facilities would likely be applied to surrounding agricultural fields. Because the soil types to be removed are common throughout the project area, the removal of this small area of soil would be a low impact.

Temporary impacts would result from activities such as road construction (with associated underground collector system) and turbine pad construction, which may require the removal of surface vegetation, and expose soils. Turbine pad areas would be covered with non-erosive material, such as gravel or concrete, immediately following exposure, thereby limiting the time for wind or water erosion to soils stockpiled from turbine pad excavation.

Temporary impacts would occur with creation of staging areas and excavation for underground collector cables not associated with roads. Staging areas would be constructed in a similar fashion as for the BPA action alternatives. BMPs would be used to minimize the impacts of wind erosion. In actively cropped areas, the wheat crop would protect the stockpiles from wind erosion. In other areas, hay bales or others similar containment would be provided. As needed, water trucks would be used to keep wind erosion losses to a minimum. After construction, the staging areas would no longer be needed, the sites would be brought back to their original contours, topsoil would be spread on the site, and normal cropping or revegetation would occur. Any disturbed CRP areas and other non-cropped vegetated areas would be revegetated with the appropriate species. In addition to revegetation, BMPs would likely include the use of silt fences, straw bales, watering, check dams, and other similar erosion control methods.

Construction would require the use of heavy equipment and haul trucks to deliver aggregate, cement, water, and other materials. The repeated traffic of heavy machinery could cause localized soil compaction. To minimize compaction, truck traffic would be limited to designated existing and improved road surfaces, whenever feasible. Any compacted soils outside of the permanent project footprint would be restored.

No soil impacts would be expected from chemicals during construction, operation, or retirement. There would be minimal amounts of chemicals used at the facility sites such as lubricating oils and cleaners for the turbines and pesticides for weed control. Chemicals would be stored on site according to all applicable requirements and regulations to limit the risk of adverse effects. The risk of a chemical spill is negligible, and the impacts of any such spill would be limited due to the small amounts of chemicals that would be transported to the facility sites.

Temporary impacts would disturb about 484 acres (about 97 acres from Klondike III and about 387 acres from Biglow Canyon). An additional 173 acres would be temporarily disturbed by activities that may be needed for habitat enhancement mitigation.

4.4.3.2 Mitigation Measures

Construction of all features of the project would be in compliance with an erosion control plan and National Pollutant Discharge Elimination System (NPDES) 1200-C construction permit that would require BMPs to minimize possible impacts from erosion. Erosion control measures that would be installed during work on the access roads, staging areas, and turbine sites would include the following:

- Not removing vegetation unless absolutely necessary and not removing existing vegetation any sooner than would be absolutely necessary.
- Maintaining vegetative buffer strips between the areas impacted by construction activities and any receiving waters.
- Installing sediment fence/straw bale barriers to filter sediments prior to reaching adjacent resources.
- Surfacing the areas with gravel or other non-erodible surface as quickly as possible.
- Planting designated seed mixes at impacted areas adjacent to the roads.
- Watering roads and exposed soils in dry weather when wind exposure may cause erosion.

All non-agricultural areas that are impacted by the construction would be seeded when there would be adequate soil moisture. Sediment fences, straw bale barriers, and other erosion control measures would remain in place until the impacted areas are revegetated and the risk of erosion has been eliminated.

To the extent possible, haul truck traffic would be limited to improved road surfaces, limiting soil compaction and disturbances. Proper erosion control methods would be employed to limit soil loss due to water and wind action, and all areas of temporary disturbance would be reclaimed at the end of construction activities.

4.4.4 No Action Alternative

Under the No Action Alternative, no new wind power generation or transmission facilities would be built. No new impacts to soil or geologic resources would occur.

4.4.5 Cumulative Impacts

Soil loss through both wind and water erosion has occurred throughout the project vicinity as a result of past and present development. Practices creating soil losses include road construction, and other development, expansion of towns and cities, and the conversion of native lands to crops and grazing lands. The proposed projects would incrementally increase the potential for soil erosion in the analysis area.

Cumulative impacts include the permanent conversion of soils to energy generation, transmission, and substation facilities and appurtenances (e.g., O&M facilities meteorological towers, access roads). Other development could result in additional soil conversion within the region.

4.5 Water Resources

4.5.1 Floodplain Impact Levels

No impacts to floodplains are anticipated, as none are mapped within the project study area.

4.5.2 Groundwater Resources Impact Levels

No impacts to groundwater resources are anticipated. The proposed project would not appreciably affect the ability for precipitation to infiltrate and recharge local and regional aquifers. Runoff from any new impervious surfaces would be shed to adjacent undeveloped pervious areas where it would be allowed to percolate into soils.

4.5.3 Wetlands and Surface Water Resources Impact Levels

Impacts would be considered **high** where actions would:

- Permanently alter wetland hydrology, vegetation, and/or soils by excavation or fill, where the ecological integrity of a wetland was impaired; or
- Completely fill a wetland or destroy a wetland function.

Impacts would be considered **moderate** where actions would:

- Partially fill a wetland or degrade a wetland function to the point where recovery would require restoration and monitoring.

Impacts would be considered **low** where actions would:

- Change vegetation or soils for the short term but would not change hydrology; or
- Cause a short-term disruption of a wetland function.

No impact would occur if the action avoids wetlands and their buffers and would not affect wetland functions.

4.5.4 BPA Proposed Action

4.5.4.1 Impacts

The BPA Proposed Action is located far from any of the wetlands identified in the analysis area, therefore no impacts to wetlands would occur. The three jurisdictional drainages (Drainages A, B and C) crossed by the Proposed Action would be spanned, and no access roads would be constructed across them (see Table 4-3). No impacts to surface waters would result from the project.

Table 4-3 Summary of Impacts to Wetlands and Surface Waters

Water Resource	Project Area	Proposed Action	Impact Level
Wetland W1	Biglow Canyon	Avoided	None
Wetland W2	Klondike III	Avoided	None
Drainage A	BPA Proposed Action	Spanned, no access roads	None
Drainage B	BPA Proposed Action	Spanned, no access roads	Low
Drainage C	BPA Proposed Action	Spanned, no access roads	Low
Drainage D	Middle Alternative	Spanned, no access roads	None
Drainage E	Middle Alternative	Spanned, no access roads	None
Drainage F	Middle Alternative	Spanned, no access roads	None

4.5.4.2 Mitigation Measures

Since no impacts to wetlands or surface waters would result from construction of the BPA Proposed Action, no mitigation would be necessary to compensate for project activities.

4.5.5 Middle Alternative

4.5.5.1 Impacts

The Middle Alternative is located far from any of the wetlands identified in the analysis area, therefore no impacts to wetlands would occur. The three jurisdictional drainages (Drainage D, E, and F) crossed by the Middle Alternative would be spanned, and no access roads would be constructed across them (see Table 4-3). No impacts to surface waters would result from the project.

4.5.5.2 Mitigation Measures

Since no impacts to wetlands or surface waters would result from construction of the Middle Alternative, no mitigation would be necessary to compensate for project activities.

4.5.6 Klondike III Wind Project

4.5.6.1 Impacts

No impacts to wetlands or other waters of the state and US are anticipated as a result of this proposed project (DEA, 2005). The one wetland identified within the site boundary (W2) would be avoided through appropriate siting and construction techniques. No impacts to wetlands or surface waters are expected.

4.5.6.2 Mitigation

Since no impacts to wetlands or surface waters would result from construction of the Klondike III Wind Project, no mitigation would be necessary to compensate for project activities.

4.5.7 Biglow Canyon Wind Farm

4.5.7.1 Impacts

Only one wetland was identified in the Biglow Canyon analysis area (W1) and it would not be affected because the collector system would be located to avoid any impacts to that resource (i.e., no impact). Impacts to wetlands and surface water would be limited to minor disturbance of non-jurisdictional drainages, a low impact.

4.5.7.2 Mitigation Measures

Since no impacts to wetlands or surface waters would result from construction of the Biglow Canyon Wind Farm, no mitigation would be necessary to compensate for project activities.

4.5.8 No Action Alternative

No new impacts to wetlands or surface waters would occur under the No Action Alternative.

4.5.9 Cumulative Impacts

Wetland and water resources have been impacted in the region because of past and current development and agricultural operations. Future development activities could result in the further degradation and reduction of wetlands and water resources in the region.

Most of the project wetland analysis area has been previously disturbed by human activities. No impacts to jurisdictional wetlands or waters are anticipated from the BPA transmission line and substation, Klondike III Wind Project or the Biglow Canyon Wind Farm, and the proposed actions would not contribute to cumulative impacts to water resources.

4.6 Fish and Wildlife

The analysis area contains no habitat for fish species. Only intermittent streams are present in the analysis area (see Section 3.6.2.6). Fish and fish habitat are not discussed further in this section.

4.6.1 Wildlife Impact Levels

Impacts would be considered **high** where actions would:

- Create a short- or long-term adverse effect on a species ***federally listed*** as threatened or endangered that could not be mitigated; or
- Create a short or long-term adverse effect on a state-listed species, other rare or declining species or species with high public profiles, values or appeal that could not be mitigated; or
- Create a long-term reduction in the quality or quantity or regional wildlife habitats.

Impacts would be considered **moderate** where actions would:

- Create a short or long-term adverse effect on a species federally listed as threatened or endangered that could be partially mitigated; or
- Create a long-term adverse effect on a state-listed species, other rare or declining species or species with high public profiles, values or appeal that could be partially mitigated; or
- Cause a short-term reduction in the quality or quantity of regional wildlife habitats; or
- Harm or kill individuals of a wildlife species, but not contribute to a reduction in the viability of regional populations.
- Temporarily disturb common wildlife species during critical life stages (e.g., breeding, rearing or roosting).

Impacts would be considered **low** where actions would:

- Create a short- or long-term adverse effect on a species federally listed as threatened or endangered that could be fully mitigated; or

- Create a short- or long-term adverse effect on a state-listed species, other rare or declining species or species with high public profiles, values or appeal that could be fully mitigated; or
- Cause a temporary reduction in the quality or quantity of regional wildlife habitats; or
- Harm or kill isolated individuals of a wildlife species, which would not contribute to a reduction in the viability of local populations.
- Temporarily disturb common wildlife species during non-critical life stages.

No impact would occur when an action would have no effect on wildlife habitat, populations, or individuals.

4.6.2 BPA Proposed Action

4.6.2.1 Impacts

Undeveloped habitats in the analysis area would be spanned by structures or avoided by alignment placement, and no direct impacts to species listed as threatened or endangered under the ESA or by the State of Oregon are anticipated. Bald eagles and peregrine falcons may be present near the analysis area, especially at the northern end near the Columbia River. However, modern transmission line structures are common in bald eagle and peregrine falcon habitat and are only rarely, if at all, implicated in causes of mortality for these species. Therefore, no impact to bald eagles and peregrine falcons from the construction and operation of the transmission line is expected. Impacts to other state-listed sensitive species range from no impact to moderate impacts (see Table 4-4).

One small area of upland tree habitat east of Scott Canyon Road was found to contain a Swainson's hawk nest along an existing public road south of the proposed transmission line route for the Proposed Action (WEST, 2005a). The nest site could be temporarily and indirectly affected by construction activities, but impacts from operations (potential for collision, noise, etc.) would be low considering the size and extent of the lines. Since seasonal restrictions would be implemented if the nest was found to be active, impact levels would be low, since critical life stages would not be impacted. No other raptor nests are present within 0.25 mile of the proposed transmission line.

Impacts from the transmission line to other sensitive bird species would range from none to low. In some instances, such as during very foggy weather, some bird species may strike the overhead ground wire or a conductor and be harmed or killed. Other species, especially songbirds, could be hit by construction vehicles or the small number of additional vehicles associated with maintenance activities as they fly across roads. Both of these events are expected to be rare and only involve individual birds. Impacts from these types of events would not reduce the viability of local populations of any of these species and would be considered a low impact.

Table 4-4 Impact to Federal and State Listed Threatened, Endangered and Sensitive Species

Species Common Name ***(Species Scientific Name)***	**Federal Status**	**State Status**	**Impact Level**				
			BPA Proposed Action	BPA Middle Alternative	No Action Alternative	Klondike III Wind Project	Biglow Canyon Wind Project
Birds							
Bald Eagle *(Haliaeetus leucocephalus)*	T/EA	T	None	None	None	Low	Low
Peregrine Falcon *(Falco peregrinus anatum)*	--	E	None	None	None	Low	Low
Golden eagle (*Aquila chrysaetos*)	EA	--	None	None	None	Low	Low
Swainson's hawk (*Buteo swainsoni*)	--	SV	Low	Low	None	Moderate	Moderate
Rough-legged hawk (*Buteo lagopus*)	--	--	Low	Low	None	Moderate	Moderate
Red-tailed hawk (*Buteo jamaicensis*)	--	--	Low	Low	None	Moderate	Moderate
Ferruginous hawk (*Buteo regalis*)	SoC	SC	Low	Low	None	Moderate	Moderate
Long-billed curlew (*Numenius americanus*)	--	SV	Low	Low	None	Low	Low
Bank swallow (*Riparia riparia*)	--	SU	Low	Low	None	Low	Low
Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*)	SoC	--	None	None	None	None	None
Western greater sage grouse (*Centrocercus urophasianus*)	SoC	SV	None	None	None	None	None
Common nighthawk (*Chordeiles minor*)	--	SC	Low	Low	None	Low	Low
Eastern Oregon willow flycatcher (*Empidonax traillii adastus*)	SoC	SU	None	None	None	None	Low
Western burrowing owl (*Athene cunicularia hypugaea*)	SoC	SC	Low	Low	None	Low	Low
Grasshopper sparrow (*Ammodramus savannarum*)	--	SV/SP	Low	Low	None	Moderate	Moderate
Lewis' woodpecker (*Melanerpes lewis*)	SoC	SC	None	None	None	None	None
Western bluebird (*Sialia mexicana*)	--	SV	Low	Low	None	Low	Low
Western meadowlark (*Sturnella neglecta*)	--	SC	Low	Low	None	Moderate	Moderate
Yellow-breasted chat (*Icteria virens*)	SoC	Soc	Low	Low	None	Low	Low
Loggerhead shrike (*Lanius ludovicianus*)	--	SV	Low	Low	None	Low	Low

Species Common Name ***(Species Scientific Name)***	**Federal Status**	**State Status**	**Impact Level**				
			BPA Proposed Action	BPA Middle Alternative	No Action Alternative	Klondike III Wind Project	Biglow Canyon Wind Project
Mammals							
California bighorn sheep (*Ovis canadensis californiana*)	SoC	--	None	None	None	None	None
White-tailed jackrabbit (*Lepus townsendii*)	--	SU	Moderate	Moderate	None	Moderate	Moderate
Hoary bat (*Lasiurus cinereus*)	--	--	None	None	None	Moderate	Moderate
Long-eared myotis (*Myotis evotis*)	SoC	SU	None	None	None	Low	Low
Long-legged myotis (*Myotis volans*)	SoC	SU	None	None	None	Low	Low
Pale western big-eared bat (*Corynorhinus townsendii pallescens*)	SoC	SC	None	None	None	Low	Low
Pallid bat (*Antrozous pallidus pallidus*)	--	SV	None	None	None	Low	Low
Silver-haired bat (*Lasionycteris noctivagans*)	SoC	SU	None	None	None	Moderate	Moderate
Western small-footed myotis (*Myotis ciliolabrum*)	SoC	SU	None	None	None	Low	Low
Yuma myotis (*Myotis yumanensis*)	SoC	--	None	None	None	Low	Low
Amphibians							
Northern leopard frog *(Rana pretiosa)*	--	SC	None	None	None	None	Low
Western Toad *(Bufo boreas)*	--	SV	None	None	None	None	Low
Painted turtle *(Chrysemys picta)*	--	SC	None	None	None	None	None
Western rattlesnake *(Crotalus viridis oregonus)*	--	SV	Low	Low	None	Low	Low

EA – Bald and Golden Eagle Protection Act; **E –** Endangered; **T –** Threatened; **SoC** – Species of Concern; **SC** – State Sensitive-Critical; **SV** – State Sensitive-Vulnerable; **SU** – State Sensitive-Undetermined Status.

Sensitive mammal species would not be affected by the construction or operation of the transmission line with the possible exception of the white-tailed jackrabbit. This species could be temporarily affected during the breeding season by construction activities, a moderate impact. Bat species would not be affected, as they can echolocate transmission line conductors, ground wires and towers, and are not susceptible to collisions with them.

Common wildlife species would be affected in a similar manner to that described for sensitive species.

Bird fatalities could result from impacts with overhead ground wires during foggy conditions, and from increased road traffic along access roads. There could also be temporary disturbance of common nesting birds such as horned lark and meadowlark, denning coyotes, rabbits, or resting sites of ungulates from equipment traveling along access roads (low to moderate impact). Other construction activities such as boring, trenching, and excavation could temporarily disturb these and other common species, such as reptiles. Temporary disturbance to these species during critical life stages is considered a moderate impact for common species and a low impact at all other times. Indirect effects, such as the increase in raptor perching opportunities, could benefit raptors, and decrease small rodent or snake populations, which are preyed upon by these raptors. However these effects are not expected to result in noticeable changes in populations of these species (low impact).

4.6.2.2 Mitigation Measures

According to Oregon Department of Fish and Wildlife (ODFW) standards, the upland tree habitat is considered irreplaceable, since it supports a species (Swainson's hawk) that ODFW considers a State Sensitive species. If the Swainson's hawk nests in this area in subsequent years, construction activities would be coordinated with ODFW and limited during the Seasonality and Sensitive Period for the species, which is June 1 through August 31 (ODFW, 1994). With this coordination and mitigation, there would be no impact to Swainson's hawks from the BPA Proposed Action.

The following mitigation actions would apply to all project activities and would benefit all habitat types and wildlife species in the project vicinity:

- Sensitive areas would include all undeveloped habitats within the project corridor, since these may provide nesting or denning areas for special status/sensitive wildlife. These areas would be flagged in the field prior to construction and the construction contractors would be directed to avoid them during construction.
- Road construction and vehicle use would be minimized where possible to minimize impacts to agricultural habitats. For instance, if construction occurs during summer, access to tower locations would not have to be graveled.
- For habitat restoration and revegetation, seed mixes would be developed in consultation with ODFW. Restoration efforts would be discussed with the

landowner to take into consideration existing land use activities and their potential impacts to the vegetation restoration efforts.

- Measures to reduce the potential spread of noxious weeds would be developed in consultation with the Sherman County Soil and Water Conservation District. The facility would be monitored regularly to prevent the spread of noxious weeds.
- Best management practices and erosion and sediment control measures would be employed during project construction to avoid and/or minimize impacts to downslope areas. Areas of unavoidable soil disturbance would be stabilized downslope with straw wattles and bio-filter bags.

4.6.3 Middle Alternative

4.6.3.1 Impacts

Impacts would be similar to those described for the Proposed Action, except that the Swainson's hawk nest near Scott Canyon Road would not be disturbed by this alternative.

4.6.3.2 Mitigation Measures

Mitigation would be the same as those described for the Proposed Action.

4.6.4 Klondike III Wind Project

4.6.4.1 Impacts

Impacts to federal and state listed and sensitive species are shown in Table 4-4.

No impacts to bald eagles or bald eagle habitat are anticipated from the Klondike III Wind Project due to the lack of suitable bald eagle habitat near the proposed project and the generally low levels of observed raptor mortality at recent wind power projects. For similar reasons an extremely low risk of mortality is anticipated for species only infrequently observed within the site boundaries, such as the peregrine falcon.

A Swainson's hawk nest was identified less than 100 feet north of Dehler Road. The nest lies within a small locust tree in a weedy area used to store farm equipment and tractors. The upland tree habitat is considered irreplaceable by ODFW since it supports a State-listed Sensitive Species. If the Swainson's hawk nests in this area in subsequent years, construction activities would be coordinated with ODFW and limited during the Seasonality and Sensitive Period for the species, which is June 1 through August 31 (ODFW, 1994). An active Swainson's hawk nest was seen in a locust tree near an abandoned house south of Gosson Lane. It lies about 200 feet outside the analysis area. The female was seen sitting on the nest and the male was displaying territorial behavior during site visits (DEA 2005). Since the nest is outside the analysis area, seasonal restrictions would not be necessary.

No other raptor sightings (such as red-tailed hawks or northern harrier) in the analysis area were associated with known nests; they were incidental sightings within the raptors' larger home range. Raptor mortality estimates from the Stateline Wind Project and the Nine Canyon Wind Project have ranged from 0.05 to 0.07 raptor fatalities per turbine per year, with most fatalities consisting of red-tailed hawks and American kestrels (Erickson et al., 2004). Raptor mortality for Klondike III is expected to be similar (8 to 12 per year).

A breeding loggerhead shrike was found in an area within a small island of small locust trees surrounded by agricultural land. The Seasonality and Sensitive Period for the species is April 15 through September 1. ODFW would be consulted on this species and construction activities may be limited during this time period. Impacts would be low.

Average fatality estimates for all birds from regional wind facilities have ranged from 0.9 to 2.9 birds per MW per year. Overall bird use and species richness estimated for the facility was low relative to other wind facility sites in the United States, including other open habitat sites, because most available habitat is cultivated. Overall bird fatality is anticipated to be between 1 and 2.75 fatalities per MW per year (for a total between 275 and 756), a moderate impact. The most common bird fatality probably would be horned larks, a common grassland species. This would be considered a moderate impact since it would create a long-term adverse affect on a common species, but not a high impact, since few rare or special status birds are anticipated to be affected.

A single white-tailed jackrabbit was found outside the analysis area just north of McDonald Ferry Lane, at the easternmost edge of the Klondike III Wind Project in CRP habitat. No ground-disturbing activities are proposed outside the road prism adjacent to the sighting. Therefore, no impact would result and no seasonal restrictions or coordination with ODFW is recommended.

Big game species such as deer would likely be temporarily displaced during active construction (a low impact). Slightly increased human presence during operation of the facility may cause slightly more periodic disturbance than currently exists, however the presence of the turbines is not expected to cause long-term impacts as big game species typically adapt to the presence of large stationary or semi-stationary objects.

Most bat species roost in structures such as buildings, caves, mines and bridges, which are rare to absent within the analysis area; therefore, the construction or retirement of the facility is not anticipated to result in the loss or degradation of bat roosting and foraging habitat in the analysis area. The potential impact to bats could be from collision mortality during operation. Available evidence indicates that this is confined primarily to the migratory species, especially for open agriculture and grassland projects in the West. Migratory bat mortality would likely be in the range of 1.5 to 2.5 bats per MW per year for migratory bat species (for a total of 410 to 683 bats), a moderate impact and lower for resident bat species (low impact).

Other common wildlife species could be temporarily disturbed or displaced during critical nesting or denning periods, which would be a moderate impact. No specific mitigation measures are proposed for these species, as they are relatively common and the project would not have an effect on the health of their populations.

Overall, impacts to wildlife species from the proposed project range from low to moderate.

4.6.4.2 Mitigation Measures

The project would have no impacts on federally-listed species; therefore no mitigation for listed species is necessary.

The mitigation measures that would be implemented for Klondike III would be similar to those described for the BPA action alternatives. They would apply to all project activities and are anticipated to benefit all habitat types/categories and wildlife species.

4.6.5 Biglow Canyon Wind Farm

4.6.5.1 Impacts

Impacts to wildlife species for the Biglow Canyon Wind Farm would be similar to those described for the Klondike III project.

Because of the low probability of use by bald eagles and peregrine falcons in the analysis area and the mitigation measures described below, it is not expected that the facility would have any impact on federal or state-listed bird species.

During diurnal walking surveys for sensitive status species, the following species were observed: grasshopper sparrows, short-eared owls, Swainson's hawk, white-tailed jackrabbits, and ferruginous hawk. During nocturnal surveys, white-tailed jackrabbits and western toads were observed (WEST, 2005b).

Two active raptor nests were seen within 1,000 feet of proposed turbine corridors: one Swainson's hawk and one red-tailed hawk. Two additional Swainson's hawk nests were located 1,794 feet and 1,968 feet from a proposed turbine corridor centerline. One additional red-tailed hawk nest was documented in riparian trees 1,220 feet from a proposed turbine corridor centerline. The only other nest in upland trees is an inactive nest of unknown species 1,591 feet from a turbine corridor centerline.

Average fatality estimates for all birds from regional wind facilities have ranged from 0.9 to 2.9 birds per MW per year. Overall bird use and species richness estimated for the facility was low relative to other wind facility sites in the United States, including other open habitat sites, because most available habitat is cultivated. Overall bird fatality is anticipated to be between 1 and 2.75 fatalities per MW per year (for a total between 450 and 1,238), a moderate impact. The most common bird fatality probably would be horned larks, a common grassland species. This would be considered a moderate impact since it would create a long-term adverse affect on a common species, but not a high impact, since few rare or special status birds are anticipated to be affected.

Waterfowl mortality is expected to be low, based on monitoring results of existing facilities in the region, the lack of open water habitat, and the relatively infrequent use of the facility by Canada geese.

Displacement impacts to birds in grassland and shrub-steppe habitats are anticipated to be minimal with reduced densities occurring within less than 328 feet of facilities located in these habitats. Less than 1 percent of the area within 492 feet of the facility is either native grassland or shrub-steppe habitats. This would be a low impact.

Results of fatality monitoring for existing Columbia Basin wind facilities indicate a mortality range from 1.0 to 2.5 bats per MW per year. Based on this range and on similar characteristics of the facility area to those other facilities, bat mortality would also be similar (for a total of 450 to 1,125 bats per year) and primarily involve migratory silver-haired and hoary bats. This would be a moderate impact.

Little risk is expected to non-migratory bat populations in the facility area, given the lack of habitat and fatality results of other facilities in similar habitats, and no impacts to threatened or endangered bat species are anticipated.

Big game species such as deer would likely be temporarily displaced during active construction (a low impact). Slightly increased human presence during operation of the facility may cause slightly more periodic disturbance than currently exists, however the presence of the turbines is not expected to cause long-term impacts as big game species typically adapt to the presence of large stationary or semi-stationary objects.

Road and facility construction would result in a slight loss of foraging and breeding habitat for small mammals. Ground-dwelling mammals would lose the use of the permanently affected areas; however, they are expected to repopulate the temporarily affected areas. Some small mammal fatalities can be expected from vehicle activity during operations, but impact levels are expected to be low. No evidence exists that supports the presence of Washington ground squirrels in Sherman County.

No impacts to amphibians are anticipated during operations. Impacts to reptiles during operation are likely to be limited to direct mortality as a result of vehicle collisions and are expected to be low.

The most probable impact to birds resulting from the operation of the facility is direct mortality or injury caused by collisions with the turbines. Collisions could occur with resident birds foraging and flying within the facility area, or with birds migrating through the facility area. Other impacts could include abandonment of the area because of disturbance caused by facility activities, and mortality or injury caused by collisions with vehicles or other equipment. Both types of impacts would be considered low to moderate as they would likely be isolated occurrences involving individual birds as opposed to large flocks of birds.

4.6.5.2 Mitigation

The Biglow Canyon Wind Farm is not expected to affect listed species; therefore, no mitigation for listed species impacts is required.

The following mitigation measures would be implemented to minimize potential adverse impacts to birds and sensitive habitat.

- Permanent meteorological towers either would not have guy wires, to reduce the potential for collision of birds with guy wires, or if guy wires are used they would be equipped with the type of bird deflectors approved by the ODFW.
- Orion Energy would survey the status of known Swainson's hawk or other raptor nests in the vicinity of proposed construction activities (i.e., within 0.5 mile) before construction activities begin. If an active nest is found, and construction activities are scheduled to occur during the sensitive nesting and breeding season (i.e., mid-April to mid-August), Orion Energy would not engage in construction activities within a 0.25-mile buffer around the nest until the nest fledges young or the nest fails (e.g., is abandoned), unless ODFW approves an alternative plan. If ground-disturbing construction activities continue into the sensitive nesting and breeding season for the following year, Orion Energy would not engage in ground-disturbing construction activities within the 0.25-mile buffer, if the nest site is found to be active, until the nest fledges young or the nests fails (e.g., is abandoned), unless ODFW approves an alternative plan.
- A monitoring program would be designed to collect data that is standardized with methods used in monitoring programs at regional and national wind power facilities. Aspects and objectives of the monitoring proposal will incorporate comments and concerns of ODFW and the Oregon Department of Energy, and will likely include standardized casualty searches, searcher efficiency trials, a Wildlife Response and Reporting System for operations and maintenance personnel, and fatality monitoring during the first 2 years of project operations.

4.6.6 No Action Alternative

No new impacts to fish and wildlife habitats would occur under the No Action Alternative.

4.6.7 Cumulative Impacts

Potential cumulative impacts to fish and other aquatic resources from past, present, and future development in the region include the loss of riparian habitat, increased sediment loading, increased stream temperatures, pollution from herbicide and insecticide use, changes in peak and low stream flows, fragmentation of fish habitat, decreases in streambank stability, and altered nutrient supply. No impacts to fish species are anticipated from the BPA transmission line and substation, Klondike III Wind Project, or the Biglow Canyon Wind Farm, and the proposed projects would not contribute to cumulative impacts to fish species.

The construction of multiple wind power and transmission facilities as well as other development in the project vicinity could cause cumulative impacts to some wildlife species. Cumulative impacts from the operation of the wind power and transmission line facilities on bird and bat species is more likely than impacts to terrestrial species, because these facilities have potential to harm or kill animals that strike them. A study of the potential cumulative impacts to bird and bat species was conducted in 2006 for the

Klondike I and II, Klondike III, Biglow Canyon and Orion South projects (West, 2006) This study is included as Appendix A to this EIS. An additional regional analysis of possible cumulative impacts to birds was also completed using the cumulative wind projects identified in Table 4-1. The following summarizes the results of these two cumulative analyses.

Non-Avian Species

The current and proposed wind projects near the analysis area would have no to low impacts to non-avian terrestrial species because almost the entire area is under wheat cultivation and disturbance to these species occurs regularly. The reduction in habitat for terrestrial species from construction of the facilities is not expected to result in any changes in regional populations. Likewise, operation of these facilities is not expected to adversely affect terrestrial species.

Raptors

Red-tailed hawk, American kestrel, and northern harrier account for most of the raptor use in spring, summer and fall in the analysis areas. In the winter, rough-legged hawk and red-tailed hawk account for most of the raptor use. These species are expected to be the raptor species with the highest risk of mortality across the projects. The potential exists for other raptor species to collide with turbines, including Swainson's hawk, ferruginous hawk, turkey vulture, golden eagle, Cooper's hawk, sharp-shinned hawk, and prairie falcon. However, the mortality risk associated with these species is expected to be much lower than the risk for red-tailed hawks and American kestrel due to the lower use estimates and exposure indices for these species. Common owl species such as great-horned owls, which are typically not effectively surveyed during the day, may also be at risk of collision. Some raptors such as turkey vultures appear less susceptible to collision than most other raptors (Orloff and Flannery 1992, Erickson et al. 2001). In addition, there have been very few northern harrier, ferruginous hawk, and rough-legged hawk fatalities recorded at wind plants, based on recent published data (Erickson et al. 2002). Golden eagle use of the sites is low relative to other wind sites (e.g., Foote Creek Rim, Young et al. 2003) and mortality for golden eagles is also expected to be very low.

Raptor mortality is expected to be similar to other new generation wind projects with similar turbine types located in the Oregon-Washington region. At these other projects, raptor use estimates ranged from about 0.2 to 0.6 per 20-minute survey compared to an average estimate of 0.3 raptors/20-minute survey for Sherman County (West, 2006).

Potential raptor mortality within the combined analysis area would be about 0.024 raptors per turbine per year or one raptor for every 40 turbines per year. Using this raptor mortality rate, the total annual raptor mortality estimate would be about 11 raptor fatalities per year for the three projects combined if all 440 of the proposed turbines are constructed (or one raptor for every 63 MW of generating capacity). This fatality estimate may vary from the expected range based on many factors, including the number of occupied raptor nests near the wind projects after construction, turbine size and other site specific and/or weather variables.

The potential raptor mortality from all of the regional wind projects identified in Table 4-1 would be about 50 raptors per year.

Passerines

Passerines have been the most abundant avian fatality at other wind projects studied (Johnson et al. 2002, Young et al. 2003, Erickson et al. 2000, 2001, 2002), often comprising more than 80 percent of the avian fatalities. Both migrant and resident passerine fatalities have been observed. Given that passerines make up the vast majority of the avian observations at the sites, it is expected passerines would make up the largest proportion of fatalities for all projects combined. Passerine species most common to the project sites would likely be most at risk, including horned lark and western meadowlark.

Mortality rates at other regional wind projects for all birds combined have ranged from about 0.63 birds per turbine per year to 2.56 birds per turbine per year (or 0.42 to 1.71 birds per MW per year assuming 1.5 MW turbines). Based on the mortality estimates from the other wind plants studied, it is expected that all passerine bird mortality would fall within the mid range or about 1 to 2 birds per turbine per year. Under the assumption that 440 turbines are constructed for all three projects, the total range of passerine mortality would be 440 to 880 fatalities per year, or 0.63 to 1.28 bird fatalities per MW per year. Because horned lark made up slightly more than 50 percent of the bird use during the studies, it is expected that about 50 percent of the fatalities would be of this species. This trend has been shown at the other regional projects in agriculture settings. Using this assumption, about 200-400 horned lark fatalities would occur if all the wind turbines were constructed. The level of estimated mortality is not expected to have any local population level consequences for individual species, due to the expected low fatality rates for most species and the high population sizes of the common species such as horned lark, western meadowlark, and European starling.

As additional wind facilities are developed in the region, more birds would be killed. To further understand the relative level of potential impacts to passerine bird populations from the construction of these wind projects, estimates were made of how many birds could be killed and how much of the current regional bird population would be affected if all of the reasonably foreseeable wind projects (see Table 4-1) in the region are constructed.

To determine regional population effects an area of similar terrain and topography in the eastern portion of the Columbia Basin was selected that included the wind projects listed in Table 4-1. This area lies between The Dalles to the west and Boardman to the east, and within an area about 22 miles wide on either side of the Columbia River (north to south direction). This area totals about 2,600 square miles of mostly agricultural and shrub-steppe areas and is similar in topography, habitat and bird use to the Klondike-Biglow area covered by the local cumulative impacts study, and to other areas from which regional avian mortality data exists. There is a biological justification for assuming, and no apparent reason not to assume, that impacts within the 2,600 square mile region will be similar to and fall within the range of reported impacts at existing projects within this region. Within the 2,600 square mile region it is appropriate, at the level of considering cumulative impacts, to take existing mortality data expressed as per turbine/per megawatt figures, and to extrapolate by multiplying these figures by the total numbers of turbines or megawatts making up all "reasonably foreseeable" projects.

The reasonably foreseeable wind projects total about 3,134 MW of generating capacity. Using the mortality rates observed at some of these facilities (see above), the total passerine mortality if all of these projects are constructed could range from about 1,980 to 4,000 birds per year.

Data on bird density in shrub-steppe habitat was then collected. Two studies that looked at passerine bird density were identified (Smith, et al. 1984, Schroeder 2001). The average passerine density identified was about 392 birds per square mile which, when multiplied by the regional area, results in a total population of about 1,033,000 birds. Both studies looked at relatively undisturbed shrub-steppe habitat, so they probably represent an overestimation of the actual bird density in the region, which is mostly in agricultural lands and tends to have a lower bird species density than undisturbed shrub-steppe habitat.

From these passerine bird mortality, density and population estimates, the impact to the total passerine bird population of the region from the proposed wind projects (if they are all constructed) is conservatively estimated to range from about 0.19 percent to 0.39 percent each year, and is likely much lower. Some species may have proportionately higher impacts based on abundance and habitat requirements (see previous discussion about horned larks), but given the overall relatively low observed impacts from similar wind projects, the cumulative impacts to all bird species is expected to be moderate, and mortality rates are not expected to reduce the viability of any bird species populations in the region.

ESA-Listed Species

The only ESA-listed bird species present in the analysis area and surrounding areas is the bald eagle. This species tends to congregate near open water or forested areas. Current and proposed wind farms are generally located well away from these areas, thus any impacts to this species from turbine or transmission line impacts would be isolated and rare.

Bats

Bat foraging areas such as riparian zones, shrublands, streams, and other water sources are limited in the project area. Wind projects, especially those in open habitats, pose little risk to non-migratory bat populations. Based on the available monitoring information and characteristics of the sites, bat mortality at the projects proposed for northern Sherman County is not expected to vary significantly from other regional wind projects. The results of fatality monitoring for regional wind projects indicate mortality ranges from less than 1 to slightly over 3.0 bats per turbine per year or about 1 to 2.5 bats per MW per year (West, 2006).

Results of the Klondike I monitoring suggest that impacts in Sherman County may be on the lower end of this range. A conservative estimate of bat mortality would fall within the mid range or about 1.5 to 2.5 bats per turbine (or per MW) per year. Provided that 440 turbines are constructed for all three projects, the total range of bat mortality would be from 660 to 1,100 fatalities per year. Actual levels of mortality are unknown and could be lower or higher, depending on factors such as regional migratory patterns of bats, patterns of local movements through the area, and the response of bats to turbines, individually and collectively. Mortality would involve primarily silver-haired and hoary bats, and no impacts to threatened or endangered bat species are anticipated. The level of this impact on hoary and silver-haired bat populations is hard to predict, as there is very little information available regarding the overall population size and distribution of the bats potentially affected. Other regional monitoring studies suggest resident bats do not appear to be significantly affected by wind turbines and almost all mortality is observed during the fall migration period. Also, hoary bat and silver-haired bats, which are expected to be the most common fatalities, are widely distributed in North America.

For the larger region (the 2,600-square mile area described previously), total bat mortality could range from 3,130 to 8,000 bats annually if all of the proposed wind projects are constructed. Overall populations of bats in the region are not well documented, thus conclusions about population effects from turbine mortality would be speculative.

4.7 Vegetation

4.7.1 Impact Levels

Impacts would be considered **high** where actions would:

- Create an unavoidable adverse effect on a federally-listed threatened or endangered plant species;
- Significantly reduce the quantity or quality of a regionally or nationally important botanical reserve, plant population, or similar botanical habitat area;
- Spread noxious weeds due to construction or maintenance; or
- Adversely affect rare or declining species at the regional level.

Impacts would be considered **moderate** where actions would:

- Create an effect on threatened or endangered plant species that could be partially mitigated;

- Temporarily disturb sensitive plants during construction but would not affect the viability of local populations;
- Cause a local reduction in the quantity or quality of vegetation communities (as opposed to regional reductions); or
- Marginally reduce the productivity of adjacent vegetation communities or resources (such as wetland plant communities or botanical reserves).

Impacts would be considered **low** where actions would:

- Create an effect that could be largely mitigated;
- Reduce the quantity or quality of vegetation communities confined to the site of the action;
- Cause no major effect on productivity of adjacent vegetation communities;
- Temporarily disturb common plant species;
- Reduce plant communities that are very common in the project vicinity;
- Adversely affect relatively common species at a local level (i.e., occurring within the immediate vicinity of the project and not affecting regional populations); or
- Cause temporary effects or those that could be minimized by site planning or by placing seasonal restrictions on construction activities.

No impacts would occur when an action would create no impacts or fewer impacts than the low impact level.

4.7.2 BPA Proposed Action

4.7.2.1 Impacts

The Proposed Action would affect only agricultural areas in the long term. Towers and substation facilities would remove about 16.6 acres of agricultural plant communities, which are very common in the region (see Table 4-5). Therefore, impacts would be low. Undeveloped habitats (i.e., not in agricultural use) would be spanned by structures or avoided, so no long-term impacts to those vegetative communities would occur.

During construction, temporary access to tower construction sites would be gained by crossing existing agricultural lands, which would be re-planted with agricultural crops or cover crops to restrict the spread of weeds. The total amount of temporary disturbance would be about 116 acres. Short-term impacts would be low.

4.7.2.2 Mitigation Measures

The following mitigation actions would apply to all project activities and are anticipated to benefit all habitat vegetation/categories and wildlife species:

- Maps would be prepared to show sensitive areas that are off limits during the construction phase. These areas would be flagged in the field prior to construction and the construction contractors would be directed to avoid them during construction. Sensitive areas may include vegetation types that provide nesting or denning areas for special status/sensitive wildlife.
- Road construction and vehicle use would be minimized where possible to minimize impacts to sensitive habitats. For instance, if construction occurs during summer, access to tower locations would not have to be graveled.
- For habitat restoration and revegetation, seed mixes would be developed in consultation with ODFW. Restoration efforts would be discussed with the landowner to take into consideration existing land use activities and their potential impacts to the vegetation restoration efforts.
- A weed survey would be completed prior to and following construction. Measures to reduce the potential spread of noxious weeds would be developed in consultation with the Sherman County Soil and Water Conservation District. The facility would be monitored regularly to prevent the spread of noxious weeds.
- BMPs and erosion and sediment control measures would be employed during project construction to avoid and/or minimize impacts to downslope areas. Areas of unavoidable soil disturbance would be bounded downslope with straw wattles and bio-filter bags.

Table 4-5 Vegetation Impacts

Type of Land Disturbed	BPA Proposed Action	BPA Middle Alternative	BPA No Action Alternative	Klondike III Wind Project	Biglow Canyon Wind Farm
Temporary Impacts					
Grassland	0	0	0	3.6	1.0
Shrub-Steppe	0	0	0	1.4	1.3
CRP	0	0	0	10.4	15.5
Agricultural	116.19	119.95	0	81.7	369.14
Total	**116.19**	**119.95**	**0**	**97.1**	**386.94**
Permanent Impacts					
Grassland	0	0	0	0.8	1.1
Shrub-Steppe	0	0	0	0.1	0.2
CRP	0	0	0	6.5	11.2
Agricultural	16.56	16.63	0	56.4	157.34
Total	**16.56**	**16.63**	**0**	**63.8**	**169.84**

4.7.3 Middle Alternative

4.7.3.1 Impacts

Impacts of the Middle Alternative would be similar to those of the Proposed Action. Towers and substation facilities would eliminate about 16.6 acres of agricultural plant communities. The total amount of temporary disturbance would be about 120 acres. Impacts to vegetation would be low.

4.7.3.2 Mitigation Measures

The same mitigation measures listed for the Proposed Action would be implemented for the Middle Alternative.

4.7.4 Klondike III Wind Project

4.7.4.1 Impacts

The Klondike III Wind Project facilities would permanently impact about 0.8 acre of grassland habitat, 0.1 acre of shrub-steppe habitat, 6.5 acres of CRP habitat, and 56.4 acres of agricultural habitat. Because the impacts would be confined to the site of the action and the agricultural impacts would reduce common plant communities, the impacts would be low.

Construction activities would temporarily impact about 3.6 acres of grassland, 1.4 acres of shrub-steppe, 10.4 acres of CRP, and 81.7 acres of agricultural lands. There would also be about 0.03 acre of upland tree habitat temporarily impacted, although no trees would be removed or altered. The impacts would be confined to the site of the action, are temporary, and would only reduce common plant communities; therefore, the impact level would be low.

During the site visits conducted for the Klondike III Wind Project, no habitat for special status/sensitive plant species was found, and none is believed to be within the project corridor based on degraded site conditions.

4.7.4.2 Mitigation Measures

To mitigate for long-term effects to grassland habitat, PPM Energy would enhance other grassland habitats in the analysis area. In addition to the enhancement, a conservation easement, deed restriction, or other similar protective measure would be undertaken for the area in order to protect this area as wildlife habitat.

Temporary, construction-related impacts would be mitigated by:

- Requiring project facilities to be the minimum size needed for operations.
- Replacing agricultural topsoil to original condition.
- Using BMPs to prevent loss of topsoil during construction.

- Performing repair activities during operations.
- Controlling noxious weeds in areas disturbed by construction activities.

4.7.5 Biglow Canyon Wind Farm

4.7.5.1 Impacts

The Biglow Canyon Wind Farm facilities would permanently impact about 1.1 acres of grassland habitat, 0.2 acre of shrub-steppe habitat, 11.2 acres of CRP habitat, and 157.3 acres of agricultural habitat. Because the impacts would be confined to the site of the action and the agricultural impacts would reduce common plant communities, the impacts would be low.

Construction activities would temporarily impact about 1.0 acre of grassland, 1.3 acres of shrub-steppe, 15.5 acres of CRP, and 369.1 acres of agricultural areas. The impacts would be confined to the site of the action, are temporary, and would reduce common plant communities; therefore, the impact level would be low.

4.7.5.2 Mitigation Measures

Orion Energy would enhance or create at least 11 acres of shrub-steppe habitat to mitigate for long-term impacts to undeveloped vegetative communities. A number of areas near and in the John Day River Canyon have been identified as potential areas for mitigation. These potential areas are located away from turbine corridors. A detailed mitigation plan would be finalized with willing landowners, with the concurrence of ODFW regarding mitigation area size, location, and vegetative goals. Both ODFW and the Sherman County Soil and Water Conservation District would be consulted regarding procedures for weed control and vegetation establishment and management.

Temporary impacts from construction activities would be mitigated by:

- Noxious weed control in construction areas, as described previously.
- Use of BMPs to minimize topsoil loss, and compliance with an erosion and sedimentation control plan approved by DEQ as part of the NPDES program in areas adjacent to drainage features.
- Consulting with Sherman County Soil and Water Conservation District for proper procedures for restoring agricultural quality to its original condition.

Because noxious weeds can have detrimental effects on native plant populations, the following additional measures would be implemented to control the introduction and spread of undesirable plants during and after construction:

- Areas disturbed during construction would be revegetated expeditiously.
- A noxious weed control plan would be developed following guidelines based upon consultation with the Sherman County Soil and Water Conservation District.

- The noxious weed control plan would be finalized prior to construction and would be implemented over the life of the Biglow Canyon Wind Farm facility.

4.7.6 No Action Alternative

No new impacts to vegetative resources would occur under the No Action Alternative. Current levels of disturbance would continue under this alternative. These levels include any impacts currently associated with maintenance activities for the existing BPA transmission lines and substations. These impacts could include noxious weed transport due to vehicular traffic, transmission structure maintenance, current vegetation management practices, and other such activities. However, any potential ongoing impacts from maintenance of existing BPA transmission lines and substations would occur within a previously disturbed environment, which would result in no new impacts to undisturbed resources.

4.7.7 Cumulative Impacts

Native plant communities are being lost in the region because of past and current development and actions, and these trends will likely result in the further reduction of native plant communities. Cumulative projects in the region including the wind projects listed in Table 4-1 have impacted or could impact agricultural land and native habitats.

Most vegetative communities in the analysis area have been previously disturbed by human activities. The actions associated with the proposed projects would contribute incrementally and in a relatively minor way to the continuing cumulative loss of native vegetation communities. However, it is expected that long-term impacts of BPA's Proposed Action and the wind projects to undeveloped habitats would be mitigated and not contribute to cumulative impacts.

4.8 Visual Resources

4.8.1 Impact Levels

Impacts would be considered **high** where actions would:

- Become the dominant feature or focal point of the view, especially from residences or schools; or
- Become the dominant feature or focal point of the view and adversely affect the existing character and quality of views from parks, recreation facilities, public trails, and public lands and waters used for dispersed recreation where the appreciation of natural and scenic resources is a valued part of the use, such as the CRGNSA; or
- Affect a large number of sensitive viewers in predominantly the ***foreground*** and middle ground of the view; or

- Become the dominant feature or focal point of view from major travel corridors along which existing scenic quality is high and/or policies have been applied to preserve and enhance aesthetic values.

Impacts would be considered **moderate** where actions would:

- Be clearly visible in the view but not the dominant feature of the view; or
- Affect a large number of sensitive viewers mostly in the middleground of their view; or
- Not become the dominant view but are in view from parks, recreation facilities, public trails, and public lands and waters used for dispersed recreation where the appreciation of natural and scenic resources is a valued part of the use; or
- Not become the dominant view but would be in view from major travel corridors along which existing scenic quality is high and/or policies have been applied to preserve and enhance aesthetic values; or
- Not become the dominant view but would be in view from locally important roads along which visual quality is not high and which have not been designated for scenic protection.

Impacts would be considered **low** where actions would:

- Be somewhat visible but not obtrusive in the view; or
- Be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view.

No impact would occur if:

- The facilities would be isolated, screened, not noticed in the view, or seen from a distance greater than three miles; or
- No visually sensitive resources would be affected.

4.8.2 Summary of Impacts from the Proposed Project

Table 4-6 summarizes potential impacts to visual resources within the analysis area. More information is also in Appendix B.

Table 4-6 Summary of Impacts to Visual Resources within the Analysis Area

Visual Resource	Level of Impact		
	BPA Action Alts.	Klondike III	Biglow Canyon
General Project Vicinity	Moderate	Moderate to High	Moderate to High
Columbia River Gorge National Scenic Area	Low to None	Low to None	Low to None
John Day River Canyon	None	Low to Moderate	Low to Moderate
Oregon National Historic Trail High Potential Sites:			
Fourmile Canyon	None	None	None
John Day River Crossing (a.k.a. McDonald Ferry)	None	Low to Moderate	None
Biggs Junction	None	None	None
Deschutes River Crossing	None	None	None
The Dalles Complex	None	None	None
Lower Deschutes River Canyon	None	None	Low to None
Lower Klickitat River Canyon	None	None	None
Journey Through Time Scenic Byway	Low	Low to Moderate	Low to Moderate

4.8.3 BPA Proposed Action

4.8.3.1 Impacts

Residential Areas

The Proposed Action would be visible from residences in the analysis area at distances ranging from the near foreground (less than 1,000 feet) to the distant background (greater than 20 miles). However, the local project vicinity includes few residences or other sensitive viewers, lacks KVAs, and lacks important visual resources with the exception of the John Day River Canyon.

The Proposed Action would result in moderate impacts because the transmission lines, towers, and substation facilities generally would be clearly visible in the view but would not be the dominant feature of the view.

Recreation Areas

Columbia River Gorge National Scenic Area

Portions of the Proposed Action would potentially be visible from the CRGNSA, although opportunities for viewing would be very limited. The proposed facility would be subordinate to the landscape setting that typically includes substantial human development such as interstate and rail transportation corridors, transmission lines, and urban and rural development in the foreground, middle ground, and background. Attenuating climatic conditions such as distance, haze, humidity, weather, or background landscape would further reduce visibility.

Impacts to the CRGNSA would be low to none because the proposed facility would be somewhat visible, but not obtrusive; would be seen by few sensitive viewers in the background; and would be seen from a distance of greater than 3 miles.

John Day River Canyon

The BLM administers the majority of public lands within the John Day River Canyon and has indicated that its concern would be visual impacts seen from the John Day River (Mottl, H., 2005a). The Proposed Action may be visible from higher portions of the John Day River Canyon (i.e., near the canyon rim), but it would not be visible from the river.

No impacts would occur to the John Day River Canyon because the Proposed Action would not be seen from the river.

Oregon National Historic Trail

The proposed transmission line would cross the trail alignment in areas where previous agricultural activities have destroyed any evidence of the trail. The proposed facility would not be visible at Fourmile Canyon, Biggs Junction, the Deschutes River Crossing, McDonald Ferry, or The Dalles Complex. Therefore, there would be no impact to those resources.

Lower Deschutes River Canyon

The Proposed Action would not be visible from the Lower Deschutes River Canyon. Therefore, there would be no impact to that resource.

Lower Klickitat River Canyon

The Proposed Action would not be visible from the Lower Klickitat River Canyon. Therefore, there would be no impact to that resource.

Transportation Facilities

Journey Through Time Scenic Byway

Portions of the Proposed Action would likely be visible from the Byway. However, the proposed facility would be compatible with the Journey Through Time Management Plan's stated goals. The communities of Wasco and Moro have no stated scenic or visual management goals or objectives and the Sherman County Comp Plan Goal XVIII supports the development of wind energy (Sherman County, 2003c).

The Proposed Action would have low impacts on the Journey Through Time Scenic Byway because it would be somewhat visible but not obtrusive in the view and would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view.

The Proposed Action would be visible in the middleground and background from portions of US 97 in Oregon and SR-14 in Washington. The Proposed Action would have low impacts on motorists who used these roads because it would be somewhat visible but not obtrusive in the view and would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view.

The Proposed Action would result in moderate impacts to local roads because the transmission lines, towers, and substation facilities generally would be clearly visible in the view but would not be the dominant feature of the view.

4.8.3.2 Mitigation Measures

Impacts to the general project vicinity would be moderate, but would be compatible with applicable management plans and land use policies. Impacts to important visual resources would be low to none and would also be compatible with applicable management plans and land use policies. Therefore, mitigation would not be required. However, the following measures would be implemented to further reduce potential impacts.

- Use of steel tubes (vs. steel lattice) for towers to the extent possible.
- Use of non-reflective gray paint on tower structures.
- Use of non-specular conductors (i.e., a conductor that has been modified to reduce the amount of reflected light from its surface).

4.8.4 Middle Alternative

4.8.4.1 Impacts

Impacts would be the same for the Middle Alternative as for the Proposed Action.

4.8.4.2 Mitigation Measures

Mitigation measures would be the same as for the Proposed Action.

4.8.5 Klondike III Wind Project

4.8.5.1 Impacts

Residential Areas

The Proposed Action would be visible from many locations in the analysis area at distances ranging from the immediate foreground (less than 100 feet) to the distant background (greater than 20 miles). The proposed facility would be highly visible in the foreground and middleground from local residences.

The facility would result in moderate to high impacts because the turbines and associated facilities (e.g., O&M building, roads, substation) would become the dominant feature or focal point of the view and would be clearly visible. The general project vicinity includes few sensitive viewers, lacks KVAs, and lacks important visual resources with the exception of the John Day River Canyon.

Recreation Areas

Columbia River Gorge National Scenic Area

Portions of the proposed facility would potentially be visible from the CRGNSA. Effects would be viewed at such great distances (about 9 miles or more) that impacts, if any, would be low. Almost without exception, topography or vegetation would screen the proposed facility from view. Opportunities to view the proposed facility are also minimal. In those areas where the proposed facility would be visible, it would be subordinate to the landscape setting that typically includes substantial human development such as interstate and rail transportation corridors, transmission line corridors, and urban and rural development in the foreground and middle ground.

Impacts to the CRGNSA would be low to none because the proposed facility would be somewhat visible, but not obtrusive; would be seen by few sensitive viewers in the background; and would be seen from a distance of more than 3 miles.

John Day River Canyon

The BLM administers the majority of public lands within the John Day Canyon and has indicated that its concern would be visual impacts seen from the John Day River (Mottl, H., 2005a). Therefore, the following assessment keys on impacts to the river and its shoreline and does not consider impacts to the canyon walls that have very limited access.

Portions of the proposed facility would be visible from two river segments: one near McDonald Ferry, the other between approximate river miles 15.9 and 16.8. From the vicinity of McDonald Ferry, the blade tips of three turbines would be visible. The nacelle and blades of a fourth turbine would also be visible. The turbines would not be visible from the nearby BLM interpretive facility for the Historic Oregon Trail or its access road. Viewing opportunities for boaters would be limited to about 1.5 minutes. The blade tips of six turbines would be visible at different times for different durations through the segment between river miles 15.9 and 16.8. Most turbines would be visible for much less of the 1-mile segment. Viewing opportunities for boaters would be limited to about 14 minutes. In many cases, the turbines’ silhouettes would be barely discernible, if at all.

The turbines would appear small in scale in the background compared to other human development impacts in the canyon (e.g., irrigated pasture, farm and irrigation equipment, farm houses, trailers, fences, livestock, power lines) that are visible in the foreground and middle ground from the river. Other factors contributing to the minimal contrast of the proposed facility include viewing distance, angle of observation, light conditions, and atmospheric conditions, which have the effect of making the turbines less visible when the sun is in the west or when views are obscured by precipitation, haze, dust, smoke, or fog.

Impacts would be compatible with BLM's VRM Class II management objective: "management activities resulting in changes to the existing character of the landscape may be allowed, provided they do not attract the attention of the casual observer" (BLM, 2000).

Impacts resulting from the proposed facility would be low to moderate because the proposed facility:

- would not become the dominant view but would be in view from parks, recreation facilities, public trails, public lands and waters used for dispersed recreation where the appreciation of natural and scenic resources is a valued part of the use;
- would be somewhat visible but not obtrusive in the view; and
- would be seen by few sensitive viewers because facility would be substantially screened by existing topography.

Oregon National Historic Trail

The proposed facility would not be visible at Fourmile Canyon, Biggs Junction, the Deschutes River Crossing, and The Dalles Complex. Therefore, there would be no impacts to those resources.

Portions of four turbines would be visible from the John Day River and small portions of its banks at McDonald Ferry as described above. Impacts would be the same as described above, that is, while portions of the proposed facility would be visible, turbines would appear small in scale and in the background compared to other human developments.

Lower Deschutes River Canyon

The proposed facility would not be visible from the Lower Deschutes River Canyon. Therefore, there would be no impact to that resource.

Lower Klickitat River Canyon

The proposed facility would not be visible from the Lower Klickitat River Canyon. Therefore, there would be no impact to that resource.

Transportation

Journey Through Time Scenic Byway

Portions of the proposed facility would be visible from and would be compatible with the Journey Through Time Scenic Byway stated goals. Topography and vegetation would substantially block views in the foreground and middle ground, though several turbines would be partially visible in the middle ground.

