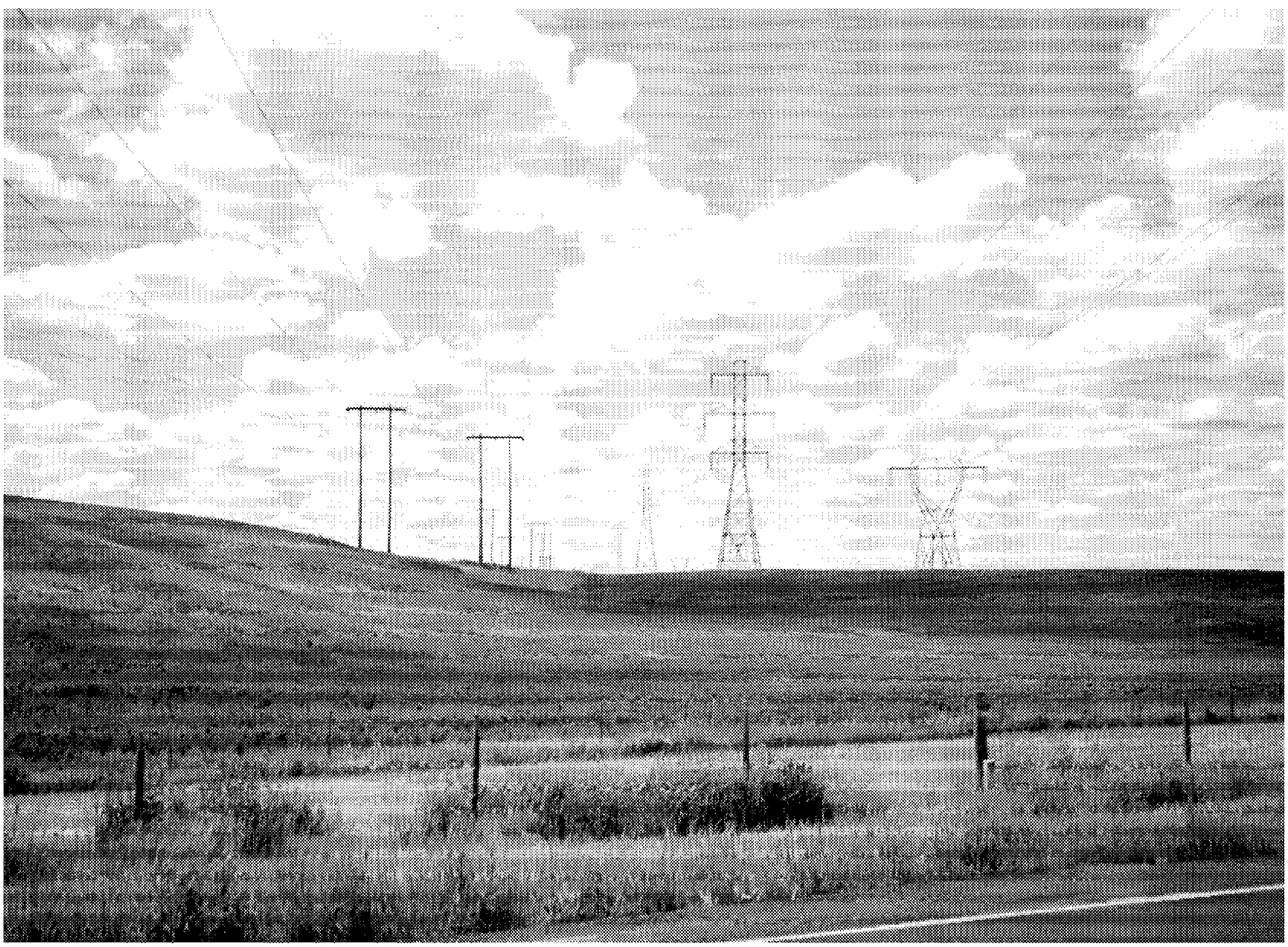
AUGUST 2002

GRAND COULEE - BELL 500-kV TRANSMISSION LINE PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

DOE/EIS-0344



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

BONNEVILLE POWER ADMINISTRATION

Grand Coulee – Bell 500-kV Transmission Line Project

Draft

Environmental Impact Statement

Bonneville Power Administration
August 2002

Grand Coulee – Bell 500-kV Transmission Line Project

Draft Environmental Impact Statement
(DOE/EIS-0344)

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

Cooperating Agencies: U.S. Department of Interior, Bureau of Reclamation.

States Involved: Washington

Abstract: BPA is proposing to construct a 500-kilovolt (kV) transmission line that would extend approximately 84 miles between the Grand Coulee 500-kV Switchyard, near Grand Coulee Dam, and the Bell Substation, in Mead just north of Spokane. The new line would cross portions of Douglas, Grant, Lincoln, and Spokane counties. In addition to the transmission line, new equipment would be installed at the substations at each end of the new line and at other facilities. The proposed action would remove an existing 115-kV transmission line and replace it with the new 500-kV line on existing right-of-way for most of its length. Additional right-of-way would be needed in the first 3.5 miles out of the Grand Coulee Switchyard to connect to the existing 115-kV right-of-way. Since the mid-1990s, the transmission path west of Spokane, called the West of Hatwai transmission pathway, has grown increasingly constrained. To date, BPA has been able to manage operation of the path through available operating practices, and customer needs have been met while maintaining the reliability of the path. However, in early 2001, operations showed that the amount of electricity that needs to flow from east to west along this path creates severe transmission congestion. Under these conditions, the system is at risk of overloads and violation of industry safety and reliability standards. The problem is particularly acute in the spring and summer months because of the large amount of power generated by dams east of the path. Large amounts of water cannot be spilled during that time in order for BPA to fulfill its obligation to protect threatened and endangered fish. The amount of power that needs to move through this area during these months at times could exceed the carrying capacity of the existing transmission lines. If additional capacity is not added, BPA will run a significant risk that it will not be able to continue to meet its contractual obligations to deliver power and maintain reliability standards that minimize risks to public safety and to equipment. BPA is considering two construction alternatives, the Agency Proposed Action and the Alternative Action. The Alternative Action would include all the components of the Preferred Action except a double-circuit line would be constructed in the Spokane area between a point about 2 miles west of the Spokane River and Bell Substation, a distance of about 9 miles. BPA is also considering the No Action Alternative.

Public comments are being accepted through September 23, 2002.

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To receive additional copies of the Draft Environmental Impact Statement (EIS) or Summary, call BPA's document request line at 1-800-622-4520. You may access the Draft EIS on BPA's web site at http://www.bpa.gov; look for environmental analysis, Active Projects.

For information on DOE National Environmental Policy Act (NEPA) activities, please contact:

Carol Borgstrom, Director, Office of NEPA Policy and Compliance, EH-42, U.S. Department of Energy, 1000 Independence Avenue SW, Washington D.C. 20585, 1-800-472-2756; or visit the DOE NEPA web site at www.eh.doe.gov/nepa.

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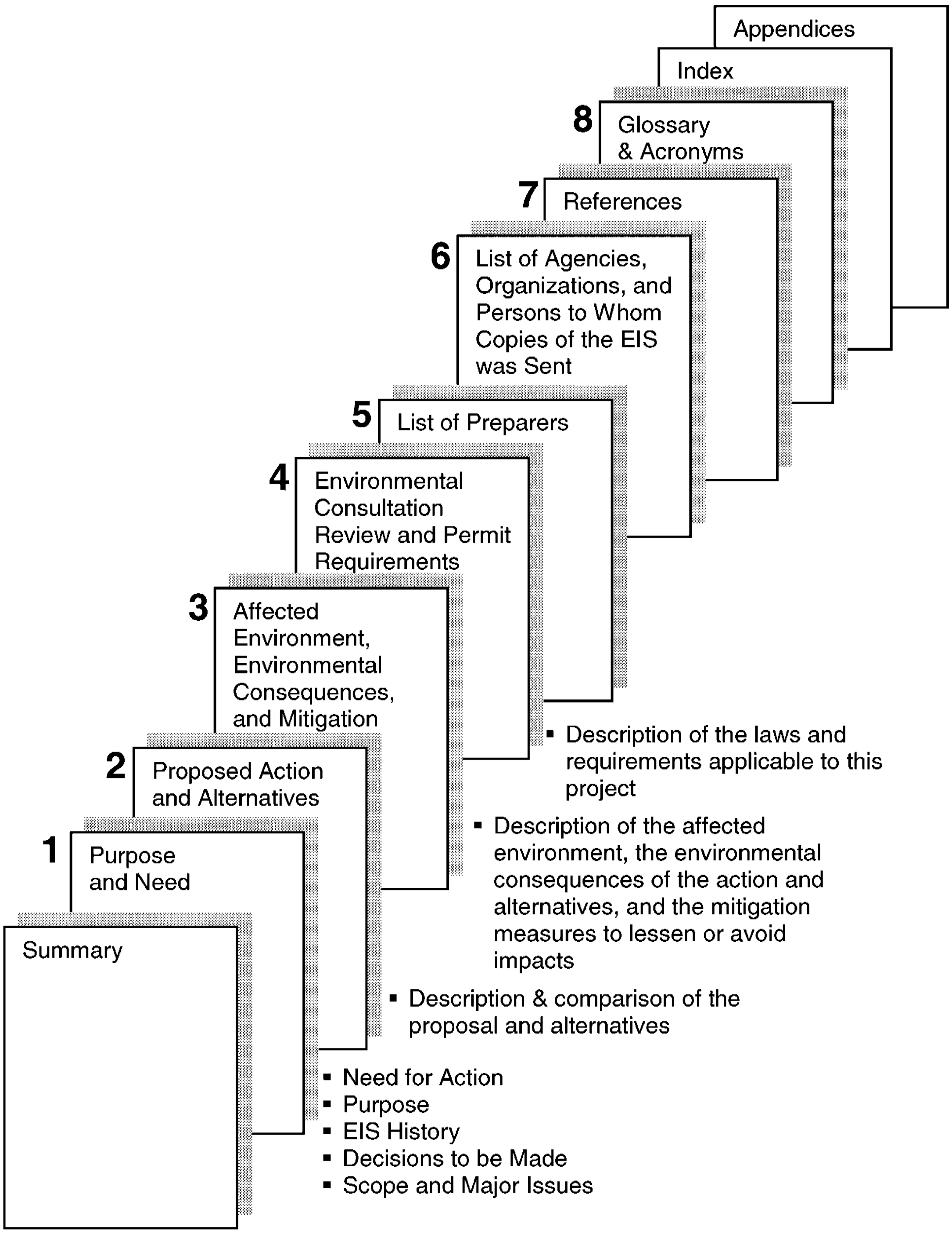
HOW THIS EIS IS ORGANIZED

(This EIS is presented in a summary and eight chapters as illustrated)



Summary

Introduction

This Environmental Impact Statement (EIS) discloses the potential impacts associated with construction and operation of the proposed Grand Coulee – Bell 500-kV Transmission Line Project. Bonneville Power Administration (BPA) would construct a new 500-kilovolt (kV) transmission line that would replace a single-circuit 115-kV transmission line in an existing corridor that has multiple transmission lines for most of the project's length. The transmission line would extend between the Grand Coulee 500-kV Switchyard and Bell Substation near Spokane, a distance of 84 miles (see Figure S-1). Detailed information about the project and its environmental impacts is provided in the main body of this document (Chapters 1, 2, and 3).

This chapter summarizes information about the proposed project's:

- purpose and need;
- alternatives; and
- affected environment, impacts, and mitigating measures.

Need for Action

BPA, a federal agency, is responsible for marketing and transmitting electrical power to utility and certain industrial customers in the Pacific Northwest. BPA owns and operates over 15,000 miles of transmission lines that it uses to market and transmit power from the federal hydropower system in the Northwest. BPA also transmits power that it purchases and markets from other generation sources in the region, as required by statute.

BPA enters into contracts to deliver power where it is needed. These obligations include long-term firm transmission agreements with entities that generate power and with utilities that provide electricity for homes, businesses, and farms in the Northwest. BPA has a statutory obligation to ensure that there is sufficient capacity in its transmission system to serve its customers, and to ensure that the system is safe and reliable. Among many other requirements, the Federal Columbia River Transmission System Act directs BPA to transmit electric power from Federal and non-federal generating sources [16 U.S.C. §838b(a)], and to construct additional transmission lines necessary for maintaining the electrical stability and reliability of the transmission system [§ 838b(d)].

As a result of a problem that exists in eastern Washington on BPA's transmission system, BPA needs to take action to ensure that it can meet its statutory and contractual obligations to deliver power to where it is needed.

As part of its transmission system, BPA owns and operates several transmission lines in eastern Washington that move electricity from generation sources in northeastern Washington, northern Idaho, and Montana to load centers to the west. The portion of the system west of Spokane, Washington, that transfers power from east to west is called the "West of Hatwai" transmission path.

Since the mid-1990s, the West of Hatwai transmission path has grown increasingly constrained. To date, BPA has been able to manage operation of the path through all available operating practices, including short-term remedial actions, and customer needs have been met while maintaining the reliability of the path. However, in early 2001, the problem was made worse when two of BPA's large direct service industries (DSI) customers located east of the transmission path closed their facilities. These customers were aluminum smelters that were served by generation sources in Montana. The closure of these smelters meant that the electricity that would have supplied the smelters now flows west across the West of Hatwai transmission path. Because the path does not have the capacity to handle this excess energy, all of this energy must compete for space with other users of the path, which creates severe transmission congestion. Under these conditions, the system is at risk of overloads and violation of industry safety and reliability standards.

The problem is particularly acute in the early spring and summer months because of the large amount of power generated by dams east of the path. The amount of power that needs to move through this area during these months at times could exceed the carrying capacity of the existing transmission lines. Operations in summer 2001 showed that using all available operating practices to mitigate the capacity limitations of the West of Hatwai transmission path is insufficient as a long-term solution to ensure the flow of power while maintaining system reliability.

The problems that occurred in 2001 showed that the risk for future generation curtailments is already too high, and that the problem must be solved on a long-term basis as soon as possible. If additional capacity is not added, BPA will run a significant risk that it will not be able to continue to meet its contractual obligations to deliver power and still maintain reliability standards that minimize risks to public safety and to equipment. Action thus is needed to comply with BPA's Congressional mandates to provide adequate transmission capacity and to maintain electrical system stability and reliability, as well as to continue to fulfill its contractual obligations. 2004 is the earliest possible date that a long-term solution could be implemented considering time needed for environmental review, design, and construction.

GRAND COULEE - BELL 500-kV TRANSMISSION LINE PROJECT

LOCATION MAP

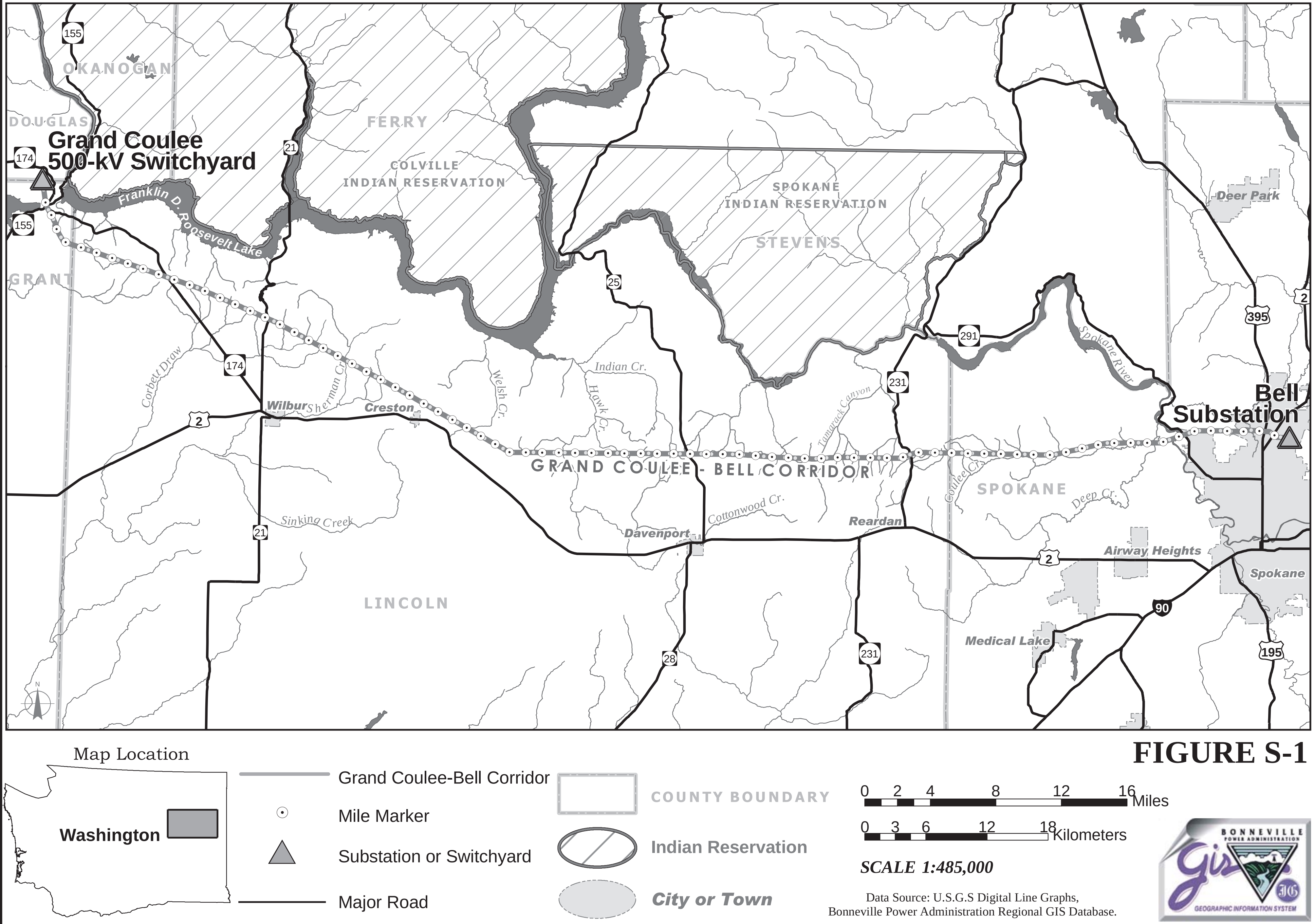


FIGURE S-1

Data Source: U.S.G.S Digital Line Graphs, Bonneville Power Administration Regional GIS Database.

Purposes

The purposes identified below have been used to evaluate the reasonableness of a wide range of potential project alternatives. BPA decision-makers will consider how well the alternatives evaluated in this EIS meet these purposes when making a decision among them. The alternative selected should:

- Maintain transmission system reliability to industry standards;
- Comply with BPA's statutory obligations;
- Continue to meet BPA's contractual obligations;
- Minimize environmental impacts;
- Minimize costs; and
- Allow BPA to solve its transmission capacity problem by no later than fall 2004.

Cooperating Agencies

BPA is the lead federal agency on this project and supervises the preparation of the EIS. The proposed project crosses land managed by the U.S. Department of Interior, Bureau of Reclamation (BOR) at Grand Coulee Dam, and the western end of the proposed line terminates at BOR's Grand Coulee Switchyard. BOR thus has agreed to cooperate in the EIS process.

Proposed Action and Alternatives

BPA developed alternatives based on its knowledge of the system and potential environmental impacts, on public input from an earlier National Environmental Policy Act (NEPA) process begun in the mid-1990s, on results of scoping for this Environmental Impact Statement (EIS), and on input from an industry technical committee that reviewed improvements to BPA's entire transmission system.

BPA's proposal to construct an 84-mile, 500-kilovolt (kV) transmission line between the Grand Coulee 500-kV Switchyard and Bell Substation, in Mead just north of Spokane, considers two construction alternatives: the Agency Proposed Action and the Alternative. Both construction alternatives remove an existing transmission line and replace it with a new line on existing right-of-way for most of its length. Additional right-of-way would be needed in the first 3.5 miles out of the Grand Coulee Switchyard. In addition to the transmission line, new equipment would be installed at the substations at each end of the new line and at other facilities.

BPA is also considering the No Action Alternative. NEPA requires Federal agencies to analyze the consequences of taking no action, in this case, continuing to operate the transmission system under present conditions.

Agency Proposed Action

The proposed action involves removing an existing 115-kV transmission line (Grand Coulee – Bell No. 1 line) and replacing it with a 500-kV transmission line. BPA would construct a single-circuit 500-kV transmission line over most of the route between the end points or terminations. A double-circuit transmission line would be constructed for short distances (slightly less than one mile) where the right-of-way is constrained. The Agency Proposed Action would cost about $152 million (2002 dollars).

The new transmission line would be located primarily in an existing BPA corridor. The existing corridor, over most of its length, has five transmission lines on four sets of structures. To make room for the new transmission line, BPA would remove its Grand Coulee-Bell No. 1 115-kV wood pole transmission line and replace it with the 500-kV line on new lattice steel towers.

Towers

A new single-circuit tower design for the lattice steel towers would be used for the project. The typical height of the towers would be 125 to 150 feet although the height of each tower would vary with location and surrounding landforms. In most cases, the towers would be placed adjacent to existing double-circuit 230-kV steel towers in the corridor. The double-circuit 500-kV towers to be used for the short sections where the corridor is constrained would typically be 175 feet tall.

About five structures per mile would be used to match the spans of the existing 230-kV steel towers in the right-of-way. About 420 towers would be needed.

Conductors

Wires called conductors carry the electrical current in a transmission line. Three sets of conductors make up a circuit. For a single-circuit 500-kV transmission line, there would be three sets of conductors and for a double-circuit line there would be six sets of conductors. Each set of conductors consists of three conductor wires referred to as conductor bundles.

Conductors are attached to the tower using glass, porcelain, or fiberglass insulators that prevent the electricity in the conductors from moving to other conductors, the tower and the ground. Transmission towers elevate conductors to provide safety within the right-of-way for people and vehicles. One or two smaller wires, called overhead ground wires, are attached to the top of transmission towers to protect the transmission line against lightning damage. BPA could use fiber optic cable as the overhead ground wire or fiber optic cable attached elsewhere on the tower to also provide a communication link.

Line Termination Facilities

At Bell Substation, BPA would expand the existing fenced yard by about 11.7 acres to make room for new line termination facilities and other equipment. The expansion would include three bays with six circuit breakers, one group of series capacitors, a new control house, and associated equipment. Existing BPA property would be used. The Grand Coulee Switchyard would not need to be expanded because there is space within the existing fenced yard to accommodate a new bay with two circuit breakers, a shunt reactor and breaker, and associated equipment.

115-kV System and Tap Point/Substation Changes

Removing the Grand Coulee-Bell No. 1 115-kV line would entail removing structures and conductors over the 84-mile route with some line reconfiguration. In addition, customers currently tap off of both of BPA's existing 115-kV lines at four locations. Making room for the new 500-kV line by removing the Grand Coulee – Bell No. 1 115-kV line would make electrical changes necessary along the right-of-way at the four tap points on the remaining No. 2 115-kV line. Electrical changes at tap points at Wagner Lake Substation, Creston Substation, Larene Substation, and Springhill Substation would be necessary.

Construction

Construction is scheduled to begin in January 2003 and to be complete by November 2004. BPA would follow existing practices for removing and replacing the transmission line. Temporary staging areas would be needed along or near the proposed transmission line for construction crews to store materials and trucks. Access to tower sites for construction and maintenance would need to be provided at several locations along the corridor. Access work, which would take place principally within the right-of-way, would consist of making improvements to existing roads, constructing new roads, and constructing spurs to individual tower sites. A total of about 24 miles of new permanent access roads or road improvements would be needed.

Most new permanent access roads would be constructed in rangeland areas. Only a limited amount of permanent access road construction would be allowed in cultivated or fallow agricultural fields. Any temporary roads constructed in cropland would be removed and the ground would be restored to its original contour when the line is completed. Rights, usually easements, for access roads would be acquired from property owners as necessary. After the line is built, access roads would also be used for line maintenance.

Selective cutting of trees and tall brush may occur in the existing right-of-way to accommodate construction and provide for conductor clearance. Trees would be cut outside of the right-of-way that are identified as "danger trees" or trees that, because of their height and condition, may pose a threat to the adjacent line. At structure sites, trees and brush would be cut and removed within a one-half-acre area, and a portion of the site would be graded to provide a relatively level work surface. Woody debris and other vegetation would either be left or would be taken off-site. Burning would not be used to dispose of woody debris.

Steel towers are anchored to the ground with footings. Typically, a hole is excavated, steel plates or a grid of crossbeams is placed in the hole, and the hole is filled up with the original excavated material. Towers are either assembled at the tower site and lifted into place by a large crane, or assembled at a staging area and set in place by a large helicopter. The towers are bolted to the footings after they are set in place. After transmission towers are in place, conductors are strung from tower to tower through pulleys on the towers. Tensioning sites of about 1 acre would be needed every 2.5 miles.

Vegetation Management

After construction, maintenance crews would be responsible for managing vegetation. No tall-growing vegetation would be allowed to grow inside the right-of-way except for vegetation in deep canyons where it will not interfere with the much higher conductor. BPA would develop maintenance criteria consistent with its Transmission System Vegetation Management Program.

Alternative Action

The Alternative Action would include all the components of the Preferred Action except a double-circuit line would be constructed in the Spokane area between a point about 2 miles west of the Spokane River and Bell Substation, a distance of about 9 miles. The purpose of this alternative would be to anticipate and provide for potential unknown future transmission needs without needing to find a new route out of the Bell Substation for another 500-kV line at a later date if the need should arise. Both sides of the towers would be strung with conductors and connected to operate as a single-circuit line; it would be available for a second circuit at some unknown future date.

No Action Alternative

Description of No Action

The No Action Alternative is traditionally defined as the status quo alternative. In this case, the No Action Alternative assumes the following scenario:

- BPA would not build a new transmission line to solve the problem identified in Chapter 1, nor would another entity.
- The amount of power that needs to be transferred from east to west would not diminish and probably would increase.
- Requirements to protect ESA-listed fish would not change, so dams in Montana would continue to generate power at current levels.

Impacts of the No Action Alternative

Under this alternative, BPA would continue to operate the existing West of Hatwai transmission path as it does now. Because the conditions and problems described in Chapter 1 would substantially increase the risk that this portion of the transmission system would overload, BPA would continue to implement ***remedial action schemes (RAS)*** to protect the existing system, as it has for several years. A RAS is a computer-driven set of actions to prevent an overload. If a major transmission line ***outage*** occurs, the transmission system would automatically take measures to protect itself, such as disconnecting generation or transmission. However, the amount of generation that would be dropped when one line is out of service is exceptionally large (up to 2250 MW), and the potential for dropping this amount is very high during summer. This level of reliance on RAS has the following risks: damage to generator plants when generation is disconnected suddenly, spill conditions at hydro projects that could violate Endangered Species Act requirements, higher power costs to consumers, and higher potential for blackouts.

In addition, given this scenario, even with all existing transmission lines in the Grand Coulee-Bell corridor transferring power, the congestion is so high that BPA would be unable to meet its present and future obligations in a reliable manner.

If BPA does not take action, it is theoretically possible that another entity might propose to do so. It was suggested during scoping that other entities could take action to solve the problem, and that proposals existed to do so. BPA is not aware, however, of any current proposals by other entities that address the problem as described in Chapter 1. The section entitled "Actions by Other Entities" briefly describes proposals by Avista, a utility with part ownership in the West of Hatwai path and with facilities in the area, and the problems those proposals would solve.

No Action could also result in adverse socioeconomic impacts. Reduced capacity and reliability could lead to higher energy costs for industry and consumers. This would tend to lower productivity and efficiency for industries and areas that are affected, making them less competitive with other industries and areas. The consequences of this would be lower employment and income levels than would otherwise be the case, reduced levels of economic activity, and reduced governmental tax revenues and the services they support.

The quality and reliability of electrical power has been a key to economic growth and improving industrial productivity levels. With structural economic change, particularly with the new digital economy, power quality and reliability requirements have increased markedly. To the extent that transmission capacity deficiencies reduce power reliability and quality, regional businesses and industries would be affected by costly process disruptions.

Maintenance activities would continue within the corridor under the No Action Alternative. Vegetation clearing, maintenance vehicle traffic, and human presence could adversely affect water quality, vegetation, wildlife, fish, and wetland resources.

Alternatives Considered but Eliminated from Detailed Study

BPA considered a range of alternatives to solve the problem. Alternatives that would not meet the need and purposes were eliminated from detailed study. The following alternatives did not meet the need and purposes.

Design Alternatives

Actions by Other Entities

Existing proposals by Avista to improve its system in the eastern Washington/North Idaho area would not solve the problem identified in Chapter 1.

System Improvements

BPA and Avista have implemented a number of system improvements and remedial actions to increase the power transfer capability of the system as far as is technically prudent without significant new line construction. BPA knows of no other improvements or upgrades that could be undertaken that would meet the need identified in Chapter 1.

Burying the Transmission Line

For this 500-kV line, six individual cables would have to be manufactured and installed at a total cost of 10 to 15 times the cost of an overhead design. Because of cost, BPA uses underground cable only in limited situations. While it remains an option available for special situations, because of its high cost it was eliminated from further study.

Replace Existing Grand Coulee-Bell Line with a Double-Circuit Line

As an alternative to removing one of its existing lines from the transmission corridor and constructing the Grand-Coulee-Bell 500-kV line, BPA could instead replace the existing line from the Grand Coulee Switchyard to the Bell Substation for its entire length with double-circuit towers that could accommodate two lines. This alternative would cost approximately twice as much as the proposed action and would have greater visual effects. Because this alternative would not meet the purpose of minimizing project costs and would not reduce expected environmental impacts, it was considered but eliminated from detailed study in this EIS.

Transmission Alternatives

Rerouting Lines in the Spokane Area

When locating new transmission lines, BPA tries either to replace existing lines or to use or parallel an existing transmission right-of-way. Adding a transmission line on existing right-of-way next to an existing one can cause fewer visual, land use, and ground disturbance-related impacts than a new, totally separate line, and the need for new access roads can be kept to a minimum by using existing access roads. Using an existing corridor also avoids the impact of having to clear miles of new 150-foot wide right-of-way. Following this right-of-way practice can greatly reduce costs and environmental impacts.

BPA studied the area around Spokane for possible corridor routes. Studies found no routes near Spokane for a new transmission corridor, and no suitable alternative existing utility corridor, that would accommodate the transmission towers with less environmental impact or for less cost than the proposal.

Other Transmission Line Alternatives

BPA studied a variety of transmission alternatives and alternative design options to fill the need. After study, the following alternatives were eliminated from further consideration.

1. Bell-Ashe 500-kV Line: It would be 145 miles long between Spokane and the Hanford Reservation near Richland, would require new right-of-way, would cost about $95 million more than the Grand Coulee-Bell 500-kV project, and completion would be at least 2 years later.

2. Taft-Lower Granite 500-kV Line: It would be 150 miles long between the continental divide in Montana and southeastern Washington, would require new right-of-way, would cost about $105 million more than the Grand Coulee-Bell 500-kV project, would require building a new 500-kV line from Lower Granite substation to Lower Monumental substation, and completion would be at least 2 years later.

Non-Transmission Alternatives

As possible non-transmission alternatives to the proposed action, BPA considered implementation of energy conservation and demand reduction measures to reduce demand on the transmission system, load and generation curtailment during outage conditions, generation additions, and fuel switching. An analysis to determine whether non-transmission alternatives would be viable for these projects found that implementation of non-transmission alternatives was not viable because they would not allow BPA to meet its obligations under existing contracts.

Pricing Alternatives

Alternative methods of pricing power transfers, particularly congestion pricing, were considered but eliminated from detailed study. The problem west of Spokane would not be solved because raising the price works to reduce congestion when there are competitive markets for generation or controllable demand on either side of a transmission constraint. These conditions do not exist in this area.

Affected Environment, Environmental Consequences, and Mitigation

The affected environment, potential impacts, and mitigation for the resource areas evaluated in this EIS are briefly summarized below.

Land Use

Affected Environment

- The corridor crosses four counties and two cities in eastern central Washington: Douglas, Grant, Lincoln and Spokane counties and the cities of Grand Coulee and Spokane.
- Approximately one-half of the corridor passes through agricultural land, which mainly consists of dryland wheat and other grain crops.
- The corridor crosses open range and scablands in portions of Grant and Douglas counties, and in central Lincoln County. Rangelands constitute approximately one-third of the corridor.
- Developed land within rural and urban portions of the corridor includes single and multi-family residences, commercial and industrial businesses and related lands. Most developed land is in the Spokane area.
- Recreational areas traversed by the corridor include North Dam Park within the City of Grand Coulee and Riverside State Park in rural Spokane County.

Environmental Consequences

- New transmission line along 3.5 miles of right-of-way where none now exists; remainder of project would be in existing transmission line corridor or BPA property.
- Approximately 24 acres would be needed on a permanent basis for tower sites.

- Approximately 40 acres would be needed temporarily for staging areas and conductor pulling/tensioning sites.
- Approximately 22 acres would be needed for new permanent access roads and road spurs; mostly in rangeland.
- Approximately 52 acres would be needed for access road improvements.
- Approximately 12 acres of agricultural land would be removed from production permanently (about 4 acres of prime farm land); net loss would be about 3.3 acres.
- Up to 765 acres of cropland would be removed from production for one or two seasons.
- Potential interference with farming activities during construction and operation.
- Potential interference with recreational use at North Dam Park.
- Temporary disturbances to recreational use at Riverside State Park and nearby residential uses in the Spokane area.
- Commercial activities (recreational vehicle parking) in corridor near U.S. Highway 2 may be incompatible; change in land use may occur.
- Potential disruption of traffic during construction.
- Potential for spread of noxious weeds by ground disturbance and vehicles.
- Consistent with land use plans and zoning; double-circuit towers exceed height restrictions in City of Spokane and Spokane County.
- Land use impact would be low to moderate.

Cumulative Impacts

- Because the proposed action is the rebuild of an existing transmission line in the corridor with three other lines, cumulatively, the impacts represent a relatively small increment of change. Land use compatibility issues would likely be minor.
- There are no other known plans or proposed projects that would remove agricultural lands from production in Lincoln, Douglas or Grant counties that would result in adverse cumulative impacts.

- Increased activity/use within Riverside State Park and other open spaces could lead to a greater level of compatibility impacts with users.
- Increased development activity and human presence over time would contribute to cumulative impacts such as associated traffic congestion, potential land use compatibility conflicts, and other impacts of proximity to transmission lines.

Mitigation

- Provide schedule of construction activities to all landowners along the corridor that could be affected by construction.
- Coordinate with the City of Grand Coulee to site towers within North Dam Park.
- Place certified weed-free gravel on existing roads within North Dam Park to reduce the spread of noxious weeds.
- Pre-treat areas of high weed concentrations in North Dam Park during plant emergence to reduce weed spread.
- Use Best Management Practices to limit erosion and the spread of noxious weeds.
- Plan and schedule construction activities, when practical, to minimize temporary disturbance, displacement of crops, and interference with farming activities.
- Restore compacted soil in cropland.
- Compensate farmers for crop damage.
- Place new towers adjacent to existing towers, where practical, to enhance maneuverability of farm equipment.
- Revegetate disturbed areas with native species.
- Coordinate with Riverside State Park officials to locate access roads to minimize disturbance to vegetation.
- Use weed-free materials during construction.

Noise

Affected Environment

- Along the corridor of the proposed 500-kV transmission line, existing noise levels vary with the proximity to existing transmission lines and the proximity to other noise-generating activities.
- In the more developed areas, traffic and noise associated with human activity would be major contributors to background noise.

Environmental Consequences

- Residents at distances up to 400 to 600 feet from construction activity could experience noise levels that exceed Washington noise standards.
- Small increase in audible noise levels at the edge of the right-of-way during operation; median noise levels would be within standards.
- Noise impact levels would be low to moderate.
- Potential radio and television interference.

Cumulative Impacts

- Future increases in traffic and human activity related to population and economic development would increase background noise levels. This would most likely occur in the Spokane area and to a lesser extent in the Grand Coulee area.

Mitigation

- Provide sound-control devices no less effective than those provided on original equipment.
- Provide muffled exhaust on all construction equipment and vehicles.
- Limit construction activities to daytime hours.
- No noise-generating construction activity will be conducted within 1,000 feet of a residence between 10:00 p.m. and 7:00 a.m.
- Notify landowners directly impacted along the corridor prior to construction activities.

- Restore radio or television reception to a quality as good or better than before if interference.

Public Health/Safety

Affected Environment

- Potential hazards along the corridor include fire (both natural and human-caused), existing overhead transmission line crossings, and natural gas pipeline crossings.

- Transmission lines, like all electric devices and equipment, produce electric fields and magnetic fields (EMF). Electric and magnetic fields are found around all electrical wiring, including household wiring and common electrical appliances.

- All BPA lines are designed and constructed in accordance with the National Electrical Safety Code. NESC standards specify the minimum allowable distances between the lines and the ground or other objects.

- There are no national (United States) guidelines or standards for electric fields from transmission lines except for the 5-milliampere criterion for maximum permissible shock current from vehicles. Washington has no electric-field limit. BPA designs new transmission lines to meet its electric-field guideline of 9-kV/m maximum on the right-of-way and 5-kV/m maximum at the edge of the right-of-way.

Environmental Consequences

- Potential risk of fire and injury associated with use of equipment during construction, and traffic safety issues.

- Potential incidence of electric field-induced nuisance shocks.

- Potential for health effects from magnetic fields in residential and business areas would be minor due to sparse population or field levels that would decrease or would not change from the current condition (except for 0.6-mile section where a slight increase would be expected outside of the right-of-way). The overall level of impacts would be low except for the short section of the line that crosses a commercial area, where the level would be moderate to high.

Cumulative Impacts

- The proposed project would contribute a small increase in the overall risk of fire and injury to the public that could occur during construction and operation/maintenance.

- Incidences of nuisance shocks could occur infrequently under the proposed line.

Mitigation

- Prior to starting construction, contractor would prepare and maintain a safety plan in compliance with Washington requirements. This plan would be kept on-site and would detail how to manage hazardous materials such as fuel, and how to respond to emergency situations.

- During construction, the contractors would also hold crew safety meetings at the start of each workday to go over potential safety issues and concerns.

- At the end of each workday, the contractor and subcontractors will secure the site to protect equipment and the general public.

- Employees would be trained, as necessary, in tower climbing, cardiopulmonary resuscitation, first aid, rescue techniques, and safety equipment inspection.

- Assure that the contractor complies with State regulations regarding on-site fire equipment.

- To minimize the risk of fire, fuel all highway-authorized vehicles off-site. Fueling of construction equipment that was transported to the site via truck and is not highway authorized would be done in accordance with regulated construction practices and state and local laws. Helicopters would be fueled and housed at local airfields or at staging areas.

- Helicopter pilots and contractor take into account public safety during flights. For example, flight paths could be established for transport of project components in order to avoid flying over populated areas or near schools (Helicopter Association 1993).

- Provide notice to public of construction activities, including blasting.

- Take appropriate safety measures for blasting consistent with state and local codes and regulations. Remove all explosives from the work site at the end of the workday.

- If implosion fittings are used to connect the conductors, install in such a way as to minimize potential health and safety risks.

- Operation and maintenance vehicles would carry fire suppression equipment including (but not limited to) shovels and fire extinguishers.

- Stay on established access roads during routine operation and maintenance activities.

- Keep roads watered.
- Keep vegetation cleared according to BPA standards to avoid contact with transmission lines.
- Submit final tower locations and heights to the Federal Aviation Administration for review and potential marking and lighting requirements.
- Construct and operate the new transmission line to meet or exceed the National Electrical Safety Code.
- During construction, follow BPA specifications for grounding fences and other objects on and near the proposed right-of-way.
- Burning would not be allowed for clearing.

Visual Resources

Affected Environment

- The project area encompasses a variety of landscape settings ranging from the Roosevelt Lake reservoir and the rugged basalt outcrops near Grand Coulee to agricultural, rangeland and scrubland over most of the route, to urban environments near and in Spokane.
- At the west end of the corridor near the Columbia River, terrain is rugged, with large basalt outcrops, steep slopes and canyons. The area is scenic because the landscape is vast and encompasses a variety of landscape features of differing form, color, and texture, including the Grand Coulee Dam and Lake Roosevelt.
- The setting in the eastern part of the study area is more urban and varied. It includes the scenic Spokane River and adjacent park land; residential, commercial, and institutional areas east of the Spokane River; and an industrial landscape near Bell Substation.

Environmental Consequences

- Temporary viewscape changes during construction.
- Low to high visual impacts due to change in views for residents in the Grand Coulee and Spokane areas, and for users at North Dam Park and Riverside State Park.

- Moderate to high impacts to viewers of line where it crosses the Spokane River.
- Moderate to high impacts to residents of housing developments east of Nine Mile Road and in other areas between there and Bell Substation.
- Potentially high impact for viewshed from archaeological site near Grand Coulee.

Cumulative Impacts

- The rough texture and dark brown color of the existing wood pole structures are natural looking, smaller, weather to a lighter color, and tend to blend into the surrounding landscape better over time.
- The proposed project would increase the number of steel structures within the corridor in relation to what exists today, leading to greater combined visual impacts associated with the corridor's transmission lines.
- Greater residential development could occur in the vicinity of the line that would contribute to greater cumulative impacts over time.
- The greatest cumulative impact would be in the urban Spokane area where residents, recreational uses and scenic views would be affected.

Mitigation

- Use tower steel that has been treated to reduce reflectivity.
- Use non-specular conductors.
- Use non-luminous insulators (i.e., non-ceramic insulators or porcelain).
- Plant vegetative screens, do selective clearing/tree topping at Riverside State Park and other selected sites.
- Use existing topography and vegetation when ever possible to limit views of lines and structures.
- Locate construction staging areas out of site of potential viewers as much as possible.
- Require contractors to maintain a clean construction site.
- Maintain permanent access roads.

Air Quality

Affected Environment

- The Grand Coulee-Bell Corridor project area has an arid to semiarid climate.
- Most winds in eastern Washington are from the north during the fall and winter, and from the south and southwest during spring and summer.
- Portions of the Spokane area have been designated as non-attainment areas for particulate matter less than 10 microns in diameter (PM-10) and for carbon monoxide because the area has exceeded National Ambient Air Quality Standards for these pollutants on a persistent basis.
- The corridor passes through about 6 miles of the non-attainment area for each of these pollutants.

Environmental Consequences

- Short-term increase in pollutant levels during construction.

Cumulative Impacts

- Eastern Washington, including the Spokane area, experiences air quality pollution problems from particulates associated with burning of grass seed fields, dust from farm fields, and wildfires. The proposed action would contribute to these prevailing problems on a short-term basis during construction.

Mitigation

- Use water trucks to control dust during construction.
- Use low sulfur fuel for on-road diesel vehicles.
- Lop and scatter, pile, mulch, chip, or take woody debris and other vegetation off-site.

Cultural Resources

Affected Environment

Cultural Resources

- A 1994 survey identified 29 prehistoric sites.
- Seven historic cultural sites were identified in a 1994 study in or near the corridor.
- A 2002 survey identified five additional prehistoric sites located within the project area or immediate vicinity of the project, but determined that most of the previously recorded sites were considered not to be cultural in origin.
- Six previous archaeological investigations were conducted in the vicinity of the Bell Substation; no recorded archaeological sites were located in the project area of potential effect.
- A 2002 survey of the substation expansion area and vicinity resulted in the identification of two historic-period cultural resources; one is within the substation expansion area.
- No evidence for historical cemeteries was observed in the surveyed area.

Environmental Consequences

- Unless avoided by construction activities, potential for direct disturbance effects of several prehistoric and historic sites (low to high impact levels). Four of the archaeological sites are considered to have traditional cultural property values.
- Unless avoided, possible disturbance (moderate effect) of two archaeological sites by dismantling of the existing 115-kV line in the Grand Coulee area.
- High potential effect on historic site at Bell Substation.

Cumulative Impacts

- Any disturbance of sites would contribute to overall degradation of cultural resources that accompanies development. On the other hand, information learned from the identified sites contributes to greater knowledge of prehistoric and historic culture.
- The construction alternatives would improve access to sites and could increase the potential for impacts to them.

Mitigation

- Position tower locations to provide avoidance of cultural resources.
- Locate new access roads to avoid cultural resources.
- Limit road improvements to the existing roadbed when in close proximity to known cultural resource sites.
- Avoid cultural resource sites when dismantling the portion of the 115-kV line in the Grand Coulee area.
- Mitigate impacts for sites that are eligible for NRHP listing and cannot be avoided.
- Halt work if cultural resources are discovered during construction activities and engage cultural resource specialists to evaluate the discoveries.

Socioeconomics

Affected Environment

- Except for the Spokane area, the study area is sparsely populated.
- Farming is the principal economic activity in the rural counties; Spokane County's economy is diversified.
- The four-county area lags the state in per capita income levels.
- Disproportionate low-income and minority populations are not present based on average statistics for the four-county area.

Environmental Consequences

- Minimal impact on housing to meet construction worker needs.
- Beneficial impact on employment, personal income, and local sales tax revenues.
- Small amount of foregone agricultural production.
- Low potential for trespass and vandalism of homes and businesses.
- Low potential for long-term adverse impacts on property values.

- No disproportionate impacts on low-income or minority populations.

Cumulative Impacts

- Some cultivated areas within the project area would be temporarily taken out of agricultural production. The amount is negligible compared to the decreases in cultivated land over the last 10 years. There are no known plans or programs that would reduce the agricultural land base to which the project would cumulatively contribute.

- Other than normal economic growth in the Spokane area, there are no other known plans or proposed projects in the area that would result in adverse cumulative socioeconomic impacts. Project employment and income impacts would represent a very small fraction of regional employment and income levels now and in the future.

Mitigation

- Compensate landowners at fair market value for any new land rights required for easements for new right-of-way or for access roads.

- Compensate farmers for crop damage.

- Correct soil compaction or compensate landowners.

- Site towers to maintain efficient crop patterns and minimize adverse impacts to farming activities.

Soils and Geology

Affected Environment

- The corridor for the proposed transmission line is within the northern boundary of the Columbia River Plateau, a broad rolling basalt plateau that slopes gently to the southwest. Topography is gently rolling to moderately hilly; elevations generally range from 985 to 1,970 feet above mean sea level. Landforms include uplands covered by loess (wind-deposited sediment), channeled scablands, canyons, and river terraces.

- Channeled scablands are unique geologic features that are found primarily within the western half of the corridor and within scattered areas in the eastern half of the corridor. These areas consist of numerous dry, deeply cut channels in Columbia River basalt and typically contain shallow, stony soils.

- Soils along the project corridor have formed primarily in loess, glacial outwash, colluvium, alluvium, and weathered granite. Four general categories of soils occur within the corridor: deep silt loam soils, shallow rocky soils, deep sandy soils, and soils found in deep canyons.

- Approximately 50 percent of the corridor has a low erosion susceptibility, 41 percent a moderate erosion susceptibility, and 7 percent a high erosion susceptibility, which is usually associated with the steep slopes of canyons.

Environmental Consequences

- Disturbance of the ground surface and subsurface and removal of vegetation during existing structure removal, construction area clearing, new access road construction, existing access road improvements, and structure site preparation increase the risk of soil erosion and mass movement, and may change soil productivity and physical characteristics.
- Soils at conductor tensioning sites and staging areas will be compacted during construction, thereby affecting soil productivity, reducing infiltration capacity, and increasing runoff and erosion.
- In areas along the corridor where loess soils have developed as a result of wind deposition, removal of vegetation at construction sites would likely increase the rate of wind erosion.
- The level of impacts would range from low to high.

Cumulative Impacts

- Agricultural practices can be a major contributor to soil erosion and increased sedimentation of streams. On slopes over 7 percent, it is estimated that cultivated soils have lost over 6 inches of topsoil over a 90-year period (U.S. Department of Agriculture, Soil Conservation Service, October 1981).
- Interference with existing or planned conservation measures could result in increased or continued erosion and subsequent sedimentation.
- Where practical, new transmission towers will be aligned with existing steel towers, thus interference with farm conservation efforts is not expected.
- It is expected that these increases in erosion, runoff, and sedimentation would contribute minimally to the area's ongoing soil loss and sedimentation of drainages.

Mitigation

- Properly spaced and sized culverts, cross-drains, and water bars will be used. Contractors will armor ditches and drain inlets and outlets where needed for erosion control.
- Avoid construction on steep, unstable slopes if possible.
- All excavated material not reused would be deposited in an upland area and stabilized. No used material would be deposited in environmentally sensitive areas such as streams, riparian areas, wetlands, or floodplains.
- Apply erosion control measures such as silt fence, straw mulch, straw wattles, straw bale check dams, other soil stabilizers, and reseeding disturbed areas as required (prepare a Stormwater Pollution Prevention Plan).
- Regularly inspect and maintain project facilities, including the access roads, to ensure erosion levels remain the same or less than current conditions.
- Where agricultural and rangeland soils are compacted, assistance would be provided to farmers and ranchers for subsoiling to restore soil productivity.

Water Quality

Affected Environment

Surface Water

- The corridor crosses 34 perennial streams and 55 ephemeral streams. An east-to-west trending ridge spans most of the project area, creating two separate drainages. Streams on the north side of the ridge flow to the north into the Columbia or Spokane rivers. Drainage south of the ridge follows broad, shallow scabland channels from northeast to southwest before eventually reaching Crab Creek and the Columbia River.
- No surface water quality problems are reported in the perennial and ephemeral streams that cross the corridor except for Sherman Creek, Deep Creek, and the Spokane River.

Groundwater

- Groundwater quality is generally good to excellent throughout the area. Groundwater is the major water source for public water supplies, irrigation, and industrial uses for most of the area.

- Basalts of the Columbia River group are the most important groundwater aquifers west of the Spokane River. The aquifers are chiefly permeable zones lying between the top and bottom of successive basalt lava flows. Intermittent stream channels of the scablands recharge groundwater to the aquifers. Regional movement of groundwater in the aquifers is generally to the southwest.

- The Environmental Protection Agency (EPA) has proposed the Eastern Columbia Plateau Aquifer System as a sole source aquifer.

- The Spokane Valley-Rathdrum Prairie aquifer is the major source of domestic water for Spokane County residents. EPA designated this aquifer a sole source aquifer.

Environmental Consequences

Surface Water

- Surface water quality could be impacted in the vicinity of perennial and ephemeral streams due to erosion, increased runoff, and sedimentation associated with construction of new access roads, access road improvements, and construction of spur roads to new tower sites. The potential for impacts would depend on the timing of construction, the presence or absence of water in the stream, the weather conditions, local topography, the erosion potential of soils, and the effectiveness of standard control practices implemented during construction to minimize soil erosion. The likelihood that water quality would be adversely impacted in these streams is low.

- Culvert placement and the installation of new culverts could cause temporary increased erosion and degradation of water quality due to increased turbidity.

- Potential contamination of surface water resources during project construction could result from accidental spills or leaks of petroleum products used by construction equipment.

- The removal of vegetation at construction sites has the potential to increase wind and water erosion rates and surface water temperature. Erosion rates would most likely return to their current level following construction if plants become reestablished at these sites, naturally, or through revegetation. The potential for water temperature to be impacted is low as not all of the riparian vegetation would be removed within the corridor and the width of the riparian vegetation that is within the corridor is only a small fraction of the total length of the streams that cross the corridor.

- Potential impacts to surface waters from routine maintenance activities are expected to be low.