The proposed facility would have low to moderate impacts on the Journey Through Time Scenic Byway because portions of the project:

- would be visible in the view but not the dominant feature of the view;
- would not become the dominant view but would be in view from locally important roads along which visual quality is not high and which have not been designated for scenic protection;
- would be somewhat visible but not obtrusive in the view; and
- would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middle ground and background of the view.

The proposed facility would be visible in the middle ground and background from portions of US 97 in Oregon and SR-14 in Washington. The proposed facility would have low impacts on these roads because it would be somewhat visible but not obtrusive in the view and would be seen by few sensitive viewers because facilities (turbines and towers) would be screened by topography, or predominantly viewed in the middle ground and background of the view.

The proposed facility would be highly visible in the foreground from local roads and would result in moderate to high impacts because the turbines and related facilities (e.g., roads, substations, O&M building) would become the dominant feature or focal point of the view, or would be clearly visible in the view but not the dominant feature of the view. The local project vicinity includes few sensitive viewers, lacks KVAs, and lacks important visual resources, with the exception of the John Day River Canyon.

4.8.5.2 Mitigation Measures

Impacts to residential areas would be moderate to high, but would be compatible with applicable management plans and local land use policies. Therefore, mitigation would not be required.

Impacts to the John Day River Canyon, including McDonald Ferry, would be low to moderate. Since the proposed facility would be compatible with applicable management plans and local land use policies, mitigation would not be required.

Impacts to other recreation areas would be low to none, so mitigation would not be required.

Impacts to the Journey Through Time Scenic Byway (US 97 in Oregon) would be low to moderate. Since the proposed facility would be compatible with applicable management plans and local land use policies, mitigation would not be required.

Impacts to other transportation facilities (e.g., local roads, SR-14, and US 97 in Washington) would be low to high, and would be compatible with applicable management plans and local land use policies. Therefore, mitigation would not be required.

Although mitigation would not be required, the following measures would be implemented to reduce potential impacts:

- Implementation of active dust suppression measures during the construction period to minimize the creation of fugitive dust clouds.
- Use of wind turbine towers, nacelles, and rotors that are locally uniform and that conform to high standards of industrial design to present a trim, uncluttered, aesthetic appearance.
- Use of low-reflectivity, neutral gray, white, off-white, or earth tone finishes for the towers, nacelles, and rotors to minimize contrast with the sky backdrop and to minimize the reflections that can call attention to structures in the landscape.
- Use of neutral gray, white, off-white, or earth tone finishes for the small cabinets containing pad-mounted equipment that might be located at the base of each turbine, to help the cabinets blend into the surrounding ground plane.
- Restriction of exterior lighting on the turbines to the aviation warning lights required by the FAA, which will be kept to the minimum required number and intensity to meet FAA standards.
- Placement of much of the electrical collection system underground, minimizing the system's visual impacts.
- Use of a low-reflectivity finish for the exterior of the O&M facility building to maximize its visual integration into the surrounding landscape.
- Restriction of outdoor night lighting at the O&M facility and the substation to the minimum required for safety and security; sensors and switches will be used to keep lighting turned off when not required, and all lights will be hooded and directed to minimize backscatter and offsite light trespass.
- Use of a low-reflectivity finish for substation equipment.
- Use of low-reflectivity insulators in the substations.
- Use of fencing with a dull finish around the substation to reduce the fence's contrast with the surroundings.

4.8.6 Biglow Canyon Wind Farm

4.8.6.1 Impacts

Residential Areas

Impacts would be the same as those described for the Klondike III Wind Farm.

Recreation Areas

Columbia River Gorge National Scenic Area

Impacts would be the same as those described for the Klondike III Wind Farm.

John Day River

The proposed facility would be visible to varying degrees from sections of the BLM lands in the canyon, from the Wild and Scenic River/Oregon Scenic Waterway segment of the river, and the lands extending 0.25 mile on either side of the river. Most of the lands in this area are privately-owned ranch lands that are used for cattle grazing; transmission lines of various voltages can be seen on the hills along the edge of the canyon or crossing the canyon. Public access to these lands is very limited.

In the limited areas along the river corridor from which facility's turbines would potentially be visible, few turbines would be visible from any one point, and only the blades would likely be visible from many locations. In the places where turbines would be visible, they would appear as elements on the ridgelines in the landscape's background and would have minimal direct effect on the appearance of the walls of the canyon or the canyon floor. Although the turbines would potentially be noticeable in some of the views, because of their small numbers, their location in the background, and the viewing distance (which would range from 1 to 3.5 miles), they would not likely be dominant elements in the scene. To the extent to which they would be visible, the turbines would be subordinate elements of the view, and because views from the canyon already include views of transmission and distribution lines, the presence of the turbines would not substantially alter the existing character and quality of views from the river corridor.

The proposed facility would have moderate to low impacts because the proposed facility:

- would not become the dominant view but would be in view from public lands and waters used for dispersed recreation where the appreciation of natural and scenic resources is a valued part of the use;
- would be somewhat visible but not obtrusive in the view; and
- would be seen by few sensitive viewers because facilities would be partially screened by existing topography.

Oregon National Historic Trail

The proposed facility would not be visible from the High Potential Sites (McDonald Ferry, Fourmile Canyon, Biggs Junction, the Deschutes River Crossing, and The Dalles Complex) within the analysis area. Therefore, there would be no impacts to those resources.

Deschutes River Canyon

The proposed facility would not be visible from the areas in the Deschutes River Canyon along the Deschutes Wild and Scenic River and would be visible only from a small area of the BLM lands within and adjacent to the canyon. Because none of the BLM or private lands that lie within the canyon would be directly affected by the facility and because the facility would not be visible from the interior of the canyon, the facility would be consistent with the BLM Two Rivers Plan and with the provisions of the Wasco County and Sherman County comprehensive plans that identify the Deschutes River Canyon as an important landscape feature.

Impacts to the Deschutes River Canyon would be low to none because the proposed facility would be seen by few sensitive viewers because facilities are partially screened, or predominantly viewed in the middle ground and background of the view; and would not be noticed in the view, or seen from a distance more than 3 miles.

Lower Klickitat River Canyon

The proposed facility would not be visible from the Lower Klickitat River Canyon. Therefore, there would be no impact to that resource.

Transportation

Impacts would be the same (i.e., low to moderate) as those described for the Klondike III Wind Farm.

4.8.6.2 Mitigation Measures

Mitigation would be the same as that described for the Klondike III Wind Farm.

4.8.7 No Action Alternative

No new impacts to visual resources would occur under the No Action Alternative.

4.8.8 Cumulative Impacts

Existing and future development cumulatively increases human-made elements in the rural landscape of the region, adding vertical elements such as farm/agricultural buildings, fences, and signs to the natural terrain. Since the land in the project area is comprised mainly of agricultural uses, these human-made elements are an expected component of the rural landscape.

Cumulative impacts to visual resources potentially increase when industrial and other facilities not related to agriculture are constructed in a rural landscape. The identified cumulative projects would contribute incrementally to potential cumulative impacts on visual resources in the project vicinity. These new facilities would result in moderate to high cumulative impacts to views in the general project area, but this area includes no KVAs or important visual resources (except for the John Day River Canyon) and current viewer sensitivity is low. Cumulative impacts would likely be low to moderate to important visual resources such as the John Day River Canyon and the Journey Through Time Scenic Byway where facilities would potentially be visible in the foreground and middle ground. Cumulative impacts would likely not occur or would be low to the remaining important visual resources in the project vicinity because the cumulative projects would not be visible, or would be visible at such great distances that effects, if any, would be negligible.

Other wind projects in the region, combined with the proposed projects, could create a moderate to high impact to views of various ranges, hillsides and gorges in the region. To many viewers wind farms are a visual attraction, but this perception may diminish as they become commonplace and impact more of the landscape.

4.9 Socioeconomics

4.9.1 Impact Levels

A **positive** impact would occur when an alternative produces one or more of the following effects: provides employment, increases property values, increases tax revenues, or creates other similar effects on the social and economic vitality of affected communities.

A **negative** impact would occur when an alternative produces one or more of the following effects: reduces employment, reduces a tax base, takes land out of production without compensation, exceeds current capacities for housing and public services, or creates other similar effects on the social and economic vitality of affected communities.

No impact would occur if employment levels, tax revenues, property values, land production, demand for housing and public services, or other similar effects remain unchanged or if impacts would be of short duration.

4.9.2 Action Alternatives

4.9.2.1 Impacts

Socioeconomic Impacts are addressed together because the BPA, Klondike III and Biglow Canyon projects could be constructed at the same time. The BPA Proposed

Action and the Middle Alternative would have no discernable differences in their impact to socioeconomics in the area.

Lodging

Local labor would be hired to the extent practicable, but construction of the action alternatives would require construction workers to relocate temporarily to the area. It is likely that the two wind power projects and BPA interconnection would be constructed simultaneously, potentially requiring temporary housing for construction workers on the three projects at the same time. The Klondike III Wind Project and Biglow Canyon Wind Farm ASCs estimate that about 50 to 70 percent of construction staff would be hired from outside the area. Assuming 60 percent of the construction workforce is from outside of the area; lodging would be needed for about 250 temporary employees (30 employees for transmission and substation construction, 70 employees for Klondike III Wind Project and 150 for Biglow Canyon Wind Farm in addition to construction personnel hired locally at peak construction periods). BPA would hire contractors for constructing the transmission line and associated facilities, but would use BPA staff to build spans connecting to the substations. Because work would be temporary, most out-of-town workers would not likely bring their families. Local hiring could be greater, depending on the availability of workers with appropriate skills. Additional workers might commute daily from communities outside the area (e.g., Hood River, and Klickitat County), which would lessen the impacts associated with temporary in-migration of outside workers. Local establishments would benefit from temporarily housing construction workers by increasing demand of available accommodations.

Motels, hotels, and trailer or RV parks would be the most available housing options for temporary residents. Within 30 miles, there are over 750 hotel and motel rooms in The Dalles, Moro, Rufus, Biggs, and Wasco (CH2MHill, 2005). Additional lodging may be available in communities in Washington State or in local campgrounds. Although not all of these lodging facilities would likely be available at any given time, it is expected that there would an adequate supply to meet the needs of the anticipated number of temporary workers, which could be up to 250 people at one time, and that the proposed project would not have a negative impact.

Local Spending and Employment

Constructing the transmission line, substation, and substation expansion (not including the wind power facilities) is estimated to cost between $40 and $45 million. Construction activities would have short-term positive impacts on the local economy by providing construction-related employment opportunities for local residents. Local businesses would benefit from goods and services sold to construction workers.

Construction workers would likely include a mix of locally hired workers for road and turbine pad construction for the wind projects and excavation for the transmission line towers. Specialized workers would be hired for some portions of construction (e.g., substation and electrical transmission construction, turbine erection, turbine testing, etc.).

While neighboring counties would not gain revenue from the site operation through tax payments, residents from communities within those counties could be employed during the construction and/or operation. Income earned by those individuals would contribute to the local economy indirectly through local purchases. In addition, the proposed facilities would purchase goods and services from local and regional businesses, from facility maintenance services to office equipment to business services. Lease payments to local landowners would also benefit the local economy because it is likely that a portion of the lease payments would be spent in nearby communities. All of this would result in a net inflow of dollars into the local economy and would have a beneficial effect beyond that of the project employment.

An estimated 15 to 20 operational personnel would be employed at each wind facility, increasing local employment within Sherman County by 30 to 40 full-time positions. Additional staff would not be required to maintain the new substation and transmission line, although some maintenance tasks, such as vegetation removal, could be hired locally. An increase in employment opportunities would have a positive effect on the economy in Sherman County, particularly because the area has had difficulty replacing jobs lost when aluminum manufacturers closed in 2001. The wind power facilities would provide long-term employment for the life of the facility, expected to be at least 30 years.

Population

Construction would have short- and long-term positive impacts to the Sherman County population. Short-term population increases would be from construction workers temporarily relocating to the area for a portion or duration of construction. During peak construction periods when potentially all three projects would be under construction, population is estimated to increase by 220 residents. The increase in population related to construction would be temporary and would have no permanent impact because they would leave when their work is complete. Temporary population increases would have a positive impact to the local economy from the goods and services they would buy.

Permanent increases in population would be minimal, increasing slightly from operations staff moving to the area for the wind power facilities. No additional staff would be needed for the transmission lines and substation facilities. Orion Energy and PPM Energy expect that about 40 percent of the O&M staff would be hired locally. The remaining 60 percent of permanent positions would be filled from outside the area, adding about 72 new residents (24 new employees x 3.00 average persons per household) to the region's population. Assuming 25 percent of new residents moved to Sherman County, Sherman County's population would increase by less than1 percent.

The area could benefit from increased population because it could increase demand for housing units in an area with high vacancy rates. It is likely that full-time, operations in-migrant employees would relocate to communities near the proposed wind power projects where sewer and water services are provided by those local jurisdictions, but some new residents could also relocate to a rural area outside of a town or city where the residences would have private wells and septic systems. Because of the high vacancy rates in Sherman County and its communities, and the small number of expected in-migrants, new residents would likely move to existing housing units that would already be connected to local utilities and would have no impact to those services.

Economic Factors

The proposed project would permanently remove some land from agricultural production, about 225 acres for the transmission line towers, substations and wind power facilities. Landowners would be compensated for impacts to their property. Wind power facility operators would lease land from landowners for each turbine site. Landowners who receive payments for permitting the location of turbines on their property would see an increase in income, having a positive impact to the local economy.

The proposed project would not have an adverse impact on economic activity in the area. Rather, revenues generated from purchases of goods and services in the local area would benefit public services, including schools and others services.

Community Values and Concerns

The public scoping process for the proposed transmission line and substation identified support and concerns for the proposed actions. Generally, comments were in support of the project. Other comments can generally be grouped into five categories: location of the transmission facilities, avoidance of populated areas and homes in rural areas, potential impacts to cultural and archeological resources, impacts to avian species, and visual impacts in the immediate vicinity of the project.

Location of the proposed transmission line was the greatest public concern. Several landowners felt that locating the transmission line along existing roads would have the least impact on farming operations and that transmission line towers located in the middle of fields could have an adverse impact on farming operations. The Middle Alternative would generally avoid placing towers in the middle of field because it would be located along public rights-of-way or along property lines. The BPA Proposed Action would generally follow public rights-of-way, but would travel across several parcels where it turns west towards the John Day Substation, potentially having a negative impact on the landowners' ability to efficiently use their properties.

Other comments identified concerns about locating the transmission line near homes or in local communities, potential impacts to archeological and cultural resources from ground disturbing activities, and impacts to avian species. Locating the transmission facilities near populated areas, particularly Wasco, were generally in reference to alternatives considered but not advanced for further study, mainly Alternative E, which would have been located near Wasco and a new home. Other concerns about impacts to cultural and archeological resources and impacts to avian species are addressed in Sections 4.10 and 4.6, respectively.

Local and State Taxes

As with other wind power facilities in Sherman County, the proposed energy facilities would be a new source of property tax revenue to local government. Improvements would be included in local property tax valuations. Property tax increases would be paid by the landowner with funds provided by project owners. Additional property tax revenues would provide more funds for schools, roads, police, fire, and other municipal needs, which would benefit the entire community.

Income earned from leases to wind power facilities operators would be taxed as income in Oregon, which would have a positive, albeit minor, impact to state tax revenue.

4.9.2.2 Mitigation Measures

The proposed project would have no negative socioeconomic effects.

4.9.3 BPA No Action Alternative

Under the No Action Alternative, socioeconomic conditions would remain similar to those of today. Temporary and permanent employment related to the action alternatives would not occur. Landowners would not receive lease payments or have any land purchased, and Sherman County would not receive additional tax revenue.

4.9.4 Cumulative Impacts

Development of the identified cumulative projects would generally have a beneficial cumulative socioeconomic effect. In addition to providing additional property tax revenues to local economies, many of these projects would likely increase employment in the general area, with employees hired both locally and from out of town. To the extent that out-of-town workers are hired, there are sufficient accommodations in the region for the cumulative increase in workers due to the cumulative projects.

The cumulative wind projects would require the acquisition of long-term easements and lease agreements for wind project facilities, which would result in a cumulative loss of agricultural land in Sherman County. However, this economic loss would be mitigated by payments to the landowners. The cumulative effect would benefit the local economy. Additional property tax revenues from the wind power facilities would also benefit Sherman County.

Development of the proposed projects could contribute incrementally to a positive cumulative impact on the economy in the project area from a potential reduction in unemployment, and revenues from increased spending on accommodations, goods, and services during construction. An estimated 15 to 20 operational personnel would be employed at each wind facility in addition to the eight employees at Klondike Wind Project phases I and II, increasing local employment within Sherman County by 38 to 48 full-time positions related to wind power projects.

Other proposed or planned wind projects in Sherman and other counties could also provide employment opportunities.

4.10 Cultural Resources

4.10.1 Impact Levels

- A **high** impact would occur if a resource site is within an access road, substation, tower, turbine, or other proposed facility site. Direct physical disturbance of the site is certain unless adequate avoidance measures are taken.
- A **moderate** impact would occur if a resource site is within 100 feet of the proposed disturbance area or if the site is down slope of potential disturbance. Direct physical disturbance is possible.
- A **low** impact would occur if the resource site is outside the high and moderate impact areas or is in a deep, narrow draw or canyon that may be spanned. Direct physical disturbance is unlikely. Indirect forms of disturbance could occur.
- **No** impact would occur if the proposed facility is design to avoid the resource site and any disturbance to the site.

4.10.2 BPA Proposed Action

4.10.2.1 Impacts

The archaeological survey and records review for the Proposed Action indicate that most of the previous studies and recorded sites are along the Columbia, Deschutes, and John Day rivers, and are outside of the analysis area. Historic-period documents indicate that the Oregon Trail crossed the proposed route, but field surveys did not identify any evidence of the trail, primarily because much of the project area is cultivated or ROW and has been previously disturbed.

The two archeological sites identified within the project corridor could be affected by construction (AINW, 2005a), although the impact to those sites would depend on the specific location of transmission line towers. Because the archeological sites are small, the towers would be placed to avoid the identified resources, which would cause no impact to cultural resources.

4.10.2.2 Mitigation Measures

For both action alternatives, BPA would avoid disturbing known archaeological and historic resources. Local tribes that historically lived in the area would be consulted to identify any cultural resources to avoid.

During construction, archaeological sites and historic homesteads would be temporarily flagged in the field and on construction maps before and during construction.

If necessary, archaeological construction monitors would be present during construction in selected locations to prevent accidental damage to identified cultural resources.

In the event that undiscovered archaeological sites are inadvertently disturbed during construction, construction work would be halted at the site until an archaeologist or cultural resource specialist could assess the site and determine appropriate mitigation measures.

4.10.3 BPA Middle Alternative

4.10.3.1 Impacts

As with the Proposed Action, the archaeological survey and records review for the Middle Alternative indicate that most of the previous studies and recorded sites are along the Columbia, Deschutes, and John Day rivers, and are outside of the analysis area. Historic-period documents indicate that the Oregon Trail crossed the Middle Alternative route. The portion of the Middle Alternative that would cross the Oregon Trail was not surveyed because access was not granted to the private property where the route would be located. As with the Proposed Action, most of private property in the area is cultivated and the surface is disturbed from farming activities. It is likely that no evidence of the trail remains, although if this alternative were chosen, additional surveys would be required to identify any evidence of intact trail segments.

The two archaeological sites identified within the project corridor could be affected by the construction (AINW, 2005a), although as with the Proposed Action, the impact to those sites would depend on the specific locations of transmission line towers. It is the general policy of the Oregon SHPO that archaeological isolates are not significant resources and are not eligible for listing in the NRHP. These isolates would not be considered significant resources (AINW, 2005a). Because the archeological sites are small, it is likely that the towers could be placed to avoid the identified resources. Because the entire length of the Middle Alternative was not surveyed, other archeological sites could exist within the Middle Alternative corridor.

4.10.3.2 Mitigation Measures

Mitigation measures would be the same as for the BPA Proposed Action.

4.10.4 Klondike III Wind Project

4.10.4.1 Impacts

No identified archaeological or historic resources would be impacted by the Klondike III Wind Project.

Despite the lack of physical evidence for the Oregon Trail within the Klondike III Wind Project site boundary, the trail alignment has been recognized at both federal and state levels. Any intact segments are highly likely to be eligible for listing on the NRHP and would also likely be eligible for designation as a National Historic Landmark. Due to the importance of the trail, construction of the Klondike III Wind Project would avoid the mapped alignment of the Oregon Trail. Should intact physical evidence of the trail that is not currently recognized be observed where there is potential for adverse effects, concerted efforts would be made to avoid any disturbance to the intact segments.

Construction and operation of proposed facility is not likely to result in major adverse impacts to archaeological resources because only scattered isolates occur within the site boundary, nor is it likely to have direct effects on the Oregon Trail because no intact sections have been observed within the site boundary. The project may have adverse impact on the visual setting of the trail, which is described in Section 4.8.

4.10.4.2 Mitigation Measures

If intact trail segments are identified during construction and could not be avoided, the Klondike III Wind Project would consult with the SHPO to determine appropriate mitigation measures.

The turbine strings, particularly those in the northeastern Klondike III Wind Project area, would cross the Oregon Trail alignment. However, there are no known intact trail segments. The trail would not be visible from the five High Potential Sites identified in the trail's management plan. However, the following mitigation measures are proposed to minimize visual effects to the rural setting of the trail alignment:

- The present setting of the Oregon Trail alignment from the John Day River Canyon to Biggs would be documented through photographs and videotape prior to construction of the Klondike III Wind Project; and

- Klondike III Wind Project would partner with the Sherman County Development League and consult with the Sherman County Historical Society to develop and enhance educational and interpretive displays and materials on the Oregon Trail at Biggs, which offers the best opportunity for visitor contact given the presence of an intact segment of the trail at Biggs and the proximity to I-84.

Archaeological sites and historic homesteads would be temporarily flagged in the field and on construction maps before and during construction. If necessary, archaeological construction monitors would be present during construction in selected locations to prevent accidental damage to identified cultural resources.

In the event that undiscovered archaeological sites are inadvertently disturbed during construction, construction work would be halted at the site until an archaeologist or cultural resource specialist could assess the site and determine appropriate mitigation measures.

4.10.5 Biglow Canyon Wind Farm

4.10.5.1 Impacts

None of the properties identified within the project boundaries of the Biglow Canyon Wind Farm are believed to be eligible for listing on the NRHP. Homestead A, described in Section 3.10.3, could be directly affected by construction of the proposed facility, but the property is not an eligible resource and impacts would not be significant (CH2MHill, 2005). All other cultural resources would be avoided during construction, operation, and retirement of the proposed facility.

A Cultural Resource Management Plan has been developed for the proposed facility in coordination with the Oregon SHPO. The management plan includes specific protocols and procedures for protecting identified cultural resources, as well as any additional sites discovered during construction.

4.10.5.2 Mitigation Measures

During construction, archaeological sites and historic homesteads would be temporarily flagged in the field and on construction maps before and during construction. If necessary, archaeological construction monitors would be present during construction in selected locations to prevent accidental damage to identified cultural resources.

In the event that undiscovered archaeological sites are inadvertently disturbed during construction, construction work would be halted at the site until an archaeologist or cultural resource specialist can assess the site and appropriate mitigation measures be completed.

4.10.6 BPA No Action Alternative

Under the BPA No Action Alternative, no historic or cultural resources would be affected.

4.10.7 Cumulative Impacts

Cultural resources in the project area have been and are being affected because of past and current development activities. Potential adverse effects on cultural resources include disturbance of cultural sites, increased likelihood of vandalism, reduction of the cultural integrity of certain sites, and increased encroachment on cultural sites. Future development could impact cultural resources if developments are not designed to avoid the resources. Cultural resource surveys and coordination with affected Tribes, as required under the National Historic Preservation Act and other environmental laws, would identify the locations of these resources so they could be avoided to the extent possible. While impacts to cultural resources from the identified cumulative projects could result in a net cumulative loss of cultural resource values in the region, implementation of mitigation programs would help reduce cumulative impacts to the extent possible.

Development of the proposed projects would contribute incrementally to these cumulative effects on cultural resources in the analysis area. No known archaeological or historic resources would be directly affected by any of the proposed projects. Visual impacts to historic resources, particularly the Oregon Trail, could occur. Cumulative impacts as they relate to visual resources are described in Section 4.8.8.

4.11 Noise, Public Health and Safety

4.11.1 Noise Levels

4.11.1.1 Construction Noise

Construction of the BPA action alternatives and the wind projects would cause localized, short-duration noise. Such temporarily increased noise levels would result from normal construction activities. Noise levels from construction activities can be expected to range from ambient to 100 dBA at a distance of 50 feet from the activities. OAR 340-035-0035(5)(g) specifically exempts construction activity from regulation. Impacts would be temporary.

4.11.1.2 Transmission Line

Corona-generated audible noise levels were calculated for average conductor heights for fair and foul weather conditions. The predicted levels of audible noise for the proposed transmission line operated at a voltage of 237-kV are given in Table 4-7 and plotted in Figure 2. (See Appendix C for more detail.)

The calculated median level (L_{50}) during foul weather at the edge of the ROW, of the proposed 230-kV transmission line ROW (62.5 feet from centerline) is 42 dBA, the calculated maximum level (L_5) during foul weather at the edge of the ROW is 46 dBA. During fair weather conditions, which occur about 94 percent of the time in the Wasco area, audible noise levels at the edge of the ROW would be about 20 dBA if corona were present. These lower levels could be masked by ambient noise on and off the ROW.

The calculated foul-weather corona noise levels for the proposed transmission line would be comparable to, or less than, those from the existing 230-kV lines in Oregon. During fair weather, noise from conductors might be perceivable on the edge of the ROW; however, beyond the ROW, it would very likely be masked or so low as to not be perceived. During foul weather, when ambient noise is higher, it is also likely that corona-generated noise off the ROW would be masked to some extent as well.

Figure 2: Predicted Foul-weather Audible Noise Levels for the 230-kV Transmission Line.

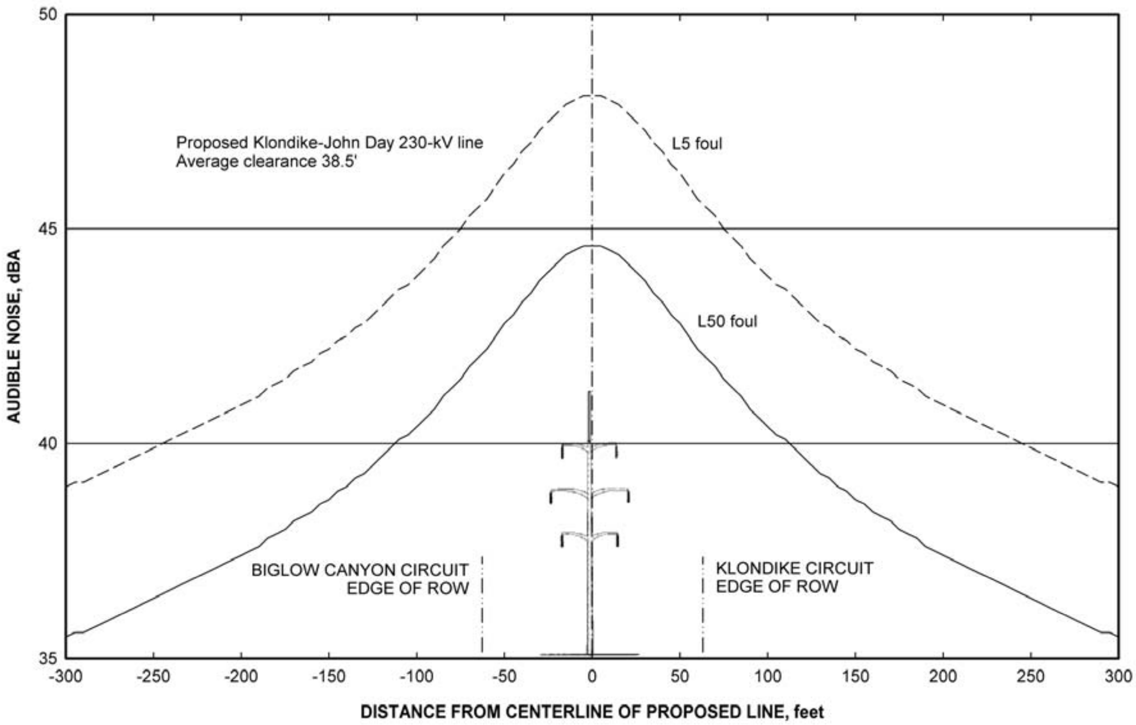


Table 4-7 Predicted Audible Noise Levels at Edge of 230-kV Line ROW

Edge of 230-kV Line Right-of-Way Audible Noise		
Descriptor	**L_{50}, dBA**	**L_5, dBA**
Foul weather	42	46
Fair weather	17	21
Note: AN levels expressed in decibels on the A-weighted scale (dBA). L_{50} and L_5 denote the levels exceeded 50 and 5 percent of the time, respectively.		

On and off the ROW, the levels of audible noise from the proposed transmission line during foul weather would be well below the 55-dBA level that could interfere with speech outdoors. The distance to the nearest residence to the proposed line is about 0.25 miles. At this distance, the AN from the line would be about 30 dBA during foul weather, and probable not be perceived above background noise. During such periods, ambient noise levels could be increased due to wind and rain hitting foliage or buildings.

The computed annual L_{dn} level for transmission lines operating in areas with about 6 percent foul weather is about $L_{dn} = L_{50} – 3$ dBA (Bracken, 1987); therefore, assuming such conditions in the area of the proposed 230-kV line, the estimated L_{dn} at the edge of the ROW would be about 39 dBA, which is well below the EPA L_{dn} guideline of 55 dBA.

Along the proposed transmission line routes there could be increases in the perceived noise above ambient levels during foul weather at the edges of the proposed 230-kV ROW. The corona–generated noise during foul weather would be masked to some extent by naturally occurring sounds such as wind and rain on foliage. During fair weather, the noise levels off the ROW from the proposed transmission line would probably not be detectable above ambient levels. The noise levels from the proposed transmission line would be below levels identified as causing interference with speech or sleep. The audible noise from the transmission line would be below EPA guidelines levels and would meet the BPA design criteria that comply with state noise regulations. Similarly the new substation would be designed and constructed to meet all federal, state and local regulations.

4.11.1.3 Substation

The proposed transformers and other equipment installed at the new John Day 230-kV Substation would be specified so that BPA noise level criterion of 50 dBA for new substations would be met at the edge of the property (USDOE, 2006). This will ensure that all applicable federal, state and local regulations are met.

However, the new equipment would be placed in an environment with noise from existing transmission lines, and existing equipment in the John Day 500-kV Substation. The combined noise level from the existing and new facilities could exceed 50 dBA design levels at points on the perimeter of the expanded substation; however, the levels would be controlled to meet all applicable regulations at the edge of the property.

4.11.1.4 Wind Projects

The project vicinity is rural and existing noise levels are low with infrequent noise from agricultural activities. DEQ regulations at OAR 340-035-0035 establish noise standards at sensitive receptors. At the proposed project sites, residences are the only noise sensitive properties identified. New noise sources on sites that have not previously been used for commercial or industrial purposes have a limit on the allowable increase over existing ambient noise levels. Generally, sources on new sites may not increase the noise levels by more than 10 dBA.

Both the Klondike III Wind Project and the Biglow Canyon Wind Farm may increase the noise levels by more than 10 dBA. Oregon law allows owners of sensitive receptors to execute a noise easement with the industrial facility to legally exceed this standard, provided some benefit accrues to the property owner. Both wind projects anticipate obtaining such noise easements from owners of property that might experience noise over the 10 dBA standard.

4.11.2 Electric and Magnetic Field Effects

Electric and magnetic fields from the proposed transmission line have been characterized using well-known techniques accepted within the scientific and engineering community. The expected electric-field levels from the proposed transmission line at minimum design clearance would be comparable to those from existing 230-kV lines in Oregon, and elsewhere. The expected magnetic-field levels from the proposed transmission line would be comparable to those from other 230-kV lines in Oregon and elsewhere. See Appendix D for more information about research regarding effects of EMF.

4.11.2.1 Transmission Line Calculated Values for Electric Fields

The peak electric field expected under the proposed transmission line would be 2.4 kV/m; the maximum value at the edge of the ROW would be about 0.3 kV/m. Clearances at road crossings would be increased to reduce the peak electric field to 0.5 kV/m or less. The electric field from the proposed line would meet regulatory limits for public exposure in Oregon and all other states that have limits and would meet the regulatory limits or guidelines for peak fields established by national and international guidelines setting organizations.

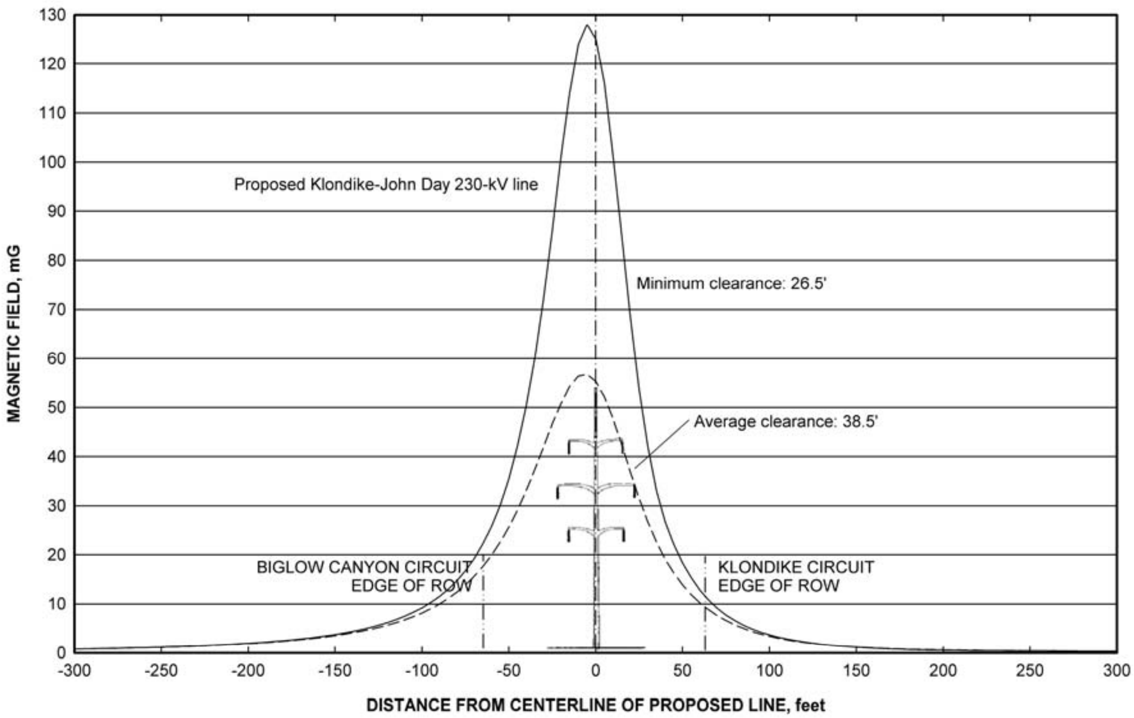
Short-term effects from transmission line fields are well understood and can be mitigated. Nuisance shocks arising from electric-field induced currents and voltages could be perceived on the ROW of the proposed transmission line. To mitigate these effects it is common practice to ground permanent conducting objects during and after construction to guard against such occurrences.

4.11.2.2 Transmission Line Calculated Values for Magnetic Fields

The magnetic fields from the proposed transmission line would be within regulatory limits of the two states that have established them and would be within guidelines for public exposure established by the ICNIRP and IEEE.

Under maximum current conditions on both circuits, the maximum magnetic fields under the proposed transmission line would be 128 mG; at the edge of the ROW of the proposed transmission line the maximum magnetic field would be 24 mG (see Figure 3). With only the Biglow Canyon circuit loaded to maximum current levels, the magnetic fields would increase to a maximum of 150 mG on the ROW and 44 mG along the ROW edge. Over a year, the magnetic field levels would average about 30 percent of the above levels, due to the intermittent nature of the wind resource.

Figure 3 Magnetic-field Profiles for the Proposed Transmission Line Under Maximum Current Conditions.



4.11.2.3 Wind Project Collectors

The wind projects would use 34.5-kV collectors to collect power from the wind turbines. Klondike III's circuits would all be below ground; Biglow Canyon would use above ground and below ground collectors. Above ground circuits emit electric fields and are measurable at the ground; however, buried cables, buried at a depth of 4 feet, emit no electric fields since the electric field is contained within the buried cables.

The voltage, and therefore the electric field, around a conductor, remains practically steady and is not affected by the common daily and seasonal fluctuations in usage of electricity by customers. Electric fields are inversely proportional to the distance a sensor (such as a person) is from the conductors, so that the electric field strength declines as the distance form the conductor increases. The strength of the field (measured in units of kilovolts per meter [kV/m]) at any location depends on the voltage of the conductor, the geometry of the construction, the degree of the cancellation from other conductors, and the distance of the conductors. The maximum electric field under Biglow Canyon's overhead 34.5-kV distribution line would be less than 1 kV/m (CH2MHill, 2005).

Maximum magnetic fields are measured at 1 meter above the ground. Both buried cables and overhead conductors emit magnetic fields. The maximum magnetic field values for the underground circuits occur directly over the buried cable of an isolated circuit, and would be 62.9 mG for the Biglow Canyon project and 41.1 mG for the Klondike III project (DEA, 2005). The maximum magnetic field values for the overhead circuits would be directly under the circuits and would amount to 144.6 mG for Biglow Canyon (CH2MHill, 2005).

4.11.3 Toxic and Hazardous Substances

4.11.3.1 BPA Construction

Several common construction materials (e.g., concrete, paint, and wood preservatives) and petroleum products (e.g., fuels, lubricants, and hydraulic fluids) would be used during construction. BPA would follow strict procedures for disposal of these or any other hazardous materials. A spill response plan would be in place and any spills would be contained and contaminated materials disposed of properly. **No** impacts would occur.

4.11.3.2 Mitigation

BPA would develop and implement a Spill Prevention and Contingency Plan to minimize the potential for spills of hazardous material including provisions for storage of hazardous materials and refueling of construction equipment outside of riparian zones.

4.11.3.3 Wind Projects

Hazardous materials would be used in a manner that is protective of human health and the environment and would comply with all applicable federal, state and local environmental laws and regulations. Accidental releases of hazardous materials (e.g., vehicle fuels during construction/maintenance or lubricating oils for the turbines) would be prevented or minimized through proper containment of these substances during transportation and use. Any oily waste, rags or dirty or hazardous solid waste would be collected in sealable drums and either removed for recycling or properly disposed of by a licensed contractor.

4.11.3.4 Mitigation

In the unlikely event of an accidental hazardous materials release, any spill or release would be cleaned up and the contaminated soil or other materials properly disposed of and treated according to applicable regulations. Spill kits containing items such as absorbent pads would be located on equipment and in on-site temporary storage facilities to respond to accidental spills, if any were to occur. Employees handling hazardous materials would be instructed in the proper handling and storage of these materials as well as where the on-site spill kits would be located.

4.11.4 Fire Protection – All Projects

Construction of the new transmission line, substation and wind projects would take place primarily during spring, summer, and fall. During a portion of this time, the weather could be hot and dry, with increased danger of fire. At such times the potential for fire is high; the potential would increase even more with the increased use of vehicles and other motorized equipment. The addition of construction workers in the area also would elevate the potential for fire. Restrictions on operations during fire season may limit timing of some construction activities. Operation and maintenance, including vegetation management if necessary, would involve increased activity along the line by employees and contractors, slightly increasing the potential for fire. Impacts would be low.

The North Sherman County Rural Fire Protection District has indicated that the proposed projects would not affect the department's ability to provide fire protection or ambulance service for their service areas (Thomas, 2005).

4.11.4.1 Mitigation

To minimize the potential of fires starting from construction-related activities, roads would be established prior to construction to minimize vehicle contact with dry grass; idling vehicles in grassy areas would be avoided; and open flames, such as cutting torches, would be kept away from grassy areas. Staging areas would be graveled to minimize fire potential.

BPA would take all appropriate precautions to prevent fires and follow the fire control regulations, including equipping all vehicles with basic fire-fighting equipment including extinguishers, shovels, and other equipment deemed appropriate for fighting grass fires. BPA will also develop a fire prevention and suppression plan. BPA prohibits the storage of flammable materials on the ROW. Operation and maintenance of the proposed line and substation would follow prescribed policies that minimize the potential for fire.

The proposed turbines for the wind projects have built-in equipment protection features that shut down the turbine automatically to minimize the chance of a mechanical problem causing major damage or a fire. The underground electrical collection system substantially reduces the risk of fire from short circuits caused by wildlife or weather.

The county fire department will be given a copy of the approved site plan indicating the identification number assigned to each turbine, and the location of the substation and accessory structures. The fire department will also receive any gate keys to the facility.

All on-site employees will receive annual fire prevention and response training by qualified instructors or members of the local fire department. Employees will also be required to keep all vehicles on roads and off dry grassland during the dry months of the year, unless such activities are required for emergency purposes, in which case fire precautions will be observed. Service vehicles shall be equipped with a shovel and portable fire extinguisher of a 4A5OBC or equivalent rating.

4.11.5 Radio Interference (RI) and Television Interference (TVI)

The wind projects are not expected to cause radio or TV interference.

The single 1.6-inch diameter conductor that BPA would use for the proposed 230-kV transmission line would mitigate corona generation and keep radio and television interference at acceptable levels below those of many existing 230-kV lines with smaller conductors.

Predicted EMI levels for the proposed 230-kV transmission line are comparable to, or lower than, those that already exist near 230-kV lines and no impacts of corona-generated interference on radio, television or together receptors (such as cell phones) are anticipated. Furthermore, if interference should occur, there are various methods for correcting it, and BPA has a program for responding to legitimate complaints. Impacts would be low.

4.11.6 Sheriff Services

In the event response is required at project facilities, sheriff services can be accommodated with existing department resources. No adverse impacts to the Sheriff's Department are anticipated as a result of the proposed projects (Larhey, 2005).

4.11.7 Health Care

The proposed projects would not adversely impact medical services in the analysis area. Mid-Columbia Valley Medical Center in The Dalles would be capable of providing services for construction and operational employees in case of an emergency (Thomas, 2005).

4.11.8 Additional Health and Safety Mitigation Measures

In addition to the mitigation measures previously identified in Section 4.11, the following additional mitigation measures would help minimize the low potential health and safety risks to workers and the public for construction of the proposed transmission line:

- Prior to the start of construction, the contractor would receive environmental and safety training and prepare and submit for BPA's approval a safety plan. This plan would detail how the contractor would how they would manage hazardous materials such as fuel, oil, solvents etc., and how emergency situations would be handled. The safety plan would be kept on site at all times during construction.
- During construction, the contractor would hold meetings, as needed, to go over potential safety issues and concerns.
- At the end of each workday, the contractor and any subcontractors would secure the site to protect equipment and the general public.

- The contractor and any subcontractors would be trained in tower climbing rescue techniques, first aid including cardiopulmonary resuscitation, and safety equipment inspection.
- BPA would provide notice to the landowners and the public of construction activities.
- If implosive fittings are used to connect the conductors, BPA or the contractor would notify landowners and local government officials in advance.
- During construction activities, the contractor would follow BPA specifications for grounding fences and other objects on and near the proposed ROW.

4.11.9 No Action Alternative

Under the No Action Alterative, the proposed transmission line and wind farms would not be built and the potential health and safety risks associated with them would not occur.

4.11.10 Cumulative Impacts

The proposed projects would have no to low impacts on noise. These impacts would be localized and would not be expected to add cumulatively to noise from other cumulative projects identified in the project vicinity.

Public health and safety for the residents and visitors in the analysis area could be incrementally impacted for a short time during construction, but would not be impacted over the long term. These impacts, added to the impacts from the identified cumulative projects including current and proposed wind farms, would not be expected to strain the existing health and safety infrastructure nor greatly increase risks to local residents and visitors. Additional wind projects and other development would likely have similar low impacts in the general area.

4.12 Air Quality

4.12.1 Impact Levels

Impacts would be considered **high** where actions would:

- Create an effect that could not be mitigated.
- Create a widespread reduction in air quality.
- Create a probable risk to human health or safety.

Impacts would be considered **moderate** where actions would:

- Create an effect that could be partially mitigated.

- Create a localized reduction in air quality.
- Create a possible, but unlikely risk to human health or safety.

Impacts would be considered **low** where actions would:

- Create an effect that could be largely mitigated.
- Create reduced air quality confined to the site of the action or to the time of construction.
- Create insignificant or very unlikely health and safety risks.

No impact would occur if no new source of air pollutants were created.

4.12.2 Impacts from BPA's Action Alternatives and the Wind Projects

Of the six criteria air pollutants, particulate matter, or PM-10, is the main concern for the proposed transmission line, substation and wind farm facilities. PM-10 are particles with aerodynamic diameter smaller than 10 micrometers and include: "dust, dirt, soot, smoke and liquid droplets directly emitted into the air by sources such as factories, power plants, cars, construction activity, fires, and natural windblown dust" (U.S. Environmental Protection Agency, September, 2003). PM-2.5 are "fine particles" with aerodynamic diameter smaller than 2.5 micrometers. PM-2.5 particles can be "directly emitted from sources such as forest fires or they can form when gases emitted from power plants, industry and automobiles react in the air" (U.S. Environmental Protection Agency, March 1, 2006.) The greatest potential for increased emissions in Sherman County, associated with the proposed projects, is the release of particulate matter into the air during the construction phase. However, construction may not take place simultaneously and the wind projects could be completed in phases, so a small amount of soil would be exposed at any one time.

Fugitive dust emissions would result from dust entrained during project site preparation including road building, on-site travel on unpaved surfaces, and soil disrupting operations. Wind erosion of disturbed areas would also contribute to fugitive dust.

Construction activities also temporarily generate small amounts of carbon monoxide (CO). Heavy trucks and construction equipment powered by gasoline and diesel engines would generate CO from exhaust emissions. If construction traffic were to delay or reduce the speed of other vehicles in the area, CO emissions from traffic would increase slightly. CO emissions would be temporary and limited to the immediate area surrounding the construction site.

Wind farms help off-set the production of air pollutants and greenhouse gasses by replacing a small percentage of energy that otherwise would have to be generated, presumably, by traditional, 'dirtier' energy sources such as a gas or coal fired turbines.

Sherman County is an attainment area with the lowest total emissions of any county in Oregon. The proposed construction time varies and the projects may be completed in phases. Overall, air quality impacts would be low because impacts would occur in the short term in a very localized area, during construction only, with very unlikely health and safety risks.

Permanent operations and maintenance staff would drive to the wind projects daily, likely using gasoline- or diesel-powered vehicles that would generate CO. The exhaust from those vehicles would have almost no impact to air quality in the area considering current air quality and the small number of trips from operations and maintenance staff (15 to 20 employees) needed to operate each facility.

Operations and maintenance staff would perform periodic maintenance on the transmission line and turbines, requiring equipment to drive along gravel or dirt roads along the turbine strings. Depending on the amount of moisture within the soils, some dust could be generated. No long-term impacts are anticipated because the dust generated from those activities would be minimal, particularly when compared to the much higher levels of dust generated from ongoing farming activities in the surrounding area. CO emissions from the small number of maintenance vehicles required would also be minimal and temporary. There would be no long-term impact to air quality.

4.12.3 Mitigation Measures

There are activities that can be taken to mitigate for adverse impacts to air quality due to construction activities. BPA, and PPM and Orion would mitigate for dust during construction and follow all necessary local and federal requirements. The following mitigation measures could be used:

- Water trucks would be used on an as-needed basis to minimize dust
- Gravel (2-3 inch) will be placed on access roads before turbine construction
- All construction vehicles will travel at low speeds to minimize dust
- Chipping or "lop and scatter" would be used to dispose of small limbs and branches. No burning will be allowed.
- All on-road vehicles will comply with Oregon State emission standards.
- Off-road vehicles would be in good running condition, minimizing their emissions.
- On-road diesel vehicles will use low sulfur fuel.
- Reseeding and revegetation will minimize exposed soil prone to erosion.

4.12.4 No Action Alternative

Under the No Action Alterative, the proposed transmission line and wind farms would not be built and the potential air quality impacts would not occur.

4.12.5 Cumulative Impacts

The primary air quality impact from the identified cumulative projects would be temporary dust emissions from construction of these projects. Whether these impacts would be cumulatively additive would depend on construction timing, the effectiveness of dust mitigation measures employed, and the distance between the projects.

If some of the cumulative projects have similar construction windows and are located in relative proximity to each other, they could have a temporary low-level impact to air quality in the immediate vicinity of the construction site(s). These impacts would be temporary and localized. With implementation of dust control mitigation measures, construction-related air quality impacts would be reduced. If the projects are completed in phases, these temporary impacts would be created over time, but would not result in long-term cumulative impacts to air quality.

BPA's Proposed Action and the wind projects would add vehicle emissions from construction equipment, as well as cars and other vehicles used by construction, operation, and maintenance staff. These emissions would contribute incrementally to cumulative impacts on air quality from vehicle emissions in the region. However, given the current excellent air quality conditions in the region and the temporary and localized effects of expected vehicle emissions related to the identified cumulative projects, this cumulative impact would be expected to be low.

4.13 Short-Term Use of the Environment and the Maintenance and Enhancement of Long-Term Productivity

The BPA action alternatives, Klondike III Wind Project, and Biglow Canyon Wind Farm would permanently remove about 17, 64, and 170 acres respectively, (246 acres total), of primarily agricultural land and temporarily disturb about 120, 97, and 387 acres, respectively, (604 acres total) of primarily agricultural land. Following construction, the 604 acres of temporarily disturbed land would be restored (e.g., regraded and replanted) to its pre-project use.

The operators of the Klondike III Wind Project and Biglow Canyon Wind Farm would be required to retire their facilities after the wind projects have ceased operation. Facility retirement would include removal and to the extent practicable, recycling of turbines, turbine pads and other equipment, and returning the land underneath to productive farmland or other habitat. Roads that are improved for the project may be removed or left in place at the request of the property owner. These actions would maintain long-term productivity of farmed lands and wildlife habitat.

4.14 Irreversible and Irretrievable Commitment of Resources

As stated above, most of the impacts to farmland and wildlife habitat would be reversed upon retirement of the projects. However, an unknown acreage of improved farm roads would be left in place at that time and these impacts would not be reversed.

The only irretrievable commitment of resources expected to result from the project is the consumption of fossil fuels during construction, operations, and maintenance of the projects.

4.15 Adverse Effects that Cannot Be Avoided

Implementation of the proposed project would result in some adverse impacts that cannot be fully avoided; many of the impacts would be temporary and others longer term. These impacts and proposed mitigation are discussed under specific resource sections earlier in this chapter. Some of the adverse effects that cannot be avoided in the proposed project include the following:

- Mortality of individual bird and bats.
- Temporary and permanent conversions of land areas to be used for structure sites, access roads, staging areas, tensioning sites, and new substations.
- Interference with farming operations.
- Temporary disturbances to motorists and residents during construction.
- Increased noise levels during construction and operation.
- Potential for health effects from magnetic fields.
- Visual impacts associated with the proposed steel poles, lattice steel towers, substation facilities, and wind turbines.
- Short-term increase in pollutant levels during construction from dust and vehicles.
- Negligible reduction in agricultural production.
- The elimination of small areas of vegetation from permanent physical developments.
- Short-term soil compaction, erosion, and vegetation degradation from construction and maintenance.
- Short-term disturbance to wildlife during construction.
- A reduction in the amount of vegetation available for wildlife habitat.

Chapter 5 - Consultation, Permit and Review Requirements

In this Chapter:

- Laws and procedures to be met
- Actions taken
- Consultations

5.1 National Environmental Policy Act

This Draft EIS was prepared by BPA pursuant to regulations implementing the National Environmental Policy Act (NEPA) (42 USC 4321 et seq.), which requires federal agencies to assess the impacts that their actions may have on the environment. BPA's proposal to construct the transmission line and substation requires that it assess the potential environmental effects of the proposed project, describe them in an EIS, make the EIS available for public comment, and consider the impacts and comments when deciding whether to proceed with the project.

5.2 Endangered and Threatened Species

The ESA (16 USC 1536) provides for the conservation of endangered and threatened species of fish, wildlife and plants. Federal agencies must ensure proposed actions do not jeopardize the continued existence of any endangered or threatened species, or cause the destruction or adverse modification of their habitat. When conducting any environmental impact analysis for specific projects, agencies must identify practicable alternatives to conserve or enhance such species.

Possible impacts of the proposed facilities to known or suspected occurrences of federal threatened or endangered species or their habitat are discussed in Chapter 4 of the DEIS. Bald eagles are the only federally listed species that could be affected by the proposed project.

Section 7 of the Endangered Species Act, 16 U.S.C. Section 1536(a)(2), requires all federal agencies to consult with the National Marine Fisheries Service (NMFS) for marine and anadromous species, or with the United States Fish and Wildlife Services (USFWS) for fresh-water and wildlife species, if they are proposing an action that may affect listed species or their designated habitat. Each federal agency shall insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

If listed species or designated critical habitat is present and could be affected by the proposed project a ***biological assessment*** (BA) must be prepared to analyze the potential effects of the project on listed species and critical habitat and make an effects determination. NMFS and/or USFWS review the BA and, if they conclude that the project may adversely affect a listed species or their habitat, issue a biological opinion, which includes a take statement and a list of reasonable and prudent alternatives to follow during construction. If NMFS and/or USFWS find that the project may affect, but is not likely to adversely affect a listed species or their habitat, they will issue a letter of concurrence.

BPA contacted the USFWS for a list of threatened and endangered species with potential to occur in the vicinity of the proposed project. The only species listed on the ESA that occurs in the project vicinity is the bald eagle. Other listed or candidate species which, as determined through further analysis, are not expected to occur in the analysis area, include the yellow-billed cuckoo and the Washington ground squirrel.

No listed species would be adversely impacted by this project and so a biological assessment is not required.

5.3 Fish and Wildlife Conservation

5.3.1 Fish and Wildlife Conservation Act

The Fish and Wildlife Conservation Act of 1980 (16 USC 2901 et seq.) encourages federal agencies to conserve and promote conservation of non-game fish and wildlife species and their habitats. In addition, the Fish and Wildlife Coordination Act (16 USC 661 et seq.) requires federal agencies undertaking projects affecting water resources to coordinate with the USFWS and the state agency responsible for fish and wildlife resources. Because the proposed project would not affect water resources, the Fish and Wildlife Coordination Act is not applicable.

Mitigation measures designed to conserve fish, wildlife and their habitat are listed in Chapter 4. Standard erosion control measures would be used during construction to control limit erosion; removal of woody vegetation would be minimized.

5.3.2 Essential Fish Habitat

Public Law 104-297, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to establish new requirements for Essential Fish Habitat (EFH): an EFH description in federal fishery management plans, and to require federal agencies to consult with NMFS on activities that may adversely affect EFH.

There is no EFH in the analysis area.

5.3.3 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 USC sections 703-712, July 3, 1918, as amended 1936, 1960, 1968, 969, 1974, 1978, 1986 and 1989) implements various treaties and conventions between the United States and other countries, including Canada, Japan, Mexico, and the former Soviet Union, for the protection of migratory birds. Under the act, taking, killing or possessing migratory birds of their eggs or nests is unlawful. Most species of birds are classified as migratory under the Act, except for upland birds such as pheasant, chukar and gray partridge.

The proposed project may impact birds, including some bird species classified as migratory under the Migratory Bird Treaty Act. Potential impacts to birds as a result of the proposed project are discussed in Section 4.6 of this EIS. In summary, bird fatalities could result from impacts with overhead ground wires during foggy conditions, from increased road traffic along access roads, and from impacts with wind turbines. Average fatality estimates for all birds from regional wind facilities have ranged from 0.9 to 2.9 birds per MW per year. Overall bird use and species richness estimated for the area was low relative to other wind facility sites in the United States, including other open habitat sites. Raptor fatality rates for the proposed project are anticipated to be low (< 0.1 per MW per year). As discussed in Chapter 4, appropriate mitigation measures have been identified to reduce impacts to birds and minimize the risk of bird mortality.

5.3.4 Bald Eagle and Golden Eagle Protection Act

The Bald Eagle Protection Act (16 USC 668-668d, June 8, 1940, as amended in 1959, 1962, 1972, and 1978) prohibits the taking of possession of and commerce in bald and golden eagles, with limited exceptions. Because a small number of bald and golden eagles may reside within foraging distance of the proposed project, there is a remote possibility some mortality could result. However, because the Act covers only intentional acts, or acts in “wanton disregard” of the safety of golden or bald eagles, this project is not viewed as subject to its compliance. See also Section 4.6 of this DEIS.

5.4 Heritage Conservation

The US Congress has passed many federal laws to protect the nation’s cultural resources. These include the National Historic Preservation Act, the Archeological Resources Protections Act, the American Indian Religious Freedom Act, the National Landmarks Program, and the World Heritage List.

A cultural resource is an object, structure, building, site or district that provides irreplaceable evidence of natural or human history of nation, state or local significance. A cultural resource can also include traditions, beliefs, practices, lifeways, arts, crafts, and social institutions of any community, often referred to as ***traditional cultural property***. Cultural resources include traditional cultural property, National Landmarks, archeological sites, and properties listed (or eligible for listing) on the NRHP.

Construction, and operation and maintenance of BPA’s action alternatives could potentially affect cultural resources. A literature review of the analysis area was done to determine the prehistory and history of the area and the probability of finding cultural resources that may be affected by the project. A cultural survey of the action alternatives’ rights-of-way was conducted in fall 2005. None of the previously recorded cultural resource sites occur on or near the proposed project area. None of the cultural resource isolates identified during the surveys appear to be eligible for listing on the NRHP.

If, during construction, previously unidentified cultural resources that would be affected by the proposed project are found, BPA would follow all required procedures set forth in the following regulations, laws, and guidelines: Section 106 (36 CFR Part 800) of the National Historic Preservation Act of 1969, as amended (16 USC Section 470); NEPA (42 USC Sections 4321-4327); the American Indian Religious Freedom Act of 1978 (PL 95-341; the Archaeological Resources Protection Act of 1979 (16 USC 470a-470m); and the Native American Graves Protection and Repatriation Act of 1990 (PL 101-601). See also Section 4.10.

Construction, and operation and maintenance of the wind projects could also potentially affect cultural resources. See Section 4.10.

5.5 Federal, State, Area-wide, and Local Plan and Program Consistency

The proposed transmission line and new John Day 230-kV substation would be constructed by BPA, which is a federal agency. Pursuant to the supremacy clause of the U.S. Constitution, BPA is not subject to local and state land use or building regulations, and this is not obligated to obtain state and local land use approvals or permits. BPA would, however, strive to meet or exceed the substantive standards and policies of state and local regulations.

The proposed wind projects would be required to obtain applicable state and local land use approvals and permits.

5.5.1 Federal Management Plans

5.5.1.1 Two Rivers Resource Management Plan Record of Decision (June 1986)

This plan identifies the Deschutes River and John Day River canyons as areas of high visual quality. These areas are designated as Special Management Areas. Because the proposed projects would not occur on BLM administered land, BLM management plans and policies would not apply to the transmission line routes or proposed wind power facilities.

5.5.1.2 Record of Decision John Day Proposed Management Plan, Two Rivers and John Day Resource Management Plan Amendments (February 2001)

Beginning at Tumwater Falls, near river mile 10, and upstream through the analysis area, the John Day River is designated as a National Wild and Scenic River. The Wild and Scenic designation and the management plan apply to the river itself and to the lands that lie within 0.25 to 1 mile of each bank.

Along the part of the river in the study area, there would be no change in the VRM class, which would mean that the BLM lands in the Wild and Scenic River along this segment of the river would be managed in accordance with VRM Class II standards, permitting changes to the existing character of the landscape that do not attract the attention of the casual observer. Because the area of jurisdiction of this plan is the National Wild and Scenic River, which has a variable boundary that extends only 0.25 to 1 mile on either side of the river, developments outside of the boundary, regardless of their scenic impacts, would not be regulated by this plan.

5.5.1.3 Lower Deschutes River Management Plan Record of Decision (February 1993)

The geographic jurisdiction of this plan is the lower section of the Deschutes River designated as a National Wild and Scenic River, which has a variable boundary averaging approximately 0.25 mile on either side of the river. This plan does not regulate developments outside of the boundary, regardless of scenic impacts.

5.5.1.4 Management Plan for the Columbia River Gorge National Scenic Area (September 1992, revised May 2004)

The CRGNSA consists of the 80-mile corridor extending along the Columbia River from Troutdale to the Deschutes River. The transmission line and proposed wind projects lie outside of the scenic area's eastern boundary. Four key viewing areas within the CRGNSA are located near the proposed projects: the Columbia River, the Historic Columbia River Highway, I-84, and SR-14. Management plans for the CRGNSA would not apply to the proposed BPA transmission line or wind power facilities because they are outside of the planning area boundary. No direct federal CRGNSA review of activities is required.

5.5.2 Sherman County Planning Framework

The project area is within unincorporated Sherman County, Oregon. The Sherman County Comprehensive Plan (2003a) outlines goals and policies that direct how development should occur, including energy facilities, to protect the scenic, economic, historic, and recreational qualities of the county. The most applicable goals and policies related to the project are contained in Section XV-Energy Policy I, which encourages the County to cooperate with public agencies and private individuals in the use and development of renewable resources; and Policy III, which addresses the need for high-voltage transmission lines (in excess of 230-kV) to locate within existing ROW, unless approved by the County.

Typically, Sherman County reviews wind power facilities as conditional uses, although as part of the ASC, the Oregon Department of Energy can also review the ASC based on local development standards to determine if the proposed project meets local development standards. The local planning department provides comments on the application and proposed conditions of approval, which are incorporated into the land use decision.

Because BPA is a federal agency, federal sovereignty applies, and no local permitting is required. Federal actions are exempt from the Sherman County planning process (Macnab, 2005), although BPA would comply, to the greatest extent practicable, with local land use regulations.

Section XI of the Sherman County Comprehensive Plan identifies important landscape features within the County. These include rock outcroppings, trees, and the John Day River and Deschutes River canyons. The County's Goal X is to "preserve the integrity of the Sherman County Landscape." Policy I of Goal X states "trees should be considered an important feature of the landscape and therefore the County Court shall encourage the retention of this resource when practical." Goal XII is to "provide for the rational use of all resources within the designated Deschutes and John Day Oregon State Scenic Waterways." None of the proposed actions would have a direct impact on either scenic area.

5.6 Farmland Protection

The Farmland Protection Policy Act (Public Law 97-98) (FPPA) is authorized by the NRCS. The purpose of the FPPA is to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. The FPPA attempts to ensure that federal programs are administered in a manner that, to the best extent practicable, will be compatible with state, unit of local government, and private programs and policies to protect farmland. The FPPA does not cover private construction subject to federal permitting and licensing, projects planned and completed without any assistance from a federal agency, federal projects related to national defense during a national emergency, and projects proposed on land already committed to urban development.

The FPPA designates farmland as prime, unique, of statewide importance, and of local importance. There are no unique farmland map units recognized in Sherman County (Campbell, 2006). Prime, statewide importance, and local importance are defined as:

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion, as determined by the USDA. Prime farmland also includes land that possesses the above characteristics but is being used currently to produce livestock and timber; farmland, other than prime or unique farmland, that is of statewide or local importance for the production of food, feed, fiber, forage, or oilseed crops, as determined by the appropriate State or unit of local government agency or agencies, and that the USDA determines should be considered as farmland.

Soils in the analysis area are shown in Table 3-3 in Section 3.4. The State of Oregon rates farmland based on soil capability information produced by the NRCS. The

State considers any soil map unit in eastern Oregon in land capability class 6 or less to be farmland of statewide importance (Campbell, 2006). Within the analysis area, seven soil map units are classified as farmland of statewide importance and seven soil map units as prime farmland only if irrigated. The irrigated land that would be impacted by the proposed project is not one of the soil units considered prime farmland if irrigated.

Sherman County does not consider any soils map unit within the county as high-value farmland, although because federal funds would be used to construct the transmission line and substation, and because the NRCS and State of Oregon have designated high-value farmland that would be converted to other uses, BPA completed and submitted the Farmland Conversion Impact Rating AD-1006 to NRCS. NRCS determined that both action alternatives would affect a similar amount of soils considered prime, unique, statewide or locally important farmland. BPA determined that the proposed project would minimize conversion of farmland by permitting existing farming practices to continue within the transmission line ROW and would be consistent with the FPPA. See Sections 3.1, Land Use, and 3.4, Geology and Soils, for a description of agricultural practices in the analysis area.

5.7 Recreation Resources

5.7.1 Federal

Guidance provided by the United States Department of the Interior regarding Federal Wild and Scenic Rivers states “management principles may apply to private lands only to the extent required by other laws such as local zoning and air and water pollution regulations” (Federal Register, 1982). The proposed facility is outside the Federal Wild and Scenic Rivers Act’s jurisdiction because the site boundary is beyond the designated Wild and Scenic River corridor and because the Sherman County Comprehensive Plan does not place additional restrictions on development relevant to the Wild and Scenic River designation.

5.7.2 State of Oregon

The Oregon State Scenic Waterways Act also does not govern the facilities, because they would be located beyond the Act’s jurisdiction, which extends to all land within 0.25 mile of the bank on each side of the scenic waterway. ORS 390.805(1), 390.845(2)(e); see also OAR 736-040-0015(5) and (10).

The proposed facilities would not be visible from state parks within the analysis area.

5.8 Floodplain/Wetlands Assessment

In accordance with USDOE regulations on compliance with Floodplains/Wetlands environmental review requirements (10 CFR 1022.12), and Executive Orders

(EOs) 11988 and 11990, BPA has prepared the following assessment of the impacts of the alternatives on floodplains and wetlands.

5.8.1 Project Description

The analysis area lies in an arid climate; waterways and wetlands are rare. All transmission and wind turbine towers and substation facilities can be located to avoid waters of the US. Linear features, such as roads and underground transmission systems, cannot always avoid these features.

5.8.2 Floodplain/Wetlands Effects

The project would not impact any floodplain. The Biglow Canyon Wind Farm would impact about 0.02 acre of intermittent streams, which are jurisdictional waters of the US. A US Army Corps of Engineers (Corps) permit is required under Section 404 of the Clean Water Act for these impacts. Orion Energy will apply for the permit.

5.8.3 Alternatives

Both BPA action alternatives and the No Action Alternative would have no impacts to waters of the US.

5.8.4 Mitigation

Mitigation for the proposed impacts includes seeding and planting a 2,000-square-foot area adjacent to one of the intermittent drainages.

5.9 Executive Order on Environmental Justice

Executive Order (EO) 12898 on Environmental Justice requires agencies undertaking federal projects to evaluate whether any adverse human health or environmental impacts of the proposed project would fall disproportionately on low-income or minority populations in the analysis area, and ensures outreach to and involvement of minority and low-income communities in the decision-making process.

An important component of EO 12898 is assuring that all portions of the population have a meaningful opportunity to participate in the development of federal projects regardless of race, color, national origin, or income. Council on Environmental Quality guidance states that agencies should acknowledge and seek to overcome linguistic, institutional, geographic, and other barriers to meaningful participation, and should incorporate active outreach to affected groups. The public involvement process is described in Section 1.3, Scoping and Major Issues. An additional public meeting will be held during the public comment period for this DEIS. Copies of this DEIS will be sent to the interested parties listed in Chapter 7.

US Census information from 2000 was used to identify potential impacts. None of the action alternatives would have a disproportionate adverse impact on minority or low-income populations. No displacements would occur as a result of the action alternatives and construction would generally be located outside of any population centers.

5.10 Global Warming

The mass transfer or carbon from the earth to the atmosphere and back again is called the carbon cycle. The atmosphere, plants, oceans, rocks and sediments act as reservoirs for carbon. Since industrial times, this carbon balance has been upset because of fossil fuel consumption and timber harvesting, and there has been a dramatic increase in the amount of carbon dioxide in the earth's atmosphere. Because carbon dioxide is a greenhouse gas, its increasing atmospheric concentration is thought to contribute to global warming.

The project would enable construction and operation of about 700 MW of wind power generating capacity. Wind power technology does not emit greenhouse gasses, except in the manufacture of the equipment and during construction. No removal of woody vegetation would occur. All areas cleared for construction would be revegetated.

5.11 Energy Conservation at Federal Facilities

No new buildings would be installed at BPA substations other than control houses. The building designs for the control houses would meet federal energy conservation design standards.

5.12 Pollution Control at Federal Facilities

There are two pollution control acts that apply to this project:

Resource Conservation and Recovery Act (RCRA) - The Resource Conservation and Recovery Act, as amended, is designed to provide a program for managing and controlling hazardous waste by imposing requirements on generators and transporters of this waste, and on owners and operators of treatment, storage and disposal (TSD) facilities. Each TSD facility owner or operator is required to have a permit issued by EPA or the state.

Typical construction and maintenance activities in BPA's experience have generated small amounts of these hazardous wastes: solvents, pesticides, paint products, motor and lubricating oils and cleaners. Small amounts of hazardous wastes may be generated by the project. These materials would be disposed of according to state law and RCRA.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) - This Act registers and regulates pesticides. BPA uses herbicides only under controlled circumstances.

Herbicides are used on transmission line rights-of-way and in substation yards to control vegetation, including noxious weeds.

When BPA uses herbicides, the date, dose and chemical used is recorded and reported to state government officials, as required by state law. Herbicide containers are disposed of according to RCRA standards. And any herbicides used on private land, would only be done so with the knowledge and permission of the landowner.

Noise Control Act - The federal Noise Control Act of 1972 (42 USC 4903) requires that federal entities, such as BPA, comply with state and local noise requirements.

As discussed in Section 4.11, the calculated median level (L_{50}) during foul weather at the edge of the ROW would be about 46 dBA, below the BPA transmission line design criteria for corona-generated audible noise which is 50 dBA at the edge of the ROW. During fair weather conditions, which occur about 94 percent of the time, audible noise levels at the edge of the ROW would be about 20 dBA if corona were present. The lower levels would likely be masked by ambient noise (such as wind or traffic noise) on and off the ROW.

The 46 dBA level would meet the Oregon Administrative Code limit for transmission lines.

5.13 Emission Permits under the Clean Air Act

DEQ and local air pollution monitoring agencies operate air quality monitors in Portland, Salem, Eugene and Medford, Oregon. Air pollution can be from one or a number of sources (e.g., vehicle emissions, industry, and natural occurrences, such as blowing dust). DEQ has authority to designate nonattainment or maintenance areas where emissions exceed US Environmental Protection Agency (EPA) air quality standards. Nonattainment areas are geographic areas that have not consistently met the NAAQS. Maintenance areas are geographic areas that have had a history of nonattainment but now consistently meet the NAAQS.

No emission permits would be required for the proposed project. Any impacts to air quality would be short-term and construction-related. There are no identified air quality problems in the analysis area, which is in attainment for all NAAQS.

5.14 Discharge Permits under the Clean Water Act

The Clean Water Act regulates discharges in to waters of the US.

Section 401 – Section 401 of the Clean Water Act, the State Water Quality Certification program, requires that states certify compliance of federal permits and licensees with state water quality requirements.

Section 402 – This section authorizes storm water discharges associated with construction activities greater than 1 acre. For Oregon, DEQ has a general permit authorizing entities to do construction projects, provided appropriate erosion control measures are implemented.

Section 404 – Authorization for the US Army Corps of Engineers is required when there is a discharge of dredge materials or fill material into waters of the US, including wetlands.

The BPA action alternatives, the Klondike III Wind Project, and the Biglow Canyon Wind Farm would each result in disturbance of more than 1 acre of land, and a general permit for storm water discharges associated with construction activities will be obtained from DEQ.

Waters of the US could potentially be impacted by one of the wind power projects. The Biglow Canyon Wind Farm project would impact 0.02 acre of intermittent streams, which are jurisdictional waters of the US. A Corps permit is required under Section 404 of the Clean Water Act for these impacts. Orion Energy will apply for the permit.

5.15 Underground Injection Permits under the Safe Drinking Water Act

No underground injection permits would be needed.

5.16 Notice to the Federal Aviation Administration

As part of transmission line design, BPA seeks to comply with FAA procedures. Final locations of structures, structure types, and structure heights are submitted to FAA for the project. The information includes identifying structures tall than 200 feet above ground, and listing all structures within prescribed distances of airports listed in the FAA airport directory. BPA also assists the FAA in field review of the project by identifying structure locations. The FAA then conducts its own study of the project and makes recommendation to BPA for airway marking and lighting. General BPA policy is to follow FAA recommendations.

Because of the size of the wind turbines, the FAA may require aviation warning lights on some turbines. The number of turbines with lights and the lighting pattern of the turbines would be determined in consultation with the FAA.

Chapter 6 - EIS Preparers

Kathleen Concannon, Assistant Environmental Coordinator, Concannon Creative Services. Responsible for various aspects of the environmental process including analysis and document preparation. Education: B.S. Earth Sciences. Experience: Environmental analysis, resource planning and NEPA review. With BPA from 1979 to 1990, providing contract services to the agency since that time.

Doug Corkran, Writer/editor and Fish and Wildlife Biologist. Responsible for editing various sections of the EIS and overseeing the fish and wildlife sections. Education: MA Environmental Planning, BA, Biology. Experience: Fish and wildlife biology, NEPA compliance, ESA compliance; with BPA since 2005.

Alex Dupey, AICP, Planner, David Evans and Associates, Inc.. Responsible for Land Use, Transportation, Recreation, Socioeconomics, Air Quality, FFPA, and Environmental Justice. Education: Master of Community and Regional Planning. Experience: Land use and environmental planning, with DEA since 2000.

David Ellis, Archeologist, Archaeological Investigations Northwest Inc. Responsible for Cultural Resources. Education: B.A. Anthropology, Master of Public Administration. Experience: Field Archaeology; with AINW since 1990.

Gene Lynard, Senior Environmental Specialist, Project Environmental Lead. Responsible for providing environmental clearance on the proposed action. Education: B.A., Geography, Master of City and Regional Planning. Experience: Environmental planning and real estate development economics in private and public sectors; with BPA as a contractor and employee since 1984.

Kristina Gifford McKenzie, Planner, David Evans and Associates, Inc. Responsible for Alternatives (Klondike III and Biglow Canyon wind projects), and document quality review. Education: B.A. Communications; Master of Urban and Regional Planning. Experience: Land use planning, environmental analysis and NEPA review; with DEA since 1990.

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Dana Siegfried, Project Manager, David Evans and Associates, Inc. Responsible for overall EIS preparation, staffing, and project management. Education: B.S. Zoology, M.S. Marine Resource Management. Experience: Environmental regulations and permitting; with DEA since 1998.

Sean Sullivan, Landscape Architect (OR No. 412), David Evans and Associates, Inc. Responsible for Scenic Resources and Geology. Education: Bachelor of Landscape Architecture; Master of Landscape Architecture. Experience: Aesthetic and recreation resource assessment, visual and environmental mitigation design, visual simulations, and ecological restoration; with DEA since 1996.

Aaron Turecek, GIS Specialist, David Evans and Associates, Inc. Responsible for mapping and graphics. Education: B.A. Geological Science; Experience: applying GIS and remote sensing technology to natural resource management projects in the Pacific Northwest; with DEA since 2000.

Doug Wittren, GIS Specialist, Bonneville Power Administration. Responsible for spatial data coordination, analysis and mapping products. Education: M.S., B.S. Earth Sciences (Geography emphasis). With BPA since 1992 producing spatial technology solutions using GIS for a variety of BPA projects throughout the Northwest.

Chapter 7 - List of Agencies, Organizations, and Persons Sent the EIS

The project mailing list contains potentially interested or affected landowners; tribes; local, state and federal agencies; public officials and businesses. They have directly received or have been given instructions on how to receive all project information made available so far, and they will have an opportunity to review the Draft and Final EIS.

INDIVIDUALS

Helen Andrews

Phillip Andrews

Steve Becknet

Douglas Bish

Tiffini Blaylock

Vera Campbell

Jessie Casswell

M J Clark

Donald C Coats

Kathryn Coats

Joe Dabulskis

Illa Jean Ellis

Karen Falk

Nerine Fields

John & Nancy Fields

Barbara Gray

Les Gray

Brett Gray

Darryl Hart

Gordon Hiderbrand

John & Wanda Hilderbrand

Roseanna Hulse

Delta M Johnson

Larry Edward Kasebert

Steve Kaseberg

Birginia Laughlin

Kevin MacIntyre

Charles R and Gary J MacNab

George L ad Junietta E MacNab

Patrick G MacNab

Peter MacNab

Thomas MacNab

Helen MacNab

Edna & John MacNab

Carole Makinster

Betsy Martin

Douglas Martin

Robert Martin

Thomas & Constance Martin

William Martin

DeeAnn Massie

John McCoy

Kevin & Kathy McCullough

Richard & Jean McGregor

Eugene McMillin

Stephen McMillin

Dick McNabb

James McNabb

Catherine Medler

Daryl Melzer

Wayne Melzer

Ernie Moore

Philip O'Meara

Forest Peters

Scott Peters

Diana Poston

Pat Powell

Betty Rathbun

Doug Reid

Christine Rice

Daniel Richelderfer

David Richelderfer

Dee Richelderfer

De'Lynn Richelderfer

Donald Richelderfer

Jon Richelderfer

Martin Richelderfer

Richard Richelderfer

Theron Richelderfer

Scott Robar

Mike Sandberg

Dana Siegfried

Grant Simpson

Nancy Simpson

Patricia Ann & Shawn Skiles

Delmar & Margaret Smith

Ray Smith

Margaret Stoltenberg

Kathleen Strege

Kent Thomas

Melva Thomas

Gary Thompson

Thomson Thomson

Arthur & Marjorie Vangilder

Raymond & Vera Vangilder

Eulalie Welk

Dora O Wright

Mary Zachariasen

Frank & Deanna Zaniker

Barnett Estate Partnership

China Hollow Ranch

Farm & Ranch Management

Reid Ranch

Simantel Farms, Rob Simantel

Weedman Ranches Inc.

FEDERAL AGENCIES

Bonneville Power Administration

Bureau of Land Management

Department of Energy

Fish and Wildlife Service

TRIBES OR TRIBAL GROUPS

Confederated Tribes of the Colville Reservation

Confederated Tribes of the Umatilla Indian Reservation

Confederated Tribes of Warm Springs

Nez Perce Tribe

Wanapum Tribe

Yakama Nation

STATE AGENCIES, OREGON

Department of Fish and Wildlife

Department of Agriculture

Department of Transportation

Department of Lands

State of Oregon, Oregon Public Utility Commission

PUBLIC OFFICIALS, OREGON

Federal Congressional

US House of Representatives, Greg Walden

US Senate, Ron Wyden

US Senate, Gordon Smith

Governor, Ted Kulongoski

State Senator and Representatives

John H. Dallum

LOCAL GOVERNMENTS, OREGON

City of The Dalles

City of Moro

City of Portland

City of Rufus

County of Sherman

County of Wasco

BUSINESSES

CH2M Hill

GE Energy

PPM Energy Inc

Stole Rives Boley LLP

Wasco Electric Coop Inc

West Inc

Western Wind Power

INTERESTED PARTIES

Association of Oregon Counties

City of Portland Office of Sustainable Development

County of Sherman Department of Planning

County of Sherman Weed District

Michels Organization

Portland Audubon Society Conservation Committee

Renewable Northwest Project

Sierra Club Oregon Chapter

LIBRARY

The Dalles/Wasco County Public Library

MEDIA

The Dalles Chronicle

Times Journal New Editor

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Chapter 9 - Glossary and Abbreviations

9.1 Abbreviations and Acronyms

AINW	Archaeological Investigations Northwest Inc.
ASC	Application for Site Certificate
BG	Block Group (Census)
BLM	US Department of the Interior, Bureau of Land Management
BMPs	best management practices
BPA	Bonneville Power Administration
Corps	US Department of the Army, Corps of Engineers
CRGNSA	Columbia River Gorge National Scenic Area
CRP	Conservation Reserve Program
dBA	Decibels (A-weighted)
DEA	David Evans and Associates, Inc.
DEIS	draft environmental impact statement
DEQ	Oregon Department of Environmental Quality
DOGAMI	Oregon Department of Geology and Mineral Industries
DSL	Oregon Department of State Lands
EFH	Essential Fish Habitat
EIS	environmental impact statement
EMF	electric and magnetic (electromagnetic) fields
EO	Executive Order
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FCRPS	Federal Columbia River Power System
FCRTS	Federal Columbia River Transmission System
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FPPA	Farmland Protection Policy Act
GIS	geographic information system
GSU	generator step-up
kV	kilovolt
KVA	Key Viewing Area

LGIA	Large Generator Interconnection Agreement
LLC	limited liability corporation
LOS	level of service
mph	miles per hour
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NH	Natural Hazards (Sherman County zone combining district)
NMFS	US Department of Commerce, National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPS	US Department of the Interior, National Park Service
NRCS	US Department of Agriculture, Natural Resources Conservation Service
NRHP	National Register of Historic Places
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
O&M	operation and maintenance
OR	Oregon Route
ORNHIC	Oregon Natural Heritage Information Center
ORS	Oregon Revised Statute
PCB	polychlorinated biphenyl
PPM	PPM Energy, Inc.
RI	radio interference
ROD	Record of Decision
RV	recreational vehicle
SCADA	supervisory, control and data acquisition
SHPO	State Historic Preservation Office
SR-14	Washington State Route 14
TSP	Transportation System Plan
TVI	television interference
USC	United States Code
USDA	US Department of Agriculture
USDOE	US Department of Energy
USFS	US Department of Agriculture, Forest Service

USFWS	US Department of the Interior, Fish and Wildlife Service
USGS	US Geological Survey
VRM	Visual Resource Management

9.2 Glossary

Access road – Roads constructed to each structure site first to build the tower and line, and later to maintain and repair it. Access roads are built where no roads exist. Where county roads or other access is already established, access roads are built as short spurs to the structure site. Access roads are maintained after construction, except where they pass through cultivated land. There, the road is restored for crop production after construction is completed.

Bay – An area set aside in a substation for special equipment.

Best management practices (BMPs) – A practice or combination of practices that are most effective and practical means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

Biological Assessment – A document required by the Endangered Species Act, which requires an evaluation of potential effects on listed species and critical habitat prior to implementing a proposed action. Projected action is defined as any activity authorized, funded or carried out by a federal agency.

Bus pedestals – Supports that elevate bus tubing within a substation.

Bus tubing – A metal “bar” used to carry electricity from one piece of equipment to another within a substation.

Capacity – The maximum ***load*** that a generator, piece of equipment, substation, transmission line, or system can carry under existing service conditions.

Circuit breaker – A switch, installed at a substation, which breaks or restores the flow of current through the line.

Conductor – The wire cable strung between transmission towers through which electric current flows.

Conservation Reserve Program (CRP) - A voluntary federal program to assist private landowners to convert highly erodible and environmentally sensitive cropland to permanent vegetative cover.

Counterpoise – A buried wire system connected to footing of towers or poles supporting a transmission line. Used to establish a low resistance path to earth, usually for lightning protection.

Cumulative Impact – Cumulative impacts are created by the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions.

Current – The amount of electrical charge flowing through a conductor (as compared to voltage, which is the force that drives the electrical charge).

dBA – The first two letters (dB) are an abbreviation for decibel, the unit in which sound is most commonly measured (see decibel). The last letter (A) is an abbreviation for the scale (A scale) on which the sound measurements were made.

Dead-end structures – Heavy towers designed for use where the transmission line loads the tower primarily in tension rather than compression, such as turning large angles along a line or bringing a line into a substation.

Decibel – A decibel is a unit for expressing relative difference in power, usually between acoustic signals, equal to 10 times the common logarithm of the ratio of two levels.

Dispersed recreation – Outdoor recreation in which participants are diffused over a relatively wide area.

Double-circuit – The placing of two separate electrical circuits on the same tower.

Easement – A grant of certain rights to use of a piece of land (which becomes a "right-of-way"). BPA acquires easements for many of its transmission facilities. This includes the right to enter the right-of-way to build, maintain, and repair the facilities. Permission for these activities is included in the negotiation process for acquiring easements over private land.

Electric and magnetic fields (EMF) – The two kinds of fields produced around the electric wire or conductor when an electric transmission line or any electric wiring is in operation.

Endangered species – Those species officially designated by the US Fish and Wildlife Service or NOAA that are in danger of extinction throughout all or a significant portion of their range.

Endangered Species Act – A 1973 federal law, amended in 1978 and 1982 to protect troubled species from extinction**.** The National Marine Fisheries Service (NOAA Fisheries) and the U.S. Fish and Wildlife Service decide whether to list species as threatened or endangered. Under the Act, federal agencies must avoid jeopardy to and the recovery of listed species.

Environmental impact statement (EIS) – A detailed statement of environmental impacts caused by an action, written as required by the National Environmental Policy Act (NEPA).

Federally listed – Species listed as threatened or endangered by the US Fish and Wildlife Service.

Fiber-optic lines – Special wire installed on the transmission line that is used for communication between one location and another.

Floodplain – That portion of a river valley adjacent to the stream channel which is covered with water when the stream overflows its banks during flood stage.

Footings – The supporting base for the transmission towers. Usually steel assemblies buried in the ground for lattice-steel towers.

Forb – any herbaceous plant that is not a grass or grass like.

Foreground – The viewed landscape from 0 to 0.5 miles from an observer.

Geographic information system (GIS) – A computer system that analyzes graphical map data.

Grillage – Transmission tower footings composed of a 12.5' x 12.5' assembly of steel I-beams that have been welded together and buried14 to 16 feet deep. Generally used to support heavier towers, such as **dead-end structures.**

Ground wire – Wire that is strung from the top of one tower to the next; it shields the line against lightning strikes.

High Voltage – Lines with 230-kV or above electrical capacity.

Hydrology – The science dealing with the properties, distribution, and circulation of water.

Insulators – A ceramic or other nonconducting material used to keep electrical circuits from jumping over to ground.

Intermittent – referring to periodic water flow in creaks or streams.

Kilovolt [kV] – One thousand volts.

Lattice steel – refers to a transmission tower constructed of multiple steel members that are connected together to make up the frame.

Load – The amount of electric power or energy delivered or required at any specific point on a system. Load originates primarily at the energy-consuming equipment of customers.

Megawatt (MW) – One million watts, or one thousand kilowatts; an electrical unit of power.

Milligauss (mG) - A unit used to measure magnetic field strength. One-thousandth of a gauss.

Mitigation – Steps taken to lessen the effected predicted for each resource, as potentially cause by the transmission project. They may include reducing the impact, avoiding it completely, or compensating for the impact.

National Environmental Policy Act (NEPA) – This act requires an environmental impact statement on all major Federal actions significantly affecting the quality of the human environment. [42 U.S.C. 4332 2 (2)(C).]

Non-Attainment Area – An area that does not meet air quality standards set by the Clean Air Act for specified localities and periods.

Notice of Intent - A public notice that an environmental impact statement will be prepared and considered in the decision-making for a proposed action.

Physiographic – Pertaining to the physical features of a geographic area.

Revegetate – Reestablishing vegetation on a disturbed site.

Right-of-way – An easement for a certain purpose over the land of another, such as a strip of land used for a road, electric transmission line, pipeline, etc.

Scoping – Part of the environmental impact document process where significant issues are identified for detailed analysis.

Species – A group of interbreeding individual not interbreeding with another group.

Structure – A type of support used to hold up transmission or substation equipment, such as a transmission tower.

Substation – The fenced site that contains the terminal switching and transformation equipment needed at the end of a transmission line.

Substation dead-end towers – Dead end towers within the confines of the substation where incoming and outgoing transmission lines end. Dead ends are typically the tallest structures in a substation.

Substation fence – the chain-link fence with barbed wire on top provides security and safety. Space to maneuver construction and maintenance vehicles is provided between the fence and electrical equipment.

Substation rock surfacing – A three-inch layer of rock selected for its insulating properties is placed on the ground within the substation to protect operation and maintenance personnel from electrical danger during substation electrical failures.

Switches – Devices used to mechanically disconnect or isolate equipment; found on both sides of circuit breakers.

Traditional Cultural Properties- A traditional cultural property is defined as one that is eligible for inclusion in the National Register of Historic Places because of its association with cultural practices or beliefs (e.g., traditions, beliefs, practices, life ways, arts, crafts, and social institutions) of a living community that are rooted in that community's history and are important in maintaining the continuing cultural identity of the community.

Transformer – Electrical equipment usually contained in a substation that is needed to change voltage on a transmission system.

Transmission dead-end towers - Dead end towers not within the confines of the substation, where segments of the transmission alignment come together at an angle.

Transmission line – The structures, insulators, conductors, and other equipment used to transmit electrical power from one point to another.

Volt – The international system unit of electrical potential and electromotive force.

Voltage – The drive force that causes a current to flow in an electrical circuit.

Wetlands – Those areas that are inundated, or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Chapter 10 - Index

Figure 1 Proposed 230-kV Towers and Rights-of-Way

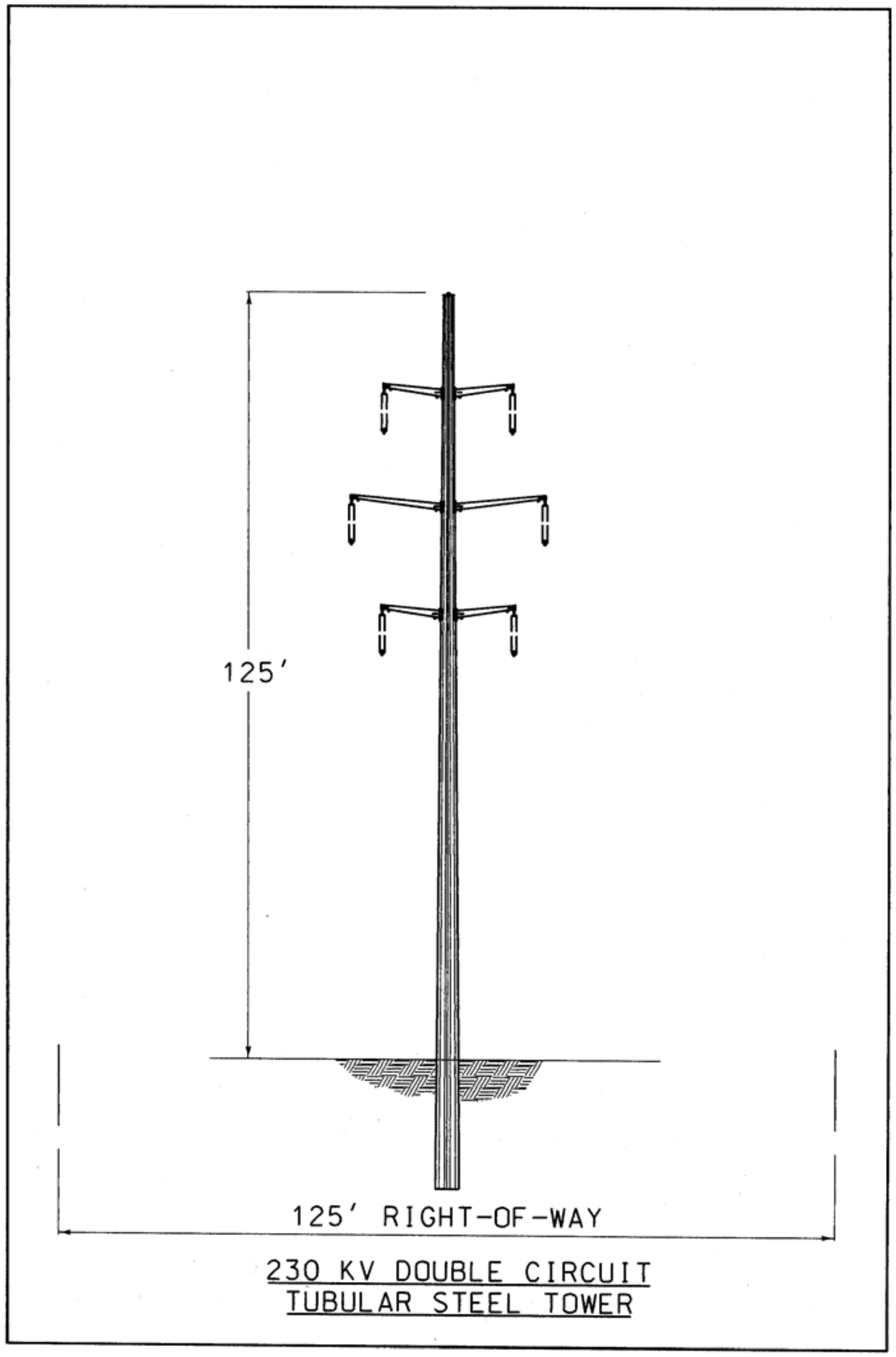
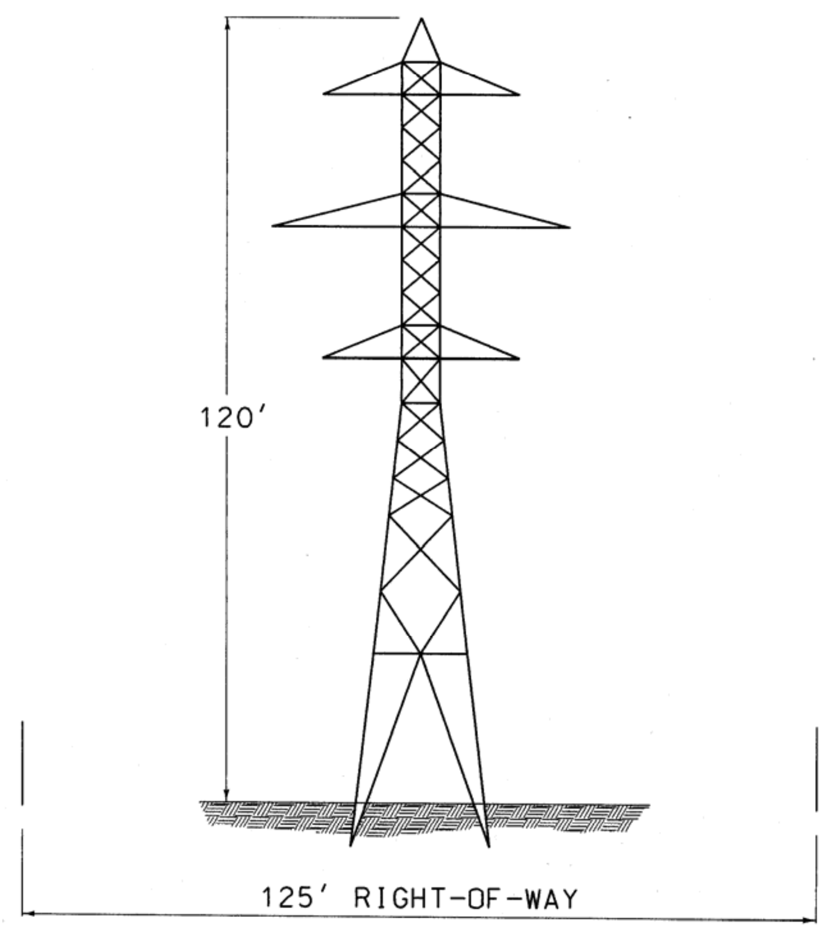
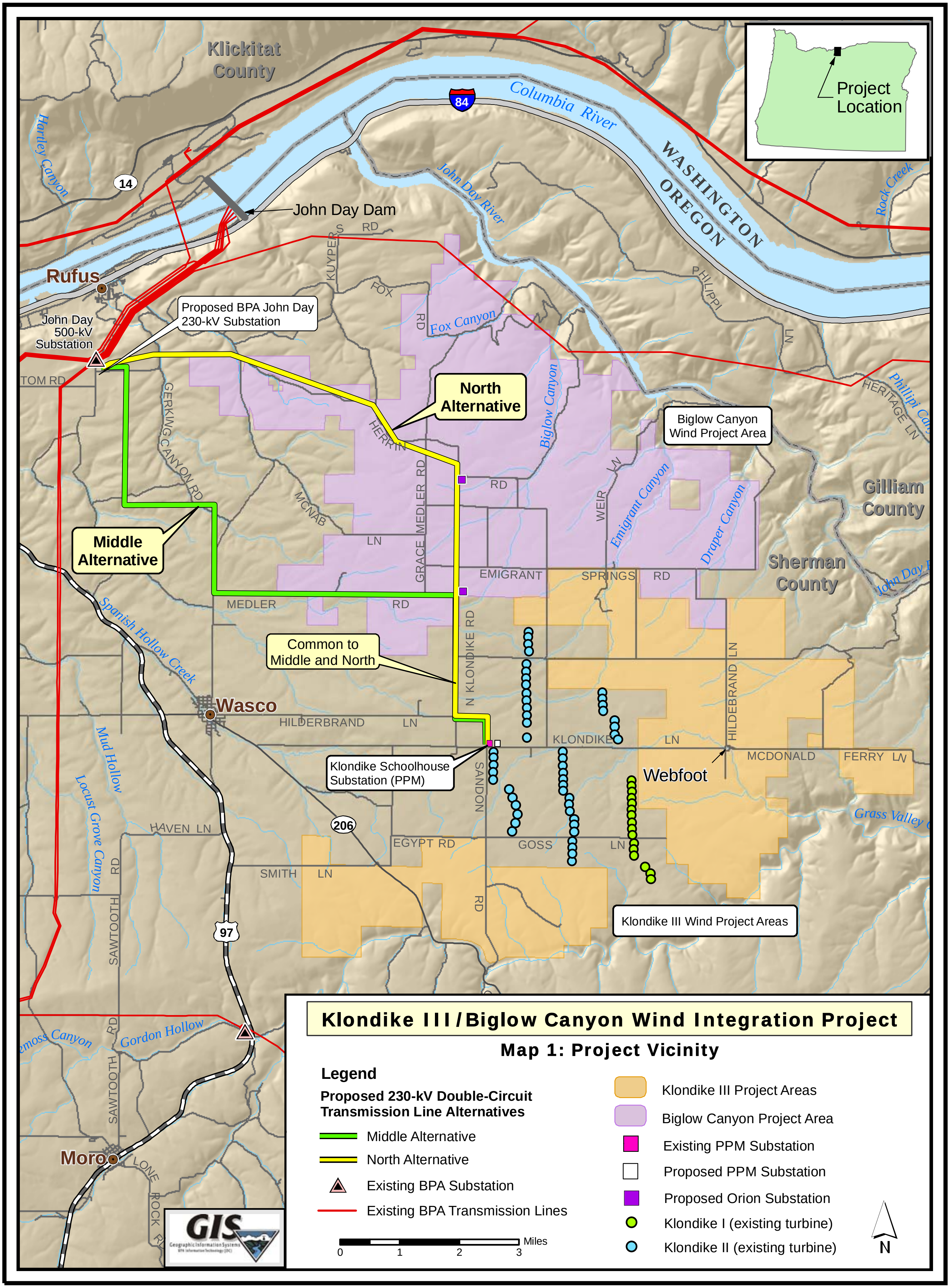


Figure 1, continued



230 KV DOUBLE CIRCUIT
LATTICE STEEL TOWER


Klickitat County
Columbia River
84
WASHINGTON
OREGON
Project Location
Hartley Canyon
14
John Day Dam
John Day River
Rock Creek
Rufus
John Day 500-kV Substation
Proposed BPA John Day 230-kV Substation
KUYPER S RD
FOX
Fox Canyon
PHILIPPI
LN
TOM RD
North Alternative
GERKING CANYON RD
HERRIN
Biglow Canyon
Biglow Canyon Wind Project Area
Phillipi Can
HERITAGE LN
MCNAB
GRACE MEDLER RD
RD
LN
WEIR LN
Emigrant Canyon
Draper Canyon
Gilliam County
Middle Alternative
EMIGRANT SPRINGS RD
Sherman County
John Day R
Spanish Hollow Creek
MEDLER RD
N KLONDIKE RD
Common to Middle and North
Wasco
HILDERBRAND LN
HILDEBRAND LN
KLONDIKE LN
MCDONALD FERRY LN
Klondike Schoolhouse Substation (PPM)
Webfoot
Mud Hollow
Locust Grove Canyon
SANDON RD
Grass Valley
206
HAVEN LN
EGYPT RD
GOSS LN
SMITH LN
RD
SAWTOOTH RD
97
Klondike III Wind Project Areas
Gordon Hollow
Moro
LONE ROCK RD
GIS
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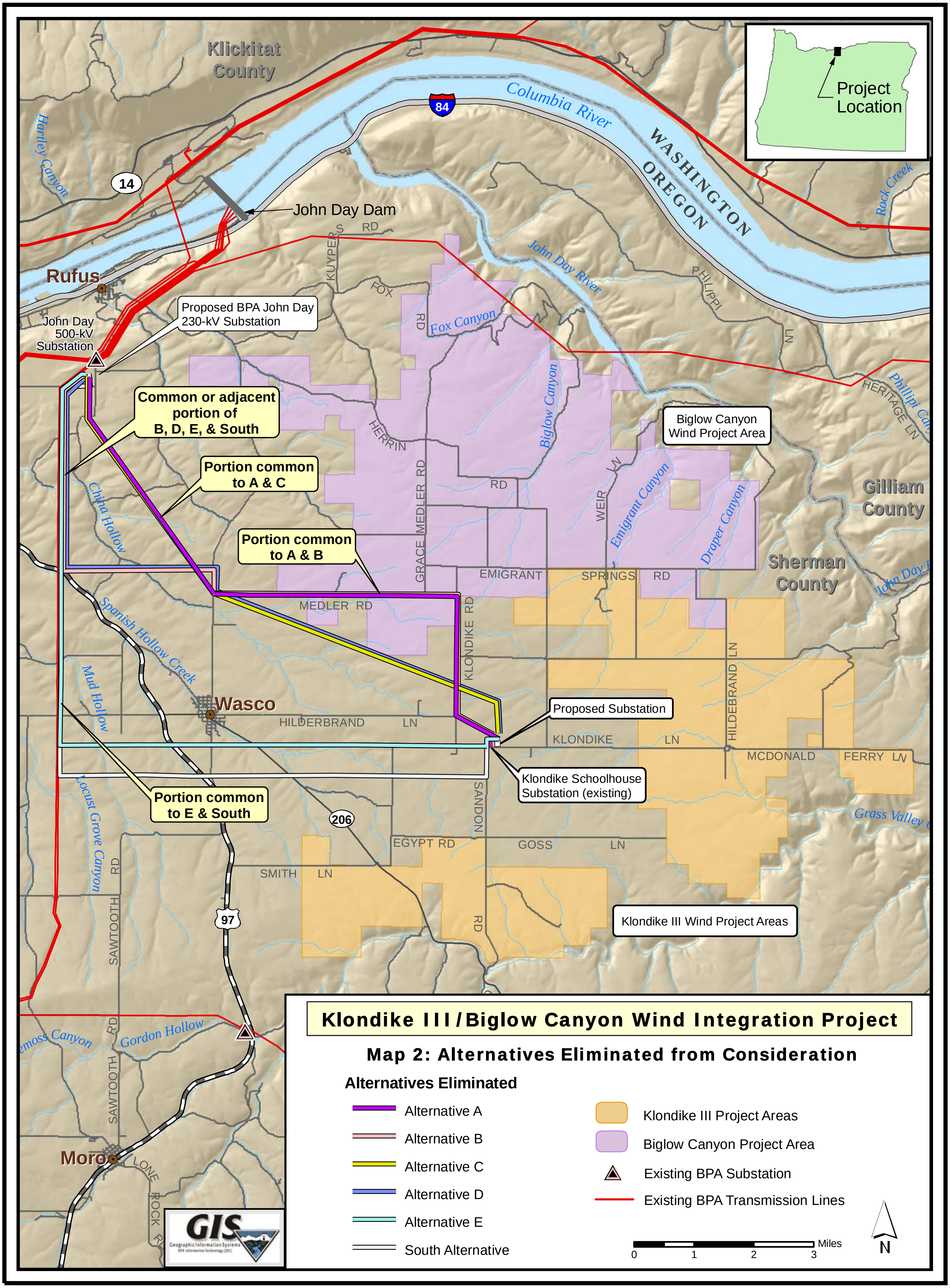
Middle Alternative
North Alternative
Existing BPA Substation
Existing BPA Transmission Lines
Klondike III Project Areas
Biglow Canyon Project Area
Existing PPM Substation
Proposed PPM Substation
Proposed Orion Substation
Klondike I (existing turbine)
Klondike II (existing turbine)
0 1 2 3 Miles
N


Klickitat County
Columbia River
84
14
John Day Dam
WASHINGTON
OREGON
Hartley Canyon
Rock Creek
John Day River
Rufus
John Day 500-kV Substation
Proposed BPA John Day 230-kV Substation
KUYPERS RD
FOX
Fox Canyon
PHILLIPI LN
Phillipi Canyon
HERITAGE LN
Common or adjacent portion of B, D, E, & South
Portion common to A & C
Portion common to A & B
Portion common to E & South
Biglow Canyon Wind Project Area
Biglow Canyon
HERRIN
GRACE MEDLER RD
RD
WEIR LN
Emigrant Canyon
Draper Canyon
Gilliam County
Sherman County
China Hollow
EMIGRANT
SPRINGS
RD
MEDLER RD
KLONDIKE RD
Spanish Hollow Creek
Mud Hollow
Wasco
HILDERBRAND LN
HILDEBRAND LN
Proposed Substation
KLONDIKE LN
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FERRY LN
Klondike Schoolhouse Substation (existing)
Grass Valley
SANDON RD
206
EGYPT RD
GOSS LN
SMITH LN
Locust Grove Canyon
SAWTOOTH RD
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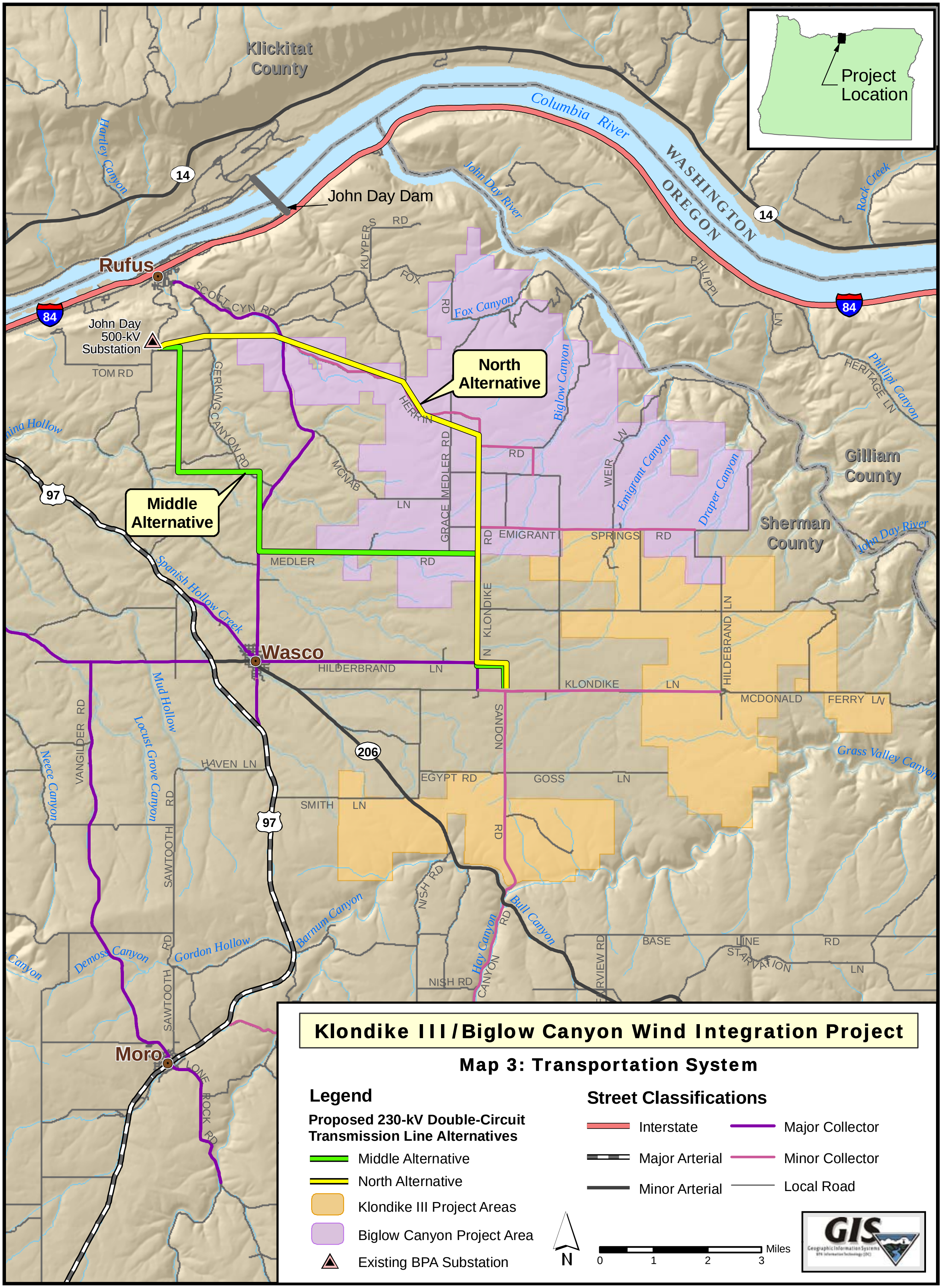
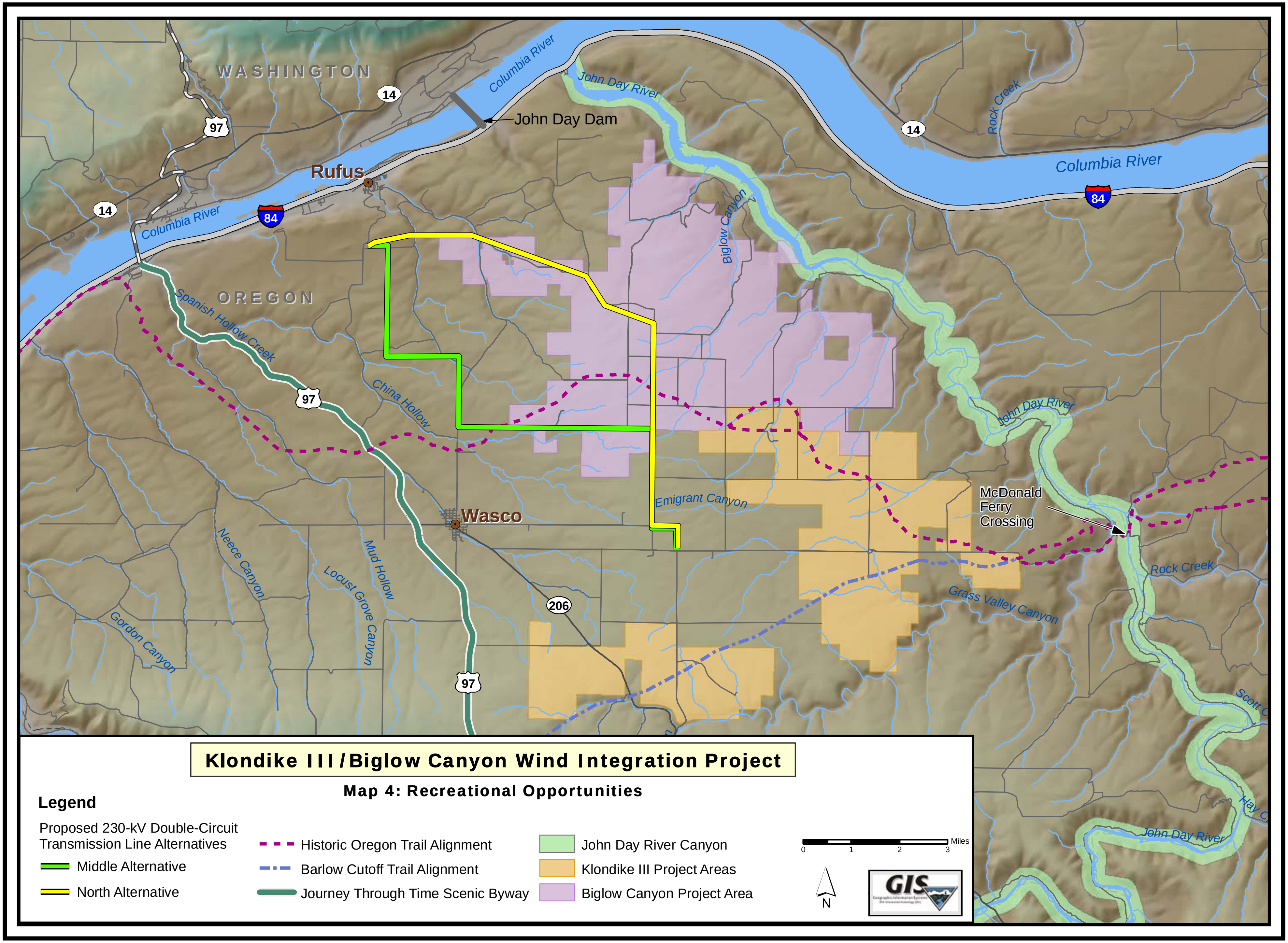
Klondike III Wind Project Areas
Gordon Hollow
Moro
LONE ROCK RD
Klondike III / Biglow Canyon Wind Integration Project
Map 2: Alternatives Eliminated from Consideration
Alternatives Eliminated
Alternative A
Alternative B
Alternative C
Alternative D
Alternative E
South Alternative
Klondike III Project Areas
Biglow Canyon Project Area
Existing BPA Substation
Existing BPA Transmission Lines
0 1 2 3 Miles
N
Project Location
GIS