Groundwater

- Construction activities generally would not be expected to directly or indirectly impact groundwater aquifers (no to low impact level).
- Potential spills or leaks of petroleum products used by construction equipment would likely be of insufficient volume to present risk to groundwater resources. Potential impacts to groundwater from construction activities are expected to be low.
- The removal of the 115-kV conductor and poles, clearing of vegetation at tower construction sites, and the assembly of new towers may result in localized soil compaction, thereby reducing infiltration capacity and increasing surface runoff to streams.
- Routine operation and maintenance of the transmission line is not expected to impact groundwater quality.

Cumulative Impacts

- Agricultural practices can be a major contributor to soil erosion and increased sedimentation of streams. The U.S. Department of Agriculture's Conservation Compliance Program for Highly Erodible Land was instituted to promote soil conservation practices among farm operators.
- Interference with farm conservation efforts is not expected compared to existing conditions. It is expected that soil erosion and sedimentation increases would contribute minimally to the area's ongoing soil loss and sedimentation of drainages, thus resulting in minimal impacts to water quality.

Mitigation

- Culverts will be properly sized and spaced and BPA would work with the Washington State Department of Fish and Wildlife (WDFW) to comply with hydraulic permit requirements
- No solid materials, including building materials, would be discharged into waters of the United States unless authorized by a Section 404 permit of the Clean Water Act.
- Off-site tracking of sediment and dust generation shall be minimized.
- Vegetative buffers would be left along stream courses to minimize erosion and bank instability, where possible.

- Schedule construction during periods when precipitation and runoff are at a minimum, when practical.

- All excavated material not reused would be deposited in an upland area and stabilized. No used material would be deposited in environmentally sensitive areas such as streams, riparian areas, wetlands, and floodplains.

- Avoid construction within designated wetland and wetlands buffers to protect potential groundwater recharge areas.

- Locate structures, new roads, and staging areas so as to avoid waters of the U.S. Limit disturbance to the minimum necessary when working in or next to water bodies.

- Avoid mechanized land clearing within stream channels and riparian areas to avoid soil compaction from heavy machinery, destruction of live plants, and potential alteration of surface water patterns to reduce groundwater turbidity risk.

- Apply erosion control measures such as silt fence, straw mulch, straw wattles, straw bale check dams, other soil stabilizers, and reseeding disturbed areas as required (prepare a Stormwater Pollution Prevention Plan).

- Regularly inspect and maintain project facilities, including the access roads, to ensure erosion levels remain the same or less than current conditions.

- Avoid refueling and/or mixing hazardous materials where accidental spills could enter surface or groundwater.

- Use existing road systems, where possible, to access tower locations and for the clearing of the transmission line alignment.

- Avoid construction on steep, unstable slopes if possible.

Wetlands

Affected Environment

- A total of 43 wetlands were identified within the project corridor. Most wetlands within the corridor are emergent, seasonally flooded, isolated, depressional wetlands that are flooded by precipitation and/or snowmelt.

- Some wetlands in the corridor are locally important because they function as a source of water in an arid environment, providing valuable habitat for waterfowl and resident and migrating birds.
- Most of the wetlands in the corridor are in excellent condition and vegetated primarily with native species.

Environmental Consequences

- Construction of new towers, the removal of existing structures, new access road construction, and access road maintenance would avoid wetlands and are not expected to result in direct impacts (filling) to wetlands; low to moderate impacts to several wetlands located within 100 feet of access roads or towers could occur.
- Areas needed for access roads or tower placements, therefore no impacts are expected.
- Operation and maintenance of the transmission line could result in low to moderate impacts to wetlands due to the possible clearing of tall wetland vegetation (trees).

Cumulative Impacts

- Incremental losses and degradation of wetlands over time have depleted wetland resources.
- Some wetlands were previously impacted by construction of the existing lines (from access road construction and placement of structures in wetlands) and from agricultural activities.
- Executive Order 11990 requires Federal agencies to avoid adverse impacts to wetlands to the extent possible; BPA will span or avoid wetlands where possible.

Mitigation

- Before construction, wetlands with the potential to be impacted will be identified and flagged on the ground by a wetlands specialist.
- Avoid construction within designated wetland and wetlands buffers to protect potential groundwater recharge areas by avoiding wetland flagged areas.
- Locate structures, new roads, and staging areas so as to avoid waters of the U.S., including wetlands.
- Limit disturbance to the minimum necessary when working in or next to wetlands.

- Avoid mechanized land clearing within wetlands and riparian areas to avoid soil compaction from heavy machinery, destruction of live plants, and potential alteration of surface water patterns to reduce groundwater turbidity risk.
- Apply erosion control measures such as silt fence, straw mulch, straw wattles, straw bale check dams, other soil stabilizers, and reseeding disturbed areas as required (prepare a Stormwater Pollution Prevention Plan).
- Regularly inspect and maintain project facilities, including the access roads, to ensure erosion levels remain the same or less than current conditions.
- Avoid refueling and/or mixing hazardous materials where accidental spills could enter surface or groundwater.
- Use existing road systems, where possible, to access tower locations and for the clearing of the transmission line alignment.
- Avoid construction on steep, unstable slopes if possible.
- Place tower footings on upland areas and limit access road construction adjacent to wetlands, if possible.
- All excavated material not reused would be deposited in an upland area and stabilized.
- Where feasible, top trees instead of removing trees so roots and soil remain intact.

Vegetation

Affected Environment

- Four major vegetative communities were identified along the corridor using land use information (agricultural lands (50 percent), grass/forb and lithosol (3 percent), shrub/steppe (20 percent), and forest/deciduous shrub (25 percent). Other relatively non-vegetated areas (2 percent) in the project area include rocky outcrops, and disturbed areas such as gravel pits, open water.
- Grass/forb communities grow mainly within channelized scablands, where the topography is characterized by a series of small mounds, usually less than 50 feet in diameter, with intervening low lying areas, often lithosols.
- The shrub steppe community is found mainly on scablands common across the western portion of the corridor from the Grand Coulee Switchyard to near the town of Creston.

- The forest and deciduous shrub community typically occurs as scattered patches within agricultural areas, along drainages and in canyons.

- USFWS has identified three federally -isted threatened species, Ute Ladies'-tresses (*Spiranthes diluvialis*), Spalding's catchfly (*Silene sapldingii*), and Howellia (*Howellia aquatilis*) as having potential habitat present within the project corridor. A survey of the corridor identified potential habitat for Ute ladies'-tresses and Spalding's catchfly. Some of the wetlands within the project area are potential habitat for Ute ladies'-tresses. Potential Spalding's catchfly habitat is present within some of the forest/deciduous shrub community, as evidenced by the presence of the species it is normally associated with.

- Some weeds were noted in the project area during the summer of 2002 and a comprehensive weed survey will be conducted prior to construction. Weeds of concern within the project area include Canada thistle, common tansy, dalmation toadflax, diffuse knapweed, perennial sowthistle, and St. John's wort.

Environmental Consequences

- Tower construction would remove vegetation from immediate work areas and cause direct, short-term impacts to vegetation; the total area disturbed would be about 210 acres, about one-half of this in agricultural fields. The level of impacts would be moderate.

- New access road and spur road construction and access road maintenance would occur mainly in shrub steppe community areas that have already been disturbed by access road use and are not likely to be substantially affected by access road construction or improvement.

- Vegetation would be impacted by the operation of the transmission line. Maintenance typically involves removing tall trees that could interfere with lines, and keeping access roads open. The continued use of access roads within the project corridor could continue to cause indirect impacts such as soil compaction, damaging root structures, and dust clogging leaf surfaces. Because the maintenance activities would be almost entirely within an existing corridor that has been maintained for nearly 50 years, continued maintenance would have low to moderate impacts.

- Disturbed areas such as transmission corridors often become infested with noxious plant species. BPA would take measures to lessen the spread or introduction of noxious plants during construction. The level of impacts would be low to moderate.

- A biological assessment analyzing the effects of the project on federally-listed threatened and endangered species will be conducted pursuant to Section 7 of the Endangered Species Act.

Cumulative Impacts

- During the last century, agricultural development in the project area has had a significant impact on the amount of native plant communities within the landscape and on native plant ***biodiversity***. Due to the high value of some agricultural lands within the Columbia River Basin, the loss of shrub/steppe has accelerated. Within the area, the Department of Natural Resources continues to offer leases to state-owned lands for agricultural uses. In Washington, the continued loss of shrub/steppe in the next 50 years is projected to be high.

- Impacts to rare plant species could occur due to land use such as grazing, but it is likely that federal agencies will prioritize the protection of rare species habitats. However, rare plant species in private areas receive little to no protection under federal and state rare and endangered species legislation. Rare species would be continued to be impacted by a variety of land uses typical of private lands, including farming, ranching and development.

- Native steppe and shrub/steppe communities have declined substantially in recent years; however, such undisturbed plant communities are essentially absent from the corridor. The evidence supporting this conclusion is the presence of a diversity of native species that have persisted in the corridor despite the operation and maintenance of four transmission lines.

Mitigation

- Keep the proposed project within the existing corridor; locate staging areas and conductor tensioning sites outside of good quality native habitat areas.

- Use existing access roads, with minimal development of new roads.

- Keep additional vegetation clearing to the minimum needed to maintain safety and operational standards.

- Reseed or revegetate disturbed areas following construction.

- Conduct a pre- and post-construction noxious weed inventory to gather baseline information and determine the need for a noxious weed control plan including preventing noxious weed infestations by cleaning equipment traveling in and out of noxious weed-infested areas, using herbicide or biocontrol treatments, and reseeding disturbed areas with native species.

- If federally listed plant species are identified during the plant survey, these areas would be avoided, if possible. A Biological Assessment, as required under the Endangered Species Act, would be produced and detailed actions to reduce or eliminate impacts on listed species would be discussed.

Fish

Affected Environment

- The corridor crosses 89 streams. The majority (55) are ephemeral non-fish-bearing streams that contain flowing water only during relatively brief periods following snow melt or rain storms. The remaining 34 streams are considered to be perennial and contain some water year-round during normal rainfall years. The corridor crosses only three creeks (Hawk Creek, Coulee Creek, and Deep Creek) and the Spokane River that contain sufficient water flow to support seasonal or year-round fisheries.

- Hawk Creek, which contains flowing water year-round, is thought to contain populations of brook and rainbow trout. Bull trout may occasionally enter the lower creek, but are prevented from moving upstream by Hawk Creek Falls.

- Coulee Creek and Deep Creek are ephemeral streams. When water is flowing in these creeks they are thought to support brook and rainbow trout.

- The Spokane River supports fish species adapted to both riverine and lacustrine environments. Salmonid species include rainbow trout, brown trout, and mountain whitefish. Other fish species may include largemouth sucker, sculpins, dace, redside shiner, and northern pikeminnow.

- Bull trout that may occur in the Spokane River in the vicinity of the project are believed to be migrants from the Pend Oreille bull trout stock as water temperatures in the Spokane River are considered to be too high to allow the fish to successfully reproduce. Although the Pend Oreille stock is regulated under ESA, bull trout within Lake Roosevelt or its tributaries are not regulated under ESA.

Environmental Consequences

- Routine operation of the transmission line is not expected to have any impacts on fish.

- Construction could cause short-term and localized increases in turbidity and sediment in fish-bearing streams due to the erosion of exposed soils entering the streams. Increases in turbidity could result in avoidance of immediate work areas by fish. Increases in sediment during the spawning and incubation period could result in sediment deposition over spawning areas, suffocating eggs and fry. Removing riparian vegetation during construction and maintenance could increase water temperatures above those preferred by fish, reduce vegetative cover along stream banks and reduce rates of wood recruitment into the stream. The level of impacts could range from low to high depending upon timing of construction.

Cumulative Impacts

- In the Columbia River Basin ecosystem, fish distribution and population have been reduced by loss, fragmentation, and degradation of streams. Species such as salmon and trout have declined dramatically in the region since the conversion of rivers to reservoirs.
- Erosion and sedimentation of streams and loss of riparian habitat within the study area has increased over the past 100 years due to land use practices such as grazing, agriculture, road building, land clearing, military operations, and other disturbances, contributing to stream habitat degradation.
- The planned improvements to the access road in the vicinity of Hawk Creek are expected to have long-term beneficial effects on fish populations by reducing the amount of road runoff and erosion that is currently occurring in the vicinity of this creek.

Mitigation

- Use silt fences and straw bales to separate construction activities from watercourses and drainages.
- Limit disturbance to the minimum necessary when working adjacent to fish-bearing streams.
- Avoid mechanized land clearing within riparian areas to avoid soil compaction from heavy machinery, destruction of live plants, and potential alteration of surface water patterns.
- Deposit and stabilize all excavated material not reused in an upland area. No used material would be deposited in environmentally sensitive areas such as streams, riparian areas, wetlands, and floodplains.
- Apply erosion control measures such as silt fence, straw mulch, straw wattles, straw bale check dams, or other soil stabilizers in the vicinity of fish bearing streams.
- Coordinate with the WDFW on placement or replacement of suitable-sized culverts at all drainage crossings.
- Revegetate all construction-caused, exposed soils with native plants.

- Avoid refueling and/or mixing hazardous materials where accidental spills could enter surface or groundwater.

- Avoid construction activities near fish-bearing streams during the April-June period of trout egg incubation to the extent possible.

Wildlife

Affected Environment

- The corridor passes through three major wildlife habitat communities: agricultural, steppe (grass/forb and shrub steppe vegetation communities), and pine forest. In addition, the corridor crosses distinct, localized habitat areas: riparian and riverine habitats along the Spokane River; rock outcroppings and cliff habitats between the Columbia River and Banks Lake; and areas disturbed by urban development north of Spokane.

- Agricultural habitat does not support large wildlife populations; however, it does provide cover for short periods of time while vegetation is maturing, and emerging sprigs and waste grain provide a food source.

- Steppe habitat includes grass/forb and shrub steppe vegetation communities and over 70 wildlife species use these areas.

- Forested and deciduous shrub habitat forests provide habitat for a variety of wildlife, especially the peregrine falcon, western tanager, Cassin's finch, red crossbill, wild turkey, yellow pine chipmunk, and porcupine. Pine habitats near the Spokane River riparian zone are heavily used by Northwest white-tailed deer and beavers.

- Along and near the corridor priority habitat for mule deer, northern white-tailed deer, Rocky Mountain elk, bald eagle, sharp-tailed grouse, riparian priority habitats, and Urban Natural Open Spaces are designated.

- USFWS has identified two federally-listed species as potentially occurring in the area: bald eagles, listed as threatened, and the pygmy rabbit, listed as endangered. No habitat for bald eagles exists in the corridor. Although portions of the corridor are comprised of the shrub steppe habitat preferred by pygmy rabbits, no known populations exist within the corridor.

Environmental Consequences

- Increases in noise and loss of vegetation due to construction activities could have short- and long-term impacts to wildlife within and adjacent to the transmission line corridor. Noise associated with construction activities occurring during the breeding season

(March to August) in shrub steppe, forested, and riparian habitats, where wildlife abundance and diversity is usually greatest, could have a high impact.

- The level of impacts to wildlife habitat by removing vegetation during construction would be low to high.

- Road work, including construction of spurs, new access roads, and improvements to existing access roads, would cover approximately 25.5 miles and 80 acres. About 80 percent of this loss would be in steppe habitats, mostly shrub steppe. Impacts from road work are expected to be low to high.

- Some level of ongoing waterfowl, and perhaps raptor, mortality would be expected to occur as a result of the installation of the new transmission lines. Waterfowl losses to transmission line collisions are rarely shown to be biologically significant. Any raptor collisions would not be at levels that would change local breeding populations or distributions.

Cumulative Impacts

- In the Columbia River Basin ecosystem, biodiversity has been reduced by loss and fragmentation of native habitats, especially shrub/steppe habitat and dependent wildlife communities. Species dependants on shrub/steppe habitat, such as Columbian sharp-tailed grouse and pygmy rabbits, have declined dramatically in the region since conversion of steppe to agriculture land. The proposed project would contribute marginally to the loss of habitat.

- Important vegetation corridors connecting key wildlife habitats, such as riparian zones and Urban Natural Opens Space areas, in most cases would not be substantially impacted by the project.

Mitigation

- Mark with bird flight diverters or remove the ground wire at the span crossing the Spokane River and where the line spans wetlands.

- Limit removal of large riparian trees at the Spokane River crossing.

- Limit the removal of forest habitat to only those trees that would directly interfere with transmission lines. Retain or create snags within the corridor at a density of at least 2 snags per 1 acre. This partially compensates for forest characteristics lost during tree removal.

- When possible, avoid construction activities within high-use native habitats, especially riparian, tall sagebrush, and dense pine forest habitats, during the breeding season (March 1 to August 15).

- Gate and lock access to the corridor, especially where the corridor crosses habitats heavily used by wildlife.
- Limit vehicular travel to access roads through sensitive habitat such as shrub/steppe.

Floodplains

Affected Environment

- The corridor crosses seven drainages identified on Federal Insurance Rate Maps as 100-year floodplains (Sherman Creek, Hawk Creek, Stock Creek, Coulee Creek, Deep Creek, the Spokane River, and Country Homes Canal).

Environmental Consequences

- All floodplains would be spanned; no impacts are expected due to construction of new towers, staging areas, or tensioning sites.
- Improvements to existing access roads and construction of new access roads are expected to have no impacts on floodplains.
- Existing wood pole structures located in or adjacent to floodplains would be cut off at ground level to avoid potential impacts associated with excavation and backfilling; no impacts would be expected.
- Riparian vegetation associated with proposed new right-of-ways in floodplain areas is not expected to be substantially impacted, thus no impact to floodplains is expected from new right-of-ways.
- Operation and maintenance are expected to have no impact on floodplains.

Cumulative Impacts

- The proposed project would not contribute to cumulative impacts to floodplains.

Mitigation

- Design the project to locate roads and structures to avoid floodplains completely.
- Locate structures to minimize the potential for creating obstructions to floodwaters.

- Near floodplain areas, deposit all excavated material not reused in an upland area and stabilize it.
- Re-contour and re-vegetate disturbed areas near floodplains with native and local species.
- Remove debris from construction and clearing within and near floodplains.

Chapter 1
Purpose of and Need for Action

This chapter provides descriptions of:

- Need for Action
- Purposes (Decision Factors)
- EIS History
- Decisions to be Made
- Cooperating Agencies
- Scoping and Major Issues

The ***Bonneville Power Administration (BPA)***[1], a federal agency, owns and operates over 15,000 miles of ***transmission lines*** throughout the Northwest. BPA uses its ***transmission system*** to market and transmit power from the federal hydropower system in the Northwest. BPA also transmits power that it purchases and markets from other generation sources in the region to adequately serve its customers, as required by statute.

BPA enters into contracts to deliver power where it is needed. These ***obligation***s include ***long-term firm transmission agreements*** with entities that generate power and with utilities that provide electricity for homes, businesses, and farms in the Northwest. BPA's customers also include large ***direct service industries (DSIs)***, such as aluminum plants, and the agency provides power to regions outside of the Northwest, such as Canada and California.

This chapter explains a problem that exists in eastern Washington on BPA's transmission system. It describes conditions that have come together to create a need for action to solve the problem, and identifies objectives (purposes) to be achieved that BPA will use to evaluate possible alternative solutions.

[1] Words and acronyms in bold are defined in **Chapter 8 Glossary and Acronyms.**

Need for Action

BPA needs to take action to ensure that it can continue to meet its statutory and contractual obligations to deliver power to where it is needed.

BPA has a statutory obligation to ensure that there is sufficient ***capacity*** in its transmission system to serve its customers, and to ensure that the system is safe and reliable. Among many other requirements, the Federal Columbia River Transmission Act directs BPA to construct additional transmission lines that are necessary to integrate and transmit electric power from Federal and non-federal generating sources [16 U.S.C. §838b(a)]; and to construct additional transmission lines necessary for maintaining the electrical stability and reliability of the transmission system [§ 838b(d)]. Reliability standards are developed by the industry to minimize risks to public safety and to equipment. In addition, the Act directs BPA to construct transmission system additions required to provide interregional transmission facilities [G838b(c)].

As part of its transmission system, BPA owns and operates several transmission lines in eastern Washington that move electricity from generation sources in Montana such as Libby and Hungry Horse dams to load centers to the west (e.g., Seattle, Washington and Portland, Oregon). The system also transmits power from generation sources in northern Idaho and northeastern Washington. The portion of the system west of Spokane, Washington, that transfers power from east to west, called the "West of Hatwai" transmission path, has a total capacity of 2,800 ***megawatts (MW)***. Of this capacity 2200 MW is allocated to BPA and 600 MW to Avista, an electric utility with facilities in eastern Washington and northern Idaho. The full capacity of this path historically has been used to transport firm power from east to west. BPA has the ability to use Avista's share of 600 MW only if it is available, and the additional 600 MW would not be firm power because BPA would not be able to guarantee that the capacity would be always available.

Since the mid-1990s, the West of Hatwai transmission path has grown increasingly constrained. To date, BPA has been able to manage operation of the path through all available operating practices, including short-term remedial actions. As a result, generation was not severely curtailed and customer needs have been met while maintaining the reliability of the path. However, in early 2001, the problem was made worse when two of BPA's large DSI customers located east of the transmission path closed their facilities. These customers were aluminum smelters with a combined load of approximately 800 MW that was served by generation sources in Montana. The closure of these smelters meant that this 800 MW now flows west across the West of Hatwai transmission path instead of serving the two DSIs. Because the path does not have the capacity to handle this excess energy, all of this energy must compete for space with other users of the path, which creates severe transmission congestion. Under these conditions, the system is at risk of ***overloads*** and violation of industry safety and reliability standards.

Although the capacity and reliability problems of this path exist year round, the problem is particularly acute in the spring and summer months because of the large amount of power generated by dams east of the path. During these months, spring runoff increases water flows, and reservoirs behind the dams reach high levels. While some of this water is spilled to aid migrating fish in their downstream journey, large amounts of water cannot be spilled due to potential adverse effects on those fish. This means that more water must flow through turbines at the dams, which generates more power. The amount of power that needs to move through this area during these months at times could exceed the carrying capacity of the existing transmission lines. The resulting congestion can be likened to that caused by all the interstate traffic from a six-lane freeway being funneled for 84 miles onto a narrow, two-lane state route.

Operations in summer 2001 showed that using all available operating practices to mitigate the capacity limitations of the West of Hatwai transmission path is insufficient as a long-term solution to ensure the flow of power while maintaining system reliability. The problems that occurred in 2001 showed that the risk for future generation curtailments is already too high, and that the problem must be solved on a long-term basis as soon as possible. Because of the time required for completing the environmental review and for design and construction of potential facilities, 2004 likely is the earliest possible date that a long-term solution could be implemented.

If additional capacity is not added, BPA will run a significant risk that it will not be able to continue to meet its contractual obligations to deliver power and still maintain reliability standards that minimize risks to public safety and to equipment. Action thus is needed to allow BPA to continue to fulfill its contractual obligations, as well as to comply with BPA's Congressional mandates to provide necessary interregional transmission facilities and adequate transmission capacity, and to maintain electrical system stability and reliability.

Purposes

Purposes are goals or objectives to be achieved while meeting the underlying need. The purposes identified below have been used to evaluate the reasonableness of a wide range of potential project alternatives. In addition, BPA decision-makers will consider how well the alternatives evaluated in detail in this EIS meet these purposes when making a decision among them. In this case, the alternative selected should:

- Maintain transmission system reliability to industry standards;
- Comply with BPA's statutory obligations;
- Continue to meet BPA's contractual obligations;
- Minimize environmental impacts;
- Minimize costs; and
- Allow BPA to solve its transmission capacity problem by no later than fall 2004.

EIS History

BPA previously identified a problem on this part of the system in the early 1990s. At that time, BPA prepared a preliminary ***Environmental Impact Statement (EIS)*** and presented alternative solutions to the public, which included new, much longer transmission lines. The EIS was not completed, and the problems identified at the time were solved in other ways (see Chapter 2).

Since then, BPA has continued to examine the long-term performance of the system and has determined that it must take action as soon as possible to solve problems in the area. In developing the current set of alternatives, BPA used input from the public received during the earlier EIS process. Input was also received during the public scoping process for this EIS as well as from other outreach efforts. BPA also consulted with a technical and economic review committee, consisting of individuals from other utilities and BPA customers, who evaluate proposed transmission projects based on whether they provide the most effective solutions from a "single utility" planning concept: in other words, as though the Northwest's electrical system were operated by only one entity. Chapter 2 discusses the actions that BPA has taken to date to solve the problem, as well as solutions currently proposed or eliminated from consideration.

This EIS (which builds on the preliminary document prepared in the mid-1990s), and its review by the public, will help refine the potential solutions. Chapter 3 identifies the environmental resources that could be affected, and discloses the potential impacts to the resources that could be caused by the alternatives identified to date.

Decisions to be Made

BPA is distributing the Draft EIS to the public and other agencies and entities for review and comment. BPA will consider the comments it receives, respond to them, and make any necessary changes to the proposal or impacts in a Final EIS. Decision-makers will then use the Final EIS to make the following decisions.

- BPA must decide whether or not to build a new transmission line to meet the need (see Chapter 2 for descriptions of specific proposals and alternatives).
- If the decision is to build a transmission line, BPA must select one of the alternatives described in Chapter 2, identify the factors leading to this decision, and identify which measures discussed in the EIS to mitigate construction and operational impacts have been adopted.
- If BPA decides to build a transmission line, Bureau of Reclamation (BOR), a cooperating agency (see "Cooperating Agencies" section below), must decide if the project meets the conditions of the long-standing Memorandum of Understanding with BPA to allow the crossing of BOR land and waterways.

Cooperating Agencies

When a project could involve more than one federal agency, those agencies often work together during the planning and decision-making process. Because BPA is proposing to take action to address problems on the West of Hatwai transmission path, BPA is the lead federal agency on this project and supervises the preparation of the EIS. The proposed project crosses land managed by the U.S. Department of Interior, Bureau of Reclamation (BOR) at Grand Coulee Dam, and the western end of the proposed line terminates at BOR's Grand Coulee Switchyard. BOR thus has agreed to cooperate in the EIS process.

Scoping and Major Issues

Scoping refers to a time early in the NEPA process when the public may help define the issues and concerns that should be considered in an EIS.

In scoping the EIS, BPA contacted people who lived along or near the proposed transmission line route, federal, state, and local agencies who manage lands or have other jurisdictions along the route, Indian tribes in the area, and interest groups. BPA sought and received comments in a number of ways.

On January 14, 2002, BPA published a Notice of Intent to prepare an EIS and to conduct public scoping meetings for the proposed project. In January, BPA also sent a letter to the public explaining the proposal, the environmental process, and how to participate. A comment sheet was included to encourage individuals to mail comments back to BPA. A toll-free telephone number and an e-mail address were also given to enable people to comment by phone or by e-mail. Public meetings were held in Grand Coulee, Davenport, and Spokane, Washington between January 29 and February 6, 2002.

In all, BPA received about 300 comments at the public meetings, in briefings with key stakeholders, and by telephone, mail, and e-mail. The comments focused on:

- potential impacts to farming practices (erosion, noxious weeds, distance between structures, crop damage, and construction schedule);
- ***double-circuit*** vs. ***single-circuit*** structures (removing both 115-***kilovolt (kV)*** wood pole structures and replacing them with one steel structure; using single-circuit for the entire transmission line route);
- land use (crossing Riverside State Park, Whitworth College, and residential areas);
- noise, public health and safety including electromagnetic fields;
- visual effects; and

- need for the transmission line and Avista's plans to expand its transmission system.

After reviewing the comments, BPA modified its proposed action so that a single-circuit line would be constructed in the Spokane area (except for a short section (less than 1 mile) through a commercial area where the right-of-way is constrained). A double-circuit line in the Spokane area (9 miles long) is included as an alternative action (see Chapter 2). In addition, BPA sent a letter to interested parties in March summarizing the comments and explaining next steps. Copies of the public mailings are included in Appendix A, **Public Involvement**.

Chapter 2
Proposed Action and Alternatives

This Chapter describes and compares:

- Agency Proposed Action
- Alternatives to the Proposed Action, including No Action
- Alternatives considered but eliminated from detailed study

BPA proposes to construct a 500-kilovolt (kV) transmission line that would extend approximately 84 miles between the Grand Coulee 500-kV Switchyard, near Grand Coulee Dam, and the Bell Substation, in Mead just north of Spokane. In addition to the transmission line, new equipment would be installed at the ***substations*** at each end of the new line and at other facilities. BPA is considering two construction alternatives, the Agency Proposed Action and the Alternative Action. Both construction alternatives would remove an existing transmission line and replace it with a new line on existing right-of-way for most of its length. Additional right-of-way would be needed in the first 3.5 miles out of the Grand Coulee Switchyard to connect the new 500-kV ***bay*** with the existing 115-kV right-of-way.

BPA is also considering the No Action Alternative. NEPA requires Federal agencies to analyze the consequences of taking no action, in this case, continuing to operate the transmission system under present conditions.

This chapter also describes other alternatives, such as burying a new transmission line, that have been suggested but eliminated from detailed study for technical, environmental, and economic reasons.

How the Alternatives Were Developed

In developing this EIS, BPA considered a wide range of potential alternatives to solve the problem. This range included alternatives developed by BPA based on its knowledge of transmission line design and possible environmental issues; alternatives considered and presented to the public in a previous process undertaken in the mid-1990s (see EIS History in Chapter 1); and alternatives that were suggested or that responded to concerns raised during the scoping process for this EIS.

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2 Proposed Action and Alternatives

Development of the alternatives for this project was aided by BPA's participation in the Infrastructure Technical Review Committee (ITRC). This committee was formed in the summer of 2001, at the request of Northwest utilities, to consider how BPA might provide the most cost-effective, reliable service for the region's consumers. The ITRC included individuals from BPA, the Northwest Power Pool (NWPP) Transmission Planning Committee, Operating Committee, and the Northwest Regional Transmission Association (NRTA) Planning Committee. The ITRC evaluated and prioritized transmission projects throughout the Northwest based on whether they would provide appropriate business, technical, and cost-effective solutions to identified problems, and as though only one utility operated the entire system ("single utility" planning concept). In August 2001, the committee released its report, entitled *Upgrading the Capacity and Reliability of the BPA Transmission System*, which is incorporated by reference in this EIS. The report provides the ITRC's conclusions regarding various potential transmission projects throughout the region (including the proposed action and alternatives to it), and identified nine transmission projects (among them the proposed action) as high priority.

In establishing the range of reasonable alternatives to be evaluated in detail in this EIS, BPA assessed whether the alternative solved the problem as identified under Need for Action in Chapter 1, and how well it met other key objectives (listed under Purposes in Chapter 1). Those alternatives that solved the problem and achieved the objectives are evaluated in detail in this EIS. Alternatives considered unreasonable (e.g., those that cost substantially more or had much higher environmental impacts) were eliminated from detailed evaluation.

The remainder of this chapter describes the alternatives that are evaluated in detail, as well as those that were eliminated and why.

Agency Proposed Action

Location

The proposed action involves removing an existing 115-kV transmission line (Grand Coulee – Bell No. 1 line) and replacing it with a 500-kV transmission line. BPA would construct a single-circuit 500-kV transmission line over most of the route between the terminal at the Bureau of Reclamation's existing Grand Coulee Switchyard and BPA's existing Bell Substation. A double-circuit transmission line would be constructed for short distances where the right-of-way is constrained between corridor mile 73/1 (mile 73, structure 1) and corridor mile 73/4, and between corridor mile 83/1 and corridor mile 83/6 just northwest of Hawthorne Road in the north Spokane area (see Figures 2-1 and 2-2). Combined, the two double-circuit segments amount to slightly less than one mile of transmission line. The Agency Proposed Action would cost about $152 million (2002 dollars).

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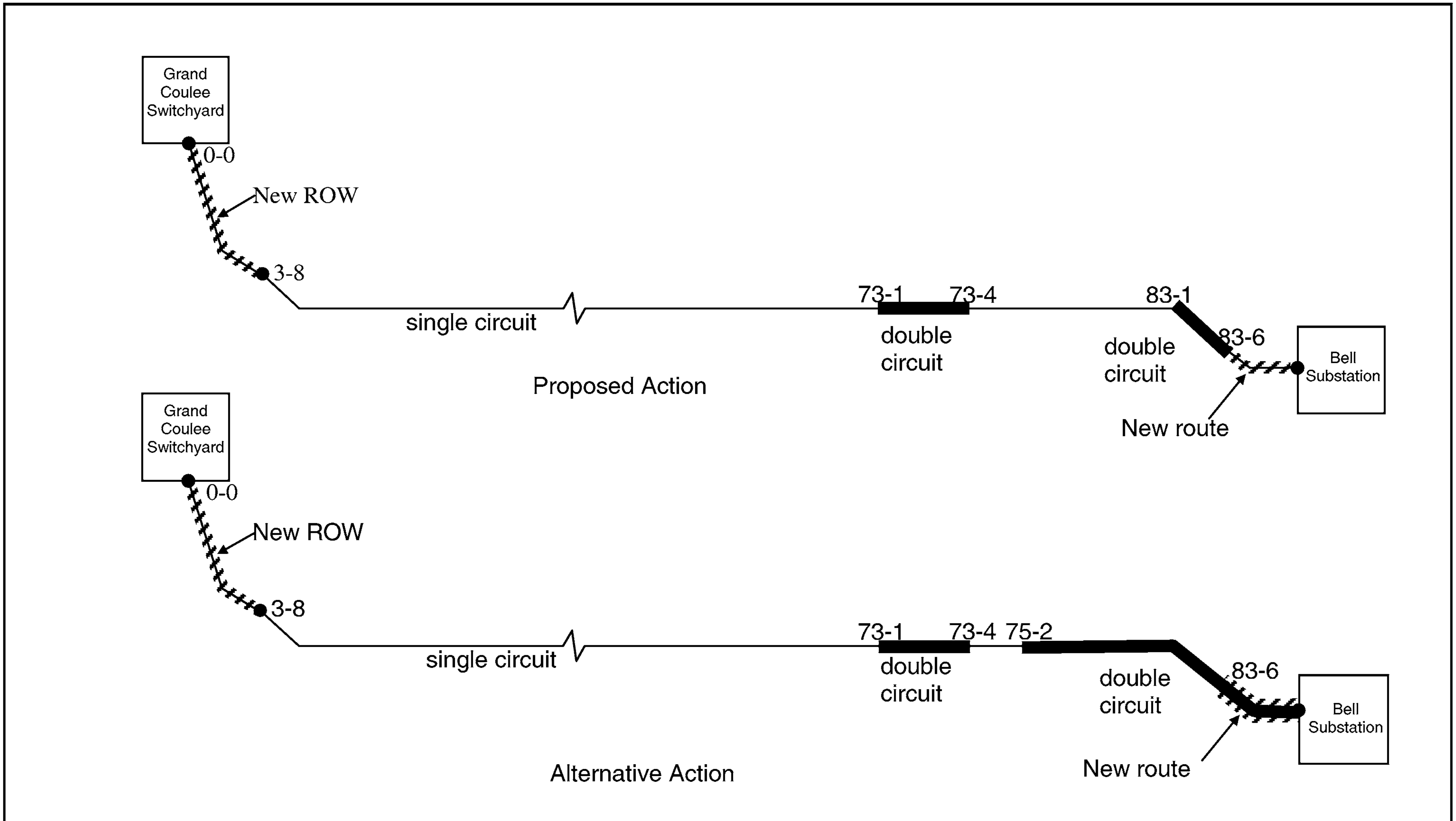

Bonneville Power Administration Grand Coulee-Bell 500-kV Transmission Line Project	Figure 2-1 Diagram of Transmission System Alternatives (not to scale)

GRAND COULEE - BELL 500-kV TRANSMISSION LINE PROJECT

LOCATION MAP

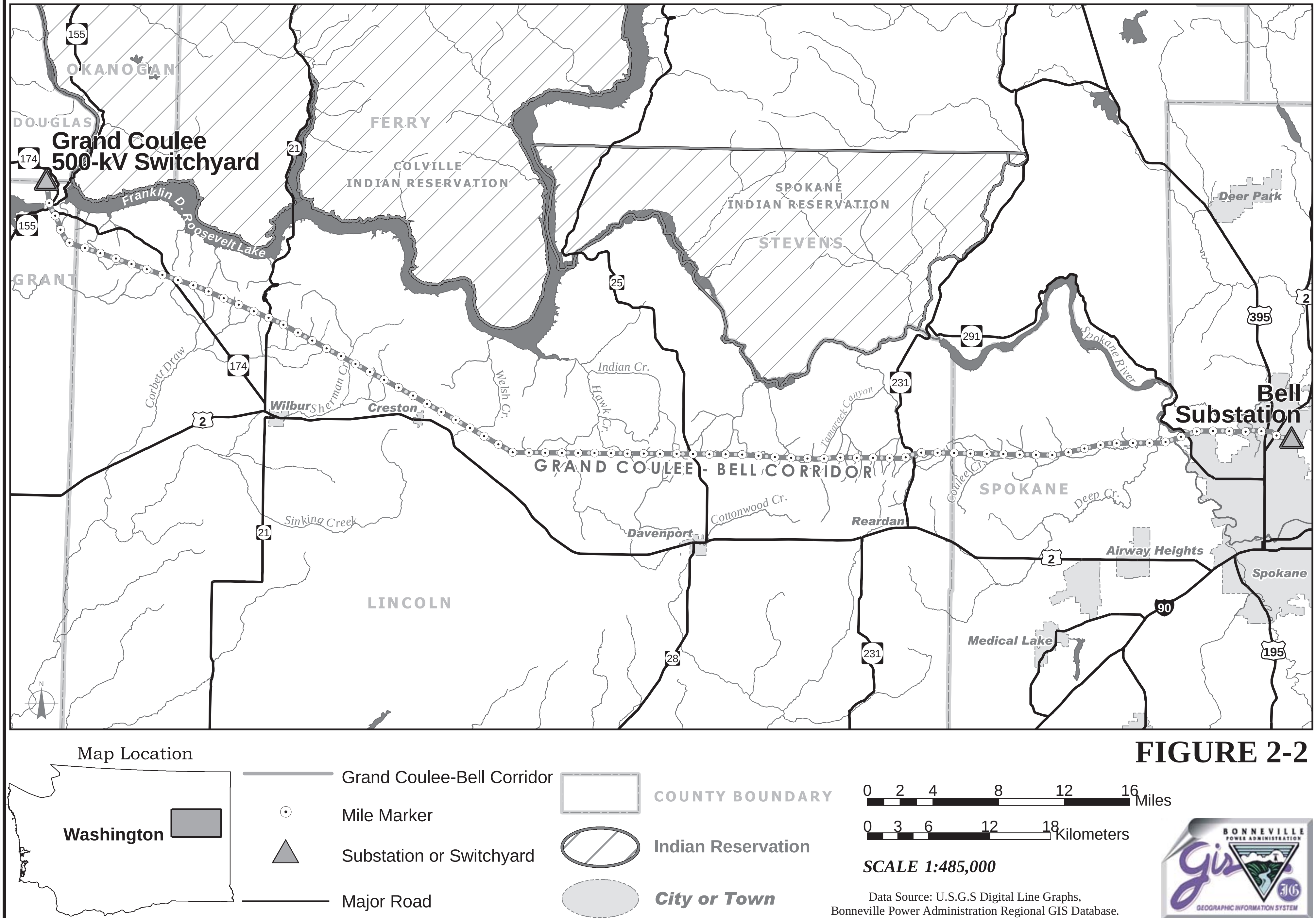

FIGURE 2-2

Please note: The nomenclature of corridor miles refers to structures in existing transmission line corridors that the new 500-kV line would parallel, with mile 1 starting at Grand Coulee Switchyard, and ending with mile 84 at Bell Substation in Spokane. Up to corridor mile 3/1, this document refers to structures in the Grand Coulee-Hanford No. 1 500-kV line. Starting at corridor mile 3/8, the reference is to the Grand Coulee-Bell No. 1 115-kV wood pole transmission line that would be replaced.

The new transmission line would be primarily located in an existing BPA corridor. The existing corridor, over most of its length, has five transmission lines on four sets of structures. From the north to the south side of the corridor, they are a single-circuit 230-kV line on ***lattice steel towers***, a double-circuit 230-kV line on lattice steel towers, and two single-circuit 115-kV lines on wood pole structures. To make room for the new transmission line, BPA would remove its Grand Coulee-Bell No. 1 115-kV wood pole transmission line, which currently extends from the 115-kV Switchyard at Grand Coulee substation to Bell Substation, and replace it with the 500-kV line on new lattice steel towers. The Grand Coulee-Bell No. 1 115-kV transmission line is the northerly of the two 115-kV lines. The new line would be built in the existing corridor over most of its length. There are two exceptions:

1. The new line would require about 3.5 miles of new right-of-way from the Grand Coulee 500-kV Switchyard to corridor mile 3/8 (see Figure 2-3). The new right-of-way would be about 150 feet wide and BPA would acquire new ***easements***. About 3 miles of the new right-of-way would parallel BPA's existing Grand Coulee-Hanford No. 1 500-kV line on the east side (to corridor mile 3/1). From corridor mile 3/1 to 3/8, the new line would extend southeasterly in a new corridor. The space in the existing Grand Coulee-Bell No. 1 115-kV transmission line corridor from the 115-kV Switchyard to corridor mile 3/8 would then be vacated or reconfigured to take advantage of better access for the remaining No. 2 line.

2. The new transmission line would diverge from the existing corridor at corridor mile 83/6 and would be routed across BPA property to the ***terminus*** in the expanded 500-kV yard at Bell Substation (Figure 2-4). In addition, at corridor mile 83/1 the remaining 115-kV transmission line (Grand Coulee – Bell No. 2) would cross over and connect to the Grand Coulee – Bell No. 1 line. From this point to a point just a short distance before the termination at Bell Substation, the Grand Coulee – Bell No. 1 line would be operated as the Grand Coulee – Bell No. 2 line. The remaining de-energized section of the Grand Coulee Bell No. 2 line would be left in place to support the existing ***fiber optic*** cable.

Where double-circuit line would be constructed between corridor mile 73/1 and 73/4 (Coulee Hite Road area), the conductors on the second 115-kV line (Grand Coulee-Bell No. 2) would be removed and replaced by new conductors on the new double-circuit towers. This is necessary to avoid expanding the right-of-way because there is insufficient room to accommodate the new 500-kV transmission line and leave the No. 2 line on existing structures. Thus, the structures in this section would carry two circuits: one to be operated at 500-kV and one to be operated at 115-kV. 115-kV dead-end structures would replace existing suspension structures at each end (near structures 72/7 and 73/5) to accommodate the transition from single circuit to double circuit. Expansion of the right-of-way is not considered feasible because additional right-of-way in this area is unavailable.

In addition, the existing corridor may need to be widened by approximately 75 feet in a few isolated areas along its length. Safety standards require that some extra-long 500-kV spans have more right-of-way to allow for lateral movement or swing in the conductors. The expanded right-of-way may also be used for access.

Towers

Most of the existing transmission corridor is about 400 feet wide. As noted, it has three 230-kV lines on two steel towers (one double-circuit and one single-circuit), and two 115-kV lines on two wood pole structures. In most cases, the new lattice steel towers would be placed adjacent to the existing double-circuit 230-kV steel towers in the corridor.

A new single-circuit tower design would be used for the project. The new design is shown in Figure 2-5. The typical height of this tower would be 125 to 150 feet although the height of each tower would vary depending on characteristics of the location and surrounding landforms. The towers would generally not require a bigger base and, in most cases, would be about the same height as the existing double-circuit 230-kV towers.

The tower design for the double-circuit towers proposed for the short sections in the Coulee Hite Road area (corridor mile 73/2 to 73/5) and northwest of the Bell Substation (corridor mile 83/1 to 83/6) is shown in Figure 2-6. Their height would typically be 175 feet. In the Coulee Hite Road area, the 500-kV conductors would be strung on the left (northerly) side of the towers and the remaining 115-kV transmission line (Grand Coulee – Bell No. 2) would be strung on the right (south) side. In the section northwest of Bell Substation, both sides of the towers would be strung with conductors and connected to operate as a single-circuit line; it would be available for a second circuit at some unknown future date. These configurations are necessary in order to accommodate the uniquely narrow right-of-way in these areas.

About five structures per mile would be used to match the spans of the existing 230-kV steel towers in the right-of-way. A combination of about 420 single- and double-circuit towers would be needed.