Klondike III / Biglow Canyon Wind Integration Project

Map 3: Transportation System


WASHINGTON
OREGON
Columbia River
Columbia River
Columbia River
John Day Dam
John Day River
John Day River
John Day River
Rufus
Wasco
Rock Creek
Rock Creek
Biglow Canyon
Spanish Hollow Creek
China Hollow
Emigrant Canyon
McDonald Ferry Crossing
Grass Valley Canyon
Neece Canyon
Locust Grove Canyon
Mud Hollow
Gordon Canyon
14
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14
97
97
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84
84
206
Klondike III / Biglow Canyon Wind Integration Project
Map 4: Recreational Opportunities
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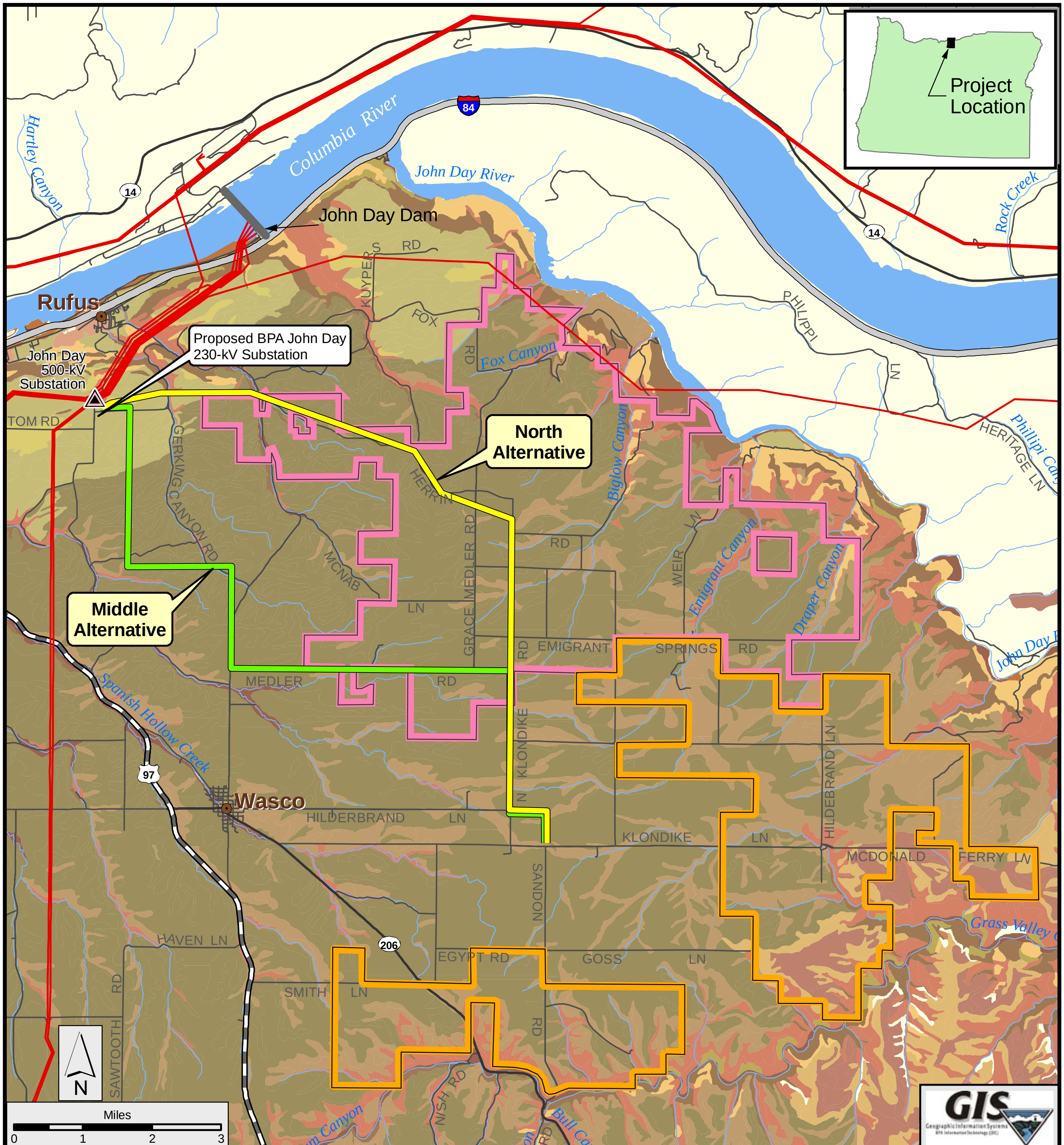
Middle Alternative
North Alternative
Historic Oregon Trail Alignment
Barlow Cutoff Trail Alignment
Journey Through Time Scenic Byway
John Day River Canyon
Klondike III Project Areas
Biglow Canyon Project Area
Miles
0
1
2
3
N
GIS

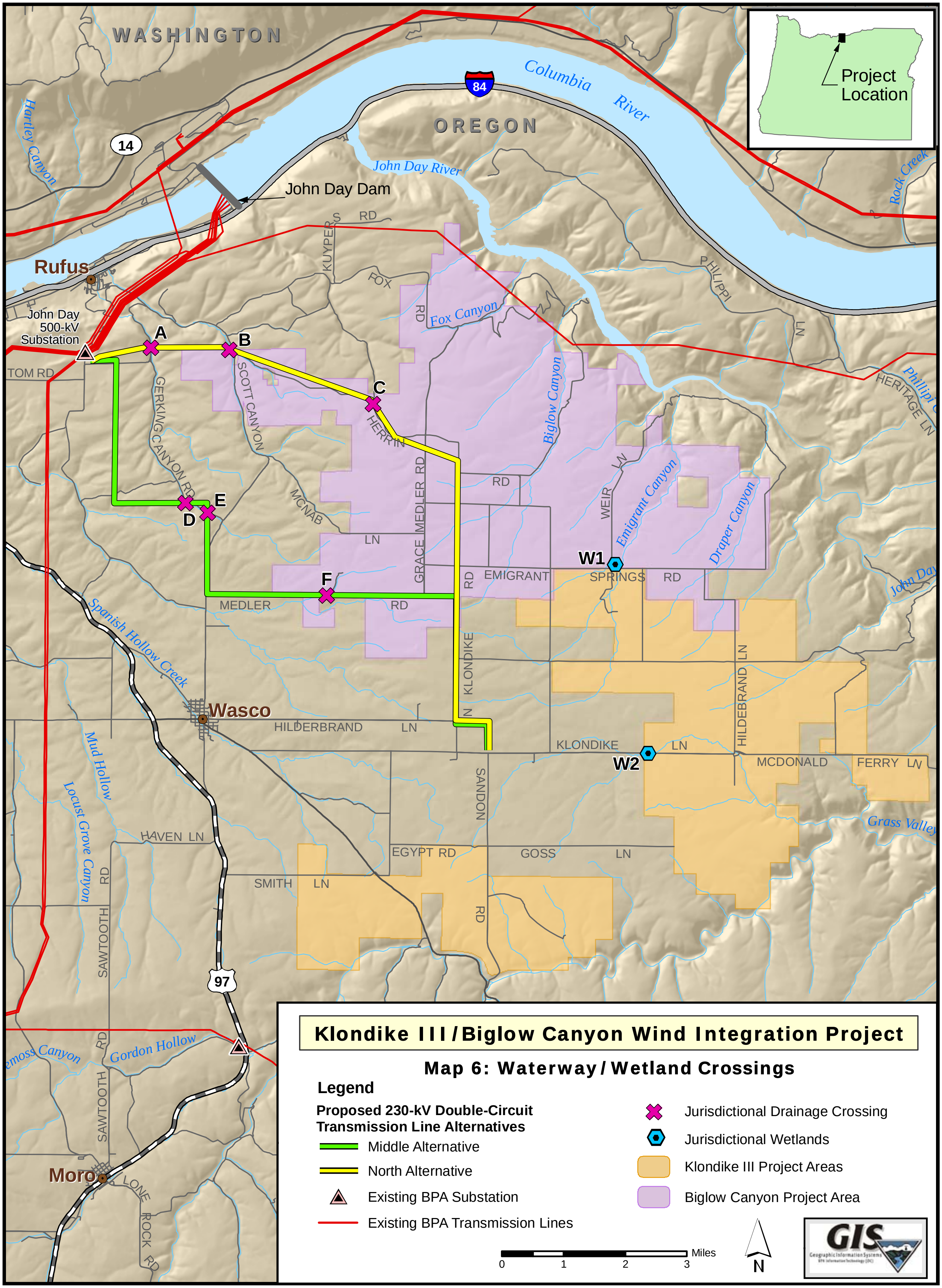


Klondike III / Biglow Canyon Wind Integration Project - Map 5: Soils

Legend

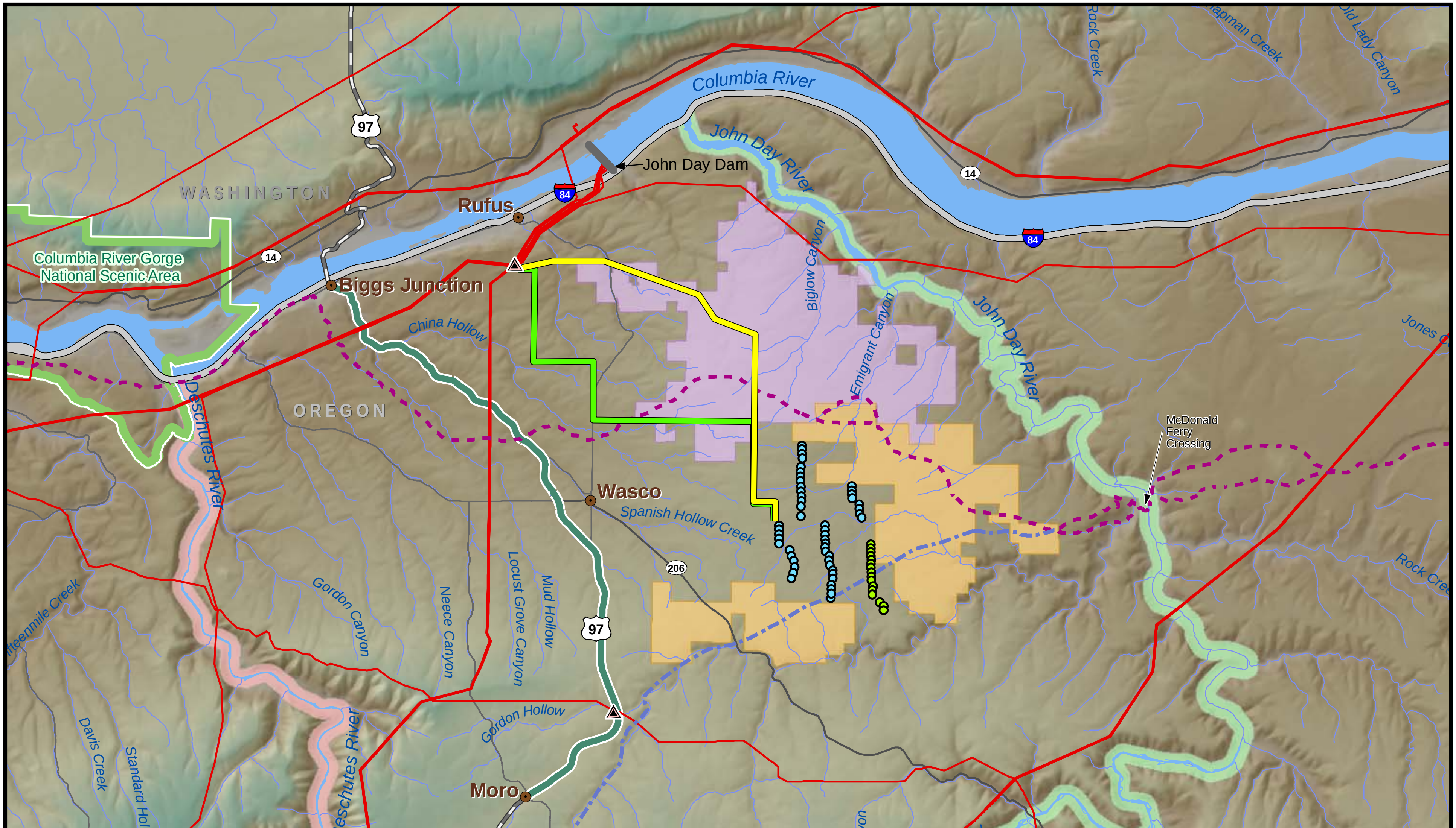
Soil Type (NRCS, 2004)

- Anderly silt loam
- Anders very fine sandy loam
- Endersby fine sandy loam
- Kuhl sandy loam
- Lickskillet
- Mikkalo silt loam
- Nansene-Rock outcrop complex
- Quincy loamy fine sand
- Ritzville silt loam
- Riverwash
- Rock outcrop
- Walla Walla silt loam
- Wato very fine sandy loam
- Klondike III Project Areas
- Biglow Canyon Project Area
- BPA Middle Alternative
- BPA North Alternative
- Existing BPA Transmission Lines
- Existing BPA Substation



Klondike III / Biglow Canyon Wind Integration Project

Map 6: Waterway / Wetland Crossings



Klondike III / Biglow Canyon Wind Integration Project

Map 7: Sensitive Visual Resources

Legend

Proposed 230-kV Double-Circuit Transmission Line Alternatives
- Middle Alternative
- North Alternative
- Historic Oregon Trail Alignment
- Barlow Cutoff Trail Alignment
- Journey Through Time Scenic Byway
- Columbia River Gorge NSA
- John Day River Canyon
- Lower Deschutes River Canyon
- Klondike III Project Areas
- Biglow Canyon Project Area
- Klondike I (existing turbine)
- Klondike II (existing turbine)
- Existing BPA Substation
- Existing BPA Transmission Lines

0 1 2 3 4 Miles

N

GIS

Appendix A **Cumulative Impacts Analysis For Avian Resources From Proposed Wind Projects In Sherman County, Washington**

CUMULATIVE IMPACTS ANALYSIS FOR AVIAN RESOURCES FROM PROPOSED WIND PROJECTS IN SHERMAN COUNTY, WASHINGTON

FINAL REPORT

March 2006

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1.0 INTRODUCTION AND BACKGROUND

In recent years there has been a surge of interest in wind power development in Sherman County, Oregon. A central issue for wind power developments is the potential impacts to avian resources, and in particular direct impacts such as avian fatalities. Wind power proposals are commonly reviewed by natural resource agencies and private conservation groups. Frequently, baseline studies are conducted that are designed to estimate avian use and occurrence at proposed development sites and gather site specific information used in the overall impact assessment and siting of the project.

Currently, at least two different developers have constructed and/or propose construction of several wind projects in Sherman County. The projects include: (1) the Klondike Wind Projects, which include three phases Klondike I, II (KIWP), and III (KIIIWP); and (2) the Biglow Canyon Wind Project (BCWP), which also included study on a Reference Area (BCRA) (Figure 1). Details of the individual wind projects such as the number and size of turbines, turbine locations, roads, and project timing can be found in the various permitting documents. Provided all the proposed projects are constructed, Sherman County could support up to 440 turbines and produce up to 690 MW of energy. The actual number of turbines developed could vary based on a number of factors including turbine model selected, electricity markets, transmission constraints, and results of site surveys and permitting requirements.

The total study area using the lease area boundaries of the three projects is approximately 41,345 acres (64.6 mi^2). The total study area used in the analysis was larger than this due to the Biglow Canyon reference area to the south of the proposed wind projects (see Figure 1). Over the past four to five years the avian resources at each of these sites has been studied using fairly detailed sampling protocols. A one-year baseline study for the KIWP which included the area for Klondike Phase II was completed in April 2002 (Johnson et al. 2002). A one-year fatality monitoring study was conducted at the KIWP turbines in 2002 (Johnson et al. 2003). The KIIIWP site was studied from November 2004 to May 2005 (Mabee et al. 2005). Studies of the BCWP and BCRA sites took place from March 2004 to March 2005 (WEST 2005). While the three studies varied in duration, year, and location, similar field survey methods were used for the avian surveys providing comparable data from each site. Point count stations were established on all four sites from which approximately weekly surveys were conducted during the respective study periods. Detailed descriptions of the methods and data analyses for each project-specific study are reported in the respective baseline study reports (see Johnson et al. 2002, Mabee et al. 2005, and WEST 2005).

To supplement the environmental impact analysis being conducted by BPA for their decisions in the Klondike III and Biglow Canyon projects, it was determined that a cumulative effects analysis that incorporated all the avian survey data conducted for the various projects would be useful. Because all the projects are relatively close together (see Figure 1), it could be reasonably argued that once all the projects are complete, northern Sherman County will host one very large wind project. This cumulative effects analysis takes the general approach of considering the data from the individual projects and combining them as they were one large project. Because the surveyed areas are relatively close together (Figure 1), the predominant vegetation type for all projects was cultivated agriculture (see below), and the avian survey data was all collected using similar methods, the analysis treats all of the studies as one to estimate impacts and risk to avian resources. This report provides this cumulative effects analysis for avian resources. In addition a summary of impacts to bats from other wind projects that have been monitored is included that provides a basis for a cumulative effects analysis for bats.

2.0 METHODS

This report is intended to provide a broader analysis utilizing the combined data sets from all four project areas and thus provide a cumulative impact analysis of potential impacts to avian resources. This report does not reiterate results from the individual project reports. Additional details about each study, results and methods of the data analyses, and an estimate of potential avian impacts from each individual project are provided in the project specific reports. The data sets analyzed in this report were all collected using similar methods, and were collected from the same general geographical area (northern Sherman County), which provides a useful basis for the cumulative effects analysis presented in this report.

The general approach was to combine the data sets from the individual projects as if the four combined project areas were one large project. The results of this analysis could then be used in the impact assessment for all the projects combined. For this report, when more than one data set existed for a season, each data set was analyzed separately and then averaged for that season. For the flight height and exposure index tables, the four data sets were combined into one database. The overall use estimates and exposure indices are used to estimate potential impacts for all the projects combined based primarily on other monitoring studies within the northeast Oregon and southeast Washington region.

To standardize the data for comparison between sites, points, seasons, and other studies; avian use, frequency of occurrence, and species composition were calculated from observations within 800 m (~1/2 mile) of the survey point. Avian use by species was calculated as the mean number of observations per 20-minute survey[1]. Because individual birds were not marked, counts do not distinguish between individuals; rather, they provide an estimate of avian use of the study area. For example, if one red-tailed hawk was observed during five surveys, it is unknown if this was the same bird seen five times or five different birds seen once. Use estimates provide an index of the relative abundance of a species in the study area and therefore the risk of that species being affected by the proposed project. Because of this, references to abundance are use estimates and are not absolute density or numbers of individuals. Species composition is represented by the mean use for a species divided by the total use for all species and multiplied by 100 to provide percent composition. Frequency of occurrence was calculated as the percent of surveys where a particular species was observed.

[1] Fixed-point surveys at KIWP, BCWP, and BCRA were conducted for 30 minutes. For the purposes of this report and analysis, the surveys were standardized to a 20-minute count for all project sites and only those observations recorded within the first 20 minutes of the observation period were included.

2.1 Study Area

The data included in the analyses were from the following studies:

- Klondike I and II (KIWP): bird surveys conducted from April 2001 to April 2002 (Johnson et al. 2002)
- Klondike III (KIIIWP): bird surveys conducted between November 2004 and May 2005 (Mabee et al. 2005)
- Biglow Canyon (BCWP): bird surveys conducted between March 2004 and March 2005 (WEST 2005)
- Biglow Canyon Reference Area (BCRA): bird surveys conducted between March 2004 and March 2005 (WEST 2005)

For each of the individual study areas the predominant vegetation type was agriculture. The Biglow Canyon project area was described as greater than 90% cultivated agriculture (WEST 2005). The Klondike project areas were also primarily agriculture and described as having very little acreage of native plant communities (Mabee et al. 2005, Johnson et al. 2002). Throughout the entire study area there are some fields of Conservation Reserve Program (CRP) land which are generally previously cultivated areas that have been seeded back to grasslands to minimize soil erosion. For all projects, nearly all the turbines will occur in either cultivate agriculture (mostly wheat) or CRP pastures.

3.0 RESULTS

While the dates of surveys varied among the studies, all of the data sets are fairly contemporary and provide replication for the different seasons within the last five years. In addition, the study areas are located within a contiguous block of land with similar vegetation types and habitat. Over all, the combination of the data sets are believed to provide a reasonable picture of the bird resources throughout the agriculture setting of northern Sherman County.

3.1 Avian Fixed-point Surveys

The KIWP (Klondike I and II) surveys were conducted at 7 fixed-point count stations located within the study area (Figure 1). For the KIIIWP, surveys were conducted at 16 fixed-point stations (Figure 1). For the BCWP and BCRA, surveys were conducted at 22 fixed-point stations, 9 within the study area (BCWP) and 13 south of the study area in the reference area (BCRA) (Figure 1). At each site, each point was surveyed on an approximately weekly basis during the respective study periods but some surveys were missed due to bad weather. For all of the sites, a total of 1,195 individual 20-minute point count surveys were conducted.

For all study areas combined, a total of 75 avian species and an additional 13 unidentified bird types (best possible identification, e.g., unidentified buteo) were observed during the fixed-point surveys (Table 1). Over all studies, 25,262 total observations in 3,612 different groups[2] were recorded during the fixed-point surveys (Table 1). These are raw counts of observations, that are not

[2] Group is defined as an observation of a species of bird regardless of number seen together. For example, a flock of eight American robins flying together is considered a group as well as an individual robin observed by itself.

standardized by the number of hours of observation, but do provide an overall list of what was observed. These counts likely contain duplicate sightings of the same birds. Of the 75 avian species recorded (Table 1), six species were only observed during the last ten minutes of surveys for KIWP, BCWP, or BCRA and, because the analyses are based on a standardized 20-minute point count survey, these six species do not factor into the remainder of the analysis. In most cases, only a few individuals or groups of these species were observed and it is unlikely that they would be at risk due to very low use of the project areas.

Over all three studies, passerines were by far the most numerous group comprising approximately 76.1% of all groups and 66.4% of all birds observed. For all of the study areas, horned lark (*Eremophila alpestris*) was the most numerous passerine observed, followed by unidentified blackbirds, European starling (*Sturnus vulgaris*), and western meadowlark (*Sturnella neglecta*). Raptors comprised approximately 16.1% of all groups but only 2.4% of all birds observed. For all study areas, red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (*Buteo lagopus*), and northern harrier (*Cyanus circus*) were the most common raptors observed. Waterfowl comprised 2.67% of all groups and 29.1% of all birds observed. Canada goose (*Branta canadensis*) was the most common waterfowl species seen in the fall and winter in large flocks. Upland gamebirds comprised 2.9% of all groups and 0.9% of all birds observed; doves/pigeons comprised 1.5% of all groups and 0.6% of all birds observed; and waterbirds, shorebirds, other birds, unidentified birds, and coots each comprised less than 1% of all groups and all birds observed. Within these groups the more common species seen were ring-necked pheasant, mourning dove, and sandhill crane (Table 1).

3.1.1 Avian Use

Use was calculated by season and over all surveys (Table 2). For spring, based on an average use across the four areas, the five most abundant species in the study area were horned lark (3.223 detections/20-minute survey), western meadowlark (1.308 detections), European starling (0.319 detections), Brewer’s blackbird (*Euphagus cyanocephalus*) (0.285 detections), and American goldfinch (*Carduelis tristis*) (0.267 detections). Together these species comprised 76.5% of the total bird use during the spring (Table 3).

During the summer, the five most abundant species were horned lark (2.008 detections/survey), western meadowlark (0.483), barn swallow (*Hirundo rustica*) (0.285), red-winged blackbird (*Agelaius phoeniceus*) (0.248), and European starling (0.175). These species comprised 72.6% of the total bird use during the summer (Table 3).

In the fall, the five most abundant species were horned lark (4.512 detections), American pipit (*Anthus rubescens*) (0.669), western meadowlark (0.611), Brewer’s blackbird (0.372), and European starling (0.355). Together these five species comprised 74.3% of the total bird use (Table 3).

Winter was the only season where the top five species were not all passerines. Horned lark (11.496) had the highest used followed by, Canada goose (5.794), European starling (2.184), unidentified blackbird (0.923), and western meadowlark (0.598). These species comprised 84.6% of the total bird use for the winter (Table 3).

Overall seasons, horned lark was the most common bird observed with 7.731 detections per survey, followed by Canada goose (2.474), European starling (0.955), western meadowlark (0.758), and unidentified blackbird (0.627) (Table 2). These five species comprised 81.9% of all bird use of the sites for the study periods (Table 3).

Averaged over all seasons and based on use, passerines were the most abundant group observed followed by waterfowl, raptors, and upland gamebirds (Table 2). Passerines as a group had the highest use in all four seasons. Waterfowl had the second highest use in the winter, raptors had the second highest use estimates in the spring and summer, and upland gamebirds had the second highest use in the fall followed closely by raptors. The high winter waterfowl use was due primarily to large flocks of Canada goose that frequented the study areas during the winter season (see Table 1).

3.1.2 Avian Diversity

Frequency of occurrence and percent composition provide relative estimates of the avian diversity of the study area. For all study areas combined, the overall number of species recorded was relatively high (see Table 1), however, as is expected for predominantly agricultural settings, the majority of avian use for the study area was confined to relatively few species. For example, one species, horned lark was observed in almost three-fourths of all surveys (72.1%) and accounted for slightly more than 50.5% of all bird use recorded during the studies (Tables 3 and 4). Three other species made up approximately 5% or more of the bird use recorded: Canada goose (16.2%), European starling (6.2%), and western meadowlark (5.0%). These four species cumulatively accounted for more than 3/4th of all the bird observations (77.9% of all observations) made during the studies (Table 3). Only seven species were seen in more than 5% of all surveys: horned lark (72.1%), western meadowlark (26.5%), common raven (*Corvus corax*) (12.1%), red-tailed hawk (6.8%), rough-legged hawk (5.9%); European starling (5.2%); and American kestrel (5.2%) (Table 4). The vast majority of species were observed in less than 1% of the surveys (Table 4).

As a group, and due primarily to the abundance of horned lark, western meadowlark, and European starling, passerines comprised 79.3% of the avian use on the sites (Table 3) and were observed in 85.6% of all surveys (Table 4). The influx of large groups of Canada geese in the fall and winter had the relative effect of lowering passerine use and raising waterfowl use in the winter (see Table 3). Raptors as a group comprised 2.0% of the total avian use of the sites (Table 3) and were observed in 22.9% of the surveys (Table 4).

3.1.3 Flight Height Characteristics and Exposure Indices

The proportion of observations of a bird species flying within the area occupied by the turbine rotors provides a rough estimate of risk to that species based on its propensity to fly within the "zone of risk" defined as the rotor swept area (Table 5). Turbines vary in dimensions such as tower height and blade length and it is likely that a variety of turbine types and sizes will be used if all of the projects are built. For this analysis, generic turbine dimensions were used to define the zone of risk that were based on the estimated maximum turbine size and tower height. The maximum tower height and rotor diameters for turbines is likely to be 80 m (262 ft). Provided an 80 m diameter rotor is placed on top of an 80 m tower the maximum height with a blade pointed straight up would be 120 m (~394 feet). A small buffer of approximately 5 m at the top and bottom of the rotor swept area was added to account for possible variations around these maxima and the zone of risk analyzed in this report was defined as the area from approximately 25 m (~82 ft) to 125 m (~410 ft) above ground level (AGL). This range is a conservative estimate by virtue that it is larger than most turbines so leads to an over estimate of potential bird exposure.

Most of the passerines observed, with the exception of starlings, finches, corvids, warblers, and swallows, were regularly observed flying less than 82 feet (25 m) above the ground (Table 5). Larger birds tended to fly higher, and frequently flew greater than 82 feet (25 m) high, which is within the primary zone of risk for turbine blades used in this analysis. As a group, 62.4% of waterfowl observed flying were observed in the zone of risk. As a group 48.3% of raptors were observed in the rotor swept area. Raptor subgroups observed more often in the zone of risk included buteos (62.7%), eagles (87.5%), and vultures (66.7%). Flying passerines were observed within the zone of risk approximately 21.2 % of the time (Table 5). These estimates are consistent with estimates from other projects, and are an overestimate of exposure, since the zone of risk applied is slightly larger than a typical turbine.

The exposure index is a relative measure of the risk of each species coming in contact with a turbine that factors in the use estimates (measure of abundance) and the flight characteristics observed for that species. Canada goose, horned lark, and unidentified blackbird had the highest exposure indices (Table 6). These three species were commonly observed on site and often observed flying in large flocks which increased exposure indices. Of the raptors, rough-legged hawk and red-tailed hawk had the highest exposure indices. Most of the other raptors were seen less frequently (i.e., use was lower) which reduced their exposure index.

3.2 Bat Surveys

No field surveys or primary field data collection was conducted for bats for the three wind projects considered in this analysis. However, results of the monitoring study at the Klondike 1 project indicate that bats are at risk of collision with the turbines in apparently low numbers (Johnson et al. 2003). Other monitoring studies of wind projects in the Washington/Oregon region have also recorded a level of bat mortality (Table 7). The overall bat mortality estimates that are based on carcass search studies including carcass removal and searcher efficiency bias trials have indicated that approximately 1.62 bats per turbine or 1.59 bats per MW are killed annually at wind turbines in Washington and Oregon (Table 7).

4.0 DISCUSSION

In most cases of wind project development in the Pacific Northwest, baseline or pre-construction avian studies are conducted with two primary objectives: to provide information useful in addressing potential impacts from the project and to provide information that may be helpful in siting the turbines. For each of the wind projects proposed for Sherman County these baseline studies have been conducted. Under the National Environmental Policy Act (NEPA) federal agencies are charged with addressing potential impacts, including cumulative impacts, from projects that they implement, fund, or authorize. Under NEPA, the full build out of potential wind projects in Sherman County would be considered cumulative impacts. It was determined that an analysis of all the avian survey data collected for the various wind projects in Sherman County would be helpful in analyzing these cumulative impacts. The purpose of this analysis was therefore to determine, based on the cumulative data, what the over all impacts from build out of the proposed wind projects in Sherman County would be. It was determined that combining data from all the projects was a valid approach because: (1) the proposals were all within relatively close proximity to each other; (2) all the projects fall within areas with the primary land use being agriculture; (3) all the avian survey data was collected using similar methods; and (4) the combined data sets provided some replication over years for the project area. The analysis conducted on the combined data set was very similar to that of each individual project.

Over the last five years during the same time frame as the studies in Sherman County, a number of wind projects have been constructed and monitored in the northeast Oregon and southeast Washington region (Columbia Basin Physiographic Province). These projects have been primarily east of Sherman County and include Vansycle, Umatilla County, Oregon; Stateline, Walla Walla County, Washington and Umatilla County, Oregon; Nine Canyon, Benton County Washington; and Combine Hills, Umatilla County, Oregon. In addition to these studies the 16 turbines that comprised the Klondike I project were also monitored for fatalities for a one-year period. These studies provide a regional database of avian use and mortality associated with wind developments that can provide a basis for impact predictions. Another project, the Condon wind project in Gilliam County, Oregon, was also completed in 2002; however, the monitoring effort at this project was ad hoc in nature and not standardized over the study period and the methods used were not similar enough to compare results to the other studies (see Galen 2003).

4.1 Avian Impacts

For the Sherman County projects, several common passerine species comprised the majority of avian use for the area studied. There were a few species - horned lark, western meadowlark, and European starling - that were seen either in large flocks (affecting total numbers seen) and/or observed in most of the surveys. This varied across seasons but had the effect of increasing use estimates for passerines. In contrast, raptors were observed in slightly more than 20% of the surveys but were typically seen individually or in small groups. This resulted in lower use estimates for raptors than passerines and even waterfowl and upland gamebirds. These results are typical of many wind sites studied where passerines have the highest use estimates but where a few raptor species (e.g., red-tailed hawk, American kestrel) are seen regularly. These results are expected given the low diversity of habitats across the three study areas. For most studies that have occurred in agricultural settings, a few common species make up the majority of bird observations at the site, however, a variety of other species are recorded but typically in low numbers and frequency.

4.1.1 Raptors

Based on the estimated levels of raptor use within the study areas, raptor mortality is expected to be similar to other new generation wind projects with similar turbine types located in the Oregon-Washington region. At these other projects, raptor use estimates ranged from approximately 0.2 to 0.6 per 20-minute survey compared to an average estimate of 0.3 raptors/20-minute survey for Sherman County analyzed in this report.

Considering the calculated raptor use estimates developed in each of the baseline studies, it is estimated that potential raptor mortality within the combined study area would be approximately 0.024 raptors per turbine per year. Under the assumption that raptor mortality would be similar in Sherman County as at the other projects where raptor use was similar, we would expect approximately 0.024 raptors per turbine per year or one raptor for every 40 turbines per year. Using this raptor mortality rate, the total annual raptor mortality estimate would be approximately 10-11 raptor fatalities per year for the three projects (KIWP including KIIWP, KIIIWP, and BCWP) combined if 440 turbines are constructed. It should be noted that the fatality estimates may vary from the expected range based on many factors, including the number of occupied raptor nests near the wind projects after construction, turbine size and other site specific and/or weather variables.

Red-tailed hawk, American kestrel, and northern harrier account for most of the raptor use in spring, summer and fall at the four projects areas. In the winter, rough-legged hawk and red-tailed hawk account for majority of the raptor use. These species are expected to be the raptor species with the highest risk of mortality across the projects. The potential exists for other raptor species to collide with turbines, including Swainson's hawk, ferruginous hawk, turkey vulture, golden eagle, Cooper's hawk, sharp-shinned hawk, and prairie falcon. However, the mortality risk associated with these species is expected to be much lower than the risk for red-tailed hawks and American kestrel due to the lower use estimates and exposure indices for these species. Common owl species such as great-horned owls, which are typically not effectively surveyed during the day, may also be at risk of collision. Some raptors such as turkey vultures appear less susceptible to collision than most other raptors (see Orloff and Flannery 1992, Erickson et al. 2001). In addition, there have been very few northern harrier, ferruginous hawk, and rough-legged hawk fatalities recorded at wind plants, based on recent published data (Erickson *et al.* 2002). Golden eagle use of the sites is low relative to other wind sites (e.g., Foote Creek Rim, Young et al. 2003) and mortality for golden eagles is also expected to be very low.

4.1.2 Passerines

Passerines have been the most abundant avian fatality at other wind projects studied (see Johnson *et al.* 2002, Young *et al.* 2003b, Erickson *et al.* 2000, 2001, 2002), often comprising more than 80% of the avian fatalities. Both migrant and resident passerine fatalities have been observed. Given that passerines make up the vast majority of the avian observations at the sites, it is expected passerines will make up the largest proportion of fatalities for all projects combined. Passerine species most common to the project sites will likely be most at risk, including horned lark and western meadowlark. European starling fatalities would also be expected, however, there is little concern over potential mortality of this species, an introduced non-protected species. Horned larks have been the most commonly observed fatality at several wind projects, including Vansycle, Combine Hills, and Stateline (Erickson *et al.* 2003, Young *et al.* 2005, Erickson *et al*. 2004). Nocturnal migrating species may also be affected, but it is not expected that they would be found in large numbers. Estimates for nocturnal migrant mortality at the regional wind projects have been variable and have ranged from 0.27 to 0.55 per turbine per year. Also, there have been only two multiple individual mortality events reported at new generation wind projects in the U.S. based on data collected at other wind plants. For example, at Buffalo Ridge, Minnesota, fourteen migrating passerine fatalities (vireos, warblers, flycatchers) were observed at two turbines during a single night in May 2002 (Johnson *et al*. 2002), while approximately 25 to 30 migrating passerine fatalities (mostly warblers) were observed near one turbine and a well-lit substation at the Backbone Mountain, West Virginia, wind project (Kerns and Kerlinger 2004).

Mortality rates at other the other region wind projects for all birds combined have ranged from approximately 0.63 birds per turbine per year to 2.56 birds per turbine per year (Table 8). Based on the mortality estimates from the other wind plants studied, it is expected that all bird mortality would fall within the mid range or approximately 1-2 birds per turbine per year. Under the assumption that 440 turbines are constructed for all three projects, the total range of passerine mortality would be 440 to 880 fatalities per year. Because horned lark made up slightly more than 50% of the bird use during the studies, it is expected that approximately 50% of the fatalities would be of this species. This trend has been shown at the other regional projects in agriculture settings. For example, 50% of the fatalities at Nine Canyon; 46% of the fatalities at Stateline; and 41% of the fatalities at Combine Hills were horned larks (see Erickson *et al*. 2003, 2004; Young *et al*. 2005). Under this assumption we would expected approximately 200-400 horned lark fatalities if all the wind turbines were constructed. The level of estimated mortality is not expected to have any population level consequences for individual species, due to the expected low fatality rates for most species and the high population sizes of the common species such as horned lark, western meadowlark, and European starling.

4.2 Bat Impacts

Monitoring studies at other wind projects nationwide have shown consistent trends in impacts to bat. The species at highest risk appear to be foliage dwelling (forest, trees) fall migratory species (Johnson 2005). For the Pacific Northwest region these species are hoary bat (*Lasiurus cinereus*) and silver-haired bat (*Lasionycteris noctivagans*). These two species are by far the most common fatalities found at the regional wind projects monitored comprising more than 90% of all bat fatalities found in the studies (see Erickson *et al*. 2003, 2004; Young *et al*. 2005, Johnson *et al*. 2003). The annual period when most bat fatalities occur is in August and September (Johnson 2005). Hoary and silver-haired bats are wide spread across North America and breed into the boreal forests regions of Canada and migrate south to winter in the southern U.S., Mexico, and potentially further south in Central and South America. Many bats will migrate short distances to suitable hibernacula; however, other species do not appear to be at as great a risk based on the monitoring studies.

Bat foraging areas such as riparian zones, shrublands, streams, and other water sources are limited in the project area. At several wind projects studied in the U.S., bat collision mortality during the breeding season was far less, despite the fact that relatively large populations of resident bats of several species were documented in proximity to the wind plant (see Gruver 2002; Johnson et al., 2003, 2004; Johnson 2005). Based on these studies, it appears that wind projects, especially those in open habitats, pose little risk to non-migratory bat populations.

Based on the available monitoring information and characteristics of the sites, bat mortality at the projects proposed for northern Sherman County is not expected to vary significantly from other regional wind projects (see Table 7). The results of fatality monitoring for the regional wind projects indicate mortality ranges from less than 1 to slightly over 3 .0 bat per turbine per year or approximately 1 to 2.5 bats per MW per year (see Table 7). Results of the Klondike I monitoring suggest that impacts in Sherman County may be on the lower end of this range.

Although future mortality of migratory bats is difficult to predict in any location, an estimate can be calculated based on levels of mortality documented at other wind projects in similar habitats. Based on these fairly consistent results, and considering the similarities in the characteristics of the project areas and other regional projects, a conservative estimate of bat mortality would fall within the mid range or approximately 1.5-2.5 bats per turbine (or per MW) per year. Provided that 440 turbines are constructed for all three projects, the total range of bat mortality would be from 660 to 1,100 fatalities per year. Actual levels of mortality are unknown and could be lower or higher, depending on factors such as regional migratory patterns of bats, patterns of local movements through the area, and the response of bats to turbines, individually and collectively. Mortality would involve primarily silver-haired and hoary bats, and no impacts to threatened or endangered bat species are anticipated. The significance of this impact on hoary and silver-haired bat populations is hard to predict, as there is very little information available regarding the overall population size and distribution of the bats potentially affected. The other regional monitoring studies suggest resident bats do not appear to be significantly affected by wind turbines and almost all mortality is observed during the fall migration period. Also, hoary bat and sliver-haired bats, which are expected to be the most common fatalities, are widely distributed in North America.

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Table 1. Avian species observed during fixed-point surveys[a] for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Seasons	Spring		Summer		Fall		Winter		Totals	
Group/Species	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**
Waterbirds	**81**	**5**	**1**	**1**	**0**	**0**	**2**	**2**	**84**	**8**
great blue heron	1	1	0	0	0	0	2	2	3	3
ring-billed gull[c]	2	1	0	0	0	0	0	0	2	1
sandhill crane	75	2	0	0	0	0	0	0	75	2
unidentified gull	3	1	1	1	0	0	0	0	4	2
Waterfowl	**60**	**7**	**40**	**1**	**551**	**9**	**6698**	**76**	**7349**	**93**
American wigeon	0	0	0	0	0	0	1	1	1	1
Canada goose	53	4	40	1	551	9	6662	70	7306	84
green-winged teal	0	0	0	0	0	0	1	1	1	1
hooded merganser[b]	2	2	0	0	0	0	0	0	2	2
Mallard	0	0	0	0	0	0	24	2	24	2
trumpeter swan	0	0	0	0	0	0	10	2	10	2
unidentified duck[c]	5	1	0	0	0	0	0	0	5	1
Shorebirds	**15**	**8**	**0**	**0**	**1**	**1**	**8**	**6**	**24**	**15**
Killdeer	7	5	0	0	1	1	8	6	16	12
long-billed curlew	8	3	0	0	0	0	0	0	8	3
Rails/Coots										
American coot[b]	6	1	0	0	0	0	0	0	6	1
Raptors/Vultures	**188**	**178**	**97**	**88**	**62**	**55**	**268**	**262**	**615**	**583**
Accipiters	*1*	*1*	*0*	*0*	*2*	*2*	*0*	*0*	*3*	*3*
Cooper's hawk	0	0	0	0	1	1	0	0	1	1
sharp-shinned hawk	1	1	0	0	1	1	0	0	2	2
Buteos	*109*	*101*	*46*	*41*	*38*	*35*	*181*	*178*	*374*	*355*
Swainson's hawk	23	21	11	10	4	3	0	0	38	34
ferruginous hawk	0	0	1	1	0	0	1	1	2	2
red-tailed hawk	48	45	30	26	21	21	36	35	135	127
rough-legged hawk	14	13	0	0	3	3	117	116	134	132
unidentified buteo	24	22	4	4	10	8	27	26	65	60
Northern Harriers										
northern harrier	39	39	21	21	7	7	38	38	105	105
Eagles	*3*	*3*	*1*	*1*	*0*	*0*	*4*	*4*	*8*	*8*
golden eagle	2	2	1	1	0	0	2	2	5	5
unidentified eagle	1	1	0	0	0	0	2	2	3	3
Falcons	*30*	*29*	*25*	*23*	*15*	*11*	*26*	*25*	*96*	*88*
American kestrel	24	23	24	22	15	11	18	17	81	73
prairie falcon	5	5	1	1	0	0	7	7	13	13
unidentified falcon	1	1	0	0	0	0	1	1	2	2
Other Raptors										
unidentified raptor	3	2	0	0	0	0	19	17	22	19
Vultures										
turkey vulture	3	3	4	2	0	0	0	0	7	5
Passerines	**2428**	**1040**	**595**	**318**	**1465**	**352**	**12298**	**1037**	**16786**	**2747**
American crow	6	1	0	0	1	1	1	1	8	3
American goldfinch	64	5	4	2	56	8	44	7	168	22
American pipit	189	9	0	0	77	9	157	7	423	25
American robin	14	9	3	3	4	3	15	6	36	21
barn swallow	16	11	31	8	9	3	0	0	56	22
black-billed magpie	0	0	1	1	4	2	14	5	19	8
Brewer's blackbird	114	13	7	5	45	7	114	6	280	31

Table 1. Avian species observed during fixed-point surveys[a] for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Seasons	Spring		Summer		Fall		Winter		Totals	
Group/Species	obs	grp	obs	grp	obs	grp	obs	grp	obs	grp
brown-headed cowbird	0	0	8	2	0	0	3	1	11	3
Cassin's finch	0	0	0	0	9	1	0	0	9	1
cliff swallow	10	2	25	9	0	0	0	0	35	11
common raven	88	55	11	9	56	36	152	103	307	203
common redpoll	0	0	0	0	0	0	7	1	7	1
common yellowthroat[b]	0	0	1	1	0	0	0	0	1	1
dark-eyed junco	0	0	0	0	3	2	25	3	28	5
European starling	91	14	18	4	61	8	770	32	940	58
golden-crowned kinglet[b]	0	0	0	0	1	1	0	0	1	1
golden-crowned sparrow	0	0	0	0	1	1	0	0	1	1
grasshopper sparrow	10	10	3	2	0	0	0	0	13	12
horned lark	1144	576	320	188	909	189	8800	656	11173	1609
house finch	8	4	1	1	7	2	75	5	91	12
lapland longspur	0	0	0	0	0	0	53	7	53	7
lark sparrow	2	1	0	0	1	1	0	0	3	2
Lincoln's sparrow	0	0	0	0	1	1	0	0	1	1
loggerhead shrike	1	1	8	7	0	0	1	1	10	9
N .rough-winged swallow	6	4	14	3	1	1	0	0	21	8
northern shrike	0	0	0	0	0	0	3	3	3	3
orange-crowned warbler	0	0	0	0	1	1	0	0	1	1
pine siskin	0	0	0	0	0	0	2	1	2	1
red-breasted nuthatch	0	0	0	0	2	2	0	0	2	2
red-winged blackbird	27	5	36	4	31	6	222	10	316	25
rock wren[b]	0	0	0	0	2	1	0	0	2	1
rusty blackbird	11	2	0	0	0	0	0	0	11	2
savannah sparrow	13	9	4	2	4	2	0	0	21	13
Say's phoebe	37	32	5	4	3	3	13	9	58	48
song sparrow	11	5	6	2	2	2	17	7	36	16
spotted towhee	2	2	0	0	1	1	3	3	6	6
tree swallow	5	2	0	0	0	0	0	0	5	2
unidentified blackbird	1	1	0	0	0	0	1056	6	1057	7
unidentified finch	1	1	0	0	0	0	33	3	34	4
unidentified passerine	48	17	1	1	38	10	352	23	439	51
unidentified shrike	0	0	0	0	0	0	1	1	1	1
unidentified sparrow	2	1	2	2	4	2	1	1	9	6
unidentified swallow	43	3	2	1	8	5	0	0	53	9
varied thrush[b]	0	0	0	0	0	0	1	1	1	1
vesper sparrow	2	2	3	1	1	1	0	0	6	4
violet-green swallow	25	4	0	0	0	0	0	0	25	4
western kingbird	8	5	13	9	3	3	0	0	24	17
western meadowlark	416	231	68	47	95	31	321	121	900	430
white-crowned sparrow	13	3	0	0	11	3	33	5	57	11
yellow-rumped warbler	0	0	0	0	13	3	9	2	22	5
Upland Gamebirds	**75**	**60**	**12**	**12**	**47**	**10**	**104**	**22**	**238**	**104**
California quail	7	3	1	1	4	1	62	5	74	10
Chukar	11	7	0	0	13	2	27	8	51	17
gray partridge	4	2	0	0	0	0	0	0	4	2
ring-necked pheasant	53	48	11	11	30	7	15	9	109	75

Table 1. Avian species observed during fixed-point surveys[a] for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Seasons	Spring		Summer		Fall		Winter		Totals	
Group/Species	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**
Doves/Pigeons	**30**	**12**	**30**	**14**	**43**	**17**	**47**	**10**	**150**	**53**
mourning dove	23	11	30	14	35	14	25	7	113	46
rock pigeon	7	1	0	0	8	3	22	3	37	7
Other Birds	**0**	**0**	**0**	**0**	**7**	**5**	**2**	**2**	**9**	**7**
Vaux's swift	0	0	0	0	3	1	0	0	3	1
northern flicker	0	0	0	0	4	4	2	2	6	6
Unidentified Birds										
unidentified large bird[c]	0	0	0	0	0	0	1	1	1	1
Overall Total	**2883**	**1311**	**775**	**434**	**2176**	**449**	**19428**	**1418**	**25262**	**3612**

[a] Includes all observations even those in the last ten minutes of surveys.
[b] Only observed in the last ten minutes of either the KIWP, BCWP, or BCRA surveys.
[c] Only observed outside 800m.

Table 2. Estimated mean use (number of observations per 20-minute survey) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Waterbirds	**0.013**	**0.004**	**0.000**	**0.003**	**0.005**
great blue heron	0.002	0.000	0.000	0.003	0.002
sandhill crane	0.011	0.000	0.000	0.000	0.003
unidentified gull	0.000	0.004	0.000	0.000	0.001
Waterfowl	**0.000**	**0.000**	**0.119**	**5.877**	**2.505**
American wigeon	0.000	0.000	0.000	0.003	0.001
Canada goose	0.000	0.000	0.119	5.794	2.474
green-winged teal	0.000	0.000	0.000	0.003	0.001
Mallard	0.000	0.000	0.000	0.073	0.025
trumpeter swan	0.000	0.000	0.000	0.004	0.003
Shorebirds	**0.018**	**0.000**	**0.005**	**0.011**	**0.011**
Killdeer	0.014	0.000	0.005	0.011	0.010
long-billed curlew	0.004	0.000	0.000	0.000	0.001
Raptors/Vultures	**0.354**	**0.392**	**0.232**	**0.309**	**0.306**
Accipiters	*0.000*	*0.019*	*0.000*	*0.000*	*0.003*
Cooper's hawk	0.000	0.000	0.009	0.000	0.001
sharp-shinned hawk	0.000	0.000	0.009	0.000	0.001
Swainson's hawk	0.036	0.018	0.010	0.000	0.016
Buteos	*0.168*	*0.133*	*0.206*	*0.180*	*0.177*
ferruginous hawk	0.000	0.004	0.000	0.000	0.001
red-tailed hawk	0.108	0.139	0.096	0.053	0.083
rough-legged hawk	0.026	0.000	0.013	0.146	0.067
unidentified buteo	0.009	0.007	0.014	0.007	0.010
Harriers					
northern harrier	0.097	0.029	0.014	0.045	0.048
Eagles	*0.004*	*0.000*	*0.003*	*0.002*	*0.003*
golden eagle	0.000	0.004	0.000	0.002	0.002
unidentified eagle	0.002	0.000	0.000	0.002	0.002
Falcons	*0.165*	*0.066*	*0.051*	*0.068*	*0.068*
American kestrel	0.061	0.162	0.066	0.032	0.058
prairie falcon	0.007	0.004	0.000	0.018	0.009
unidentified falcon	0.000	0.000	0.000	0.001	0.001
Other Raptors					
unidentified raptor	0.000	0.000	0.000	0.003	0.002
Vultures					
turkey vulture	0.007	0.026	0.000	0.000	0.005
Passerines	**6.402**	**3.792**	**7.922**	**18.147**	**12.139**
American crow	0.033	0.000	0.000	0.001	0.009
American goldfinch	0.267	0.026	0.285	0.122	0.145
American pipit	0.050	0.000	0.669	0.554	0.314
American robin	0.035	0.011	0.024	0.031	0.025

Table 2. Estimated mean use (number of observations per 20-minute survey) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Brewer's blackbird	0.285	0.049	0.372	0.191	0.230
Cassin's finch	0.000	0.000	0.083	0.000	0.013
European starling	0.319	0.175	0.355	2.184	0.955
Lincoln's sparrow	0.000	0.000	0.006	0.000	0.001
Say's phoebe	0.104	0.018	0.019	0.028	0.046
barn swallow	0.043	0.285	0.028	0.000	0.048
black-billed magpie	0.000	0.004	0.028	0.054	0.025
brown-headed cowbird	0.000	0.000	0.000	0.003	0.002
cliff swallow	0.032	0.018	0.000	0.000	0.009
common raven	0.201	0.042	0.301	0.208	0.192
common redpoll	0.000	0.000	0.000	0.006	0.004
dark-eyed junco	0.000	0.000	0.006	0.001	0.002
golden-crowned sparrow	0.000	0.000	0.006	0.000	0.001
grasshopper sparrow	0.021	0.028	0.000	0.000	0.010
horned lark	3.223	2.008	4.512	11.496	7.731
house finch	0.007	0.009	0.053	0.339	0.135
lapland longspur	0.000	0.000	0.000	0.164	0.059
lark sparrow	0.011	0.000	0.005	0.000	0.004
loggerhead shrike	0.003	0.026	0.000	0.001	0.005
northern rough-winged swallow	0.019	0.115	0.005	0.000	0.018
northern shrike	0.000	0.000	0.000	0.004	0.001
orange-crowned warbler	0.000	0.000	0.006	0.000	0.001
pine siskin	0.000	0.000	0.000	0.008	0.003
red-breasted nuthatch	0.000	0.000	0.016	0.000	0.002
red-winged blackbird	0.098	0.248	0.192	0.535	0.273
rusty blackbird	0.037	0.000	0.000	0.000	0.011
savannah sparrow	0.029	0.050	0.026	0.000	0.019
song sparrow	0.038	0.054	0.006	0.051	0.036
spotted towhee	0.004	0.000	0.006	0.007	0.004
tree swallow	0.020	0.000	0.000	0.000	0.003
unidentified blackbird	0.002	0.000	0.000	0.923	0.627
unidentified finch	0.002	0.000	0.000	0.010	0.007
unidentified passerine	0.063	0.000	0.182	0.496	0.284
unidentified shrike	0.000	0.000	0.000	0.001	0.001
unidentified sparrow	0.000	0.016	0.026	0.005	0.008
unidentified swallow	0.069	0.000	0.019	0.000	0.025
vesper sparrow	0.002	0.048	0.000	0.000	0.006
violet-green swallow	0.006	0.000	0.000	0.000	0.001
western kingbird	0.015	0.079	0.005	0.000	0.015
western meadowlark	1.308	0.483	0.611	0.598	0.758
white-crowned sparrow	0.058	0.000	0.069	0.090	0.058
yellow-rumped warbler	0.000	0.000	0.000	0.036	0.013

Table 2. Estimated mean use (number of observations per 20-minute survey) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Upland Gamebirds	**0.189**	**0.045**	**0.282**	**0.312**	**0.214**
California quail	0.000	0.009	0.026	0.225	0.086
chukar	0.019	0.000	0.071	0.061	0.040
gray partridge	0.022	0.000	0.000	0.000	0.006
ring-necked pheasant	0.147	0.036	0.186	0.027	0.082
Doves/Pigeons	**0.084**	**0.173**	**0.186**	**0.147**	**0.123**
mourning dove	0.084	0.173	0.123	0.070	0.087
rock pigeon	0.000	0.000	0.063	0.077	0.037
Other Birds	**0.000**	**0.000**	**0.030**	**0.004**	**0.006**
Vaux's swift	0.000	0.000	0.019	0.000	0.003
northern flicker	0.000	0.000	0.011	0.004	0.003

Table 3. Estimated percent composition (mean use divided by total use for all species) for each species observed within 800 m of the survey point all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Waterbirds	**0.18**	**0.08**	**0.00**	**0.01**	**0.03**
great blue heron	0.02	0.00	0.00	0.01	0.01
sandhill crane	0.16	0.00	0.00	0.00	0.02
unidentified gull	0.00	0.08	0.00	0.00	0.00
Waterfowl	**0.00**	**0.00**	**1.36**	**23.69**	**16.36**
American wigeon	0.00	0.00	0.00	0.01	0.01
Canada goose	0.00	0.00	1.36	23.35	16.16
green-winged teal	0.00	0.00	0.00	0.01	0.01
mallard	0.00	0.00	0.00	0.29	0.17
trumpeter swan	0.00	0.00	0.00	0.02	0.02
Shorebirds	**0.25**	**0.00**	**0.05**	**0.05**	**0.07**
killdeer	0.20	0.00	0.05	0.05	0.07
long-billed curlew	0.06	0.00	0.00	0.00	0.00
Raptors	**5.01**	**8.89**	**2.64**	**1.24**	**2.00**
Accipiters	*0.00*	*0.00*	*0.21*	*0.00*	*0.02*
Cooper's hawk	0.00	0.00	0.11	0.00	0.01
sharp-shinned hawk	0.00	0.00	0.11	0.00	0.01
Buteos	*2.55*	*3.81*	*1.51*	*0.83*	*1.15*
ferruginous hawk	0.00	0.08	0.00	0.00	0.00
rough-legged hawk	0.37	0.00	0.15	0.59	0.44
red-tailed hawk	1.53	3.15	1.10	0.22	0.54
Swainson's hawk	0.52	0.42	0.11	0.00	0.11
unidentified buteo	0.13	0.17	0.16	0.03	0.06
Northern Harrier					
northern harrier	1.37	0.67	0.16	0.18	0.32
Eagles	*0.02*	*0.08*	*0.00*	*0.01*	*0.02*
golden eagle	0.00	0.08	0.00	0.01	0.01
unidentified eagle	0.02	0.00	0.00	0.01	0.01
Falcon	*0.96*	*3.75*	*0.75*	*0.21*	*0.44*
American kestrel	0.87	3.67	0.75	0.13	0.38
prairie falcon	0.10	0.08	0.00	0.07	0.06
unidentified falcon	0.00	0.00	0.00	0.00	0.00
Other Raptors					
unidentified raptor	0.00	0.00	0.00	0.01	0.01
Vultures					
turkey vulture	0.10	0.58	0.00	0.00	0.03
Passerines	**90.69**	**86.06**	**90.27**	**73.14**	**79.29**
American crow	0.47	0.00	0.00	0.00	0.06
American goldfinch	3.79	0.59	3.25	0.49	0.95
American pipit	0.71	0.00	7.63	2.23	2.05
American robin	0.50	0.25	0.27	0.13	0.17