The single- and double-circuit towers shown in Figures 2-5 and 2-6 are "tangent" or "suspension" towers. Most towers used on the proposed line would be this kind of tower. Other towers, called "dead-end" towers, would be needed every few miles and where the transmission line changes direction, has an excessively long span, crosses extremely steep or rugged terrain,

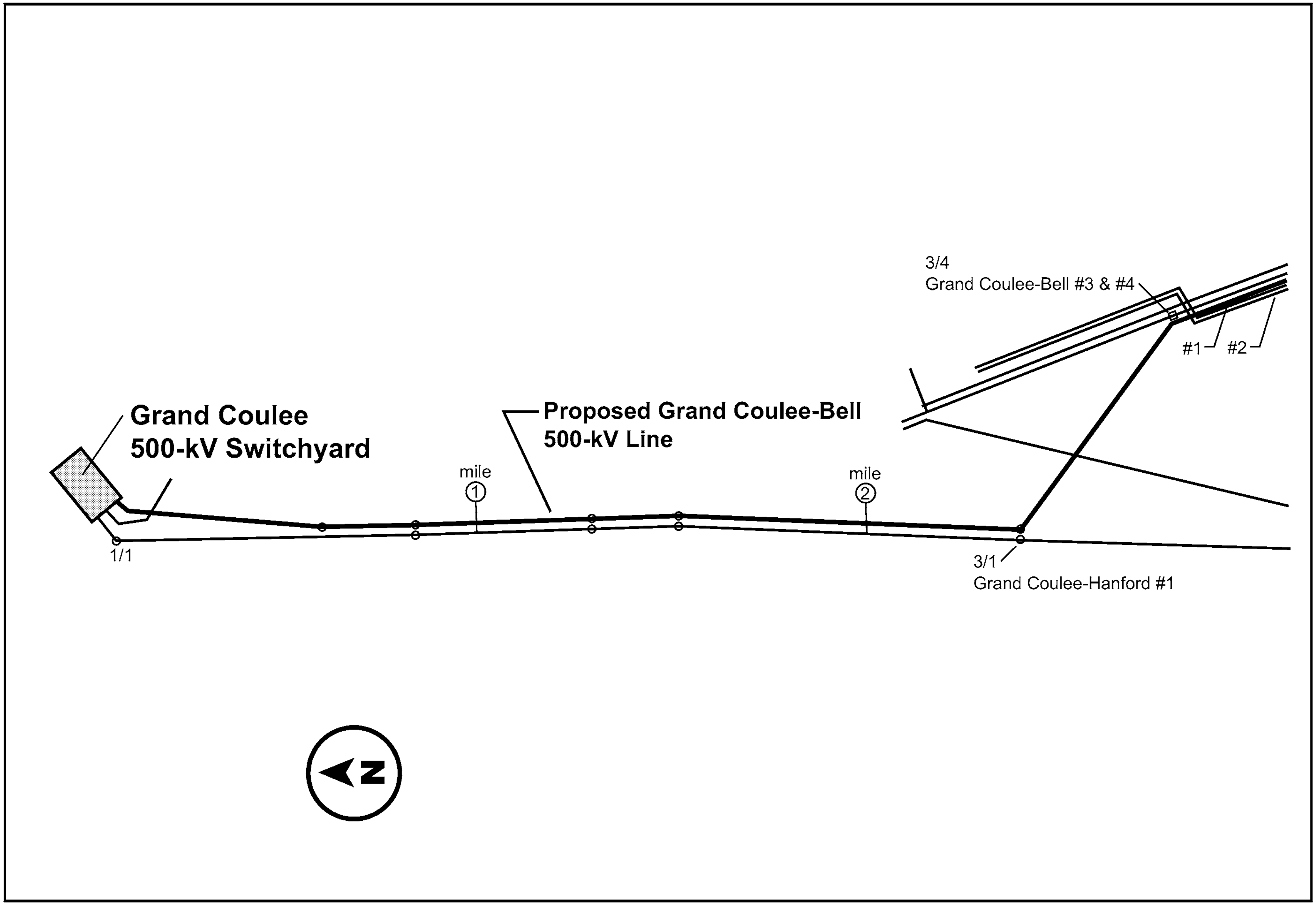

Figure 2-3

Proposed Grand Coulee-Bell 500-kV Transmission Line & 500-kV Switchyard Expansion

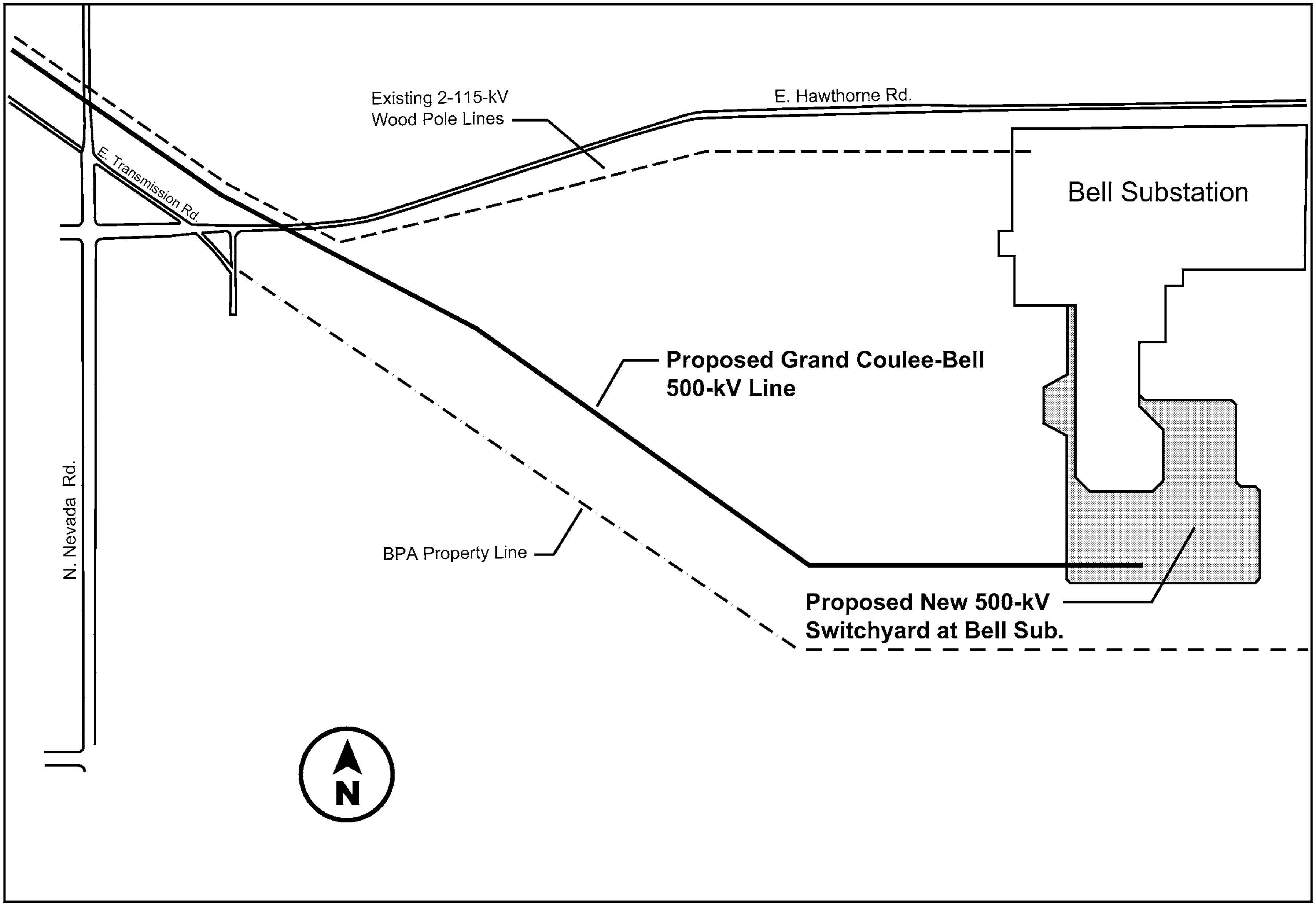

Figure 2-4
Proposed Grand Coulee-Bell 500-kV Transmission Line
& 500-kV Switchyard at Bell Substation

Grand Coulee - Bell Project

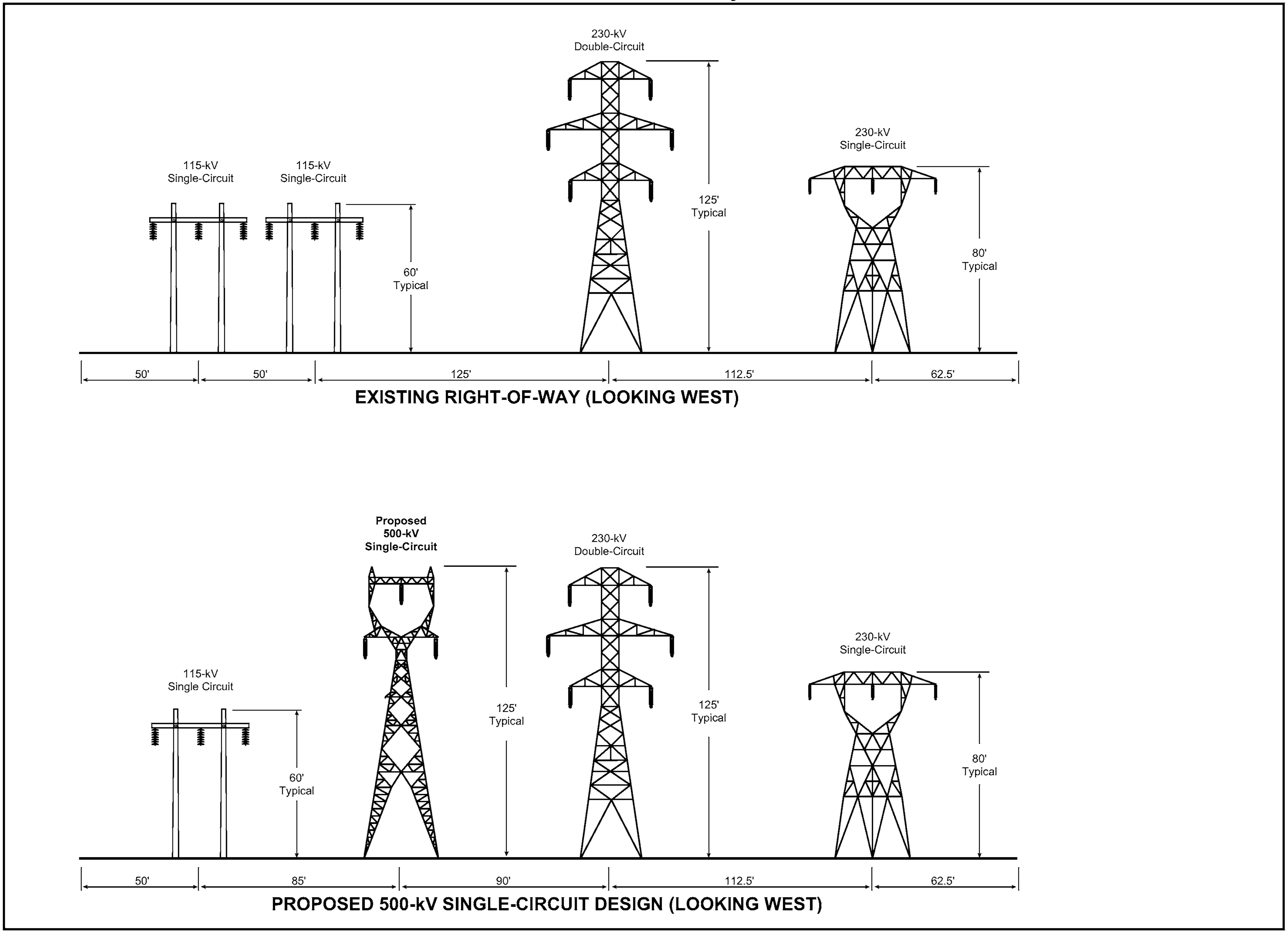

Figure 2-5
Tower Configurations
Proposed Action

Grand Coulee - Bell Project

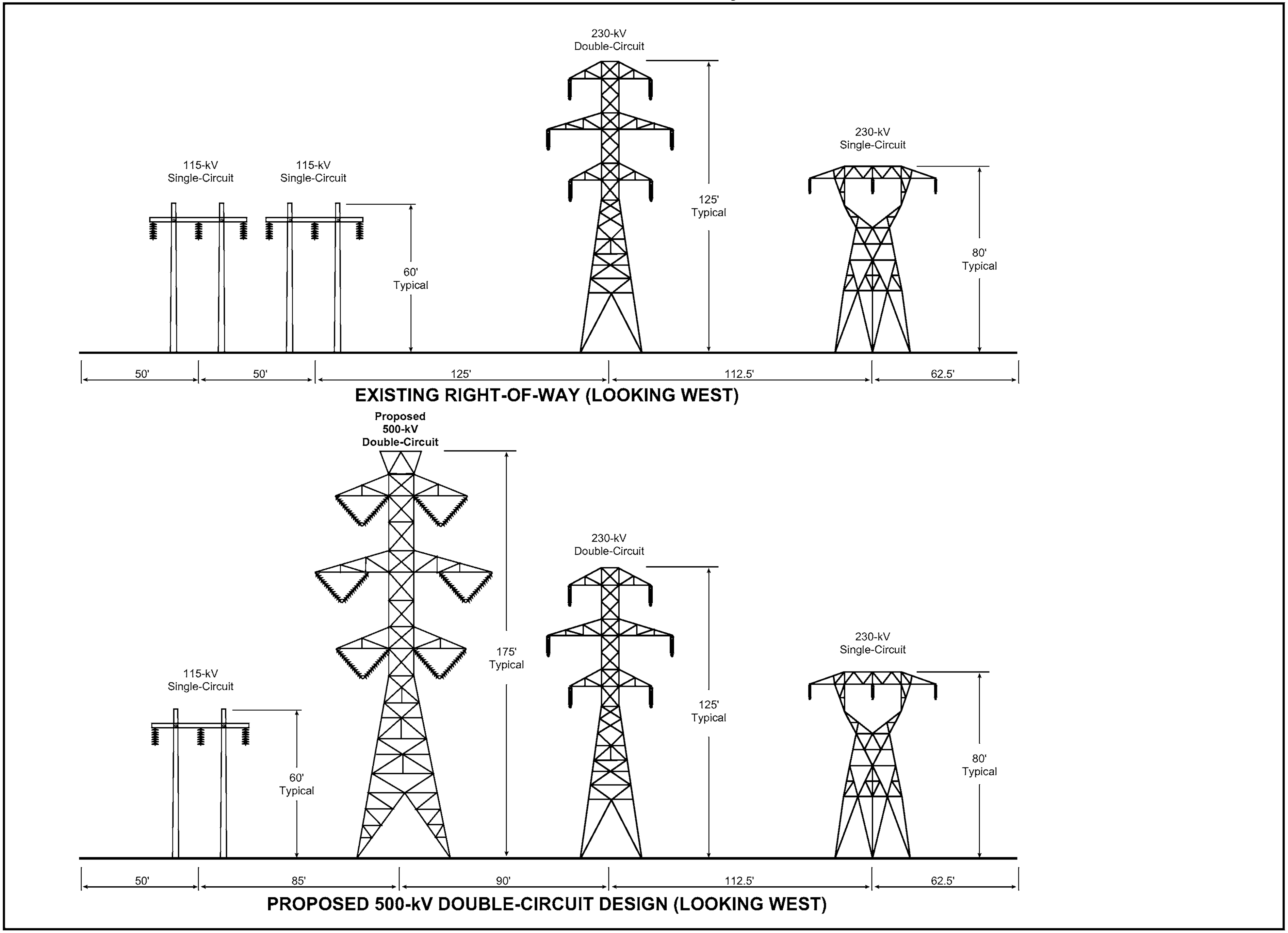

Figure 2-6
Tower Configurations
Alternative Action

or crosses highways or rivers. Dead-end towers equalize stresses on the conductors in these situations. Dead-end towers use more ***insulators*** and heavier steel than the other kind of tower, which makes them more visible. Dead-end towers also are more expensive than other towers.

Conductors

The wires or lines that carry the electrical current in a transmission line are called conductors (see Figure 2-7). ***Alternating current*** transmission lines, like the proposed line, require three sets of conductors to make up a circuit. For a single-circuit 500-kV transmission line, there would be three sets of conductors and for a double-circuit line, six sets of conductors. Each set of conductors consists of three conductor wires that are each 1.3 inches in diameter. Conductors are attached to the tower using glass, porcelain, or fiberglass insulators. Insulators prevent the electricity in the conductors from moving to other conductors, the tower and the ground. Conductors are not covered with insulating material, but use the air for insulation instead. Each ***bundle*** of conductors is physically separated on the transmission tower.

Transmission towers elevate conductors to provide safety within the right-of-way for people and vehicles. Minimum conductor-to-ground clearance for a 500-kV line is 29 feet. Greater clearance would be provided over highway, railroad, and river crossings.

One or two smaller wires, called overhead ***ground wires***, are attached to the top of transmission towers for the entire length of the line to protect the transmission line against lightning damage. The ground wires are strung from the top of one structure to the next. To disseminate the electrical power from lightning, the ground wires are connected to wires called ***counterpoise***, which route the lightning energy to the ground. BPA could use fiber optic cable as the overhead ground wire to also provide a communication link, or a fiber optic cable could be attached elsewhere on the tower.

Line Termination Facilities

A substation contains different kinds of equipment to carry out electrical operations and maintenance, and to minimize risks to workers. At Bell Substation, BPA would expand the existing fenced yard to make room for the new line termination facilities and other equipment. The expansion would encompass about 11.7 acres at the south end of the substation that would include three bays with six ***circuit breakers***, one group of ***series capacitors***, a new control house, and associated equipment. Existing BPA property would be used. The Grand Coulee Switchyard would not need to be expanded because there is space within the existing fenced yard to accommodate a new bay with two circuit breakers, a ***shunt reactor*** and breaker, and associated equipment. The following equipment would be installed at Grand Coulee Switchyard and Bell Substation:

Power Circuit Breakers — Breakers automatically interrupt power flow on a transmission line at the time of a fault. Faults are caused by lightning, trees falling into the line and other unusual events. Several kinds of breakers have been used in substations. The breakers planned for this project, called gas breakers, are insulated by special non-conducting gas (sulfur hexafluoride). Small amounts of hydraulic fluids are used to open and close the electrical contacts within gas insulated breakers. The hydraulic fluid is the only toxic or hazardous material that would be used. In addition to the new 500-kV breakers at Grand Coulee Switchyard and Bell Substation, some existing 115-kV breakers at Bell Substation would be replaced.

Switches — **Switches** are devices used to mechanically disconnect or isolate equipment. Switches are normally on both sides of circuit breakers.

Bus Tubing, Bus Pedestals — Power moves within a substation and between breakers and other equipment on ridged aluminum pipes called bus tubing. ***Bus tubing*** is elevated by supports called ***bus pedestal***s.

Substation Dead Ends — ***Dead ends*** are towers within the confines of the substation where incoming and outgoing transmission lines end. Dead ends are typically the tallest structures in a substation.

Transmission Dead End Towers — The last transmission line towers on both the incoming and outgoing sides of the substation are called dead end towers. These towers are built extra strong to reduce conductor tension on substation dead ends and provide added reliability to the substation.

Substation Fence— This 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 3-inch layer of rock selected for its insulating properties is placed on the ground within the substation to protect operations and maintenance personnel from electrical danger during substation electrical failures.

Shunt Reactors — Shunt reactors are electrical devices that reduce voltage on a line if it is too high. Shunt reactors are oil-filled to reduce their size.

Oil Spill Containment—Oil spill containment would be installed at Grand Coulee Switchyard and at Bell Substation to collect any oil spilled from the shunt reactors.

In addition, the Proposed Action would require series capacitors and related equipment. Series capacitors are electrical devices that can increase loading on a transmission line. Series capacitors and related equipment would be placed on platforms near the line termination facilities at Bell Substation.

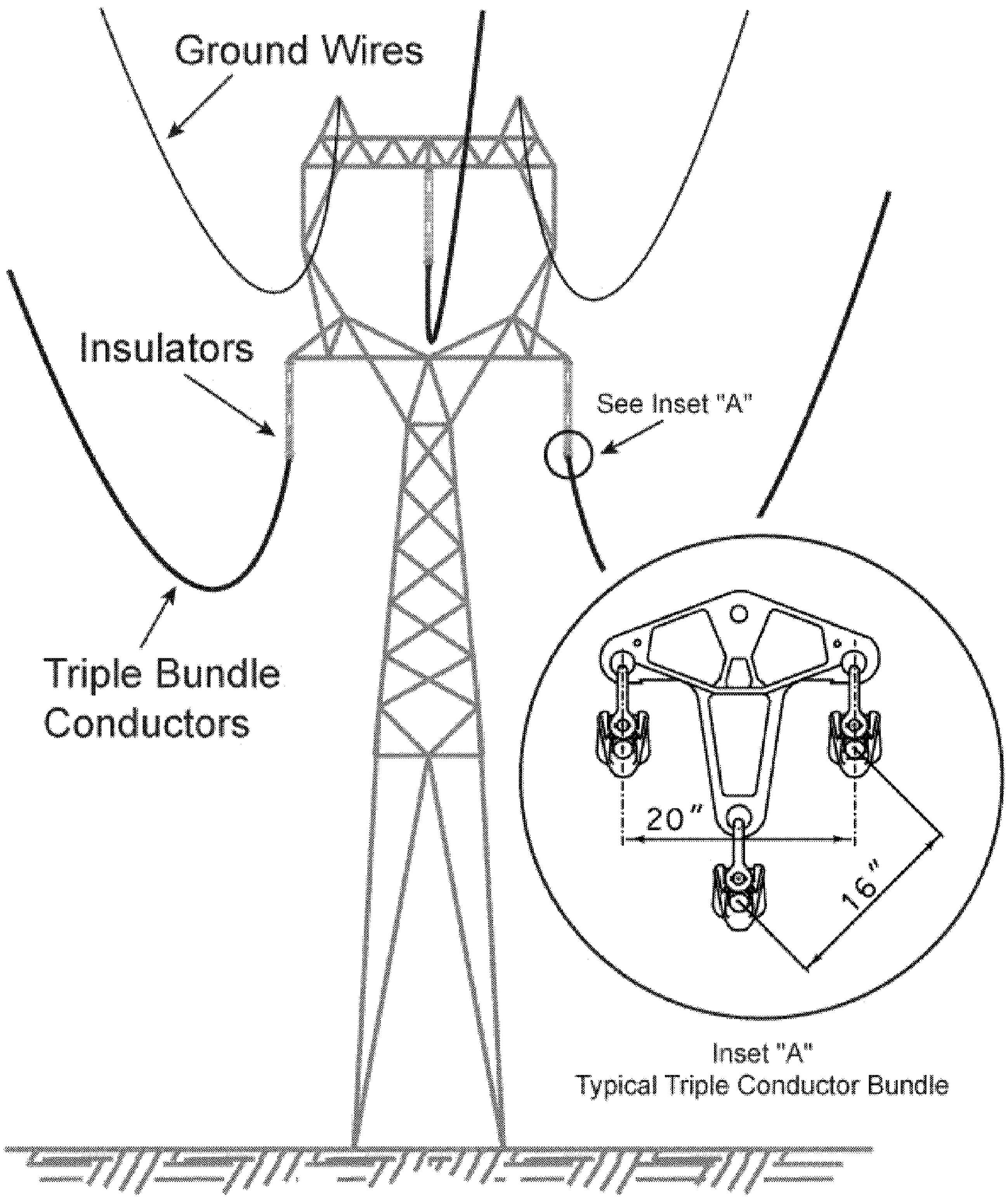

Figure 2-7
Conductors, Insulators, & Ground Wires
for a Typical Single-Circuit Lattice Tower

Each electric ***phase*** on the transmission line would require one platform. Each platform would be about 38 feet x 38 feet and 38 feet high. The platforms would contain capacitors and related equipment such as ***metal oxide varistors*** and a ***discharge reactor***. Bus, breakers and disconnect switches would surround each platform. Grading and excavation would be required to mount and secure the electrical equipment. Surface rock would be used to insulate and protect workers.

Additional Features of the Proposed Action

115-kV System and Tap Point/Substation Changes

In general, removing the Grand Coulee-Bell No. 1 115-kV line would entail removing structures and conductors over the 84-mile route, with some line reconfiguration as noted previously. Additional reconfiguration would be required for the section of line taken out of service between the Grand Coulee 115-kV Substation and corridor mile 3/8. This would involve reconfiguring conductors to use a combination of existing double and single-circuit structures on the two 115-kV lines, and stringing some new spans between existing structures.

Customers currently tap off of both of BPA's existing 115-kV lines at four locations. Making room for the new 500-kV line by removing the Grand Coulee – Bell No. 1 115-kV line would make electrical changes necessary along the right-of-way at the four ***tap points*** on the remaining No. 2 115-kV line. Electrical changes at tap points and substations that would be necessary along the right-of-way are as follows:

- Grand Coulee 115-kV Substation: Replace ***relays***.
- Wagner Lake Substation (corridor mile 19/3): Disconnect tap from Grand Coulee – Bell No. 1 115-kV line, modify existing three-pole dead-end structure (19/3) to a three-pole dead end for a switch, install switch, and install new two-pole guyed dead end and line disconnect switch just east of structure 19/3.
- Creston Substation (corridor mile 30/1): Disconnect tap from Grand Coulee – Bell No. 1 115-kV line. The tap of the remaining Grand Coulee – Bell No. 2 115-kV line will be isolated; i.e., it will be dead-ended from both directions. Three-pole guyed dead-end structures will be added just outside the substation in both directions. Structures would be modified and overhead ground wire installed on the 115-kV line one-half mile in each direction from the substation. In addition, other changes at the substation would be a new bus, disconnect switches, circuit breakers, and control house. All changes would be within the existing substation or right-of-way. The Grand Coulee – Bell No. 2 115-kV line would then become the Grand Coulee – Creston No. 1 115-kV line and the Creston – Bell No. 1 115-kV line.

- Larene Substation (corridor mile 46/8): Disconnect tap from Grand Coulee – Bell No. 1 115-kV line and install new switches.

- Springhill Substation (corridor mile 74/5): Disconnect tap from Grand Coulee – Bell No. 1 115-kV line and install two line disconnect switches with two-pole guyed dead ends.

- Bell 115-kV Substation: Replace relays.

Outside of the project area, one group of series capacitors would need to be installed on an expanded site at the Dworshak 500-kV Substation, and existing series capacitors would need to be replaced within the current boundary of the Garrison 500-kV Substation. A separate environmental review under NEPA was completed for the site preparation work at Dworshak Substation. The work consists of civil work to expand the yard and fenced area to prepare for future equipment installation. The area of expansion was filled and leveled for future use when the substation was constructed in 1972-73. Some reconfiguring of access roads will occur on previously disturbed areas. The site preparation work will have no adverse environmental impact, will not limit the choice of reasonable alternatives, and is not considered an excessive waste of resources if BPA decides on the No Action alternative under this EIS. The replacement of series capacitors at Garrison Substation is an action included in this EIS.

Communication Facilities

BPA would install new communication equipment at the affected facilities and at other existing remote facilities using existing communication pathways. The communications equipment would be used to monitor the performance of and control the transmission system.

Construction

BPA would follow its existing practices for removing and replacing the transmission line. When BPA removes old structures and conductors (wires), any material that can be recycled or salvaged is saved. Other materials are disposed of according to law. BPA would build or upgrade existing permanent ***access road***s as necessary. If additional easements for right-of-way or permanent access roads are needed, additional rights would be obtained from landowners. Usually BPA/BPA's contractor clears an area, called a ***staging area***, to store and assemble materials or structures. After structures are in place and conductors are strung between the structures, the areas disturbed by construction are restored to original conditions, if possible, and revegetated.

Construction of the transmission line (and its later operation) requires land for various purposes (the corridor, tower sites, access roads, etc.) Some requirements are temporary and some permanent; some temporary disturbances could result in long-term effects. A summary of some of the characteristics of the proposed action is provided below.

Corridor length	84 miles
Single circuit	83.1 miles
Double circuit	0.9 miles
New corridor or right-of-way	4.2 miles
Land occupied by:	
Corridor (150-foot width)	1,528 acres
Tower construction (1/2 acre each)	210 acres
Tower clearing (100 feet x 100 feet)	97 acres
Towers (2,500 sq. ft. each)	24 acres
Staging areas (4 at 2 acres each)	8 acres
Pulling/tensioning sites (1 site every 2.5 miles, 1 acre each)	34 acres
Access roads:	
New roads	15.6 acres
Access road improvements	52.5 acres
Permanent access road spurs	6.3 acres
Temporary access road spurs	6.3 acres
Land area "reclaimed" with removal of wood pole structures (1,000 sq. ft. per structure)	17.4 acres

Construction Schedule

Construction is scheduled to begin in January 2003 and to be complete by November 2004.

Staging Areas

Temporary staging areas would be needed along or near the proposed transmission line for construction crews to store materials and trucks. The contractors hired to construct the transmission line would be responsible for determining appropriate staging area locations and for obtaining any required permits or environmental reviews for staging areas. It is estimated that four 2-acre staging areas would be needed.

Access Roads

Access to tower sites for construction and maintenance would need to be provided at several locations along the corridor. Access road construction would take place principally within the right-of-way, but also off of the right-of-way. Access road construction would consist of improvements to existing roads, development of new roads, and construction of spurs to individual tower sites. New access road requirements are summarized below:

	Length (miles)	Area (acres)
Improvements	16.6	52.5
New access roads	4.9	15.6
Road spurs:		
Permanent	2.0	6.3
Temporary	2.0	6.3

Improvements would consist of widening existing access road surfaces from 11 feet to 16 feet (with additional road width of 20 feet for curves), improving ditches and side slopes, grading, rocking, and/or installation of ***water bars*** and ***drain dips*** as needed. In addition, some improvements would be needed at approaches to existing access roads from public roads.

Most new permanent access roads would be constructed in rangeland areas. Clearing and construction activities for new access roads would disturb a 26-foot wide area (16-foot road width plus an additional area 5 feet wide along each side of the road). Roads would be dirt or gravel. New roads would be within the right-of-way wherever possible to avoid removing vegetation, but where conditions require, roads would be constructed and used outside the right-of-way. Before the transmission line is built, dips and culverts would be installed within the roadbed to provide drainage. Fences, gates, cattle guards and additional rock would be added to access roads where necessary.

Most access roads in cultivated or fallow fields would be temporary; in only a few locations would permanent access road construction occur in these areas. Any temporary roads constructed in cropland would be removed and the ground would be restored to its original contour when the line is completed. Ground disturbed for temporary roads in other locations would be repaired and, if the land use permits, the road would be reseeded with native grass or other appropriate native seed mixtures.

Spur roads would need to be constructed between access roads and individual tower sites. Construction activities would be the same as for new access roads. It is estimated that spur roads would be 50 feet long on average.

Rights, usually easements, for access roads would be acquired from property owners as necessary. A 50-foot wide right-of-way would be acquired for new road access outside the present right-of-way and a 20-foot wide right-of-way would be acquired for existing access roads outside the right-of-way.

Access roads would also be used for line maintenance after construction. If the ground is disturbed by maintenance activities, the roadbed would be repaired and revegetated if necessary.

Right-of-Way and Tower Site Preparation

Trees and tall brush would be selectively cut in the existing right-of-way to accommodate construction and to provide for long-term clearances between conductors and vegetation that are required to meet safety and reliability standards for 500-kV lines. Some trees also would be cut outside of the right-of-way if they are identified as "***danger trees***" (trees that, because of their height and condition, may pose a threat to the adjacent line). Trees are carefully analyzed so that only those trees that would interfere are removed. Where it does not already have rights, BPA would obtain rights to cut trees outside the right-of-way. Trees would also need to be cut in the new 500-kV line right-of-way in the first 4 miles out of Grand Coulee and on existing right-of-way or fee-owned property in the last 2 miles in to Bell Substation where no transmission line exists now. Trees would be cut (as a maintenance action) at about the same time within the right-of-way of the adjacent existing 115-kV line that will remain.

To accommodate construction activities at the structure sites, most trees and brush would be cut and removed within a one-half-acre area (total of 210 acres), with root systems being removed from a 100-by-100-foot area for the tower footings (total of 97 acres). A portion of the site would be graded to provide a relatively level work surface for the erection crane. The Proposed Action would require an estimated 97 acres to be cleared for structure footings along the 84-mile route.

Woody debris and other vegetation would either be left lopped and scattered, piled, mulched or chipped, or would be taken off-site. Burning would not be used to dispose of debris.

Tower Footings

Steel towers would be anchored to the ground with ***footings***. Four footings would anchor each tower at four points. The design for each footing would vary based on the soil, depth to bedrock, and quality of bedrock at each site. For a typical tower site, four holes would be excavated, then steel plates or a grid of crossbeams would be placed in each hole and connected to a tower leg. The hole would then be filled up with the original excavated material, and excess material would be spread around the tower legs.

For a single-circuit tower, a hole about 30 feet in diameter at ground level and about 6 feet in diameter at the bottom (12-foot depth) typically would be excavated for each of the four footings. For a double-circuit tower, an excavated hole about 38 feet in diameter at ground level and about 10 feet in diameter at the bottom (14-foot depth) would be needed for each footing. If no bedrock is found, a hole about 12 feet deep would excavated. If bedrock is found and is adequate for using anchor borings, holes may be drilled in the bedrock and steel rods and grout would be inserted. The rods then would be attached to a concrete footing and covered with compacted soil. If the bedrock cannot support anchor rods, the bedrock may need to be blasted to reach an adequate footing depth.

Erecting Towers

Towers would be either assembled at the tower site and lifted into place by a large crane or assembled at a staging area and set in place by a large sky-crane helicopter. The towers would be assembled in sections. Each tower would contain three components: the tower legs, the tower body, and the ***bridge***. The bridge is the uppermost portion of the tower and serves as the attachment point for the insulators, which in turn would support the conductors. The towers would be bolted to the footings after they are set in place.

Stringing Conductors

The conductors would be strung from tower to tower through pulleys on the towers. After transmission towers are in place, workers would first attach a smaller steel cable to the towers; the cable would be attached to the conductor, then the workers would pull the conductor under tension through the towers. Conductors would be attached to the tower using glass, porcelain, or fiberglass insulators, as noted previously. As the lines are strung, the ground surface would be disturbed at the tensioning sites, and noise and dust would be generated by equipment. Tensioning sites would occupy approximately 1 acre and would be needed approximately every 2.5 miles. There would be at least 34 tensioning sites for a total of 34 acres.

Removal of Existing Wood Pole Structures

Wood pole structures on the old Grand Coulee-Bell No. 1 line will be removed. In agricultural land wood poles would either be excavated and holes backfilled with native material, or cut off 2 feet below ground level and backfilled with native material. In non-agricultural land, wood poles would either be excavated and holes backfilled with native material, cut off at ground level, or cut off 2 feet below ground level and backfilled with native material. In sensitive areas where disturbance must be kept to a minimum, wood poles would be cut off at ground level and poles dragged out or lifted out by crane to avoid bringing in construction equipment all the way to the structure. Existing access roads would be used travel to structure sites. It is estimated that an area of about 1,000 square feet at the site of existing structures would be converted from use for transmission facilities to another use (e.g., in agricultural land, the area that was occupied by the wood pole structures would be available for cultivation).

Vegetation Management

After construction, maintenance crews would be responsible for managing vegetation. No tall-growing vegetation would be allowed to grow inside the right-of-way except for vegetation in deep canyons when it will not interfere with the conductor. BPA would develop maintenance criteria consistent with its Transmission System Vegetation Management Program, which is incorporated by reference in this EIS. Under maintenance criteria, healthy, stable trees outside the right-of-way would be left in place. Only those trees that pose a potential threat to the line would be removed.

Alternative Action

The Alternative Action would include all the components of the Preferred Action except a double-circuit line would be constructed between corridor mile 75/2 (2 miles west of the Spokane River) and Bell Substation, a distance of about 9 miles. The purpose of this alternative would be to anticipate and provide for potential unknown future transmission needs without needing to find a new route out of the Bell Substation for another 500-kV line at a later date if the need should arise. Both sides of the double-circuit towers would be strung with conductors and connected to operate as a single-circuit line; it would be available for a second circuit at some unknown future date. The corridor and towers would be the same as shown on Figure 2-6. Estimated cost of the Alternative Action is $160 million.

No Action Alternative

Description of No Action

The No Action Alternative is traditionally defined as the status quo alternative. In this case, the No Action Alternative assumes the following scenario:

- BPA would not build a new transmission line to solve the problem identified in Chapter 1, nor would another entity.
- The amount of power that needs to be transferred from east to west would not diminish and probably would increase.
- Requirements to protect ESA-listed fish would not change, so dams in Montana would continue to generate power at current levels.

Impacts of the No Action Alternative

Under this alternative, BPA would continue to operate the existing West of Hatwai transmission path as it does now. Because the conditions and problems described in Chapter 1 would substantially increase the risk that this portion of the transmission system would overload, BPA would continue to implement ***remedial action schemes (RAS)*** to protect the existing system, as it has for several years. A RAS is a computer-driven set of actions to prevent an overload. If a major transmission line ***outage*** occurs, the transmission system would automatically take measures to protect itself, such as disconnecting generation or transmission. However, the amount of generation that would be dropped when one line is out of service is exceptionally large (up to 2250 MW), and the potential for dropping this amount is very high during summer. This level of reliance on RAS has the following risks: damage to generator plants when generation is disconnected suddenly, spill conditions at hydro projects that could violate

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Endangered Species Act requirements, higher power costs to consumers, and higher potential for blackouts.

In addition, given this scenario, even with all existing transmission lines in the Grand Coulee-Bell corridor transferring power, the congestion is so high that BPA would be unable to continue to meet its present and future obligations in a reliable manner.

If BPA does not take action, it is theoretically possible that another entity might propose to do so. It was suggested during scoping that other entities could take action to solve the problem, and that proposals existed to do so. BPA is not aware, however, of any current proposals by other entities that address the problem as described in Chapter 1. The section entitled "Actions by Other Entities" briefly describes proposals by Avista, a utility with part ownership in the West of Hatwai path and with facilities in the area, and the problems those proposals would solve.

No Action could also result in adverse socioeconomic impacts. Reduced capacity and reliability could lead to higher energy costs for industry and consumers. This would tend to lower productivity and efficiency for industries and areas that are affected, making them less competitive with other industries and areas. The consequences of this would be lower employment and income levels than would otherwise be the case, reduced levels of economic activity, and reduced governmental tax revenues and the services they support.

The quality and reliability of electrical power has been a key to economic growth and improving industrial productivity levels. With structural economic change, particularly with the new digital economy, power quality and reliability requirements have increased markedly. [For instance, the "old industrial economy" used less sophisticated electro-mechanical devises that were sensitive to long outages, but not sensitive to voltage sags. New digital economy equipment and processes are very sensitive to voltage sags.] To the extent that transmission capacity deficiencies reduce power reliability and quality, regional businesses and industries would be affected by costly process disruptions.

Maintenance activities would continue within the corridor under the No Action Alternative. Vegetation clearing, maintenance vehicle traffic, and human presence could adversely affect water quality, vegetation, wildlife, fish, and wetland resources.

Alternatives Considered but Eliminated from Detailed Study

The actions described in the following subsections were not evaluated in detail because, although technically feasible, they do not solve the problem and do not achieve one or more of the purposes. See Chapter 1 for a discussion of the need and purposes and the beginning of this chapter for a brief description of how the alternatives were developed.

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Actions by Other Entities

In a letter dated November 21, 2001, Avista outlined a transmission plan it believed to be less expensive and would provide the region with needed additional capacity on the West of Hatwai path. In response to this letter, BPA began discussions with Avista and agreed to perform a joint transmission study with them to identify the best plan. The study was performed by the Northwest Power Pool Transmission Planning Committee (NWPP TPC). Following completion of these studies, the NWPP TPC concluded that the best one utility plan was to build the Grand Coulee-Bell 500-kV line to reinforce the West of Hatwai path and for Avista to reinforce its system to handle growing loads in the Spokane and Lewiston areas. The following summarizes the plan Avista proposed to build to improve its system.

Avista plans a number of projects that would improve their area's 230-kV transmission system. They would remove a bottleneck that exists between the generation in northern Idaho and western Montana and Avista's Spokane/Coeur d'Alene load, as well as a bottleneck between Spokane/Coeur d'Alene and the southern portion of Avista's system. In addition, projects in the Lewiston area would relieve constraints that occur during heavy flows to Idaho. They would also improve the reliability of the local area load service. While these projects would remove some bottlenecks within Avista's system, without improvements to the transmission system west of Spokane, they would not meet the need as described in Chapter 1 -- to provide adequate capacity to transfer generation from Montana, northern Idaho, and northeastern Washington to load centers in western Washington and Oregon. Therefore, they are not considered reasonable alternatives to the proposed action.

System Improvements

BPA and Avista have implemented a number of system improvements and remedial actions for increasing the power transfer capability of the system as far as is technically prudent without significant new line construction. Improvements that have been implemented or are currently in progress include:

- Upgrade of the existing Grand Coulee-Bell 230-kV lines to maximum capability at 100 degrees Celsius operation (BPA).
- Upgrade of other 230-kV and 115-kV lines in the area, including Lancaster-Bell 230-kV, Bell-Boundary 230-kV, and North Lewiston-Walla Walla 115-kV lines (BPA).
- Reconfiguration of the 230-kV bus at Bell Substation to reduce impacts to Avista's parallel 115-kV system for 230-kV line outages (BPA).
- Curtailment of generation at Dworshak and Libby dams, Lancaster Substation, and Colstrip coal-fired plants for certain line outages at high transfer levels (BPA).
- A thermal protection scheme that monitors loading on the Benewah-Moscow 230-kV line and trips the line if it overloads following an outage of the parallel 500-kV line (Avista).

- A thermal protection scheme that monitors loading on the Noxon-Pine Creek 230-kV line and reduces generation at Noxon as necessary to prevent overloads during certain 230-kV or 500-kV line outages (Avista).
- Operation of much of Avista's 115-kV system sectionalized to avoid overloads when parallel 230-kV or 500-kV lines are out of service (Avista).

While these system improvements have increased capacity, they do not fully address the problem identified in Chapter 1. BPA does not know of any other system improvements or upgrades that could be undertaken to solve the problem identified in Chapter 1.

Design Alternatives

These alternatives would use different kinds of structures than the proposed and alternative action, but in the same location.

Burying the Transmission Line Underground

During the scoping process, some people suggested burying the transmission line.

Transmission line cables are highly complex when compared to overhead transmission lines and to lower voltage distribution line cables used to deliver power to individual homes. For this 500-kV line, six individual cables would have to be manufactured and installed at a total cost of 10 to 15 times the cost of an overhead design.

Because costs are so high, BPA uses underground cable only in limited situations. Underground cables are considered where an overhead route is not appropriate, such as for long water crossings (e.g., in the San Juan Islands) or in highly developed urban areas.

Underground transmission cables used by BPA are short in comparison to typical overhead transmission lines. BPA's longest underground transmission cable is a submarine cable 9 miles long in the San Juan Islands. It also is 115-kV, a relatively low transmission voltage. The Bureau of Reclamation operates two 500-kV underground cable circuits at Grand Coulee Dam. These circuits are only about 6,000 feet long.

In addition to significantly higher construction costs, installation and maintenance of underground transmission cables also result in significantly higher maintenance costs and environmental impacts that are typically the same or greater than impacts associated with an overhead line. Installation of underground cable would require the use of large excavators and other heavy equipment to dig a continuous cable trench a minimum of ten feet wide and six feet deep to install the cables. All trees and brush would need to be cleared along this construction corridor. This construction activity would cause significant surface and subsurface disturbance, soil erosion potential, and noise and air quality impacts along the transmission line route. In areas where bedrock is near the surface, construction would also require blasting, which would result in significant noise and air quality impacts. In areas where the cables would cross waterbodies such as the Spokane River, construction activities could result in significant impacts to wetlands and riparian areas that could largely be avoided with an overhead transmission line.

Once the cables are installed, a permanent right-of-way approximately 50 feet in width would be required with a continuous parallel access road along the undergrounded transmission line route to allow necessary maintenance and repair of the cables. Repair activities would require continual excavation along the affected reach when these activities are needed. The cables that would be installed likely would be oil filled cables. These cables would require above-ground termination and oil storage equipment at several locations along the line. This equipment would result in visual impacts. Because the cables would be underground, the cables would be more susceptible to damage and failure due to geological hazards such as seismic activity, landslides, and soil erosion. Failures also can result from aging of the cables, heat stress, and a variety of other external and internal causes. In addition, because the cables would be buried, it would be much more difficult to locate failed or damaged cables occur, restoration of service likely would take weeks or months as compared to hours or days for restoration of service on an overhead line. The reliability and life expectancy of an underground system also could be less than an overhead system.

Underground cable remains a tool available for special situations, but because of its high cost and environmental impacts, it is not considered a reasonable alternative to solve the problem identified in Chapter 1. It therefore was eliminated from detailed evaluation.

Replace Existing Grand Coulee-Bell Line with a Double-Circuit Line

As an alternative to removing one of its existing lines from the transmission corridor and constructing the Grand-Coulee-Bell 500-kV line as described in the alternatives evaluated in detail, BPA could instead replace the existing line from the Grand Coulee Switchyard to the Bell Substation for its entire length with towers that could accommodate two lines—double-circuit towers.

Although BPA considered this alternative in the mid-1990s, it was eliminated primarily due to excessive costs and to public concerns about visual impacts. The transmission towers for a double-circuit line would cost approximately twice as much as for a single-circuit line (significantly heavier towers would be needed to carry the double-circuit conductors). In addition, double circuiting would not be expected to result in any significant reduction in the level of environmental impact as compared to the proposed action. Tower removal and construction as well as access road enhancements would still disturb the ground; thus the alternative would have at least as much potential for land use disturbance, vegetation removal, and erosion potential as the proposed action. This alternative would also have greater visual effects than the proposed action because it would require 175-foot towers along the entire corridor, which would be more visible than the 125-foot-tall towers used for single-circuit lines. Because this alternative would not meet the purpose of minimizing project costs and would not reduce expected environmental impacts, it was considered but eliminated from detailed study in this EIS.

Transmission Line Route Alternatives

These alternatives considered locations other than use of the existing right-of-way as proposed.

Rerouting Lines in the Spokane Area

During the scoping process, many people suggested considering other locations for a new transmission line.

When locating new transmission lines, BPA tries either to replace existing lines, or to use or parallel an existing transmission right-of-way. Adding a transmission line on existing right-of-way next to an existing one can cause fewer visual, land use, and ground disturbance-related impacts than a new, totally separate line, and the need for new access roads can be kept to a minimum by using existing access roads. Using an existing corridor also avoids the impact of having to clear miles of new 150-foot wide right-of-way. Following this right-of-way practice can greatly reduce costs and environmental impacts.

BPA studied the area around Spokane for possible corridor routes. Studies found no routes near Spokane for a new transmission corridor, and no suitable alternative existing utility corridor, that would accommodate the transmission towers with less environmental impact or for less cost than the proposal.

Other Transmission Line Alternatives

Two alternatives to the Grand Coulee-Bell 500-kV line project were considered and eliminated from detailed study. These alternatives are:

1. **Bell-Ashe 500-kV Line**

    - This line would be approximately 145 miles long, all on new right-of-way between Bell Substation in Spokane, and Ashe Substation on the Hanford Reservation, north of Richland, Washington.
    - The other components of the project would be the same as for the Grand Coulee-Bell 500-kV project.
    - The project would cost about $95 million more than the Grand Coulee-Bell 500-kV project, due in part to the requirement for new right-of-way and because it is 60 miles longer.
    - Although the Bell-Ashe 500-kV line provides a slightly greater benefit in reducing the loading on parallel paths, the benefit to system stability during disturbances is significantly less than for the Grand Coulee-Bell 500-kV line.

- To meet Western Electricity Coordinating Council (WECC) reliability criteria, the Bell-Ashe 500-kV line alternative could potentially require fewer remedial actions (such as automatic generator tripping following a line outage) than a Grand Coulee-Bell 500-kV line because it is not located on right-of-way parallel to the existing Grand Coulee-Bell 230-kV lines.
- The need for new right-of-way would delay completion by at least 2 years compared to the Grand Coulee-Bell 500-kV line because of negotiations required to obtain easements.
- Construction of this alternative on 145 miles of new right-of-way would be expected to result in greater amounts of ground disturbance than the proposed action and thus the potential for greater effects to vegetation, wildlife habitat, wetlands, land uses, and recreation.
- Because this alternative would involve constructing 145 miles of new transmission line in a new transmission corridor rather than in an existing corridor with existing lines, this alternative would be expected to have greater visual impacts than the proposed action, and the potential for greater avian impacts than the proposed action.

This alternative was eliminated because, although it is technically feasible and meets reliability standards better than the proposal, it does not achieve at least three other purposes: its costs are excessive compared to other alternatives, it would take at least two years longer to implement, and it would cause substantially greater environmental impacts due to its location on new right-of-way that is nearly double the length of the proposed line.

2. Taft-Lower Granite 500-kV Line

- This line would be approximately 150 miles long, all on new right-of-way between Taft Substation near the continental divide in western Montana and Lower Granite Substation adjacent to the Snake River in southeastern Washington.
- The other components of the project would be the same as for the Grand Coulee-Bell 500-kV project, except that a series capacitor would be located at Lower Granite Substation instead of at Bell Substation.
- This project would also require building a third 500-kV line from Lower Granite Substation to Lower Monumental Substation near the Lower Monumental Dam on the Snake River, near Kahlotus, Washington, a distance of approximately 57 miles. Without this additional line, the full capacity of the West of Hatwai path could not be used because of how lines in the area must be operated.
- The project would cost about $105 million more than the Grand Coulee-Bell 500-kV project, not including the cost of the Lower Granite-Lower Monumental line.
- To meet WECC reliability requirements, this new line could not be constructed adjacent to the existing 500-kV line and provide a significant increase in allowed transfer capability. In this case, two 500-kV lines would be parallel to each other. If both went out of service, there are no other lines to assume part of the load, as is the case in the Grand Coulee-Bell corridor. In addition, if two lines were out of service

in the Grand Coulee-Bell corridor, only one would be 500-kV, so less load would need to be transferred over other lines than under this alternative.

- The requirement for new right-of-way would delay completion by at least 2 years compared to the Grand Coulee-Bell 500-kV line due to negotiations required to obtain easements.
- Construction of this alternative on 150 miles of new right-of-way would be expected to result in greater amounts of ground disturbance than the proposed action and thus the potential for greater effects to vegetation, wildlife habitat, wetlands, land uses, and recreation.
- Because this alternative would involving constructing 150 miles of new transmission line in a new transmission corridor rather than in an existing corridor with existing lines, this alternative would be expected to have greater visual impacts than the proposed action, and the potential for greater avian impacts than the proposed action.

This alternative was eliminated because, although it is technically feasible, it does not achieve at least three purposes: like Bell-Ashe, its costs are excessive compared to other alternatives, it would take at least two years longer to implement, and it would cause substantially greater environmental impacts, for the same reasons as Bell-Ashe, even without the additional line between Lower Granite and Lower Monumental dams.

Non-Transmission Alternatives

These alternatives examined ways to meet the need that would not require a new transmission line.

As explained in Chapter 1, BPA owns and operates a system of transmission lines that move electricity from generation sources in Montana, northern Idaho, and northeastern Washington to load centers to the west. Since the mid-1990s, the portion of the system west of Spokane has grown increasingly constrained. During spring and early summer months, the amount of power that needs to move through this area at times could exceed the carrying capacity of the existing transmission lines. The problem was exacerbated in 2001 when two aluminum smelters closed that were located east of the West of Hatwai ***cutplane*** (the West of Hatwai cutplane is the point just west of Spokane where insufficient transmission capacity exists to transmit all available power any farther to the west).

To meet the need described in Chapter 1, BPA considered non-transmission alternatives, including energy conservation and demand reduction measures to reduce overload on the transmission system, as well as load and generation curtailment during outage conditions. As part of this effort, BPA used the results of a report entitled "Expansion of BPA Transmission Planning Capabilities," which has been incorporated by reference in this EIS (Energy and Environmental Economics, Nov. 2001). This report was prepared for BPA by outside consultants to recommend how BPA might more effectively plan to meet transmission needs. The report also provided a preliminary screening of various transmission improvement projects (including the Proposed Action) to determine whether non-transmission alternatives to them would be viable. The conclusions summarized below confirmed BPA's earlier assessment that non-transmission alternatives were not reasonable alternatives to meet the need as described in Chapter 1.

Conservation and Demand Management Alternatives

Conservation that reduces load from the Spokane area to the east will only make the problem worse by increasing the amount of generation that must cross the cutplane. Other alternatives such as fuel switching (from electric to gas) or curtailing load will cause the problem to worsen because they reduce area load, thereby increasing the generation that must flow across the constrained path. New generation additions in the area east of the cutplane will exacerbate the congestion problem, similar to what happened when the aluminum smelters closed, causing a decrease in load (see Chapter 1).

West of the cutplane, conservation, generation additions, fuel switching or curtailing load will not improve the problem unless existing generation east of the cutplane is shut down. Curtailing generation at some hydroelectric projects would lead to spill conditions that violate Endangered Species Act requirements (see Chapter 1).

In sum, these non-transmission alternatives would likely exacerbate, not solve, the problem described in Chapter 1.

Pricing Alternatives

Currently, BPA, like all utilities in the Northwest, charges for transmission services using a fixed price for each megawatt of power delivered. The price is determined in a formal process known as a rate case. Alternatives such as ***locational pricing*** and ***time-of-use rates*** provide price signals to encourage parties to use limited transmission capability more efficiently. Most ***Regional Transmission Organizations (RTOs)*** essentially change the price of transmission when the grid becomes constrained, an approach called ***congestion pricing***.

BPA considered these alternative pricing structures in the rate case that determined the transmission rates currently in effect. Rate case participants argued that these pricing approaches were best developed in a region-wide RTO environment, and should be deferred until the ***proposed RTO West*** is operational. BPA's current rates expire on September 30, 2003. BPA will assess the situation and examine alternative rate constructs in the next rate case.

Congestion pricing works to reduce congestion by allowing generation on the surplus side of the constraint (east of the cutplane) to shut down and purchase replacement power (or controllable demand) on the deficit (west) side. This approach is effective when there are competitive markets for generation or controllable demand on both sides of the transmission constraint.

The east side of the West of Hatwai cutplane has a significant generation surplus, much of which is hydro that cannot readily be redispatched during the summer because the water would be spilled. Spilling water at several dams would violate ESA conditions. At a minimum, the value of the energy (spilled water) would be lost. Other generation on the east side of the cutplane comes from coal plants in Montana. This generation has relatively low fuel costs, so that the plant operators would not be willing to pay very much for replacement generation west of the cutplane.

Hydro, nuclear and coal resources west of the cutplane tend to run close at their maximum output to serve regional needs and compete in the California market at this time of year. Remaining natural gas resources, if any, are likely to be much more expensive than the coal on the east side. Congestion on paths such as West of Hatwai contributed to overall higher prices and volatility that plagued the western energy markets in 2001. This is not a good candidate for congestion pricing, especially given the magnitude of the constraint.

Therefore, because the alternative would not solve the problem without violating ESA conditions or significantly increase costs to consumers, it is not considered a reasonable alternative and was eliminated from detailed study.

Comparison of Alternatives

Table 2-1 compares the Agency Proposed Action and alternatives, including the No Action Alternative, to the purposes of the project described in Chapter 1. Table 2-2 provides a summary of the environmental impacts and mitigation for the alternatives.

The east side of the West of Hatwai cutplane has a significant generation surplus, much of which is hydro that cannot readily be redispatched during the summer because the water would be spilled. Spilling water at several dams would violate ESA conditions. At a minimum, the value of the energy (spilled water) would be lost. Other generation on the east side of the cutplane comes from coal plants in Montana. This generation has relatively low fuel costs, so that the plant operators would not be willing to pay very much for replacement generation west of the cutplane.

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Therefore, because the alternative would not solve the problem without violating ESA conditions or significantly increase costs to consumers, it is not considered a reasonable alternative and was eliminated from detailed study.

Comparison of Alternatives

Table 2-1 compares the Agency Proposed Action and alternatives, including the No Action Alternative, to the purposes of the project described in Chapter 1. Table 2-2 provides a summary of the environmental impacts and mitigation for the alternatives.

Table 2-1. Comparison of Alternatives to Project Purposes

Purpose	Agency Proposed Action	Alternative Action	No Action Alternative
Maintain transmission system reliability	▪ Replacing a 115-kV line with a 500-kV line provides needed capacity to move power from generation sources in Montana to load centers to the west, even during peak generation periods and even if one transmission line is out of service, thus meeting industry reliability standards.	▪ The alternative action, which would provide for double-circuit 500-kV towers for a 9-mile section west of Bell Substation, would provide the same system reliability enhancements as the proposed action.	▪ Maintaining the transmission system at its current capacity means it could be required to drop substantial load (up to 2250 MW) in order to meet reliability standards during a transmission line outage, especially during peak seasons. The system would be at a continually increasing risk of overloads and violation of reliability standards.
Continue to meet contractual obligations	▪ The proposed action would provide adequate capacity to enable BPA to continue to meet contractual obligations	▪ The Alternative Action would also provide adequate capacity to enable BPA to continue to meet contractual obligations.	▪ BPA would be unable to continue to meet its present and future contractual obligations to deliver power to its custom-ers in a reliable manner.
Comply with BPA's statutory obligations	▪ The proposed action is consistent with BPA's obligations under the Federal Columbia River Transmission Act to construct additional transmission lines necessary for transmitting electric power and maintaining electrical stability and reliability.	▪ The Alternative Action would also comply with BPA's statutory obligations.	▪ BPA would not be in compliance with its obligations to construct additional transmission lines necessary for transmitting electric power and maintaining electrical stability and reliability.

Table 2-1 (cont'd)

Purpose	Agency Proposed Action	Alternative Action	No Action Alternative
Minimize environmental impacts *(see Table 2-2, Summary of Impacts)*	▪ By replacing an existing line in an already developed corridor, the proposed action minimizes environmental impacts compared to the clearing and disturbance required to construct a new line and access roads in an undisturbed area. ▪ The proposed action minimizes visual impact compared to the alternative action by using shorter, single-circuit towers for all but about 1 mile of the 84 miles of line.	▪ The Alternative Action would result in environmental impacts that are approximately the same as for the proposed action. The principal difference would be greater impacts associated with the double-circuit towers in the 9-mile section in the Spokane area (potentially greater visual impacts, risk of bird collisions). Conversely, it would benefit land use in the long term by reserving a location for an additional 500-kV line in the 9-mile section for a future unknown need. This line segment could experience future constraints to expansion due to its proximity to a growing population in the Spokane area.	▪ The No Action Alternative would not cause any construction-related environmental impacts. ▪ No Action could also result in adverse socioeconomic impacts such as lower employment and income levels, reduced levels of economic activity, and reduced tax revenues and services as a result of reduced capacity and reliability. ▪ Maintenance activities associated with vegetation clearing, vehicle traffic, and human presence could adversely affect water quality, vegetation, wildlife, fish, and wetland resources.
Minimize costs	▪ Estimated cost of $152 million.	▪ Estimated cost of $160 million.	▪ No direct construction costs would be associated with this alternative.
Solve transmission capacity problem by late 2004	▪ The new line would be in service by late 2004.	▪ The new line would be in service by late 2004.	▪ Problem would not be solved.

Table 2-2. Summary of Impacts and Mitigating Measures for the Proposed Action and Alternatives

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	**Alternative Action**		
Land Use			
▪ Imposition of a transmission line on 3.5 miles of right-of-way where none now exists; remainder of project would be in existing transmission line corridor or BPA property. ▪ Approximately 24 acres would be needed on a permanent basis for tower sites. ▪ Approximately 40 acres would be needed temporarily for staging areas and conductor pulling/tensioning sites. ▪ Approximately 22 acres would be needed for new permanent access roads and road spurs; mostly in rangeland. ▪ Approximately 52 acres would be needed for access road improvements. ▪ Approximately 12 acres of agricultural land would be removed from production permanently (about 4 acres of prime farm land); net loss would be about 3.3 acres. ▪ Up to 765 acres of cropland would be removed from production for one or two seasons. ▪ Potential interference with farming activities during construction; towers would interfere with farming during operation.	▪ Impacts would be the same as for the Agency Proposed Action.	▪ Provide schedule of construction activities to all landowners along the corridor that could be affected by construction. ▪ Coordinate with the City of Grand Coulee to site towers within North Dam Park. ▪ Place gravel on existing roads within North Dam Park to reduce the spread of noxious weeds. ▪ Pre-treat areas of high weed concentrations in North Dam Park during plant emergence to reduce weed spread. ▪ Use Best Management Practices to limit erosion and the spread of noxious weeds. ▪ Plan and schedule construction activities, when practical, to minimize temporary disturbance, displacement of crops, and interference with farming activities. ▪ Restore compacted soil in cropland. ▪ Compensate farmers for crop damage. ▪ Place new towers parallel to existing towers, where practical, to enhance maneuverability of farm equipment. ▪ Revegetate disturbed areas with native species. ▪ Coordinate with Riverside State Park officials to locate access roads to minimize disturbance to vegetation.	▪ No new impacts.

Table 2-2 (cont'd)

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	Alternative Action		
Land Use (cont'd)			
▪ Potential interference with recreational use at North Dam Park. ▪ Temporary disturbances to recreational use at Riverside State Park and nearby residential uses in the Spokane area. ▪ Commercial activities (recreational vehicle parking) in corridor near U.S. Highway 2 may be incompatible; change in land use may occur. ▪ Potential disruption of traffic during construction. ▪ Potential for spread of noxious weeds by ground disturbance and vehicles. ▪ Consistent with land use plans and zoning; double-circuit towers exceed height restrictions in City of Spokane and Spokane County. ▪ Land use impact levels would be low to moderate.			

Table 2-2 (cont'd)

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	Alternative Action		
Noise			
▪ Residents at distances up to 400 to 600 feet from construction activity could experience noise levels that exceed Washington noise standards. ▪ Small increase in audible noise levels at the edge of the right-of-way during operation; median noise levels would be within standards. ▪ Noise impact levels would be low to moderate. ▪ Potential radio and television interference.	▪ Construction impacts would be the same as for the Agency Proposed Action. ▪ Audible noise levels during line operation would be 1 to 2 dBA higher than proposed action, impacts could be slightly greater.	▪ Provide sound-control devices no less effective than those provided on original equipment. ▪ Provide muffled exhaust on all construction equipment and vehicles. ▪ Limit construction activities to daytime hours. ▪ No noise-generating construction activity will be conducted within 1,000 feet of a residence between 10:00 p.m. and 7:00 a.m. ▪ Notify landowners directly impacted along the corridor prior to construction activities. ▪ Restore radio or television reception to a quality as good or better than before if interference occurs.	▪ No new impacts.
Public Health/Safety			
▪ Potential risk of fire and injury associated with use of equipment during construction, and traffic safety issues. ▪ Potential incidence of electric field-induced nuisance shocks. ▪ Potential for health effects from magnetic fields in residential and business areas would be minor due to sparse population or field levels that would decrease or would not change from the current condition (except for 0.6-mile section in a residential and commercial area close to the right-of-way where a slight increase	▪ Fire, injury, traffic, and nuisance shock effects would be the same as for the proposed action. ▪ Potential for health effects from exposure to magnetic fields is slightly less than proposed action.	▪ Prepare and maintain a safety plan in compliance with Washington requirements. ▪ Hold crew safety meetings at the start of each workday. ▪ Secure the site to protect equipment and the general public at the end of each workday. ▪ Provide employee training in tower climbing, first aid, rescue techniques, and safety equipment inspection. ▪ Assure contractor complies with State regulations regarding on-site fire equipment. ▪ Fuel all highway-authorized vehicles off-site.	▪ No new impacts.

Table 2-2 (cont'd)

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	Alternative Action		
Public Health/Safety (cont'd)			
would be expected outside of the right-of-way). The overall level of impacts would be low except for the commercial area, where the level would be moderate to high.		▪ When transporting project components, establish helicopter flight paths that avoid populated areas and schools. ▪ Provide notice to public of construction activities, including blasting. Take appropriate safety measures for blasting consistent with state and local codes and regulations. Remove all explosives from the work site at the end of the workday. ▪ Install implosion fittings used to connect the conductors in such a way as to minimize potential health and safety risks. ▪ Require operation and maintenance vehicles to carry fire suppression equipment. ▪ Stay on established access roads during routine operation and maintenance activities. ▪ Keep vegetation cleared according to BPA standards to avoid contact with transmission lines. ▪ Submit final tower locations and heights to the Federal Aviation Administration for review and potential marking and lighting requirements. ▪ Construct and operate the new transmission line to meet or exceed the National Electrical Safety Code. ▪ Follow BPA specifications for grounding fences and other objects on and near the proposed right-of-way.	

Table 2-2 (cont'd)

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	Alternative Action		
Visual Resources			
▪ Temporary viewscape changes during construction. ▪ Low to high visual impacts due to change in views for residents in the Grand Coulee and Spokane areas, and for users at North Dam Park and Riverside State Park. ▪ Moderate to high impacts to viewers of line where it crosses the Spokane River. ▪ Moderate to high impacts to residents of housing developments east of Nine Mile Road and in other areas between there and Bell Substation. ▪ Potentially high impact for viewshed from archaeological site near Grand Coulee.	▪ Impacts would be greater in the Spokane area where taller, double-circuit towers would be used.	▪ Use tower steel that has been treated to reduce reflectivity. ▪ Use non-specular conductors. ▪ Use non-luminous insulators (i.e., non-ceramic insulators or porcelain). ▪ Plant vegetative screens, do selective clearing/tree topping at Riverside State Park and other selected sites. ▪ Use existing topography and vegetation when ever possible to limit views of lines and structures. ▪ Locate construction staging areas out of site of potential viewers as much as possible. ▪ Require contractors to maintain a clean construction site. ▪ Maintain permanent access roads. ▪ Consult Colville Tribe on impacts to archaeological site near Grand Coulee.	▪ No new impacts.
Air Quality			
▪ Short-term increase in pollutant levels during construction from dust and vehicles. ▪ The level of impacts during construction and operation would be low.	▪ Impacts would be the same as for the Agency Proposed Action.	▪ Use water trucks to control dust during construction ▪ Use low sulfur fuel for on-road diesel vehicles ▪ Lop and scatter, pile, mulch or chip, or take woody debris and other vegetation off-site.	▪ No new impacts.

Table 2-2 (cont'd)

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	Alternative Action		
Cultural Resources			
▪ Unless avoided by construction activities, potential for direct disturbance effects of several prehistoric and historic sites (low to high impact levels). Four of the archaeological sites are considered to have traditional cultural property values. ▪ Unless avoided, possible disturbance (moderate effect) of two archaeological sites by dismantling of the existing 115-kV line in the Grand Coulee area. ▪ High potential effect on historic site at Bell Substation.	▪ Impacts would be the same as for the Agency Proposed Action.	▪ Avoid archaeological sites where practical including spanning them or positioning towers to separate them from cultural resources. ▪ Site new access roads to avoid cultural resources. ▪ Limit road improvements to the existing roadbed near cultural resource sites. ▪ Avoid cultural resource sites when dismantling the portion of the 115-kV line in the Grand Coulee area. ▪ Mitigate impacts for sites that are eligible for NRHP listing and cannot be avoided. ▪ Halt work if resources are discovered during construction activities and engage cultural resource specialists to evaluate the discoveries.	▪ No new impacts.
Socioeconomics			
▪ Minimal impact on housing to meet construction worker needs. ▪ Beneficial impact on employment, personal income, and local sales tax revenues. ▪ Small amount of foregone agricultural production. ▪ Low potential for trespass and vandalism of homes and businesses. ▪ Low potential for long-term adverse impacts on property values.	▪ Impacts would be the same as for the Agency Proposed Action.	▪ Compensate landowners at fair market value for any new land rights required for easements for new right-of-way or for access roads. ▪ Compensate farmers for crop damage. Correct soil compaction or compensate landowners. ▪ Site towers to maintain efficient crop patterns and minimize adverse impacts to farming activities.	▪ No Action could result in lower em-ployment and income levels, reduced levels of economic activity, and reduced tax revenues and services as a

Table 2-2 (cont'd)

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	Alternative Action		
Socioeconomics (cont'd)			
▪ No disproportionate impacts on low-income or minority populations.			result of reduced capacity and reliability.
Soils and Geology			
▪ Disturbance of soils and removal of vegetation during construction increase the risk of soil erosion and mass movement, and may change soil productivity and physical characteristics causing low to high impacts. ▪ Removal of vegetation in areas with loess soils would likely increase the rate of wind erosion.	▪ Impacts would be the same as for the Agency Proposed Action.	▪ Install runoff and erosion controls. ▪ Use environmental specialist to decide which mitigation approaches are best suited to reduce erosion and runoff, and to stabilize disturbed areas. ▪ Deposit excavated material in upland areas and stabilize. ▪ Promptly seed disturbed sites with an herbaceous seed mixture suited to the site. ▪ Use vegetative buffers and sediment barriers to prevent sediment from moving off site and into water bodies. ▪ Provide assistance to farmers and ranchers for subsoiling where agricultural and rangeland soils are compacted. ▪ Conduct follow-up inspections and maintain erosion and runoff controls and revegetation. ▪ Avoid construction on steep, unstable slopes if possible.	▪ No new impacts.

Table 2-2 (cont'd)

Potential Impact: Agency Proposed Action	Potential Impact: Alternative Action	Mitigation	No Action Potential Impact
Water Quality			
▪ Temporary local increases in erosion and sedimentation during, and for a brief time after, construction would have low to moderate impacts. ▪ Potential contamination of surface water resources during project construction from accidental spills or leaks of petroleum products would have a low impact. ▪ Potential increase in wind and water erosion rates. ▪ Potential increase in surface water temperature would have a low impact. ▪ Construction activities generally would not be expected to directly or indirectly impact groundwater aquifers (no to low impact level). ▪ Low risk to groundwater resources from potential spills or leaks of petroleum products (low impact level).	▪ Impacts would be the same as for the Agency Proposed Action.	▪ Use best management practices to divert flows from exposed soils, store flows, or otherwise limit runoff and erosion on the site ▪ Use properly sized culverts ▪ Start stabilization measures soon after construction activities have ceased ▪ Place devices at all discharge locations and along the length of any outfall channel to slow velocity of water and avoid any significant change in the hydrology of waters downstream ▪ Restrict discharges of solid materials into waters of the United States ▪ Deposit excavated material not reused in an upland area and stabilize ▪ Schedule construction, when practical, during periods when precipitation and runoff possibilities are at a minimum ▪ Set back towers near water crossings from stream banks.	▪ No new impacts.
Wetlands			
▪ Potential indirect impacts to several wetlands located within 100 feet of the new towers would have low to moderate impacts. ▪ Potential impacts to several wetlands located within 100 feet of access road maintenance activity would have low to moderate impacts .	▪ Impacts would be the same as for the Agency Proposed Action.	▪ Use standard best management practices to avoid or reduce indirect impacts to wetlands. ▪ Stockpile soil and replace or loosen compacted soils; revegetate disturbed areas adjacent to wetlands with native species. ▪ Avoid construction within flagged wetland and wetlands buffers and on step unstable slopes.	▪ No new impacts.

Table 2-2 (cont'd)

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	**Alternative Action**		
Wetlands (cont'd)			
▪ New corridor areas acquired for access roads or tower placements would avoid wetlands (no impact). ▪ Potential impacts to wetlands due to the possible clearing of tall wetland vegetation (trees) during operation and maintenance (low to moderate impact level).		▪ Locate structures, new roads, and staging areas so as to avoid waters of the U.S., including wetlands. ▪ Avoid mechanized land clearing within wetlands and riparian areas. ▪ Regularly inspect and maintain project facilities. ▪ Avoid refueling and/or mixing hazardous materials near wetlands. ▪ Use existing road systems. ▪ All excavated material not reused would be deposited in an upland area and stabilized. ▪ Where feasible, top trees instead of removing trees so roots and soil remain intact.	
Vegetation			
▪ Removal of vegetation from 210 acres for construction of towers would have moderate impacts. ▪ Destruction of plants by construction vehicles would have a low impact. ▪ Continued maintenance involving removal of tall trees would have a low impact level. ▪ Indirect impacts such as soil compaction, damaging root structures, and dust clogging leaf surfaces through use of access roads would have low to moderate impacts.	▪ Impacts would be the same as for the Agency Proposed Action.	▪ Maximize use of the existing corridor and roads for construction activities. ▪ Restrict vegetation clearing to the minimum needed to maintain safety and operational standards. ▪ Reseed or revegetate disturbed areas following construction. ▪ Implement measures to lessen the spread or introduction of noxious plants during and following construction. ▪ Locate staging areas and conductor tensioning sites outside of good quality native habitat areas, where possible.	▪ No new impacts.

Table 2-2 (cont'd)

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	Alternative Action		
Vegetation (cont'd)			
▪ Infestation of disturbed areas with noxious plant species would have low to moderate impacts.		▪ Restrict travel to one area where spur roads would traverse lithosols to prevent damage to sensitive plant communities.	
Fish			
▪ Short-term and localized increases in turbidity and sediment in fish-bearing streams would have low impacts, except fish-bearing streams, where impacts could be low to high depending on timing of sedimentation. ▪ Avoidance of immediate work areas by fish due to increases in turbidity would have low impacts. ▪ Potential sediment deposition over spawning areas that could suffocate eggs and fry would have high impacts. ▪ Potential increase in water temperatures above those preferred by fish and reduced rates of wood recruitment into the stream due to removal of riparian vegetation would have moderate to high impacts.	▪ Impacts would be the same as for the Agency Proposed Action.	▪ Implement WDFW recommendations for culvert replacements. ▪ Install silt fences and straw bales to separate construction activities from watercourses and drainages. ▪ Deposit excavated material not reused in an upland area and stabilize. Restrict deposition from environmentally sensitive areas such as streams, riparian areas, wetlands, or floodplains. ▪ Promptly seed disturbed sites with an herbaceous seed mixture suited to the site. ▪ Use vegetative buffers and sediment barriers to prevent sediment from moving off site and into water bodies. ▪ Avoid construction activities near fish-bearing streams during the April-June period of trout egg incubation to the extent possible. ▪ Minimize vegetation cutting within riparian zones to protect stream banks and maintain water temperature. ▪ Avoid mechanized land clearing within riparian areas.	▪ No new impacts.

Table 2-2 (cont'd)

<table>
<tr><th colspan="2">Potential Impact</th><th rowspan="2">Mitigation</th><th rowspan="2">No Action Potential Impact</th></tr>
<tr><th>Agency Proposed Action</th><th>Alternative Action</th></tr>
<tr><td colspan="4">Fish (cont'd)</td></tr>
<tr><td></td><td></td><td>▪ Avoid refueling and/or mixing hazardous materials where accidental spills could enter surface or groundwater.</td><td></td></tr>
<tr><td colspan="4">Wildlife</td></tr>
<tr><td>▪ Potential impacts on wildlife in shrub steppe, forested, and riparian habitats during the breeding season (March to August) due to noise associated with construction activities would have a high impact.
▪ Reduction in wildlife foraging areas and ground nesting habitat due to vegetation removal during construction would have low to high impacts, depending on time of year.
▪ Avian species could collide with the new transmission line (low impact level).</td><td>▪ Impacts would be the same as for the Agency Proposed Action.</td><td>▪ Mark or remove the ground wire at the span crossing the Spokane River and wetlands.
▪ Limit the removal of forest habitat to only those trees that would directly interfere with transmission lines.
▪ Retain or create snags within the corridor at a density of at least 2 snags per 1 acre.
▪ Avoid construction activities within high-use native habitats during the breeding season (March 1 to August 15), when possible.
▪ Gate and lock access to the corridor, when practical, especially where the corridor crosses habitats heavily used by wildlife.
▪ Limit vehicular travel to access roads through sensitive habitat such as shrub/steppe.</td><td>▪ No new impacts.</td></tr>
<tr><td colspan="4">Floodplains</td></tr>
<tr><td>▪ Construction within a floodplain would not create obstructions to floodwater and alter flow patterns and floodplain acreage (no impact level).
▪ Removal of riparian vegetation during construction is not expected to impact floodplains (no impact level).</td><td>▪ Impacts would be the same as for the Agency Proposed Action.</td><td>▪ Use erosion control measures.
▪ Leave vegetative buffers next to all water bodies where possible.
▪ Span floodplains wherever possible.
▪ Place fill used for temporary access road widening on fabric and remove it to an upland site after construction.</td><td>▪ No new impacts.</td></tr>
</table>

Table 2-2 (cont'd)

Potential Impact		Mitigation	No Action Potential Impact
Agency Proposed Action	**Alternative Action**		
Floodplains (cont'd)			
▪ No impact on floodplains due to operation and maintenance.		▪ Design the project to locate roads and structures to avoid floodplains or to minimize the potential for creating obstructions to floodwaters. ▪ Near floodplain areas, deposit all excavated material not reused in an upland area and stabilize it.	

Chapter 3 Affected Environment, Environmental Consequences, and Mitigation

Introduction

This Chapter discusses the environmental analyses for:

- Human resources;
- Natural resources; and
- Protected resources.

For each type of resource, this chapter describes the existing environment that would be affected by the alternatives, the environmental impacts of the alternatives, and mitigation. Each construction alternative would be built within the existing BPA Grand Coulee-Bell transmission corridor or on BPA property except between corridor mile 3/8 and the Grand Coulee Switchyard where the transmission line would divert from the existing corridor for approximately 3.5 miles. The existing corridor is about 84 miles long and crosses four counties and two cities in east-central Washington: Douglas, Grant, Lincoln and Spokane counties and Grand Coulee City and Spokane.

Figure 3-1 shows that most of the existing corridor, about 77 miles, passes through privately owned land. The Bureau of Reclamation owns the Grand Coulee Switchyard and the lands immediately surrounding the switchyard. About 3 miles of the corridor cross Riverside State Park in Spokane County, owned by Washington State.

To evaluate 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 with each resource. Impact definitions are given in the first part of the discussion of impacts for each resource.

Specialists considered direct and indirect impacts in the short term and long term. Direct impacts occur within or next to the corridor during a construction activity; indirect impacts occur after a construction activity, or in an area adjacent to construction activities or removed from the corridor.

The impact analysis discusses cumulative impacts of the alternatives and lists ***mitigation*** that could reduce impacts. Cumulative impacts are impacts from the proposed project, together with impacts from past, present, and/or foreseeable future projects. If no cumulative impacts are expected, none are listed.

Generally, direct impacts from the construction alternatives would be confined to the existing corridor, except in those areas where new right-of-way is needed, and where access road improvements are planned outside the corridor. If the affected environment for a specific natural or other resource extends beyond the general limits of the existing corridor, it is noted under the specific resource.

For the convenience of readers who live in the area and are familiar with local landmarks, the location of an affected resource may be identified by corridor mile and local landmarks. Corridor miles refer to a specific structure in a given mile (from west to east) of the existing Grand Coulee-Bell 115-kV transmission lines. For example, a resource near corridor mile 76/5 refers to the fifth existing structure in mile 76, east of Grand Coulee. Local landmarks used are county roads, parks, etc. However, because the entire corridor is shown on most maps, and the maps are small, not all landmarks mentioned in the text appear on the maps.

Environmental studies were performed for this project in the mid-1990s and a preliminary Draft EIS was prepared but not released to the public for comment. The system capacity problems identified at that time were solved in other ways and the EIS was not completed. The environmental analyses in this chapter build on and update the information in the previous studies (Enserch Environmental, 1994) and in the previous preliminary Draft EIS. In addition, this EIS incorporates by reference the Transmission System Vegetation Management Program EIS (Bonneville Power Administration, 2000).

GRAND COULEE - BELL 500kV TRANSMISSION LINE PROJECT

LAND USE

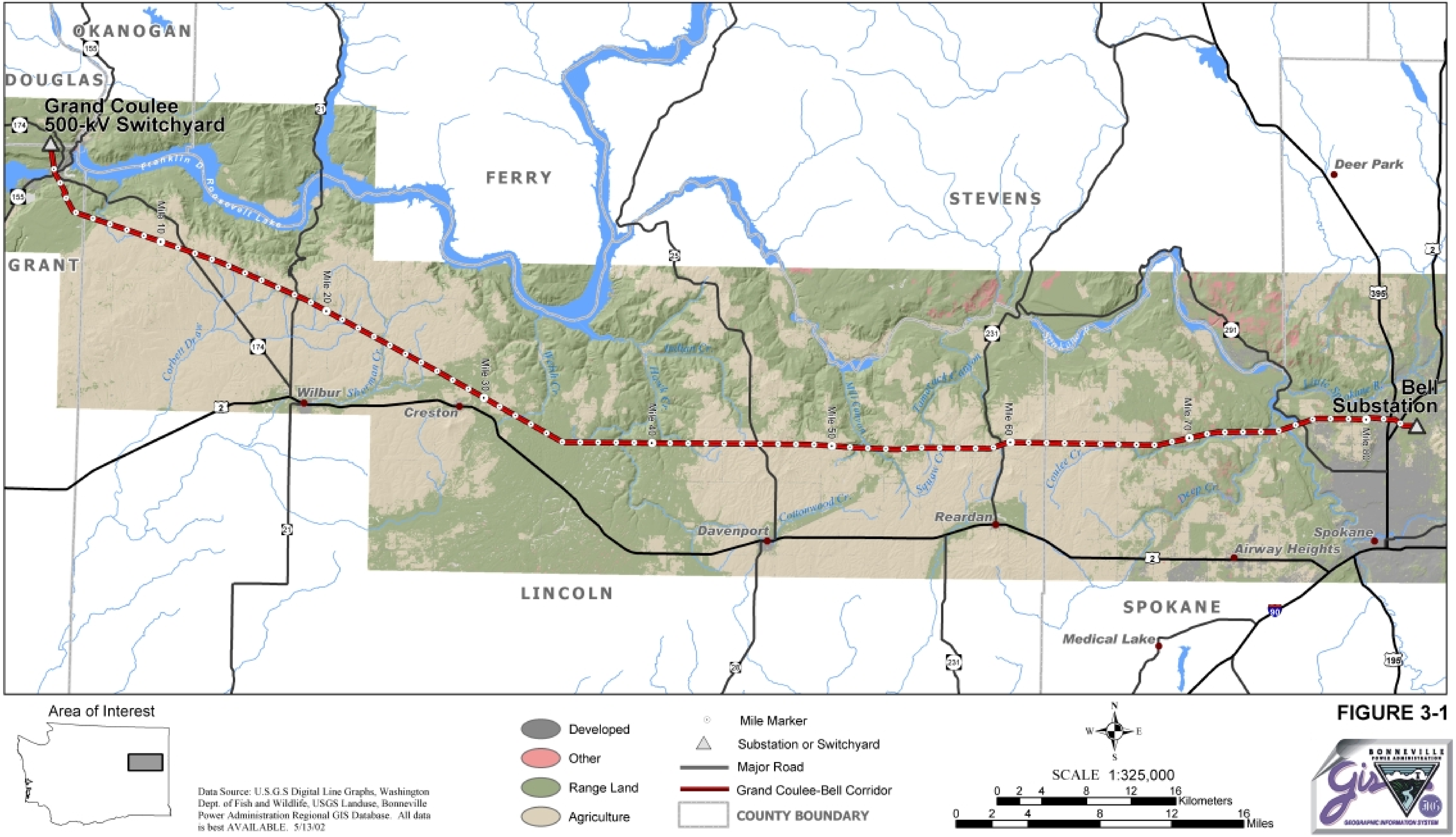


FIGURE 3-1

Land Use

Affected Environment

The affected environment for land use impacts includes the existing corridor and land up to 1,200 feet on either side of the existing corridor. The following discussion describes existing and planned land use in the affected environment, and local, county, and regional plans and policies (including zoning) that affect land use.

Land use is divided into four categories (see Table 3-1). They represent general categories next to and within the corridor. The distribution of these uses is shown on Figure 3-1. In general, developed land occurs at the western (City of Grand Coulee) and eastern (north Spokane) ends of the line. Most agricultural land consists mainly of dryland wheat and other crops located in western and eastern Lincoln County. Most rangeland is present in central Lincoln County and in scattered tracts associated with drainages. Most recreational land crossed on or near the transmission lines is in the north and northwest Spokane area; a small recreation site is crossed in the Grand Coulee area near Banks Lake.

Table 3-1: Land Use Categories in the Corridor

Land Use	Approximate miles	Approximate Percent of Corridor
Developed	8	10
Agriculture	42	50
Rangeland	30	36
Recreation	4	4
Total	84	100

Developed Land

Developed land includes single and multifamily dwellings in subdivisions and rural areas, commercial and industrial businesses, and related lands. Ten percent of the corridor is developed land. Although some farmsteads and other rural dwellings are near the corridor (about 23 rural residences in Lincoln County; 25 rural residences in Spokane County), most residential, commercial and industrial land next to the corridor is near Spokane and Grand Coulee.

City of Grand Coulee and Grant County

The corridor crosses the western edge of the Grand Coulee City urban area in Grant County. Residential, commercial, agricultural and recreation lands, and Banks Lake are in this area (see

Figure 3-2). An expanding regional municipal landfill is also in this area. About 85 buildings are within 1,200 feet of the new right-of-way in Grant County and the City of Grand Coulee.

Approximately 2 miles south of the Grand Coulee Switchyard, the right-of-way would pass adjacent to Pleasant Hills, an older rural residential area within Grant County. It is zoned for agricultural use.

Between the city limits and the north dam of Banks Lake, and north of State Route 155, the new right-of-way would cross North Dam Park, recently developed by the City of Grand Coulee (see the section on **Recreational Land**).

South of SR 155, the new right-of-way would cross an area developed as a regional landfill. The Delano Landfill is located on Grant County property within the city limits of Grand Coulee. The existing landfill site is approximately 35 acres with a tentatively planned expansion area of about 8.5 acres to the east. There are about 20 acres of fill area currently available at the main site. The governments of Grand Coulee, Electric City, Coulee Dam, and Elmer City are jointly developing the landfill. Stage 1 of the landfill is expected to close in the summer of 2003. The entire landfill is expected to close in 2030.

Just west of the landfill, the new right-of-way would be next to Delano Heights, a rural residential area. This residential area is west of Grand Coulee's city limits and is zoned Agricultural and Residential.

Rural Area Between Grand Coulee and Spokane

Principal land types between Grand Coulee and Spokane are farmlands and rangelands (including woodlands). Farmsteads and other rural dwellings and small commercial businesses are scattered in this area. Developed areas are distant from each other. A few small communities (Wilbur, Creston, Davenport and Reardan) are present along U.S. Highway 2, which generally parallels the transmission corridor. The nearest is Creston, which is about one mile south of the corridor.

City of Spokane and Spokane County

The corridor passes through about 7 miles of the outer edge of the Spokane urban area, consisting mostly of distinct areas of expanding residential, industrial, commercial and institutional development (see Figure 3-3). Development has occurred up to the right-of-way. The corridor separates subdivisions, and is used by walkers, joggers, bicyclists, and motorcyclists.

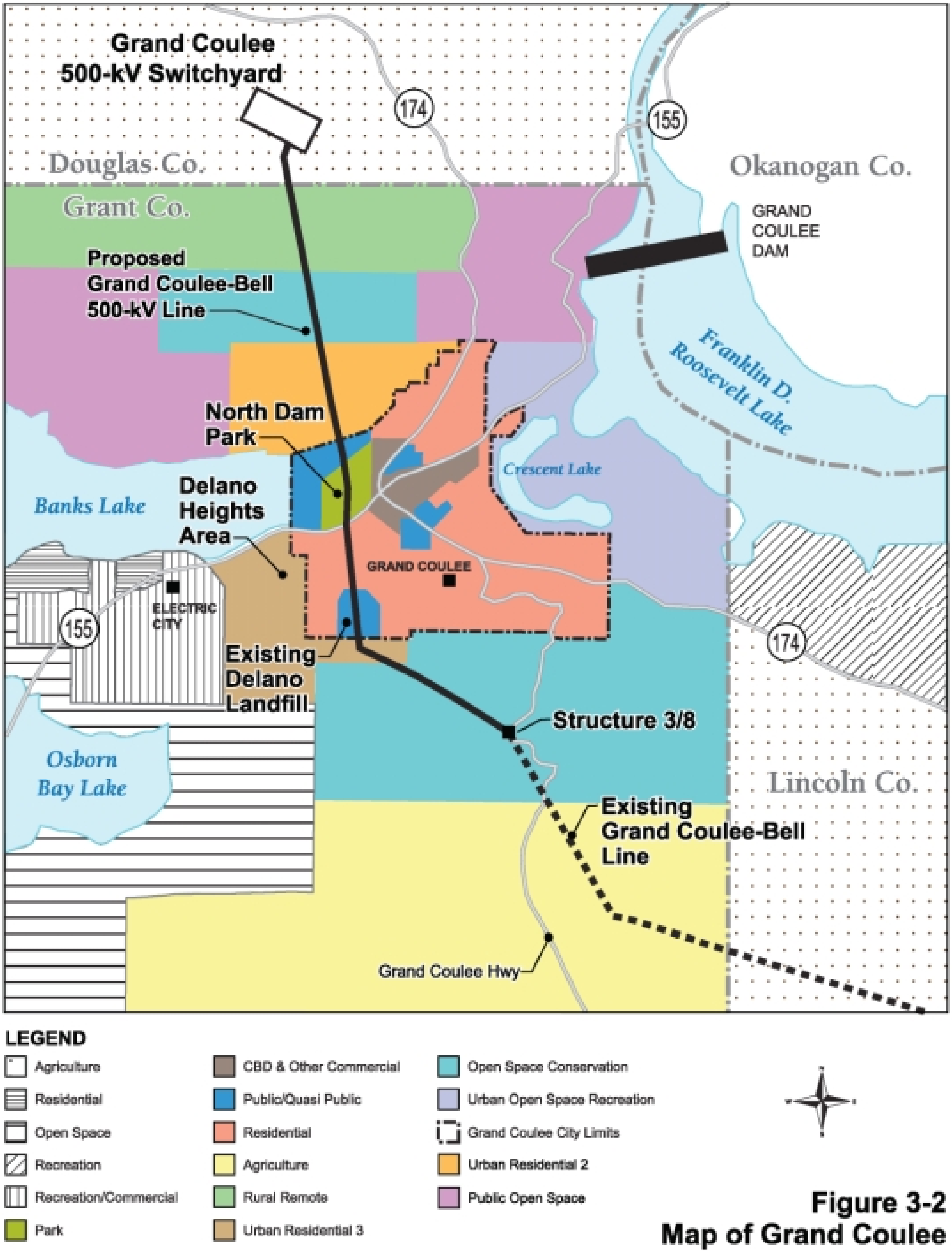
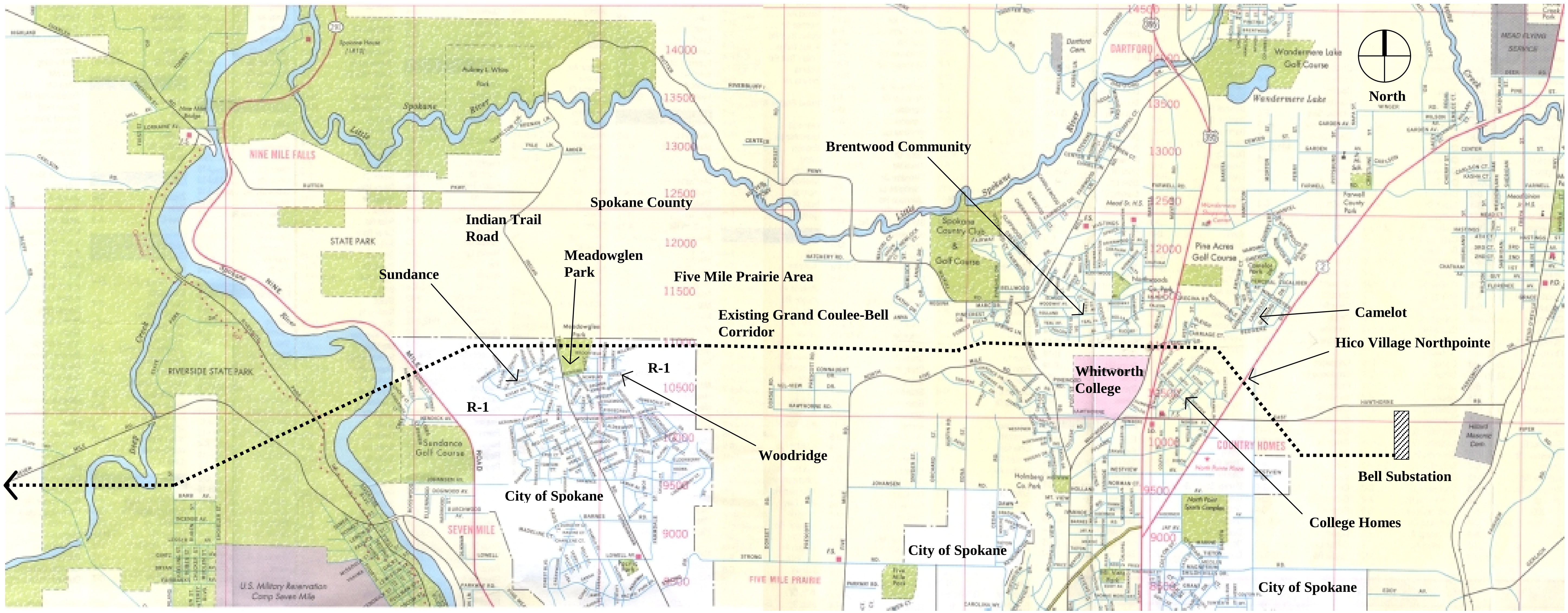


Figure 3-2
Map of Grand Coulee



Source: Rand McNally Spokane, Washington City Map, 1999

Figure 3-3 Map of Spokane Area

As the corridor enters the Spokane urban area from the west it crosses Riverside State Park. Riverside State Park is discussed in the section on **Recreational Land**. A small area of private land is within the park. This land is zoned Residential, 10-acre minimum parcel size. Large-acreage residential developments are scattered north and south of the corridor.

After crossing the Spokane River, the corridor passes through an area zoned Urban Residential, 3.5 lots per acre (see Appendix F for a map of Spokane area zoning). This area, north of Kendick Avenue and Sun Dance Golf Course and west of Nine Mile Road, is heavily wooded, with some residential development. Additional residential development is limited until more utility services are added (Penderson, 2002).

The corridor passes through two communities, Sundance and Woodridge, divided by Indian Trail Road. These communities are zoned Residential, maximum 3.5 lots per acre. Development of both of these communities has been completed and houses are adjacent to the corridor.

Near Indian Trail Road, the corridor converges with Avista's 110-kV transmission right-of-way and parallels it from corridor mile 78/6 to near the Bell Substation. The corridor crosses to the north of Avista's 110-kV transmission line right-of-way at corridor mile 81/7, west of Whitworth College.

The corridor extends within the northern edge of Spokane City limits between Nine Mile Road and the eastern edge of the Woodridge neighborhood. Land use in Spokane County north of the city limits is scattered, large-parcel, rural residential development. The land is zoned Rural Residential, and cannot be developed until utility services and roads for increased traffic are available (Penderson, 2002).

East of Woodridge, the corridor leaves the City of Spokane and re-enters Spokane County, where it climbs the west-facing slope of Five Mile Butte. It then crosses the top of Five Mile Prairie before dropping down the north-facing, heavily timbered steep slopes of the Butte. For the first mile between corridor mile 80/2 and 80/7, the corridor passes north of a residential subdivision on top of Five Mile Prairie. This area is zoned Suburban Residential, 1-acre minimum parcel size. Further development on the top of Five Mile Butte/Prairie depends on expensive extensions of city sewer and water utilities and improvements to major roads serving the area (Brokin, 2002). The area north of the corridor is the steep north-facing slope of Five Mile Butte. The steep slope and lack of utilities make development difficult.

East of Five Mile Road, the corridor travels down the steep north face of Five Mile Butte, which runs parallel to North Fivemile Road, and across Waikiki Road. Along North Fivemile Road, a few homes have views of the Little Spokane River Valley to the north.

Continuing to the east, the corridor passes Waikiki Road at corridor mile 81/9, and continues on north of Whitworth College's residential community.

Between Waikiki Road and U.S. Highway 395 (corridor mile 82/1 to 82/7), the corridor passes to the north of Whitworth College, where it forms a boundary between the Whitworth College campus to the south and the residential community of Brentwood to the north. Brentwood is completely developed to the northern boundary of the corridor. Whitworth College, a private 4-year liberal arts college, occupies 175 acres. Football and baseball fields have been developed south of the corridor, separated from the corridor by 200 feet of wooded area and Avista's right-of-way. The main campus is about 1,000 feet south of the corridor.

Between U.S. Highway 395 and U.S. Highway 2 (corridor miles 82/8 to 83/3), the transmission lines create a boundary between the residential communities of College Homes to the south and Camelot to the north. Both communities are fully developed up to the corridor.

After crossing U.S. Highway 2, the corridor borders a small commercial area (Hico Village Northpointe) consisting of a car wash and a RV parking area to the south, and commercial uses to the north. Some of these uses are present within the corridor.

The corridor then crosses industrial land before terminating at Bell Substation.

Agricultural Land

Agricultural land refers to pasture and irrigated and dry croplands. About one half of the existing transmission line corridor crosses agricultural land (see Table 3-1). Most agricultural land use is in Lincoln County, with the rest in western Spokane County. Most agricultural land is dry cropland used for growing cereal grains (wheat, oats, barley), hay, and rapeseed. Farmers cultivate and tend crops within and next to the corridor, often quite close to existing transmission towers.

Prime and Unique Farmland

Prime farmland refers to land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oil seed crops. Prime farmland could include cropland, pastureland, rangeland, forest land or other land, but not urban lands or water. Unique farmland is land other than prime farmland that is used for the production of specific high value food or fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. Based on these definitions there are no prime or unique farmlands in the corridor in Douglas and Grant counties. There are scattered patches of prime farmland within the corridor in Lincoln County, totaling 440 acres, and in the western half of the Spokane County, totaling 120 acres.

Rangeland

Rangeland includes open range (grasslands and shrublands), ***scablands*** and ***woodlands***. About one-third of the corridor is rangeland. In Grant and Douglas counties and in central Lincoln County the corridor crosses open range and scablands. In eastern Lincoln County and western Spokane County, the corridor crosses open range interspersed with extensive areas of noncommercial woodlands. In many cases, non-commercial woodlands are associated with ravines and other drainage channels. Woodlands are interrupted by patches of open range, and lands cleared in past years for grazing and other agricultural uses.

Rangeland is used predominately for cattle and horse grazing, but also provides wildlife habitat and open space for recreation.

Recreational Land

Recreational land includes some open land and local and state parks. People use land and water in the counties and cities crossed by the existing corridor for both active and passive forms of recreation.

City of Grand Coulee and Grant County

The City of Grand Coulee has built North Dam Park near the intersection of State Highways 155 and 174 adjacent to the north dam of Banks Lake. North Dam Park has ball fields, picnic areas, tennis courts, parking areas, footpaths, and play areas. Further development of the park is planned, which would include a BMX bike track, wetlands and other play fields. Future development of the park will depend on the placement of tower structures and overhead transmission lines. North Dam Park is approximately 50.5 acres.

Rural Area Between Grand Coulee and Spokane

Between the cities of Grand Coulee and Spokane, rural areas offer limited public outdoor recreation such as hunting and fishing. Most rural land is privately owned. The open and wooded rangeland between Creston and Davenport has networks of four-wheel-drive roads and county and corridor access roads that provide access to Hawk Creek tributaries and surrounding lands. Also, county roads crossing or close to the corridor provide access to other streams for dispersed recreation.

City of Spokane and Spokane County

Riverside State Park, which is managed by the Washington State Parks Commission, is a 7,500-acre recreation and natural area next to the Spokane River. The park has areas for camping, picnicking, boating, hiking, horseback riding, and off-road vehicle use. The park also includes the Little Spokane River Natural Area, and an Interpretive Center. Spokane Hatchery, which is managed by the State, is next to the park. The Centennial Trail runs through the park and is crossed by the Grand Coulee-Bell corridor.

In 2001, according to the Washington State Parks and Recreation, 1,334,721 visitors used the park during the day, and 8,570 visitors stayed overnight within the park (Price, 2002).

The City of Spokane owns 30 acres of undeveloped park site near the corridor. The site is just east of Indian Trail Road and is known as Meadow Glen (see Figure 3-3). The site is presently used as passive, natural resource land or conservation land. A small area of the park located at the intersection of Indian Trail Road and Bedford may be developed into a neighborhood park. However, there is no program or development schedule planned for the park any time soon. With the exception of the neighborhood park, the rest of the park will remain as conservation land (Crutchfield, 2002).

Two golf courses are close to the corridor. Sun Dance Golf Course is about 300 feet south of the corridor. The Spokane Country Club and Golf Course is approximately one-half mile from the corridor.

Local residents use the corridor to walk, hike, bicycle, and ride motorized vehicles (mostly motorcycles and off-road vehicles).

Whitworth College maintains many trails on its campus. Students and the public use the trails for cross-country training, walking, jogging, and mountain biking. Trails intersect the corridor in several places. Whitworth College also has football and baseball fields near the corridor.

Other

Other lands near the corridor include special use areas managed by the Federal or state government (see Figure 3-4).

Federally managed lands are found at each end of the corridor. At the west end, the Bureau of Reclamation owns and manages Grand Coulee Dam, the Visitor Center, and the Switchyard, which will be the terminus for one end of the proposed new transmission line. The National Park Service manages the Coulee Dam National Recreation Area along Lake Roosevelt. Lake Roosevelt has facilities for boating, fishing, camping, picnicking and other activities. No Park Service lands are crossed by the corridor.

The Washington Department of Natural Resources (***DNR***) manages trust lands near the corridor. DNR trust lands support a number of state facilities, such as public schools, universities, and prisons. No DNR trust lands are crossed by the corridor, but several parcels are within one-half mile.

GRAND COULEE - BELL 500kV TRANSMISSION LINE PROJECT

MAJOR LAND OWNERSHIP OR DESIGNATION

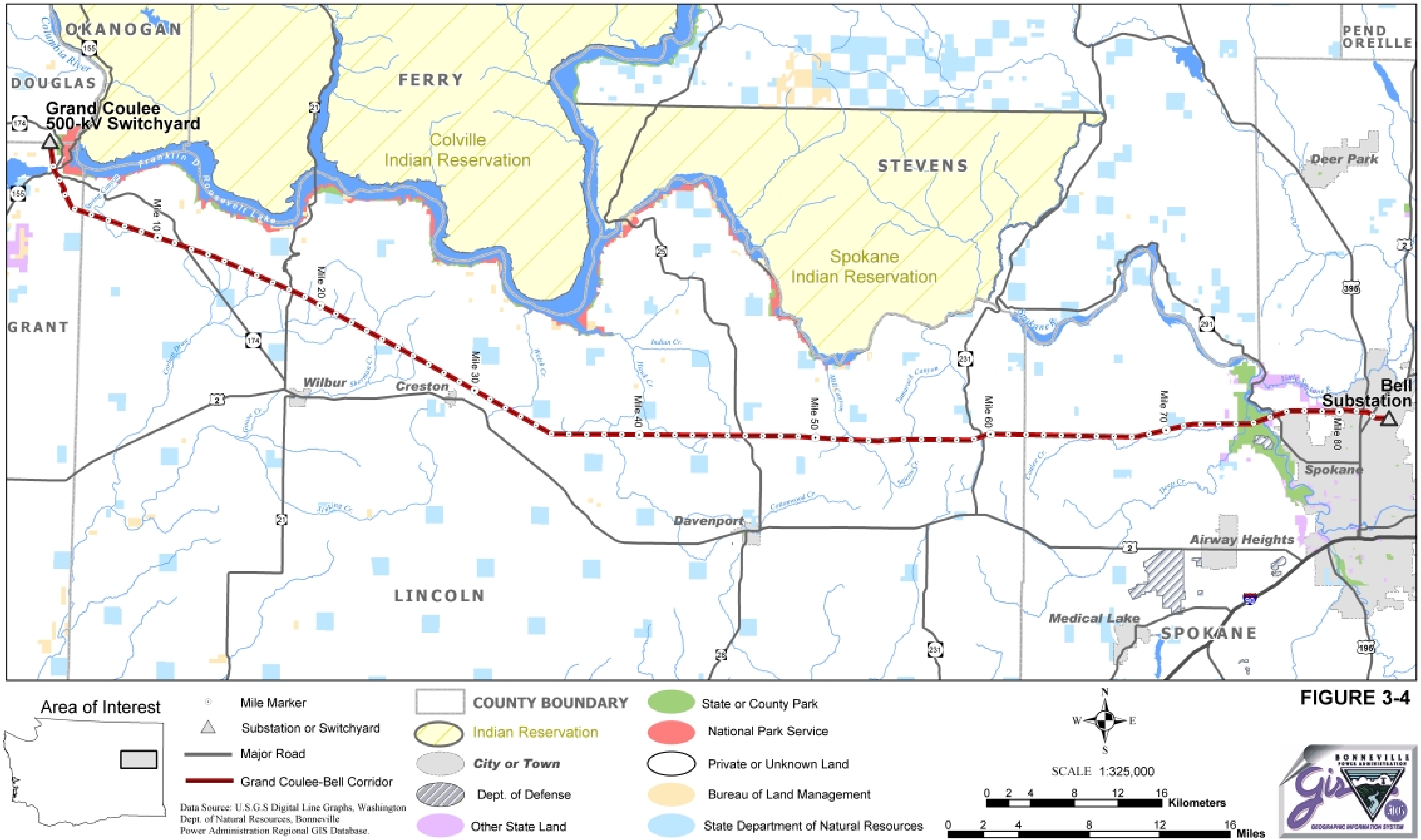


FIGURE 3-4

At the east end, the Bonneville Power Administration owns and manages the land where the proposed new transmission line will terminate.

Plans and Policies Affecting Land Use

Each county and city crossed by the existing corridor has a comprehensive plan and a zoning ordinance. These jurisdictions have comprehensive land use plans that address utility corridors: the City of Grand Coulee, Lincoln County, Spokane County and the City of Spokane. The existing corridor is an allowed land use in these plans. For Douglas and Grant counties, whose plans do not address utility corridors, expansion and upgrading of existing utilities is permitted in the zones the corridor crosses.

Zoning ordinances in some jurisdictions specifically address utility corridors. The corridor is a permitted use in zoning ordinances for these jurisdictions: Lincoln, Grant, and Douglas counties. Spokane County and the City of Spokane zoning ordinances allow transmission line corridors as a permitted use in a variety of zones to a height of 125 feet (see Chapter 4, **State, Areawide, and Local Plan and Program Consistency**).

Environmental Consequences

This assessment of potential land use impacts from the proposed project is limited to changes in and interference with land use activities, effects on local traffic, and consistency with local plans. The proposed project would affect several resources closely related to land use such as public health and safety, visual resources, socioeconomics, vegetation, and air quality. Please refer to the resource sections in this chapter for discussion of these project effects.

Construction, operation and maintenance of a new transmission line typically changes some land within the corridor to permanent tower sites and access roads. However, for most of the length of the corridor, the existing land use is for transmission facilities and the proposed action would not change this. Estimates of land area involved or occupied by various aspects of the proposed project are summarized below:

	Developed	Agriculture	Range (acres)	Recreational	Total
Corridor (150' wide)	145	765	545	73	1,528
Tower construction (0.5 acre each)	20	105	75	10	210
Towers – permanent use (2,500 sf each)	2.3	12	8.6	1.1	24
Staging areas (4 at 2 acres each)	0	4	4	0	8
Pulling/tensioning sites (every 2.5 miles at 1 acre each)	3	17	12	1	34
Permanent access roads – new	3	0	11.1	1.5	15.6
Permanent access roads – improvements	10	0	37.5	5	52.5

Permanent access roads – spurs	1.2	0	4.5	0.6	6.3
Removal of wood pole structures (1,000 sf each)	1.7	8.7	6.2	0.8	17.4

During construction of towers, an estimated 210 acres would be disturbed. Land permanently needed for towers is estimated to be 24 acres. Staging areas and pulling/tensioning sites would require 42 acres during construction, which would be a temporary impact. Approximately 4.9 miles of new access road construction would be required, which would occupy slightly less than 16 acres; and about 2 miles of permanent spur roads to tower sites would be required, which would occupy an additional 6.3 acres. Another 16.6 miles of existing access roads would need to be improved, ranging from grading to widening and ditching; this would not represent a change in land use. Nearly all of the permanent access road improvements would take place in rangeland areas. Access roads in agricultural areas would be temporary for the most part. Where permanent access would need to be developed in these areas, it would principally affect non-cultivated areas (e.g., draws/gullies). Removal of the existing wood pole structures would cause a temporary disturbance to an estimated 17.4 acres; this area could be reclaimed for use after the structures are removed.

Construction, operation and maintenance could cause short-term impacts such as traffic detours and delays. Temporary disturbances from traffic in areas close to and more distant from the corridor are also common.

Impact Definitions

A **high** impact would occur if the project changes existing land uses completely and permanently, and if there is little or no potential for mitigation.

A **moderate** impact would occur if the project causes limited permanent changes in existing land uses or causes extensive and lengthy temporary disturbances, and there is some potential for mitigation.

A **low** impact would occur if the project leads to some brief, temporary disturbances to existing land uses that can be mitigated.

No impact would occur if the project does not trigger any changes in land use.