Table 3. Estimated percent composition (mean use divided by total use for all species) for each species observed within 800 m of the survey point all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
barn swallow	0.60	6.48	0.32	0.00	0.31
black-billed magpie	0.00	0.08	0.32	0.22	0.16
brown-headed cowbird	0.00	0.00	0.00	0.01	0.01
Brewer's blackbird	4.03	1.12	4.24	0.77	1.50
Cassin's finch	0.00	0.00	0.95	0.00	0.09
cliff swallow	0.45	0.42	0.00	0.00	0.06
common raven	2.84	0.94	3.43	0.84	1.26
common redpoll	0.00	0.00	0.00	0.02	0.03
dark-eyed junco	0.00	0.00	0.07	0.00	0.01
European starling	4.52	3.96	4.05	8.80	6.24
golden-crowned sparrow	0.00	0.00	0.07	0.00	0.01
grasshopper sparrow	0.29	0.63	0.00	0.00	0.06
house finch	0.11	0.21	0.61	1.37	0.88
horned lark	45.66	45.58	51.42	46.34	50.50
lapland longspur	0.00	0.00	0.00	0.66	0.38
lark sparrow	0.16	0.00	0.05	0.00	0.02
Lincoln's sparrow	0.00	0.00	0.07	0.00	0.01
loggerhead shrike	0.05	0.60	0.00	0.00	0.03
northern rough-winged swallow	0.27	2.62	0.05	0.00	0.11
northern shrike	0.00	0.00	0.00	0.02	0.01
orange-crowned warbler	0.00	0.00	0.07	0.00	0.01
pine siskin	0.00	0.00	0.00	0.03	0.02
red-breasted nuthatch	0.00	0.00	0.18	0.00	0.02
rusty blackbird	0.52	0.00	0.00	0.00	0.07
red-winged blackbird	1.38	5.63	2.19	2.16	1.78
Say's phoebe	1.47	0.40	0.21	0.11	0.30
savannah sparrow	0.41	1.14	0.29	0.00	0.12
song sparrow	0.54	1.23	0.07	0.20	0.24
spotted towhee	0.06	0.00	0.07	0.03	0.03
tree swallow	0.28	0.00	0.00	0.00	0.02
unidentified blackbird	0.02	0.00	0.00	3.72	4.10
unidentified finch	0.02	0.00	0.00	0.04	0.05
unidentified passerine	0.89	0.00	2.08	2.00	1.86
unidentified shrike	0.00	0.00	0.00	0.00	0.00
unidentified sparrow	0.00	0.36	0.29	0.02	0.05
unidentified swallow	0.98	0.00	0.22	0.00	0.16
vesper sparrow	0.02	1.08	0.00	0.00	0.04
violet-green swallow	0.08	0.00	0.00	0.00	0.01
white-crowned sparrow	0.82	0.00	0.78	0.36	0.38
western kingbird	0.21	1.78	0.05	0.00	0.10
western meadowlark	18.53	10.96	6.96	2.41	4.95
yellow-rumped warbler	0.00	0.00	0.00	0.14	0.09

Table 3. Estimated percent composition (mean use divided by total use for all species) for each species observed within 800 m of the survey point all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Upland Gamebirds	**2.68**	**1.03**	**3.21**	**1.26**	**1.40**
California quail	0.00	0.21	0.29	0.91	0.56
chukar	0.28	0.00	0.80	0.24	0.26
gray partridge	0.31	0.00	0.00	0.00	0.04
ring-necked pheasant	2.09	0.82	2.12	0.11	0.54
Doves/Pigeons	**1.19**	**3.93**	**2.11**	**0.59**	**0.80**
mourning dove	1.19	3.93	1.40	0.28	0.57
rock pigeon	0.00	0.00	0.71	0.31	0.24
Other Birds	**0.00**	**0.00**	**0.35**	**0.02**	**0.04**
northern flicker	0.00	0.00	0.13	0.02	0.02
Vaux's swift	0.00	0.00	0.22	0.00	0.02

Table 4. Estimated frequency of occurrence (average percent of surveys species/group is recorded) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Waterbirds	**0.73**	**0.37**	**0.00**	**0.30**	**0.37**
great blue heron	0.17	0.00	0.00	0.30	0.16
sandhill crane	0.56	0.00	0.00	0.00	0.15
unidentified gull	0.00	0.37	0.00	0.00	0.07
Waterfowl	**0.00**	**0.00**	**0.48**	**5.91**	**2.52**
American wigeon	0.00	0.00	0.00	0.30	0.10
Canada goose	0.00	0.00	0.48	4.87	2.12
green-winged teal	0.00	0.00	0.00	0.30	0.10
mallard	0.00	0.00	0.00	0.65	0.23
trumpeter swan	0.00	0.00	0.00	0.09	0.06
Shorebirds	**1.26**	**0.00**	**0.48**	**0.78**	**0.78**
killdeer	0.87	0.00	0.48	0.78	0.71
long-billed curlew	0.40	0.00	0.00	0.00	0.07
Raptors/Vultures	**27.57**	**25.88**	**16.69**	**23.58**	**22.94**
Accipiters	*0.00*	*0.00*	*1.85*	*0.00*	*0.29*
Cooper's hawk	0.00	0.00	0.93	0.00	0.15
sharp-shinned hawk	0.00	0.00	0.93	0.00	0.15
Buteos	*14.28*	*11.21*	*10.58*	*16.95*	*13.99*
ferruginous hawk	0.00	0.37	0.00	0.00	0.07
rough-legged hawk	2.25	0.00	1.28	12.72	5.90
red-tailed hawk	8.82	9.01	8.35	5.04	6.78
Swainson's hawk	2.60	1.47	0.95	0.00	1.23
unidentified buteo	0.95	0.73	0.95	0.59	0.86
Northern Harrier					
northern harrier	8.59	2.56	1.43	4.12	4.37
Eagles	*0.17*	*0.37*	*0.00*	*0.33*	*0.35*
golden eagle	0.00	0.37	0.00	0.16	0.18
unidentified eagle	0.17	0.00	0.00	0.16	0.17
Falcon	*6.80*	*13.59*	*5.19*	*4.73*	*6.06*
American kestrel	6.11	13.22	5.19	3.17	5.16
prairie falcon	0.69	0.37	0.00	1.78	0.95
unidentified falcon	0.00	0.00	0.00	0.08	0.06
Other Raptors					
unidentified raptor	0.00	0.00	0.00	0.33	0.23
Vultures					
turkey vulture	0.52	0.85	0.00	0.00	0.26
Passerines	**92.71**	**79.30**	**86.18**	**83.31**	**85.59**
American crow	0.56	0.00	0.00	0.08	0.20
American goldfinch	1.90	1.29	2.35	2.04	1.74
American pipit	0.56	0.00	5.82	2.12	1.80
American robin	1.97	1.10	1.88	1.22	1.38
barn swallow	2.78	6.31	1.40	0.00	1.66
black-billed magpie	0.00	0.37	0.93	1.70	0.84
brown-headed cowbird	0.00	0.00	0.00	0.09	0.06

Table 4. Estimated frequency of occurrence (average percent of surveys species/group is recorded) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Brewer's blackbird	2.58	4.01	4.06	0.74	2.10
Cassin's finch	0.00	0.00	0.93	0.00	0.15
cliff swallow	0.40	1.47	0.00	0.00	0.34
common raven	12.02	3.30	18.86	13.56	12.15
common redpoll	0.00	0.00	0.00	0.08	0.06
dark-eyed junco	0.00	0.00	0.64	0.08	0.15
European starling	5.30	3.44	3.13	7.50	5.21
golden-crowned sparrow	0.00	0.00	0.64	0.00	0.10
grasshopper sparrow	1.57	0.93	0.00	0.00	0.59
house finch	0.57	0.93	1.57	2.00	1.20
horned lark	80.74	58.16	68.95	69.71	72.10
lapland longspur	0.00	0.00	0.00	2.10	0.75
lark sparrow	0.56	0.00	0.48	0.00	0.21
Lincoln's sparrow	0.00	0.00	0.64	0.00	0.10
loggerhead shrike	0.35	1.78	0.00	0.09	0.36
northern rough-winged swallow	0.97	1.78	0.48	0.00	0.46
northern shrike	0.00	0.00	0.00	0.40	0.15
orange-crowned warbler	0.00	0.00	0.64	0.00	0.10
pine siskin	0.00	0.00	0.00	0.40	0.15
red-breasted nuthatch	0.00	0.00	1.57	0.00	0.24
rusty blackbird	0.67	0.00	0.00	0.00	0.20
red-winged blackbird	1.90	2.71	3.21	1.91	1.95
Say's phoebe	9.43	1.78	1.85	1.92	3.89
savannah sparrow	1.57	2.51	1.28	0.00	0.97
song sparrow	1.77	1.78	0.64	1.61	1.39
spotted towhee	0.40	0.00	0.64	0.74	0.45
tree swallow	0.79	0.00	0.00	0.00	0.14
unidentified blackbird	0.17	0.00	0.00	0.42	0.34
unidentified finch	0.17	0.00	0.00	0.08	0.11
unidentified passerine	1.91	0.00	5.18	3.17	2.86
unidentified shrike	0.00	0.00	0.00	0.08	0.06
unidentified sparrow	0.00	1.60	1.28	0.51	0.60
unidentified swallow	0.35	0.00	1.43	0.00	0.32
vesper sparrow	0.17	1.59	0.00	0.00	0.24
violet-green swallow	0.57	0.00	0.00	0.00	0.12
white-crowned sparrow	1.20	0.00	1.76	1.23	1.04
western kingbird	0.73	4.67	0.48	0.00	0.86
western meadowlark	49.30	23.29	16.23	18.35	26.51
yellow-rumped warbler	0.00	0.00	0.00	0.79	0.29
Upland Gamebirds	**13.41**	**4.54**	**3.97**	**4.66**	**6.46**
California quail	0.00	0.93	0.64	1.82	0.86
chukar	1.25	0.00	0.64	1.50	1.07
gray partridge	1.11	0.00	0.00	0.00	0.29

Table 4. Estimated frequency of occurrence (average percent of surveys species/group is recorded) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
ring-necked pheasant	11.61	3.61	3.33	1.33	4.48
Doves/Pigeons	**3.59**	**4.17**	**6.68**	**2.44**	**3.33**
mourning dove	3.59	4.17	4.47	1.79	2.76
rock pigeon	0.00	0.00	2.21	0.65	0.57
Other Birds	**0.00**	**0.00**	**1.76**	**0.38**	**0.42**
northern flicker	0.00	0.00	1.12	0.38	0.32
Vaux's swift	0.00	0.00	0.64	0.00	0.10

Table 5. Flight height characteristics of bird species and groups observed during the fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

				% w/i Height Categories		
Group/Species	**Number groups flying**	**Number birds flying**	**Percent of birds flying**	**<25 m**	**25-125m**	**> 125 m**
Waterbirds	**2**	**2**	**25.00**	**50.00**	**50.00**	**0.00**
great blue heron	1	1	50.00	0.00	100.00	0.00
sandhill crane	0	0	0.00	N/A	N/A	N/A
unidentified gull	1	1	25.00	100.00	0.00	0.00
Waterfowl	**54**	**4847**	**86.54**	**32.14**	**62.41**	**5.45**
American wigeon	0	0	0.00	N/A	N/A	N/A
Canada goose	52	4837	87.00	32.21	62.33	5.46
green-winged teal	0	0	0.00	N/A	N/A	N/A
mallard	0	0	0.00	N/A	N/A	N/A
trumpeter swan	2	10	100.00	0.00	100.00	0.00
unidentified duck	0	0	0.00	N/A	N/A	N/A
Shorebirds	**10**	**18**	**78.26**	**83.33**	**16.67**	**0.00**
killdeer	8	11	73.33	81.82	18.18	0.00
long-billed curlew	2	7	87.50	85.71	14.29	0.00
Raptors/Vultures	**359**	**383**	**81.14**	**41.78**	**48.30**	**9.92**
Accipiters	*2*	*2*	*100.00*	*100.00*	*0.00*	*0.00*
Cooper's hawk	1	1	100.00	100.00	0.00	0.00
sharp-shinned hawk	1	1	100.00	100.00	0.00	0.00
Buteos	*219*	*233*	*78.72*	*25.75*	*62.66*	*11.59*
Swainson's hawk	20	22	73.33	22.73	50.00	27.27
ferruginous hawk	1	1	100.00	0.00	0.00	100.00
red-tailed hawk	72	79	73.15	32.91	51.90	15.19
rough-legged hawk	86	88	83.81	25.00	72.73	2.27
unidentified buteo	40	43	82.69	16.28	69.77	13.95
Northern Harriers						
northern harrier	63	63	94.03	87.30	11.11	1.59
Eagles	*8*	*8*	*100.00*	*0.00*	*87.50*	*12.50*
golden eagle	5	5	100.00	0.00	100.00	0.00
unidentified eagle	3	3	100.00	0.00	66.67	33.33
Falcons	*44*	*49*	*69.01*	*73.47*	*24.49*	*2.04*
American kestrel	31	36	62.07	77.78	22.22	0.00
prairie falcon	11	11	100.00	63.64	27.27	9.09
unidentified falcon	2	2	100.00	50.00	50.00	0.00
Other Raptors						
unidentified raptor	19	22	100.00	22.73	40.91	36.36
Vultures						
turkey vulture	4	6	100.00	33.33	66.67	0.00
Passerines	**1609**	**13107**	**85.64**	**78.70**	**21.16**	**0.14**
American crow	1	1	14.29	0.00	100.00	0.00

Table 5. Flight height characteristics of bird species and groups observed during the fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

				% w/i Height Categories		
Group/Species	**Number groups flying**	**Number birds flying**	**Percent of birds flying**	**<25 m**	**25-125m**	**> 125 m**
American goldfinch	12	124	86.11	50.81	49.19	0.00
American pipit	11	226	94.17	99.56	0.44	0.00
American robin	9	15	48.39	80.00	20.00	0.00
Brewer's blackbird	20	200	75.47	60.50	39.50	0.00
Cassin's finch	1	9	100.00	0.00	100.00	0.00
European starling	38	691	78.52	45.88	54.12	0.00
Lincoln's sparrow	1	1	100.00	100.00	0.00	0.00
Say's phoebe	18	24	57.14	100.00	0.00	0.00
barn swallow	18	46	100.00	97.83	2.17	0.00
black-billed magpie	4	14	82.35	50.00	50.00	0.00
brown-headed cowbird	1	3	100.00	100.00	0.00	0.00
cliff swallow	5	13	100.00	100.00	0.00	0.00
common raven	129	197	85.28	56.35	37.06	6.60
common redpoll	1	7	100.00	100.00	0.00	0.00
dark-eyed junco	2	2	100.00	100.00	0.00	0.00
golden-crowned sparrow	0	0	0.00	N/A	N/A	N/A
grasshopper sparrow	2	2	16.67	100.00	0.00	0.00
horned lark	1037	9315	89.49	88.32	11.68	0.00
house finch	9	82	95.35	95.12	4.88	0.00
lapland longspur	2	34	70.83	50.00	50.00	0.00
lark sparrow	2	3	100.00	100.00	0.00	0.00
loggerhead shrike	5	5	100.00	100.00	0.00	0.00
northern rough-winged swallow	7	20	100.00	60.00	40.00	0.00
northern shrike	0	0	0.00	N/A	N/A	N/A
orange-crowned warbler	0	0	0.00	N/A	N/A	N/A
pine siskin	1	2	100.00	100.00	0.00	0.00
red-breasted nuthatch	0	0	0.00	N/A	N/A	N/A
red-winged blackbird	8	46	17.16	100.00	0.00	0.00
rusty blackbird	0	0	0.00	N/A	N/A	N/A
savannah sparrow	8	15	75.00	100.00	0.00	0.00
song sparrow	4	8	23.53	100.00	0.00	0.00
spotted towhee	2	2	40.00	100.00	0.00	0.00
tree swallow	2	5	100.00	20.00	80.00	0.00
unidentified blackbird	7	1057	100.00	5.39	94.61	0.00
unidentified finch	2	13	100.00	100.00	0.00	0.00
unidentified passerine	37	406	99.27	90.64	7.88	1.48
unidentified shrike	1	1	100.00	100.00	0.00	0.00
unidentified sparrow	3	5	71.43	100.00	0.00	0.00
unidentified swallow	5	44	100.00	97.73	2.27	0.00
vesper sparrow	1	3	75.00	100.00	0.00	0.00
violet-green swallow	2	2	100.00	50.00	50.00	0.00

Table 5. Flight height characteristics of bird species and groups observed during the fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

				% w/i Height Categories		
Group/Species	**Number groups flying**	**Number birds flying**	**Percent of birds flying**	**<25 m**	**25-125m**	**> 125 m**
western kingbird	10	15	93.75	100.00	0.00	0.00
western meadowlark	174	405	49.33	99.01	0.99	0.00
white-crowned sparrow	5	35	70.00	100.00	0.00	0.00
yellow-rumped warbler	2	9	100.00	44.44	55.56	0.00
Upland Gamebirds	**25**	**101**	**49.75**	**100.00**	**0.00**	**0.00**
California quail	2	48	71.64	100.00	0.00	0.00
chukar	6	13	30.23	100.00	0.00	0.00
gray partridge	1	2	50.00	100.00	0.00	0.00
ring-necked pheasant	16	38	42.70	100.00	0.00	0.00
Doves/Pigeons	**38**	**102**	**82.93**	**62.75**	**37.25**	**0.00**
mourning dove	32	72	77.42	88.89	11.11	0.00
rock pigeon	6	30	100.00	0.00	100.00	0.00
Other Birds	**4**	**6**	**85.71**	**33.33**	**66.67**	**0.00**
Vaux's swift	1	3	100.00	0.00	100.00	0.00
northern flicker	3	3	75.00	66.67	33.33	0.00
Unidentified Birds						
unidentified large bird	1	1	100.00	100.00	0.00	0.00
Overall	2102	18567	85.40	65.80	32.47	1.73

Table 6. Exposure indices calculated for species observed during fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

Group/Species	Mean use	Percent flying	Percent flying within RSA	Exposure Index
Waterbirds	**0.005**	**25.00**	**50.00**	**0.001**
great blue heron	0.002	50.00	100.00	0.001
sandhill crane	0.003	0.00	N/A	N/A
unidentified gull	0.001	25.00	0.00	0.000
Waterfowl	**2.505**	**86.54**	**62.41**	**1.353**
American wigeon	0.001	0.00	N/A	N/A
Canada goose	2.474	87.00	62.33	1.342
green-winged teal	0.001	0.00	N/A	N/A
mallard	0.025	0.00	N/A	N/A
trumpeter swan	0.003	100.00	100.00	0.003
unidentified duck	N/A	0.00	N/A	N/A
Shorebirds	**0.011**	**78.26**	**16.67**	**0.001**
killdeer	0.010	73.33	18.18	0.001
long-billed curlew	0.001	87.50	14.29	0.000
Raptors	**0.306**	**81.14**	**48.30**	**0.120**
Accipiters	*0.003*	*100.00*	*0.00*	*0.000*
Cooper's hawk	0.001	100.00	0.00	0.000
sharp-shinned hawk	0.001	100.00	0.00	0.000
Buteos	*0.177*	*78.72*	*62.66*	*0.087*
Swainson's hawk	0.016	73.33	50.00	0.006
ferruginous hawk	0.001	100.00	0.00	0.000
red-tailed hawk	0.083	73.15	51.90	0.031
rough-legged hawk	0.067	83.81	72.73	0.041
unidentified buteo	0.010	82.69	69.77	0.006
Northern Harriers				
northern harrier	0.048	94.03	11.11	0.005
Eagles	*0.003*	*100.00*	*87.50*	*0.003*
golden eagle	0.002	100.00	100.00	0.002
unidentified eagle	0.002	100.00	66.67	0.001
Falcon	*0.068*	*69.01*	*24.49*	*0.011*
American kestrel	0.058	62.07	22.22	0.008
prairie falcon	0.009	100.00	27.27	0.003
unidentified falcon	0.001	100.00	50.00	0.000
Other Raptors				
unidentified raptor	0.002	100.00	40.91	0.001
Vultures				
turkey vulture	0.005	100.00	66.67	0.003
Passerines	**12.139**	**85.64**	**21.16**	**2.200**
American crow	0.009	14.29	100.00	0.001
American goldfinch	0.145	86.11	49.19	0.062

Table 6. Exposure indices calculated for species observed during fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

Group/Species	Mean use	Percent flying	Percent flying within RSA	Exposure Index
American pipit	0.314	94.17	0.44	0.001
American robin	0.025	48.39	20.00	0.002
Brewer's blackbird	0.230	75.47	39.50	0.069
Cassin's finch	0.013	100.00	100.00	0.013
European starling	0.955	78.52	54.12	0.406
Lincoln's sparrow	0.001	100.00	0.00	0.000
Say's phoebe	0.046	57.14	0.00	0.000
barn swallow	0.048	100.00	2.17	0.001
black-billed magpie	0.025	82.35	50.00	0.010
brown-headed cowbird	0.002	100.00	0.00	0.000
cliff swallow	0.009	100.00	0.00	0.000
common raven	0.192	85.28	37.06	0.061
common redpoll	0.004	100.00	0.00	0.000
dark-eyed junco	0.002	100.00	0.00	0.000
golden-crowned sparrow	0.001	0.00	N/A	N/A
grasshopper sparrow	0.010	16.67	0.00	0.000
horned lark	7.731	89.49	11.68	0.808
house finch	0.135	95.35	4.88	0.006
lapland longspur	0.059	70.83	50.00	0.021
lark sparrow	0.004	100.00	0.00	0.000
loggerhead shrike	0.005	100.00	0.00	0.000
northern rough-winged swallow	0.018	100.00	40.00	0.007
northern shrike	0.001	0.00	N/A	N/A
orange-crowned warbler	0.001	0.00	N/A	N/A
pine siskin	0.003	100.00	0.00	0.000
red-breasted nuthatch	0.002	0.00	N/A	N/A
red-winged blackbird	0.273	17.16	0.00	0.000
rusty blackbird	0.011	0.00	N/A	N/A
savannah sparrow	0.019	75.00	0.00	0.000
song sparrow	0.036	23.53	0.00	0.000
spotted towhee	0.004	40.00	0.00	0.000
tree swallow	0.003	100.00	80.00	0.003
unidentified blackbird	0.627	100.00	94.61	0.593
unidentified finch	0.007	100.00	0.00	0.000
unidentified passerine	0.284	99.27	7.88	0.022
unidentified shrike	0.001	100.00	0.00	0.000
unidentified sparrow	0.008	71.43	0.00	0.000
unidentified swallow	0.025	100.00	2.27	0.001
vesper sparrow	0.006	75.00	0.00	0.000
violet-green swallow	0.001	100.00	50.00	0.001
western kingbird	0.015	93.75	0.00	0.000
western meadowlark	0.758	49.33	0.99	0.004

Table 6. Exposure indices calculated for species observed during fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

Group/Species	Mean use	Percent flying	Percent flying within RSA	Exposure Index
white-crowned sparrow	0.058	70.00	0.00	0.000
yellow-rumped warbler	0.013	100.00	55.56	0.007
Upland Gamebirds	**0.214**	**49.75**	**0.00**	**0.000**
California quail	0.086	71.64	0.00	0.000
chukar	0.040	30.23	0.00	0.000
gray partridge	0.006	50.00	0.00	0.000
ring-necked pheasant	0.082	42.70	0.00	0.000
Doves/Pigeons	**0.123**	**82.93**	**37.25**	**0.038**
mourning dove	0.087	77.42	11.11	0.007
rock pigeon	0.037	100.00	100.00	0.037
Other Birds	**0.006**	**85.71**	**66.67**	**0.004**
Vaux's swift	0.003	100.00	100.00	0.003
northern flicker	0.003	75.00	33.33	0.001
Unidentified Birds				
unidentified large bird	N/A	100.00	0.00	N/A

Table 7. Summary of Bat Mortality for Newer Generation Wind Plant Monitoring Studies in the Western U.S.

Project Name [state]	No. Bats /turbine/year	Approx. Bats per MW[1]	Reference
Washington/Oregon Sites			
Stateline [OR/WA]	1.12	1.70	Erickson et al. 2003
Vansycle [OR]	0.74	1.12	Erickson et al. 2000
Klondike [OR]	1.16	0.77	Johnson et al. 2003
Nine Canyon [WA]	3.21	2.46	Erickson et al. 2003
Combine Hills [OR]	1.88	1.88	Young et al. 2006
Average	1.62	1.59	
Other West and Midwest Sites			
Foote Creek Rim I [WY]	1.34	2.23	Young et al. 2003a
Foote Creek Rim II [WY]	0.79	1.05	Young et al. 2003b
Buffalo Ridge [MN]	2.05	3.10	Johnson et al. 2000
Wisconsin [WI]	4.30	6.51	Howe et al. 2002
Overall Average	1.84	2.31	

[1] Most reports do not provide number of birds per MW of energy produced so this number was calculated based on the mortality per turbine and capacity of turbines studied.

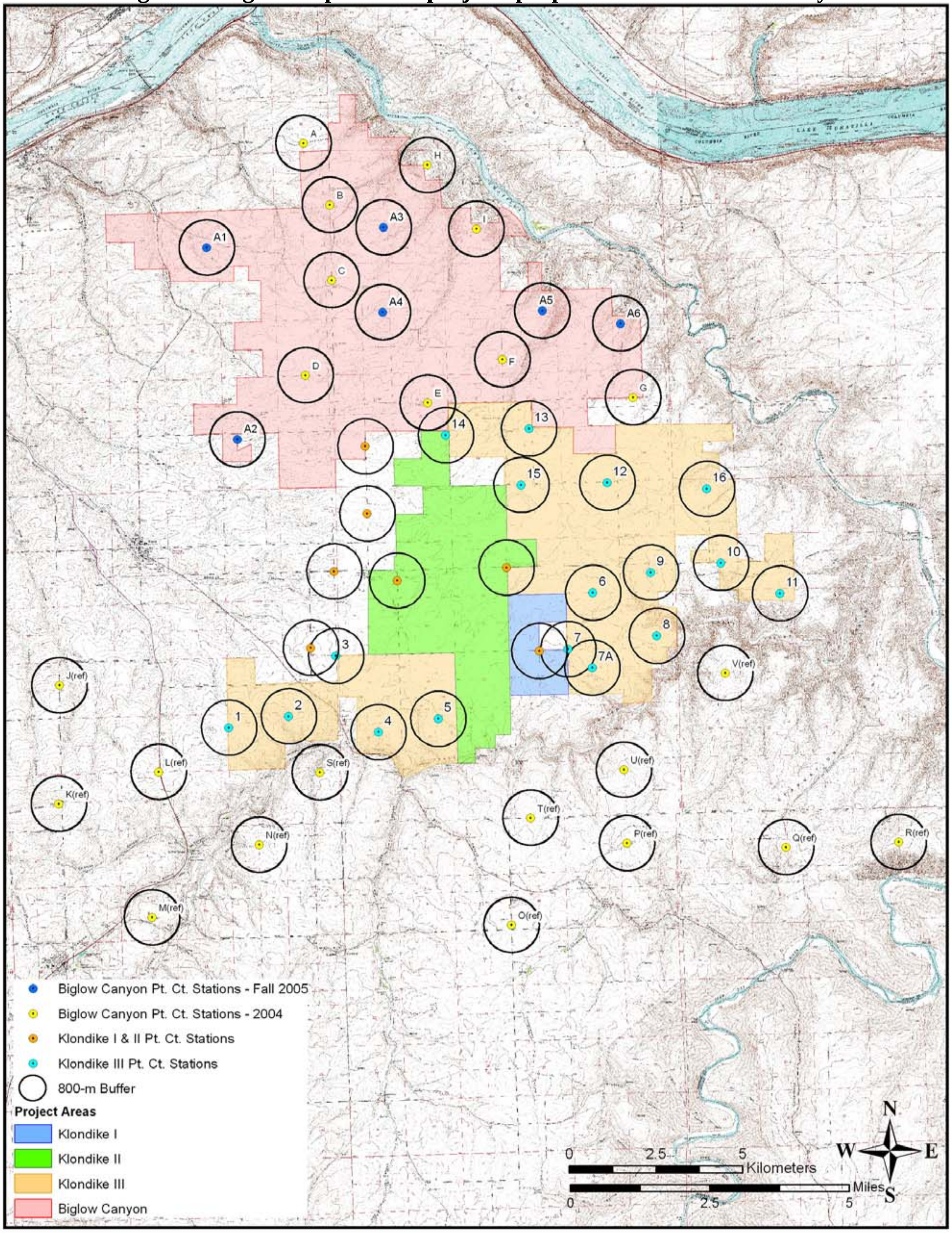
Table 8. Mean raptor use estimates standardized to 20-min surveys and raptor mortality estimates based on fatality studies at region wind projects.

Project	Raptor Use Estimate (#/20-min survey)	Raptor Mortality (#/turbine/year)	References
Vansycle, OR	0.51	0	URS&WEST 2001; Erickson et al. 2000
Stateline, OR	0.41	0.053	URS&WEST 2001; Erickson et al. 2004
Combine Hills, OR	0.61	0	Young et al. 2003 Young et al. 2005
Nine Canyon, WA	0.27	0.065	Erickson et al. 2001 Erickson et al. 2003
Klondike I, OR	0.42	0	Johnson et al. 2002; Johnson et al. 2003
Average	0.44	0.024	

Table 9. Mean bird use estimates standardized to 20-min surveys and all bird mortality estimates based on fatality studies at region wind projects.

Project	All Bird Use Estimate (#/20-min survey)	All Bird Mortality (#/turbine/year)	References
Vansycle, OR	7.06	0.63	URS&WEST 2001; Erickson et al. 2000
Stateline, OR	8.77	1.93	URS&WEST 2001; Erickson et al. 2004
Combine Hills, OR	4.11	2.56	Young et al. 2003 Young et al. 2005
Nine Canyon, WA	6.28	3.59	Erickson et al. 2001 Erickson et al. 2003
Klondike I, OR	9.34	1.42	Johnson et al. 2002; Johnson et al. 2003
Average		2.03	

Figure 1. Region map of wind projects proposed for Sherman County.



Appendix B Visual Resources Technical Memorandum

Visual Resources
Technical Memorandum

Klondike III/Biglow Canyon
Wind Integration Project

Prepared for Bonneville Power Administration, Portland, OR
Prepared by David Evans and Associates, Inc., Portland, OR
January 2006

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1 INTRODUCTION

David Evans and Associates, Inc. (DEA) prepared this visual resources technical memorandum for the Bonneville Power Administration (BPA) to support an Environmental Impact Statement for the Klondike III/Biglow Canyon Wind Integration Project.

The project would occur in rural, northeast Sherman County (Figure 1, Appendix A) and generally involves the development of a new transmission line, substation expansion, and appurtenances to integrate proposed private energy facilities (i.e., Klondike III Wind Project and Biglow Canyon Wind Farm) into BPA's transmission system. The transmission line begins roughly one mile south of the Columbia River at the John Day Substation to a point approximately four and a half miles east of Wasco, Oregon, and lies roughly three miles southwest of the John Day River at its closest point.

The Klondike III Wind Project, which would be built by PPM Energy, would consist of an approximately 273 megawatt (MW) wind generation project. The proposed project is adjacent to PPM Energy's Klondike I (24 MW) and Klondike II (75 MW) wind projects. It would be constructed on privately-owned land and be connected to the BPA Klondike Schoolhouse Substation. Klondike III Wind Project facilities would consist of up to 165 wind turbines and towers, approximately 19 miles of new roads, an operations and maintenance (O&M) facility, and two substations.

The Biglow Canyon Wind Farm facility, proposed by Orion Energy, would be an approximately 450 MW wind generation project. The Biglow Canyon Wind Farm will be connected to BPA's transmission system at one of two alternative substations on the Biglow Canyon Wind Farm site. Orion Energy is responsible for selecting its substation alternative. Orion Energy is responsible for selecting the option to be implemented. The Biglow Canyon Wind Farm would consist of up to 225 wind turbines and towers, approximately 40 miles of new roads, an O&M facility, and a substation.

Unless otherwise stated, all figures referenced herein are included in Appendix A; all photographs are in Appendix B.

1.1 METHODS

The analysis area (Figure 1) for visual resources extends approximately 30 miles beyond the transmission alignments. DEA conducted a site visit December 29 and 30, 2005, for the Klondike III/Biglow Canyon Wind Integration Project. DEA also reviewed recent documents from the Klondike III Wind Project Application for Site Certificate (ASC) (DEA, 2005) and the Biglow Canyon Wind Farm ASC (CH2M Hill 2005) and field-verified the findings of these documents to the extent practical. The findings of this memorandum are based upon information gathered during the field investigation, review of reference materials, and DEA's knowledge of visual and aesthetic resource management. DEA staff used a compilation of evaluation techniques prescribed by US Bureau of Land Management (BLM) and US Forest Service (USFS) to identify and assess potential impacts.

Spatial analyses and computer simulations were prepared using Geographic Information System (GIS) software and a suite of graphic software applications. The visibility analysis was conducted using US Geological Survey (USGS) Digital Elevation Models (DEMs). Visibility analysis and modeling techniques were used to determine areas from which the proposed facility would potentially be visible. The DEMs used in the analyses have 30-meter and 10-meter resolutions, meaning the ground is represented by a grid of squares that are 30m x 30m or 10m x 10m, and each square is assigned a single elevation. As such, the resolution of the DEMs is a limiting factor in the precision of these analyses. The models used in the analyses also do not include vegetation or structures, and do not account for attenuating climatic conditions such as distance, haze, humidity, weather, or background landscape. Therefore, it should be noted that these analyses generally overestimate areas of visibility.

Methods specific to the Klondike III Wind Project and Biglow Canyon Wind Farm visual analyses are described in detail in the respective ASCs for those projects.

2 PROPOSED ACTION AND ALTERNATIVES

BPA is considering two action alternatives and a No Action Alternative. The action alternatives consist of: 1) The Proposed Action – signing interconnection agreements with two wind developers, expanding an existing substation, building a new substation, and building a new double-circuit 230-kV transmission line along a northerly route alignment; and 2) The Middle Alternative, which includes the same elements of the Proposed Action but the transmission line alignment is different. Under the No Action Alternative, BPA would not build any new facilities, or sign any interconnection agreements.

The proposals for two wind projects, Klondike III Wind Project and Biglow Canyon Wind Farm, are also described in this section. The two wind projects would utilize the proposed BPA facilities and interconnection agreement to tie into BPA's power grid.

2.1 BPA PROPOSED ACTION

In the Proposed Action, BPA would build and operate a new double-circuit 230-kilovolt (kV) transmission line, build a new 230-kV substation, and expand its existing John Day 500-kV Substation. The double-circuit 230-kV transmission line would be built from BPA's new John Day 230-kV Substation to the Klondike III Wind Project's West Collector Substation. The line would carry 600 MW of capacity in each circuit. The Biglow Canyon Wind Farm project would be looped into one of the circuits located in between Klondike and the new John Day 230-kV Substation.

BPA would expand its existing John Day 500-KV Substation by about 0.3 acre inside the existing yard to include a new 500-kV bay with two transformers. The south fence would be extended and a dead end tower on the southwest corner would be built to connect to a new 230-kV substation.

BPA would build a new 230-kV substation adjacent to and south of John Day 500-kV Substation. The new substation would include a transformer, ring bus and other typical substation equipment. The new substation would encompass about 5 acres.

In addition, BPA proposes to analyze a new substation site in the vicinity of the Klondike III West Collector substation, not needed now, but possibly needed in the future.

2.1.1 Proposed Double-Circuit 230-kV Transmission Line

BPA proposes to build a double-circuit 230-kV transmission line. The proposed route for this line is the North Alternative, which is about 12 miles long.

2.1.1.1 Transmission Structures

Steel tubes and lattice steel transmission towers would be used to suspend the 230-kV transmission line in the air. Steel tubes would be used for tangent and small angle structures. Steel tubes average about 110 feet tall, with the average span 900 to 1,000 feet. Steel tubes are usually preferred in agricultural areas because they do not disrupt farming practices as much as other types of structures.

BPA would use lattice steel towers for the dead-end structures needed for the lines. Deadend structures equalize tension of the conductors between two segments of transmission line where the line makes a turn. Lattice steel towers would be used because they are more cost effective than steel tubes. Lattice steel towers average about 120 feet tall, with the average span 1,000-1,200 feet.

The steel tubes would be embedded in the ground about 20 to 25 feet, in a hole about 5 feet in diameter. The lattice steel towers would be attached to the ground on plate or grillage footings. Plate footings are 6 foot x 6 foot steel plates buried about 10 feet deep. Grillage footings are a 10 foot x 10 foot assembly of steel I-beams that have been welded together and buried 10-12 feet deep.

A trackhoe would be used to excavate an area for the footings. The excavation sidewalls would be sloped or shored to prevent collapse. All the soil and rock materials removed would later be used to backfill the excavated area once the footings are installed.

Transmission structures are normally assembled in sections at a structure site and lifted into place by a large crane (30-100 ton capacity). The construction of a tower and its footings could disturb an area of about an acre (200 feet x 200 feet) using plate and grillage footings.

2.1.1.2 Conductors and Insulators

The wires that carry electrical current in a transmission line are called conductors. The conductor proposed for this project would be about 1.3-1.6 inches in diameter. Conductors are suspended from tubes and towers with insulators. Insulators are made of nonconductive materials (rubber, porcelain or fiberglass) that prevent electric current from passing through the towers to the ground. Insulator strings of non-reflective material for BPA's line would be 10 inches in diameter, and 7 feet long.

Conductors and insulators are installed after the tubes and towers have been built. A pulling cable called a "sock line" is placed on pulleys or travelers that are attached to the insulators on the structures. The sock line is pulled through the pulleys, usually by helicopter. The end of the sock line is attached to a conductor on large reels mounted on trucks equipped with a brake system that allows the conductor to be unwound under tension. The sock line is used to pull the conductors through the series of pulleys mounted on the structures. Conductor tensioning sites are usually located every 2-3 miles.

About 10 tensioning sites would be required for this project. Conductor tensioning sites typically disturb an area of about 1 acre. Disturbance is temporary. Any disturbed area would be restored to pre-construction conditions.

At the dead-end structures, BPA uses two methods to attach the conductor to the structure. The first method, hydraulic compression fittings, uses a large press and pump that closes a metal clamp or sleeve onto the conductor. This method requires heavy equipment and is time consuming. The second method, implosive fittings, uses explosives to compress the metal together. The implosive fittings do a better job of compressing the sleeve onto the conductor and actually weld the metals together. Implosive fittings do not require heavy equipment, but do create noise similar to a loud explosion when the primer is struck. BPA is proposing to use implosive fittings on this project.

Two smaller wires, called ground wires, would also be attached to the top of the transmission structures. Ground wires are used for lightning protection. There is also a series of wires and/or grounding rods (called counterpoise) buried in the ground at each structure. These wires are used to establish a low resistance path to earth, usually for lightning protection.

A fiber optic cable would also be strung on the structures. The fiber optic cable would have up to 36 fibers. The fibers would be used for communications as part of the power system. Fiber optics technology uses light pulses instead of radio or electrical signals to transmit messages. This communication system can gather information about the system (such as the transmission lines in service and the amount of power being carried, meter readings at interchange points, and status of equipment and alarms).

2.1.1.3 Right-of-Way

BPA would acquire easements to build, operate and maintain the transmission line across private properties. The Proposed Action would require new right-of-way 125 feet wide over about 12 miles.

2.1.1.4 Right-of-Way Clearing

Tall trees cannot be allowed to grow into or near the lines because electricity can arc, which can start a fire or injure or kill someone nearby. Most of the land along the right-of-way is in wheat production or has other low-growing vegetation compatible with transmission lines. There are few tall trees along the proposed route and no trees would likely be removed.

2.1.1.5 Access Roads

BPA would use the existing road system as much as possible for construction. However, access would be necessary for construction to each structure site. Any roads needed in farmed fields would be about 14-feet wide, would be temporary and would be removed after construction. If construction were scheduled during the dry season, little or no rock would be necessary on the roads. Access roads would be used by cranes, excavators, supply trucks, boom trucks, and line trucks for construction of the transmission line.

Ground disturbed for temporary roads would be restored to its pre-construction condition after the transmission lines would be built. If crop damage were to occur during construction or maintenance, landowners would be compensated. The exact location of temporary roads, if any would be needed, would not be known until a construction contractor defines their access needs. Access road locations would be coordinated with landowners, to the extent practical, to minimize impacts on property.

2.1.1.6 Stream Crossings

The transmission line would occasionally span across waters of the State or US. The majority of the drainages mapped as intermittent streams on USGS maps did not meet criteria for regulation as jurisdictional waters. The USGS typically bases its mapping of intermittent streams on topography rather than field observation. During the site visit, DEA determined that many of the historically mapped drainages had been plowed through and no longer displayed bed and bank characteristics or other characteristics necessary for indicating the presence of a jurisdictional water body.

Six drainage features containing waters of the state and US (i.e., jurisdictional) were identified during the site visit. They are displayed in Figure 2, and are described separately in the Affected Environment section below.

2.1.1.7 Gates

Some landowners/land managers have policies regarding public access to their properties. Locked gates are commonly used to restrict public access. BPA cooperates with landowners on a case-by-case basis on permanent access, gates and locks.

2.1.1.8 Staging Areas

During transmission line construction, steel, electrical conductors, insulators and hardware are often stockpiled at a site called a staging area or material yard. The contractor(s) hired to construct the line would secure temporary rights to establish a staging area. One 5-acre staging area would be needed for this project. To facilitate construction efficiency, staging areas tend to be located next to highways and main roads. Staging areas are only used prior to and during construction.

2.1.2 Substations

Substations contain electrical equipment that enables BPA to interconnect several different transmission lines, disconnect lines for maintenance or outage conditions, and regulate voltage.

BPA proposes to expand its existing John Day 500-KV Substation by about 0.3 acre inside the existing yard to include a new 500-kV bay with two transformers. The south fence would be extended and a dead end tower on the southwest corner would be built to connect to a new 230-kV substation.

BPA would build a new 230-kV substation adjacent to and south of John Day 500-kV Substation. The new substation would include a transformer, ring bus and other typical substation equipment. The new substation would encompass about 5 acres.

BPA also intends to consider the impacts of building another substation in the area. Because more local wind generation projects are expected to be constructed in the coming years, a substation is likely to be needed in the vicinity to integrate them into BPA's transmission system; however, another substation is not needed at this time.

2.1.3 Communication Facilities

Microwave communication sites and fiber-optic communication lines connect BPA's high-voltage substations to system control centers located in Vancouver and Spokane, Washington. Dispatchers within the control centers remotely monitor meters and gauges on electric power equipment within each substation and receive alarm signals if an emergency were to occur. Dispatchers have the ability to disconnect lines and electrical equipment when transmission failures do occur.

Communications between the wind farm collector facilities and the proposed new 230-kV substation would be accomplished with fiber optic cables. Redundant fiber optics cables with alternate routes would be installed between the new substation and the existing 500-kV substation to ensure that no single failure would disable communications. The circuits would be connected to the existing BPA communication system.

2.1.4 Maintenance

During the life of the project, BPA would perform routine, periodic maintenance and emergency repairs to the transmission line. Maintenance usually involves replacing insulators. Twice a year, a helicopter would fly over the line to look for hot spots (areas where electricity may not be flowing correctly) or other problems indicating that a repair may be needed.

Vegetation is also maintained along the line for safe operation and to allow access to the line. The project area would need little vegetation maintenance because it is mostly farmed.

If vegetation maintenance is needed, BPA would use an integrated vegetation management strategy for controlling vegetation along its transmission line rights-of-way. The strategy involves choosing the appropriate method for controlling the vegetation based on the type of vegetation and its density, the natural resources present at a particular site, landowner requests, regulations, and costs. BPA may use a number of different methods: manual (hand-pulling, chainsaws), mechanical (roller-choppers, brush-hogs), biological (insects or fungus for attacking noxious weeds), and herbicides.

Prior to controlling vegetation, BPA sends notices to landowners and requests information that might help in determining appropriate methods and mitigation measures (such as herbicide-free buffer zones around springs or wells). Noxious weed control is also part of BPA's vegetation maintenance program and BPA works with the county weed boards and landowners on area-wide plans for noxious weed control.

2.2 MIDDLE ALTERNATIVE

The Middle Alternative would originate from the same location north of PPM's Klondike Schoolhouse Substation as the Proposed Action, but would follow a different route to the new 230-kV substation. This alternative would be approximately 12.5 miles long.

The Middle Alternative has all the components of the Proposed Action, but uses a different alignment.

2.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, no interconnection agreements would be signed with PPM and Orion, and no new substation, substation expansion or transmission line would be constructed.

2.4 KLONDIKE III WIND PROJECT

The Klondike III Wind Project, which would be built by PPM Energy, would consist of an approximately 273 megawatt (MW) wind generation project in northern Sherman County, Oregon. The proposed project is adjacent to PPM Energy's Klondike I (24 MW) and Klondike II (75 MW) wind projects. It would be constructed on privately-owned land and be connected to the BPA Klondike Schoolhouse Substation.

All Klondike III project facilities would be on private agricultural land upon which PPM Energy has negotiated long-term wind energy leases with the landowners. The wind energy leases allow PPM Energy to permit, construct, and operate wind energy facilities for a defined period. In exchange, the landowners receive compensation. The terms of the wind energy leases allow landowners to continue their farming operations in and around the wind turbine generators and other facilities where the farming activities would not impact operation and maintenance of the wind generation equipment.

Klondike III Wind Project facilities would consist of up to 165 wind turbines and towers, approximately 19 miles of new roads, an operations and maintenance (O&M) facility, and two substations. Wind turbines and roads would be built within 900-foot-wide corridors. Project facilities would occupy approximately 70 acres of land.

2.4.1 Turbines and Towers

Wind turbines consist of two primary components: a tubular tower, and the nacelle, which rests on the tower. The nacelle houses equipment such as the gearbox and supports the turbine blades and hub. The turbines are interconnected with an underground power collection system and linked to the project substation.

The wind turbines would be grouped in linear strings, some of which would include aviation warning lights required by the Federal Aviation Administration (FAA). The number of turbines with lights and the lighting pattern of the turbines would be determined in consultation with the FAA.

One of two turbine types may be used for the project; PPM Energy has not yet made a selection. However, both types would have similar environmental effects and power generation capabilities. The analysis in this technical memorandum is based on a “worst-case” situation; e.g., for the visual assessment, the taller of the two turbines was analysed, and for the noise evaluation, the louder was analyzed.

The blade diameter of the turbines would range from 77 to 82 meters. The height at the hub would be up to 80 meters. The swept area of the rotor would be from 4,658 to 5,281 square meters, and the rotor speed could be between 10 and 18 revolutions per minute (rpm).

The tower supporting each wind turbine would be a tapered monopole, roughly 80 meters tall. It would be supported by a spread footer concrete foundation. The underground footprint of each foundation would be approximately 2,000 square feet. The actual foundation design would be determined based on site-specific geotechnical information and structural loading requirements of the selected turbine model. The towers would be uniformly painted a neutral gray or white color. Each tower would have a locked entry door at ground level and an internal access ladder with safety platforms for access to the nacelle. A controller cabinet would be inside each tower at its base. Towers are typically fabricated in three sections that are assembled on-site, and they are designed to withstand the maximum wind speeds expected at the project – typically 60 meters per second (m/s) (134 miles per hour [mph]) at hub height.

A generator step-up (GSU) transformer would be installed at the base of each wind turbine to increase the output voltage of the wind turbine to the voltage of the power collection system (typically 34.5 kV). Small concrete slab foundations would support the GSU transformers.

2.4.2 Power Collection System

A network of underground power lines would be installed within the prism of new and existing roads at the project to collect power generated by the individual wind turbines and route the power to a collector substation for delivery into the utility grid. The power collection system would operate at 34.5 kV. Where geotechnical conditions or other engineering considerations require, the collector system may be aboveground.

Power from the eastern section of the project would be routed to a collector substation near Webfoot. From that substation, aboveground power lines, hung on single wood or steel poles of a type similar to other power lines in the area, would carry the power approximately 3.5 miles to the BPA Klondike Schoolhouse Substation. The poles would be approximately 110 feet tall, sunk 30 feet deep. They would be spaced approximately 500 to 700 feet apart. All poles would conform to raptor protection guidelines.

2.4.3 Interconnection/Substations

Additional substation equipment near the existing BPA Klondike Schoolhouse Substation would be constructed to accommodate and step up the additional power entering the grid. The additional substation equipment would include foundations, circuit breakers, power transformer(s), bus and insulators, disconnect switches, relaying, battery and charger, surge arrestors, AC and DC supplies, control house, metering equipment, SCADA provision, grounding, fence, and associated control wiring. The facilities would conform to all applicable Oregon and BPA regulations and standards, as required.

The proposed collector substation would occupy approximately four acres of land.

A collector substation would also be built on a four-acre parcel near Webfoot. The O&M facility would be on the same parcel.

2.4.4 Operations and Maintenance Facility

An approximately 5,000-square-foot O&M building would be built on the Klondike III project site, on a four-acre parcel near Webfoot. A water supply (on-site well of <5000 gallons/day) and sanitary facilities would be constructed at the new O&M site to serve the Klondike III project. Power to the new O&M building would be supplied by Wasco Electric Cooperative and would be carried from the existing O&M building one mile east on the poles of the aboveground collection system

2.4.5 SCADA System

A supervisory, control and data acquisition (SCADA) system to be installed at the project would collect operating and performance data from each wind turbine and the project as a whole, and provide remote operation of the wind turbines. The wind turbines would be linked to a central computer via a fiber optic network. The host computer is expected to be located in the operations and maintenance (O&M) facility at the project site.

2.4.6 Meteorological Towers

Three permanent, un-guyed, meteorological towers would also be part of the facility. They would collect wind resource data.

2.4.7 Roads

Within the project, approximately 19 miles of new roads would be constructed to access turbines. The roads would be 20 feet wide and constructed with crushed gravel.

Existing roads in the project vicinity would be upgraded and widened, where necessary, to accommodate construction and O&M equipment.

Temporary access roads may also be built during construction. They would be removed after construction.

2.4.8 Construction Laydown Areas

Approximately 55 acres of temporary disturbance would occur in 19 laydown areas that would be used to stage construction and store supplies and equipment during construction. A 2-acre laydown area would be adjacent to each proposed turbine string, and four 4-acre laydown areas would be located throughout the project site. The laydown areas would have a crushed gravel surface. After construction, the laydown areas would be removed, and the disturbed areas would be restored to their pre-construction conditions.

2.5 BIGLOW CANYON WIND FARM

The Biglow Canyon Wind Farm facility, proposed by Orion Energy, would be an approximately 450 MW wind generation project in northern Sherman County. The Biglow Canyon Wind Farm will be connected to BPA's transmission system at one of two alternative substations on the Biglow Canyon Wind Farm site. Orion Energy is responsible for selecting its substation alternative.

The project would be built on private land. Orion Energy has negotiated long-term wind energy leases with the landowners in which the energy facilities would be constructed and operated in exchange for compensation to the landowners.

The Biglow Canyon Wind Farm would consist of up to 225 wind turbines and towers, approximately 40 miles of new roads, an O&M facility, and a substation. Wind turbines and roads would be built within 500-foot-wide corridors. Project facilities would occupy approximately 177 acres of land.

2.5.1 Turbines and Towers

Generally, the turbines and towers for the Biglow Canyon Wind Farm project would be similar to those described for the Klondike III Wind Project. As with the Klondike III project, the specific turbine type has not yet been selected. The blade diameter of the turbines would likely be up to 100 meters, and the tower height would be up to 85 meters. The analysis in this technical memorandum is based on a “worst-case” scenario, as described for the Klondike III project.

2.5.2 Power Collection System

A transformer would be placed next to each turbine tower to increase the output voltage to 34.5 kV. Each transformer would be placed on a concrete slab. From the transformer, power would be transmitted via electric cables, some of which would be buried. In areas where collector cables from several turbine strings follow the same alignment (e.g., near the facility substation), multiple sets of cables could be installed within a single trench. There would be approximately 700,000 feet of underground electric cables.

In some areas, collector lines may be installed above ground on pole or tower structures. Aboveground lines would allow the collector lines to span terrain such as canyons, native grasslands, wetlands, and intermittent streams, thereby reducing environmental impacts, or to span cultivated areas and reduce impacts to farming. Overhead structures would generally be between 23 and 28 feet tall.

2.5.3 Substation and Interconnection to BPA

The Biglow Canyon Wind Farm will be connected to BPA’s transmission system at one of two alternative substations on the Biglow Canyon Wind Farm site. Orion Energy is responsible for selecting its substation alternative. With either option, the proposed substation site would be a graveled, fenced area of up to 6 acres, with transformer and switching equipment and a parking area. Transformers would be non-PCB (polychlorinated biphenyl), oil-filled types.

2.5.4 Operations and Maintenance Facility

A permanent O&M facility would include approximately 5,000 square feet of enclosed space, including office and workshop areas, control room, kitchen, bathroom, shower, utility sink, and other facilities. Water would come from a well that would be constructed on the site. Water use is not expected to exceed 1,000 gallons per day. Domestic wastewater would drain to an on-site septic system. A graveled parking area for employees, visitors, and equipment would be built in the vicinity of the building. The O&M facility may be built adjacent to the proposed substation on the Biglow Canyon project site.

2.5.5 SCADA System

A SCADA system, similar to that described for the Klondike III project, would be installed and linked to a central computer in the O&M building.

2.5.6 Meteorological Towers

Up to 10 meteorological towers would be placed throughout the Biglow Canyon project site. The towers, which would be up to 279 feet tall, would collect wind resource data.

2.5.7 Roads

Existing roads in the project vicinity are typically 16 to 20 feet wide. Some existing roads would be widened—up to 35 feet wide for construction, and up to 16 or 18 feet wide for operation, including an additional 5 to 6 feet of shoulders. Roads would be improved, where necessary, by adding an all-weather surface.

New access roads would be constructed where there are no roads near proposed turbine strings. Approximately 40 miles of new access roads would be built. They would be approximately 16 to 18 feet wide for operation, including an additional 5 to 6 feet of shoulders.

Temporary access roads may also be built during construction. They would be removed after construction.

2.5.8 Construction Laydown Areas

Up to six principal, temporary laydown areas for construction staging would be located on site. Each laydown area would comprise up to five acres and would be covered with gravel. After construction, the gravel would be removed and the area restored.

In addition to the principal laydown areas, temporary laydown areas would be located at each turbine location and at each turbine string. Each turbine laydown area would temporarily disturb approximately 4,000 square feet. Placement of blades in the laydown areas is expected to result in little or no soil disturbance.

In total, construction activities (e.g., laydown areas and collector system trenches) would disturb approximately 375 acres.

3 AFFECTED ENVIRONMENT

3.1 GENERAL LANDSCAPE CHARACTER

The general landscape character within the analysis area typically features rolling hills in dry land winter wheat production or grasses dedicated to conservation easements through the Conservation Reserve Program (CRP) administered by the Natural Resources Conservation Service (NRCS). Most of the project area is in wheat production. Very little acreage of native plant communities remain, occurring in small patches along tributaries and unnamed drainages to the Columbia, John Day, and Deschutes rivers. These communities consist of shrublands dominated by sagebrush (*Artemisia tridentata*) and rabbitbrush (*Chrysothamnus* sp.), and native bunchgrass grasslands (various spp.), which generally have a high percent cover of invasive species such as cheatgrass (*Bromus tectorum*) mixed with sparse cover of native grasses such as bluebunch wheatgrass (*Pseudoroegneria spicata*), Sandberg bluegrass (*Poa secunda*), and Idaho fescue (*Festuca idahoensis*) where fire and human disturbance has not eliminated them from the landscape. Agricultural areas dominate the plateau to the east. Agricultural areas that are enrolled under the CRP are located mainly in the western portion of the project corridor. CRP areas have been planted with a mix of native and non-native bunch grasses with the primary intent of increasing wildlife habitat in the area.

The Deschutes River Canyon and John Day River Canyon are important features draining to the Columbia River. Basalt cliffs and rock outcrops are typical within the river canyons and are important visual elements. Where vegetation is not in agricultural production or conservation, it is characterized by shrub-steppe habitat typical to central Oregon. Trees are very sparse, usually occurring in ravines or near the few homesites as shelter belts. The Cascade Mountains, including views of Mount Hood and other peaks and ridgelines, are visible in the distant background in clear conditions when not blocked by local topography. Elevations along the plateau, within the project area, range from approximately 1,250 feet to 1,500 feet. Elevations at the western end of the project corridor drop to roughly 800 feet at the bottom of the Gerking Canyon drainage. Photos 1 through 4 (Appendix B) provide typical images of the landscape in the project area including existing wind turbines and substation facilities.

Multiple transmission and distribution lines cross the project area as well as transportation corridors including the Columbia River, Interstate 84 (I-84), US Highway 97, Oregon Route (OR) 206, and Washington State Route 14 (SR-14).

3.2 IMPORTANT VISUAL RESOURCES

Several important visual resources have been identified in the analysis area. These resources, described below, are summarized in Table 1 and identified in Figures 2 and 3.

Table 1. Important Visual Resources within the Analysis Area and Their Approximate Minimum Distance from the Proposed Facilities

Visual Resource	Direction/Distance (miles) from		
	BPA	Klondike III	Biglow
Columbia River Gorge National Scenic Area	W, 9	NW, 12.2	W, 10
John Day River Canyon	E, 2.5	E, 0.8	W, 23
Oregon National Historic Trail High Potential Sites:			
Fourmile Canyon	E, 25	E, 20.0	E, 23
John Day River Crossing (a.k.a. McDonald Ferry)	SE, 4	E, 2.0	SE, 6
Biggs Junction	W, 7	NW, 11.0	W, 8
Deschutes River Crossing	W, 10	NW, 13.5	W, 11
The Dalles Complex	W, 24	W, 28.0	W, 25
Lower Deschutes River Canyon	W, 9	W, 8.0	W, 10
Lower Klickitat River Canyon	W, 25	NW, 27.5	W, 26
Journey Through Time Scenic Byway	SW, 1.5	W, 0.5	W, 2

3.2.1 Columbia River Gorge National Scenic Area

The Columbia River Gorge National Scenic Area (CRGNSA) is managed for an "unparalleled combination of scenery, geology, plants, wildlife, and multicultural history" (Columbia River Gorge

Commission and USFS, 1992). The exceptional beauty of this region is largely derived from its diverse character. Key viewing areas (KVAs) are important viewpoints open to the public offering opportunities to view the Gorge. KVAs within the analysis area include Historic Columbia River Highway, I-84, Washington SR-14, the Columbia River, and Rowena Plateau (i.e., Tom McCall Preserve). Designated Scenic Travel Corridors in the analysis area include the Historic Columbia River Highway, I-84, SR-14, and Washington State Route 142 (SR-142), and I-84. A view from the eastern boundary of the CRGNSA along SR-14 to the project area is shown in Photo 5.