Developed Land

City of Grand Coulee and Grant County

BPA would need to acquire about 3.5 miles of new right-of-way easements in the Grand Coulee area. Less than one-half mile of this total would traverse developed land in this area (most of the remainder would traverse rangeland). The 150-foot right-of-way would encompass approximately 64 acres total (about 8 acres of developed land). Temporary disturbance during construction would affect about 9 acres around tower sites (about 1 acre of developed land). However, on a permanent basis approximately 1 acre would be used for tower sites (about one-tenth of an acre of developed land – currently vacant but developable). About 3.1 acres would be needed for new access roads (assuming about 1 mile of new access roads will be needed in this area). Permanent access road improvements in this area would occur mostly on undeveloped rangeland and not on developed land. The new line would pass next to the Pleasant Hills rural residential neighborhood but would not directly affect residential use in this area.

The level of direct impacts from construction would be low, because they would be limited to brief, temporary, disturbance effects, mostly on traffic. Developing staging areas, constructing towers, improving access roads or building new access roads would take place on vacant land and would not displace existing uses. The level of direct impacts from operation/maintenance would be moderate due to some permanent but limited changes in land use caused by the new right-of-way (i.e., new towers and conductors, as well as access roads, that displace vacant land that is zoned for residential use). In view of the large number of transmission lines in the area, the new transmission line would be considered a compatible land use.

Conversely, the right-of-way of the existing Grand Coulee-Bell 115-kV line No. 1 that is being replaced would remain as right-of-way, but the wood poles would be removed. The land area that would become available for potential use would nearly offset the area displaced for tower sites under the proposed action.

Rural Area Between Grand Coulee and Spokane

Rural residents near the corridor may experience temporary inconveniences from closed roads, more traffic, and construction or improvement of access roads. In this area, residences and other developed areas are distant from each other, and construction would disturb few properties. The level of indirect land use impacts on developed land is expected to be low because disturbance would be minimal and temporary. No direct land use impacts are expected in rural areas.

City of Spokane and Spokane County

As the corridor crosses Nine Mile Road from the west (corridor mile 77/5), it enters the Spokane urban area. In the area between Nine Mile Road and Bell Substation (between corridor miles 77/5 and 84/4), direct and indirect impacts could include increases in traffic, detours along some roads, and disrupted access to driveways and/or businesses along the corridor. Access road improvements would be made at a few locations and a new corridor path approaching Bell Substation would be established across BPA property. Access road improvements would generally consist of blading the surface and adding new crushed rock. New access road improvements in this area would take place within the corridor for the most part, would not affect developed land uses, and would not represent a land use change.

Some existing uses between corridor mile 83/4 and 83/6 may be affected. As noted previously, some commercial uses are present adjacent to and within the corridor in this area, which is at the western edge of the Kaiser-Mead industrial area. Activities that currently are allowed in this area under the 115-kV Grand Coulee-Bell No. 1 line right-of-way may be determined to be incompatible with the construction and operation of the proposed 500-kV line. Therefore, there may be some change in land use on the right-of-way that would affect commercial activities. Potential loss of income for landowners may result because of the changes to commercial uses. The level of impacts at this location would be moderate.

All other impacts on developed areas would be temporary, short term and low, except new permanent access roads. The level of impacts due to new access roads would be moderate; although they are permanent, they would be constructed within the existing corridor and therefore would not represent a change in land use.

Agricultural Land

Potential direct impacts to agricultural land during construction could include interference with farming activities next to and within the corridor. Farming activities that may be affected include choice of machinery, tilling and plowing patterns, kinds of crops, and timing of planting. Some construction activities could prevent agricultural uses; others may make farming in some areas inconvenient or more costly.

Construction would temporarily take 765 acres out of production for one growing season on a cumulative basis (approximately one-half during one growing season and the other one-half the next growing season). This is based on a "worst-case" scenario of a 150-foot wide, 42-mile long right-of-way in agricultural areas. Actual losses, however, likely would be much less, since in most cases only the area surrounding the tower site (about one-half acre), the access road leading to the site, pulling/ tensioning sites and staging areas, and where the wood pole structures are being removed would be kept out of production.

Impacts would be widespread, and would cause temporary land use changes and disruptions, but they can be mitigated. The level of impacts would be moderate.

Once the towers have been constructed, impacts on agricultural land uses vary. New towers create a permanent loss of agricultural lands. The space needed for new towers would take approximately 12 acres of agricultural land out of production permanently. About 3.8 acres are prime agricultural lands. The net loss would be less after subtracting land regained from the removal of the wood pole line from the land needed for new tower sites (net loss of about 3.3 acres with an estimated 1 acre being prime farmland). Wood pole structure sites would be restored for productive use, and essentially all access roads across cultivated farmland would be returned to production after construction.

Other impacts created from maneuvering farm equipment around new towers could be more difficult or more costly. However, aligning the new towers with the existing 230-kV transmission line towers should improve maneuverability of farm equipment. Soil compacted, disturbed, or eroded could lower crop production. Weeds could be introduced in and next to the corridor. Towers and conductors would incrementally increase hazards for aerial spraying.

Some of these impacts can be mitigated through careful placement of towers to facilitate equipment maneuvering, aggressive weed control, and other mitigation. The level of impacts on agricultural land use from operation and maintenance of the line is expected to be moderate.

Rangeland

During construction, the only potential impact is disturbance to vegetation within the corridor to accommodate construction activities, discussed in the **Vegetation** and **Wildlife** Sections. Approximately 75 acres of rangeland within the corridor would be disturbed for tower construction, assuming a one-half-acre area around each tower would be disturbed during construction. Also, staging areas and conductor pulling/tensioning sites may be located on rangeland. Assuming two 2-acre staging areas would be located in rangeland areas and 1-acre pulling/tensioning sites are needed every 2.5 miles, then an additional 16 acres of rangeland would be temporarily disturbed. Changes in rangeland during construction would be minor and temporary. The level of impacts is expected to be low.

The permanent loss of about 8.6 acres of rangeland to accommodate the footprint of the new towers, less the land reclaimed from removal of the wood pole line (6.2 acres), would be minor. In addition, an estimated 15.6 acres of rangeland would be converted to use for access roads assuming all new permanent access roads will occur in rangeland areas. These would be the only long-term effects, as land within the corridor could continue to be grazed. The level of impact would be considered moderate.

Recreational Land

City of Grand Coulee and Grant County

The City of Grand Coulee has developed North Dam Park next to corridor mile 2/3 of the Grand Coulee-Hanford line. As noted previously, the park includes ball fields, picnic areas, tennis courts, a play lot, trails, parking and landscaping built between transmission lines and structures. There is presently a large problem with diffuse knapweed in the park. Construction and maintenance activities could further spread the ***noxious weed***.

Though BPA is coordinating with the city on tower placement, further development of the park could be permanently impacted. These impacts would depend on where the transmission lines cross the park, because no structures, parking, or fields can be built under the lines. The impact level would be moderate.

Rural Area Between Grand Coulee and Spokane

The area along the corridor providing the greatest opportunities for recreational activities is the network of four-wheel drive trails and county roads that access Hawk Creek, its tributaries and surrounding lands.

Potential direct and indirect impacts to recreational access for Hawk Creek and other streams along the corridor could include increased traffic from construction vehicles, and temporary closures of local roads during construction activities. Impacts would be minor and temporary, and the impact level is considered to be low.

City of Spokane and Spokane County

Trees may be removed or topped in Riverside State Park. Tower sites would be permanently converted from park use (net change of 0.3 acre), and about 2.1 acres of park land within the existing corridor would be used for new access roads. Tower construction and pulling/tensioning sites would affect about 15 acres on a temporary basis. Temporary disturbances during construction, and to a lesser extent during operation, would also affect park activities along and near the corridor. This would include interruptions in use of the Centennial Trail. There is limited opportunity for mitigation. The level of impacts to the park and Centennial Trail would be moderate.

Direct and indirect impacts to recreational uses of Whitworth College campus include the proximity effects of construction and traffic activity. These activities could disrupt existing land uses and campus recreational activities, but effects would be temporary and minor, and the level of impacts would be low.

Although public recreation in the corridor is not allowed, many recreational activities occur such as walking, jogging, bicycling, and motorcycling. These activities take place at various sites along the corridor near neighborhoods or subdivisions, or at sites such as Whitworth College. These activities may be disrupted on a short-term basis during construction, but would likely be unaffected on a long-term basis. The level of impact is considered to be low.

Plan Consistency

The corridor passes through a number of jurisdictions that have local land use plans and policies. The project is generally consistent with these adopted plans. At this time, the project could be inconsistent with Spokane County's height restriction (125 feet) for transmission towers (see Chapter 4, **State, Areawide, and Local Plan and Program Consistency**). The Agency Preferred Action would use towers that would nominally be 125 feet tall, except where the corridor narrows between structures 83/1 and 83/6 where 175-foot tall towers would be used. In addition, some locations with longer spans may require taller towers that would exceed 125 feet. The Alternative Action would use towers that are 175 feet tall.

Cumulative Impacts

In general, because the proposed action is the rebuild of an existing transmission line in the corridor with three other lines, cumulatively, the impacts represent a relatively small increment of change. Only a small amount of land would be removed from uses other than transmission lines. The greatest change would be one of scale (the corridor would have three lines with lattice steel towers) and the perception of land use compatibility. Because the incremental change would be small, compatibility issues would likely be minor. Likewise, short-term proximity impacts associated with construction (noise, dust and traffic interference) would result in minor cumulative impacts.

The City of Grand Coulee has grown and developed because of hydropower generation from the nearby dam. In the immediate area, transmission lines, generating facilities and switching stations are commonplace. Upgrading of lines and stations would not change its character, nor would it change land uses significantly. The Grand Coulee-Bell corridor would pass through North Dam Park and the city is concerned that construction activities would increase the spread of noxious weeds such as diffuse knapweed, which already heavily infests the park area.

In the rural sections through Douglas, Grant, or Lincoln counties, the permanent loss of agricultural land and rangeland from this project would be approximately 40 acres. Losses would be small compared to the total agricultural and rangeland acreage in the area. Lincoln County alone has about 876,000 acres in cultivation. Since 1992, there has been a reduction of about 125,000 acres cultivated land. The amount of land temporarily taken out of production, and the amount of cultivated agricultural land not being used would be negligible compared to the total amount of agricultural lands in production. There are no other known plans or proposed projects that would remove agricultural lands from production in Lincoln, Douglas or Grant counties that would result in adverse cumulative impacts.

Improved access would open up areas for recreational uses. As development increases over the next ten years, demands on public parks, such as Riverside State Park, will increase proportionately. Increased activity/use within Riverside State Park and other open spaces could lead to a greater level of compatibility impacts with park users.

In the greater Spokane area, land uses are changing rapidly. Over the next 5 to 10 years, demand for parks, roads, schools and other neighborhood amenities may increase. Development in urban and some rural areas within Spokane County are driven by the availability of utilities and the type of land uses allowed. There is a 6-year plan to provide sewer capacity north of North Five Mile Road, in the Waikiki Road area (Spokane County Capital Facilities Plan, 2001), which would tend to stimulate residential development. Other developed areas within the greater Spokane area are either built out, designated as rural conservation, urban reserve or are designated commercial, industrial and mixed use. Increased development activity and human presence over time would contribute to cumulative impacts such as associated traffic congestion, potential land use compatibility conflicts, and other impacts of proximity to transmission lines.

There are no projects planned now or in the future that would remove agricultural lands, rangeland or scrublands within northwestern Spokane County. The Spokane County Comprehensive Plan protects these lands from incompatible development so they can continue to benefit future generations (Spokane County Comprehensive Plan 2001, 11/2001).

Residents and representatives of park areas and institutions have expressed concern about rebuilding in the corridor. Some feel they are being asked to bear the impacts of a regional power transmission grid while not receiving any direct benefits. They fear the present corridor will continue to be used in the future for rebuilding rather than establishing new corridors, and they will be affected more than those who benefit from future expansion.

Environmental Consequences of the Alternative Action

The Alternative Action Alternative would include all the components of the Preferred Action except a double-circuit line would be constructed between corridor mile 75/2 and Bell Substation, a distance of about 9 miles. The corridor and towers would be the same as shown on Figure 2-3. The double-circuit towers would occupy a slightly larger footprint and therefore remove additional land from existing uses. Otherwise, land use impacts would essentially be the same as for the Agency Proposed Action.

Mitigation

Mitigation reduces or prevents impacts on the natural environment during, and/or after construction. Mitigation can include avoiding an impact altogether, lessening impacts by limiting the size of a construction or maintenance action, correcting an impact by repairing or restoring, reducing or eliminating the impact over time by preservation or maintenance, and compensating for the impact by replacing or providing substitute resources or environments.

The following mitigation would reduce potential impacts to land use from the project:

- A schedule of construction activities will be distributed to all landowners along the corridor that could be affected by construction.
- BPA will coordinate with the City of Grand Coulee to site towers within North Dam Park. This will improve compatibility with park uses and help reduce long-term impacts to future park development.
- Existing roads within North Dam Park will be graveled to reduce the spread of noxious weeds.

- During and after construction, areas of high weed concentrations in North Dam Park would be pre-treated during plant emergence to reduce weed spread.
- During construction activities BPA would use Best Management Practices to limit erosion and the spread of noxious weeds.
- Temporary disturbance during construction would be limited by careful planning and scheduling of construction activities. Construction will be scheduled, when practical, to try to minimize to the extent possible displacement of crops and interference with farming activities.
- Restore compacted soil in cropland.
- Farmers would be compensated for crop damage.
- Place new towers parallel to existing towers, where practical, making it easier to maneuver farm equipment around the structures.
- BPA will revegetate with native grass species except in cropland.
- BPA will continue to work with Riverside State Park officials to locate access roads to ensure minimum disturbance to vegetation where practical.
- BPA will work with Riverside State Park officials to alert users of the Centennial Trail when the trail near the corridor would be closed for construction activities. BPA would minimize the amount of time that the trail would be closed by keeping work duration and the number of closures to the least amount possible to complete the work.

Environmental Consequences of the No Action Alternative

Existing land uses in the project corridor would continue under the No Action Alternative. Impacts associated with the ongoing operations and maintenance activities for the existing transmission line, substations, right-of-way, and accesses roads would continue. No new land use impacts would be expected.

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Noise

Affected Environment

Noise is commonly defined as unwanted sound that disrupts normal human activities or diminishes the quality of the human environment. ***Transient noise*** sources, such as passing aircraft or motor vehicles, produce noise usually of short duration excluded from regulation. Stationary sources such as a substation can emit noise over a longer period. ***Ambient noise*** is all noise generated in the vicinity of a site by typical noise sources such as traffic, wind, neighboring industries, and aircraft. The total ambient noise level is a typical mix of distant and nearby sources.

Sources of noise associated with electrical transmission systems include construction and maintenance equipment, transmission line ***corona***, and electrical transformer "hum." Corona is the partial electrical breakdown of the insulating properties of air around the transmission line wires. Corona-generated noise can be characterized as a hissing, crackling sound that is accompanied by a 120-***Hertz*** (***Hz***) hum under certain conditions.

Noise from transmission lines generally occurs during wet weather. Conductors can be wet during periods of rain, fog, snow, or icing. Such conditions are expected to occur approximately 15 percent of the time in the Spokane area and much less frequently at the western end of the project area..

Environmental noise, including transmission line noise, is usually measured in ***decibels*** on the A-weighted scale (***dBA***). This scale measures sound in approximately the same way the human ear responds. Table 3-21 shows typical noise levels for common sources expressed in dBA.

Table 3-2. 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 rainfall on foliage
40	Refrigerator
25	Bedroom at night

* Decibels (A-weighted)
Sources: Adapted from Bonneville 1986, 1996.

Noise levels and, in particular, corona-generated noise vary over time. 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 during a specified period. Thus, L_{50} refers to a particular sound level that is exceeded 50 percent of the time.

Along the corridor of the proposed 500-kV transmission line, existing noise levels vary with the proximity to existing transmission lines and the proximity to other noise-generating activities. Except in the Grand Coulee and Spokane areas, most of the transmission line corridor is in rural, undeveloped areas. During foul weather, the existing parallel lines over most of the route would be a principal source of background noise, along with wind and rain hitting vegetation. In the more developed areas, traffic and noise associated with human activity are major contributors to background noise.

The Washington Administrative Code (WAC 173-60) specifies noise limits according to the type of property where the noise would be heard (the "receiving property") as well as land use of the noise source. Nighttime noise limitations in residential neighborhoods are 50 dBA; in commercial areas the limitation is 55 dBA; and in industrial areas the limitation is 60 dBA. Transmission lines are classified as industrial sources for purposes of establishing allowable noise levels at receiving property. Bonneville has established a design criterion for corona-generated audible noise from transmission lines of 50 dBA for the L_{50} (foul weather) at the edge of the right-of-way. Washington has interpreted this criterion to meet its noise regulations.

Environmental Consequences—Proposed Action

Impact Definitions

Impact levels are dependent on public and occupational use of the land. The potential for noise impacts increases in areas where human activities take place.

A **high** impact would occur if noise levels for the new line exceed existing state standards.

A **moderate** impact would occur if residents are present and nuisance noise levels occur, exceeding ambient noise levels during a portion of the time.

A **low** impact would occur if any contribution of the new line on ambient noise levels would not be easily perceived by nearby residents.

Impacts During Construction

Construction activities create noise that is short term and typically does not cause any serious disturbances to residents. Sources of noise associated with construction of the proposed project include

- construction of access roads and foundations at each tower site,
- erection of steel towers at each tower site,

- helicopter assistance during tower erection and stringing of conductors, and
- potential use of implosive fittings for conductor stringing.

Access roads and foundations at each tower site would be installed using conventional construction equipment (see Chapter 2). Table 3-3 summarizes noise levels produced by typical construction equipment that would likely be used for the proposed project.

Table 3-3. Construction Equipment Noise Associated with the Proposed Project

Type of Equipment	Maximum Level (dBA) at 50 Feet
Road Grader	85
Bulldozers	85
Heavy Trucks	88
Backhoe	80
Pneumatic Tools	85
Concrete Pump	82
Crane	85
Combined Equipment	89
Source: Thalheimer 1996.	

To account for fluctuating sound levels, statistical descriptors have been developed for environmental noise. The ***equivalent sound level (L_{eq})*** is generally accepted as the average sound level.

The overall noise caused by the conventional equipment involved in construction is estimated to be 89 dB L_{eq} at a reference distance of 50 feet. Noise produced by construction equipment would decrease with distance at a rate of about 6 dB per doubling of distance from the site. Based on that assumed attenuation rate, Table 3-4 shows the estimated construction noise levels at various distances from the construction site.

Although daytime construction activities are excluded from noise regulations, for this evaluation it was assumed that construction noise levels exceeding the Washington State limits for permanent industrial operations would constitute a temporary (several days at most) environmental impact. The Washington noise limit for noise levels at residential areas caused by permanent daytime industrial operations is 65 dBA. Construction noise levels would exceed Washington Department of Ecology daytime industrial operations limits at distances up to 400 to 800 feet from construction activity.

Construction noise impacts would not occur over most of the corridor due to its sparse development and population. Potential impacts during construction would be limited mainly to the Grand Coulee and Spokane areas. In Grand Coulee, residences in the small residential area near corridor mile 2/1, users of North Dam Park (corridor mile 2/2 to 2/3), and residents in

Delano Heights (east of corridor mile 2/4) could experience temporary construction noise impacts. In the Spokane area, residents in subdivisions between corridor miles 78/2 and 79/1 and between 82/8 and 83/3, and in the more dispersed residential area between 79/9 and 81/9 would also likely experience construction noise impacts. The nearest structures at Whitworth College are about 600 feet from the new tower sites; this area could be affected by noise from construction of the proposed project. The level of noise impacts at these areas is considered to be moderate.

Table 3-4. Construction Noise in the Vicinity of a Representative Construction Site

Distance from Construction Site (feet)	Hourly Leq (dBA)
50	89
100	83
200	77
400	71
800	65
1600	59

Note: The following assumptions were used:
Equipment used: (1) each- grader, bulldozer, heavy truck, backhoe, Pneumatic tools, concrete pump, crane
Reference noise level: 89 dBA (L_{eq})
Distance for the reference noise level: 50 feet
Noise attenuation rate: 6 dBA/doubling of distance
This calculation does not include the effects, if any, of local shielding or atmospheric attenuation.

Noise levels generated during erection of each tower would depend on the type of method used. If conventional construction methods were used to erect the towers, then the noise levels would be comparable to those listed in Table 3-4. However, BPA's construction contractor may elect to use a large helicopter to assist with tower erection. In that case, all of the towers would be preassembled at one or more central staging areas, then a helicopter would transfer the assembled towers from the staging area to the remote tower sites. The helicopter would hover at each tower site for a total of 2 to 10 minutes during a 1-hour period while the tower sections are placed on the foundation. In addition, the helicopter would hover at the central staging area for 2 to 5 minutes per tower as it picked up each tower section. Homes within approximately 1 mile of the helicopters would be exposed to temporary noise levels above 65 dBA. However, helicopters operated during the daytime to support construction activity are exempted from Washington State noise regulations.

Impacts During Operation and Maintenance

Noise impacts during operation and maintenance of the proposed project would be negligible. About every two months, a helicopter would fly the line to look for any problems or repair needs. When and if these needs arise, field vehicles would be used to access the trouble spots.

The proposed line would increase the corona-generated foul weather audible noise level at the edge of the right-of-way. Audible noise levels were calculated for average voltage and average conductor heights for fair- and foul-weather conditions. The predicted levels of corona-generated audible noise for the proposed line operated at a voltage of 540 kV are given in Table 8 and plotted in Figure 4 in Appendix B-1.

At the edge of the right-of-way adjacent to the existing 500-kV line between Grand Coulee Switchyard and corridor mile 3/1, the foul weather L_{50} audible noise level would change by an indiscernible 1 dBA with the addition of the proposed line. The calculated median level (L_{50}) during foul weather at the edge of the proposed Grand Coulee - Bell 500-kV line right-of-way where there are no parallel lines (corridor mile 3/1 to 3/8, where there are no residences) is 49 dBA. The calculated maximum level (L_5) during foul weather at the edge of the right-of-way is 52 dBA. These levels are comparable to levels at the edges of some existing 500-kV lines in Washington and slightly lower than the levels from the existing Grand Coulee-Hanford 500-kV line between Grand Coulee Switchyard and corridor mile 3/1. Thus, audible noise levels for these areas would be comparable to those for existing 500-kV lines in Washington, and the level of impact is considered to be low.

For the remainder of the corridor with multiple parallel lines (except between corridor mile 83/1 and 83/6), the foul weather L_{50} audible noise level at the edge of the right-of-way would be 42 to 49 dBA. For these areas, audible noise from the proposed 500-kV line during foul weather would add 3 to 10 dBA to existing levels at the edges of the right-of-way. The response to such increases would range from barely perceptible to a perceived doubling of the sound level. The level of impact would range from low to moderate. Between corridor mile 83/1 and 83/6, which abuts commercial property, the edge-of-right-of-way audible noise levels would be 51 and 48 dBA at the north and south edges of the right-of-way, respectively. The noise standard for commercial areas is 55 dBA; therefore, the level of impact would be low.

During fair-weather conditions, which occur about 85 percent of the time in the Spokane area, audible noise levels at the edge of the right-of-way would be about 20 dBA lower than the foul weather levels (if corona were present). These lower levels could be masked by ambient noise on and off the right-of-way.

In conclusion, the calculated foul-weather corona noise levels for the proposed line where there are no parallel lines would be comparable to, or less, than those from existing 500-kV lines in Washington. During fair weather, noise from the conductors might be perceivable on the right-of-way, but beyond the right-of-way it would likely be masked or so low as not to be perceived.

During foul weather when ambient noise is higher, it is also likely that noise off the right-of-way would be masked to some extent. Where the proposed line is located in the center of a corridor with multiple existing lines, the increase of 10 dBA or less due to the addition of the 500-kV line would be perceived as at most as a doubling of the audible noise level at the edge of the right-of-way and beyond. The maximum impact level would be moderate.

Off the right-of-way, the levels of audible noise from the proposed line during foul weather would be below the 55 dBA level that can produce interference with speech outdoors. Since residential buildings provide significant sound attenuation (-12 dBA with windows open; -24 dBA with windows closed), the noise levels off the right-of-way would be well below the 45 dBA level required for interference with speech indoors and below the 35 dBA level where sleep interference can occur (EPA, 1973; EPA, 1978). Since corona is a foul-weather phenomenon, people tend to be inside with windows possibly closed, providing additional attenuation when corona noise is present. In addition, ambient noise levels can be high during such periods (due to rain hitting foliage or buildings), and can mask corona noise.

The 49-dBA level for the proposed line would meet the BPA design criterion and, hence, the Washington Administrative Code limits for transmission lines.

No transformers are being added to the existing Grand Coulee and Bell Substations. Noise from the existing substation equipment and transmission lines would remain the primary source of environmental noise at these locations. The large-diameter tubular conductors in the stations do not generate corona noise during fair weather and any noise generated during foul weather would be masked by noise from the transmission lines entering and leaving the station. During foul weather the noise from the proposed and existing lines would mask the substation noise at the outer edges of the rights-of-way.

In summary, the overall impacts from this project related to audible noise are low to moderate. Impacts would increase slightly in populated areas where audible noise from construction could be heard and where corona noise from the new line could be perceived. In the commercial area at the east end of the line near Bell Substation, corona noise from the line would increase foul weather noise levels by as much as 24 dBA at the edge of the right-of-way, resulting in a moderate impact. However, ambient noise is anticipated to be higher in this commercial area because of traffic and other activities.

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. 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 bundle of three 1.3-inch (or 1.602-inch) diameter conductors used in the design of the proposed

500-kV line would mitigate corona generation and thus keep radio and television interference levels at acceptable levels.

Predicted EMI levels for the proposed 500-kV transmission line are comparable to, or lower, than those that already exist near 500-kV lines; no impacts of corona-generated interference on radio, television, or other reception are anticipated. If the proposed transmission line is found to be the source of radio or television interference in areas with reasonably good reception, BPA would take measures to restore the reception to a quality as good or better than before the interference (see Federal Communications Commission, Chapter 4 for further discussion).

Environmental Consequences of the Alternative Action

Construction noise impacts would be the same as for the Agency Proposed Action. The audible noise level increase for a double-circuit configuration would be slightly more (1 to 2 dBA) than for a single-circuit configuration at the same location. Therefore, noise impacts would be slightly greater in the adjacent residential neighborhoods in the north Spokane area where the double-circuit configuration would be used.

Cumulative Impacts

The noise analysis addresses cumulative impacts associated with the incremental addition of the 500-kV line within the existing corridor. No cumulative impacts are anticipated over most of the rural, undeveloped portions of the corridor. However, future increases in traffic and human activity related to population and economic development would increase background noise levels. This would most likely occur in the Spokane area and to a lesser extent in the Grand Coulee area. There are no known identified projects that would contribute to cumulative noise levels in these areas. Population levels are projected to increase by 11.6 percent in the Spokane area over the next 10 years, which would lead to higher levels of background noise in the future. The precise level of cumulative noise impacts is unknown.

Mitigation

To reduce the potential for temporary, adverse noise impacts during construction, the following measures would be incorporated into contract specifications.

- All construction equipment would have sound-control devices no less effective than those provided on the original equipment.
- All construction equipment and vehicles would have muffled exhaust.
- Construction activities would be limited to daytime hours (i.e., construction would occur only between 7:00 am and 10:00 pm).

- Landowners directly impacted along the corridor will be notified prior to construction activities.
- If radio or television interference occurs, measures would be taken to restore the reception to a quality as good or better than before the interference.

Environmental Consequences of the No Action Alternative

Existing background noise levels in the project vicinity would continue under the No Action Alternative. No new noise impacts would be expected.

Public Health and Safety

Affected Environment

Transmission facilities 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 any electrical line can kill or seriously injure people. Transmission structures and conductors can present an obstruction for aircraft. This section describes public health and safety concerns such as electrical shocks, fires, aircraft obstruction warnings, and electric and magnetic fields related to transmission facilities or construction activities.

The Federal Aviation Administration establishes requirements for towers and other tall structures that would potentially interfere with aircraft safety. Structures taller than 200 feet may require flashing warning lights for aircraft safety. BPA submits the final locations of structures and structure heights to FAA for their review and recommendations on airway marking and lighting (See Chapter 4 of this EIS).

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

Electric and magnetic fields are found around any electrical wiring, including household wiring and electrical appliances and equipment. Electric fields are measured in units of volts per meter (V/m) or kilovolts per meter (thousands of volts per meter, kV/m). Magnetic fields are measured in units of gauss (G) or milligauss (thousandths of a gauss).

Throughout a home, the electric field strength from wiring and appliances is typically less than 0.01 kV/m. However, fields of 0.1 kV/m and higher can be found very close to electrical appliances.

There are no national (United States) guidelines or standards for electric fields from transmission lines. . Washington has no electric-field limit. BPA designs new transmission lines to meet its electric-field guideline of 9-kV/m maximum on the right-of-way and 5-kV/m maximum at the edge of the right-of-way. The National Electric Safety Code (NESC) specifies that the maximum permissible induced shock current from large vehicles under transmission lines cannot exceed 5 milliamperes (mA). Because the induced current is directly inked to the electric field, this 5-mA criterion imposes a limit on electric fields where vehicles can be present under transmission lines.

Average magnetic field strength in most homes (away from electrical appliances and home wiring, etc.) is typically less than 2 ***mG***. Fields of tens or hundreds of milligauss are present very close to appliances carrying high current. Typical magnetic field strengths for some common electrical appliances are given in Table 3-5. Unlike electric fields, magnetic fields from outside power lines are not reduced in strength by trees and building material. Transmission lines and distribution lines (the lines feeding a neighborhood or home) can be a major source of magnetic field exposure throughout a home located close to the line.

There are no national United States guidelines or standards for magnetic fields. The state of Washington does not have magnetic field limits. BPA does not have a guideline for magnetic field exposures. Guidelines for public and occupational magnetic-field exposures are well above environmental levels and above the levels found near transmission lines; they are based on short-term stimulation, not effects of long-term exposures.

Table 3-5: Typical Magnetic Field Strengths
(1 foot from common appliances)

Appliance	Magnetic Fields (mG)[1]
Coffee maker	1-1.5
Electric range	4-40
Hair dryer	0.1-70
Television	0.4-20
Vacuum cleaner	20-200
Electric blanket[2]	15-100

mG = milligauss
[1] The magnetic field from appliances usually decreases to less than 1 mG at 3 to 5 feet from appliances.
[2] Values are for distance from blanket in normal use (less than 1 foot away).
Source: Miler 1974; Gauger 1985

Environmental Consequences—Proposed and Alternative Actions

Potential health and safety impacts associated with the project include those that could affect construction workers, operation and maintenance personnel, crop dusters, other agricultural workers, the public, and others who have occasion to enter the project corridor.

Impact Levels

Impact levels are dependent on public and occupational use of the land. The potential for public health and safety impacts increases in areas where human activities take place.

A **high** impact would occur if the new line precludes the use of the right-of-way for pre-existing activities.

A **moderate** impact would occur if the new line alters pre-existing right-of-way activities.

A **low** impact would occur if the new line would not produce a change in ROW activities.

Impacts During Construction

During construction and installation of the towers and conductor/ground wires, there is a risk of fire and injury associated with the use of heavy equipment, hazardous materials such as fuels, cranes, helicopters, potential bedrock blasting for towers or access roads, and other risks associated with working near high-voltage lines. There is also a potential for fire during refueling of hot equipment such as trackhoes and bulldozers that cannot be taken off-site for refueling. Connection of conductors may be accomplished using implosion fittings, which could be a source of injury to construction personnel. In addition, there are potential safety issues with more traffic on the highways and roads in the project area during construction.

Impacts During Operation and Maintenance

Electrical Safety. Power lines, like electrical wiring, can cause serious electric shocks if certain precautions are not taken. These precautions include building the lines to minimize shock hazard. All BPA lines are designed and constructed in accordance with the National Electrical Safety Code (NESC) and BPA practices. The NESC specifies the minimum allowable distance between the lines and the ground or other objects. These requirements determine the height of the line, and the edge of the right of way; i.e., the closest point that houses, other buildings, and vehicles are allowed to the line.

People must take precautions when working or playing near power lines. It is extremely important that a person not bring anything, such as a TV antenna, irrigation pipe, or water streams from an irrigation sprinkler too close to the lines. BPA provides a free booklet that describes safety precautions for people who live or work near transmission lines (see Appendix D, Living and Working Safely Around High Voltage Power Lines).

Electric and Magnetic Fields. Possible effects associated with the interaction of electric and magnetic fields 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.

Short-term effects and the levels of electric and magnetic fields near the proposed transmission lines are discussed below and in detail in Appendix B-1, *Electrical Effects*. A review of recent studies and their implications for health-related effects is provided in a separate technical report, Appendix B-2, *Assessment of Research Regarding EMF and Health and Environmental Effects*. In addition, the Department of Energy provides a booklet on this topic (Questions and Answers about EMF published in 1995).

The issue of whether there are long-term health effects associated with exposure to fields from transmission lines and other sources has been investigated for several decades. There is little evidence that electric fields cause long-term health effects. Estimates of magnetic-field exposures have been associated with certain health effects in studies of residential and occupational populations. Research in this area is continuing to determine whether such associations might reflect a causal relationship.

Scientific reviews of the research on EMF and health have stated that there is insufficient evidence to conclude that EMF exposures lead to long-term health effects, such as adult cancer, or adverse effects on reproduction, pregnancy, or growth and development of the embryo. Based on epidemiology studies, some uncertainty remains about the possible effect of magnetic-field exposure above 4 mG on the risk of childhood leukemia. However, as the scientific reviews also indicate, animal or cellular studies provide little support for the idea that the statistical associations reflect a causal relationship, i.e., that magnetic-field exposure increases the risk of childhood or adult cancer. Furthermore, national and international organizations have established public and occupational EMF exposure guidelines on the basis of short-term stimulation effects, rather than long-term health effects. In so doing, these organizations did not find data sufficient to justify the setting of a standard to restrict long-term exposures to electric or magnetic fields.

Short-term Effects – Electric Fields. Electric fields from high-voltage transmission lines can cause nuisance shocks when a grounded person touches an ungrounded object under a line or when an ungrounded person touches a grounded object. Transmission lines are designed so that the electric field will be below levels where primary shocks could occur from even the largest (ungrounded) vehicles expected under the line. Fences and other metal structures on and near the right-of-way would be grounded during construction to limit the potential for nuisance shocks. Questions about grounding or reports of nuisance shock received under a line should be directed to BPA. Electric fields from the proposed line would not exceed the BPA electric-field guidelines of 9 kV/m on the right-of-way and 5 kV/m at the edge of the right-of-way.

Short-term Effects - Magnetic Fields. Magnetic fields from transmission lines can induce currents and voltages on long conducting objects parallel to the lines. These voltages can also serve as a source of nuisance shocks. However, the effects are well understood and can be mitigated by grounding and other measures. Magnetic fields from transmission lines (and other sources) can distort the image on computer monitors. The threshold for interference depends on the type and size of monitor. Historically, this phenomenon is reported at magnetic-field levels at or above 10 mG, but some more sensitive monitors may exhibit image distortion at lower levels. Interference from transmission line magnetic fields is generally not a problem at distances greater than 200 to 250 feet from a line.

Locations of Line Configurations Evaluated. For this project there are ten line configurations consisting of different transmission lines and of varying lengths along the corridor. The Agency

Proposed Action would involve Configurations 1,2, 3, 4, 6, 8, and 10. The locations are described in that order for the reader.

- **Configuration 1**: About 2 miles of the right-of-way are represented in Configuration 1 (see Figure 3-5). This configuration would be located where the proposed line parallels the existing Grand Coulee-Hanford 500 kV line just south of the Grand Coulee substation (corridor mile 0/0 to 3/1). This segment of line passes west of the City of Grand Coulee and east of Delano Heights.

- **Configuration 2**: One mile of the right-of-way is represented in Configuration 2 (see Figure 3-6). This configuration would be located where the proposed line leaves the Grand Coulee-Hanford corridor and crosses the plateau south of the City of Grand Coulee to meet the Grand Coulee-Bell corridor (corridor mile 3/1 to 3/8). There are very few residences or buildings, if any, adjacent to the right-of-way in this area.

- **Configuration 3**: About 75 miles of the right-of-way are represented in Configuration 3 (see Figure 3-7). This configuration would be located from the plateau south of the City of Grand Coulee to a point about 600 feet west of Indian Trail Road in Spokane, Washington (corridor mile 3/8 to 78/6). This segment of line is sparsely populated. For this configuration, the proposed single-circuit line would be entirely within the existing Grand Coulee-Bell right-of-way.

- **Configuration 4**: About one-third of a mile of the right-of-way would be represented in Configuration 4 (see Figure 3-8). This configuration would replace a portion of Configuration 3 in the cliff area adjacent to Coulee-Hite Road just west of Springhill substation (corridor mile 73/1 to 73/4). This segment of line is sparsely populated. This configuration is a proposed double-circuit line that would be entirely within the existing Grand Coulee-Bell right-of-way.

- **Configuration 6**: About 3 miles of the right-of-way would be represented in Configuration 6 (see Figure 3-9). This configuration would be located from a point 600 feet west of Indian Trail Road to about 0.5 mile west of Waikiki Road (corridor mile 78/6 to 81/7). This segment of line passes through residential areas of Spokane and Spokane County. For this configuration, the proposed single-circuit line would be entirely within the existing Grand Coulee-Bell right-of-way.

- **Configuration 8**: About 1.5 miles of the right-of-way would be represented in Configuration 8 (see Figure 3-10). This configuration would be located from 0.5 mile west of Waikiki Road to about one-quarter mile east of Highway 395 (corridor mile 81/7 to 83/1). This segment of line passes through residential areas in Spokane County and north of Whitworth College. For this configuration, the proposed single-circuit line would be entirely within the existing Grand Coulee-Bell right-of-way.

- **Configuration 10**: About 0.6 miles of the right-of-way would be represented in Configuration 10 (see Figure 3-11). This configuration would be located from one-quarter mile east of Highway 395 to one-quarter mile east of Highway 2 (corridor mile 81/7 to 83/6). This segment of line passes through residential areas and a commercial area, including the Hico Village Northpointe facility. For this configuration, the proposed double-circuit line would be entirely within the existing Grand Coulee-Bell right-of-way.

Configurations 5, 7 and 9 address the double-circuit alternative of the Alternative Action and are described below.

- **Configuration 5**: About 3.5 miles of the right-of-way would be represented in Configuration 5 (see Figure 3-12). This configuration would be a double-circuit alternative at the eastern end of configuration 3 from a point about one-quarter mile west of Riverside State Park to a point about 600 feet west of Indian Trail Road in Spokane, Washington (corridor mile 75/2 to 78/6). This segment of line is sparsely populated. For this configuration, the proposed double-circuit line would be entirely within the existing Grand Coulee-Bell right-of-way.

- **Configuration 7**: Configuration 7 (see Figure 3-13) would be a double-circuit alternative to Configuration 6 (corridor mile 78/6 to 81/7). This configuration would be located from a point 600 feet west of Indian Trail Road to about 0.5 mile west of Waikiki Road (corridor mile 78/6 to 81/7). This segment of line passes through residential areas of Spokane and Spokane County.

- **Configuration 9**: Configuration 9 (see Figure 3-14) would be a double-circuit alternative to Configuration 8 (corridor mile 81/7 to 83/1). This configuration would be located from 0.5 mile west of Waikiki Road to about one-quarter mile east of Highway 395 (corridor mile 81/7 to 83/1). This segment of line passes through residential areas in Spokane County and north of Whitworth College.

<u>Electric and Magnetic Field Levels.</u> An increase in public exposure to electric and magnetic fields could occur if field levels increase and if residences or other structures attract people to these areas. The predicted field levels are only indicators of how the proposed project may affect the magnetic-field environment. They are not measures of risk or impacts on health. The 84-mile-long corridor in which the proposed line would be built is sparsely populated along most of its length, except for the easternmost seven miles, which passes through residential and other more densely populated areas.

BPA has predicted the annual peak electric and magnetic fields from the proposed and existing transmission lines along the corridor. (Appendix B-1 contains this information). This allows a comparison between the fields with the proposed line and the fields from existing lines without the proposed line (the no-action alternative) in the various areas. The field levels from the existing and proposed lines change along the corridor, depending on how many lines are in the corridor, where they are located relative to one another, and the width of the right-of-way. The predicted levels for electric and magnetic fields are maximum levels that would occur under maximum voltage conditions for electric fields and annual peak current conditions for magnetic fields. Magnetic fields averaged over a year would be one-half or less than the estimated maximum values reported in Appendix B-1 and summarized in the sections below.

In Configurations 1 and 2 for about three miles immediately south of the Grand Coulee Substation, the proposed line would be on new right-of-way and adjacent to the edge of the right-of-way. For these configurations the changes in electric fields at the edges of the righ-of-way associated with the proposed line versus the existing line (Configuration 1) or no line (Configuration 2), range from no change to an increase of 2.5 kV/m.

Changes in magnetic fields at the edges of the right-of-way for Configurations 1 and 2 would range from a decrease of 14 mG to an increase of 83 mG. Plots of the maximum magnetic field versus distance from the line for the proposed and no-action alternatives are shown in Figure 3-5 for Configuration 1 and in Figure 3-6 for Configuration 2.

The changes in electric and magnetic fields for Configurations 1 and 2 of the proposed action would not affect land use in the area. However, the physical presence of a second 500-kV line in the populated area near the City of Grand Coulee (Configuration 1) could impact the use of recreational areas. The Public Health and Safety impacts for Configurations 1 and 2 are therefore Low/Moderate and Low, respectively.

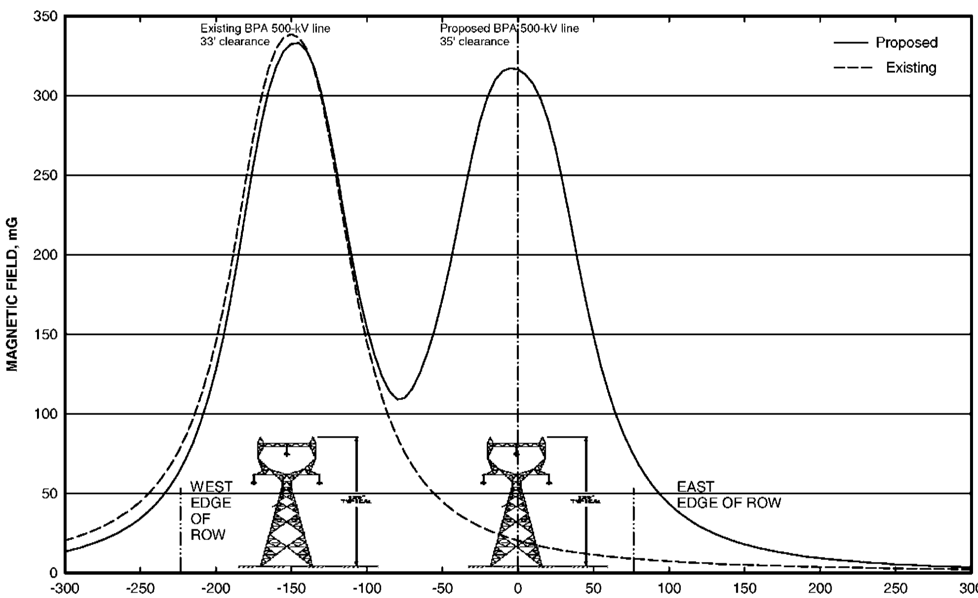

Figure 3-5 Right-of-Way Configuration 1

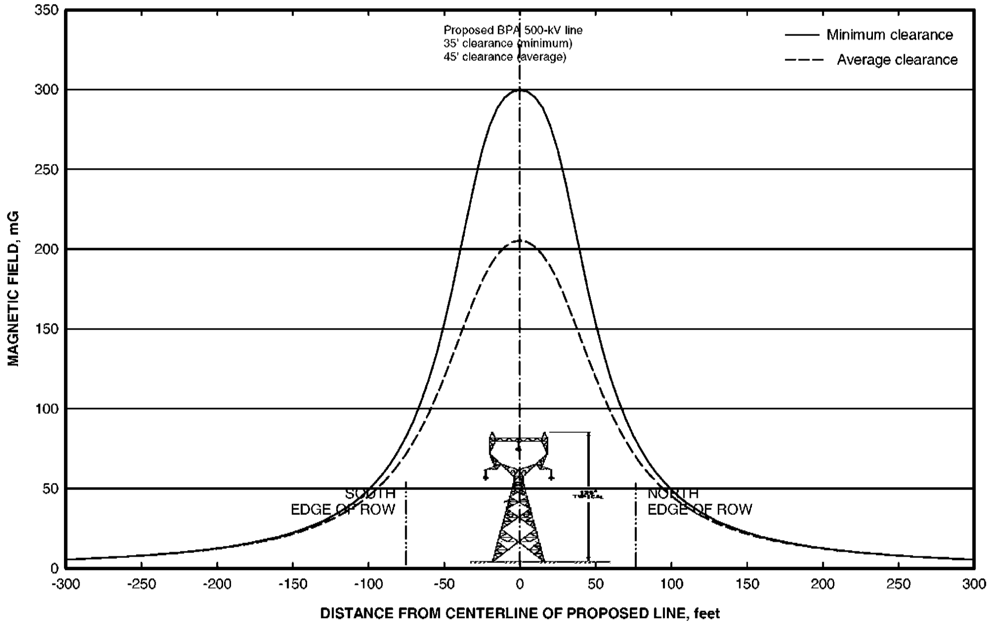

Figure 3-6 Right-of-Way Configuration 2

In Configurations 3 through 10, the remaining 81 miles of the proposed line would be located on the existing right-of-way of the Grand Coulee – Bell corridor and would not be adjacent to the edge of that right-of-way. In Configurations 3, 6, and 8 the proposed line would be on single-circuit structures, while in Configurations 4, 5, 7, 9, and 10 the proposed line would be on double-circuit structures.

The proposed action is to link Configurations 3, 4, 6, 8, and 10 over the length of the Grand Coulee – Bell corridor. In this action, double-circuit structures would be used only in the short sections near the escarpment west of the Springhill Substation (Configuration 4 - 0.68 miles) and across the commercial area leading into the Bell Substation (Configuration 10 - 0.6 miles). In the alternative action, double-circuit configurations would replace a portion of single-circuit Configuration 3, and all of Configurations 6 and 8.

For Configurations 3 through 10, the addition of the proposed line would reduce or not change the electric field at the edge of the right-of-way of the Grand Coulee – Bell corridor compared to the electric field from the existing lines. However, for these configurations, the peak electric fields on the right-of-way would increase from the levels associated with 115-kV lines (1.4 kV/m) and 230-kV lines (2.9 – 3.4 kV/m) to those associated with the proposed 500-kV line (7.4 – 8.9 kV/m).

For Configurations 3 through 10, the addition of the proposed line would reduce or not change the magnetic field at the edge of the right-of-way with three exceptions. There would be a maximum increase of 9 mG at the south edge of the right-of-way in Configuration 4 (0.68 miles), a maximum increase of 5 mG at the north edge of the right-of-way in Configuration 10, and a maximum increase of 1 mG at the south edge of the right-of-way in Configuration 10. For these configurations, peak magnetic fields on the ROW would increase or decrease depending on the configuration. Peak fields for the proposed action single-circuit configurations tend to be higher than those for the no-action alternative, while peak fields for the alternative action double-circuit configurations are lower than those for the no action alternative. Plots of magnetic field versus distance from the line for the configurations in the proposed action are shown in Figures 3-7 to 3-11. Magnetic fields from the alternative action configurations with double-circuit structures (Configurations 5, 7, and 9) are shown in Figures 3-12 to 3-14.

For Configurations 3 through 9, the proposed and alternative actions would replace an existing line in a multiple-line corridor. Electric and magnetic field changes would essentially occur only on the right-of-way where exposures are transitory. In many instances the proposed action would reduce electric and magnetic field levels at the edge of the right-of-way and beyond. Therefore, the changes in electric and magnetic fields in Configurations 3 through 9 will not affect land use on or adjacent to the right-of-way. The Public Health and Safety impacts for these configurations are therefore Low.

In Configuration 10, there is considerable activity involving large vehicles and storage of vehicles on the right-of-way. Therefore the addition of a 500-kV line with higher electric fields will substantially impact the use of this commercial area. The changes in electric fields off the ROW and the changes in magnetic fields on and off the right-of-way will not affect land use in Configuration 10. The Public Health and Safety impacts for Configuration 10 are Moderate/High.

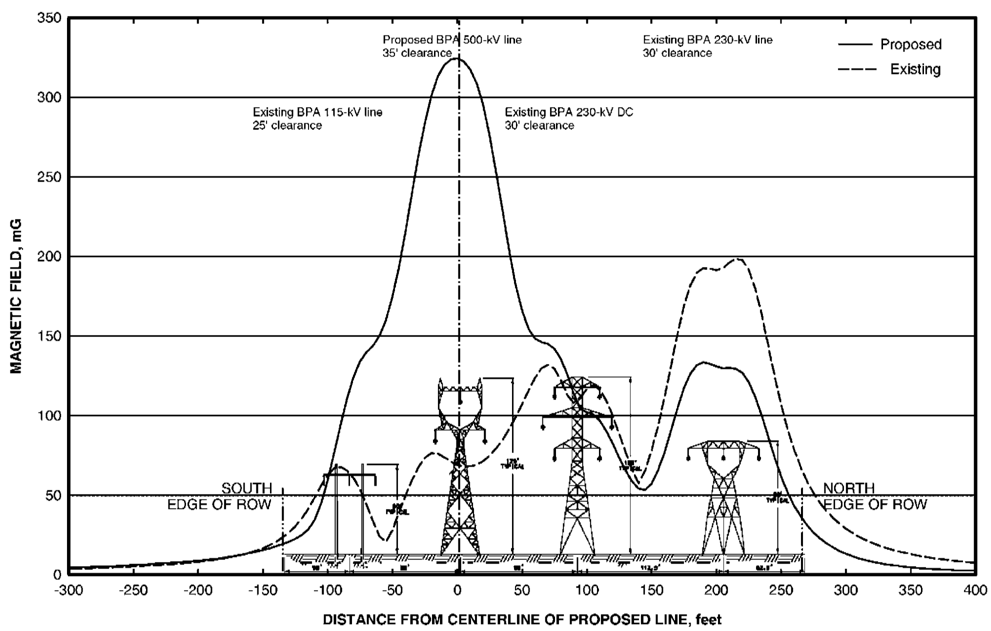

Figure 3-7 Right-of-Way Configuration 3

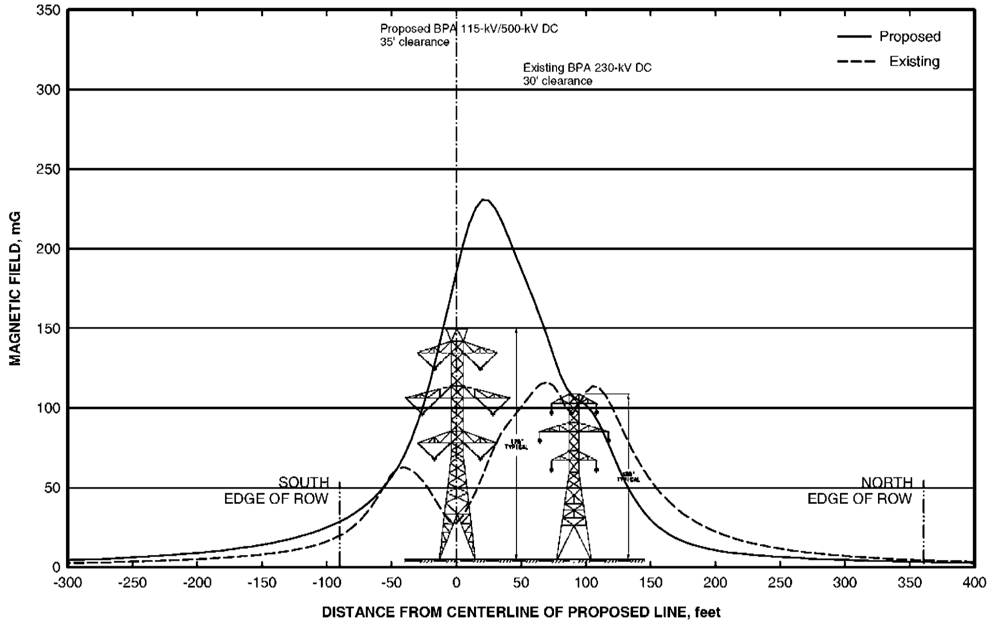

Figure 3-8 Right-of-Way Configuration 4

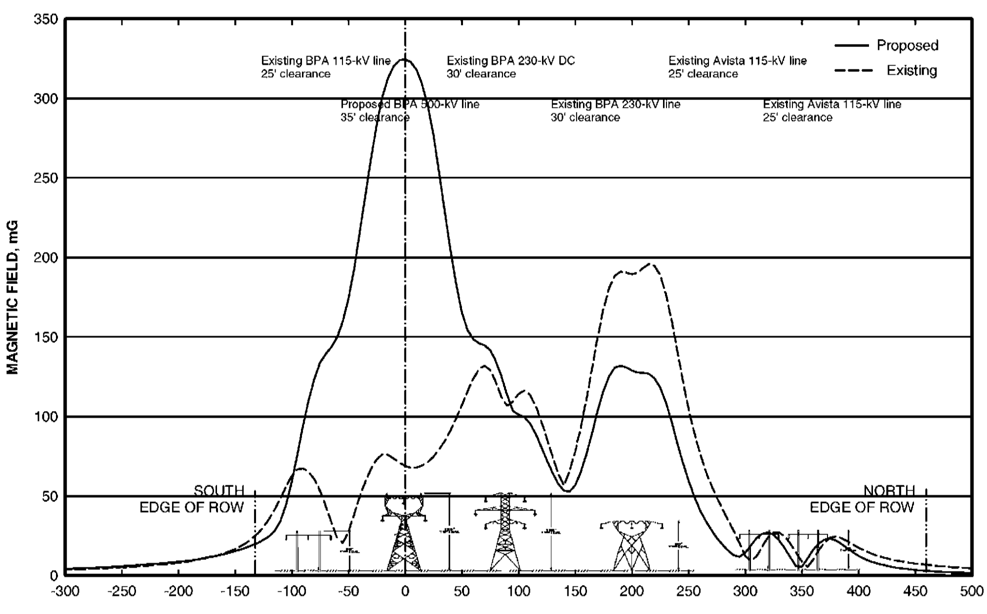

Figure 3-9 Right-of-Way Configuration 6

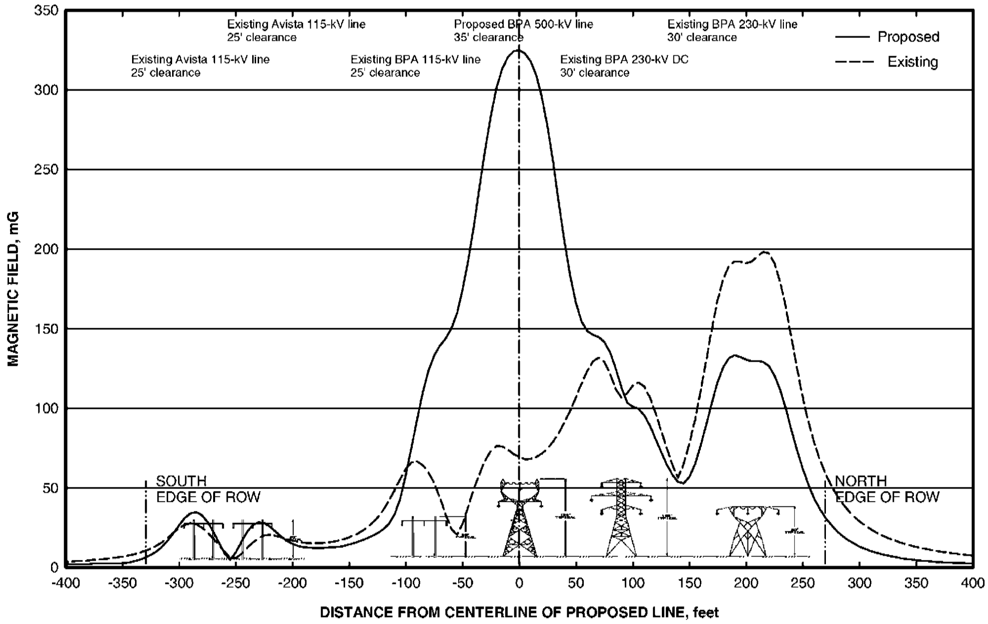

Figure 3-10 Right-of-Way Configuration 8

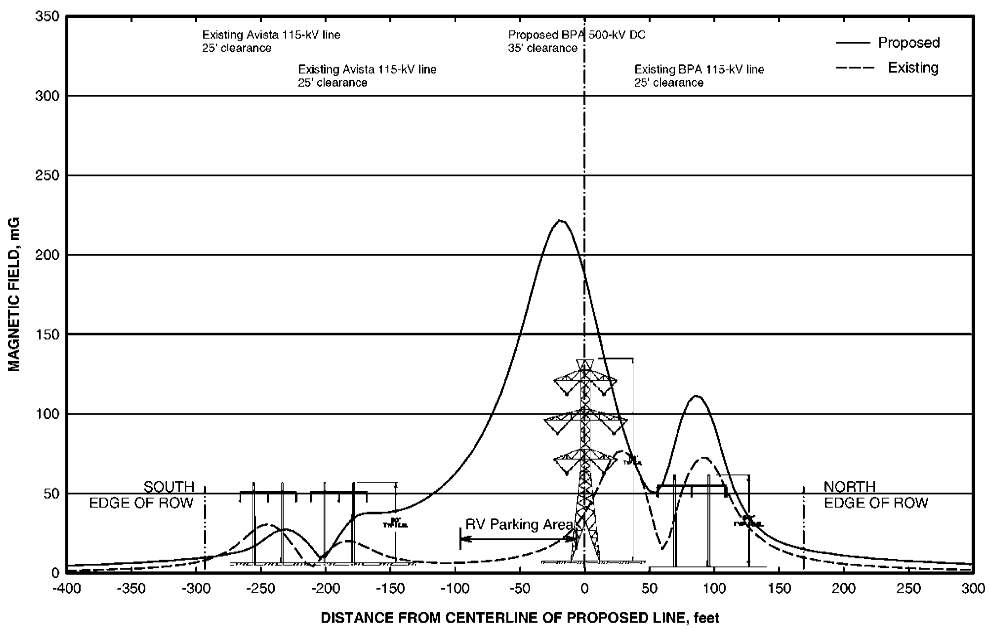

Figure 3-11 Right-of-Way Configuration 10

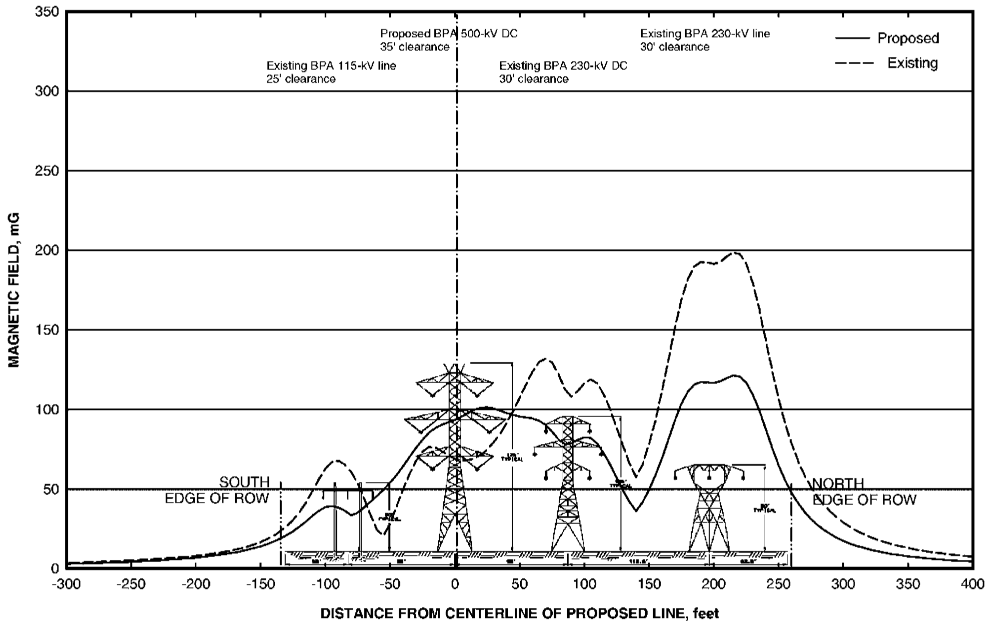

Figure 3-12 Right-of-Way Configuration 5

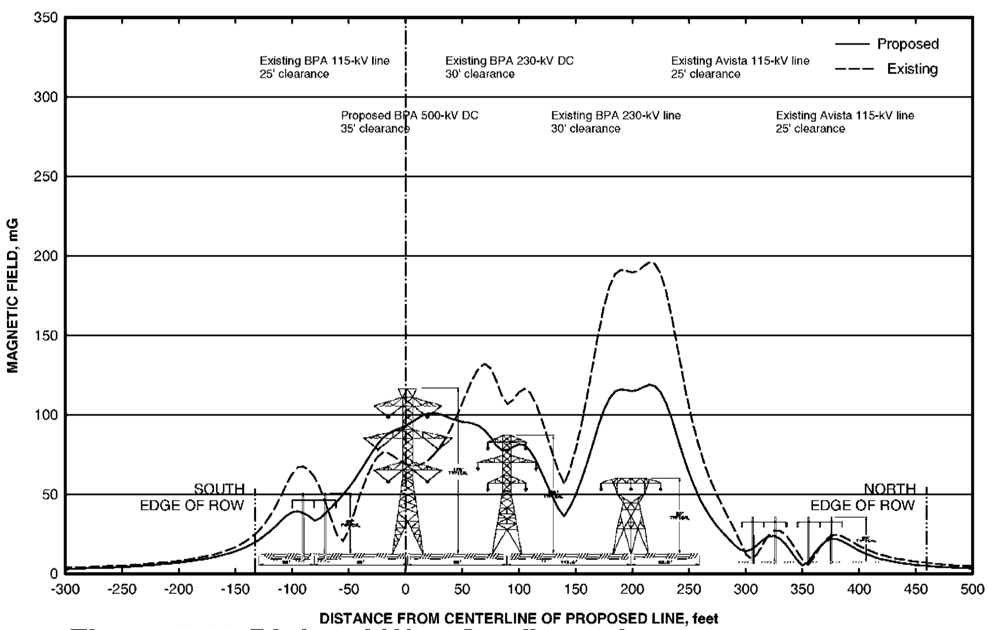

Figure 3-13 Right-of-Way Configuration 7

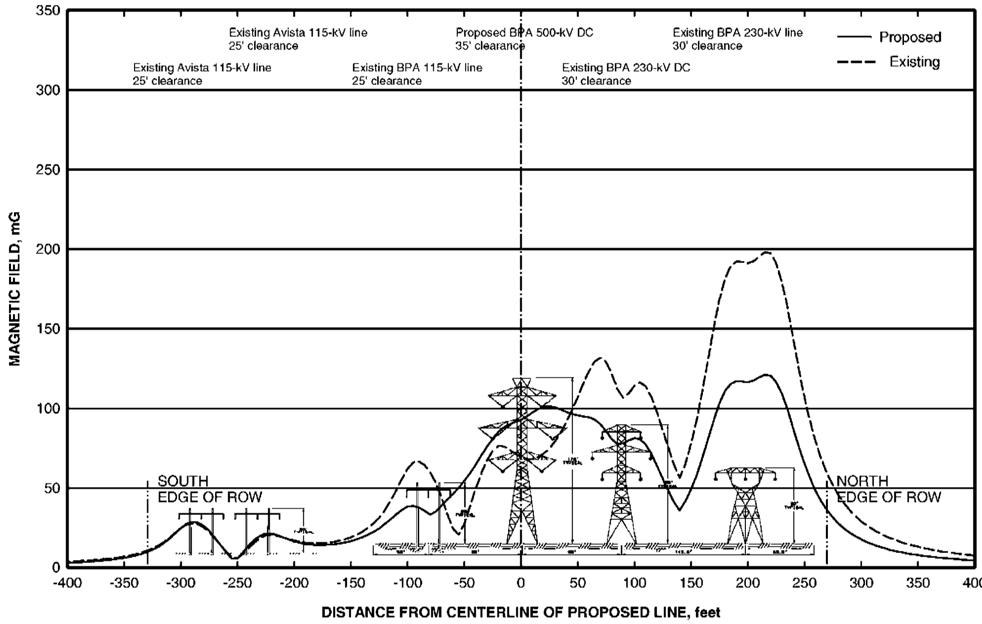

Figure 3-14 Right-of-Way Configuration 9

Environmental Consequences of the Alternative Action

Summary

The public health and safety impacts for the proposed action, the alternative action and no action are summarized in the chart below.

Action	Configuration									
	1	2	3	4	5	6	7	8	9	10
Proposed	L/M	L	L	L	N/A	L	N/A	L	N/A	M/H
Alternative	L/M	L	L	L	L	N/A	L	N/A	L	M/H
No Action	N/A	N/A	L	L	L	L	L	L	L	L

L = Low, M= Moderate, H = High, N/A = Not applicable

In summary, the overall impacts from this project related to public health and safety would be low. Impacts are increased in a few areas where intensive use of the right-of-way occurs and the proposed 500-kV line could impact activities either because of safety concerns or nuisance shocks related to electric fields. In populated areas, changes to electric- and magnetic-field exposures at residences along the corridor will be minimal or decreased.

Toxic and Hazardous Substances

There are no known occurrences of hazardous materials or contaminants within the transmission line corridor. However, if a hazardous material, toxic substance, or petroleum product is discovered that could pose an immediate threat to human health or the environment, BPA requires that the contractor notify the Contracting Officer's Technical Representative (COTR) immediately. Other conditions such as large dump sites, drums of unknown substances, suspicious odors, stained soil, etc. shall also be reported immediately to the COTR. The COTR would coordinate with the appropriate personnel within BPA. In addition, the contractor would not be allowed to disturb such conditions until the COTR has given the notice to proceed.

Cumulative Impacts

The proposed project would contribute a small increase in the overall risk of fire and injury to the public that could occur during construction and operation/maintenance. The incidence of nuisance shocks could occur infrequently under the proposed line.

Mitigation

The following mitigating measures would help minimize potential health and safety risks.

- Prior to starting construction, contractor would prepare and maintain a safety plan in compliance with Washington requirements. This plan would be kept on-site and would detail how to manage hazardous materials such as fuel, and how to respond to emergency situations.

- During construction, the contractors would also hold crew safety meetings at the start of each workday to go over potential safety issues and concerns.

- At the end of each workday, the contractor and subcontractors will secure the site to protect equipment and the general public.

- Employees would be trained, as necessary, in tower climbing, cardiopulmonary resuscitation, first aid, rescue techniques, and safety equipment inspection.

- To minimize the risk of fire, fuel all highway-authorized vehicles off-site. Fueling of construction equipment that was transported to the site via truck and is not highway authorized would be done in accordance with regulated construction practices and state and local laws. Helicopters would be fueled and housed at local airfields or at staging areas.

- Helicopter pilots and contractor take into account public safety during flights. For example, flight paths could be established for transport of project components in order to avoid flying over populated areas or near schools (Helicopter Association 1993).

- Provide notice to public of construction activities, including blasting.

- Take appropriate safety measures for blasting consistent with state and local codes and regulations. Remove all explosives from the work site at the end of the workday.

- If implosion fittings are used to connect the conductors, install in such a way as to minimize potential health and safety risks to workers?.

- Operation and maintenance vehicles would carry fire suppression equipment including (but not limited to) shovels and fire extinguishers.

- Stay on established access roads during routine operation and maintenance activities.

- Keep vegetation cleared according to BPA standards to avoid contact with transmission lines.

- Submit final tower locations and heights to the Federal Aviation Administration for review and potential marking and lighting requirements.

- Construct and operate the new transmission line to meet the National Electrical Safety Code, as required by law.

- During construction, follow BPA specifications for grounding fences and other objects on and near the proposed right-of-way.

Environmental Consequences of the No Action Alternative

Potential health and safety risks associated with the ongoing operations and maintenance activities for the existing transmission line, substations, right-of-way, and accesses roads would continue. No new public health and safety impacts would be expected.

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Visual Resources

Affected Environment

The affected area for visual resources extends beyond the corridor to adjacent lands.

The project area encompasses a variety of landscape settings ranging from the Roosevelt Lake reservoir and the rugged basalt outcrops near Grand Coulee to agricultural, rangeland, woodland, and scrubland over most of the route, to urban environments near and in Spokane. Important visual and recreational features include Grand Coulee Dam, Banks Lake, Roosevelt Lake, the Spokane River, and Riverside State Park along the Spokane River just outside the City of Spokane. No other distinct or rare land forms or other features are present. However, a common element of the visual setting is that it includes a corridor with four transmission lines over most of the project's length.

At the west end of the corridor near the Columbia River, terrain is rugged, with large basalt outcrops, steep slopes and canyons. The area is scenic because the landscape is vast and encompasses a variety of landscape features of differing form, color, and texture, including the Grand Coulee Dam and Lake Roosevelt. The City of Grand Coulee is also located here, which was built around the construction of Grand Coulee Dam. Grand Coulee Dam is a major producer of electricity, and there are many transmission lines of different sizes, shapes, and colors that cross the area (see Figure 3-15 and 16).

The landscape east of Grand Coulee is dominated by large dryland farms broken in places by intervening drainages (some rugged and forested), rangelands and scrublands. Much of the terrain east of Grand Coulee is relatively flat and rolling farmland that changes seasonally as farmers plow fields, plant and harvest crops (see Figure 3-17). The rights-of-way in this area tend to blend with the adjacent land because crops are grown in the right-of-way. The area is dry and a surface haze often lessens distant views.

The setting in the eastern part of the study area is more urban and varied. It encompasses the scenic Spokane River and adjacent park land; residential, commercial, and institutional areas east of the Spokane River; and an industrial landscape near Bell Substation. The Spokane River, which flows through Spokane, has numerous recreational and scenic opportunities along its banks (see Figure 3-18). The main resource for scenic and recreational opportunities along the Spokane River is within Riverside State Park. The existing Grand Coulee-Bell corridor crosses the park north of Deep Creek. The crossing is visible from Nine Mile Road to the east and Riverside Park Drive to the west approximately between corridor mile 76/8 and 77/6.

Figure 3-15. Grand Coulee Area (from North Dam Park looking south)

Figure 3-16. Grand Coulee Area (looking north from Delano Heights)

Figure 3-17. Cultivated Area (looking east)

Figure 3-18. Spokane River/Riverside Park (looking east).

Suburban Spokane is hilly and tree-covered, with many housing developments next to the corridor or within view of it (see Figures 3-19, 20 and 21). The corridor is readily apparent in this area because trees have been cleared and/or houses are present up to the edge of the ROW. Along Indian Trail Road between corridor mile 78/2 and 79/2, two subdivisions have been built adjacent to the southern corridor boundary. Lattice steel towers and wood poles are clearly visible from the housing developments. The corridor skirts the northern edge of Fivemile Prairie, with more sparsely developed residential uses in the area, and then descends in elevation toward Whitman College. Continuing east, the right-of-way passes between single-family housing developments and Whitworth College (see Figures 3-22). The northern boundary of Whitworth College campus does not have views of the corridor due to grade changes and screening by trees. On the northern boundary of the corridor between Waikiki Road and U.S. Highway 395 (corridor mile 81/10 to 82/7) single-family homes are present adjacent to the corridor. Those homes immediately adjacent to the corridor have clear views of the existing lattice steel towers and wood pole structures. The corridor passes near another single-family housing development between corridor mile 82/8 and 83/3. Homes in this area are more set back from the right-of-way (there are two intervening Avista 110-kV transmission lines in this area, and trees provide partial screening). Between corridor mile 83/4 and 83/6, the corridor (which consists of just the two 115-kV lines in this area) traverses the Hico Village Northpointe commercial area (see Figure 3-23). Near Bell Substation the land is flat and covered with grass (see Figure 3-24). This is an industrial area with the Kaiser Aluminum plant adjacent to Bell Substation.

Figure 3-19. Residences Next to Corridor – Indian Trails Area.

Figure 3-20. Residences Next to Corridor – Brentwood Area.

Figure 3-21. Middle Ground View From Subdivision.

Figure 3-22. Whitworth College Area

Figure 3-23. Commercial Area

Figure 3-24. Industrial Area.

Environmental Consequences

Construction, operation and maintenance of transmission facilities can affect visual resources for both the long and the short term. Any part of the facility can contribute to visual impacts: structures, conductors, insulators, spacers, aeronautical safety markings, right-of-way clearing, access roads, clearing for structures, and pulling and reeling sites for the conductors. Distance from sensitive viewpoints decreases visibility. Different landforms and vegetation influence visual impact; some are more able to screen transmission line features. The visual setting also influences the visual experience. Because the setting already contains four transmission lines, impacts would be less than for a setting without transmission lines. Also, due to aviation safety concerns, it could be necessary to paint or light towers in some locations (e.g., hill tops or river crossings).

Facilities can be visible from potential viewpoints such as private residences, highways and roads, and commercial areas. Locating facilities in areas where soils are highly erodible or have poor potential for revegetation contributes to visual impact. Because a transmission line is a physical element, its visual presence would last from construction through the life of the line.

Residents are normally very sensitive to changes in their surrounding environments and views. Changes to facilities within the corridor would alter existing views, depending on the topography, vegetation, and size and color of the new structures. Residents in those areas adjacent to the corridor would be more adversely affected by the change in views. However, those traveling on highways are not as sensitive to changes in view because they only pass the lines for a short time and are generally headed to other destinations.

Impact Definitions

A **high** impact would have these outcomes.

- A large number of people highly sensitive to their surroundings see the line in ***foreground*** and ***middle ground*** views; or
- The lines dominate views and/or appear uncoordinated and chaotic. This may occur when two or more lines are visible and are dissimilar in size, configuration, color and/or spacing.
- The area is officially recognized for its scenic or recreational values.

A **moderate** impact would have these outcomes.

- The line would be visible to large numbers of people but it is not a dominant element in the landscape because electrical facilities are commonplace in the area, views are partially screened, large segments of the line may be visible but only for a short time, and/or most views are in the middle ground.
- Scarring, and/or erosion from access roads or clearing is evident but not severe or extensive.
- The line would conflict with prevailing land patterns but be visible to few people or for short periods.

A **low** impact would have the following outcomes.

- Few viewers would see the line because it is isolated, screened, or seen at a distance; existing conditions (transmission lines) have already established impacts.
- Access road scars and clearing would not significantly detract from the setting.
- Views would be short-lived and no visually sensitive resource would be affected.

Impacts

Transmission lines are commonplace in the Grand Coulee area and they are a major element of the visual setting. There are many transmission lines that vary in size, shape, and color and extend in many directions. The new transmission line would be a relatively small addition to the setting. The new line would extend across North Dam Park, an existing landfill, and SR 155 near single-family housing. Residents in and around Grand Coulee, tourists, motorists and pedestrians would be able to see the transmission lines. The line would be in the immediate foreground of users of the park, which may adversely affect their experience. The new towers, though large, would be consistent with existing conditions. Overall, the impacts would be low to moderate because the large number of the existing lines has altered the visual character of the existing landscape (see Figures 3-25 and 26). However, depending on tower placement, the line could intrude on a viewshed that encompasses Grand Coulee and the Columbia River from an archeological site in the area. If such visual intrusion occurs, the level of impact would be high.

Figure 3-25. Grand Coulee Area With Photo Simulation (from North Dam Park looking south)

Figure 3-26. Grand Coulee Area With Photo Simulation (looking north from Delano Heights)

At corridor mile 3/8, the new transmission line would join and be part of the existing corridor that has already impacted the area. The old Grand Coulee Highway passes under and parallels the corridor from corridor mile 3/8 to 4/4. The level of impacts would be low because traffic volume is light and road conditions require drivers' attention. Motorists would have intermittent, brief views of the line. The change from existing conditions would not be apparent to the average viewer.

From corridor mile 4/5 to 6/4, the corridor is isolated and not easily seen. Terrain is rugged basalt outcrops and coulees with sparse vegetation. Impacts would be low.

Between corridor miles 6/4 and 6/5, cultivated fields begin and continue to corridor mile 68/9, interrupted only by intervening drainages, woodlands, and scrublands, especially in the Bachelor Prairie/Hawk Creek area, where rugged terrain prevents farming. Though most of this segment is isolated, it does parallel and/or cross local and county roads. Most viewers would see the line briefly and/or in the background. Because most views are from afar, the expansiveness of the landscape would diminish the scale of the large towers and would absorb the towers into the landscape. An exception may be during periods of low sun angles in the early morning and late afternoon. Unless mitigated, the sun reflecting off the towers, conductors, and insulators would increase visibility by several miles. A representative view of the corridor traversing agricultural land is shown on Figure 3-27.

Figure 3-27. Cultivated Area with Photo Simulation (looking east)

In the agricultural land the right-of-way would not be visible. In the non-agricultural areas, vegetation is sparse and canyons can be spanned with minimal clearing. These areas are isolated with few viewing opportunities. Overall, the level of impacts for this segment would be low because the segment is isolated, few people would see the line because there are few residences and roads are lightly traveled, and it would be in an established corridor.

The line remains isolated until corridor mile 69/8 near the crossing of Brook Road and Coulee Hite Road. Here the line would be visible to travelers on these roads and to rural residents. From corridor mile 70/3 to corridor mile 72/7 the line is out of view and would have low impacts. Between corridor mile 73/1 and 74/7, the line is next to Coulee Hite Road and crosses Four Mound Road. Travelers would see the line in the foreground for 2 to 4 minutes. The new line would appear more massive and provide greater contrast with use of double-circuit towers (approximately 175 feet high) between corridor mile 73/1 and 73/4. From corridor mile 74/7 to 76/6 the line is not seen except for two crossings of Seven Mile Road. These are rural roads, traffic is light on these roads, and, there are few residences; impacts would be low to moderate.

The corridor passes through Riverside State Park between corridor miles 76/7 and 77/6. The park allows public access to the Spokane River for recreational and scenic uses. Visitors to Riverside State Park and the Centennial Trail would experience moderate to high impacts depending on their distance from the line. The line within the park is generally not visible except when next to or under the line. Existing lines have already impacted the park but park visitors normally have a high awareness of their surroundings. Mitigation, such as using plants as screens at critical vantage points, is recommended.

The transmission line crossing of the Spokane River would cause moderate to high impacts to viewers depending on viewer location (see Figure 3-28). Most views would be in the middle ground and background with towers ***backdropped*** or well screened by trees and topography. Motorists using Nine Mile Road would have moderate impacts. Traffic is light but motorists would see the line for 2 to 3 minutes.

Between towers 77/7 and 81/8, the line is next to housing developments (see Figure 3-29) and/or visible to many residents with middle ground and background views. East of Nine Mile Road the corridor passes immediately adjacent to a housing development between corridor miles 78/1 and 79/2. In this section, the line would remain a prominent feature and be visible to many viewers, with impacts ranging from moderate to high. In some areas, such as near Five Mile Road, residents would have panoramic views of the new line because towers and conductors would occupy most of their view. The level of impacts would be high in these areas.

Crossing Waikiki Road and continuing to corridor mile 83/3 the new line would be close to and in direct view of many residents (see Figure 3-30). The northern boundary of the corridor is adjacent to single-family homes between corridor miles 81/10 and 83/1. The size of the 500-kV line and conductors, in relation to nearby objects, would be more dominating. Residents nearest

Figure 3-28. Spokane River/Riverside Park with Photo Simulation (looking east)

Figure 3-29. Residences Next to Corridor with Photo Simulation –Indian Trails Area

Figure 3-30. Residences Next to Corridor with Photo Simulation – Brentwood Area

to the corridor would likely experience high impacts, but as people become accustomed to the new line, their awareness of it would moderate over time. Most residents beyond about 500 feet would have low to moderate impacts because much of the line would be blocked from view by other houses or vegetation (see Figure 3-31**)**.

Between corridor miles 82/1 and 82/6 the corridor runs adjacent to the northern boundary of Whitworth College (see Figure 3-32). The northern boundary of the college slopes down to the corridor and is heavily vegetated. The new transmission line would have a low impact to the college given the amount of vegetation and topography. At corridor mile 83/1 the corridor travels southeasterly towards Bell Substation. Between corridor miles 83/1 and 83/3 the corridor passes close to existing single-family homes. The impact to these homes would be low to moderate depending on the amount of screening of the line from existing vegetation.

Between corridor miles 82/6 and 83/7 the line would be less visible because the flat terrain and screening from trees and buildings would limit views from off the right-of-way. With use of double-circuit towers between corridor mile 83/1 and 83/6, the transmission line would contrast with the existing corridor to a greater extent, and would be more visually apparent to viewers. Between corridor mile 83/4 and 83/6 where the corridor traverses across a commercial area that also supports RV use, the transmission line would be readily apparent in the foreground (see Figure 3-33). In this area, the double-circuit lattice steel towers would be on the southerly side of the corridor. Impacts would be moderate in this area. Commuters on U.S. Highway 395 and U.S. Highway 2 would have views of the line but impacts would be low to moderate because views would be brief, with other distractions such as traffic, road signs and vegetation competing for viewer's attention.

Figure 3-31. Middle Ground View From Subdivision with Photo Simulation

Figure 3-32. Whitworth College Area with Photo Simulation

Figure 3-33. Commercial Area with Photo Simulation

Impacts would be low from corridor mile 83/6 to Bell Substation. This is an industrial area that has been modified by many lines entering Bell Substation (see Figure 3-34).

Short-term construction activity within the corridor would introduce new elements into the visual environment. Access roads would be built or improved as necessary, and staging areas designated along the corridor. Materials stockpiled within staging areas such as tower steel, bolts, conductor reels, insulators, and culverts would provide rectangular bulk and linear complexity to the existing visual landscape. The color and texture of these materials may be reflective and different compared to the backdrop of the existing landscape. Areas along the corridor that would be the most sensitive to construction activity are those near residential, recreational or scenic uses. These areas include new right-of-way coming into Grand Coulee that passes over and/or near residential and recreational areas; and sections of the corridor from corridor mile 76/5 to 77/6, 78/2 to 79/2, and 79/9 to 83/3 through Riverside Park and adjacent to residential areas. Once constructed, all unused material would be disposed of or recycled, equipment removed, and the landscape restored to its original condition. Overall, the level of visual impacts during construction would be low to moderate.

Figure 3-34. Industrial Area with Photo Simulation.

Environmental Consequences of the Alternative Action

Constructing a double-circuit transmission line within the easterly 9 miles of the corridor would result in greater visual impacts. The taller towers (nominally 175 feet) and their greater complexity (double versus single circuit) would provide greater contrast with the existing transmission structures in the corridor. Their greater size would also increase their visibility to residents and travelers in the area, which is the most populous section of the corridor. Overall, impacts would be moderate to high and greater than under the Agency Proposed Action.

Cumulative Impacts

The Grand Coulee-Bell corridor consists of lattice steel and wood pole structures. The proposed project would replace one of the existing wood pole structures and upgrade it with a lattice steel structure. The rough texture and dark brown color of the wood pole structures are natural looking, smaller, weather to a lighter color, and tend to blend into the surrounding landscape better over time. The proposed project would increase the number of steel structures within the corridor in relation to what exists today, leading to greater combined visual impacts associated with the corridor's transmission lines. In addition, greater residential development will occur in the vicinity of the line that would contribute to greater cumulative impacts over time. The greatest cumulative impact would be in the urban Spokane area where residents, recreational uses and scenic views would be affected. However, as loads continue to grow, using existing right-of-way by removing small lines and building larger ones may be a preferred choice for utilities because, in some cases, using existing right-of-way may have fewer environmental impacts and potentially lower economic costs to ratepayers. No known additional changes to the transmission system in the area are planned that would contribute to adverse visual impacts.

Mitigation

The transmission lines and structures would blend more effectively with the surrounding environment using the following mitigation:

- Impacts will be lessened with placement of towers adjacent to the existing 230-kV towers, where practical, and by maintaining tower heights that are about the same as the 230-kV towers.
- Use tower steel that has been treated to reduce reflectivity.
- Use ***non-specular*** conductors.
- Use non-luminous insulators (i.e., non-ceramic insulators or porcelain).
- Plant vegetative screens, do selective clearing/tree topping at Riverside State Park and other selected sites.
- Develop site-specific mitigation after construction is complete. For example, because the new transmission line would potentially detract from recreational users' experience at North Dam Park in Grand Coulee, improvement of park access roads or comparable mitigation could help offset this impact.
- Use existing topography and vegetation when ever possible to limit views of lines and structures.
- Locate construction staging areas out of sight of potential viewers as much as possible.
- Require that contractors maintain a clean construction site and that the corridor is kept clean after construction.
- Maintain permanent access roads.
- BPA will work with the Federal Aviation Administration to determine if there are any concerns about aviation safety and whether painted or lighted towers need to be considered.

Also, if any new towers intrude on the viewshed east of an archeological site in the Grand Coulee area, the Colville Confederated Tribe's Historic Preservation Officer will be consulted.

Environmental Consequences of the No Action Alternative

Existing transmission lines in the corridor would continue to be seen. No new visual impacts would be expected.

Air Quality

Affected Environment

Climate

Eastern Washington has an arid to semiarid climate. Average daily temperatures and annual average precipitation in eastern Washington vary moderately (see Table 3-6). Spokane is generally cooler than Grand Coulee. Temperature varies with altitude, with higher locations being cooler. The land gradually rises from the Columbia River in a northerly and easterly direction to the Rocky Mountains east of Spokane, with a few rolling hills in-between. The area between Wilbur and Davenport is on a rolling hill, which exposes the area to prevailing seasonal winds, causing more extreme temperatures than in Spokane. Most winds in eastern Washington are from the north during the fall and winter, and from the south and southwest during spring and summer.

The Cascade Mountains cast a rain shadow over part of eastern Washington. Annual average precipitation varies from about 11 inches per year at Grand Coulee Dam to 17 inches per year at Spokane.

Table 3-6. Average Temperatures and Precipitation in Eastern Washington

City	Average Daily Temperatures (degrees F)	Annual Average Precipitation (inches)
Grand Coulee	49.15	10.66
Wilbur	46.8	12.08
Davenport	46.3	16.06
Spokane	47.15	17.19

Airshed

Portions of the Spokane area have been designated as ***non-attainment*** areas for ***particulate matter*** less than 10 microns in diameter (***PM-10***) and for carbon monoxide because the area has exceeded National Ambient Air Quality Standards for these pollutants on a persistent basis. The eastern part of the corridor between approximately the Spokane River and Bell Substation are located in these non-attainment areas. The corridor passes through about 6 miles of the non-attainment area for each of these pollutants.

Environmental Consequences

Impact Definitions

A **high** impact would create one or more of these outcomes:

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

A **moderate** impact would create one or more of these outcomes:

- Create an effect that could be partially mitigated.
- Cause a localized reduction in air quality.
- Create a possible, but unlikely risk to human health or safety.

A **low** impact would create one or more of these results:

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

Impacts

Transmission line construction is scheduled to begin in January 2003 and be completed in November 2004. Construction activities would affect air quality on a short-term basis. Construction activity, including line removal, would take place over two construction seasons. Depending upon how construction is sequenced, construction activities in any given area would take place over a month's duration or less. Dust from construction activities, particularly access road construction, and from traffic on unpaved roads would be emitted into the atmosphere. Water trucks would be used to control dust and would reduce air quality impacts to a low impact.

Heavy equipment and vehicles emit pollutants such as carbon monoxide, carbon dioxide, sulfur oxides, particulates, oxides of nitrogen and volatile organic hydrocarbons. Typical construction equipment would consist of about twenty vehicles (pickups and vans), three bucket trucks, one conductor reel machine, three large excavators, one line tensioner, and one helicopter. Vehicle and equipment emissions would be relatively small and comparable to current conditions in agricultural areas. Impacts are expected to be short term, with a low level of impact on air quality. Short-term emissions from construction are exempt from air quality permitting requirements.

Trees and tall brush would be cleared in the existing right-of-way to accommodate height restrictions of the new 500-kV line. It is not anticipated that a large number of trees would need to be cleared because most of the route was cleared earlier for the existing 115-kV line. Trees would be cut outside of the right-of-way that are identified as "danger trees" or trees that, because of their height and condition, may pose a threat to the adjacent line. About 97 acres would be cleared under a worst-case scenario. Marketable timber from cleared sections would be sold and the remaining slash, branches and treetops would either be left lopped and scattered, piled, or chipped, or would be taken off-site. Burning would not be carried out and there would be no pollutants from wood burning.

The transmission lines themselves cause limited air emissions. The high electric field strength of 500-kV transmission lines causes a breakdown of air at the surface of the conductors called corona. Corona has a popping sound that is most easily heard during rainstorms (see **Noise** Section). When corona occurs, small amounts of ozone and oxides of nitrogen are released. These substances are released in such small quantities that they are generally too small to be measured or to have any significant effect on humans, animals or plants.

Environmental Consequences of the Alternative Action

Air quality impacts would be the same for the alternative that would have more double-circuit line.

Cumulative Impacts

Eastern Washington, including the Spokane area, experiences air quality pollution problems from particulates associated with burning of grass seed fields, dust from farm fields, and wildfires. Studies are currently underway to determine the extent of the problem and what actions can be taken to lessen impacts. The Washington Department of Ecology is implementing restrictions on burning of grass seed fields. To the extent that these restrictions are successful, cumulative impacts at certain times of the year would be less than existing conditions. The proposed action would contribute to prevailing air quality pollution problems on a short-term basis during construction.

Certain manufactured and natural gases absorb and re-radiate infrared radiation preventing heat loss to space. These gases are known as greenhouse gases. An increase in the concentration of greenhouse gases since pre-industrial times is believed by many to be the cause of an apparent warming trend on earth during the last century.

For this project there would be no to low impacts on global warming (see **Global Warming** in the **Environmental Consultation, Review and Permit Requirements** Section).

Mitigation

- Because work in non-attainment areas is anticipated to occur during the worst air quality seasons, water trucks would be used to control dust during construction operations.
- All on-road vehicles would comply with Washington State tailpipe emission standards.
- On-road diesel vehicles will use low sulfur fuel.
- All vehicle engines will be in good operating condition to minimize exhaust emissions.
- Wood debris will be lopped, chipped, and scattered on site to decay (burning would occur only where such debris would create a fire hazard or interfere with transmission line operation and maintenance).

Environmental Consequences of the No Action Alternative

Minor releases of combustion byproducts and fugitive dust associated with maintenance activities for the existing transmission line would continue under the No Action Alternative. No new air quality impacts would be expected.

Cultural Resources

Cultural resources are nonrenewable evidence of human occupation or activity. Historic properties, a subset of cultural resources, consist of any district, site, building, structure, artifact, ruin, object, work of art, architecture, or natural feature important in human history at the national, state, or local level. Several investigations were conducted to determine the existence of any cultural resources in the project area.

Eastern Washington University conducted the first study for BPA in 1994. The study area that was surveyed for the 1994 cultural resources investigation includes the existing corridor and access road system and any surrounding area that could be affected. Resources were divided into prehistoric and historic resources. Thirty-one prehistoric sites, seven historic sites, and two sites of unknown origin were identified.

A second study, an archaeological field survey conducted by the Confederated Tribes of the Colville Reservation, was completed in May 2002. The study area, or Area of Potential Effect (***APE***), for this survey is a 100-foot wide corridor that encompasses the route of the proposed 500-kV line. The 31 sites previously recorded in 1994 were revisited and the information updated as necessary. In addition, an assessment of potential impacts to traditional cultural properties was completed by the Confederated Tribes of the Colville Reservation.

A third archaeological survey that encompassed the expansion area at Bell Substation was conducted by Applied Archaeological Research in May 2002. In addition to documenting the presence or absence of cultural resources, a purpose of the survey was to determine if the project APE was formerly part of a pauper cemetery for the City of Spokane and/or Spokane County in the early 1900s and to assess its potential to contain unmarked human burials.

Additional surveys will be undertaken as needed until project design is complete and all locations of towers and any new roads are known. The Spokane Tribe will also be providing an assessment of potential impacts to traditional cultural properties.

Affected Environment

Prehistoric Resources

The 1994 survey identified 29 prehistoric sites as pits in basalt ***talus***, a site type common in east-central Washington. Often, sites are a number of circular pits, 3 to 7 feet in diameter and 0.7 to 2.0 feet deep, though pits can occur alone, have different forms, and can be larger or smaller than this size range. Native Americans used talus pits for both burial and food storage (cache) activities.

Few recorded talus pits in eastern Washington have been excavated. Human remains were recovered from talus sites (not part of this project) in major eastern Washington river valleys and in the lower Grand Coulee. Nine talus pits at three sites near Creston, Washington (not part of this project) were excavated and no prehistoric cultural resources were found.

Many talus pit sites have been recorded in eastern Washington, but little is known about the origin, contents, and use of the talus pit sites. Depressions in talus are not always made by humans. Conversely, if no human artifacts are found, it does not mean the pits are natural. No reliable criteria exists to separate cultural and natural talus pits if no cultural or natural remains exist.

The other two prehistoric sites identified by the 1994 survey are a campsite and a mound of stones erected as a memorial or landmark, called a ***cairn***.

Seven new archaeological sites were located and recorded in the project area or immediate vicinity during the 2002 survey; five are prehistoric and two are historic. Four of the prehistoric sites are rock features (shelter or cairns); two of these are not within the 500-kV transmission line corridor but are near the 115-kV that would be dismantled. Two of these sites are probably eligible for inclusion in the National Register of Historic Places (***NRHP***), one is probably not eligible, and the other would require further evaluation. The fifth site is a ***lithic*** scatter within the corridor; it would probably not be eligible for inclusion in the NRHP. Ten other locations were recorded as isolated finds, consisting usually of individual prehistoric artifacts or low density scatters of historic artifacts; the isolated finds do not require further management and are not discussed further herein.

In addition, many of the 31 previously recorded sites that were re-examined in 2002 were considered not to be cultural in origin.

Historic Resources

The 1994 survey identified seven historic cultural sites in or next to the corridor. These include BPA's Grand Coulee-Bell Nos. 3 and 4 double-circuit 230-kV line, which is eligible for the National Register of Historic Places. In addition, a past Avista project adversely affected the historic value of Avista's Little Falls View Line and it is no longer eligible for NRHP listing. As mitigation for the impact, the line was recorded to Historic American Engineering Record standards.

Colville Road is likely eligible for listing in the NRHP. Part of Colville Road near Washtucna is eligible for the NRHP; therefore, other segments are likely to be eligible. Colville Road was used from the 1850s to 1881. In 1881, the Northern Pacific railroad to Spokane Falls (Spokane) made the road obsolete. Colville Road does not appear on a 1912 Spokane County atlas. Other roads were used to serve the growing population in the area at that time. An unchanged portion of this historic road is on the south side of the corridor (near corridor mile 66/8). Also, part of a transmission line access road matches the alignment of the Colville Road shown on the 1881 General Land Office map.

Remains of two turn-of-the-century farmsteads were found near the corridor. The first site is a scatter of late 19th-early 20th century domestic and farming artifacts from an apparently burned farmstead near a spring. The second site is a late 19th-early 20th century farmstead with an abandoned house, corral, and well/spring house north and outside the proposed project area. Scattered farming implements from the farmstead extend into the project area. Neither site appears eligible for the NRHP.

Another site includes remnants of the foundation of a small building, a dump that contains domestic artifacts, and some log bridge decking. This site does not appear to be eligible for listing in the NRHP.

A large dump dating from before the 1940s was also found. This site's eligibility has not been evaluated.

The two historic sites identified during the 2002 survey include one that was an historic homestead (old structure, soil depression, and a mound). Further evaluation would be needed to determine NRHP eligibility. The other site consists of debris concentrations; it is probably not eligible.

Six previous archaeological investigations were conducted in the vicinity of the Bell Substation. Two historic-period archaeological resources were recorded within a mile radius of the current project area, but no recorded archaeological sites were located in the project APE. The 2002 survey of the substation expansion area and vicinity resulted in the identification of two historic-period cultural resources. One of the resources (a small concentration of metal, glass, and ceramic artifacts) is outside of the APE and would not be impacted by the project. As a result, it does not require additional investigation or treatment as part of the current project. The other (a small concentration of mostly amethyst-tinted glass vessel fragments) seems to be clearly within the APE, and it would be impacted by construction of the substation expansion. Additional field investigation is currently underway to determine the significance of the historic dump site.
No evidence for historical burials was observed in the surveyed area. Moreover, it was observed that existing transmission lines that include the Bell-Addy No. 1 line and the Bell-Trentwood No. 1 and No. 2 lines border that area. Research showed no record of burials having been found during construction of the towers supporting those lines, which are located along the southern portion of the surveyed area. While the research conducted for this project does not preclude there being burials in the substation expansion area, it has demonstrated the lack of historical documentation for such burials. Based on all of the evidence, it seems highly unlikely that burials are located in the project APE.

Unclassified Resources

Two pit sites found during the 1994 survey may have cultural or natural origins. The first site is a single trench-like pit excavated in silty sediments. The site appears to be of historic or recent age and human origin. The second site is at least four pits in rocky, silty sediments around a seasonally wet, closed scabland depression in an area of aspens and ponderosa pines. Three pits are the size range of talus pit depressions or the hole left when a tree falls over. The fourth pit is larger than the others. Cultural value of these sites is unknown.

Environmental Consequences

Transmission line construction and access road widening can damage or destroy cultural resources. Visual, audible, or atmospheric elements that alter the character or setting of a NRHP eligible historic site are forms of disturbance, as are direct physical impacts to site integrity. Increased access to cultural resources due to project construction, operation and maintenance can increase vandalism.

NRHP status of each site that has the potential for eligibility has not been determined at this time. As more information about NRHP status is available, it will be included. Most information about site eligibility will be unavailable until the NRHP process is complete (see Chapter 4, **Heritage Conservation**). Because of the nature of an NRHP listing, if a site is ineligible for inclusion in the NRHP, the project would not affect the site no matter what type of physical or other impact may occur.

In the meantime, to provide information about potential impacts from the project to cultural resources, BPA developed impact ratings. The ratings are based on a site's proximity to the corridor and area of disturbance. The impact ratings do not consider NRHP status.

Impact Definitions

A **high** impact would occur if a site is within an access road widening or a tower site -- either the site of an existing wood pole that would be removed or of a new tower. Direct physical disturbance of the site is certain unless adequate avoidance measures are taken.

A **moderate** impact would occur if a site is within 100 feet of the tower disturbance area or if the site is down slope of an access road or new tower site. Direct physical disturbance is possible.

A **low** impact would occur if the 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 highly unlikely. Indirect forms of disturbance could occur.

Impacts

Sites Surveyed in 1994

Thirty-one prehistoric sites, seven historic sites, and two sites of unknown origin were identified. Unless the sites can be avoided by construction activity, potential impacts for Colville Road, twelve talus pits, two pit sites, a dump, and a campsite were rated as high due to their proximity to the corridor. Potential impacts for another nine talus pits were rated as moderate. Potential impacts to the remaining fourteen sites were rated as low.

If Colville Road is eligible for listing in the NRHP, then the project would affect Colville Road because it would probably be disturbed by construction.

Talus pit sites are particularly sensitive because they may contain human burials. These sites should be avoided if possible. If they cannot be avoided and are eligible for NRHP status, appropriate mitigation would be done.

The Grand Coulee-Bell Nos. 3 and 4 double-circuit 230-kV line would not be impacted by the proposed project because, though it is eligible for NRHP, it lies to the north of the proposed line and would not be disturbed by construction.

Several other prehistoric and historic sites are located in the project area but would not be impacted because they are far from areas of potential construction. For sites that become eligible for inclusion in the NRHP, ongoing maintenance of the existing transmission lines may affect the sites.

2002 Surveys

Potential impacts to sites identified during the 2002 survey of the corridor would range from high to low. The historic debris concentration, one of the rock features, and the lithic scatter are within the corridor and proximal to either tower sites or access roads; potential impacts would be high unless the sites can be avoided. Moderate impacts are possible for two of the sites with rock features. Both of these are well outside of the alignment for the 500-kV line but are near the 115-kV line that would be dismantled. Low impacts would be expected for the probable old homestead site (not proximal to a tower site or construction activity) and one of the sites with rock features (outside of the right-of-way).

Of the 31 sites from the 1994 survey that were revisited in 2002, it was thought that only four should require further attention. Many of the previously recorded talus pits appeared to field archaeologists to be of natural origin rather than created as a result of cultural activities. One of the sites was identified as requiring further attention; it consists of numerous rock features atop a series of basalt outcrops. Several existing power line towers are anchored into the basalt outcrops, but do not impact the rock features. The proposed 500-kV line would be constructed through this outcrop area, and measures would be taken to avoid adversely impacting the features.

The resource within the project APE for the Bell Substation would experience high potential impacts due to construction of the substation expansion. Additional field investigation is in progress to assess the historical importance of that resource.

Traditional Cultural Properties

Traditional cultural properties (TCPs) are places important to tribes in the preservation and continuation of the community's traditional lifestyle. TCPs can be, but are not limited to, religious areas, sacred areas, resource gathering areas (plant, animal, fish, and mineral), places associated with stories and legends, archaeological and ethnographic sites, habitation sites, camp sites, rock art locations, special use sites, trails, and places with Indian names.

Historic, ethnographic and archaeological properties can be TCPs. The Colville Confederated Tribe (CCT) has a long history of cooperative relationships with anthropologists. The CCT actively plays a managerial, administrative, and/or technical role in anthropological studies associated with its constituents, and has for over 70 years. Prehistoric, ethnographic and historic properties must be evaluated for significance in light of their traditional value in conjunction with their scientific value. Archaeological and ethnographic studies are significant because they help preserve and perpetuate traditional knowledge and culture. Studies provide historical and heritage information. Cultural traditions are pertinent to the management of natural and cultural resources.

Four of the recorded archaeological sites were assessed by the CCT to have traditional cultural property values. Three of the four sites are considered to have archaeological significance; i.e., they would likely be eligible for listing on the NRHP. All of the sites are considered to have traditional significance and sacred significance; they are eligible for tribal registry.

These four sites include rock features. Included among these features are small rings of stone and stone cairns. Cairns are small piles of rocks that archaeologists understand may have multiple functions associated with them. It is believed that cairns may be associated with "Vision Quest" sites. Such sites have meaning, value, and cultural function beyond their scientific value.

As a result of the TCP studies for the proposed project, it is recommended that all of these sites should be avoided and that no project-related activities should occur near the sites. Further, for one of sites facing eastward through Grand Coulee and up the Columbia River, it is recommended that the CCT Tribal Historic Preservation Officer be consulted if any of the new towers would intrude on the viewshed east of the site.