3.2.2 John Day River Canyon

The John Day River system includes more than 500 river miles and is one of the longest free-flowing river systems in the continental United States (USDI Bureau of Land Management [BLM], 2001). The landscape within the analysis area features high desert communities of sagebrush and juniper with intermingled private ranches adding visual interest along the river (BLM, 2000). The John Day River Canyon (i.e., the area from rim to rim) is identified as an "area of high visual quality" (BLM, 1986). The BLM manages its lands in this area as a Visual Resource Management (VRM) Class II resource, meaning management activities resulting in changes to the existing character of the landscape may be allowed, provided they do not attract the attention of the casual observer (USDI 2000). A typical view of the John Day River corridor near McDonald Crossing is shown in Photo 6.

Beginning at Tumwater Falls near river mile 10 upstream through the analysis area, the river is a designated Federal Wild and Scenic River and classified as Recreational, meaning that at the time of designation, the segment was readily accessible by road or railroad, may have some shoreline development, and may have undergone some impoundment or diversion in the past. Outstanding remarkable values in this segment include "scenic, recreation, fish, wildlife, geological, paleontological, and archaeological" values. Botanical and ecological values are also deemed important (BLM, 2001). The segment is designated as a State Scenic Waterway pursuant to the Oregon State Scenic Waterways Act, ORS 390.805-390.925.

The Two Rivers Resource Management Plan Record of Decision (BLM, 1986) identifies two Special Management Areas relevant to this project: the Oregon Trail Historic Sites at Fourmile Canyon and McDonald Crossing, and the John Day River Canyon. For the trail sites, "the unusual qualities of these sites will be maintained and protected" (BLM, 1986). For the canyon, "areas of high visual and natural quality will continue to be protected while allowing other compatible uses in the same area" (BLM, 1986).

3.2.3 Oregon National Historic Trail

In 1978, Congress authorized the Oregon National Historic Trail to commemorate the historic Oregon Trail and to promote its preservation, interpretation, public use, and appreciation. The Management and Use Plan Update Final Environmental Impact Statement Oregon National Historic Trail and Mormon Pioneer National Historic Trail (USDI, National Park Service [NPS], 1999), is a coordinating document that provides broad-based polices, guidelines, and standards for administering the trail to guide its protection, interpretation, and continued use.

Within the analysis area, the plan identifies five High-Potential Sites based on "historic significance, the presence of visible historic remnants, scenic quality, and relative freedom from intrusion" (USDI 1999). These sites include Fourmile Canyon, John Day River Crossing (a.k.a. McDonald Ferry), Biggs Junction, Deschutes River Crossing, and The Dalles Complex. The plan does not identify specific scenic or aesthetic values in the analysis area beyond these five sites. Intact segments or other visual evidence (e.g., wagon ruts, scars) of the trail are not known to exist within the project area. Nearly all evidence of the trail within the analysis area has been destroyed through agricultural practices. Photo 7 depicts typical conditions along the trail alignment in the project vicinity.

3.2.4 Lower Deschutes River Canyon

The Lower Deschutes River is a designated Federal Wild and Scenic River and Oregon State Scenic Waterway. The Lower Deschutes Canyon "contains a diversity of landforms, vegetation and color" (BLM 2001) where the river has carved a dramatic canyon through rugged Columbia River basalt flows. Riparian vegetation provides stark contrast against the broken reddish brown canyon walls. Transportation corridors (roads and railroad), and rural development occur in several areas throughout the canyon.

3.2.5 Lower Klickitat River Canyon

The lower ten miles of the Klickitat River from its confluence with Wheeler Creek, near the town of Pitt, to its confluence with the Columbia River is designated a Federal Wild and Scenic River with a Recreational classification. Outstandingly remarkable resources include the river's free-flowing nature, resident and anadromous fish and their habitats, Native American dip-net fishing, and the geology of the lower gorge (USFS, 1991). A small area in the Wahkiacus drainage of the Klickitat River canyon is designated as a wildflower viewing area (Priebe, 2005).

3.2.6 Journey Through Time Scenic Byway

The Journey Through Time Scenic Byway is administered through the Oregon Department of Transportation Scenic Byway Program. The Journey Through Time Management Plan speaks to the rural heritage and history of the 286-mile route through north central Oregon. The plan establishes four goals: create jobs; maintain rural lifestyles (i.e., support traditional industries of agriculture and timber); protect important values (e.g., historical attractions); and build identity for the north central Oregon region. The plan identifies the communities of Wasco, Moro, and Grass Valley, the Historic Oregon Trail and Barlow Road, and the Sherman County Museum as points of interest within the analysis area. Photos 8 and 9 illustrate typical views from the byway at milepost 12 approximately three miles south of Wasco.

3.2.7 Local Site Features

In addition to the Deschutes and John Day rivers, Sherman County identifies rock outcroppings and trees as important landscape features (Sherman County, 2003). Gilliam County identifies "rock outcroppings marking the rim and walls of steep canyon slopes as an important characteristic of the county's landscape" as well as the John Day River (Gilliam County, 2000).

3.3 BPA'S PROPOSED ACTION

The transmission line alignment for BPA's Proposed Action does not occur within the boundary of any important visual resources (e.g., John Day Wild and Scenic River boundary); however, the transmission line would cross the Oregon National Historic Trail alignment. Segments of the Proposed Action alignment would likely be visible from small portions of the Journey Through Time Scenic Byway, the John Day River corridor, and the CRGNSA, including SR-14. The transmission line and substation facilities would be visible from (and often adjacent to) several roads in the project vicinity. Portions of the alignment would likely be visible from private residences in the project vicinity.

3.4 MIDDLE ALTERNATIVE

The Middle Alternative would be visible or not visible from the same general areas as the Proposed Action.

3.5 KLONDIKE III WIND PROJECT

The Klondike III Wind Project would not occur within the boundary of any important visual resources. The project would likely be visible from portions of the John Day River corridor, the CRGNSA, including SR-14; and the Journey Through Time Scenic Byway. Turbine strings would cross the Oregon National Historic Trail alignment in several locations. Turbines would be visible from local roads and private residences in the project vicinity.

3.6 BIGLOW CANYON WIND FARM

The Biglow Canyon Wind Farm would be visible or not visible from the same general areas as the Klondike III Wind Project.

4 ENVIRONMENTAL CONSEQUENCES

4.1 IMPACT LEVELS

Impacts would be considered **high** where actions would:

- Become the dominant feature or focal point of the view, especially from residences or schools.
- Become the dominant feature or focal point of the view and adversely affect the existing character and quality of views from parks, recreation facilities, public trails, and public lands and waters used for dispersed recreation where the appreciation of natural and scenic resources is a valued part of the use, such as the Columbia Gorge National Scenic Area.
- Affect a large number of sensitive viewers in predominantly the foreground and middle ground of the view.

- Become the dominant feature or focal point of view from major travel corridors along which existing scenic quality is high and/or policies have been applied to preserve and enhance aesthetic values.

Impacts would be considered **moderate** where actions would:

- Be clearly visible in the view but not the dominant feature of the view.
- Affect a large number of sensitive viewers mostly in the middleground of their view.
- Not become the dominant view but are in view from parks, recreation facilities, public trails, and public lands and waters used for dispersed recreation where the appreciation of natural and scenic resources is a valued part of the use.
- Not become the dominant view but would be in view from major travel corridors along which existing scenic quality is high and/or policies have been applied to preserve and enhance aesthetic values.
- Not become the dominant view but would be in view from locally important roads along which visual quality is not high and which have not been designated for scenic protection.

Impacts would be considered **low** where actions would:

- Be somewhat visible but not obtrusive in the view.
- Be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view.

No impact would occur if:

- The facilities would be isolated, screened, not noticed in the view, or seen from a distance greater than 3 miles.
- No visually sensitive resources would be affected.

Table 2 summarizes potential impacts to visual resources within the analysis area. Descriptions of impacts to the general project vicinity and important visual resources are provided below.

Table 2. Summary of Impacts to Visual Resources within the Analysis

Visual Resource	Level of Impact		
	BPA	Klondike III	Biglow

Visual Resource	Level of Impact		
	BPA	Klondike III	Biglow
General Project Vicinity	Mod	Mod to High	Mod to High
Columbia River Gorge National Scenic Area	Low to none	Low to none	Low to none
John Day River Canyon	None	Low to Mod	Low to Mod
Oregon National Historic Trail High Potential Sites:			
Fourmile Canyon	None	None	None
John Day River Crossing (a.k.a. McDonald Ferry)	None	Low to Mod	None
Biggs Junction	None	None	None
Deschutes River Crossing	None	None	None
The Dalles Complex	None	None	None
Lower Deschutes River Canyon	None	None	Low to none
Lower Klickitat River Canyon	None	None	None
Journey Through Time Scenic Byway	Low	Low to Mod	Low to Mod

4.2 BPA'S PROPOSED ACTION

4.2.1 Impacts

A visibility analysis (Figures 4 and 5) was conducted for the proposed transmission line alignment to determine areas from which the alignment would likely be visible. The analysis conservatively assumed towers would occur at angle points and at 900-foot intervals along the alignment and would be 120 feet tall. The substation facilities were not modeled because they are of similar nature and adjacent to existing facilities and would not likely increase the visual effect of the existing facilities.

The visibility analysis indicates the Proposed Action would likely be visible from portions of the CRGNSA, including SR-14; the John Day River corridor; and the Journey Through Time Scenic Byway. The Proposed Action alignment would cross the Historic Oregon Trail alignment, but not in the vicinity of any intact trail segments. The transmission alignment would not be visible from known intact trail segments or from the High Potential Sites identified in the trail's management plan (NPS, 1999).

General Project Vicinity

The proposed facility would be visible from many locations in the analysis area at distances ranging from the immediate foreground (less than 100 feet) to the distant background (greater than 20 miles).

The proposed facility would be highly visible in the foreground from local roads, local residences and agricultural lands in rural Sherman County.

Within the general project vicinity (excluding the John Day River Corridor which is discussed below), the Proposed Action would result in moderate impacts because the transmission lines, towers, and substation facilities generally would be clearly visible in the view but not the dominant feature of the view. It is important to note, however, that the local project vicinity includes few sensitive viewers, lacks Key Viewing Areas (KVAs), and lacks important visual resources with the exception of the John Day River Canyon. Further, local land use policy supports the development of wind energy in Sherman County (Sherman County, 2003).

Columbia River Gorge National Scenic Area

The visibility analysis indicates some portion of the proposed facility would potentially be visible from the CRGNSA. A site visit to I-84 and SR-14 within the CRGNSA boundary indicate the proposed facility would not be visible from I-84 and may be intermittently visible from SR-14. Visibility would occur at such great distances (approximately nine miles) that impacts, if any, would be low. Photo 5 illustrates views from the CRGNSA east boundary at SR-14 toward the project area. Almost without exception, topography or vegetation would screen the proposed facility from view.

The visibility analysis also suggests portions of the proposed facility would be visible within the CRGNSA in Oregon nearer the Deschutes River. Access to these areas is very limited, so opportunities to view the proposed facility are low. The proposed facility would be subordinate to the existing landscape character, which includes multiple transmission lines of similar character to the Proposed Action.

In summary, topography and vegetation would substantially screen the proposed facility from the majority of the CRGNSA. It is possible that the proposed facility would be visible in the distant background from some areas with limited to very limited access and opportunities for viewing. In those areas, the proposed facility would be subordinate to the landscape setting that typically includes substantial human development such as interstate and rail transportation corridors, transmission lines, and urban and rural development in the foreground, middleground, and background.

Impacts to the CRGNSA would be low to none because the proposed facility would be somewhat visible, but not obtrusive; would be seen by few sensitive viewers in the background; and would be seen from a distance of greater than three miles.

John Day River Canyon

The BLM administers the majority of public lands within the John Day River Canyon and has indicated that its concern would be visual impacts seen from the John Day River (Mottl H., 2005). The proposed facility may be visible from higher portions of the John Day River Canyon (i.e., near the canyon rim), but it would not be visible from the river.

No impacts would occur to the John Day River Canyon because the Proposed Action would not be seen from the river.

Oregon National Historic Trail

The Proposed Action alignment would cross the trail alignment in areas where previous agricultural activities have destroyed any evidence of the trail. The proposed facility would not be visible at Fourmile Canyon, Biggs Junction, the Deschutes River Crossing, McDonald Ferry, or The Dalles Complex. Therefore, there would be no impact to these resources.

Lower Deschutes River Canyon

The proposed facility would not be visible from the Lower Deschutes River Canyon. Therefore, there would be no impact to this resource.

Lower Klickitat River Canyon

The proposed facility would not be visible from the Lower Klickitat River Canyon. Therefore, there would be no impact to this resource.

Journey Through Time Scenic Byway

Portions of the proposed facility would likely be visible from the Byway. However, the proposed facility would be compatible with the Journey Through Time Management Plan's stated goals. The communities of Wasco and Moro have no stated scenic or visual management goals or objectives and the Sherman County Comp Plan Goal XVIII supports the development of wind energy (Sherman County, 2003).

The proposed facility would have low impacts on the Journey Through Time Scenic Byway because it would be somewhat visible but not obtrusive in the view and would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view.

4.2.2 Mitigation

Impacts to the general project vicinity would be moderate and would be compatible with applicable management plans and land use policies Impacts to important visual resources would be low to none. Since the Proposed Action would be compatible with applicable management plans and land use policies, no mitigation would be necessary to compensate for project impacts. However, the following best management practices would be implemented to further reduce potential impacts:

- Use of steel tubes (vs. steel lattice) for towers to the extent possible
- Use of non-reflective gray paint on tower structures

- Use of non-specular conductors (i.e., a conductor that has been modified to reduce the amount of reflected light from its surface)

4.3 MIDDLE ALTERNATIVE

4.3.1 Impacts

Impacts would be similar for the Middle Alternative as for the Proposed Action and would result in moderate impacts to the general project vicinity and low to no impacts to important visual resources. The visibility analysis (Figures 4 and 5) shows the areas from which the Middle Alternative and Proposed Action may be visible. See Section 4.2.1.

4.3.2 Mitigation

Mitigation measures would not be required since impacts would be compatible with applicable management plans and land use policies. The same best management practices would be incorporated in the Middle Alternative as in the Proposed Action to further reduce potential impacts.

4.4 KLONDIKE III WIND POWER PROJECT

4.4.1 Impacts

A visibility analysis using GIS software and USGS 30-meter and 10-meter DEMs was conducted for the proposed Klondike III Wind Project to determine areas from which the project may be visible. The visibility analysis indicates the project would be highly visible in the general project vicinity and would likely be visible from portions of the CRGNSA including SR-14, John Day River Canyon, and the Journey Through Time Scenic Byway, and from the vicinity of McDonald Crossing, an Oregon National Historic Trail High Potential Site. The discussion on potential impacts to important visual resources has been taken from the Klondike III Wind Project ASC (DEA, 2005).

General Project Vicinity

The proposed Klondike III Wind Power Project would be visible from many locations in the analysis area at distances ranging from the immediate foreground (less than 100 feet) to the distant background (greater than 20 miles). The proposed facility would be highly visible in the foreground from local roads and agricultural lands in rural Sherman County. Turbines would be visible in the middleground and background from portions of US 97 and SR-14 in Washington near Maryhill and other similar locations.

Within the general project vicinity (excluding the John Day River Corridor which is discussed below), the facility would result in moderate to high impacts because the turbines and appurtenances would become the dominant feature or focal point of the view and would be clearly visible in the view but not the dominant feature of the view. It is important to note, however, that the general project vicinity includes few sensitive viewers, lacks Key Viewing Areas (KVAs), and lacks important visual resources with the exception of the John Day River Canyon. Further, local land use policy supports the development of wind energy in Sherman County (Sherman County, 2003).

Columbia River Gorge National Scenic Area

The visibility analyses for Oregon and Washington indicate some portion of the proposed facility would potentially be visible from the CRGNSA. The principal investigator visited several locations to ground-truth the models. Site visits to the Wasco County Museum, I-84, US Highway 30, and Cherry Heights Road (west of The Dalles) indicate the proposed facility would not be visible as indicated by the visibility analysis results, or would be visible at such great distances (approximately 20 miles or greater) that impacts, if any, would be negligible. Almost without exception, topography or vegetation would screen the proposed facility from view. The model also suggests portions of the proposed facility would be visible within the CRGNSA in Oregon near the Deschutes River. Access to those areas is very limited, so opportunities to view the proposed facility are not substantial.

In Washington, the proposed facility would not be visible from SR-142 in the analysis area, and may be intermittently visible from SR-14 near the east end of CRGNSA. Further, access to the other areas within the CRGNSA from which the proposed facility would be visible is very limited, if existent at all. Opportunities to view the proposed facility are not substantial.

In summary, topography and vegetation would substantially screen the proposed facility from the majority of the CRGNSA. It is possible that the proposed facility would be visible in the distant background from some areas with limited to very limited access and opportunities for viewing. In those areas, the proposed facility would be subordinate to the landscape setting that typically includes substantial human development such as interstate and rail transportation corridors, transmission line corridors, and urban and rural development in the foreground and middleground.

Impacts to the CRGNSA would be low to none because the proposed facility would be somewhat visible, but not obtrusive; would be seen by few sensitive viewers in the background; and would be seen from a distance of greater than three miles.

John Day River Canyon

The BLM administers the majority of public lands within the John Day Canyon and has indicated that its concern would be visual impacts seen from the John Day River (Mottl H., 2005). Therefore, the following assessment keys on impacts to the river and its shoreline and does not consider impacts to the canyon walls that have very limited access. Portions of the proposed facility would be visible from locations along the upper portions of the canyon walls with the highest likelihood occurring downstream of McDonald Ferry (approximately river mile 20.7).

The computer modeling and analyses indicate portions of the proposed facility would be visible from two river segments: one near McDonald Ferry, the other between approximate river miles 15.9 and 16.8.

From the vicinity of McDonald Ferry, visibility analyses and simulations indicate the blade tips of three turbines would be visible. The nacelle and blades of another turbine would be visible. The turbines would not be visible from the nearby BLM interpretive facility for the Historic Oregon Trail or its access road. From a boater's perspective, viewing the turbines would require looking back up the canyon. Assuming a floating speed of four miles per hour (mph), the turbines would be in view for approximately one and one-half minutes. The turbines would appear small in scale in the background compared to other human development impacts in the canyon (e.g., irrigated pasture, farm and irrigation equipment, farm houses, trailers, fences, livestock, power lines) that are visible in the foreground and middleground from the river. Other factors contributing to the minimal contrast of the proposed facility include viewing distance, angle of observation, light conditions, and atmospheric conditions, which have the effect of making the turbines less visible when the sun is in the west or when views are obscured by precipitation, haze, dust, smoke, or fog.

The proposed facility as seen from McDonald Ferry would have a weak contrast and would therefore be compatible with BLM's VRM Class II management objective: "management activities resulting in changes to the existing character of the landscape may be allowed, provided they do not attract the attention of the casual observer" (BLM, 2000).

The second area of impact would occur between approximate river miles 15.9 and 16.8. Visibility analyses and simulations indicate that the blade tips of six turbines would be visible at different times for different durations through the approximately one-mile segment. Most turbines would be visible for much less of the one-mile segment. Assuming a floating speed of four mph, the viewer would move through this one-mile segment in approximately 14 minutes.

In many cases, the turbines' silhouettes would be barely discernible, if at all. Similar to the turbines' effects at McDonald Ferry, the turbines in this segment would appear small in scale compared to other development in the canyon and to the scale of the canyon in general. The distance from the viewer to the turbines, angle of observation, light conditions, and atmospheric conditions would further reduce perceived contrast and impacts. The potential impacts in this segment would be weak and would therefore be compatible with BLM's VRM Class II management objective.

Impacts resulting from the proposed facility would be low to moderate because the proposed facility would not become the dominant view but would be in view from parks, recreation facilities, public trails, public lands and waters used for dispersed recreation where the appreciation of natural and scenic resources is a valued part of the use, would be somewhat visible but not obtrusive in the view, and would be seen by few sensitive viewers because facility would be substantially screened by existing topography.

Oregon National Historic Trail

The proposed facility would not be visible at Fourmile Canyon, Biggs Junction, the Deschutes River Crossing, and The Dalles Complex (Anderson, 2005; Fitzwater, 2005). Therefore, there would be no impacts to these resources.

Portions of four turbines would be visible from the John Day River and small portions of its banks at McDonald Ferry. The proposed facility would not be visible from the BLM interpretive site near McDonald Ferry or from the road accessing the interpretive site. Factors including the limited length of viewing time, relative small size and scale of the impact, and spatial relationships substantially limit the contrast of the proposed facility against the existing landscape. Other factors including the angle of observation, light conditions, and atmospheric conditions will also limit the significance of the impact.

The proposed facility would have moderate to low impacts on McDonald Ferry because portions of the project would not become the dominant view but would be in view from public lands and waters used for dispersed recreation where the appreciation of natural and scenic resources is a valued part of the use, would be somewhat visible but not obtrusive in the view, and would be seen by few sensitive viewers because facilities are screened by existing topography.

Lower Deschutes River Canyon

The proposed facility would not be visible from the Lower Deschutes River Canyon (Anderson, 2005; Fitzwater, 2005;, Houck, 2005; Mottl, T., 2005). Therefore, there would be no impact to this resource.

Lower Klickitat River Canyon

The proposed facility would not be visible from the Lower Klickitat River Canyon. Therefore, there would be no impact to this resource.

Journey Through Time Scenic Byway

Portions of the proposed facility would be visible from the Byway. A representation of potential impacts viewed from the intersection of US 97 and Old Sherman Highway approximately one mile south of Wasco in included in Appendix C. Although portions of some turbines would be visible, the proposed facility would be compatible with the Journey Through Time Scenic Byway stated goals. Portions of the proposed facility may be visible from Wasco and its immediate surroundings, but existing buildings and topography would likely screen most of the turbines from view. The visibility analysis indicates that the proposed facility would be visible from some areas near Moro. Field investigations suggest topography and vegetation would substantially block views from Moro and the Sherman County Museum. The proposed facility would not be visible from Grass Valley. The communities of Wasco and Moro have no stated scenic or visual management goals or objectives and the Sherman County Comp Plan Goal XVIII supports the development of wind energy (Sherman County 2003).

The proposed facility would have low to moderate impacts on the Journey Through Time Scenic Byway because portions of the project:

- would be visible in the view but not the dominant feature of the view;
- would not become the dominant view but would be in view from locally important roads along which visual quality is not high and which have not been designated for scenic protection;

- would be somewhat visible but not obtrusive in the view; and
- would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view

4.4.2 Mitigation

Impacts to the general project vicinity would be moderate to high and would be compatible with applicable management plans and land use policies. Since the proposed facility would be compatible with applicable management plans and land use policies, no mitigation would be necessary to compensate for project impacts.

Impacts to the Journey Through Time Scenic Byway would be low to moderate. Since the proposed facility would be compatible with applicable management plans and local land use policies, mitigation would not be required.

Impacts to the John Day River canyon including McDonald Ferry would be low to moderate. Since the proposed facility would be compatible with applicable management plans and local land use policies, mitigation would not be required.

Impacts to other important visual resources and to the landscape in general would be low to none, so mitigation would not be required. However, the following best management practices would be implemented to further reduce potential impacts:

- Implementation of active dust suppression measures during the construction period to minimize the creation of dust clouds.
- Use of wind turbine towers, nacelles, and rotors that are locally uniform and that conform to high standards of industrial design to present a trim, uncluttered, aesthetic appearance.
- Use of low-reflectivity, neutral gray, white, off-white, or earth tone finishes for the towers, nacelles, and rotors to minimize contrast with the sky backdrop and to minimize the reflections that can call attention to structures in the landscape.
- Use of neutral gray, white, off-white, or earth tone finishes for the small cabinets containing pad-mounted equipment that might be located at the base of each turbine, to help the cabinets blend into the surrounding ground plane.
- Restriction of exterior lighting on the turbines to the aviation warning lights required by the FAA, which will be kept to the minimum required number and intensity to meet FAA standards.
- Placement of much of the electrical collection system underground, minimizing the system's visual impacts.

- Use of a low-reflectivity finish for the exterior of the O&M facility building to maximize its visual integration into the surrounding landscape.
- Restriction of outdoor night lighting at the O&M facility and the substation to the minimum required for safety and security; sensors and switches will be used to keep lighting turned off when not required, and all lights will be hooded and directed to minimize backscatter and offsite light trespass.
- Use of a low-reflectivity finish for substation equipment.
- Use of low-reflectivity insulators in the substations.
- Use of fencing with a dull finish around the substation to reduce the fence's contrast with the surroundings.

4.5 BIGLOW CANYON WIND FARM

4.5.1 Impacts

The visual impact analysis included in the Biglow Canyon Wind Farm Association considered all facility components. However, because of the large distances from most of the designated scenic resources, the limited lines of sight from the closest designated scenic resources, and the dominance of wind turbines compared to other components of the facility in terms of visual impact, the visual appearance of the facility from all scenic areas consists almost entirely of the wind turbines. For this reason, the following discussion focuses on the turbines.

General Project Vicinity

The Biglow Canyon Wind Farm would have similar general impacts to the visual environment as the Klondike III Wind Project; that is, the proposed facility would be visible from many locations in the analysis area at distances ranging from the immediate foreground to the distant background. The proposed facility would be highly visible in the foreground from local roads and agricultural lands in rural Sherman County where viewer sensitivity is presumably low, KVAs are absent, and the nearby landscape generally lacks important visual resources with the exception of the John Day River canyon. Turbines would be visible in the middleground and background from portions of US 97 and SR-14 in Washington near Maryhill and other similar locations.

Within the general project vicinity (excluding the John Day River Corridor which is discussed below), the facility would result in moderate to high impacts because the turbines and appurtenances would become the dominant feature or focal point of the view and would be clearly visible in the view but not the dominant feature of the view. Similarly to the potential impacts that would result from the Klondike III Wind Project, it is important to note that the general project vicinity includes few sensitive viewers, lacks Key Viewing Areas (KVAs), and lacks important visual resources with the exception of the John Day River Canyon.

Columbia River Gorge National Scenic Area

Because the facility lies more than ten miles outside of the closest boundaries of the CRGNSA, it is not directly regulated by the CRGNSA's plan policies and regulations. Nonetheless, this section describes potential visual impacts of the project as seen from KVAs. The facility has the potential to be visible from portions of four KVAs: the Historic Columbia River Highway, I-84, the Columbia River, and SR-14.

Historic Columbia River Highway

A relatively short segment of the Historic Columbia River Highway lies within the facility's 30-mile radius analysis area. With the possibility of one small exception, the facility would not be visible from the Historic Columbia River Highway. The exception occurs along a small segment of the roadway located at the western edge of The Dalles where the visibility analysis suggests that the turbines might be visible along about one mile of the roadway. However, the likelihood of the facility having a noticeable effect on views from this road segment is very small. In this area, most views from the roadway toward the facility site would probably be screened by intervening trees, vegetation, and structures. Moreover, at a distance of 28 miles, the turbines would be invisible in many atmospheric and weather conditions and barely detectable under the most favorable atmospheric conditions. Finally, in this area, the roadway is not oriented in the direction of the facility site, so that to the extent that the turbines would be detectable in the view, they would not appear in the primary zone of vision of highway travelers.

Impacts to the Historic Columbia River Highway would be low to none because the proposed facility would be somewhat visible but not obtrusive in the view; would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view; and would not be noticed in the view, or seen from a distance greater than three miles.

Interstate 84

For the most part, the facility will not be visible to travelers on I-84. The only places where the facility's turbines might be seen by travelers on I-84 within the CRGNSA are in a set of short segments, adding up to approximately three and one-half miles, located in the area between The Dalles and the Deschutes River at distances ranging from 13.5 to 18 miles from the facility site. From this section of the roadway, the facility site is visible on the distant ridgeline above the point where the river fades into the distance. Because of the viewing distances involved, the turbines would appear to be small and not readily detectable elements on the distant horizon and would occupy only a small area of the overall field of view.

Impacts to I-84 within the NSA would be low to none because the proposed facility would be somewhat visible but not obtrusive in the view; would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view; and would not be noticed in the view, or seen from a distance greater than three miles.

Columbia River

The facility's visibility from the Columbia River will be restricted to segments of the river reach between Horsethief Lake and Miller Island. In this reach, the river has been turned into an artificial lake, named Lake Celilo, by The Dalles Dam. The view seen from this area is of a landscape in which there is a substantial level of human modification that is reflected by the artificial impoundment of the river's waters, the I-84 freeway, large transmission lines, and wheat fields on the distant ridgelines. Users of the river in this area include boaters, commercial barges, fishermen, and windsurfers. The facility site is approximately 14 miles away. Under clear atmospheric conditions, many of the turbines would be visible, but they would appear as very small elements in the distant landscape. On a relative scale, they would be harder to discern than the existing transmission towers visible in the middleground/background. The wind turbines would be a subordinate element of the landscape and would not bring about a substantial change in the overall character and quality of the landscape seen from this area.

Impacts to the Columbia River within the CRGNSA would be low to none because the proposed facility would be somewhat visible but not obtrusive in the view; would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view; and would not be noticed in the view, or seen from a distance greater than three miles.

Washington State Route 14

The proposed facility would likely be intermittently visible along the segment of SR-14 that lies between Highway 197 north of The Dalles and the eastern boundary of the CRGNSA near Maryhill. This highway segment lies 10 to 24 miles to the west of the facility site. Because the highway in this area is located halfway up the slope of the hills that define the northern edge of the gorge, it provides panoramic views over the Gorge and the landscapes to the south.

The most important developed viewpoint along this segment of SR-14 is the one above Wishram that includes an information kiosk and interpretive panels related to Celilo Falls, an important Native American resource and cultural site that once existed in the river below this viewpoint. Celilo Falls was eliminated when Lake Celilo was created by the construction of The Dalles Dam. Visibility analyses indicate that a relatively small number of the facility's turbines would potentially be visible from this viewpoint. Given the viewpoint's 13-mile distance from the facility site, the turbines would be small elements on the distant skyline and would be less evident in the view than the existing transmission towers visible in the foreground/middleground. Although the turbines would be visible to some degree in this view, they will not dominate the view and would not create a substantial change in the view's overall character and quality.

A second developed viewpoint exists in this segment of the highway in the area just inside the CRGNSA's eastern boundary at Maryhill. The proposed turbines would be visible at a minimum distance of 10.5 miles from this viewpoint. The facility turbines would be visible but not highly evident elements in the landscape, and would not dominate the view. The turbines would be relatively small elements occupying a small part of the view and would be visually consistent with the turbines that are now an established part of the view.

Impacts to SR-14 within the CRGNSA would be low to none because the proposed facility would be somewhat visible but not obtrusive in the view; would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view; and would not be noticed in the view, or seen from a distance greater than three miles.

Deschutes River Canyon

Visibility analyses indicate that the facility would not be visible from the areas in the Deschutes River canyon along the Deschutes Wild and Scenic River and would be visible only from a small area of the BLM lands within and adjacent to the canyon. Because none of the BLM or private lands that lie within the canyon would be directly affected by the facility and because the facility would not be visible from the interior of the canyon, the facility would be consistent with the BLM Two Rivers Plan and with the provisions of the Wasco County and Sherman County comprehensive plans that identify the Deschutes River canyon as an important landscape feature.

Impacts to the Deschutes River Canyon would be low to none because the proposed facility would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view; and would not be noticed in the view, or seen from a distance greater than 3 miles.

John Day River

Visibility analyses indicate the facility would be visible to varying degrees from sections of the BLM lands in the canyon and from the Wild and Scenic River/Oregon Scenic Waterway segment of the river and the lands extending from one-quarter to one mile on either side of the river. Most of the lands in this area are privately-owned ranch lands that are used for cattle grazing; transmission lines of various voltages can be seen on the hills along the edge of the canyon or crossing the canyon. The primary access to these lands is by primitive 4x4 trails located substantially on privately-owned lands. Access is regulated by a series of locked gates so the general public has no overland access to this area. The only public right-of-way through this area is the river channel. During high flow periods in the spring, there is some very limited use of this reach of the river by canoeists and kayakers. During the summer months, low flows and a rocky river channel make passage by watercraft infeasible. Although the John Day River has a reputation as a good river for boating and other recreational activities, these activities occur primarily in the reaches of the river that lie to the south of Cottonwood in an area where the facility would not be visible. Limited access and recreational use minimize opportunities to view the proposed facility.

In the limited areas along the river corridor from which facility's turbines would potentially be visible, few turbines would be visible from any one point, and only the blades would likely be visible from many locations. In the places where turbines would be visible, they would appear as elements on the ridgelines in the landscape's background and would have minimal direct effect on the appearance of the walls of the canyon or the canyon floor. Although the turbines would potentially be noticeable in some of the views, because of their small numbers, their location in the background, and the viewing distance (which would range from one to three and one-half miles), they would not likely be dominant elements in the scene. To the extent to which they would be visible, the turbines would be subordinate elements of the view, and because views from the canyon already include views of transmission lines of various voltages and are thus not entirely pristine, the presence of the turbines would not substantially alter the existing character and quality of views from the river corridor.

The proposed facility would have moderate to low impacts because the proposed facility would not become the dominant view but would be in view from public lands and waters used for dispersed recreation where the appreciation of natural and scenic resources is a valued part of the use; would be somewhat visible but not obtrusive in the view; and would be seen by few sensitive viewers because facilities would be screened by existing topography.

Oregon National Historic Trail

The proposed facility would not be visible from the High Potential Sites (McDonald Ferry, Fourmile Canyon, Biggs Junction, the Deschutes River Crossing, and the Dalles Complex) within the analysis area. Therefore, there would be no impacts to those resources.

Lower Klickitat River Canyon

The proposed facility would not be visible from the Lower Klickitat River Canyon. Therefore, there would be no impact to this resource.

Journey Through Time Scenic Byway

Portions of the proposed facility would be visible from the byway; however, the proposed facility would be compatible with the Journey Through Time Scenic Byway’s stated goals. The proposed facility would have moderate to low impacts on the Journey Through Time Scenic Byway because portions of the project would be visible in the view but not the dominant feature of the view; would not become the dominant view but would be in view from locally important roads along which visual quality is not high and which have not been designated for scenic protection; would be somewhat visible but not obtrusive in the view; and would be seen by few sensitive viewers because facilities are screened, or predominantly viewed in the middleground and background of the view.

4.5.2 Mitigation

Impacts resulting from development of the Biglow Canyon Wind Farm would be similar to the Klondike III Wind Project. Since impacts, if any, would be compatible with applicable management plans and land use policy, mitigation is not required. Best management practices similar to those proposed for Klondike III Wind Project would be implemented to further reduce potential impacts.

4.6 CUMULATIVE IMPACTS

Klondike I, II, and III Wind Projects, Biglow Canyon Wind Farm, BPA's Action Alternatives, future wind projects, and existing BPA and other transmission and distribution lines would result in cumulative impacts to the visual environment. These intrusions would result in moderate to high impacts to the general project vicinity, but it is important to note that the area includes no KVAs or important visual resources (except for the John Day River Canyon) and that viewer sensitivity is low. Cumulative impacts would likely be low to moderate to important visual resources such as the John Day River Canyon and the Journey Through Time Scenic Byway where facilities would potentially be visible in the foreground and middleground. Cumulative impacts would likely not occur or would be low to the remaining important visual resources in the analysis area because the projects would not be visible, or would be visible at such great distances that effects, if any, would be negligible.

4.7 UNAVOIDABLE EFFECTS, IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Unavoidable effects would include the intrusion of approximately 470 turbines, substation and transmission facilities, and appurtenances on the visual landscape. In general, these impacts would be moderate to high. There would be no irreversible or irretrievable commitments of resources because the proposed project elements could be decommissioned and deconstructed; project development does require the commitment of visual resources.

4.8 NO ACTION ALTERNATIVE

No new impacts to visual resources would occur under the No Action Alternative.

5 ENVIRONMENTAL CONSULTATION, REVIEW, AND PERMIT REQUIREMENTS

No known permits or authorizations specific to visual resources have been identified. BLM was consulted about the wind projects. The transmission line wouldn't be visible from the John Day River, so consultation with BLM regarding the BPA Action Alternatives is not recommended.

6 LIST OF PREPARERS

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Appendix C Electrical Effects

KLONDIKE III/BIGLOW CANYON WIND INTEGRATION PROJECT

APPENDIX C

ELECTRICAL EFFECTS

MARCH 2006

Prepared by

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for

Bonneville Power Administration

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ELECTRICAL EFFECTS FROM BPA'S PORTION OF THE KLONDIKE III/BIGLOW CANYON WIND INTEGRATION PROJECT

1.0 Introduction

The Bonneville Power Administration (BPA) is proposing to build an approximately 12-mile (mi.) (19.3-kilometer [km]) 230-kilovolt (kV) double-circuit transmission line from the existing Klondike Schoolhouse Substation east of Wasco, Oregon, to a proposed BPA John Day 230-kV Substation adjacent to BPA's existing John Day 500-kV Substation near Rufus, Oregon. The proposed line is designated the Klondike - John Day 230-kV transmission line. The proposed line would be built on new right-of-way entirely within the state of Oregon. Two alternative routes are being considered for the proposed line – the North Alternative and the Middle Alternative (Table 1). There are no existing high-voltage transmission lines that parallel the proposed line routes.

The purpose of this report is to describe and quantify the electrical effects of the proposed Klondike - John Day 230-kV transmission line and the proposed substations. These effects include the following:

- the levels of 60-hertz (Hz; cycles per second) electric and magnetic fields (EMF) at 3.28 feet (ft.) or 1 meter (m) above the ground,
- the effects associated with those fields,
- the levels of audible noise produced by the line, and
- electromagnetic interference associated with the line.

Electrical effects occur near all transmission lines, including existing 230-kV lines in Oregon and the 500-kV lines that connect into the existing BPA John Day 500-kV Substation. Therefore, the levels of these quantities for the proposed line are computed and compared with those from the existing lines in Oregon.

The voltage on the conductors of transmission lines generates an *electric field* in the space between the conductors and the ground. The electric field is calculated or measured in units of volts-per-meter (V/m) or kilovolts-per-meter (kV/m) at a height of 3.28 ft. (1 m) above the ground. The current flowing in the conductors of the transmission line generates a *magnetic field* in the air and earth near the transmission line; current is expressed in units of amperes (A). The magnetic field is expressed in milligauss (mG), and is also usually measured or calculated at a height of 3.28 ft. (1 m) above the ground. The electric field at the surface of the conductors causes the phenomenon of *corona*. Corona is the electrical breakdown or ionization of air in very strong electric fields, and is the source of audible noise, electromagnetic radiation, and visible light.

To quantify EMF levels along the route, the electric and magnetic fields from the proposed transmission line were calculated using the BPA Corona and Field Effects Program (USDOE, undated). In this program, the calculation of 60-Hz fields uses standard superposition techniques for vector fields from several line sources: in this case, the line sources are transmission-line conductors. (Vector fields have both magnitude and direction: these must be taken into account when combining fields from different sources.) Important input parameters to the computer program are voltage, current, and geometric configuration of the line. The transmission-line conductors are assumed to be straight, parallel to each other, and located above and parallel to an infinite flat ground plane. Although such conditions do not occur under real lines because of conductor sag and variable terrain, the validity and limitations of calculations using these assumptions have been well verified by comparisons with measurements. This approach was used to estimate fields for the proposed Klondike – John Day line, where minimum clearances were assumed to provide worst-case (highest) estimates for the fields.

Electric fields are calculated using an imaging method. Fields from the conductors and their images in the ground plane are superimposed with the proper magnitude and phase to produce the total field at a selected location.

The total magnetic field is calculated from the vector summation of the fields from currents in all the transmission-line conductors. Balanced (equal) currents are assumed for each three-phase circuit; the contribution of induced image currents in the conductive earth is not included.

Electric and magnetic fields for the proposed line were calculated at the standard height (3.28 ft. or 1 m) above the ground (IEEE, 1994). Calculations were performed out to 300 ft. (91 m) from the centerline of the existing corridor. The validity and limitations of such calculations have been well verified by measurements. Because maximum voltage, maximum current, and minimum conductor height above-ground are used, **the calculated values given here represent worst-case conditions:** i.e., the calculated fields are higher than they would be in practice. Such worst-case conditions would seldom occur.

The corona performance of the proposed line was also predicted using the BPA Corona and Field Effects Program (USDOE, undated). Corona performance is calculated using empirical equations that have been developed over several years from the results of measurements on numerous high-voltage lines (Chartier and Stearns, 1981; Chartier, 1983). The validity of this approach for corona-generated audible noise has been demonstrated through comparisons with measurements on other lines all over the United States (IEEE Committee Report, 1982). The accuracy of this method for predicting corona-generated radio and television interference from transmission lines has also been established (Olsen et al., 1992). Important input parameters to the computer program are voltage, current, conductor size, and geometric configuration of the line.

Corona is a highly variable phenomenon that depends on conditions along a length of line. Predictions of the levels of corona effects are reported in statistical terms to account for this variability. Calculations of audible noise and electromagnetic interference levels were made under conditions of an estimated average operating voltage of 237 kV and with the average line height along a span of 38.5 ft. (11.7 m). Levels of audible noise, radio interference, and television interference are predicted for both fair and foul weather; however, corona is basically a foul-weather phenomenon. Wet conductors can occur during periods of rain, fog, snow, or icing. In the Rufus-Wasco area of the proposed route, such conditions are expected to occur about 6% of the time during a year based on hourly precipitation records from Moro, Oregon (near Wasco) during 2000 – 2004 (NOAA, 2005). Corona activity also increases with altitude. For purposes of evaluating corona effects from the proposed line, an altitude of 1500 ft. (460 m) was assumed.

2.0 Physical Description

2.1 Proposed Line

The proposed 230-kV transmission line would be a three-phase, double-circuit line placed on mostly tubular steel structures. (Some towers would be lattice steel construction, for example where the line changed direction. The double-circuit towers would have two sets of three phases arranged vertically on either side of the structure. Each set of phase wires comprises a circuit. Voltage and current waves are displaced by 120° in time (one-third of a cycle) on each electrical phase. The maximum phase-to-phase voltage would be 242 kV; the average voltage would be 237 kV.

The line would be operated with the load from the Biglow Canyon project on one of the circuits and the load from the Klondike III project on the other. Initially the projected peak loads for the two circuits of the proposed line are: 400 megawatts (MW) for the Biglow Canyon circuit and 300 MW for the Klondike circuit. When the Orion project is completed the peak load on the Biglow Canyon circuit would increase to 600 MW. These loads correspond to an initial maximum current per phase of 974 A on the Biglow Canyon circuit, increasing to 1462 A with the addition of the Orion load, and 731 A on the Klondike circuit. The Orion project load could be added in the future and is only considered as a cumulative impact with the proposed project.

The load factor for wind power is 0.30 (average load = peak load x load factor). Thus, the average currents on each circuit would be 30 percent of the maximum values. BPA provided the physical and operating characteristics of the proposed line.

The electrical characteristics and physical dimensions for the proposed line configuration are shown in Figure 1, and summarized in Table 2. Each phase of the proposed 230-kV line would have one 1.6-inch (in.) (4.06-centimeter [cm]) diameter conductors (AAC: all aluminum conductors).

The horizontal phase spacing between the lower and upper conductor positions would be 19.0 ft. (5.79 m). Between the middle conductors, the horizontal spacing would be 31.0 ft. (9.45 m). The vertical spacing between the conductor positions would be 18.0 ft. (5.49 m). The spacing between conductor locations would vary slightly where special towers are used, such as at angle points along the line. Short sections of the proposed line where conductor locations would change, such as upon entry to a substation, were not analyzed.

Minimum conductor-to-ground clearance would be 26.5 ft. (8.08 m) at a conductor temperature of 212°F (100°C); clearances above ground would be greater under normal operating temperatures. The average clearance above ground along a span would be approximately 38.5 ft. (11.7 m); this value was used for corona calculations. At road crossings, the ground clearance would be at least 37.5 ft. (11.4 m). The final design of the proposed line could entail larger clearances. The right-of-way width for the proposed line would be 125 ft. (38.11 m).

The electrical phasing of the proposed line would be selected to ensure that BPA criteria for electric-field and audible-noise levels are met and to minimize magnetic field to the extent practical. The results reported here for fields and corona effects assume that the electrical phasing of the two circuits would be such as to place different electrical phases on the lower conductors of each circuit and on the upper conductors of each circuit. This phasing configuration tends to minimize the fields at ground level. During the design process, BPA will verify that any changes from the phasing described here continue to meet design criteria.

2.2 Existing Lines

There are no existing transmission lines parallel to the proposed routes.

3.0 Electric Field

3.1 Basic Concepts

An electric field is said to exist in a region of space if an electrical charge, at rest in that space, experiences a force of electrical origin (i.e., electric fields cause free charges to move). Electric field is a vector quantity: that is, it has both magnitude and direction. The direction corresponds to the direction that a positive charge would move in the field. Sources of electric fields are unbalanced electrical charges (positive or negative) and time-varying magnetic fields. Transmission lines, distribution lines, house wiring, and appliances generate electric fields in their vicinity because of unbalanced electrical charge on energized conductors. The unbalanced charge is associated with the voltage on the energized system. On the power system in North America, the voltage and charge on the energized conductors are cyclic (plus to minus to plus) at a rate of 60 times per second. This changing voltage results in electric fields near sources that are also time-varying at a frequency of 60 hertz (Hz; a frequency unit equivalent to cycles per second).

As noted earlier, electric fields are expressed in units of volts per meter (V/m) or kilovolts (thousands of volts) per meter (kV/m). Electric- and magnetic-field magnitudes in this report are expressed in root-mean-square (rms) units. For sinusoidal waves, the rms amplitude is given as the peak amplitude divided by the square root of two.

The spatial uniformity of an electric field depends on the source of the field and the distance from that source. On the ground, under a transmission line, the electric field is nearly constant in magnitude and direction over distances of several feet (1 meter). However, close to transmission- or distribution-line conductors, the field decreases rapidly with distance from the conductors. Similarly, near small sources such as appliances, the field is not uniform and falls off even more rapidly with distance from the device. If an energized conductor (source) is inside a grounded conducting enclosure, then the electric field outside the enclosure is zero, and the source is said to be shielded.

Electric fields interact with the charges in all matter, including living systems. When a conducting object, such as a vehicle or person, is located in a time-varying electric field near a transmission line, the external electric field exerts forces on the charges in the object, and electric fields and currents are induced in the object. If the object is grounded, then the total current induced in the body (the "short-circuit current") flows to earth. The distribution of the currents within, say, the human body, depends on the electrical conductivities of various parts of the body: for example, muscle and blood have higher conductivity than bone and would therefore experience higher currents.

At the boundary surface between air and the conducting object, the field both in the air and perpendicular to the conductor surface is much, much larger than the field in the conductor itself. For example, the average surface field on a human standing in a 10 kV/m field is 27 kV/m; the internal fields in the body are much smaller: approximately 0.008 V/m in the torso and 0.45 V/m in the ankles.

3.2 Transmission-line Electric Fields

The electric field created by a high-voltage transmission line extends from the energized conductors to other conducting objects such as the ground, towers, vegetation, buildings, vehicles, and people. The calculated strength of the electric field at a height of 3.28 ft. (1 m) above an unvegetated, flat earth is frequently used to describe the electric field under straight, parallel transmission lines. The most important transmission-line parameters that determine the electric field at a 1-m height are conductor height above ground and line voltage.

Calculations of electric fields from transmission lines are performed with computer programs based on well-known physical principles (cf., Deno and Zaffanella, 1982). The calculated values under these conditions represent an ideal situation. When practical conditions approach this ideal model, measurements and calculations agree. Often, however, conditions are far from ideal because of variable terrain and vegetation. In these cases, fields are calculated for ideal conditions, with the lowest conductor clearances to provide upper bounds on the electric field under the transmission lines. With the use of more complex models or empirical results, it is also possible to account accurately for variations in conductor height, topography, and changes in line direction. Because the fields from different sources add vectorially, it is possible to compute the fields from several different lines if the electrical and geometrical properties of the lines are known. However, in general, electric fields near transmission lines with vegetation below are highly complex and cannot be calculated. Measured fields in such situations are highly variable.

For evaluation of EMF from transmission lines, the fields must be calculated for a specific line condition. The NESC states the condition for evaluating electric-field-induced short-circuit current for lines with voltage above 98 kV, line-to-ground, as follows: conductors are at a minimum clearance from ground corresponding to a conductor temperature of 122°F (50°C), and at a maximum voltage (IEEE, 2002). BPA has supplied the information for calculating electric and magnetic fields from the proposed transmission line: the maximum operating voltage, the estimated peak currents, and the minimum conductor clearances. The minimum clearances (100°C) provided by BPA are lower than those specified in the NESC (50°C). If the fields under the lower BPA conductor clearances meet the NESC criterion, they will also meet the criterion at the NESC specified clearance.

There are standard techniques for measuring transmission-line electric fields (IEEE, 1994). Provided that the conditions at a measurement site closely approximate those of the ideal situation assumed for calculations, measurements of electric fields agree well with the calculated values. If the ideal conditions are not approximated, the measured field can differ substantially from calculated values. Usually the actual electric field at ground level is reduced from the calculated values by various common objects that act as shields.

Maximum or peak field values occur over a small area at midspan, where conductors are closest to the ground. As the location of an electric-field profile approaches a tower, the conductor clearance increases, and the peak field decreases. A grounded tower will reduce the electric field considerably, by shielding. **Thus the assumption of minimum clearance results in peak (worst-case) fields that may be larger than what occur in practice.**

For traditional transmission lines, such as the proposed line, where the right-of-way extends laterally well beyond the conductors, electric fields at the edge of the right-of-way are not as sensitive as the peak field to conductor height. Computed values at the edge of the right-of-way for any line height are fairly representative of what can be expected all along the transmission-line corridor. However, the presence of vegetation on and at the edge of the right-of-way will reduce actual electric-field levels below calculated values.

3.3 Calculated Values of Electric Fields

Table 3 shows the calculated values of electric field at 3.28 ft. (1 m) above ground for the proposed Klondike - John Day 230-kV transmission-line operated at maximum voltage. The peak value on the right-of-way and the value at the edge of the right-of-way are given for the proposed line at minimum conductor clearance and at the estimated average clearance over a span. Figure 2 shows lateral profiles for the electric field from the proposed line at the minimum and average line heights.

The calculated peak electric field expected on the right-of-way of the proposed line is 2.4 kV/m. For average clearance, the peak field would be 1.1 kV/m or less. As shown in Figure 2, the peak values would be present only at locations directly under the 230-kV line, near mid-span, where the conductors are at the minimum clearance. The conditions of minimum conductor clearance at maximum current and maximum voltage occur very infrequently. The calculated peak levels are rarely reached under real-life conditions, because the actual line height is generally above the minimum value used in the computer model, because the actual voltage is below the maximum value used in the model, and because vegetation within and near the edge of the right-of-way tends to shield the field at ground level. Maximum electric fields on existing 230-kV corridors are typically 2.5 to 3 kV/m. On 500-kV transmission line corridors, the maximum electric fields range from 7 to 9 kV/m.

The largest value expected at the edge of the right-of-way of the proposed line is 0.3 kV/m decreasing to about 0.2 kV/m opposite conductors at average clearance.

3.4 Environmental Electric Fields

The electric fields associated with the Klondike - John Day 230-kV line can be compared with those found in other environments. Sources of 60-Hz electric (and magnetic) fields exist everywhere electricity is used; levels of these fields in the modern environment vary over a wide range. Electric-field levels associated with the use of electrical energy are orders of magnitude greater than naturally occurring 60-Hz fields of about 0.0001 V/m, which stem from atmospheric and extraterrestrial sources.

Electric fields in outdoor, publicly accessible places range from less than 1 V/m to 12 kV/m; the large fields exist close to high-voltage transmission lines of 230 kV or higher. In remote areas without electrical service, 60-Hz field levels can be much lower than 1 V/m. Electric fields in home and work environments generally are not spatially uniform like those of transmission lines; therefore, care must be taken when making comparisons between fields from different sources such as appliances and electric lines. In addition, fields from all sources can be strongly modified by the presence of conducting objects. However, it is helpful to know the levels of electric fields generated in domestic and office environments in order to compare commonly experienced field levels with those near transmission lines.

Numerous measurements of residential electric fields have been reported for various parts of the United States, Canada, and Europe. Although there have been no large studies of residential electric fields, sufficient data are available to indicate field levels and characteristics. Measurements of domestic 60-Hz electric fields indicate that levels are highly variable and source-dependent. Electric-field levels are not easily predicted because walls and other objects act as shields, because conducting objects perturb the field, and because homes contain numerous localized sources. Internal sources (wiring, fixtures, and appliances) seem to predominate in producing electric fields inside houses. Average measured electric fields in residences are generally in the range of 5 to 20 V/m. In a large occupational exposure monitoring project that included electric-field measurements at homes, average exposures for all groups away from work were generally less than 10 V/m (Bracken, 1990).

Electric fields from household appliances are localized and decrease rapidly with distance from the source. Local electric fields measured at 1 ft. (0.3 m) from small household appliances are typically in the range of 30 to 60 V/m. Stopps and Janischewskyj (1979) reported electric-field measurements near 20 different appliances; at a 1-ft. (0.3-m) distance, fields ranged from 1 to 150 V/m, with a mean of 33 V/m. In another survey, reported by Deno and Zaffanella (1982), field measurements at a 1-ft. (0.3-m) distance from common domestic and workshop sources were found to range from 3 to 70 V/m. The localized fields from appliances are not uniform, and care should be taken in comparing them with transmission-line fields.

Electric blankets can generate higher localized electric fields. Sheppard and Eisenbud (1977) reported fields of 250 V/m at a distance of approximately 1 ft. (0.3 m). Florig et al. (1987) carried out extensive empirical and theoretical analysis of electric-field exposure from electric blankets and presented results in terms of uniform equivalent fields such as those near transmission lines. Depending on what parameter was chosen to represent intensity of exposure and the grounding status of the subject, the equivalent vertical 60-Hz electric-field exposure ranged from 20 to over 3500 V/m. The largest equivalent field corresponds to the measured field on the chest with the blanket-user grounded. The average field on the chest of an ungrounded blanket-user yields an equivalent vertical field of 960 V/m. As manufacturers have become aware of the controversy surrounding EMF exposures, electric blankets have been redesigned to reduce *magnetic* fields. However, electric fields from these "low field" blankets are still comparable with those from older designs (Bassen et al., 1991).

Generally, people in occupations not directly related to high-voltage equipment are exposed to electric fields comparable with those of residential exposures. For example, the average electric field measured in 14 commercial and retail locations in rural Wisconsin and Michigan was 4.8 V/m (ITT Research Institute, 1984). Median electric field was about 3.4 V/m. These values are about one-third the values in residences reported in the same study. Power-frequency electric fields near video display terminals (VTDs) are about 10 V/m, similar to those of other appliances (Harvey, 1983). Electric-field levels in public buildings such as shops, offices, and malls appear to be comparable with levels in residences.

In a survey of 1,882 volunteers from utilities, electric-field exposures were measured for 2,082 work days and 657 non-work days (Bracken, 1990). Electric-field exposures for occupations other than those directly related to high-voltage equipment were equivalent to those for non-work exposure.

Thus, except for the relatively few occupations where high-voltage sources are prevalent, electric fields encountered in the workplace are probably similar to those of residential exposures. Even in electric-utility occupations where high field sources are present, exposures to high fields are limited on average to minutes per day.

Electric fields found in publicly accessible areas near high-voltage transmission lines can typically range up to 3 kV/m for 230-kV lines, to 10 kV/m for 500-kV lines, and to 12 kV/m for 765-kV lines. Although these peak levels are considerably higher than the levels found in other public areas, they are present only in limited areas on rights-of-way.

The calculated electric fields for the proposed Klondike - John Day 230-kV transmission line are consistent with the levels reported for other 230-kV transmission lines in Oregon, Washington, and elsewhere. The electric fields on the right-of-way of the proposed transmission line, as calculated, would be much higher than levels normally encountered in residences and offices.

4.0 Magnetic Field

4.1 Basic Concepts

Magnetic fields can be characterized by the force they exert on a moving charge or on an electrical current. As with the electric field, the magnetic field is a vector quantity characterized by both magnitude and direction. Electrical currents generate magnetic fields. In the case of transmission lines, distribution lines, house wiring, and appliances, the 60-Hz electric current flowing in the conductors generates a time-varying, 60-Hz magnetic field in the vicinity of these sources. The strength of a magnetic field is measured in terms of magnetic lines of force per unit area, or magnetic flux density. The term "magnetic field," as used here, is synonymous with magnetic flux density and is expressed in units of Gauss (G) or milligauss (mG).