Environmental Consequences of the Alternative Action

Constructing double-circuit towers between corridor mile 75/2 and Bell Substation would result in impacts on cultural resources that are essentially the same as for the Proposed Action. Tower locations and access road improvements would be the same for both alternatives.

Cumulative Impacts

The existing transmission lines and access roads have been in the corridor for about 50 years. Since the lines and roads were built, the roads have been used for maintaining the lines and by the private landowner. Some public use of access roads has also occurred on roads where the landowner has not installed a gate to limit access. Some road segments cannot be used because culverts have washed out, or bridges are too decayed for safe vehicular use. This has limited access to the corridor and any cultural sites on or near the corridor. The construction alternatives would improve access to sites and could increase the potential for impact to them, where public access is available. There are no other known projects or activities that are planned that would combine with project impacts to create more substantial cumulative impacts.

Mitigation

Sites would be avoided where practical. Avoidance would include positioning tower sites to span cultural resources or to separate the towers from cultural resources. The existing access road system would be used to the extent possible to reduce the need for new access roads. New access roads would be located to avoid cultural resources. If improvements are needed on existing access roads, such improvements would be limited to the existing roadbed if near a cultural resource site. Dismantling activities for the portion of the Grand Coulee-Bell No. 1 line that would be abandoned in the Grand Coulee area should avoid cultural resource sites that have been identified.

If a site is eligible for NRHP listing and cannot be avoided, mitigation would be carried out. Mitigation would include data recovery (including excavation) and documentation. Other mitigation would be determined in the NRHP process. Mitigation would be designed on a site-by-site basis once all NRHP sites are assessed.

The CCT Tribal Historic Preservation Officer should be consulted if any of the new towers would intrude on the viewshed east of a site in the Grand Coulee area.

Possible mitigation for Colville Road includes photographic and archival documentation, and avoiding the unaltered segment of the Colville Road next to the south side of the project area.

If cultural resources, either archaeological or historical materials, are discovered during construction activities, ground-disturbing activities would be halted in the vicinity of the find and appropriate BPA personnel would be notified immediately by the construction contractor to assure proper handling of the discovery by a qualified archaeologist.

Environmental Consequences of the No Action Alternative

Potential impacts associated with the ongoing operations and maintenance activities for the existing transmission line, substations, right-of-way, and accesses roads would continue under the No Action Alternative. No new cultural resource impacts would be expected.

Socioeconomics

Affected Environment

Demographics

The four counties crossed by the corridor have a population of about 541,300, which is about 9 percent of the state's population (numbers used in the section and accompanying tables have been rounded). Spokane County–designated as a metropolitan statistical area (MSA)–has nearly 80 percent of the population of the four counties and includes the City of Spokane, population about 195,700. Lincoln County has the smallest population (10,200) with the slowest growth rate in population between 1990 and 2001 (See Table 3-7.)

Table 3-7. Population Trends across Douglas, Grant, Lincoln, and Spokane Counties

County	1980	1990	2000	2001
Douglas County	22,144	26,205	32,603	32,800
Grant County	48,522	54,758	74,698	75,900
Lincoln County	9,604	8,864	10,184	10,200
Spokane County	341,835	361,364	417,939	422,400
Total, Four Counties	422,105	451,191	535,424	541,300
Percent Change	na	6.9%	18.7%	1.1%
Percent of Total State Population	10.2%	9.3%	9.1%	9.1%
State of Washington	4,132,156	4,866,692	5,894,121	5,974,900
Percent Change	na	17.8%	21.1%	1.4%

Note: na is not applicable
Sources: U.S. Bureau of Census; Washington State Office of Financial Management

Between 1990 and 2000, the counties as a group grew at a rate of about 19 percent, slightly slower than Washington State's overall growth rate of 21 percent. In contrast to the previous decade, much of the growth during the 1990s was due to people moving into the area; about 63 percent of the population gain in both the four county region and the State were from net in-migration.

Between 2000 and 2001, population in the four-county area increased at a much reduced rate of 1.1 percent, compared to the State at 1.4 percent. Natural population increase was slightly more than half of the population gain in the area, whereas net in-migration was responsible for about 57 percent of the State's total population increase.

Economic Characteristics

Tables 3-8 and 3-9 present employment by sector in the four counties traversed by the corridor. For the three rural counties of Douglas, Grant, and Lincoln, farming is the principal economic sector, with more than one in five workers employed in agricultural production. This four-county area is one of Washington State's most important agricultural regions. According to the most recent (1997) agricultural census, the region has about one-fourth of state's agricultural land base and the market value of agricultural products sold in the region totaled $1.1 billion. The regional agricultural economy is relatively diversified with leading commodities of wheat, barley, corn for grain, oats, dry edible beans, hay, potatoes, vegetables, fruit, cattle and calves, pigs and hogs, and sheep. Each of these counties is top-ranked among all United States counties in a number of agricultural commodities. For example, Grant leads all counties in the production of potatoes and sweet corn. (For apples and green peas, Grant ranks second among all counties.) Lincoln ranks second and third among all counties in wheat and barley respectively.

Unlike the other counties, Lincoln County's leading employment sector is government, mostly local government. Although over 93 percent of the county's total land is farmland, total farm employment (both proprietors and wage & salaried workers) represents 22 percent of the county's labor force, whereas government sector employs about 26 percent. However, about 40 percent of Lincoln County's total 1997 value of production comes from agriculture and agriculture-related activities.

In Spokane County, the services sector is the largest employer, with 32 percent of the county's total employment. The services sector is highly diverse ranging from personal and business services, hotels and lodging, automobile and miscellaneous repair services, amusement and recreation services, and hospitals and health services to legal; educational and social services; museums and art galleries; membership organizations; and engineering, accounting, research and management services. In addition, Spokane County has been a regional center to forestry, agriculture, and mining industries. Although these industries are still relatively important to the economy, the local economic base has expanded as high-technology companies have moved into the area.

Income Characteristics

One of the economic measures used in comparing geographic areas is per capita income. Per capita income is an estimate of total personal income divided by the area's total population. Total personal income is composed of labor earnings (proprietor income and wages & salaries); dividends, interest, and rent; and transfer payments.

Table 3-8. Full and Part-time Employment in Douglas, Grant, Lincoln, and Spokane Counties, 2000 (number of workers)

	Douglas County	*Grant County*	*Lincoln County*	*Spokane County*	*Four-County Region*	*Washington State*
Total full-time & part-time employment	11,270	38,573	5,108	250,334	305,285	3,560,164
Wage & salary employment	9,039	30,947	3,185	207,979	251,150	2,938,765
Proprietors' employment	2,231	7,626	1,923	42,355	54,135	621,399
Farm proprietors' employment	1,133	2,366	860	2,124	6,483	38,711
Nonfarm proprietors' employment	1,098	5,260	1,063	40,231	47,652	582,688
Farm employment	2,636	6,603	1,136	2,419	12,794	79,886
Nonfarm employment	8,634	31,970	3,972	247,915	292,491	3,480,278
Private employment	6,608	25,212	2,669	211,960	246,449	2,933,709
Ag. services, forestry & fishing	793	1,890	184	2,555	5,422	64,508
Mining	7	58	7	313	385	5,664
Construction	527	1,403	189	15,249	17,368	216,748
Manufacturing	154	4,913	91	23,591	28,749	371,436
Transportation & public utilities	408	1,426	107	9,920	11,861	167,892
Wholesale trade	371	1,512	280	14,227	16,390	168,912
Retail trade	2,088	5,395	614	44,678	52,775	594,402
Finance, insurance, & real estate	359	1,539	342	21,212	23,452	272,353
Services	1,901	7,076	855	80,215	90,047	1,071,794
Government & govt. enterprises	2,026	6,758	1,303	35,955	46,042	546,569
Federal, civilian	172	342	70	4,490	5,074	69,151
Military	135	270	37	4,852	5,294	72,831
State and local	1,719	6,146	1,196	26,613	35,674	404,587
State	78	760	74	8,989	9,901	132,128
Local	1,641	5,386	1,122	17,624	25,773	272,459

Source: U.S. Bureau of Economic Analysis, Regional Economic Information System.

Table 3-9. Wage and Salary Employment in Douglas, Grant, Lincoln, and Spokane Counties, 2000 (number of workers)

Sector	*Douglas County*	*Grant County*	*Lincoln County*	*Spokane County*	*Four-County Region Total*	*Washington State*
Agriculture, forest & fishing	2,716	6,986	332	1,669	11,703	91,530
Construction & mining	358	800	76	10,493	11,727	152,790
Manufacturing	136	4,856	73	21,970	27,035	345,830
Transportation & public utilities	327	880	40	7,826	9,073	139,684
Wholesale trade	308	1,332	249	12,760	14,649	150,196
Retail trade	1,799	4,212	365	36,136	42,512	483,740
Finance, insurance & real estate	166	504	143	10,856	11,669	133,937
Services	1,223	4,447	332	56,976	62,978	747,048
Government	1,877	6,353	1,250	30,158	39,638	458,482
Total	8,910	30,370	2,860	188,844	230,984	2,703,237

Source: Washington State Employment Security Department, Labor Market & Economic Analysis Branch.

The composition of personal income, and hence per capita income, varies among the counties and the state (see Table 3-10). For instance, net earnings (proprietor income and wages and salaries) are the dominant portion of personal income for most counties. Lincoln County is an exception, however, with an increased portion of personal income in dividends, interest, and rent and transfer payments. Combined dividends, interest, and rent and transfer payments represent more than 55 percent of Lincoln's total personal income in 2000. For the four-county region, dividends, interest, and rent and transfer payments represent a greater share of total personal income than for the state.

By and large, total personal income and per capita income within the four-county region increased in real terms (i.e., removing the effects of inflation) between 1980 and 2000. Again, the exception is Lincoln County. While dividends, interest, and rent and transfer payments have grown in the county, the combined growth was not enough to offset the sizable decline in net earnings. While Spokane and Douglas counties' total real personal income growth rates were modest between 1980 and 2000 (although at a lower rate than for the state of Washington), Grant County's personal income increased more than five-fold.

In terms of per capita income, Lincoln County's real per capita income declined between 1980 and 2000. In spite of overall growth in real per capita income, all of the four counties had lower per capita incomes than Washington State.

Environmental Justice

Environmental justice, as described by Executive Order 12898 of 1994, requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects on minority or low-income populations. The U.S. Environmental Protection Agency's Office of Environmental Justice defines environmental justice as:

> *"The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal and commercial operations or the execution of federal, state, local and tribal programs and policies"* (US EPA, 1998).

Table 3-10. Income Trends in Region (using 1999 dollars)

County/State	*1980*	*1990*	*1999*
Douglas County			
Total personal income ($000)	$405,160	$474,422	$656,611
Net earnings ($000)	$297,141	$309,042	$404,899
Dividends, interest & rent ($000)	$66,604	$95,533	$137,763
Transfer payments ($000)	$41,415	$69,848	$113,949
Per capita income ($)	$18,297	$18,104	$19,204
Grant County			
Total personal income ($000)	$275,679	$528,231	$1,398,915
Net earnings ($000)	$216,150	$367,492	$851,964
Dividends, interest & rent ($000)	$32,506	$92,576	$270,788
Transfer payments ($000)	$27,023	$68,164	$276,163
Per capita income ($)	$5,682	$9,647	$19,424
Lincoln County			
Total personal income ($000)	$229,828	$191,966	$203,368
Net earnings ($000)	$148,936	$93,619	$90,886
Dividends, interest & rent ($000)	$57,247	$67,889	$68,186
Transfer payments ($000)	$23,645	$30,457	$44,296
Per capita income ($)	$23,930	$21,657	$20,839
Spokane County			
Total personal income ($000)	$6,041,968	$7,396,490	$9,984,505
Net earnings ($000)	$4,182,467	$4,680,001	$6,333,274
Dividends, interest & rent ($000)	$1,043,061	$1,519,904	$1,972,726
Transfer payments ($000)	$816,440	$1,196,584	$1,678,505
Per capita income ($)	$17,675	$20,468	$24,368
Four-county Region			
Total personal income ($000)	$6,952,634	$8,591,109	$12,243,399
Net earnings ($000)	$4,844,694	$5,450,154	$7,681,023
Dividends, interest & rent ($000)	$1,199,418	$1,775,902	$2,449,463
Transfer payments ($000)	$908,522	$1,365,053	$2,112,913
Per capita income ($)	$16,471	$19,041	$22,973
Washington State			
Total personal income ($000)	$83,173,904	$118,706,330	$174,876,529
Net earnings ($000)	$60,486,320	$81,049,067	$122,174,863
Dividends, interest & rent ($000)	$13,718,780	$23,646,675	$32,264,589
Transfer payments ($000)	$8,968,804	$14,010,589	$20,437,077
Per capita income ($)	$20,127	$24,392	$30,380

Low-income is generally defined as a household income at or below the US Department of Health and Human Services poverty guidelines. The guidelines establish poverty thresholds on an annual basis; the poverty threshold for 2001 was $11,559 for a 2-person household in the contiguous United States. However, other thresholds may be used as appropriate. *Low-income population* means any readily identifiable group of low-income persons who live in geographic proximity and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by the Proposed Action, policy or activity.

A *minority population* is considered to be present if the minority population percentage of the affected area is greater than the minority population percentage in the general population or other appropriate unit of geographic analysis (census tracts are generally considered appropriate). Guidance from the US Council on Environmental Quality (CEQ) states that "minority populations should be identified where either (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population percentage in the general population or other appropriate unit of geographic analysis" (CEQ, 1998). *Minority Population* means any readily identifiable groups of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed program, policy or activity.

Disproportionately High and Adverse Effect on Minority and Low-Income Populations means that an adverse effect is predominately borne by a minority population and/or a low-income population and that the effect will be suffered by the minority population and/or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the rest of the population. Adverse effects to environmental justice populations are considered:

- destruction or disruptions of community cohesion;
- destruction or disruptions to access of available public and private facilities and services;
- adverse employment effects;
- displacement of businesses, housing, and people;
- tax and property value losses;
- actions injurious to the public's health (e.g., air, noise and water pollution); and
- actions harmful to the public's well being (e.g., aesthetic impacts and loss of recreational property).

Minority Population

A concentrated minority population is assumed present if the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or the minority population of the affected area exceeds 50 percent of the total population.

Table 3-11 presents the race distribution for the four-county study region and the State of Washington. As a region, the minority population combined is 8.2 percent, less than the state's average of 14.6 percent. Populations of each of the minority groups within the four-county region are lower than the state's average for each group. However, these aggregations mask the minority population levels within individual counties.

Table 3-11. Race Distribution in the Four-County Region and Washington State, 2000

	Douglas County		*Grant County*		*Lincoln County*	
Race	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
One Race	31,794	97.5%	72,451	97.0%	10,020	98.4%
White	27,599	84.7%	57,174	76.5%	9,740	95.6%
Black or African American	101	0.3%	742	1.0%	23	0.2%
American Indian or Alaska Native	355	1.1%	863	1.2%	166	1.6%
Asian	178	0.5%	652	0.9%	25	0.2%
Hawaiian & Other Pacific Islander	31	0.1%	53	0.1%	7	0.1%
Some other race	3,530	10.8%	12,967	17.4%	59	0.6%
Two or more Races	809	2.5%	2,247	3.0%	164	1.6%
Hispanic Origin (of any race)	6,433	19.7%	22,476	30.1%	191	1.9%
Total	32,603	100.0%	74,698	100.0%	10,184	100.0%
	Spokane County		*Four-County Region*		*Washington State*	
Race	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
One Race	406,386	97.2%	520,651	97.2%	5,680,602	96.4%
White	381,934	91.4%	476,447	89.0%	4,821,823	81.8%
Black or African American	6,659	1.6%	7,525	1.4%	190,267	3.2%
American Indian or Alaska Native	5,847	1.4%	7,231	1.4%	93,301	1.6%
Asian	7,870	1.9%	8,725	1.6%	322,335	5.5%
Hawaiian & Other Pacific Islander	666	0.2%	757	0.1%	23,953	0.4%
Some other race	3,410	0.8%	19,966	3.7%	228,923	3.9%
Two or more Races	11,553	2.8%	14,773	2.8%	213,519	3.6%
Hispanic Origin (of any race)	11,561	2.8%	40,661	7.6%	441,509	7.5%
Total	417,939	100.0%	535,424	100.0%	5,894,121	100.0%

Note: Some other race, refers to a "write-in" category in which respondents listed multi-racial, mixed, interracial, Hispanic or Latino. The Census Bureau estimates that 97 percent of respondents who reported as "Some other race" were Hispanic or Latino.
Source: U.S. Census Bureau.

For instance, Grant County's minority population is higher than the state's at 20.5 percent. The census category of "some other race" represents Grant County's largest minority group, with

17.4 percent of the county's total population. "Some other race's" share in Grant County compares with only 3.9 percent for Washington State. Likewise, Grant County's minority with Hispanic origins represents over 30 percent of the county's total population, a share significantly higher than Washington State. Only 6 miles of the project corridor's total 84 miles are located in Grant County, traversing the county's northern-most area in the Grand Coulee City area.

Similarly, Douglas County's minority population of "some other race" and minority with Hispanic origins have a significantly higher share of the total population (10.8 percent and 19.7 percent, respectively) than Washington State. The project's substation lies just inside the Douglas County border; i.e., less than a mile of the project corridor's total 84 miles are located within the county.

Low-Income Population

According to federal guidelines, low-income population within the environmental justice study area is relative to the median household income for Washington State ($50,689 in 2001). Income is typically measured for households with 30% (extremely low-income), 50% (very low-income), and 80% (low-income) of median income.

According to 2001 estimates, the four-county study region has a median household income of $40,552 or 80 percent of the median income according to federal income limits (Table 3-12). With Spokane County's population base representing over three-fourths of the region's population, the regional aggregations of race and median household income largely reflect Spokane County. Median household incomes in Lincoln and Grant Counties (62.2 percent and 67 percent, respectively), however, fall significantly below the 80 percent threshold of Washington State's median household income.

Table 3-12. Median Household Incomes of Study Area and Washington State, 2001

Geographic Area	*2001 Median Household Income*	*Percent of Median*
Douglas County	$40,556	80.01%
Grant County	$33,966	67.01%
Lincoln County	$31,522	62.19%
Spokane County	$41,795	82.45%
Four-County region	$40,552	80.00%
Washington State	$50,689	100.00%

Source: Washington State Office of Financial Management. 2001 Population Trends for Washington State.

Environmental Consequences

Socioeconomic impacts are both short and long term. Short-term impacts include temporary increases in local housing demand and employment, and damage to crops and agricultural land during construction. Long-term impacts include potential impacts to agricultural lands around and under tower bases being taken out of production for the life of the project.

Impact Definitions

A **high** impact would change current socioeconomic conditions and likely create adverse effects that could not be mitigated. High impacts would result from one or more of the following conditions:

- Regional reduction of the quality or quantity of social or economic resources.
- Significant reduction of long-term economic productivity.
- Consumption of significant amounts of non-renewable resources.

A **moderate** impact would change current socioeconomic conditions. However, the effects of these adverse changes could be largely mitigated. Moderate impacts would result from one or more of the following conditions:

- Local reduction of the quality or quantity of social or economic resources.
- Marginal reduction of long-term economic productivity.
- Consumption of moderate amounts of non-renewable resources.

A **low** impact would create a minimal change in current socioeconomic conditions. These effects would not require any mitigation. Low impacts would result from one or more of the following conditions:

- Reduction of the quality or quantity of social or economic resources within the site of the proposed project.
- No reduction in long-term economic productivity.
- Consumption of negligible amounts of non-renewable resources.

Impacts

Housing Availability

During peak construction in the summers of 2003 and 2004, 150 workers would work along various segments of the 84-mile corridor. This number is quite small in the context of the population and employment data presented in Tables 3-7 through 3-9. The construction contractor has indicated they would hire local firms to do the construction work. Power plant construction workers frequently commute up to 60 miles daily to project sites. It is assumed that the commuting pattern of transmission line construction workers would be similar. Therefore, most workers would be local and would commute from their permanent homes, at least for most of the construction period.

However, some workers (personnel and possibly dependents) would require temporary lodging in the local area during construction. Most, if not all, members of the construction team that relocate during construction would leave at the end of the project. It is unlikely that any workers would permanently settle in the project area. Lodging facilities within commuting distance are available to house the low number of non-local construction workers (see Table 3-13). A number of these facilities have kitchen units and could be used for extended stays by contract workers.

Housing rental vacancy rates in each of the four counties are relatively high compared to that of the state. Ranging from a high of 10.7 percent in Grant County to a low of 6.2 percent in Douglas County, the combined housing rental vacancy rate in the four-county region is 8.8 percent (2000 Census). Lincoln County, which would have more miles crossed by the proposed transmission line than the other three counties combined, had a rental vacancy rate of 6.6 percent. This vacancy rate, though lower than that of the combined four-county region, remains higher than the state, which was 5.9 percent (U. S. Bureau of the Census, 2002).

Table 3-13. Lodging Availability in the Project Area

City	*Motels & Inns*	*RV Parks & Campgrounds*	*Rooms*
Grand Coulee Dam Area	8	4	180
Wilbur	2	2	20
Davenport	3	1	25
Spokane	74	2	6,250*
Total	87	9	6,475*

* Estimated
Source: Yellow Pages directory, various cities; Spokane Area Visitors & Convention Bureau.

Because construction workers can be housed and they would not place an undue burden on communities in the area, the level of impacts is considered low.

Employment and Income

The proposed project would stimulate the regional economy during construction through material purchases in the region, payroll, and related indirect and induced spending, or "***multiplier effects***." These economic benefits would occur for a limited time during construction.

Purchases of local supplies and materials and other spending by construction workers would create positive economic impacts. Total project costs have been estimated at $152 million (2002 dollars) for the Agency Proposed Action. An estimated 5 to 10 percent of total project costs ($7 to 15 million) would involve local purchases of fuel, vehicle parts and other goods and services in the four counties. Income earned by construction workers would be about $17 million. Non-local workers spend an estimated 40 percent of their net pay locally. If 50 members of the construction crew temporarily relocate into the project area, local spending by both local and non-local construction workers would amount to about $14.6 million during the 18-month construction period; this is 0.12 percent of the four-county personal income level in 1999. Both material purchases and salary would have additional indirect effects that would create added short-term income.

These impacts are small relative to the amount of economic activity in the four counties (see Tables 3-8 through 3-10), and are short term by nature. Therefore, the level of impacts of these additional expenditures on overall regional economic activity, while positive, would be low.

After construction, the new transmission line would not increase economic activity in any of the four counties. However, the 500-kV transmission line may contribute to regional economic growth by meeting increased power demands. This is a potential long-term positive impact.

Agricultural Practices, Productivity, and Revenues

The primary crops cultivated in the corridor are wheat, barley, oats, and hay (alfalfa and other). The dollar values and yields of these crops are based on Washington State Department of Agriculture statistics for Lincoln County in 2001, which is the most recent information available.

The economic value of a temporary loss of agricultural crops was calculated based on a worst-case scenario: a 150-foot wide, 42-mile long section of agricultural land taken out of production for one growing season (it is probable that the impact would be spread over two growing seasons and involve a smaller portion of the corridor). A maximum of 765 acres would be temporarily removed from production. Consequently, estimated losses could reach $115,000 assuming a weighted average of crop values of $150 per acre, based on general productivity characteristics of agricultural land in Lincoln County. Actual losses, however, would be much less since, in most cases, only the area surrounding the tower site (about 0.5 acre) and the temporary access road leading to the site would be taken out of production.

About 12 acres of agricultural land would be permanently lost because of land required for the new towers, assuming each tower occupies an area of 50 feet by 50 feet. However, approximately 8.7 acres would be reclaimed for production from the removal of the wood-pole structures of the 115-kV line being replaced, creating a net loss of about 3.3 acres. Therefore, the anticipated net long-term loss of agricultural revenue from the project is estimated at approximately $495 per growing season, assuming the weighted average of crop values in Lincoln County of $150 per acre.

Farmers would be compensated for crop losses during construction. The amount of acreage permanently taken out of production is considered negligible. The level of impacts would be low.

Property Taxes

The construction of this project would not affect the amount of property taxes collected by the counties crossed by the proposed transmission line.

Sales Taxes

States cannot tax direct purchases by the Federal government; however, Washington would tax local purchases by government contractors building the line (Excise Tax Bulletin 316.08.193 and WAC 458-20-17001). Contractors would also be taxed on all local purchases of goods while in Washington, unless those individuals' permanent residences are within states or other political jurisdictions that are exempt from paying a local sales or "use tax" within the state. State sales tax in Washington is 6.5 percent. Each local jurisdiction also has a local sales tax which, when combined with the state sales tax, could be 7.6 to 8.1 percent in the project area (Washington Department of Revenue, 2002).

With the exception of local purchases of crushed rock for access road widening, and other minor purchases such as fuel and replacement tools, little else is expected to be purchased by the contractor. Tower steel, conductors, insulators and steel grills for footings would be supplied by BPA and would not be taxed. Any tax revenue received, however, would be a positive impact.

Nuisance, Trespassing, and Vandalism

Local residents with land crossed by the corridor could have their land use restricted by construction and periodic maintenance activities. Maintenance of the transmission line requires periodic inspection and occasional action by maintenance crews. Landowners are contacted prior to crew entry. However, crops may sometimes be damaged by vehicles used for maintenance, particularly for emergencies. Moreover, in select areas, crop production may be damaged by the spread of noxious weeds.

Access roads could be used by unauthorized motorists and hunters who could be a nuisance to farmers and other landowners. However, because most of the corridor is remote, potential impacts from trespassing and vandalism would be low.

Property Impacts

Some short-term adverse impacts on property value and saleability may occur on an individual basis. However, these impacts are highly variable, individualized, and unpredictable. The project is not expected to cause overall long-term adverse effects on property values along the existing right-of-way. Project impacts along with numerous general market factors are already reflected in the market value of properties along the existing right-of-way in the proposed project area. Project impacts associated with new transmission line or access road easements would be offset. Land needed for easements would be appraised and landowners would be offered fair market value for these land rights.

Restrictions on use (i.e., RV parking) in the commercial area between corridor mile 83/4 and 83/6 could result in adverse economic impacts for the proprietor. The extent of such impacts is not known.

Environmental Justice

The median income of residents at the four-county region, the site affected by the Proposed Action, does not meet the income threshold for poverty status (Table 3-12). In addition, the 8.2 percent minority population in the four-county study region (Table 3-11) does not surpass the minority threshold (50 percent) established as an indicator for whether a minority population affected by a proposal is meaningfully greater than that represented within the State as a whole. Therefore, the BPA Grand Coulee-Bell Transmission Line Project would not affect a proportionally high percentage of low-income and minority residents currently residing within the four-county region.

Within the four-county aggregation, however, there are individual counties that surpass either the minority and/or income thresholds. Douglas and Grant Counties exceed the minority population thresholds for "some other race" and minority with Hispanic origins, while Grant and Lincoln Counties' median household income falls below the 80 percent threshold of the state's median household income. Given the limited extent of the corridor in Douglas and Grant counties and corridor's passage through sparsely populated privately owned lands in Lincoln County, the BPA Grand Coulee-Bell Transmission Line Project would still not affect a proportionally high percentage of low-income and minority residents. In addition, even if disproportionate impacts were to occur, they would be limited to visual resource impacts. Such impacts would be no more than moderate.

Environmental Consequences of the Alternative Action

The alternative to the proposed action would result in impacts that are comparable to the proposed action.

Cumulative Impacts

Lincoln County has a total of about 876,000 cultivated acres. The acreage temporarily taken out of agricultural production (765 acres), compared to the amount in production, would be negligible. In addition, there was a reduction of about 125,000 acres of cultivated land between

1992 and the present; the project's impact is negligible compared to this. However, there is not expected to be further significant decreases in the cultivated land base because additional participation in federal crop reduction programs has decreased substantially.

Cumulative socioeconomic impacts account for those effects related to other forecasted or anticipated projects slated for the affected region. Generally, these anticipated projects are expected to represent a net addition to the four-county region's socioeconomic base.

Although statewide economic and demographic forecasts are regularly updated, local area economic and demographic forecasts are generally non-existent. Local population forecasts are updated every five years by the Washington State Office of Financial Management (OFM), with the most recent in 2002. The latest OFM forecast indicates that population within the affected region is expected to grow slightly slower than the state – an average of 6.1 percent versus 6.2 percent over the next 25 years (Washington State Office of Financial Management, 2002). Projected net in-migration, a significant measure of economic activity[1], is expected to be slower within the four-county region compared to the statewide average. Implied within this forecast is that anticipated economic activity during the next 25 years will not be a significant departure from trend-line growth. Within such a context of cumulative socioeconomic effects, the proposed project accounts for a negligible portion of the total.

Other than the normal economic growth in the Spokane area inferred above, there are no other known plans or proposed projects in the area that would result in adverse cumulative socioeconomic impacts. Project employment and income impacts would represent a very small fraction of regional employment and income levels now and in the future.

Mitigation

The following mitigation will reduce potentially adverse socioeconomic effects created by the project:

- BPA will compensate landowners at fair market value for any new land rights required for easements for new right-of-way or to construct new, temporary or permanent access roads.
- Farmers will be compensated by BPA for crop damage. Soil compaction will be corrected or landowners will be compensated.
- BPA engineers will work with farmers to site towers to maintain efficient crop patterns and minimize adverse impacts to farming activities.

[1] Net in-migration is strongly correlated with employment change within an area. Generally, population change lags behind employment change.

- BPA will compensate landowners for any danger trees that will need to be removed outside the existing right-of-way based on their stumpage value.

Environmental Consequences of the No Action Alternative

Potential beneficial (e.g., income and employment) and adverse socioeconomic impacts associated with construction and operation of the proposed project would not occur under the No Action Alternative. No Action could result in other adverse socioeconomic impacts, however. Reduced capacity and reliability under No Action could lead to higher energy costs for industry and consumers. This would tend to lower productivity and efficiency for industries and areas that are affected, making them less competitive with other industries and areas. The consequences of this would be lower employment and income levels than would otherwise be the case, reduced levels of economic activity, and reduced governmental tax revenues and the services they support.

The quality and reliability of electrical power has been a key to economic growth and improving industrial productivity levels. With structural economic change, particularly with the new digital economy, power quality and reliability requirements have increased markedly. [For instance, the "old industrial economy" used less sophisticated electro-mechanical devices that were sensitive to long outages, but not sensitive to voltage sags. New digital economy equipment and processes are very sensitive to voltage sags.] To the extent that transmission capacity deficiencies reduce power reliability and quality, regional businesses and industries would be affected by costly process disruptions.

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Geology and Soils

Affected Environment

Geology

The 84-mile corridor for the proposed transmission line is within the northern boundary of the Columbia River Plateau. The Columbia River plateau is a broad rolling basalt plateau that slopes gently to the southwest and covers approximately 63,000 square miles throughout Washington, Oregon, and Idaho. Topography is gently rolling to moderately hilly with elevations generally ranging from 985 to 1,970 feet above mean sea level. Landforms found within the project corridor and vicinity include uplands covered by ***loess*** (wind-deposited sediment), channeled ***scablands***, canyons, and river terraces.

The geology of the Columbia River plateau is dominated by the Columbia River Basalt formation. This huge basalt layer, ranging in thickness from about 2,000 to over 4,900 feet was formed from vast outpouring of lavas during the Miocene epoch (28-12 million years ago) and Pliocene epoch (12-1.5 million years ago). Younger geologic deposits consisting mainly of loess deposited in the Pleistocene epoch (1.5 million to 11,000 years ago) cover the basalt over most of the corridor.

Channeled scablands are unique geologic features that are found primarily within the western half of the corridor and within scattered areas in the eastern half of the corridor. These areas consist of numerous dry, deeply cut channels in Columbia River basalt and typically contain shallow, stony soils. The channeled scablands are thought to have formed during the Pleistocene epoch when a natural dam containing glacial Lake Missoula (located in now western Montana) failed and catastrophic floods moved south across the Columbia Plateau, taking away most of the layer of loess, creating present drainages and exposing wide stretches of basalt (Franklin and Dyrness 1988).

An east-to-west trending ridge spans most of the project area, creating two separate drainages. Streams on the north side of the ridge flow to the north into the Columbia or Spokane rivers. These drainages are located in steep canyons that cross the corridor east of the City of Creston and include Spring, Welsh, Hawk, Stock, Saben, Squaw, Coulee, and Deep creeks. Drainage south of the ridge follows broad, shallow scabland channels from northeast to southwest before eventually reaching Crab Creek and the Columbia River.

Soils

Soils along the project corridor have formed primarily in loess, ***glacial outwash***, ***colluvium***, ***alluvium***, and weathered granite. Four general categories of soils occur within the corridor.

Deep Silt Loam Soils

These soils developed on rolling, loess-covered uplands. Soils are used mostly for non-irrigated cropland. Water erosion is a concern on disturbed sites with steep slopes. Figure 3-35 shows the low, medium, and high erosion potential given the slope and soil type present.

Shallow Rocky Soils

Exposed bedrock covers much of the surface within the scablands. Soils have formed in glacial sands and gravels left by the Pleistocene floods and are covered with a thin loess layer. Soils are shallow and rocky, supporting open range for cattle grazing. On the scabland plateaus, the land is broken by circular mounds of loess surrounded by basalt cobbles.

Deep Sandy Soils

These soils developed in sandy glacial outwash deposits near Bell Substation and on terraces along the Spokane and Columbia rivers and Coulee Creek. Some soils have been reworked and are shaped like dunes. Soils support open range, woodland grazing, or are used for urban development. Soils are subject to erosion when disturbed on steep slopes.

Soils in Deep Canyons

Soils in deep canyons formed in a mix of loess and colluvium from basalt or in weathered granite and overlying loess. These soils are well drained and support open range or woodland grazing. In some places, rock outcrops are over 50 feet high. Steep slopes increase the risk of erosion of these soils.

Environmental Consequences

Construction and maintenance of transmission lines can impact earth resources in many ways. Disturbance of the ground surface and subsurface, removal of vegetation during site and corridor clearing, access road widening, and structure site preparation increase the risk of soil erosion and ***mass movement***, and may change soil productivity and physical characteristics. Areas most vulnerable include soils prone to erosion, mass movement, or compaction; steep slopes; and areas where extensive access road work and clearing are required. The ***erosion susceptibility*** of soils along the corridor was used to address impacts on soils due to construction activities. Wherever practical, such problem areas are avoided.

Sediment introduced into surface waters is a concern where loess-covered upland soils and soils in steep canyons would be disturbed. Sediment yield for loess-covered upland soils is estimated at about 0.2-0.5 acre-feet/square mile/year. Sediment yields in channeled scablands are much lower, decreasing by a factor of 10 (Pacific Northwest River Basins Commission, 1970).

GRAND COULEE - BELL 500kV TRANSMISSION LINE PROJECT

SOIL EROSION SUSCEPTIBILITY

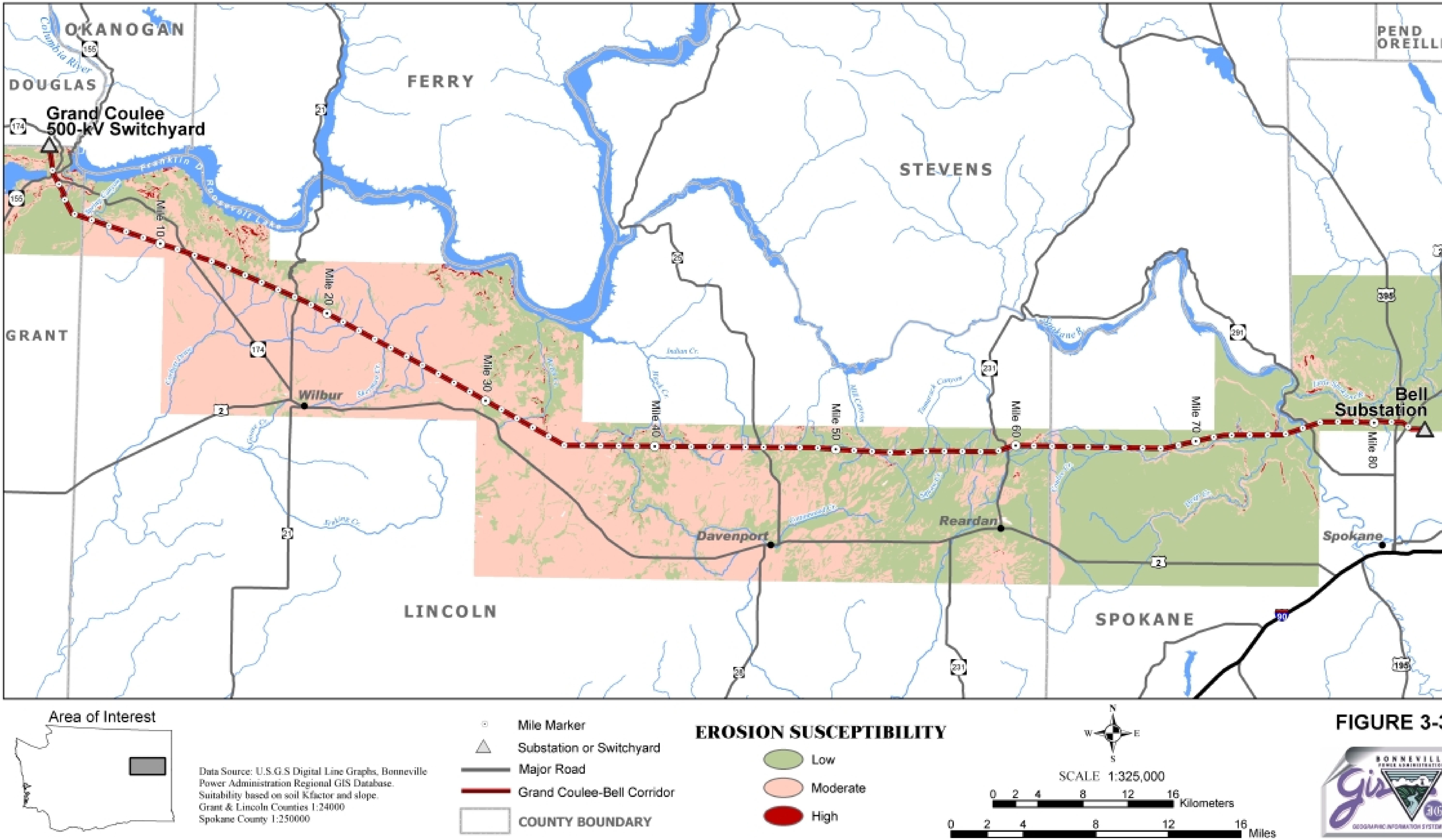

FIGURE 3-35

Most impacts would be from construction and would be short term. Impacts would be greatest during and immediately after construction until revegetation, drainage, and erosion controls are established. Long-term impacts could be caused by local changes in erosion and runoff rates from road and transmission line construction and clearing. Site restoration and mitigation would reduce both short- and long-term impacts and the effect erosion, sedimentation, and soil compaction could have on other resources such as land use, water, wetlands, vegetation, and fish.

Impact Definitions

A **high** impact would occur under the following circumstances:

- Road or facility construction and/or clearing are required on sites prone to mass movement or erosion and mitigation cannot provide full compensation.
- Soil properties or site features are so unfavorable or difficult that mitigation cannot provide full compensation.
- Project activities cause accelerated erosion, sedimentation, or slides that create long-term impacts and mitigation cannot provide full compensation.

A **moderate** impact would occur under the following circumstances:

- Road or facility construction and/or clearing takes place on soils with a moderate to high erosion potential; and mitigation could provide partial compensation.
- Soil properties and site features are such that mitigation could provide partial compensation.
- Project activities cause accelerated erosion, sedimentation, or slides that create short-term impacts and mitigation could provide partial compensation

A **low** impact would occur under the following circumstances:

- Road and facility construction and clearing takes place on soils with a low to moderate erosion hazard, mitigation could provide full compensation.
- Soil properties and site features are such that mitigation could provide full compensation.
- Project activities would not cause accelerated erosion, sedimentation, or slides that create short-term impacts and mitigation could provide full compensation.

Impacts

Towers and Related Construction

Removal of existing wooden structures would result in direct and indirect impacts to soils. Direct impacts could result from excavation, removal of vegetation or soil compaction during the access to and removal of the existing wooden structures. Typically, existing wooden structures would be excavated or cut off 2 feet below ground level and holes backfilled with native material. Typically, a 6-foot radius area would be excavated around each wood pole structure for removal. The total area disturbed for the removal of existing wood pole structures is estimated to be up to about 17 acres, with about one-half of this in soils with low erosion susceptibility. However, wood pole structures located in areas with high erosion susceptibility would be cut off at ground level. The wood poles in these locations would be dragged out or lifted out by crane to avoid bringing in construction equipment that would disturb soils. Indirect impacts could occur if vegetation was crushed to the extent that wind erosion increased. The impact level resulting from the removal of existing wooden structures would be low to moderate.

Construction areas around towers would result in direct and indirect impacts to about 210 acres of soil, with about one half in soils with low erosion susceptibility. Direct impacts would result from disturbance of soils during vegetation removal and grading. Indirect impacts would result from possible increased wind erosion.

From corridor mile 28/1 to 42/5, the corridor predominately crosses broad areas of channeled scablands, which are nearly level with rocky, shallow soils. These impacts would be low, except where the corridor crosses several important drainages. Areas of concern are the Welsh Creek drainage (corridor mile 32/8 to 32/9) and the deeply incised canyons of Hawk (38/8 to 39/5) and Stock (42/4 to 43/4) creeks. A combination of steep slopes, moderately to highly erosive soils, and clearing requirements near these areas could cause short-term increased runoff and erosion. The impact level would be moderate from construction areas near Welsh, Hawk, and Stock creeks.

The corridor crosses Saben and Squaw creeks between corridor mile 52/1 and 54/7. Slopes exceed 30 percent and are covered by talus from basalt cliffs at the top of the canyons. Construction areas could cause short-term increased runoff and erosion. The impact level would be moderate from construction areas near Saben and Squaw creeks.

Much of the corridor from corridor mile 66/4 to near Springhill Substation (corridor mile 74/5) is on relatively level, shallow, rocky scabland soils. Impacts would be low along most of this section. However, soils with moderate to high erosion potential on the side-slopes above Coulee Creek (corridor mile 72/1 to 74/1) could cause short-term increased runoff and erosion. In these areas impacts would be moderate, with soil disturbance from construction activities increasing runoff and temporary erosion rates.

From corridor mile 74/1 to Bell Substation concern for impacts would be low except where clearing is needed on slopes exceeding 15 percent. Potential for clearing on sensitive areas include: in the Coulee Creek – Deep Creek area (corridor mile 75/7 to 76/1); near the Spokane River crossing (corridor mile 75/7 to 76/7); and below Burnett Road (corridor mile 80/3 to 80/6). Clearing would increase runoff and erosion. The impacts level would be moderate due to construction areas in these areas.

Construction of new towers would result in direct and indirect impacts to 24 acres of soils, with about one half in soils with low erosion susceptibility. Direct impacts would result from disturbance of soils during vegetation removal and grading. Indirect impacts would result from possible increased wind erosion. Towers would not be placed on steep slopes and related high erosion susceptible soils; therefore, the impact level would be low to moderate for construction of new towers.

Conductor tensioning sites and staging areas would result in direct and indirect impacts to 42 acres of soils, with about one half in soils with low erosion susceptibility. Heavy equipment and increased vehicular traffic during construction and line removal may compact soils, thereby affecting soil productivity, reducing infiltration capacity, and increasing runoff and erosion. It is expected that ***subsoiling***, normal farming, cultivation, cropping, and freeze-thaw cycles would restore the soil to its pre-construction conditions (Moe, et al., 1971). Impacts to soils at conductor tensioning sites and staging areas in these areas are expected to be low to moderate.

Road Construction

Construction of new access roads would have direct and indirect impacts to 15.6 acres of soils as a result in construction of approximately 8 miles of new access roads. Direct impacts would result from soil disturbance during excavation and grading. Indirect impacts would result from vegetation removal increasing erosion. New access roads would be created in locations where the existing access roads pass beneath transmission line towers that do not provide adequate clearance for tower construction vehicles. Access roads would also be relocated in a few sites where the new proposed tower locations are within, or close to, the existing access roads. In some locations, sections of access road would be constructed to ensure that the road remained within the corridor. No permanent roads would be constructed in cultivated areas. Only temporary access on farmlands is needed. Impacts would be low and short term, causing temporary local increases in erosion and sedimentation during, and for a brief time after, construction. Construction of new access roads would likely avoid areas of high erosion susceptibility. Therefore, the impact level would be low to moderate from construction of new access roads.

Construction of temporary spur roads would have direct and indirect impacts to 12.6 acres of soil as a result in construction of approximately 6.3 miles of spur roads. Direct impacts would result from soil disturbance during excavation, and grading. Indirect impacts would result from vegetation removal increasing erosion. Construction of new access roads would likely avoid areas of high erosion susceptibility. Therefore, the impact level would be low to moderate from construction of new access roads.

Improvements to existing access roads would have direct and indirect impacts to 52.5 acres of soils as a result in improvements to about 27 miles of existing roads. Direct impacts would result from soil disturbance during excavation, and grading. Indirect impacts would result from vegetation removal increasing erosion. In order to provide for safe passage of cranes, excavators, supply trucks, boom trucks, log trucks, and line trucks needed for construction and maintenance of the transmission line, some portions of existing access roads would be improved by grading, improving drainage, and adding gravel to the road surface.

The corridor from the Grand Coulee Switchyard to Spring Creek Canyon (corridor mile 6/2) has shallow, rocky soils and rock outcrops. No ground disturbance would occur on the steep canyon walls and cliffs above Grand Coulee. Since most disturbances would be limited to level or gently sloping scabland areas, impacts would be low and would cause slight increases in runoff, erosion, and small quantities of sediment moved off site. The impact level resulting from existing road improvements in this area would be low.

Uncultivated land with shallow, rocky soils occurs between corridor mile 13/6 and 19/3. Slopes tend to be less than 15 percent and soils have a low to moderate erosion susceptibility. Existing roads would be upgraded. Increased erosion and off-site movement of sediment would be greatest during and shortly after construction. The impact level would be low to moderate due to existing road improvements in this area.

The corridor crosses Saben and Squaw creeks, tributaries to Mill Creek, between corridor mile 52/1 and 54/7. Granite outcrops are exposed in access road cuts within Squaw Canyon. Soils have a moderate to high erosion susceptibility. The impact level resulting from existing road improvements in this area would be moderate to high.

Much of the corridor from corridor mile 66/4 to near Springhill Substation (corridor mile 74/5) is on nearly level, shallow, rocky scabland soils. The potential for impacts would be low along most of this section. There is concern about impacts where access road widening would occur on soils with moderate to high erosion susceptibility on the side-slopes above Coulee Creek (corridor mile 72/1 to 74/1). The impact level resulting from existing road improvements in this area would be moderate.

From corridor mile 74/1 to Bell Substation the corridor crosses excessively drained, deep sandy and gravelly soils formed in glacial outwash. Except on steep slopes, these soils have a low susceptibility to erosion by water and the potential for impacts would be low. The potential for impacts would be moderate where access improvements are needed on slopes exceeding 15 percent. Potential wind erosion attributable to construction-related disturbance of soils would need to be reduced through revegetation. Areas potentially more sensitive to impacts include the Coulee Creek - Deep Creek area (corridor mile 75/7 to 76/1) and the area near the Spokane River crossing (corridor mile 75/7 to 76/7). The impact level would be moderate to high due to existing road improvements in these areas.

Installing/replacing culverts would have direct and indirect impacts to soils. Direct impacts would result from increased erosion due to soil disturbance. Indirect impacts would result from increased erosion due to vegetation removal. Seventeen new culverts and nine replacement culverts would be installed in areas with low to moderate soils susceptibility. Therefore, the impact level would be low to moderate due to the installation of culverts.

Operation and Maintenance

Operation of the new transmission line would not have direct and indirect impacts to soils.

Maintenance of the new transmission line would have direct and indirect impacts to soils. Direct impacts would result from localized soil disturbance and potential sedimentation due to vehicular traffic, transmission structure replacement, and access road improvements. Indirect impacts would result from increased erosion due to vegetation management activities. Anticipated erosion rates during operation and maintenance are expected to remain at or near current levels, once revegetation has occurred. Landowners would be compensated for any maintenance-related soil impacts as they would be for construction-related impacts.

Environmental Consequences of the Alternative Action

Geology and soil impacts would be the same for the alternative action.

Cumulative Impacts

Agricultural practices can be a major contributor to soil erosion and increased sedimentation of streams. On slopes over 7 percent, it is estimated that cultivated soils have lost over 6 inches of topsoil over a 90-year period (U.S. Department of Agriculture, Soil Conservation Service, October 1981). The U.S. Department of Agriculture's Conservation Compliance Program for Highly Erodible Land was instituted to promote soil conservation practices among farm operators. Interference with existing or planned conservation measures could result in increased or continued erosion and subsequent sedimentation. Where practical, new transmission towers would be aligned with existing steel towers, thus interference with farm conservation efforts is not expected and may be benefited compared to existing conditions.

Only minor, localized increases in erosion, runoff, and sedimentation may occur from the proposed action. It is expected that these increases would contribute minimally to the area's ongoing soil loss and sedimentation of drainages.

Mitigation

Any potential impacts to soils would be minimized by the installation of runoff and erosion controls and would be further diminished following revegetation.

An environmental specialist would visit the site with construction personnel to decide which mitigation approaches are best suited to individual locations to reduce erosion and runoff, and to stabilize disturbed areas. The specific location and type of mitigation would be determined when road and line designs are finalized. The following standard mitigation measures would minimize impacts:

- Properly spaced and sized culverts, cross-drains, and water bars will be used. Contractors will armor ditches and drain inlets and outlets where needed for erosion control.
- Avoid construction on steep, unstable slopes if possible.
- All excavated material not reused would be deposited in an upland area and stabilized. No used material would be deposited in environmentally sensitive areas such as streams, riparian areas, wetlands, or floodplains.
- Apply erosion control measures such as silt fence, straw mulch, straw wattles, straw bale check dams, other soil stabilizers, and reseeding disturbed areas as required (prepare a Stormwater Pollution Prevention Plan).
- Regularly inspect and maintain project facilities, including the access roads, to ensure erosion levels remain the same or less than current conditions.
- Where agricultural and rangeland soils are compacted, assistance would be provided to farmers and ranchers for subsoiling to restore soil productivity.

Environmental Consequences of the No Action Alternative

Current levels of disturbance to soils and geology associated with ongoing maintenance activities for the existing transmission line, substations, and right-of-way would continue under the No Action Alternative. This would include localized soil disturbance, potential erosion, and soil compaction due to vehicular traffic, transmission structure replacement, vegetation management activities, and access road improvements. No new impacts to soils and geology are expected under this alternative.

Water Quality

Affected Environment

Water Quality

The water quality within the project area is discussed separately for surface water and groundwater.

Surface Water

The corridor crosses 34 ***perennial*** streams and 55 ***ephemeral*** streams. Ephemeral streams contain flowing water only during a portion of the year, typically following snow melt or rain storms. An east-to-west trending ridge spans most of the project area, creating two separate drainages. Streams on the north side of the ridge flow to the north into the Columbia or Spokane rivers. These drainages are located in steep canyons that cross the corridor east of the City of Creston and include Spring, Welsh, Hawk, Stock, Saben, Squaw, Coulee, and Deep creeks. Drainage south of the ridge follows broad, shallow scabland channels from northeast to southwest before eventually reaching Crab Creek and the Columbia River.