The uniformity of a magnetic field depends on the nature and proximity of the source, just as the uniformity of an electric field does. Transmission-line-generated magnetic fields are quite uniform over horizontal and vertical distances of several feet near the ground. However, for small sources such as appliances, the magnetic field decreases rapidly over distances comparable with the size of the device.

The interaction of a time-varying magnetic field with conducting objects results in induced electric field and currents in the object. A changing magnetic field through an area generates a voltage around any conducting loop enclosing the area (Faraday's law). This is the physical basis for the operation of an electrical transformer. For a time-varying sinusoidal magnetic field, the magnitude of the induced voltage around the loop is proportional to the area of the loop, the frequency of the field, and the magnitude of the field. The induced voltage around the loop results in an induced electric field and current flow in the loop material. The induced current that flows in the loop depends on the conductivity of the loop.

4.2 Transmission-line Magnetic Fields

The magnetic field generated by currents on transmission-line conductors extends from the conductors through the air and into the ground. The magnitude of the field at a height of 3.28 ft. (1 m) is frequently used to describe the magnetic field under transmission lines. Because the magnetic field is not affected by non-ferrous materials, the field is not influenced by normal objects on the ground under the line. The direction of the maximum field varies with location. (The electric field, by contrast, is essentially vertical near the ground.) The most important transmission-line parameters that determine the magnetic field at 3.28 ft. (1 m) height are conductor height above ground and magnitude of the currents flowing in the conductors. As distance from the transmission-line conductors increases, the magnetic field decreases.

Calculations of magnetic fields from transmission lines are performed using well-known physical principles (cf., Deno and Zaffanella, 1982). The calculated values usually represent the ideal straight parallel-conductor configuration. For simplicity, a flat earth is usually assumed. Balanced currents (currents of the same magnitude for each phase) are also assumed. This is usually valid for transmission lines, where loads on all three phases are maintained in balance during operation. Induced image currents in the earth are usually ignored for calculations of magnetic field under or near the right-of-way. The resulting error is negligible. Only at distances greater than 300 ft. (91 m) from a line do such contributions become significant (Deno and Zaffanella, 1982). The clearance for magnetic-field calculations for the proposed line was the same as that used for electric-field evaluations.

Standard techniques for measuring magnetic fields near transmission lines are described in ANSI IEEE Standard No. 644-1994 (IEEE, 1994). Measured magnetic fields agree well with calculated values, provided the currents and line heights that go into the calculation correspond to the actual values for the line. To realize such agreement, it is necessary to get accurate current readings during field measurements (because currents on transmission lines can vary considerably over short periods of time) and also to account for all field sources in the vicinity of the measurements.

As with electric fields, the maximum or peak magnetic fields occur in areas near the centerline and at midspan where the conductors are the lowest. The magnetic field at the edge of the right-of-way is not very dependent on line height. For a double-circuit line or if more than one line is present, the peak field will depend on the relative electrical phasing of the conductors and the direction of power flow.

4.3 Calculated Values for Magnetic Fields

Table 4 gives the calculated values of the magnetic field at 3.28 ft. (1 m) height for the proposed Klondike – John Day 230-kV double-circuit transmission line. Field values on the right-of-way and at the edge of the right-of-way are given for projected maximum currents, for minimum and average conductor clearances. The maximum currents for the Biglow Canyon circuit and Klondike circuit are given in Table 2. The maximum current on the Biglow Canyon circuit is 974 A initially and 1462 A after the Orion load is added. The maximum current on the Klondike circuit is 731 A. Power on both circuits is assumed to flow from Klondike to John Day and the phasing of the conductors is selected to be different on the lower phases to produce minimum electric and magnetic fields.

The actual magnetic-field levels would vary, as currents on the lines change daily and seasonally and as ambient temperature changes. Average currents over the year would be about 30% of the maximum values. The levels shown in the figures represent the highest magnetic fields expected for the proposed Klondike - John Day 230-kV line. Average fields over a year would be considerably reduced from the peak values, as a result of reduced average currents and increased clearances above the minimum value due to conductor temperatures less than the design value of 100 C°.

Figure 3 shows lateral profiles of the magnetic field under maximum current and minimum clearance conditions for the proposed 230-kV transmission line. A field profile for average height under maximum current conditions is also included in Figure 3.

For the proposed 230-kV line, the maximum calculated 60-Hz magnetic field expected at 3.28 ft. (1 m) above ground is 128 mG for a minimum conductor height of 26.5 ft. (8.1 m). This field is calculated for maximum currents of 974 and 731 A on the Biglow Canyon and Klondike circuits, respectively. The maximum field would decrease for increased conductor clearance. For the average conductor height over a span of 38.5 ft. (11.7 m), the maximum field would be 57 mG.

For maximum currents in both circuits and minimum clearance conditions, the calculated magnetic fields at the edges of the 125-foot (38.1-m) right-of-way are 24 mG on the edge adjacent to the Biglow Canyon circuit and 12 mG adjacent to the Klondike circuit. For average conductor height the fields at the edge of the right-of-way are 19 and 10 mG for the Biglow Canyon and Klondike sides of the line, respectively.

With the Klondike circuit out of service (0 A), the fields from the two circuits would no longer cancel. In this case the maximum field due to the Biglow Canyon circuit alone would be 150 mG at the peak location on the right-of-way and 44 mG at the edge of the right-of-way.

All of these magnetic field levels averaged over a year would be about 30-percent of the above values. Thus, averaged over the year the maximum levels at the respective edges of the right-of-way would be about 7 and 4 mG.

4.4 Environmental Magnetic Fields

Transmission lines are not the only source of magnetic fields; as with 60-Hz electric fields, 60-Hz magnetic fields are present throughout the environment of a society that relies on electricity as a principal energy source. The magnetic fields associated with the proposed Klondike - John Day 230-kV line can be compared with fields from other sources. The range of 60-Hz magnetic-field exposures in publicly accessible locations such as open spaces, transmission-line rights-of-way, streets, pedestrian walkways, parks, shopping malls, parking lots, shops, hotels, public transportation, and so on range from less than 0.1 mG to about 1 G, with the highest values occurring near small appliances with electric motors. In occupational settings in electric utilities, where high currents are present, magnetic-field exposures for workers can be above 1 G. At 60 Hz, the magnitude of the natural magnetic field is approximately 0.0005 mG.

Several investigations of residential fields have been conducted. In a large study to identify and quantify significant sources of 60-Hz magnetic fields in residences, measurements were made in 996 houses, randomly selected throughout the country (Zaffanella, 1993). The most common sources of residential fields were power lines, the grounding system of residences, and appliances. Field levels were characterized by both point-in-time (spot) measurements and 24-hour measurements. Spot measurements averaged over all rooms in a house exceeded 0.6 mG in 50% of the houses and 2.9 mG in 5% of houses. Power lines generally produced the largest average fields in a house over a 24-hour period. On the other hand, grounding system currents proved to be a more significant source of the highest fields in a house. Appliances were found to produce the highest local fields; however, fields fell off rapidly with increased distance. For example, the median field near microwave ovens was 36.9 mG at a distance of 10.5 in. (0.27 m) and 2.1 mG at 46 in. (1.17 m). Across the entire sample of 996 houses, higher magnetic fields were found in, among others, urban areas (vs. rural); multi-unit dwellings (vs. single-family); old houses (vs. new); and houses with grounding to a municipal water system.

In an extensive measurement project to characterize the magnetic-field exposure of the general population, over 1000 randomly selected persons in the United States wore a personal exposure meter for 24 hours and recorded their location in a simple diary (Zaffanella and Kalton, 1998). Based on the measurements of 853 persons, the estimated 24-hour average exposure for the general population is 1.24 mG and the estimated median exposure is 0.88 mG. The average field “at home, not in bed” is 1.27 mG and “at home, in bed” is 1.11 mG. Average personal exposures were found to be highest “at work” (mean of 1.79 mG and median of 1.01 mG) and lowest “at home, in bed” (mean of 1.11 mG and median of 0.49 mG). Average fields in school were also low (mean of 0.88 mG and median of 0.69 mG). Factors associated with higher exposures at home were smaller residences, duplexes and apartments, metallic rather than plastic water pipes, and nearby overhead distribution lines.

As noted above, magnetic fields from appliances are localized and decrease rapidly with distance from the source. Localized 60-Hz magnetic fields have been measured near about 100 household appliances such as ranges, refrigerators, electric drills, food mixers, and shavers (Gauger, 1985). At a distance of 1 ft. (0.3 m), the maximum magnetic field ranged from 0.3 to 270 mG, with 95% of the measurements below 100 mG. Ninety-five percent of the levels at a distance of 4.9 ft. (1.5 m) were less than 1 mG. Devices that use light-weight, high-torque motors with little magnetic shielding exhibited the largest fields. These included vacuum cleaners and small hand-held appliances and tools. Microwave ovens with large power transformers also exhibited relatively large fields. Electric blankets have been a much-studied source of magnetic-field exposure because of the length of time they are used and because of the close proximity to the body. Florig and Hoburg (1988) estimated that the average magnetic field in a person using an electric blanket was 15 mG, and that the maximum field could be 100 mG. New "low-field" blankets have magnetic fields at least 10 times lower than those from conventional blankets (Bassen et al., 1991).

In a domestic magnetic-field survey, Silva et al. (1989) measured fields near different appliances at locations typifying normal use (e.g., sitting at an electric typewriter or standing at a stove). Specific appliances with relatively large fields included can openers (n = 9), with typical fields ranging from 30 to 225 mG and a maximum value up to 2.7 G; shavers (n = 4), with typical fields from 50 to 300 mG and maximum fields up to 6.9 G; and electric drills (n = 2), with typical fields from 56 to 190 mG and maximum fields up to 1.5 G. The fields from such appliances fall off very rapidly with distance and are only present for short periods. Thus, although instantaneous magnetic-field levels close to small hand-held appliances can be quite large, they do not contribute to average area levels in residences.

In a study with 162 subjects, Mezei et al. (2001) employed magnetic-field exposure measurements, simultaneous record-keeping of appliance proximity, and an appliance-use questionnaire to investigate the contributions of appliances to overall exposure. They found that individual appliance use did not contribute significantly to time-weighted-average exposure, unless the use was prolonged during the day of measurements. For example, approximately 16% of exposure accumulated during periods when a subject was using a computer. For all subjects exposure during computer use accounted for on-average 9% of total exposure. Cell phones were identified as another source of relatively low fields and long use times that could contribute to overall exposure. Use of other small appliances did not contribute significantly to accumulated exposure but did contribute to the relatively short periods when high-field exposures were observed.

Although studies of residential magnetic fields have not all considered the same independent parameters, the following consistent characterization of residential magnetic fields emerges from the data:

(1) External sources play a large role in determining residential magnetic-field levels. Transmission lines, when nearby, are an important external source. Unbalanced ground currents on neutral conductors and other conductors, such as water pipes in and near a house, can represent a significant source of magnetic field. Distribution lines per se, unless they are quite close to a residence, do not appear to be a traditional distance-dependent source.

(2) Homes with overhead electrical service appear to have higher average fields than those with underground service.

(3) Appliances represent a localized source of magnetic fields that can be much higher than average or area fields. However, fields from appliances approach area levels at distances greater than 3.28 ft. (1 m) from the device.

Although important variables in determining residential magnetic fields have been identified, quantification and modeling of their influence on fields at specific locations is not yet possible. However, a general characterization of residential magnetic-field level is possible: average levels in the United States are in the range of 0.5 to 1.0 mG, with the average field in a small number of homes exceeding this range by as much as a factor of 10 or more. Average personal exposure levels are slightly higher, possibly due to use of appliances and varying distances to other sources. Maximum fields can be much higher.

Magnetic fields in commercial and retail locations are comparable with those in residences. As with appliances, certain equipment or machines can be a local source of higher magnetic fields. Utility workers who work close to transformers, generators, cables, transmission lines, and distribution systems clearly experience high-level fields. Other sources of fields in the workplace include motors, welding machines, computers, and video display terminals (VDTs). In publicly accessible indoor areas, such as offices and stores, field levels are generally comparable with residential levels, unless a high-current source is nearby.

Because high-current sources of magnetic field are more prevalent than high-voltage sources, occupational environments with relatively high magnetic fields encompass a more diverse set of occupations than do those with high electric fields. For example, in occupational magnetic-field measurements reported by Bowman et al. (1988), the geometric mean field from 105 measurements of magnetic field in "electrical worker" job locations was 5.0 mG. "Electrical worker" environments showed the following elevated magnetic-field levels (geometric mean greater than 20 mG): industrial power supplies, alternating current (ac) welding machines, and sputtering systems for electronic assembly. For secretaries in the same study, the geometric mean field was 3.1 mG for those using VDTs (n = 6) and 1.1 mG for those not using VDTs (n = 3).

Measurements of personal exposure to magnetic fields were made for 1,882 volunteer utility workers for a total of 4,411 workdays (Bracken, 1990). Median workday mean exposures ranged from 0.5 mG for clerical workers without computers to 7.2 mG for substation operators. Occupations not specifically associated with transmission and distribution facilities had median workday exposures less than 1.5 mG, while those associated with such facilities had median exposures above 2.3 mG. Magnetic-field exposures measured in homes during this study were comparable with those recorded in offices.

Magnetic fields in publicly accessible outdoor areas seem to be, as expected, directly related to proximity to electric-power transmission and distribution facilities. Near such facilities, magnetic fields are generally higher than indoors (residential). Higher-voltage facilities tend to have higher fields. Typical maximum magnetic fields in publicly accessible areas near transmission facilities can range from less than a few milligauss up to 300 mG or more, near heavily loaded lines operated at 230 to 765 kV. The levels depend on the line load, conductor height, and location on the right-of-way. Because magnetic fields near high-voltage transmission lines depend on the current in the line, they can vary daily and seasonally. To characterize fields from the distribution system, Heroux (1987) measured 60-Hz magnetic fields with a mobile platform along 140 mi. (223 km) of roads in Montreal. The median field level averaged over nine different routes was 1.6 mG, with 90% of the measurements less than about 5.1 mG. Spot measurements indicated that typical fields directly above underground distribution systems were 5 to 19 mG. Beneath overhead distribution lines, typical fields were 1.5 to 5 mG on the primary side of the transformer, and 4 to 10 mG on the secondary side. Near ground-based transformers used in residential areas, fields were 80 to 1000 mG at the surface and 10 to 100 mG at a distance of 1 ft. (0.3 m).

The magnetic fields from the proposed line would be comparable to or less than those from existing 230-kV lines in Oregon, Washington, and elsewhere. On and near the right-of-way of the proposed line, magnetic fields would be above average residential levels. However, the fields from the line would decrease rapidly and approach common ambient levels (1 mG) at a distance of about 200 feet from the edge of the right-of-way under maximum current conditions and at about 100 feet from the edge under average current conditions. Furthermore, the fields at the edge of the right-of-way would not be above those encountered during normal activities near common sources such as hand-held appliances.

5.0 Electric and Magnetic Field (EMF) Effects

Possible effects associated with the interaction of EMF from transmission lines with people on and near a right-of-way fall into two categories: short-term effects that can be perceived and may represent a nuisance, and possible long-term health effects. Only short-term effects are discussed here. The issue of whether there are long-term health effects associated with transmission-line fields is controversial. In recent years, considerable research on possible biological effects of EMF has been conducted. A review of these studies and their implications for health-related effects is provided in a separate technical report for the environmental assessment for the proposed Klondike - John Day 230-kV transmission line.

5.1 Electric Fields: Short-term Effects

Short-term effects from transmission-line electric fields are associated with perception of induced currents and voltages or perception of the field. Induced current or spark discharge shocks can be experienced under certain conditions when a person contacts objects in an electric field. Such effects occur in the fields associated with transmission lines that have voltages of 230-kV or higher. These effects could occur infrequently under the proposed Klondike - John Day 230-kV line.

Steady-state currents are those that flow continuously after a person contacts an object and provides a path to ground for the induced current. The amplitude of the steady-state current depends on the induced current to the object in question and on the grounding path. The magnitude of the induced current to vehicles and objects under the proposed line will depend on the electric-field strength and the size and shape of the object. When an object is electrically grounded, the voltage on the object is reduced to zero, and it is not a source of current or voltage shocks. If the object is poorly grounded or not grounded at all, then it acquires some voltage relative to earth and is a possible source of current or voltage shocks.

The responses of persons to steady-state current shocks have been extensively studied, and levels of response documented (Keesey and Letcher, 1969; IEEE, 1978). Primary shocks are those that can result in direct physiological harm. Such shocks will not be possible from induced currents under the existing or proposed lines, because clearances above ground required by the NESC preclude such shocks from large vehicles and grounding practices eliminate large stationary objects as sources of such shocks.

Secondary shocks are defined as those that could cause an involuntary and potentially harmful movement, but no direct physiological harm. Secondary shocks could occur under the proposed 230-kV line when making contact with ungrounded conducting objects such as large vehicles or equipment. However, such occurrences are anticipated to be very infrequent. Shocks, when they occur under the 230-kV line, are most likely to be below the nuisance level. Induced currents would not be perceived off the right-of-way.

Induced currents are always present in electric fields under transmission lines and will be present near the proposed line. However, during initial construction, it is BPA policy to ground metal objects, such as fences, that are located on the right-of-way. The grounding eliminates these objects as sources of induced current and voltage shocks. Multiple grounding points are used to provide redundant paths for induced current flow. After construction, BPA would respond to any complaints and install or repair grounding to mitigate nuisance shocks.

Unlike fences or buildings, mobile objects such as vehicles and farm machinery cannot be grounded permanently. Limiting the possibility of induced currents from such objects to persons is accomplished in several ways. First, required clearances for above-ground conductors tend to limit field strengths to levels that do not represent a hazard or nuisance. The NESC (IEEE, 2002) requires that, for lines with voltage exceeding 98 kV line-to-ground (170 kV line-to-line), sufficient conductor clearance be maintained to limit the induced short-circuit current in the largest anticipated vehicle under the line to 5 milliamperes (mA) or less. This can be accomplished by limiting access or by increasing conductor clearances in areas where large vehicles could be present. BPA and other utilities design and operate lines to be in compliance with the NESC.

For the proposed line, conductor clearances (100°C) would be increased to at least 37.5 ft. (11.4 m) over major road crossings along the route, resulting in a maximum field of 1.2 kV/m or less at the 3.28 ft. (1 m) height. The largest truck allowed on roads in Oregon without a special permit is 14 ft. high by 8.5 ft. wide by 75 ft. long (4.3 x 2.6 x 22.9 m). The induced currents to such a vehicle oriented perpendicular to the line in a maximum field of 1.2 kV/m (at 3.28-ft. height) would be less than 1.2 mA (Reilly, 1979). For smaller trucks, the maximum induced currents for perpendicular orientation to the proposed line would be less than this value. (Larger special-permitted trucks, such as triple trailers, can be up to 105 feet in length. However, because they average the field over such a long distance, the maximum induced current to a 105-ft. vehicle oriented perpendicular to the 230-kV line at a road crossing would be less than that for the 75-foot truck.) These large vehicles are not anticipated to be off highways on the right-of-way or oriented parallel and directly under the proposed line. Thus, the NESC 5-mA criterion would be met for road crossings of the proposed line. In accordance with the NESC, line clearances would also be increased over other areas, such as over railroads, orchards and water areas suitable for sailboating.

The computed induced currents at road crossings are for worst-case conditions that occur rarely. Several factors tend to reduce the levels of induced current shocks from vehicles at road crossings and elsewhere:

(1) Activities are distributed over the whole right-of-way, and only a small percentage of time is spent in areas where the field is at or close to the maximum value.

(2) At road crossings, vehicles are aligned perpendicular to the conductors, resulting in a substantial reduction in induced current.

(3) The conductor clearance at road crossings may not be at minimum values because of lower conductor temperatures and/or location of the road crossing away from midspan.

(4) The largest vehicles are permitted only on certain highways.

(5) Off-road vehicles are in contact with soil or vegetation, which reduces shock currents substantially.

Induced voltages occur on objects, such as vehicles, in an electric field where there is an inadequate electrical ground. If the voltage is sufficiently high, then a spark discharge shock can occur as contact is made with the object. Such shocks are similar to "carpet" shocks that occur, for example, when a person touches a doorknob after walking across a carpet on a dry day. The number and severity of spark discharge shocks depend on electric-field strength and generally of concern under lines with voltages of 345-kV or higher. Nuisance shocks, which are primarily spark discharges, are not anticipated to be a problem under the proposed line.

In electric fields higher than those that would occur under the proposed line, it is theoretically possible for a spark discharge from the induced voltage on a large vehicle to ignite gasoline vapor during refueling. The probability for exactly the right conditions for ignition to occur is extremely remote. The additional clearance of conductors provided at road crossings reduces the electric field in areas where vehicles are prevalent and reduces the chances for such events. Even so, BPA recommends that vehicles should not be refueled under the proposed line unless specific precautions are taken to ground the vehicle and the fueling source (USDOE, 1995).

Under certain conditions, the electric field can be perceived through hair movement on an upraised hand or arm of a person standing on the ground under high-voltage transmission lines. The median field for perception in this manner was 7 kV/m for 136 persons; only about 12% could perceive fields of 2 kV/m or less (Deno and Zaffanella, 1982). In limited areas under the conductors at midspan, the fields at ground level would exceed the levels where field perception can occur. However it is unlikely that field perception would be common under the proposed 230-kV line because fields would generally be below the perception level. Where vegetation provides shielding, the field would not be perceived.

Conductive shielding reduces both the electric field and induced effects such as shocks. Persons inside a vehicle cab or canopy are shielded from the electric field. Similarly, a row of trees or a lower-voltage distribution line reduces the field on the ground in the vicinity. Metal pipes, wiring, and other conductors in a residence or building shield the interior from the transmission-line electric field.

The electric fields from the proposed 230-kV line would be comparable to or less than those from existing 230-kV lines in the project area and elsewhere. Potential impacts of electric fields can be mitigated through grounding policies and adherence to the NESC. Worst-case levels are used for safety analyses but, in practice, induced currents and voltages are reduced considerably by unintentional grounding. Shielding by conducting objects, such as vehicles and vegetation, also reduces the potential for electric-field effects.

5.2 Magnetic Field: Short-term Effects

Magnetic fields associated with transmission and distribution systems can induce voltage and current in long conducting objects that are parallel to the transmission line. As with electric-field induction, these induced voltages and currents are a potential source of shocks. A fence, irrigation pipe, pipeline, electrical distribution line, or telephone line forms a conducting loop when it is grounded at both ends. The earth forms the other portion of the loop. The magnetic field from a transmission line can induce a current to flow in such a loop if it is oriented parallel to the line. If only one end of the fence is grounded, then an induced voltage appears across the open end of the loop. The possibility for a shock exists if a person closes the loop at the open end by contacting both the ground and the conductor. The magnitude of this potential shock depends on the following factors: the magnitude of the field; the length of the object (the longer the object, the larger the induced voltage); the orientation of the object with respect to the transmission line (parallel as opposed to perpendicular, where no induction would occur); and the amount of electrical resistance in the loop (high resistance limits the current flow).

Magnetically induced currents from power lines have been investigated for many years; calculation methods and mitigating measures are available. A comprehensive study of gas pipelines near transmission lines developed prediction methods and mitigation techniques specifically for induced voltages on pipelines (Dabkowski and Taflove, 1979; Taflove and Dabkowski, 1979). Similar techniques and procedures are available for irrigation pipes and fences. Grounding policies employed by utilities for long fences reduce the potential magnitude of induced voltage.

The magnitude of the coupling with both pipes and fences is very dependent on the electrical unbalance (unequal currents) among the three phases of the line. Thus, a distribution line where a phase outage may go unnoticed for long periods of time can represent a larger source of induced currents than a transmission line where the loads are well-balanced (Jaffa and Stewart, 1981).

Knowledge of the phenomenon, grounding practices, and the availability of mitigation measures mean that magnetic-induction effects from the proposed 230-kV transmission line would be minimal.

Magnetic fields from transmission and distribution facilities can interfere with certain electronic equipment. Magnetic fields can cause distortion of the image on older style VDTs and computer monitors (cathode-ray tubes). The threshold field for interference depends on the type and size of monitor and the frequency of the field. Interference has been observed for certain monitors at fields at or below 10 mG (Baishiki et al., 1990; Banfai et al., 2000). The problem typically arises when computer monitors are in use near electrical distribution or transmission facilities or near the distribution system in large office buildings. Under peak current conditions fields from the proposed line would fall below this level from the edge of the right of way to about 30 ft. (9 m) beyond the right of way depending on line height. For average current conditions the field at the edge of the right-of-way and beyond would be below the 10 mG level where interference can occur.

Interference from magnetic fields does not occur for flat-screen monitors, such as used in laptop computers. If interference does occur for an older monitor, it can be eliminated by shielding the affected monitor or moving it to an area with lower fields. Similar mitigation methods could be applied to other sensitive electronics, if necessary. Interference from 60-Hz fields with computers and control circuits in vehicles and other equipment is not anticipated at the field levels found under and near the proposed 230-kV transmission line.

6.0 Regulations

Regulations that apply to transmission-line electric and magnetic fields fall into two categories. Safety standards or codes are intended to limit or eliminate electric shocks that could seriously injure or kill persons. Field limits or guidelines are intended to limit electric- and magnetic-field exposures that can cause nuisance shocks or that might cause health effects. In no case has a limit or standard been established because of a known or demonstrated health effect.

The proposed line would be designed to meet the NESC (IEEE, 2002a), which specifies how far transmission-line conductors must be from the ground and other objects. The clearances specified in the code provide safe distances that prevent harmful shocks to workers and the public. In addition, people who live and work near transmission lines must be aware of safety precautions to avoid electrical (which is not necessarily physical) contact with the conductors. For example, farmers should not up-end irrigation pipes under a transmission or other electrical line or direct the water stream from an irrigation system into or near the conductors. In addition, as a matter of safety, the NESC specifies that electric-field-induced currents from transmission lines must be below the 5 mA ("let go") threshold deemed a lower limit for primary shock. BPA publishes and distributes a brochure that describes safe practices to protect against shock hazards around power lines (USDOE, 1995).

Field limits or guidelines have been adopted in several states and countries and by national and international organizations. Electric-field limits have generally been based on minimizing nuisance shocks or field perception. In some cases, such as the state limits in Table 5, the intent of magnetic-field limits has been to limit exposures to existing levels, given the uncertainty of their potential for health effects. In the case of international standard or guideline setting organizations, magnetic field limits have been based on thresholds for possible effects from induced internal currents or electric fields (ICNIRP, 1998; IEEE, 2002b).

There are currently no national standards in the United States for 60-Hz electric and magnetic fields. Oregon's formal rule in its transmission-line-siting procedures specifically addresses field limits. The Oregon limit of 9 kV/m for electric fields is applied to areas accessible to the public (Oregon, State of, 1980). The Oregon rule also addresses grounding practices, audible noise, and radio interference. Oregon does not have a limit for magnetic fields from transmission lines.

Besides Oregon, several states have been active in establishing mandatory or suggested limits on 60-Hz electric and (in two cases) magnetic fields. Five other states have specific electric-field limits that apply to transmission lines: Florida, Minnesota, Montana, New Jersey, and New York. Florida and New York have established regulations for magnetic fields. These regulations are summarized in Table 5, adapted from TDHS Report (1989).

Government agencies and utilities operating transmission systems have established design criteria that include EMF levels. BPA has maximum allowable electric fields of 9 and 5 kV/m on and at the edge of the right-of-way, respectively (USDOE, 1996). BPA also has maximum-allowable electric-field strengths of 5 kV/m, 3.5 kV/m, and 2.5 kV/m for road crossings, shopping center parking lots, and commercial/industrial parking lots, respectively. These levels are based on limiting the maximum short-circuit currents from anticipated vehicles to less than 1 mA in shopping center lots and to less than 2 mA in commercial parking lots.

Electric-field limits for overhead power lines have also been established in other countries (Maddock, 1992). Limits for magnetic fields from overhead power lines have not been explicitly established anywhere except in Florida and New York (see Table 5). However, general guidelines and limits on EMF have been established for occupational and public exposure in several countries and by national and international organizations.

The American Conference of Governmental Industrial Hygienists (ACGIH) sets guidelines (Threshold Limit Values® or TLV®) for occupational exposures to environmental agents (ACGIH, 2000).
In general, a TLV represents the level below which it is believed that nearly all workers may be exposed repeatedly without adverse health effects. For EMF, the TLVs represent ceiling levels. For 60-Hz electric fields, occupational exposures should not exceed the TLV of 25 kV/m. However, the ACGIH also recognizes the potential for startle reactions from spark discharges and short-circuit currents in fields greater than 5-7 kV/m, and recommends implementing grounding practices. They recommend the use of conductive clothing for work in fields exceeding 15 kV/m. The TLV for occupational exposure to 60-Hz magnetic fields is a ceiling level of 10 G (10,000 mG) (ACGIH, 2000).

Electric and magnetic fields from various sources (including automobile ignitions, appliances and, possibly, transmission lines) can interfere with implanted cardiac pacemakers. In light of this potential problem, manufacturers design devices to be immune from such interference. However, research has shown that these efforts have not been completely successful and that a few older models of pacemakers could be affected by 60-Hz fields from transmission lines. There were also numerous models of pacemakers that were not affected by fields even larger than those found under transmission lines. Because of the known potential for interference with pacemakers by 60-Hz fields, field limits for pacemaker wearers have been established by the ACGIH. They recommend that wearers of pacemakers and similar medical-assist devices limit their exposure to electric fields of 1 kV/m or less and to magnetic fields to 1 G (1,000 mG) or less (ACGIH, 2000).

The International Committee on Non-ionizing Radiation Protection (ICNIRP), working in cooperation with the World Health Organization (WHO), has developed guidelines for occupational and public exposures to EMF (ICNIRP, 1998). For occupational exposures at 60 Hz, the recommended limits to exposure are 8.3 kV/m for electric fields and 4.2 G (4,200 mG) for magnetic fields. The electric-field level can be exceeded, provided precautions are taken to prevent spark discharge and induced current shocks. For the general public, the ICNIRP guidelines recommend exposure limits of 4.2 kV/m for electric fields and 0.83 G (830 mG) for magnetic fields (ICNIRP, 1998).

ICNIRP has also established guidelines for contact currents, which could occur when a grounded person contacts an ungrounded object in an electric field. The guideline levels are 1.0 mA for occupational exposure and 0.5 mA for public exposure.

The Institute of Electrical and Electronic Engineers (IEEE, 2002b) has also set limits for occupational and public exposure to electric and magnetic fields and to contact currents. The magnetic-field limits are based on an extensive assessment of possible neurological responses to magnetic field exposures. The limit for public exposure to 60-Hz magnetic fields are 9,040 mG.

The IEEE electric-field limits are based on thresholds for possible reactions to perceivable spark discharges that occur in electric fields. The limits for public exposure to electric fields are 5 kV/m except on power line rights-of-way, where the limit is 10 kV/m. The current limit for the general public is 0.5 mA for a touch contact.

The electric fields from the proposed 230-kV transmission line would meet the ACGIH, ICNIRP, and IEEE standards, provided wearers of pacemakers and similar medical-assist devices are discouraged from unshielded right-of-way use. (A passenger in an automobile under the line would be shielded from the electric field.) The magnetic fields from the proposed line would be below the ACGIH occupational limits, and well as below those of ICNIRP and IEEE for occupational and public exposures. The electric fields present on the right-of-way could induce currents in ungrounded vehicles that exceeded the ICNIRP and IEEE levels of 0.5 mA.

The estimated peak electric fields on the right-of-way of the proposed transmission line would meet the limits of all states. (see Table 5). The BPA electric field criteria would be met by the proposed line. for all configurations of the proposed line. The edge-of-right-of-way electric fields from the proposed line would be below the edge-of-right-of-way limits set by all states. The magnetic field at the edge of the right-of-way from the proposed line would be below the regulatory levels of states where such regulations exist.

7.0 Audible Noise

7.1 Basic Concepts

Audible noise (AN), as defined here, represents an unwanted sound, as from a transmission line, transformer, airport, or vehicle traffic. Sound is a pressure wave caused by a sound source vibrating or displacing air. The ear converts the pressure fluctuations into auditory sensations. AN from a source is superimposed on the background or ambient noise that is present before the source is introduced.

The amplitude of a sound wave is the incremental pressure resulting from sound above atmospheric pressure. The sound-pressure level is the fundamental measure of AN; it is generally measured on a logarithmic scale with respect to a reference pressure. The sound-pressure level (SPL) in decibels (dB) is given by:

$$SPL = 20 \log (P/P_o)dB$$

where P is the effective rms (root-mean-square) sound pressure, P_o is the reference pressure, and the logarithm (log) is to the base 10. The reference pressure for measurements concerned with hearing is usually taken as 20 micropascals (Pa), which is the approximate threshold of hearing for the human ear. A logarithmic scale is used to encompass the wide range of sound levels present in the environment. The range of human hearing is from 0 dB up to about 140 dB, a ratio of 10 million in pressure (EPA, 1978).

Logarithmic scales, such as the decibel scale, are not directly additive: to combine decibel levels, the dB values must be converted back to their respective equivalent pressure values, the total rms pressure level found, and the dB value of the total recalculated. For example, adding two sounds of equal level on the dB scale results in a 3 dB increase in sound level. Such an increase in sound pressure level of 3 dB, which corresponds to a doubling of the energy in the sound wave, is barely discernible by the human ear. It requires an increase of about 10 dB in SPL to produce a subjective doubling of sound level for humans. The upper range of hearing for humans (140 dB) corresponds to a sharply painful response (EPA, 1978).

Humans respond to sounds in the frequency range of 16 to 20,000 Hz. The human response depends on frequency, with the most sensitive range roughly between 2000 and 4000 Hz. The frequency-dependent sensitivity is reflected in various weighting scales for measuring audible noise. The A-weighted scale weights the various frequency components of a noise in approximately the same way that the human ear responds. This scale is generally used to measure and describe levels of environmental sounds such as those from vehicles or occupational sources. The A-weighted scale is also used to characterize transmission-line noise. Sound levels measured on the A-scale are expressed in units of dB(A) or dBA.

AN levels and, in particular, corona-generated audible noise (see below) vary in time. In order to account for fluctuating sound levels, statistical descriptors have been developed for environmental noise. Exceedence levels (L levels) refer to the A-weighted sound level that is exceeded for a specified percentage of the time. Thus, the L_5 level refers to the noise level that is exceeded only 5% of the time. L_{50} refers to the sound level exceeded 50% of the time. Sound-level measurements and predictions for transmission lines are often expressed in terms of exceedence levels, with the L_5 level representing the maximum level and the L_{50} level representing a median level.

Table 6 shows AN levels from various common sources. Clearly, there is wide variation. Noise exposure depends on how much time an individual spends in different locations. Outdoor noise generally does not contribute to indoor levels (EPA, 1974). Activities in a building or residence generally dominate interior AN levels.

The BPA transmission-line design criterion for corona-generated audible noise (L_{50}, foul weather) is 50 dBA at the edge of the ROW (USDOE, 2006). This criterion applies to new line construction and is under typical conditions of foul weather, altitude, and system voltage.

Audible noise from substations is generated predominantly by equipment such as transformers, reactors and other wire-wound equipment. It is characterized by a 120 Hz hum that is associated with magnetic-field caused vibrations in the equipment. Noise from such equipment varies by voltage and other operating conditions. The BPA design level for substation noise is 50 dBA at the substation property line for new construction (USDOE, 2006). The design level is met by obtaining equipment that meets specified noise limits and, for new substations, by securing a no-built buffer beyond the substation perimeter fence.

In industrial, business, commercial, or mixed use zones the AN level from substations may exceed 50 dBA but must still meet any state or local AN requirements. The design criteria also allows the 50 dBA design level to be exceeded in remote areas where development of noise sensitive properties is highly unlikely.

The EPA has established a guideline of 55 dBA for the annual average day-night level (L_{dn}) in outdoor areas (EPA, 1978). In computing this value, a 10 dB correction (penalty) is added to night-time noise between the hours of 10 p.m. and 7 a.m.

7.2 Transmission-line Audible Noise

Corona is the partial electrical breakdown of the insulating properties of air around the conductors of a transmission line. In a small volume near the surface of the conductors, energy and heat are dissipated. Part of this energy is in the form of small local pressure changes that result in audible noise. Corona-generated audible noise can be characterized as a hissing, crackling sound that, under certain conditions, is accompanied by a 120-Hz hum. Corona-generated audible noise is of concern primarily for contemporary lines operating at voltages of 345 kV and higher during foul weather. However, the proposed 230-kV line will produce some noise under foul weather conditions.

The conductors of high-voltage transmission lines are designed to be corona-free under ideal conditions. However, protrusions on the conductor surface—particularly water droplets on or dripping off the conductors—cause electric fields near the conductor surface to exceed corona onset levels, and corona occurs. Therefore, audible noise from transmission lines is generally a foul-weather (wet-conductor) phenomenon. Wet conductors can occur during periods of rain, fog, snow, or icing. Based on meteorologic records near the route of the proposed transmission line, such conditions are expected to occur about 6% of the time during the year in the Wasco area.

For a few months after line construction, residual grease or oil on the conductors can cause water to bead up on the surface. This results in more corona sources and slightly higher levels of audible noise and electromagnetic interference if the line is energized. However, the new conductors "age" in a few months, and the level of corona activity decreases to the predicted equilibrium value. During fair weather, insects and dust on the conductor can also serve as sources of corona.

7.3 Predicted Audible Noise Levels

Corona-generated audible-noise levels are calculated for average voltage and average conductor heights for fair- and foul-weather conditions. The predicted levels of audible noise for the proposed line operated at a voltage of 237 kV are given in Table 7 and plotted in Figure 4.

The calculated median level (L_{50}) during foul weather at the edge of the proposed Klondike - John Day 230-kV line right-of-way (62.5 ft. from centerline) is 42 dBA; the calculated maximum level (L_5) during foul weather at the edge of the right-of-way is 46 dBA. During fair-weather conditions, which occur about 94% of the time in the Wasco area, audible noise levels at the edge of the right-of-way would be about 20 dBA (if corona were present). These lower levels could be masked by ambient noise on and off the right-of-way.

7.4 Discussion

The calculated foul-weather corona noise levels for the proposed line would be comparable to, or less than, those from existing 230-kV lines in Oregon. During fair weather, noise from the conductors might be perceivable on the right-of-way; however, beyond the right-of-way it would very likely be masked or so low as not to be perceived. During foul weather, when ambient noise is higher, it is also likely that corona-generated noise off the right-of-way would be masked to some extent.

On and off the right-of-way, the levels of audible noise from the proposed line during foul weather would be well below the 55-dBA level that can produce interference with speech outdoors. The distance to the nearest residence to the proposed line is about 0.25 miles (0.4 km). At this distance the AN from the line would be about 30 dBA during foul weather and probably not be perceived above background noise. During such periods ambient noise levels can be increased due to wind and rain hitting foliage or buildings.

The computed annual L_{dn} level for transmission lines operating in areas with about 6% foul weather is about $L_{dn} = L_{50}$ - 3 dBA (Bracken, 1987). Therefore, assuming such conditions in the area of the proposed Klondike - John Day 230-kV line, the estimated L_{dn} at the edge of the right-of-way would be approximately 39 dBA, which is well below the EPA L_{dn} guideline of 55 dBA.

The transformers and other equipment installed at the new Klondike substation will be specified so that the BPA noise level criterion of 50 dBA for new substations will be met at the edge of the property (USDOE, 2006). This will ensure that all applicable federal, state, and local regulations are met.

For the expansion to the John Day Substation, the new equipment would be required to meet the same specifications as for new substations (USDOE, 2006). However, the new equipment would be placed in an environment with noise from existing transmission lines and existing equipment in the John Day Substation. The combined noise level from the existing and new facilities could exceed the 50 dBA design level at points on the perimeter of the expanded substation. However, the levels would be controlled to meet all applicable regulations at the edge of the property.

7.5 Conclusion

Along the proposed line route there could be increases in the perceived noise above ambient levels during foul weather at the edges of the proposed 230-kV right-of-way. The corona-generated noise during foul weather would be masked to some extent by naturally occurring sounds such as wind and rain on foliage. During fair weather, the noise off the right-of-way from the proposed line would probably not be detectable above ambient levels. The noise levels from the proposed line would be below levels identified as causing interference with speech or sleep. The audible noise from the transmission line would be below EPA guideline levels and would meet the BPA design criterion that complies with state noise regulations. Similarly the new substations would be designed and constructed to meet BPA design criteria that all federal, state and local regulations be met.

8.0 Electromagnetic Interference

8.1 Basic Concepts

Corona on transmission-line conductors can also generate electromagnetic noise in the frequency bands used for radio and television signals. The noise can cause radio and television interference (RI and TVI). In certain circumstances, corona-generated electromagnetic interference (EMI) can also affect communications systems and other sensitive receivers. Interference with electromagnetic signals by corona-generated noise is generally associated with lines operating at voltages of 345 kV or higher. This is especially true of interference with television signals. The single 1.6-in diameter conductor used in the design of the proposed 230-kV line would mitigate corona generation and keep radio and television interference levels at acceptable levels below those of many existing 230-kV lines with smaller conductors.

Spark gaps on distribution lines and on low-voltage wood-pole transmission lines are a more common source of RI/TVI than is corona from high-voltage electrical systems. This gap-type interference is primarily a fair-weather phenomenon caused by loose hardware and wires. The proposed transmission line would be constructed with modern hardware that eliminates such problems and therefore minimizes gap noise. Consequently, this source of EMI is not anticipated for the proposed line.

No state has limits for either RI or TVI. In the United States, electromagnetic interference from power transmission systems is governed by the Federal Communications Commission (FCC) Rules and Regulations presently in existence (FCC, 1988). A power transmission system falls into the FCC category of "incidental radiation device," which is defined as "a device that radiates radio frequency energy during the course of its operation although the device is not intentionally designed to generate radio frequency energy." Such a device "shall be operated so that the radio frequency energy that is emitted does not cause harmful interference. In the event that harmful interference is caused, the operator of the device shall promptly take steps to eliminate the harmful interference." For purposes of these regulations, harmful interference is defined as: "any emission, radiation or induction which endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radio communication service operating in accordance with this chapter" (FCC, 1988: Vol II, part 15. 47CFR, Ch. 1).

Electric power companies have been able to work quite well under the present FCC rule because harmful interference can generally be eliminated. It has been estimated that more than 95% of power-line sources that cause interference are due to gap-type discharges. These can be found and completely eliminated, when required to prevent interference (USDOE, 1980). Complaints related to corona-generated interference occur infrequently. This is especially true with the advent of cable television and satellite television, which are not subject to corona-generated interference. Mitigation of corona-generated interference with conventional radio and television receivers can be accomplished in several ways, such as use of a directional antenna or relocation of an existing antenna (USDOE, 1977; USDOE, 1980; Loftness et al., 1981).

8.2 Radio Interference (RI)

Radio reception in the AM broadcast band (535 to 1605 kilohertz (kHz)) is most often affected by corona-generated EMI. FM radio reception is rarely affected. Generally, only residences very near to transmission lines can be affected by RI. The IEEE Radio Noise Design Guide identifies an acceptable limit of fair-weather RI as expressed in decibels above 1 microvolt per meter (dBμV/m) of about 40 dBμV/m at 100 ft. (30 m) from the outside conductor (IEEE Committee Report, 1971). As a general rule, average levels during foul weather (when the conductors are wet) are 16 to 22 dBμV/m higher than average fair-weather levels.

8.3 Predicted RI Levels

The predicted median (L_{50}) fair- and foul-weather RI levels at 100 ft. (30 m) from the outside conductor for the proposed line operating at 237 kV are 28 and 45 dBμV/m, respectively. This level will meet the IEEE 40 dBμV/m criterion for fair weather levels at distances greater than about 100 ft. (30 m) from the outside conductor. Predicted fair-weather L_{50} levels are comparable to, or lower than, those for existing 230-kV lines in Oregon..

8.4 Television Interference (TVI)

Corona-caused TVI occurs during foul weather and is generally of concern for transmission lines with voltages of 345 kV or above, and only for conventional receivers within about 600 ft. (183 m) of such a line. As is the case for RI, gap sources on distribution and low-voltage transmission lines are the principal observed sources of TVI. The use of modern hardware and construction practices for the proposed line would minimize such sources. TVI levels are expressed in dBμV/m at 75 MHz.

8.5 Predicted TVI Levels

The foul weather TVI level predicted at 100 ft. (30 m) from the outside conductor of the proposed line is 13 dBμV/m with the line operating at 237 kV. This is considerably below foul-weather TVI levels from existing 500-kV lines (24-27 dBμV/m), where TVI can be a problem.

Other forms of TVI from transmission lines are signal reflection (ghosting) and signal blocking caused by the relative locations of the transmission structure and the receiving antenna with respect to the incoming television signal. The steel pole towers proposed for use in the design of the proposed line are less effective in causing this type of interference than are lattice steel towers. Television systems that operate at higher frequencies, such as satellite receivers, are not affected by corona-generated TVI. Cable television systems are similarly unaffected. The distance between the proposed line route and nearby residences makes this type of interference very unlikely for the proposed line.

Since residences are 0.25 miles or more distant, corona-generated TVI, signal reflection or signal blocking are not anticipated to occur due to the proposed 230-kV line. In the unlikely event that RI or TVI is caused by the proposed line, BPA has a program to identify, investigate, and mitigate legitimate RI and TVI complaints.

8.6 Interference with Other Devices

Corona-generated interference can conceivably cause disruption on other communications bands such as the citizen's (CB) and mobile bands. However, mobile-radio communications are not susceptible to transmission-line interference because they are generally frequency modulated (FM). Similarly, cellular telephones operate at a frequency of 900 MHz or higher, which is above the frequency where corona-generated interference is prevalent. In the unlikely event that interference occurs with these or other communications, mitigation can be achieved with the same techniques used for television and AM radio interference. As digital signal processing has been integrated into communications the potential impact of corona-generated EMI has decreased substantially.

8.7 Conclusion

Predicted EMI levels for the proposed 230-kV transmission line are comparable to, or lower, than those that already exist near 230-kV lines and no impacts of corona-generated interference on radio, television, or other receptors are anticipated. Furthermore, if interference should occur, there are various methods for correcting it: BPA has a program to respond to legitimate complaints.

9.0 Other Corona Effects

Corona is sometimes visible as a bluish glow or as bluish plumes on higher voltage lines. On the proposed 230-kV line, corona levels would be very low, so it is very unlikely that it could be observed. Any corona on the conductors would be observable only under the darkest conditions and only with the aid of binoculars, if at all. Without a period of adaptation for the eyes and without intentional looking for the corona, it would probably not be noticeable.

When corona is present, the air surrounding the conductors is ionized and many chemical reactions take place, producing small amounts of ozone and other oxidants. Ozone is approximately 90% of the oxidants, while the remaining 10% is composed principally of nitrogen oxides. The corona level predicted for the proposed line is much lower than that from 500-kV lines. The levels from 500-kV lines are significantly below natural levels and fluctuations in natural levels. Consequently, any production of ozone from the proposed line would be essentially undetectable at ground level.

10.0 Summary

Electric and magnetic fields from the proposed transmission line have been characterized using well-known techniques accepted within the scientific and engineering community. The expected electric-field levels from the proposed line at minimum design clearance would be comparable to those from existing 230-kV lines in Oregon, and elsewhere. The expected magnetic-field levels from the proposed line would be comparable to those from other 230-kV lines in Oregon, and elsewhere.

The peak electric field expected under the proposed line would be 2.4 kV/m; the maximum value at the edge of the right-of-way would be about 0.3 kV/m. Clearances at road crossings would be increased to reduce the peak electric-field value to 1.2 kV/m or less.

Under maximum current conditions on both circuits, the maximum magnetic fields under the proposed line would be 128 mG; at the edge of the right-of-way of the proposed line the maximum magnetic field would be 24 mG. With only the Biglow Canyon circuit loaded to maximum current the magnetic fields would increase to a maximum of 150 mG on the right-of-way and 44 mG at the edge. Over a year, the magnetic field levels would average to be about 30% of the above levels.

The electric fields from the proposed line would meet regulatory limits for public exposure in Oregon and all other states that have limits and would meet the regulatory limits or guidelines for peak fields established by national and international guideline setting organizations. The magnetic fields from the proposed line would be within the regulatory limits of the two states that have established them and within guidelines for public exposure established by ICNIRP and IEEE. The state of Oregon does not have limits for magnetic fields from transmission lines.

Short-term effects from transmission-line fields are well understood and can be mitigated. Nuisance shocks arising from electric-field induced currents and voltages could be perceivable on the right-of-way of the proposed line. It is common practice to ground permanent conducting objects during and after construction to mitigate against such occurrences.

Corona-generated audible noise from the proposed line could be perceivable during foul weather at the edge of the right-of-way. The levels would be comparable with, or less than, those near existing 230-kV transmission lines in Oregon, and would be in compliance with noise regulations in Oregon, and would be below levels specified in EPA guidelines.

Corona-generated electromagnetic interference from the proposed line would be comparable to or less than that from existing 230-kV lines in Oregon. Radio interference levels would be below limits identified as acceptable. Television interference, a foul-weather phenomenon usually associated with higher voltage lines, is not anticipated to occur from the proposed 230-kV line. If legitimate TVI complaints arise, BPA has a mitigation program.

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Table 1: Alternative routes for proposed Klondike - John Day 500-kV transmission line.

Route	**Description**	**Miles (length)**
North Alternative	Runs northwest from Klondike Substation; due north from the intersection with Old Wasco-Happner Highway; then northwest along Herrin Road to the John Day Substation.	12.0
Middle Alternative	Runs northwest from the Klondike Substation; due north to Medler Road; west along Medler Road; then north and westa nd north again along property lines to the John Day Substation.	12.5

Table 2: Physical and electrical characteristics of the proposed Klondike - John Day double-circuit 230-kV transmission-line. See Table 1 for descriptions of alternative routes and Figure 1 for physical layout of line.

Klondike - John Day 230-kV Double-circuit	
Voltage, kV Maximum/Average[1]	242/237
Peak current, A **Biglow Canyon circuit**[2] **Klondike circuit**	 974 (1462) 731
Electric phasing (north –- south)	C A B B A C
Clearance, ft. Minimum/Average[1]	26.5/38.5
Tower configuration	Vertical DC
Phase spacing, ft.[3]	19/31 H, 18 V
Conductor: #/diameter, in	1/1.6

1 Average voltage and average clearance used for corona calculations.
2 Maximum current will increase to 1462 A with addition of Orion project load.
3 H = horizontal feet; V = vertical feet

Table 3: Calculated peak and edge-of-right-of-way electric fields for the proposed Klondike - John Day 230-kV line operated at maximum voltage.

Location	Electric Field, kV/m	
Line Clearance	Minimum	Average
Peak	2.4	1.1
Edge-of-ROW	0.3	0.2

Table 4: Calculated peak and edge-of-right-of-way magnetic fields for the proposed Klondike - John Day 230-kV line operated at maximum current. Average fields would be 30% of table values.

Location	Magnetic Field, mG	
Line Clearance	Minimum	Average
Peak	128	57
Edge-of-ROW[1]	24/12	19/10

[1] Higher value is at edge of right-of-way adjacent to circuit with Biglow Canyon load.

Table 5: States with transmission-line field limits

STATE AGENCY	WITHIN RIGHT-OF-WAY	AT EDGE OF RIGHT-OF-WAY	COMMENTS
a. 60-Hz ELECTRIC-FIELD LIMIT, kV/m			
Florida Department of Environmental Regulation	8 (230 kV) 10 (500 kV)	2	Codified regulation, adopted after a public rulemaking hearing in 1989.
Minnesota Environmental Quality Board	8	—	12-kV/m limit on the high-voltage direct-current (HVDC) nominal electric field.
Montana Board of Natural Resources and Conservation	7[1]	1[2]	Codified regulation, adopted after a public rulemaking hearing in 1984.
New Jersey Department of Environmental Protection	—	3	Used only as a guideline for evaluating complaints.
New York State Public Service Commission	11.8 (7,11)[1]	1.6	Explicitly implemented in terms of a specified right-of-way width.
Oregon Facility Siting Council	9	—	Codified regulation, adopted after a public rulemaking hearing in 1980.
b. 60-Hz MAGNETIC-FIELD LIMIT, mG			
Florida Department of Environmental Regulation	—	150 (230 kV) 200 (500 kV)	Codified regulations, adopted after a public rulemaking hearing in 1989.
New York State Public Service Commission	—	200	Adopted August 29, 1990.

[1] At road crossings
[2] Landowner may waive limit

Sources: TDHS Report, 1989; TDHS Report, 1990

Table 6: Common noise levels

Sound Level, dBA	Noise Source or Effect
128	Threshold of pain
108	Rock-and-roll band
80	Truck at 50 ft.
70	Gas lawnmower at 100 ft.
60	Normal conversation indoors
50	Moderate rainfall on foliage
49	Edge of proposed 500-kV right-of-way during rain (no parallel lines)
40	Refrigerator
25	Bedroom at night
0	Hearing threshold

Adapted from: USDOE, 1996.

Table 7: Predicted foul-weather and fair-weather audible noise (AN) levels at edge of right-of-way (ROW) for the proposed Klondike - John Day 230-kV line. AN levels expressed in decibels on the A-weighted scale (dBA). L_{50} and L_5 denote the levels exceeded 50 and 5 percent of the time, respectively.

Edge of Right-of-Way Audible Noise		
Descriptor	**L_{50}, dBA**	**L_5, dBA**
Foul weather	42	46
Fair weather	17	21

Figure 1: Configuration for the proposed Klondike – John Day 230-kV transmission line. Routes and configuration are described in Tables 1 and 2.

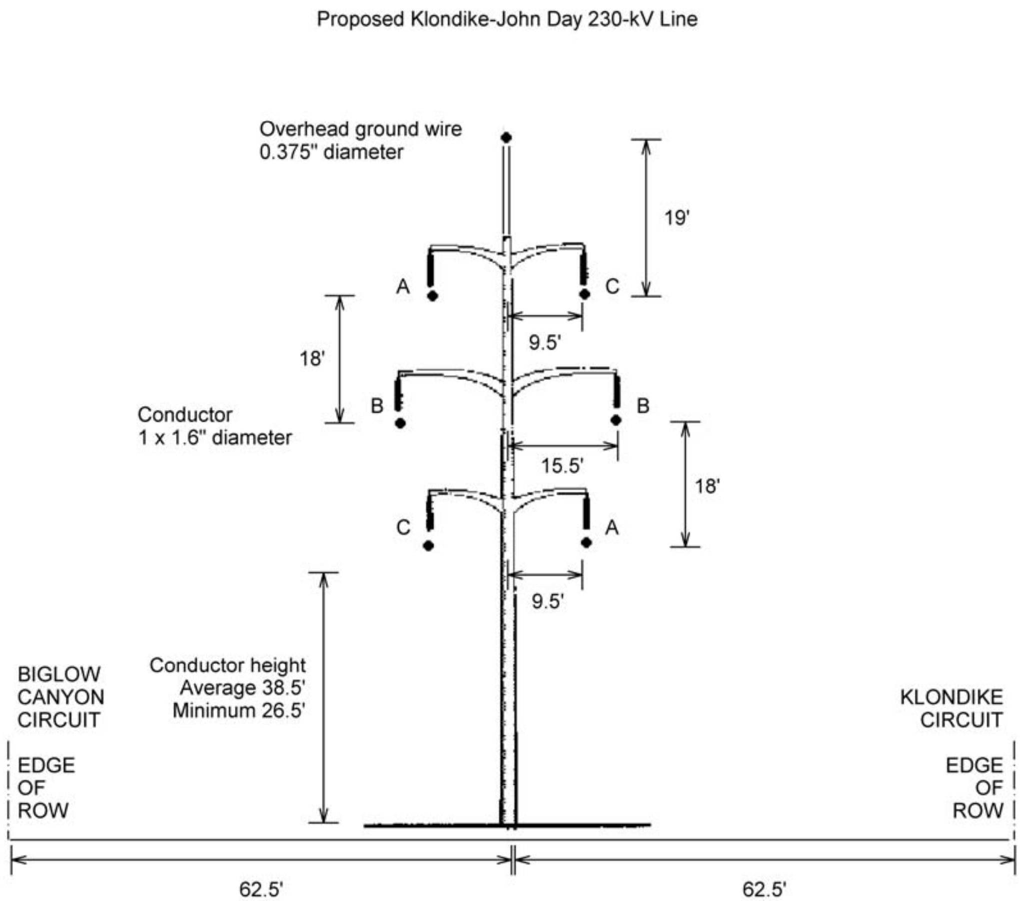


Figure 2: Electric-field profiles for the proposed Klondike – John Day 230-kV transmission line under maximum voltage conditions. Configuration is described in Table 2.

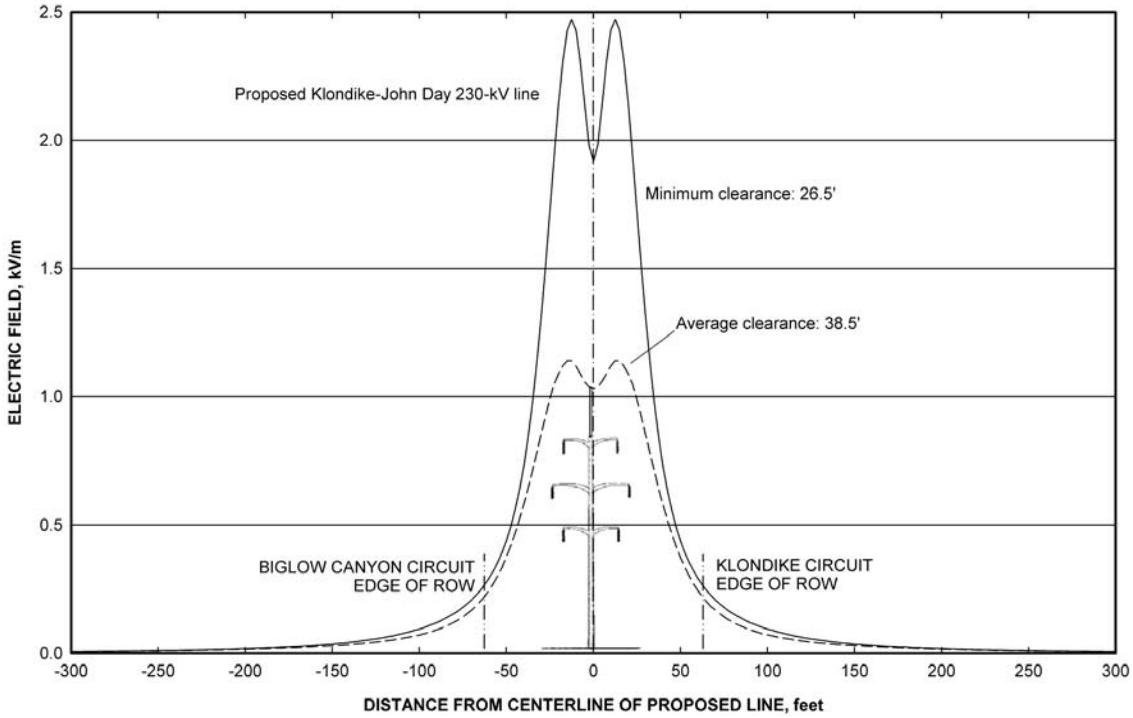


Figure 3: Magnetic-field profiles for the proposed Klondike – John Day 230-kV transmission line under maximum current conditions. Configuration is described in Table 2.

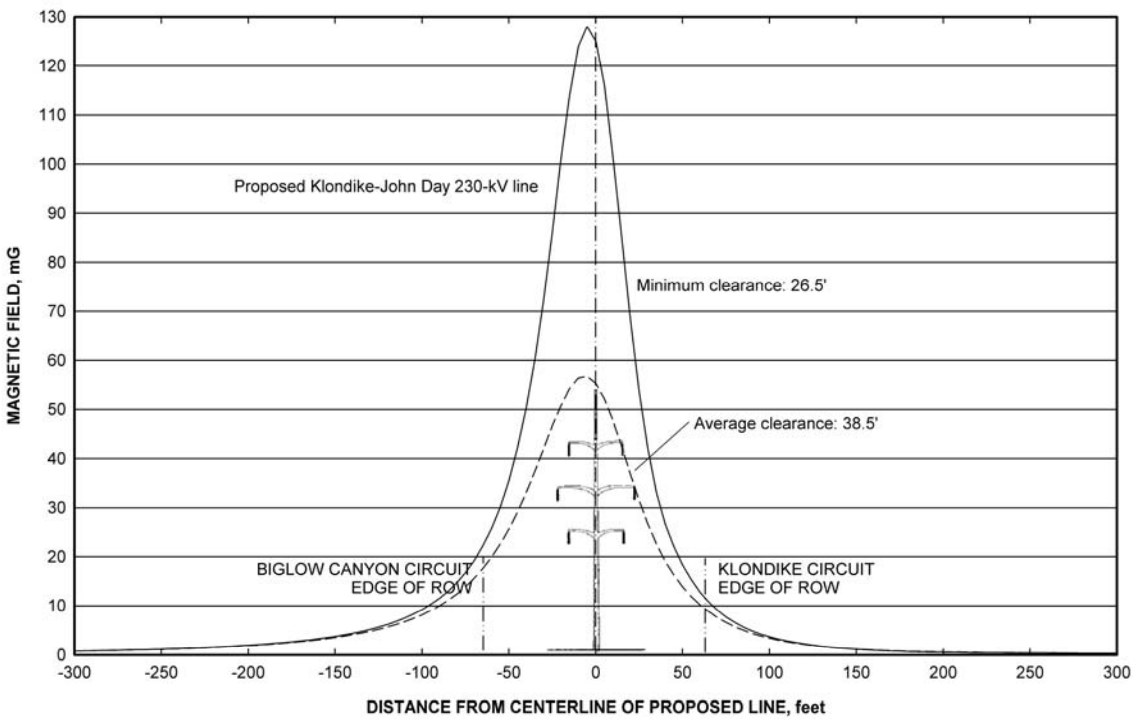
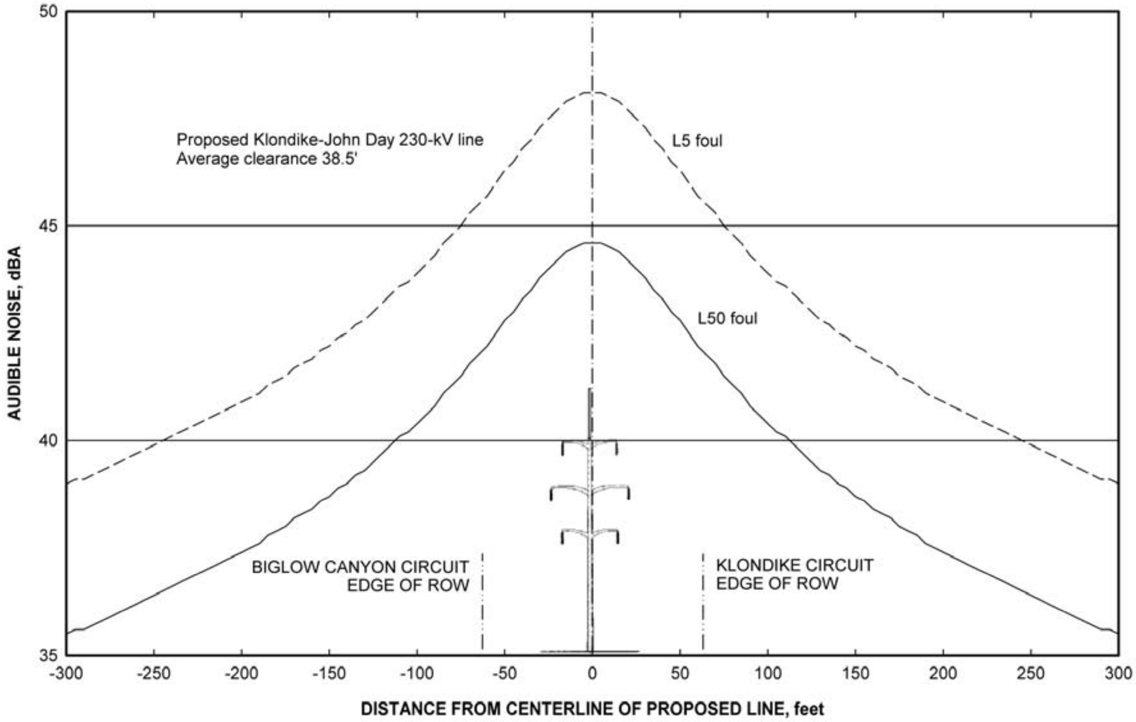


Figure 4: Predicted foul-weather L_{50} audible noise levels for the proposed Klondike - John Day 230-kV transmission line. Configuration is described in Table 2.



Appendix D Assessment Of Research Regarding EMF And Health And Environmental Effects

KLONDIKE III/BIGLOW CANYON WIND INTEGRATION PROJECT

APPENDIX D:

ASSESSMENT OF RESEARCH REGARDING EMF AND HEALTH AND ENVIRONMENTAL EFFECTS

MARCH 2006

Prepared by

Exponent

for

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and

Bonneville Power Administration

Table of Contents

1 Introduction

Over the last 25 years, research has been conducted in the United States (U.S.) and around the world to examine whether exposures to electric and magnetic fields (EMF) at 50/60 Hertz (Hz) have health or environmental effects. EMF is produced by both natural and man-made sources that surround us in our daily lives. They are found throughout nature and in our own bodies. The earth itself produces a static (0 Hz) magnetic field – this is the field that is used for compass navigation. Electricity provided to homes and offices produces EMF that changes direction and intensity 60 times per second - a frequency of 60 Hertz (Hz). Fields at this frequency are quite different from higher frequency electromagnetic fields such as radio and television signals, microwaves from ovens, cellular phones, and radar (which can have frequencies up to billions of Hz). Man-made EMF is found wherever electricity is generated, delivered, or used. Power lines, wiring in homes, workplace equipment, electrical appliances, and motors produce EMF.

One of the most important characteristics of electric and magnetic fields is that their strength diminishes as you move away from the source. This is similar to the way that the heat from a candle or campfire will diminish as you move away. Although ordinary objects do not block magnetic fields, they can be shielded by using special materials and techniques. In contrast, intervening objects, especially those that can conduct electricity, can reduce electric fields. For example, a typical house may block up to 90% of the electric field from outside sources. Scientific research on people has focused on magnetic fields since objects such as trees, walls, etc. easily shield electric fields.

Epidemiology studies have largely addressed many issues that have been raised about EMF and health. There is an overwhelming consensus in the scientific community, as expressed in multidisciplinary reviews, that the epidemiologic evidence is insufficient to demonstrate a causal relationship between extremely low frequency (ELF) -EMF and any health effect (NIEHS, 1998; NIEHS, 1999; HCN, 2001; NRPB, 2001; IARC, 2002; HCN, 2004; NRPB, 2004). Laboratory studies have not shown a biological mechanism for the development of cancer, including leukemia.

The Bonneville Power Administration (BPA) requested Exponent to update BPA on scientific research conducted on EMF and health and environmental effects in relation to exposures that might occur near the Klondike Wind Transmission Line Project. This update concentrates on recent major research studies to explain how they contribute to the assessment of effects of EMF on health (Section 2). The focus is on both epidemiologic and laboratory research, because these research approaches provide different and complementary information for determining whether an environmental exposure can affect human health. Section 3, Ecological Research, reviews studies of potential effects of EMF on plants and animals in the natural environment. This update includes studies of experimental, residential or environmental exposures to EMF that became available through June 2005.

2 Health

2.1 The NIEHS Report and Research Program

In 1998, the National Institute of Environmental Health Sciences (NIEHS) completed a comprehensive review of the scientific research on health effects of EMF. The NIEHS directed a research program that Congress funded in 1992 in response to questions regarding exposure to EMF from power sources. The program was known as the EMF RAPID Program (Research and Public Information Dissemination Program). The NIEHS convened a panel of scientists (the “Working Group”) to review and evaluate the

RAPID Program research and other research. Their report, *Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields*, was completed in July 1998 (NIEHS, 1998).

In June 1999, the director of the NIEHS prepared a health risk assessment of EMF and submitted it to Congress (NIEHS, 1999). Experts at NIEHS, who had considered a previous Working Group report, reports from four technical workshops, and research that became available after June 1998, concluded as follows:

> The scientific evidence suggesting that ELF-EMF [extremely low frequency-electric and magnetic field] exposures pose any health risk is weak. The strongest evidence for health effects comes from associations observed in human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults. . . . In contrast, the mechanistic studies and animal toxicology literature fail to demonstrate any consistent pattern. . . . No indication of increased leukemias in experimental animals has been observed. . . . The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to ELF-EMF, but it cannot completely discount the epidemiology findings. . . . The NIEHS does not believe that other cancers or other non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern (NIEHS, 1999: 9-10). (N.B. full quote in Table 1.)

Although the results of the RAPID research are described in some detail in the 1998 report, some of the studies had not been published in the peer-reviewed literature. Recognizing the need to have these results reviewed and considered for publication, the NIEHS arranged for this research to be published in a peer reviewed special edition of the journal *Radiation Research* (e.g., Balcer-Kubiczek et al., 2000; Boorman et al., 2000a; Boorman et al., 2000b; Loberg et al., 2000; Ryan et al., 2000).

2.2 Research Related to Cancer

To assess the potential health effects from any exposure, data from several types of studies, including non-experimental, epidemiologic observations of people, and experimental studies on animals, humans, and tissues in laboratory settings, must be critically evaluated.

Epidemiology is the study of diseases and their causes in the human population. Epidemiology studies are observational in that they examine and analyze people in their normal daily life. Such studies are designed to quantify and evaluate the associations between exposures to environmental factors (e.g., vegetables in the diet) and health outcomes (e.g., coronary artery disease). Epidemiologic studies can help suggest risk factors that may contribute to a disease risk, but they usually cannot be used as the sole basis for drawing inferences about cause-and-effect relationships, and they usually only provide information on a limited range of exposures.

In contrast to epidemiology studies, laboratory or experimental studies are conducted under controlled laboratory conditions. Experimental studies designed to test specific hypotheses under controlled conditions are generally required to establish cause-and-effect relationships. Conversely, the results of experimental studies, particularly of isolated tissues or cells, by themselves may not always be directly extrapolated to human populations. It is therefore both necessary and desirable that biological responses to agents that could present a potential health threat be explored by epidemiologic methods in human populations, as well as by experimental studies in the research laboratory.

Toxicology is an important part of laboratory research designed to evaluate the potential beneficial or harmful effects of an agent (e.g., a chemical or a magnetic field). The goal of toxicology studies is to identify the nature of effects that result from exposure and the dose of the agent in the target tissue that elicits that effect. A most critical distinction, therefore, must be made between harmless biological responses or effects, and those that are truly adverse or deleterious. Many agents produce biological responses in organisms—like the response of the eye to light or the influence of food and water on growth and cellular metabolism—at quite low concentrations or intensities. Hence, the mere demonstration of a biological response or effect does not indicate that an exposure to an agent is hazardous *per se*. Rather, it is imperative to ascertain whether biological responses are deleterious or innocuous, and to establish what, if any, exposure concentrations may be toxic and under what conditions.

2.2.1 Epidemiology Studies of Children

Research on EMF in residential settings and health was prompted by an epidemiology study of children exposed to EMF, mostly from neighborhood distribution lines in the U.S. (Wertheimer and Leeper, 1979). Because the source of the fields was low voltage distribution lines, not high voltage transmission lines the assumption has been that the relevant exposure associated with power lines is the magnetic field, rather than the electric field. This assumption rests on the fact that electric fields are shielded from the interior of homes (where people spend the vast majority of their time) by walls and vegetation, while magnetic fields are not. Subsequent studies have largely addressed almost all issues that have been raised about EMF and health. Summaries of two of the largest and most comprehensive studies of EMF and childhood leukemia are provided below. Both groups of investigators concluded that their data provided little evidence for an association of magnetic fields with leukemia in children.

Epidemiologic studies report results in the form of statistical associations. The term “statistical association” is used to describe the tendency of two things to be linked or to vary in the same way, such as level of exposure and occurrence of disease. However, statistical associations are not automatically an indication of *cause and effect*, because the interpretation of numerical information depends on the context, including (for example) the nature of what is being studied, the source of the data, how the data were collected, and the size of the study. The larger studies and more powerful studies of EMF have not reported convincing statistical associations between power lines and childhood leukemia (e.g., Linet et al., 1997; McBride et al., 1999; UKCCS, 1999; UKCCS, 2000). However, despite the larger sample size, these studies had a limited number of cases exposed over 4 milligauss (mG).

The National Cancer Institute (NCI) — The NCI completed a large and comprehensive study of childhood leukemia in the US in 1997. This study compared exposure to magnetic fields in children who did not have cancer to the exposure of those who had acute lymphocytic leukemia (ALL), the most common form of leukemia in children (Linet et al., 1997). The major advantage of this study was the short time between exposure assessment and diagnosis compared to previous studies, and the assessment of exposure by a variety of methods. In addition, the investigators obtained magnetic field measurements from multiple rooms in each child’s home, which included magnetic field exposures from household appliances. No association was found between ALL and the wiring configuration code at the residences occupied by the children before they had cancer. The researchers observed a statistical association between leukemia and magnetic field levels in the category 4.0 – 4.99 mG, but not for time weighted average (TWA) exposures less than 4 mG or for exposures greater than or equal to 5 mG, the highest exposure category. There was no overall trend for a stronger association with increased exposure. Further analyses indicated that distance from high-voltage lines and other exposure indexes were not related to risk for ALL (Kleinerman et al., 2000).

United Kingdom Childhood Cancer Study (UKCCS) — The largest childhood cancer study of magnetic fields to date was completed in the United Kingdom (UK) in 2000. The UKCCS investigators reported on magnetic field measurements on a portion of the cases and controls evaluated in a previous study (UKCCS, 1999). To obtain additional information, they used a method to assess exposure to magnetic fields without entering homes (UKCCS, 2000) and were able to analyze 50% more subjects (a total of 1,331 ALL cases). For all these children, they measured distances to power lines and substations.

This information, combined with data on historical current flow, was used to calculate the magnetic field from these external field sources, based on power line characteristics related to production of magnetic fields. The results of the second UKCCS study showed no evidence for an association with leukemia for magnetic fields calculated to be between 1 mG – 2 mG, 2 mG – 4 mG, or 4 mG or greater at the residence, which is consistent with the results of the earlier report in which magnetic field exposure was estimated by measurement (UKCCS, 1999). Children with leukemia are not more likely to live near distribution, high-voltage power lines or substations than control children. A more recent study of distance from transmission lines reported a weak association with childhood leukemia but not tumors of other tissues (central nervous system/brain, other) but the association was present at distances where no magnetic field would be measured (Draper et al, 2005).

Researchers have proposed that the associations that are sometimes reported between childhood leukemia and power lines might be due to other factors that can confound the analysis (other risk factors for disease that may distort the analysis). One example is heavy traffic, which may occur near power lines and can increase the levels of potentially carcinogenic chemicals in the area. Earlier studies had reported associations between traffic density and childhood cancer (Savitz et al., 1988). If power lines were more common in areas that had higher traffic density, then the increased air pollution might explain an association between power lines and childhood cancer. A recent study by Knox et al. (2005) reported stronger associations between exposures to sources of benzene, 1,3 butadiene, benzo(a)pyrene, and dioxins and childhood leukemia. These exposures should be included in future epidemiology studies of childhood leukemia (Steffen et al., 2004; Knox et al., 2005).

Meta-analyses of Studies of Leukemia

In 2000, researchers reanalyzed the data from previous epidemiology studies of magnetic fields and childhood leukemia that met specified criteria (Ahlbom et al., 2000; Greenland et al., 2000). In each of these analyses, the researchers pooled the data on individuals from each of the studies, creating a study with a much larger number of subjects and therefore greater statistical power than any single study. These meta-analyses focused on studies that assessed exposure to magnetic fields using 24-hour measurements or calculations based on the characteristics of the power lines and current load. Ahlbom et al. combined 9 studies; Greenland et al. used 12 studies, 8 of which were the same as used by Ahlbom. Both studies included ALL as well as other forms of leukemia. Neither Greenland et al. nor Ahlbom et al. included data from the recent, very large study from the UK (UKCCS, 2000), Greenland also did not include results from UKCCS (1999). The statistical results of these analyses can be summarized as follows:

- The pooled analyses provided no indication that wire codes[1] are more strongly associated with leukemia than measured magnetic fields.
- Pooling these data corroborates an absence of an association between childhood leukemia and magnetic fields for exposures below 3 mG.
- Pooling these data results in a statistical association with leukemia for exposures greater than 3-4 mG.

[1] Wire Codes are a surrogate for magnetic field exposure, based on the diameter or thickness of the wire and its distance from the residence.

It is important to note that the information from these pooled analyses is not new because, for many years, epidemiologic studies and reviews have suggested an association between magnetic fields and childhood leukemia. Previous reviews based on fewer studies had suggested an association of magnetic fields with childhood leukemia at time-weighted average exposure levels as low as 2 mG; however, an association is *not* present for exposures below about 3 to 4 mG. Average magnetic fields above 3 mG in residences are estimated to be rather rare, about 3% in the US (Zaffanella, 1993). The authors are appropriately cautious in the interpretation of their analyses and they clearly identify the limitations in their evaluation of the original studies (e.g., small sample size, uncertainty related to pooling estimates of exposure obtained by different methods from studies of diverse design).

Wartenberg (2001) published a different type of meta-analysis of data from epidemiologic studies of childhood leukemia studies. He used 19 studies overall, including the UKCCS (1999) study. This meta-analysis did not have the advantage of obtaining and pooling the data on all of the individuals in the studies, unlike those published before it (Ahlbom et al., 2000; Greenland et al., 2000). Rather than using individual data from each of the individual studies, Wartenberg used an approach based on the results from several published studies, which were reported as grouped data. No statistically consistent results in this meta-analysis were found. He reported a weak association for a) "proximity to electrical facilities" based on wire codes or distance, and b) magnetic-field level over 2 mG, based on either calculations from wiring and loading characteristics (if available) or on spot magnetic-field measurements. There are several limitations of the Wartenberg meta-analysis. The author concludes that the analysis supports an association, however, few scientifically significant odds ratios were found, and as he notes, "limitations due to design, confounding, and other biases may suggest alternative interpretations" (p 100).

2.2.2 Epidemiology Studies of Adults

Studies of occupational exposure have been conducted because these populations are presumed to have high exposure to EMF. Occupational studies have varied greatly in the methods used to estimate exposure (e.g., type of industry, exposure based only on job titles, direct electric and magnetic field measurements), study design (e.g., retrospective cohort studies based on death records, case-control studies with direct magnetic field measurements) and source of exposure to EMF (e.g., specific occupations i.e., railway workers, electricity generation and transmission industry or multiple industries). Recent studies have greatly improved estimates of EMF exposures. Occupational studies published through 2002 are described in the International Agency for Research on Cancer (IARC) monographs (IARC, 2002). No consistent relationship between residential and occupational exposures to magnetic or electric fields has been found for any type of cancer in adults, including leukemia, and types of cancer affecting the brain and breast (Gammon et al., 1988; Kheifets et al., 1999; Wrensch et al., 1999; Laden et al., 2000; Zheng et al., 2000; Davis et al., 2002; London et al., 2003; Schoenfeld et al., 2003; Forssen et al., 2005).

2.2.3 Laboratory Studies of EMF

Laboratory studies complement epidemiologic studies of people because the effects of heredity, diet, and other health-related exposures of animals can be better controlled or eliminated. The assessment of EMF and health, as for any other exposure, includes chronic, long-term studies in animals (*in vivo* studies) and studies of changes in genes or other cellular processes observed in isolated cells and tissues in the laboratory (*in vitro*).

Although the results of the RAPID Program were described in some detail in the NIEHS reports (NIEHS, 1998), many of the studies had not been published in the peer-reviewed literature. The RAPID research program included studies of four biological effects, each of which had previously been observed in only one laboratory. These effects are as follows: effects on gene expression, increased intracellular calcium in a human cell line, proliferation of cell colonies on agar, and increased activity of the enzyme ornithine decarboylase (ODC). Some scientists have suggested that these biological responses are signs of possible adverse health effects of EMF. It is standard scientific procedure to attempt to replicate results in other laboratories, because artifacts and investigator error can occur in scientific investigations. Replications, often using more experiments or more rigorous protocols, help to ensure objectivity and validity. Attempts at replication can substantiate and strengthen an observation, or they may discover the underlying reason for the observed response.

Studies in the RAPID program reported no consistent biological effects of EMF exposure on gene expression, intracellular calcium concentration, growth of cell colonies on agar, or ODC activity (Boorman et al., 2000b). For example, Balcer-Kubiczek et al. (2000) and Loberg et al. (2000) studied the expression of hundreds of cancer-related genes in human mammary or leukemia cell lines. They found no increase in gene expression with increased intensity of magnetic fields. To test the experimental procedure, they used X-rays and treatments known to affect the genes (chemical and hyperthermia). These are known as positive controls and, as expected, caused gene expression in exposed cells.

Scientists have concluded that the combined animal bioassay results provide no evidence that magnetic fields cause, enhance, or promote the development of cancer including leukemia and lymphoma, or mammary cancer (e.g., Boorman et al., 1999; McCormick et al., 1999; Boorman et al., 2000a,b; Anderson et al., 2001; IARC, 2002; NRPB 2001; McLean et al., 2003; Sommer and Lerchl, 2004).

2.2.4 Summary Regarding Cancer

Epidemiology studies do not support the hypothesis that EMF from power lines increase the risk of cancers in adults. The latest epidemiologic studies of childhood cancer, considered in the context of laboratory data, provide no persuasive evidence that leukemia in children is causally associated with magnetic fields measured at the home, calculated magnetic fields based on distance and current loading, or wire codes. Recent meta-analyses reported no association between childhood cancer and magnetic fields below 2 or 3 mG. Although some association was reported for fields above this level, fields at most residences are likely to be below 3 or 4 mG. The authors of each of these analyses list several biases and problems that render the data inconclusive and prevent resolution of the inconsistencies in the epidemiologic data. For this reason, laboratory studies can provide important complementary information. Large, well-conducted animal studies and studies of initiation and promotion, provide no basis to conclude that EMF increases leukemia, lymphoma, breast, brain, or any other type of cancer.

2.3 Research Related to Reproduction

Several epidemiology studies have examined effects of exposures to magnetic fields on pregnancy, including miscarriages (spontaneous abortion). They reported no association with birth weight, birth defects, or fetal growth retardation after exposure to sources of relatively strong magnetic fields such as electric blankets, or sources of typically weaker magnetic fields such as power lines (Bracken et al., 1995; Belanger et al., 1998; Lee et al., 2000; Blaasaas et al., 2002; Blaasaas et al., 2003; Blaasaas et al., 2004).

Two studies of EMF and miscarriage reported a positive association between miscarriage and exposure to high maximum, or instantaneous, peak magnetic fields (Li et al., 2002; Lee et al., 2002). However, no reliable associations were found with higher average magnetic field levels during the day, the typical way of assessing exposure. Neither study found that miscarriage was associated with residential wiring codes, another method presumed to identify higher magnetic fields from power lines. There are several possible issues to be considered in assessing whether these statistical associations with the maximum magnetic field exposure during the day are possibly causal in nature (Feychting et al., 2005; Mezei et al., 2005). First, the studies include possible biases. For example, each of the studies had a low response rate, which means that the study groups may not be comparable because those who participated in the studies may have differed from those who declined (selection bias). Second, these studies found no reliable association with higher daily average exposure, that is, the average of the measurements recorded throughout the day. Third, despite years of research, there is no biological basis to indicate that EMF increases the risk of miscarriage.

In summary, the recent evidence from epidemiology and laboratory studies do not support that exposure to power-frequency EMF has an adverse effect on reproduction, pregnancy, or growth and development of the embryo. The results of these recent studies are not sufficiently persuasive to change the conclusions of the NIEHS.

2.4 Implanted Medical Devices and EMF

Advances in technology have led to the development of more medical devices that can be implanted to maintain or enhance organ function. Of these devices, most concern has focused on potential interference to cardiac pacemakers and defibrillators. A cardiac pacemaker monitors the electrical activity of the heart. If the heart fails to beat, the pacemaker administers a small stimulus to trigger the 'missing' beats. An implanted cardiac defibrillator (ICD) similarly monitors the electrical activity of the heart but is designed to block disorganized contractions of the heart (arrhythmias) by administering a strong electrical shock to restore normal heart rhythms. Exposure to electric and magnetic fields could affect the function of these devices if induced signals on sensing leads are interpreted as natural cardiac activity (Griffin, 1986; CCOHS, 1988; Barold et al., 1991). However, the opportunities for exposure and interference from power lines are lower than for contact with ordinary household appliances.

Although scientific studies report that exposure to power frequency electric and magnetic fields have not resulted in adverse responses to patients with pacemakers, the possibility cannot be completely ruled out. In order to reduce potential effects of environmental exposure to electrical and magnetic fields, the Center for Devices and Radiological Health of the U.S. Food and Drug Administration (FDA) has developed guidelines for both the development of pacemakers and the design of new electrical devices to minimize susceptibility to electrical interference from any source. Pacemakers today are designed to filter out electrical stimuli from sources other than the heart, e.g., muscles of the chest, currents encountered from touching household appliances, or currents induced by electric or magnetic fields. Used in both temporary and permanent pacemakers, these electrical filters increase the pacemaker's ability to distinguish extraneous signals from legitimate cardiac signals (Toivonen et al., 1991). Most circuitry of pacemakers is encapsulated by titanium metal, which insulates the device by shielding the pacemaker's pulse generator from electric fields. Some may also be programmed to automatically pace the heart if interference from electric and magnetic fields is detected. This supports cardiac function and allows the subject to feel the pacing and move away from the source.

Due to recent design improvements, many pacemakers in use would not be particularly susceptible to low intensity electrical fields. There remains a very small possibility that some pacemakers, particularly those of older designs, and with single-lead electrodes, may sense potentials induced on the electrodes and leads of the pacemaker and provide unnecessary stimulation to the heart. In persons wearing some types or brands of implanted cardiac pacemakers, the pacing of the heart might be affected by electric fields at field intensities above about 2 kV/m. The sensitivity of ICD's to external 60-Hz fields has not been studied but might be expected to be somewhat lower than for pacemakers. The ACGIH (American Conference of Governmental Industrial Hygienists, 2001) recommends that routine occupational exposure of persons with cardiac pacemaker and similar medical electronic devices should not exceed 1 kV/m and 1000 mG (0.1 mT).

2.5 Weight-of-the-Evidence Conclusions by Multidisciplinary Groups

Numerous organizations responsible for health decisions, including national and international organizations have convened groups of scientists to review the body of EMF research. These expert groups, including the NIEHS, the IARC, the National Radiological Protection Board of Great Britain (NRPB), and the Health Council of the Netherlands (HCN), have included dozens of scientists with diverse skills that reflect the different research approaches required to answer questions about health.

2.5.1 The IARC Working Group

Based upon the review of the epidemiologic and laboratory animal studies and consideration of other supplementary data, the IARC Working Group concluded that the epidemiologic studies do not provide support for an association between childhood leukemia and residential magnetic fields at intensities less than 4 mG. The IARC Working Group concluded that the EMF data do not merit the category "carcinogenic to humans" or the category "probably carcinogenic to humans," nor did it find that "the agent is probably not carcinogenic to humans." The latter classification has been applied to only a single chemical among more than 895 exposures evaluated by IARC. Overall, magnetic fields were evaluated as "possibly carcinogenic to humans" (Group 2B), based solely upon "limited evidence" for a statistical association of higher-level residential magnetic fields with childhood leukemia. The Working Group also evaluated the animal data and concluded that they were "inadequate" to support a risk for cancer.

In the rating system used by IARC, the recognition of an association between exposure and cancer in epidemiology studies is considered "limited evidence" of carcinogenicity. A rating of "limited evidence" for epidemiology studies, even without any evidence from experimental studies that an exposure might pose a cancer risk, requires that the exposure be categorized as a "possible carcinogen" even though chance, bias and confounding cannot be ruled out as the explanation with reasonable confidence (IARC, 2002).

The evidence for EMF was insufficient to establish a causal relationship between magnetic fields and childhood leukemia because there was neither sufficient evidence from epidemiology studies that magnetic fields caused cancer in humans, nor sufficient evidence that magnetic fields caused cancer in experimental studies of animals. In addition, no strong evidence is available to suggest a biological mechanism for the development of cancer. IARC noted that many hypotheses have been suggested to explain possible carcinogenic effects of electric or magnetic fields; however, no scientific explanation for the potential carcinogenicity of these fields has been established (IARC, 2002).

2.5.2 Conclusions of Other Multidisciplinary Review Panels

The conclusions from several other national and international organizations including the NIEHS (NIEHS, 1998; NIEHS, 1999), the National Academy of Sciences (NAS, 1999), the NRPB (NRPB, 2001; NRPB, 2004), and the HCN (HCN, 2001; HCN, 2004) are listed in Table 1. These organizations assembled large (7-31 members) multidisciplinary teams of scientists to review the literature.

The assessments by IARC, the NIEHS, the NAS, the NRPB, and the HCN agree that there is little evidence suggesting that EMF is associated with adverse health effects, including most forms of adult and childhood cancer, heart disease, Alzheimer's disease, depression, and reproductive effects. However, all of the assessments concluded that epidemiology studies *in total* suggest an association between magnetic fields at higher time-weighted average exposure levels (greater than 4 mG) and childhood leukemia. All agree that the experimental laboratory data do not support a causal link between EMF and any adverse health effect, including leukemia, and have not concluded that EMF is, in fact, the cause of any disease.

Table 1. Conclusions of Large Multidisciplinary Review Groups Assembled by Health Agencies and Scientific Organizations

Agency or Scientific Organization	Conclusions
National Institute of Environmental Health Sciences (NIEHS, 1999)	"The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak. The strongest evidence for health effects comes from associations observed in human populations with two forms of cancer: childhood leukemia and chronic Lymphocytic leukemia in occupationally exposed adults. While the support from individual studies is weak, the epidemiological studies demonstrate, for some methods of measuring exposure, a fairly consistent pattern of a small, increased risk with increasing exposure that is somewhat weaker for chronic lymphocytic leukemia than for childhood leukemia. In contrast, the mechanistic studies and the animal toxicology literature fail to demonstrate any consistent pattern across studies although sporadic findings of biological effects have been reported. No indication of increased leukemias in experimental animals has been observed. The lack of connection between the human data and the experimental data (animal and mechanistic) severely complicates the interpretation of these results. The human data are in the "right" species, are tied to "real life" exposures and show some consistency that is difficult to ignore. This assessment is tempered by the observation that given the weak magnitude of these increased risks, some other factor or common source of error could explain these findings. However, no consistent explanation other than exposure to ELF-EMF has been identified. Epidemiological studies have serious limitations in their ability to demonstrate a cause and effect relationship whereas laboratory studies, by design, can clearly show that cause and effect are possible. Virtually all of the laboratory evidence in animals and humans and most of the mechanistic work done in cells fail to support a causal relationship between exposure to ELF-EMF at environmental levels and changes in biological function or disease status. The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to ELF-EMF, but it cannot completely discount the epidemiological findings. The NIEHS concludes that ELF-EMF exposure cannot be recognized at this time as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In my opinion, the conclusion of this report is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or noncancer health outcomes provide sufficient evidence of a risk to currently warrant concern."
National Academy of Sciences NAS, 1999	"An earlier Research Council assessment of the available body of information on biologic effects of power-frequency magnetic fields (NRC 1997) led to the conclusion 'that the current body of evidence does not show that exposure to these fields presents a human health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produces cancer, adverse neurobehavioral effects, or reproductive and developmental effects'. The new, largely unpublished contributions of the EMF-RAPID program are consistent with that conclusion. We conclude that no finding from the EMF-RAPID program alters the conclusions of the previous NRC review on the Possible Effects of Electromagnetic Fields on Biologic Systems (NRC 1997). In view of the negative outcomes of EMF-RAPID replication studies, it now appears even less likely that MFs [magnetic fields] in the normal domestic or occupational environment produce important health effects, including cancer."

Agency or Scientific Organization	Conclusions
National Radiological Protection Board of Great Britain (NRPB, 2001)	"Laboratory experiments have provided no good evidence that extremely low frequency [ELF] electromagnetic fields are capable of producing cancer, nor do human epidemiological studies suggests that they cause cancer in general. There is, however, some epidemiological evidence that prolonged exposure to higher levels of power frequency magnetic fields is associated with a small risk of leukemia in children. In practice, such levels of exposure are seldom encountered by the general public in the UK [or in the US]."
(NRPB, 2004)	Because of the uncertainty… and in absence of a 'dose-response' relationship, NRPB has concluded that the data concerning childhood leukemia cannot be used to derive quantitative guidance on restricting exposure."
Health Council of the Netherlands (HCN, 2001)	"Because the association is only weak and without a reasonable biological explanation, it is not unlikely that it [an association between ELF exposure and childhood leukemia] could also be explained by chance… The committee therefore sees no reason to modify its earlier conclusion that the association is not likely to be indicative of a causal relationship."
(HCN, 2004)	"The Committee, like the IARC itself, points out that there is no evidence to support the existence of a causal relationship here. Nor has research yet uncovered any evidence that a causal relationship might exist."
International Agency for Research on Cancer (IARC, 2002)	"Studies in experimental animals have not shown a consistent carcinogenic or co-carcinogenic effects of exposures to ELF [extremely low frequency] magnetic fields, and no scientific explanation has been established for the observed association of increased childhood leukaemia risk with increasing residential ELF magnetic field exposure." IARC categorized EMF as a "possible carcinogen" for exposures at high levels, based on the meta-analysis of studies of statistical links with childhood leukemia at levels above 3-4 mG.

2.6 Standards and Guidelines

There are no state or federal standards for limiting exposure to power frequency (60 hertz) magnetic fields based on health effects. However, two states, Florida and New York, have enacted standards to limit magnetic fields at the edge of rights-of-way from transmission lines (150 mG and 200 mG, respectively) (NYPSC, 1978; FDER, 1989; NYPSC, 1990; FDEP, 1996). The basis for limiting magnetic fields from transmission lines was to maintain the "status quo" so that fields from new transmission lines would be no higher than those produced by existing transmission lines.

Additionally, several scientific organizations have published guidelines for public exposure to these fields. The limit published by the International Committee on Electromagnetic Safety (ICES) is 0.904 millitesla (9,040 mG) (ICES, 2002); the value published by the International Commission on Non-ionizing Radiation (ICNIRP) is 0.083 millitesla (830 mG) (ICNIRP, 1998).

2.7 Other EMF Perspectives

Several other organizations have provided perspectives on EMF and health. These include a report from the California EMF Program and two more recent publications from the World Health Organization (WHO) and the NIEHS.

2.7.1 California EMF Program

In response to a request from the California Public Utilities Commission, three scientists from the California EMF program (two epidemiologists and a physicist) reviewed and evaluated the scientific research regarding EMF and health (Neutra et al., 2002). The scientists evaluated over a dozen health conditions and the degree that they believe these diseases are caused by exposure to EMF and completed their fourth and final draft in June 2002.

The scientists used two different approaches to conduct their evaluation. One was characterized as following the IARC approach, described above, in which reviewers summarize the “quality of evidence.” However, unlike IARC, which weighs both epidemiology and experimental data, the scientists gave little weight to the experimental data. The other approach was a set of guidelines developed by the California EMF Program, which calls for each scientist to express a degree of confidence in their belief that a disease may be caused by high EMF exposures.

The scientists evaluated data regarding approximately a dozen health conditions and concluded that the epidemiologic data provided little support for an association of EMF with nine of the conditions. For the rest, they expressed the belief “that EMFs can cause some degree of increased risk of childhood leukemia, adult brain cancer, Lou Gehrig’s disease, and miscarriage.” Their median “confidence ratings” for these conditions, however, were not high enough to indicate any strong certainty or “high probability” that EMF was a cause of these conditions. As noted previously, they state, “there is a chance that EMFs have no effect at all” (Neutra et al., 2001). For all other health effects, including breast cancer, heart disease, Alzheimer’s disease, depression, increased risk of suicide, and adult leukemia, Neutra et al. do not believe that there is evidence that exposures to EMF increases the risk of developing any of these illnesses. They agree that EMF is not a universal carcinogen (Neutra et al., 2002). The California Department of Health Services has not changed its fact sheets to the public based on this assessment (CDHS, 1999; CDHS, 2000).

2.7.2 World Health Organization

In 2002, the WHO published a handbook for risk communication on EMF. The document entitled “Establishing a Dialogue on Risks from Electromagnetic Fields” was developed because of public concern over EMF and possible health effects. It is intended for persons who need to communicate possible risks from exposure to EMF to others, and to teach the reader about risk perception and risk management. In regard to the hypothesized cause-and-effect relationship between EMF and health, the WHO states “while the classification of ELF magnetic fields as possibly carcinogenic to humans has been made by IARC, it remains possible that there are other explanations for the observed association between exposure to ELF magnetic fields and childhood leukaemia” (WHO, 2002).

2.7.3 National Institute of Environmental Health Sciences

Since the conclusions of the California EMF Program have become available, the NIEHS published a brochure on questions and answers on EMF and health (NIEHS, 2002). The status of EMF and health is summarized by NIEHS as:

> Electricity is a beneficial part of our daily lives, but whenever electricity is generated, transmitted, or used, electric and magnetic fields are created. Over the past 25 years, research has addressed the question of whether exposure to power-frequency EMF might adversely affect human health. For most health outcomes, there is no evidence that EMF exposures have adverse effects. There is some evidence from epidemiology studies that exposure to power-frequency EMF is associated with an increased risk for childhood

leukemia. This association is difficult to interpret in the absence of reproducible laboratory evidence or a scientific explanation that links magnetic fields with childhood leukemia.

EMF exposures are complex and come from multiple sources in the home and workplace in addition to power lines. Although scientists are still debating whether EMF is a hazard to health, the NIEHS recommends continued education on ways of reducing exposures. This booklet has identified some EMF sources and some simple steps you can take to limit your exposure. For your own safety, it is important that any steps you take to reduce your exposures do not increase other obvious hazards such as those from electrocution or fire. At the current time in the United States, there are no federal standards for occupational or residential exposure to 60-Hz EMF (NIEHS, 2002).

2.8 Summary of EMF and Health Research

By far, the greatest interest in EMF and health has focused on childhood leukemia and estimated long-term exposures to higher magnetic field levels. Childhood leukemia is a rare disease and the evidence for causality between EMF and leukemia is lacking (Linet et al., 2003). The larger and more rigorous epidemiology studies (e.g., NCI, UKCCS) have not found evidence to support a causal relationship between exposure to magnetic fields and childhood leukemia, nor did they find a dose response relationship with exposure to higher magnetic field levels. Laboratory studies do not provide a biological mechanism for the development of any form of cancer, including leukemia. The consensus of scientists who have reviewed the literature for scientific and regulatory organizations including the IARC, the NIEHS the HCN, and the NRPB of Great Britain is that no cause-and-effect relationship between EMF from any source and ill health has been established at the levels generally found in residential environments.

The WHO provides insight as to why the reviews by these organizations are so important to weighing 30 years of literature on a single topic and states:

> Science is a powerful tool and has earned its credibility by being predictive. However, its usefulness depends on the quality of the data, which is related to the quality and credibility of the scientists. It is important to verify the knowledge and integrity of so called “experts,” who may look and sound extremely convincing but hold unorthodox views that the media feel justified in airing “in the interests of balance.” In fact giving weight to these unorthodox views can disproportionately influence public opinion. For the public, often the best sources of information are from panels of independent experts who periodically provide summaries of the current state of knowledge (WHO, 2002).

3 Ecological Research

Scientists have studied the effects of high-voltage transmission lines on many plant and animal species in the natural environment. This section briefly reviews the research on the effects of EMF on ecological systems to assess the likelihood of adverse impacts. In addition to the comprehensive review of research on this topic by wildlife biologists at BPA (Lee et al., 1996), a search of the published scientific literature for more recent studies published between 1995 and June 2005 was conducted.

3.1 Fauna

The habitat on the transmission-line right-of-way and surrounding area shields most wildlife from electric fields. Vegetation in the form of grasses, shrubs, and small trees largely shields small ground-dwelling species such as mice, rabbits, foxes, and snakes from electric fields. Species that live underground, such as moles, woodchucks, and worms, are further shielded from electric fields by the soil; aquatic species are shielded from electric fields by water. Hence, large species such as deer and domestic livestock (e.g., sheep and cattle) have greater potential exposures to electric fields since they can stand taller than surrounding vegetation. However, the duration of exposure for deer and other large animals is likely to be limited to foraging bouts or the time it takes them to cross under the line. Furthermore, all species would be exposed to higher magnetic fields under or near a transmission line than elsewhere, as the vegetation and soil do not provide shielding from this aspect of the transmission-line electrical environment.

Field studies have been performed in which the behavior of large mammals in the vicinity of high-voltage transmission lines was monitored. No effects of electric or magnetic fields were evident in two studies from the northern U.S. on big game species, such as deer and elk, exposed to a 500-kilovolt (kV) transmission line (Goodwin 1975; Picton et al., 1985). In such studies, a possible confounding factor is audible noise. Audible noise associated with high-voltage power transmission lines (with voltages greater than 110 kV) is due to corona. Audible noise generated by transmission lines reaches its highest levels in inclement weather (rain or snow).

Much larger populations of animals that might spend time near a transmission line are livestock that graze under or near transmission lines. To provide a more sensitive and reliable test for adverse effects than informal observation, scientists have studied animals continuously exposed to fields from the lines in relatively controlled conditions. For example, grazing animals such as cows and sheep have been exposed to high-voltage transmission lines and their reproductive performance examined (Lee et al., 1996). No adverse effects were found among cattle exposed to a 500-kV direct-current overhead transmission line over one or more successive breedings (Angell et al., 1990). Compared to unexposed animals in a similar environment, the exposure to 50-Hz fields did not affect reproductive functions or pregnancy of cows (Algers and Hennichs, 1985; Algers and Hultgren, 1987).

A group of investigators from Oregon State University, Portland State University, and other academic centers evaluated the effects of long-term exposure to EMF from a 500-kV transmission line operated by BPA on various cellular aspects of immune response, including the production of proteins by leukocytes (IL-1 and IL-2) of sheep. In previous unpublished reports, the researchers found differences in IL-1 activity between exposed and control groups. However, in their most recent replication, the authors found no evidence of differences in these measures of immune function. The sheep were exposed to 27 months of continuous exposure to EMF, a period of exposure much greater than the short, intermittent exposures that sheep would incur grazing under transmission lines. Mean exposures of EMF were 35-38 mG and 5.2-5.8 kV/m, respectively (Hefeneider et al., 2001).

Scientists from the Illinois Institute of Technology (IIT) monitored the possible effects of electric and magnetic fields on fauna and flora in Michigan and Wisconsin from 1969 – 1997 to evaluate the effects of an aboveground, military-communications antenna operating at 76 Hz. The antenna produces EMF at a frequency close to that of high-voltage transmission lines, but of much lower intensity. This study, which included embryonic development, fertility, postnatal growth, maturation, aerobic metabolism, and homing behavior, showed no adverse impacts of ELF electric and magnetic fields on the animals. The fish community examined in this study showed no significant differences in species diversity, biomass or condition when compared to the control site. The results of the other studies also demonstrated no convincing evidence for effects of EMF on any of the organisms or ecosystems they examined (NRC, 1997).

Another part of the IIT study examined the effect of the antenna system fields on the growth, development, and homing behavior of birds. Studies of embryonic development (Beaver et al., 1993), fertility, postnatal growth, maturation, aerobic metabolism, and homing behavior showed no adverse impacts of ELF electric and magnetic fields on the animals (NRC, 1997). Fernie and colleagues studied the effects of continuous EMF exposure of raptors to an electric field of 10 kV/m in a controlled, laboratory setting. The exposure was designed to mimic exposure to a 765-kV transmission line. Continuous EMF exposure was reported to reduce hatching success and increase egg size, fledging success, and embryonic development (Fernie et al., 2000). In a study of the effects on body mass and food intake of reproducing falcons, the authors found that EMF lengthened the photoperiod as a result of altered melatonin levels in the male species, yet concluded that "EMF effects on adult birds may only occur after continuous, extended exposure," which is not likely to occur from resting on power lines (Fernie and Bird, 1999:620). Fernie and Reynolds (2005) conducted a review of EMF from power lines on avian species and concluded that EMF can have an effect on birds, however these results are not seen consistently or in the same direction.

The hormone melatonin, secreted at night by the pineal gland, plays a role in animals that are seasonal breeders. Studies in laboratory mice and rats have suggested that exposure to electric and/or magnetic fields might affect levels of the hormone melatonin, but results have not been consistent (Wilson et al., 1981; Holmberg, 1995; Kroeker et al., 1996; Vollrath et al., 1997; Huuskonen et al., 2001). However, when researchers examined sheep and cattle exposed to EMF from transmission lines exceeding 500-kV, they found no effect on the levels of the hormone melatonin in blood, weight gain, onset of puberty, or behavior in sheep and cattle (Stormshak et al., 1992; Lee et al., 1993; Lee et al., 1995; Thompson et al., 1995; Burchard et al., 1998; Burchard et al., 2004)

Several avian species are reported to use the earth's static magnetic field as one of the cues for navigation. It has been proposed that deposits of magnetite in specialized cells in the head are the mechanism by which the birds can detect variations in the inclination and intensity of this direct-current (dc) magnetic field (Kirschvink and Gould, 1981; Walcott et al., 1988). In early studies of transmission lines, it was reported that the migratory patterns of birds appeared to be altered near transmission lines (Southern, 1975; Larkin and Sutherland, 1977). However, these studies were of crude design, and Lee et al. (1996) concluded that, "During migration, birds must routinely fly over probably hundreds (or thousands) of electrical transmission and distribution lines. We are not aware of any evidence to suggest that such lines are disrupting migratory flights" (Lee et al., 1996:4-59). No further studies on this topic have been identified in the literature (through June 2005).

Bees, like birds, are able to detect the earth's dc magnetic fields. They are known to use magnetite particles, which are contained in an abdominal organ, as a compass (Kirschvink and Gould, 1981). In the laboratory, they are able to discriminate between a localized magnetic anomaly and a uniform background dc magnetic field (Walker et al., 1982; Kirschvink et al., 1992).

Greenberg et al. (1981) studied honeybee colonies placed near 765-kV transmission lines. They found that hives exposed to ac electric fields of 7 kV/m had decreased hive weight, abnormal amounts of propolis (a resinous material) at hive entrances, increased mortality and irritability, loss of the queen in some hives, and a decrease in the hive's overall survival compared to hives that were not exposed. Exposure to electric fields of 7-12 kV/m may induce a current or heat the interior of the hive; however, placing the hive farther from the line, shielding the hive, or using hives without metallic parts eliminates this problem. ITT studied the effects of EMF on bees exposed to the 76-Hz antenna system at lower intensities and concluded that these behavioral effects of "ELF-EMF impacts are absent or at most minimal" (NRC, 1997:102).

Crystals of magnetite have also been found in Pacific salmon (Mann et al., 1988; Walker et al., 1988). These magnetite crystals are believed to serve as a compass that orients to the earth's magnetic field.

However, other studies have not found magnetite in sockeye salmon (*Oncorhynchus nerka*) fry (Quinn et al., 1981). While salmon can apparently detect the geomagnetic field, their behavior is governed by multiple stimuli as demonstrated by the ineffectiveness of magnetic field stimuli in the daytime (Quinn et al., 1982) and the inability of strong magnetic fields from permanent magnets attached to sockeye salmon to alter their migration behavior (Ueda et al., 1998). There are no data on the effects of ac EMF on salmon navigation, but based on a study with honeybees, it appears that organisms that use magnetite crystals to orient to the earth's magnetic field would be affected only when the field levels are very much greater than the levels expected from the transmission line. Given this evidence and the salmon's ability to navigate using multiple sensory cues, the proposed transmission line is unlikely to have an adverse impact on these species of concern and the aquatic ecosystems.

Reptiles and amphibians contribute to the overall functioning of the forest ecosystems. However, little research has been performed on the effects of EMF on reptiles and amphibians in their natural habitat.

3.2 Flora

Numerous studies have been carried out to assess the effect of exposure of plants to transmission-line electric and magnetic fields. These studies have involved both forest species and agriculture crops. Researchers have found no adverse effects on plant responses, including seed germination, seedling emergence, seedling growth, leaf area per plant, flowering, seed production, germination of the seeds, longevity, and biomass production (Lee et al., 1996).

The only confirmed adverse effect of transmission lines on plants was reported for transmission lines with voltages above 1200 kV. For example, Douglas fir trees planted within 15 meters (m) of the conductors were shorter than trees planted away from the line. Shorter trees are believed to result from corona-induced damage to the branch tips. Trees between 15 and 30 m away from the line suffered needle burns, but those 30 m and beyond were not affected (Rogers et al., 1984). These effects would not occur at the lower field intensities expected of the proposed 230-kV transmission line.

3.3 Summary of Ecological Research

The habitat on the transmission-line rights-of-way and surrounding areas shields smaller animals from electric fields produced by high-voltage transmission lines; thus, vegetation easily shields small animals from electric fields. The greatest potential for larger animals to be exposed to EMF occurs when they are passing beneath the lines. Studies of animal reproductive performance, behavior, melatonin production, immune function, and navigation have found minimal or no effects of EMF. Past studies have found little effect of EMF on plants; no recent studies of plants growing near transmission lines have been performed. In summary, the literature published to date has shown little evidence of adverse effects of EMF from high-voltage transmission lines on wildlife and plants. At the field intensities associated with the proposed 230-kV transmission line, no adverse effects on wildlife or plants are expected.

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List of Preparers

Dr. William H. Bailey is a Principal Scientist in the Health Sciences Practice and Director of Exponent's New York office. Before joining Exponent, Dr. Bailey was President of Bailey Research Associates, Inc., the oldest research and consulting firm with specialized expertise in electromagnetic fields and health. Dr. Bailey specializes in applying state-of-the-art assessment methods to environmental and occupational health issues. His 30 years of training and experience include laboratory and epidemiologic research, health risk assessment, and comprehensive exposure analysis. He is particularly well known for his research on potential health effects of electromagnetic fields and has served as an advisor to numerous state, federal, and international agencies. Dr. Bailey has investigated exposures to alternating current (ac), direct current (dc), and radiofrequency electromagnetic fields, 'stray voltage' and electrical shock, as well as to a variety of chemical agents and air pollutants. Currently, he is directing research projects on effects of electrical charge on the deposition of aerosols in the respiratory tract. He is a member of a working group that advises a committee of the World Health Organization on risk assessment, perception, and communication. Dr. Bailey is a visiting scientist at the Cornell University Medical College and has lectured at Rutgers University, the University of Texas (San Antonio), and the Harvard School of Public Health. He was formerly Head of the Laboratory of Neuropharmacology and Environmental Toxicology at the New York State Institute for Basic Research, Staten Island, New York, and an Assistant Professor and NIH postdoctoral fellow in Neurochemistry at The Rockefeller University in New York.

Maria D. Van Kerkhove, M.S., is a Senior Epidemiologist in Exponent's Health Sciences practice. Ms. Van Kerkhove has experience in designing epidemiology studies and managing data for epidemiology studies. She has designed data collection instruments, organized and analyzed large datasets, and worked with state vital statistic registries. She also has experience in recruiting and interviewing subjects for epidemiologic studies. Ms. Van Kerkhove also specializes in writing critical reviews of epidemiologic literature. She has critically evaluated epidemiologic studies of electric and magnetic fields (EMF) and health and has prepared numerous reports of the literature for governmental agencies and electric utilities. She has also prepared reports regarding causality in medical areas such as respiratory conditions, infectious diseases, environmental contaminants and neurological diseases. She is skilled at communicating scientific information to scientists, executives, management, and the public. Ms. Van Kerkhove has participated in several open houses and public meetings to address health concerns including those related to EMF, air pollution and environmental contaminants.

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Appendix E Contractor Disclosure Forms

NEPA Disclosure Statement for Preparation of an EIS for the Proposed Klondike III/Biglow Canyon Wind Integration Project

CEQ regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project," for the purposes of this disclosure, is defined in the March 23, 1981 guidance entitled "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-180338 at Question 17a and b.

Financial or other interest in the outcome of the project "includes" any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients). 46 FR 18026-18038 at 18301.

In accordance with these requirements, the offerer and any proposed subcontractors hereby certify as follows: [check either (a) or (b)].

(a) ___X____ Offerer and any proposed subcontractor have no financial interest in the outcome of the project.

(b) _______ Offerer and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to the award of the contract.

Financial or Other Interests

1.
2.
3.

Certified by:

Daniel D. Heagerty
Signature

Daniel D. Heagerty / Sr. Vice President
Name

March 23, 2006
Date

DAVID EVANS AND ASSOCIATES INC.

NEPA Disclosure Statement for Preparation of an EIS for the Proposed Klondike III/Biglow Canyon Wind Integration Project

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In accordance with these requirements, the offerer and any proposed subcontractors hereby certify as follows: [check either (a) or (b)].

(a) ✓ Offerer and any proposed subcontractor have no financial interest in the outcome of the project.

(b) ______ Offerer and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to the award of the contract.

Financial or Other Interests

1.
2.
3.

Certified by: [signature]

Signature

Jo Rosse Ainn, VP

Name

3/23/06

Date

NEPA Disclosure Statement for Preparation of an EIS for the Proposed Klondike III/Biglow Canyon Wind Integration Project

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Financial or Other Interests

1.
2.
3.

Certified by:

[signature]
Signature

T. DAN BRACKEN
Name

3/24/2006
Date

NEPA Disclosure Statement for Preparation of an EIS for the Proposed Klondike III/Biglow Canyon Wind Integration Project

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Financial or Other Interests

1.
2.
3.

Certified by:

[signature]
Signature

KATHLEEN CONCANNON. Concannon Creative Services
Name

March 30, 2006
Date

NEPA Disclosure Statement for Preparation of an EIS for the Proposed Klondike III/Biglow Canyon Wind Integration Project

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Financial or Other Interests

1.
2.
3.

Certified by:

[signature] Vice-President

Signature

Dale Strickland

Name

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