No surface water quality problems are reported in the perennial and ephemeral streams that cross the corridor except for Sherman Creek, Deep Creek, and the Spokane River. Sherman Creek, which crosses the corridor between corridor miles 24/3 and 24/4, has impaired water quality due to elevated water temperatures. Deep Creek, which crosses the corridor between corridor miles 39/1 and 39/2, has impaired water quality due to elevated pH (EPA 2002a). In 1998, the Spokane River, which crosses the corridor between corridor miles 77/3 and 77/4, was identified as having impaired water quality due to elevated water temperatures. Water quality is also impaired in the Spokane River due to elevated concentrations of some metals (chromium, lead, and zinc), a plant nutrient (phosphorus), and an industrial contaminant (polychlorinated biphenyls (PCBs)) (EPA 2002b).

Groundwater

Groundwater quality is generally good to excellent throughout the area. Groundwater is the major water source for public water supplies, irrigation, and industrial uses for most of the area. Figure 3-36 shows two major groundwater sources that supply these needs, the Eastern Columbia Plateau Aquifer System and the Spokane Valley-Rathdrum Prairie aquifer.

Aquifers between Miocene basaltic rocks are prominent in the Columbia Plateau basaltic aquifer system. These aquifers consist of numerous flows of basaltic lava. Permeable zones between the lava flows form these aquifer layers. The Columbia Plateau basaltic aquifer system is a major source of water for municipal, agricultural, and domestic uses USGS 1991). ***Intermittent*** stream channels and wetlands of the scablands recharge groundwater to the aquifers. Regional movement of groundwater in the aquifers is generally to the southwest (Garrett A., 1968; and Luzier and Burt, 1974).

The Environmental Protection Agency (EPA) has proposed the Eastern Columbia Plateau Aquifer System as a ***sole source aquifer***. Figure 3-36 shows that the proposed aquifer boundaries would include all lands crossed by the corridor from Grand Coulee to west of the Spokane River and would include a state-recognized groundwater management zone in Douglas County.

The Spokane Valley-Rathdrum Prairie aquifer (see Figure 3-36), predominately glacial-fluvial deposits of sand and gravel (Drost and Seitz, 1978), is the major source of domestic water for Spokane County residents. EPA designated this aquifer a sole source aquifer. Construction projects that receive Federal financial assistance and have the potential to pollute the aquifer are subject to EPA review to ensure contamination does not occur. To protect the aquifer from degradation, Spokane County's Comprehensive Plan restricts activities within the aquifer-sensitive area to those described in the county's water quality management plan.

Adams, Franklin and Grant counties petitioned the Washington State Department of Ecology (Ecology) in 1997 to form the Columbia Basin Ground Water Management Area (GWMA). Ecology signed the order creating the Columbia Basin GWMA on February 4, 1998.

Funded by local, state and federal sources, the GWMA program will consist of water monitoring and characterization, public information and education, and implementation and research. A series of groundwater advisory committees have been formed to oversee the work program and make program recommendations to an executive committee. The executive committee will review the recommendations of the various committees and present a final set of recommendations to the local conservation districts and the Boards of County Commissioners of each county, who report to Ecology.

Six agencies have also agreed to participate in the program and in the development and implementation of locally driven solutions to address groundwater quality issues in areas of documented nitrate concern. Local agricultural industry representatives are also supportive of the GWMA program.

Environmental Consequences

Construction and maintenance of transmission lines can directly and indirectly impact water resources. Disturbance of the ground surface and subsurface, and removal of vegetation during site and right-of-way clearing, access road widening, and structure site preparation increase the risk of soil erosion and ***mass movement***, and may change soil productivity and physical characteristics. Areas most vulnerable include soils prone to erosion, mass movement, or compaction, steep slopes, and areas where extensive access road work and clearing are required.

GRAND COULEE - BELL 500kV TRANSMISSION LINE PROJECT

WATER RESOURCES

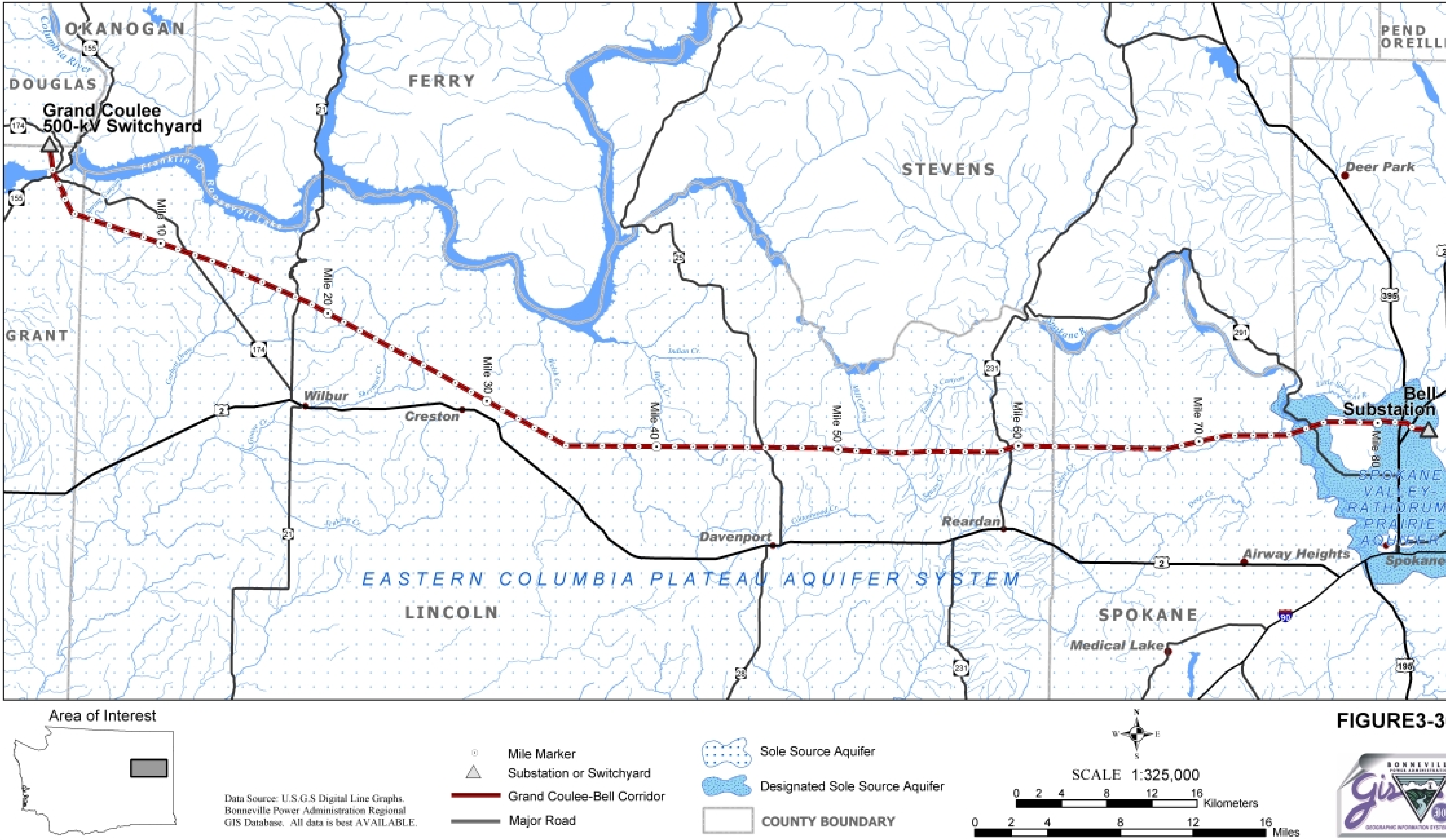

FIGURE3-36

Data Source: U.S.G.S Digital Line Graphs. Bonneville Power Administration Regional GIS Database. All data is best AVAILABLE.

Construction of access roads (clearing and widening) and towers may increase runoff, which could impair water quality by increasing turbidity and sedimentation in the streams. Increased runoff into streams could also increase bank erosion and scouring which would increase turbidity and sedimentation of the streams. Increases in sediment and turbidity depend on the degree watersheds are susceptible to erosion. Because of the connection between soil erosion and surface water quality, runoff and erosion controls may be needed to protect water quality.

Sediment introduced into surface waters is a concern where loess-covered upland soils and soils in steep canyons would be disturbed. Sediment yield for loess-covered upland soils is estimated at about 100-250 cubic meters/square km/year (0.2-0.5 acre-feet/square mile/year). Sediment yields in channeled scablands are much lower, decreasing by a factor of 10 (Pacific Northwest River Basins Commission, 1970).

Most impacts to water quality are from construction and would be short term. Impacts are greatest during and immediately after construction until revegetation, drainage, and erosion controls are established. Long-term impacts could be caused by local changes in erosion and runoff rates from road and transmission line construction and clearing. Site restoration and mitigation would reduce both short- and long-term impacts and the effect erosion, sedimentation, and soil compaction could have on other resources such as land use, water, wetlands, vegetation, and fish.

Increased runoff, as a result of construction and maintenance of a transmission line and related facilities, would not likely impact ground water resources because the surface of the aquifers are well below the ground surface and the 12-foot excavation depth for tower footings that would be placed to anchor the new steel towers.

Accidental fuel or oil spills from construction and substation equipment could impact both surface and ground waters. Accidental spills during construction and maintenance activities are usually of small volume and impacts would likely be low, especially to groundwater. Additions at Bell Substation would be designed to prevent contamination of waters in the unlikely event of a major spill or leak. Although the project is located over critical aquifers, groundwater is not likely to be affected. This project would be designed to comply with local ordinances and laws and state water quality programs to protect the quality of aquifers.

Nutrients leached from disturbed agricultural soils could increase nutrient levels in water and stimulate undesirable aquatic plants. Except for the Spokane River, nutrients have not been identified as a water quality problem along the corridor. Land use along the Spokane River within and adjacent to the corridor is not agricultural.

Extensive clearing of streamside vegetation can increases a stream's exposure to sunlight, possibly raising water temperature

Impact Definitions

A **high** impact would occur where a high-quality water body that supports fish, waterfowl, and animal habitat and/or human uses such as drinking water would be extensively altered so as to affect its uses or integrity. A high impact is expected under these conditions.

- Construction with extensive clearing and road building in highly erodible soils near or in high-quality water bodies without appropriate mitigation.
- Removal of extensive areas of riparian vegetation and shade resulting in increased temperature throughout an entire water body.
- When the possibility of oil or chemical spills reaching surface water and groundwater is high, such as in shallow groundwater areas, highly permeable soils, and no secondary spill containment or protective measures are used.

A **moderate** impact would occur where the quality of a water body would be affected locally, or if effects could be partially mitigated. A moderate impact may be expected when:

- Project activities such as erecting structures, widening access roads and clearing vegetation takes place on erodible soils near water bodies with mitigation (construct in dry season and revegetate and stabilize soils)
- Removal of riparian vegetation and shade results in localized temperature increases that affect only the immediate area, but do not jeopardize the temperature profile of an entire water body.
- There is little possibility of chemical spills affecting surface water or groundwater because groundwater table is deep, soils are relatively non-porous, and some spill-response equipment is available. Any pollution that entered water is dispersed and diluted, not affecting overall water quality.

A **low** impact would be expected where impacts to water quality could be almost completely mitigated. A low impact would be expected when:

- Structures or access roads near water bodies are in stable soils on even terrain with little or no vegetative clearing.
- Removal of very small patches of riparian vegetation along water bodies that do not contain fish and with already sparse riparian vegetation
- There is little or no possibility of oil or other pollutants affecting surface water or groundwater; groundwater is deep, soils are relatively non-porous, and facilities have good oil spill containment.

No impact occurs if surface water and groundwater are unaffected by towers and related construction, access roads, or operation and maintenance of the transmission line.

Impacts

Surface Water

Towers and Related Construction

Removal of existing wood pole structures could result in direct and indirect impacts to water quality. The greatest potential of direct impacts to water quality would result from increased erosion potential and chemical spills when wood pole structures are located immediately adjacent to water bodies. Construction equipment used in the removal process could disturb vegetation and soils in the areas around the structures to be removed, possibly resulting in disturbed soils being deposited directly in stream channels. Indirect impacts to surface water quality could result from the removal of existing wood pole structures in upland areas located away from water bodies. Disturbed vegetation and soils in areas around the structures to be removed could increase the potential for wind erosion and overland transport of soils through sheet flow to water bodies. The impact level to water quality from both direct and indirect impacts attributable to removal of existing wood pole structures is expected to be low to moderate.

There would be approximately 420 new tower sites having a disturbance area during construction of 0.5 acres each, resulting in a total area of 210 acres for new tower sites. Construction around tower sites could result in direct and indirect impacts to surface water quality. The greatest potential of direct impacts to water quality would result from increased erosion potential when tower construction sites are located immediately adjacent to water bodies. The removal of vegetation and soil disturbance at these sites has the potential to increase wind and water erosion rates, resulting in sediment deposition directly into stream channels. Erosion rates would most likely return to their current level following construction if plants become reestablished at these sites naturally or through revegetation. The potential for impacts would depend on the timing of construction, the weather conditions, local topography, the erosion potential of soils, the effectiveness of best management practices implemented during construction to minimize soil erosion, and the time required for vegetation cover to become reestablished. The potential for impacts to surface water quality would be greatest in the vicinity of perennial streams (Table 3-14). The potential impact level to water quality in these areas is expected to be low to moderate.

Indirect impacts are also possible to water quality in the vicinity of new tower sites located upland from water bodies. The potential for impacts would depend on the timing of construction, the presence or absence of water in the stream, the weather conditions, local topography, the erosion potential of soils, the effectiveness of best management practices implemented during construction to minimize soil erosion and the time required for vegetation cover to become reestablished. The impact level to water quality would be low.

Table 3-14. Proposed Activities in or Near Perennial Streams (as identified on USGS topographic maps)

Name	Corridor Mile	Proposed Activity
USBR Canal	2-1 to 2/2	None
Unnamed	3-9 to 4-1	None
Unnamed	6-2 to 6-3	None
Unnamed	6-8 to 7-1	Replace existing 4-ft dia. culvert with 6-ft dia. culvert
Unnamed	7-3 to 7-4	None
Unnamed	8-9 to 9-1	None
Unnamed	12-8 to 12-9	New access road
Unnamed	15-6 to 15-7	Access road improvements
Unnamed	15-9 to 16-1	Replace existing culvert with 32 ft. of 3-ft dia. culvert & new access road
Unnamed	16-4 to 16-5	New access road
Unnamed	16-8 to 17-1	Replace existing culvert with 32 ft. of 3-ft dia. culvert & new access road
Unnamed	17-6 to 17-7	None
Unnamed	17-9 to 17-10	None
Unnamed	18-3 to 18-4	New access road
Unnamed	18-8 to 18-9	None
Unnamed	20-1 to 20-2	New 2-ft dia. culvert
Unnamed	20-2 to 20-3	New 2-ft dia. culvert
Unnamed	20-5 to 20-6	None
Unnamed	20-7 to 20-8	None
Unnamed	21-4 to 21-5	None
Unnamed	21-6 to 21-7	None
Unnamed	22-2 to 22-3	None
Unnamed	22-7 to 22-8	None
Sherman Creek	24-3 to 24-4	Improve access to Sherman Draw Rd – add 20 cy of pit run
Unnamed	24-9 to 25-1	None
Unnamed	25-1 to 25-2	None
Unnamed	25-8 to 25-9	None
Trib. to Welsh Creek	31-8 to 32-1	None
Trib. to Welsh Creek	32-3 to 32-4	None
Welsh Creek	32-8 to 32-9	None
Trib. to Welsh Creek	33-5 to 33-6	None
Hawk Creek	39-1 to 39-2	Improve access road to reduce runoff & erosion
Spring Creek	60-8 to 60-9	None
Spokane River	77-3 to 77-4	None

Construction staging areas for the project would be temporary. Depending on their location relative to water bodies, such areas could result in direct and indirect impacts to surface water quality. If new staging areas were created adjacent to streams, or areas that drain directly to streams, they could cause potential impacts to surface water quality associated with erosion, sedimentation, and hazardous material spills. Indirect impacts could occur when such areas are sited upland and away from water bodies. The impact level to water quality from construction staging areas would be low.

Thirty-four conductor tensioning sites occupying approximately one acre each would be located about every 2.5 miles along the transmission line corridor, resulting in a total area of 34 acres. If possible, these sites would not be located within 400 feet of sensitive areas, such as water features. Equipment used for tensioning conductors may result in compaction of soils over each one-acre site, potentially resulting in increased surface runoff. Depending upon their locations relative to water bodies, they could have direct and indirect impacts. The greatest potential for direct impact would occur if conductor-tensioning sites were situated adjacent to streams, or areas that drain directly to streams, resulting in potential impacts associated with erosion, sedimentation, and hazardous material spills. Indirect impacts could occur when such areas are sited upland and away from water bodies. The impact level to water quality from conductor tensioning sites would be low.

Road Construction

The proposed project would involve improvements to existing access roads on and off the right-or-way and the construction of new access roads. Some portions of existing access roads would be improved by grading, improving drainage, and adding gravel to the road surface. In addition, new access roads would be created in locations where the existing access roads pass beneath transmission line towers that do not provide adequate clearance for tower construction vehicles. Access roads would also be relocated in a few sites where the new proposed tower locations are within, or close to, the existing access roads. In some locations, sections of access road would be constructed to ensure that the road remained within the corridor right-of-way. No permanent roads would be constructed in cultivated areas. Only temporary access on farmlands is needed. Road construction activities could have direct and indirect impacts, depending upon the locations of road construction activities relative to water bodies.

Potential impacts that are discussed below are based on a preliminary reconnaissance conducted during June 2002 to evaluate the need for new access roads and improvements to access roads. Approximately 25.5 miles (80.7 acres) of road work would be conducted including construction of 4.9 miles (15.6 acres) of new access roads, 4 miles (12.6 acres) of spur roads, and 16.6 miles (52.5 acres) of access road improvements.

Direct impacts to surface water quality could occur when road construction activities take place in or immediately adjacent to water bodies. The greatest impacts to surface water quality would due to erosion and increased runoff associated with construction of new access road, access road improvements, and construction of spurs to new tower sites. Oil and fuel spills from construction equipment could also adversely affect water quality. In areas where road construction activities occur in stream channels, direct deposition of soil in the stream channel could result in increased turbidity and sedimentation. The potential for impacts would depend on the timing of construction, the weather conditions, local topography, the erosion potential of soils, and the effectiveness of best management practices implemented during construction to minimize soil erosion. Table 3-14 identifies the locations where perennial streams cross the corridor and any locations where new access road or access road improvements would occur. Perennial streams at or near where new access roads are planned or where access road improvements are planned have the greater potential for impacts to surface water quality. The likelihood that water quality would be adversely impacted in these streams is low.

Indirect impacts to surface water quality could occur when road construction activities are located upland from water bodies. As with direct impacts, the potential for impacts would depend on the timing of construction, the presence or absence of water in the stream, the weather conditions, local topography, the erosion potential of soils, and the effectiveness of best management practices implemented during construction to minimize soil erosion. Vegetation removal and soil disturbance associated with road construction could increase erosion rates, resulting in increased wind erosion and surface runoff. Eroded soils could be carried by wind and sheet flow to water bodies, resulting in increased turbidity and sedimentation. The likelihood that water quality would be adversely impacted in these streams is low.

Culvert replacement and installation would be necessary at a number of sites where the transmission line corridor crosses streams or draws. Seventeen new culverts would be installed along the corridor and nine existing culverts would be replaced (see Table 3-15). No culvert work would be conducted in fish-bearing streams. With the exception of one culvert that would be removed and replaced with a drainage dip, all other culverts would be replaced with culverts that have a larger diameter to ensure adequate water passage during high water flow periods.

Culvert placement and the installation of new culverts could cause direct impacts to surface water quality through increased erosion and turbidity. The potential for impacts would depend on the timing of construction, the size of the area disturbed during culvert removal and placement, the weather conditions, local topography, the erosion potential of soils, and the effectiveness of best management practices implemented during construction to minimize soil erosion. Impacts would be also be minimized if construction occurs during dry periods. Thus, the potential impact to water quality due to culvert installation and replacement is expected to be low.

Potential contamination of surface water resources during project construction could result from accidental spills or leaks of petroleum products used by construction equipment. Petroleum products and other chemicals used during construction would not be stored at the project site. To minimize the risk of contamination, best management practices would be implemented. Best management practices include off-site storage of fuels and other chemicals, refueling and maintenance of construction equipment in off-site areas, inspections of construction equipment, and other practices that would limit the potential for release of chemicals at the project site.

Table 3-15. Locations of Proposed Culvert Installations and Replacements

Corridor Mile	New Culvert	Replacement Culvert
6-8 to 7-1		Replace 4-ft dia. with 6-ft dia.
13-1 to 13-2	3-ft diameter	
14-2 to 14-5	4-ft diameter	
14-9 to 15-1		Add 10 ft to 2-ft dia. culvert
15-9 to 16-1		Replace with 32 ft of 3-ft dia. culvert
16-4 to 16-5		Replace with 32 ft of 3-ft dia. culvert
16-8 to 17-1		Replace with 32 ft of 3-ft dia. culvert
20-1 to 20-2	2-ft diameter	
20-2 to 20-3	2-ft diameter	
37-3 to 37-4		2.5-ft dia. culvert with 4-ft dia culvert
39-6 to 39-7		Remove culvert & create rock drainage dip
48-4 to 48-5	Assume 2-ft diameter	
50-1		Replace 50 ft of 2-ft dia. culvert
58-4 to 58-5	Assume 2-ft diameter	
58-5 to 58-6	Assume 2-ft diameter	
58-7 to 58-8	Assume 2-ft diameter	
59-6 to 59-7	Assume 2-ft diameter	
59-7 to 59-8	Assume 2-ft diameter	
59-9 to 60-1	Assume 2-ft diameter	
61-11	Assume 2-ft diameter	
62-9 to 62-10	Assume 2-ft diameter	
63-2 to 63-3	Assume 2-ft diameter	
63-9 to 63-10	Assume 2-ft diameter	
64-2 to 64-3	Assume 2-ft diameter	
64-6 to 64-7	Assume 2-ft diameter	
66-4 to 66-5		Assume culvert replacement
Total	17	9

Operation and Maintenance

Routine operation of the transmission line would not result in direct or indirect impacts to surface water quality.

Maintenance activities could result in direct and indirect impacts to surface water quality. Direct impacts could result from vegetation maintenance including clearing of riparian vegetation, potentially resulting in localized increases in water temperature. The use of herbicides for noxious weed control could potentially impact surface water through overspray, resulting in direct application of herbicides to surface waters. However, if vegetation treatment is necessary, appropriate buffers would be established to prevent herbicides from being deposited in surface waters. Indirect impacts to surface water quality could result from use of access roads to tower maintenance. This could potentially result in erosion and sediment deposition through surface runoff, potentially impairing surface water quality. The impact level to water quality from maintenance activities is expected to be low to moderate.

Groundwater

Towers and Related Construction

The removal of existing wood pole structures, clearing of vegetation at tower construction sites, and the assembly of new towers may result in direct effects to groundwater through localized soil compaction in the vicinity of these activities, thereby reducing infiltration capacity and increasing surface runoff to streams, and spills of petroleum products. It is expected that subsoiling, normal farming, cultivation, cropping, and freeze-thaw cycles would restore soils to pre-construction conditions (Moe et al. 1971). Because no refueling would be conducted in the project area and no chemical storage would occur within the project area, any chemical spills are expected to be of small volume. Given the relatively small area that could potentially be affected, it is expected that impacts to groundwater would be low.

Construction staging areas for the project would be temporary. Impacts to groundwater associated with such areas would be direct and could include soil compaction, erosion, increased surface runoff, and hazardous material spills. However, given the relatively small area that could potentially be affected, it is expected that impacts to groundwater would be low.

Conductor tensioning sites occupying approximately one acre each would be located every 2.5 miles along the transmission line corridor. Potential impacts to groundwater would be direct. Equipment used for tensioning conductors may result in compaction of soils over each one-acre site, potentially resulting in increased surface runoff, erosion, and hazardous material spills. However, given the relatively small area that could potentially be affected, it is expected that impacts to groundwater would be low.

Road Construction

Road construction activities generally would not be expected to indirectly impact groundwater aquifers. Table 3-16 lists potential direct impacts on groundwater attributable to road construction activities. Construction activities should not affect the groundwater characteristics in the area. Potential spills or leaks of petroleum products used by construction equipment would likely be of insufficient volume to present risk to groundwater resources. Petroleum products and other chemicals used during construction would not be stored at the project site. To minimize the risk of contamination, best management practices would be implemented. Best management practices include off-site refueling of construction equipment, off-site storage of chemical, inspections of construction equipment, and other practices that would limit the potential for release of chemicals at the project site. Potential impacts to groundwater from road construction activities are expected to be low.

Table 3-16. Potential Construction Impacts to Groundwater

Construction Activity	Impact Mechanism	Potential Impact
Refueling, equipment maintenance, location of staging area	Hazardous material spills and leaks	Local groundwater contamination
Road construction and maintenance, vegetation removal, soil disturbance	Erosion and sedimentation	Increased groundwater turbidity
Road construction	Interception of subsurface flow	Local modification of hydrology and water quality in wetlands and streams

Operation and Maintenance

Routine operation and maintenance of the transmission line is expected to have no impact on groundwater quality.

Environmental Consequences of the Alternative Action

Water quality impacts are expected to be the same for the alternative action.

Cumulative Impacts

Agricultural practices can be a major contributor to soil erosion and increased sedimentation of streams. On slopes over seven percent, it is estimated that cultivated soils have lost over six inches of topsoil over a 90-year period (U.S. Department of Agriculture, Soil Conservation Service, October 1981). The U.S. Department of Agriculture's Conservation Compliance Program for Highly Erodible Land was instituted to promote soil conservation practices among farm operators. Interference with existing or planned conservation measures could result in increased or continued erosion and subsequent sedimentation. Where practical, new transmission towers would be aligned with existing steel towers; thus, interference with farm conservation efforts is not expected and would likely be improved compared to existing conditions.

Only minor, localized increases in erosion, runoff, and sedimentation may occur from the proposed action. It is expected that these increases would contribute minimally to the area's ongoing soil loss and sedimentation of drainages, thus resulting in minimal impacts to water quality.

Mitigation

Turbidity and sedimentation impacts to water resources would be reduced after temporary and permanent runoff and erosion controls are installed and would continue to diminish after revegetation.

Environmental specialists will visit the site with construction personnel to decide which standard mitigation is best suited to individual locations to reduce erosion and runoff, and stabilize disturbed areas. For areas of concern, mitigation must be undertaken during and after construction. BPA would prepare a stormwater pollution prevention plan as required under the National Pollution Discharge Elimination System General Permit. The following mitigation would be used alone or together to decrease surface runoff and exposed soil:

- Culverts will be properly sized and spaced and BPA would work with the Washington State Department of Fish and Wildlife (WDFW) to comply with hydraulic permit requirements.
- No solid materials, including building materials, would be discharged into waters of the United States unless authorized by a Section 404 permit of the Clean Water Act.
- Off-site tracking of sediment and dust generation shall be minimized.
- Vegetative buffers would be left along stream courses to minimize erosion and bank instability, where possible.
- All excavated material not reused would be deposited in an upland area and stabilized. No used material would be deposited in environmentally sensitive areas such as streams, riparian areas, wetlands, and floodplains.
- Near any water body crossing, including the Spokane River, towers would be set as far back from stream banks as practical.
- Avoid construction within designated wetland and wetland buffers to protect potential groundwater recharge areas by avoiding wetland flagged areas.
- Locate structures, new roads, and staging areas so as to avoid waters of the U.S.
- Limit disturbance to the minimum necessary when working in or next to water bodies.

- Avoid mechanized land clearing within stream channels and riparian areas to avoid soil compaction from heavy machinery, destruction of live plants, and potential alteration of surface water patterns to reduce groundwater turbidity risk.
- Apply erosion control measures such as silt fence, straw mulch, straw wattles, straw bale check dams, other soil stabilizers, and reseeding disturbed areas as required (prepare a Stormwater Pollution Prevention Plan).
- Regularly inspect and maintain project facilities, including the access roads, to ensure erosion levels remain the same or less than current conditions.
- Avoid refueling and/or mixing hazardous materials where accidental spills could enter surface or groundwater.
- Use existing road systems, where possible, to access tower locations and for the clearing of the transmission line alignment.
- Avoid construction on steep, unstable slopes if possible.
- Place tower footings on upland areas and limit access road construction adjacent to stream channels, if possible.

Environmental Consequences of the No Action Alternative

Current levels of disturbance to water quality associated with ongoing maintenance activities for the existing transmission line, substations, and right-of-way would continue under the No Action Alternative. This would include localized soil disturbance and potential sedimentation due to vehicular traffic, transmission structure replacement, vegetation management activities, and access road improvements. In addition, vehicle and machinery use and vegetation management practices could contribute minor amounts of pollutants (e.g., fuel, oil, grease, rubber particulates, woody debris) that could be transported to streams. No new impacts to water quality are expected under this alternative.

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Wetlands

Affected Environment

The National Wetlands Inventory (NWI) program identified 33 ***wetlands*** within the proposed project corridor (Figure 3-37). Field surveys, conducted to verify the presence of NWI mapped wetlands, confirmed the presence of most of these wetlands. Two areas mapped on the NWI are upland, rather than wetland areas. Twelve wetlands not identified on the NWI were found during the field surveys. Thus, this analysis finds that there are 43 wetlands in the corridor. Table C-1 in Appendix C lists the wetland areas identified within the corridor.

Most wetlands within the corridor are ***isolated***, depressional wetlands that are flooded by precipitation and/or snowmelt. Most of the wetlands within the corridor are ***seasonally*** or ***semi-permanently flooded***, and a few are either ***temporarily flooded*** or ***permanently flooded***.

The plant species and associations found in wetlands depend on the ***hydrology***. Most wetlands within the corridor are dominated by herbaceous vegetation (***emergent wetlands***), with few to no shrubs or trees. Some emergent wetlands have shrubs and some aspen present as a narrow band at the edge of portions of the wetland. A few wetlands within the corridor have trees (***forested wetlands***) or shrubs (***scrub/shrub wetlands***) as the predominant vegetation (Table C-1 in Appendix C). Open water areas in the center of wetlands are commonly bare of vegetation.

Emergent wetlands are typically dominated by spikerush, tule, cattail, rushes, common silverweed, reed canarygrass, giant wildrye, and western blue flag iris. Scrub/shrub wetlands and some emergent wetland buffers are dominated by snowberry, wild rose, red-osier dogwood, wax currant, golden currant, and willow, with some areas of quaking aspen. The only tree species noted in wetlands are quaking aspen and spring birch. The scientific name of all species mentioned in the text can be found in Table C-2 in Appendix C.

Two unique wetlands, Wetlands 28 ands 29 between Structures 40/3 through 40/4, are located in the bottom of holes in the basalt bedrock. These holes, approximately 100 and 200 feet in diameter, may have been produced by a ***vortex*** of Ice Age flood water, which had enough force to scour and remove rock like a drill. These holes are about 20 feet deep and have steep, rocky walls. Although both wetlands appear to have the same origin, are at the same elevation, and occur within 200 feet of each other, they have different vegetation. The smaller wetland (Wetland 29) is dominated by aspen with a shrub dominated edge, whereas the larger wetland (Wetland 28) is dominated by spring birch associated with a variety of other wetland and upland species.

Some wetlands in this area are locally important because they function as a source of water in an arid environment. Isolated wetlands are particularly valuable to waterfowl and migratory birds and also provide habitat for resident birds, amphibians, and reptiles. Two large wetland complexes (Wetlands 26 and 30), located in corridor mile 40, are permanently flooded wetlands, providing important wildlife habitat. Dominant vegetation in these wetlands includes tule, spikerush, western blue flag iris, Nootka rose, snowberry, and quaking aspen.

Riparian wetlands occur along Coulee Creek, the Spokane River, Spring Canyon, and along a perennial seep near Squaw Creek. Typical riparian wetlands are dominated by aspen, Nootka rose, and red-osier dogwood associated with various herbaceous species. The Squaw Creek spring supports a scrub/shrub wetland dominated by willow, Nootka rose, and wax currant.

Most wetlands in the corridor are undisturbed and in excellent condition. They are vegetated primarily with native species, although some wetlands have been invaded by reed canarygrass. Some wetlands were previously disturbed when the existing access roads were constructed, some of which go through the edge of wetlands. It is possible that the construction of some access roads enlarged wetlands due to the barrier that the road imposed to the flow of surface waters.

Environmental Consequences

Direct and indirect impacts to wetlands could occur during construction, operation, and maintenance activities for the proposed 500-kV transmission line and associated structures. The proposed transmission line right-of-way would cross valleys, depressions, stream channels, wetlands, and springs. The conductor would span wetlands, and new structures and new access roads would be sited to avoid wetlands.

Wetland scientists worked with design engineers during the design phase of the proposed project to situate roads and structures in upland areas to avoid impacts to wetlands. Some wetlands occur near existing roads and proposed structures, but with standard best management practices, impacts are expected to be minimized or eliminated at most sites. Wetlands will be clearly depicted on project maps as sensitive areas with specific restrictions on construction activities near wetlands. A field survey will be conducted prior to construction to stake or flag the boundaries of all wetlands within the corridor that could be directly or indirectly impacted by construction activities.

See Table C-1 in Appendix C for wetland and structure locations and potential impacts to wetlands from construction activities.

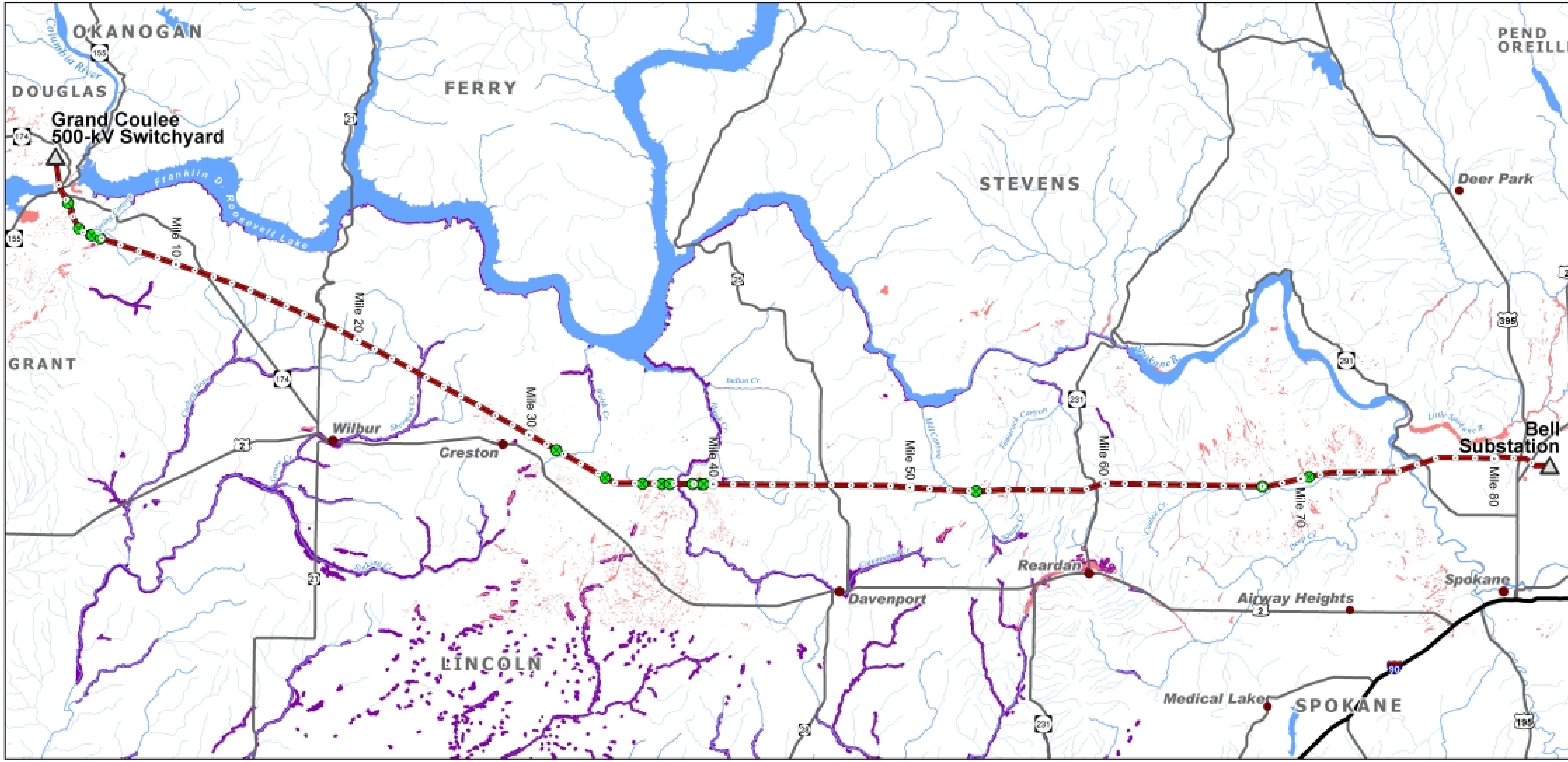
Impact Definitions

A **high** impact would occur under the following circumstances:

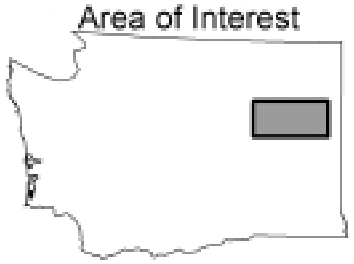
- Wetland hydrology, wetland vegetation, and/or wetland soils would be extensively or permanently altered by excavation or fill.
- Wetland functions would be permanently impaired.

GRAND COULEE - BELL 500kV TRANSMISSION LINE PROJECT

WETLANDS & FLOODPLAINS



Area of Interest



Data Source: U.S.G.S Digital Line Graphs, Washington Dept. of Natural Resources, Bonneville Power Administration Regional GIS Database. Wetlands derived from NWI Wetland inventory and field inspection.

- Mile Marker
- Substation or Switchyard
- Major Road
- Grand Coulee-Bell Corridor
- COUNTY BOUNDARY
- Field Identified Wetlands
- 100 Yr. Flood Hazard
- NWI Identified Wetlands

SCALE 1:325,000

0 2 4 8 12 16 Kilometers

0 2 4 8 12 16 Miles

FIGURE 3-37

- Recovery is generally not feasible and mitigation would be required to replace lost wetland functions.

A **moderate** impact would occur under the following circumstances:

- Wetland hydrology, wetland vegetation, or wetland soils would be slightly or temporarily altered by vegetation disturbance or the introduction of sediments.
- Wetland functions would be temporarily impaired.
- Recovery generally would require restoration and monitoring.

A **low** impact would occur under the following circumstances:

- Wetland vegetation or soils would be altered temporarily by vegetation crushing and soil compaction.
- Wetland functions would be not impaired.
- Recovery would occur naturally and would not generally require any restoration activities.

No impact occurs if wetlands would not be directly or indirectly affected by towers and related construction, access roads, or operation and maintenance of the transmission line.

Impacts

Towers and Related Construction

Removal of existing wood pole structures would result in direct and indirect impacts to wetlands. Direct impacts could result from crushing vegetation or soil compaction during the removal and access to the old wood pole structures. Typically, existing wood pole structures would be excavated or cut off 2 feet below ground level and holes backfilled with native material. However, wood pole structures located in or adjacent to wetlands, such as Structures 32/6, 40/5, and 54/9, would be cut off at ground level. The wood poles in these locations would be dragged out or lifted out by crane to avoid bringing in construction equipment that would compact soils within the wetland. Indirect impacts could occur if vegetation was crushed to the extent that noxious weeds could become introduced. The impact level resulting from the removal of existing wood pole structures would be low to moderate.

Construction of new towers could result in indirect impacts to wetlands. Typically a 0.5-acre radius around each tower would be disturbed for tower installation. Approximately five structures would be constructed within each mile of corridor. The total area disturbed for the construction of towers would be about 210 acres out of the 1,528 acres within the corridor, with about 85 acres of disturbed areas occurring in native habitats. Construction areas would be designed to avoid wetlands. Indirect impacts could occur if erosion occurred at the construction areas and affected water quality or covered wetland vegetation. The impact level resulting from the construction of towers would be low.

Construction of new towers within wetland buffer areas could result in indirect impacts to wetlands. All wetlands would be spanned by the conductor and towers would be placed in upland areas. Tower pads constructed within wetland buffers could alter overland water flow patterns, thereby increasing or decreasing wetland hydrology that could change wetland plant communities. Indirect impacts could result from the removal of wetland buffer vegetation. The reduction of vegetated buffers adjacent to wetlands could increase overland water flow and increase the likelihood of silts and sediments entering wetland surface waters and degrading water quality. Impacts would be reduced if the removal of the vegetation is done so that the roots are left intact. With the roots in place, the soils would be less likely to erode and the plants could resprout, recreating the vegetative buffer. Other indirect impacts could occur if oils and pollutants from machinery entered surface water, potentially affecting water quality. The impact level resulting from the construction of tower pads would be low to moderate.

Conductor tensioning sites and staging areas would result in no direct or indirect impacts to wetlands. Although the exact locations are unknown, these areas would not be placed within 400 feet of wetlands. The impact level resulting from conductor tensioning sites and staging areas would be no impact.

Road Construction

Construction of new access roads within and outside of the corridor would result in no direct or indirect impacts to wetlands because it is anticipated that any new access roads would avoid wetlands. However, if it is later determined that new access roads need to be built within wetlands, all necessary permits would be obtained. Direct impacts would result from the removal of wetland vegetation and the filling of wetlands within the new access road footprint. Indirect impacts would result from removal of wetland buffer vegetation or if oils and pollutants from machinery entered surface water.

Construction of temporary spur roads would result in no direct or indirect impacts to wetlands. No temporary spur roads are proposed to be built within wetlands, but it is possible that spur roads may need to be constructed within wetland buffers, which would be an indirect impact. However, if it is later determined that temporary spur roads need to be built within wetlands to access old structures for removal, all necessary permits would be obtained. Direct impacts would result from the removal of wetland vegetation and the filling of wetlands within the spur road footprint. Indirect impacts would result from removal of wetland buffer vegetation or if oils and pollutants from machinery enter surface water.

Improvements to existing access roads would result in direct and indirect impacts to wetlands (Table C-1 in Appendix C). Direct impacts could result from maintenance of access roads directly adjacent to wetlands. Road maintenance activities within wetlands would be limited to blading, grading, or rocking within the footprint of the existing road. Although no filling of wetlands is proposed at this time, some sediments could be introduced into wetlands immediately adjacent to roads (e.g. Wetlands 8 and 21). These impacts would be short term, and wetland functions would not be severely impaired. Some restoration and monitoring may be necessary in individual wetlands such as Wetlands 8 and 21. The impact level resulting from improvements to existing access roads would be low to moderate.

There are possible direct impacts to Wetland 4 from access road construction, because the access road needs to be widened to accommodate the equipment that will be used to install the new towers. The southern boundary of the wetland is five feet north of the current road. To avoid filling the wetland, the road would be widened within uplands on the side opposite the wetland. To reduce potential impacts due to sedimentation, best management practices, such as the installation of a silt fence or the use of geotextile fabric, would be followed to prevent or reduce the amount of sediment entering the wetland. The impact level to Wetland 4 would be low to moderate.

Indirect impacts could result from the disturbance of soils adjacent to wetlands from construction vehicle traffic. Stormwater runoff could cause sedimentation in wetlands; however, erosion control measures would be used during the rainy season in areas where the road is adjacent to wetlands. Therefore, impacts would be minimized or eliminated at most areas. The impact level resulting from soil disturbance would be low.

Installing/replacing culverts would result in no direct or indirect impacts to wetlands because no culvert replacements within wetlands are proposed. However, wetlands delineations would be conducted in areas where culverts are proposed to be replaced to determine if wetlands are present. If it is determined that wetlands do exist, all necessary permits would be obtained. The impact level could be low to high.

Operation and Maintenance

Operation of the new transmission line would not result in direct or indirect impacts to wetlands. The impact level resulting from operation would be no impact.

Maintenance of the new transmission line could result in direct and indirect impacts to wetlands. Direct impacts could result from vegetation maintenance including clearing of vegetation or the application of herbicides for noxious weed control. Most wetlands and wetland buffers within the corridor are dominated by herbaceous and scrub/shrub vegetation that are generally compatible with the vegetation height requirements for conductor clearance and, therefore, would not need to be cut, causing no impact. Where long conductor spans are required to span large drainages, individual trees may occasionally need to be cut to maintain required conductor clearance above trees. Such tree removal would be a low to moderate impact. If herbicide application is required, appropriate buffers would be used to keep herbicides out of wetlands. Indirect impacts could result from the use of access roads for tower maintenance. This could potentially introduce sediment into wetlands through surface runoff, potentially affecting water quality. The impact level resulting from maintenance activities would be low to moderate.

Environmental Consequences of the Alternative Action

Wetland impacts would be the same for the alternative action.

Cumulative Impacts

Incremental losses and degradation of wetlands over time have depleted wetland resources. Some wetlands were previously impacted by construction of the existing lines (from access road construction and placement of structures in wetlands) and from agricultural activities. Wetlands would be impacted by any projects within the Columbia Basin that affect wetland functions and values, including the filling of wetland areas. Although the amount of wetlands impacted within the area is unknown, information from the US Army Corps of Engineers (USACE), Spokane District, on the amount of wetlands that have been filled in Lincoln and Spokane counties has been requested (personal communication, T. Erkel, USACE, July 8, 2002).

Independent of the proposed project, BPA will replace an existing culvert off of the right-of-way within Wetland 16. The culvert replacement will fill a portion of the wetland to accommodate the larger culvert needed to prevent road erosion during high flow events.

Mitigation

The following standard mitigation measures would minimize wetland impacts.

- Before construction, wetlands with the potential to be impacted will be identified and flagged on the ground by a wetlands specialist.
- Avoid construction within wetland and wetland buffers to protect wetland functions by avoiding wetlands, where possible.
- Locate structures, new roads, and staging areas so as to avoid waters of the U.S., including wetlands, where possible.
- Limit disturbance to the minimum necessary when working in or next to wetlands.
- Avoid mechanized land clearing within wetlands and riparian areas to avoid soil compaction from heavy machinery, destruction of live plants, and potential alteration of surface water patterns to reduce groundwater turbidity risk.

- Apply erosion control measures such as silt fence, straw mulch, straw wattles, straw bale check dams, other soil stabilizers, and reseeding disturbed areas as required (prepare a Stormwater Pollution Prevention Plan).
- Regularly inspect and maintain project facilities, including the access roads, to ensure erosion levels remain the same or less than current conditions.
- Avoid refueling and/or mixing hazardous materials where accidental spills could enter surface or groundwater.
- Use existing road systems, where possible, to access tower locations and for the clearing of the transmission line alignment.
- Avoid construction on steep, unstable slopes if possible.
- Place tower footings on upland areas and limit access road construction adjacent to wetlands, if possible.
- All excavated material not reused would be deposited in an upland area and stabilized.
- Where feasible, top trees instead of removing trees so roots and soil remain intact.

Environmental Consequences of the No Action Alternative

Current levels of disturbance to wetlands associated with ongoing maintenance activities for the existing transmission line, substations, and right-of-way would continue under the No Action Alternative. This could include localized soil disturbance, potential sedimentation, and weed species introduction due to activities such as vehicular traffic, replacement of transmission structures, vegetation management, and access road improvements. No new impacts to wetlands are expected under this alternative.

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Vegetation

Affected Environment

The vegetation in the proposed project area is influenced by the topography, climate, soils, and current and past human activities. The proposed transmission line project corridor lies within the Columbia River basin region province of eastern Oregon and Washington. The topography is gently undulating to moderately hilly with elevations ranging from 985 to 1,970 ft above sea level. Climatically, the region can be characterized as arid to semiarid with low precipitation, hot, dry summers, and relatively cold winters (Franklin and Dyrness 1988).

The plant communities that dominated the Columbia River basin landscape prior to European settlement have been influenced by human activities. Most of the vegetation in the vicinity of the proposed project has been disturbed to varying degrees by the introduction of domestic livestock into the region in the 1830s, the conversion of some natural habitats to croplands in the 1900s and, more recently, by vegetation management activities within the transmission line corridor (Daubenmire 1970). As in other portions of the Columbia Basin, plant communities within the project area have been gradually invaded by invasive, nonnative species such as cheatgrass, bulbous bluegrass, diffuse knapweed, Dalmatian toadflax, and other weed species. Thus, while most of the portions of the project vicinity that are not in agricultural production are considered native communities, the species that comprise these communities have changed since their pristine, pre-European settlement condition.

The distribution of plant communities along the corridor, based on land use information, is shown in Figure 3-38. These vegetation communities include agricultural lands, grass/forb, shrub/steppe, lithosol, and forest/deciduous shrub and are described below. Relatively non-vegetated areas in the project area include some lithosol (areas with rocky soils), rock outcrops, open water, and disturbed areas such as gravel pits. The approximate acres of the major vegetation communities within the corridor are shown in Table 3-17. A list of plant species identified during field visits in June of 2002 is shown in Appendix C (Table C-2).

It should be noted that the Vegetation Map (Figure 3-38) is a general representation of the complexity of the distribution of plant communities. This generalization is necessary for a map of this scale because of the difficulties in representing locations where communities intergrade and where small pockets of community types occur within other community types. For example, lithosols occur scattered throughout all community types. Deciduous shrubs grow on north facing slopes within shrub/steppe, while areas dominated by sagebrush occur on south-facing slopes and hilltops.

Table 3-17. Vegetation Communities Within the Corridor.

Vegetation Community	Approximate Acres	Percentage of corridor	Proposed Activity	Potential Impacts
Grass/Forb and Lithosol	46	3	Tower construction, road widening, road rebuild, and new road construction	Temporary and permanent vegetation removal
Shrub/steppe	306	20	Tower construction, road widening, road rebuild, and new road construction	Temporary and permanent vegetation removal
Forest/Deciduous Shrub	382	25	Tower construction, road widening, road rebuild, and new road construction	Temporary and permanent vegetation removal
Agricultural	764	50	Tower construction and temporary road construction	Temporary vegetation removal
Other (e.g. commercial development, landfills)	30	2		

Agricultural Lands

Approximately one-half of the corridor is in agricultural production. Dryland wheat farms, fallow fields, and pasturelands compose the vegetation type from corridor miles 6/4 to 28/1, 43/4 to 52/1, and 54/9 to 66/4. Most unplowed areas adjacent to agricultural fields are vegetated primarily with non-native species. These large tracts of cultivated land contain small remnants of shrub/steppe and forest/shrub vegetation that provide important connections for plants and wildlife to native habitats outside the corridor.

Grass/Forbs

There are few areas without many woody species within the corridor. Because ponderosa pine were cut within the corridor, some grass and forb dominated areas within the corridor have woodlands on either side of the corridor and, therefore, are not true grasslands, i.e., areas that could not support the growth of tree species. Grass/forb communities grow mainly within channelized scablands, where the topography is characterized by a series of small mounds, usually less than 50 feet in diameter, with intervening low lying areas, often lithosols. The grass/forb community comprises about 121 acres (2 percent) of the corridor vegetation.

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VEGETATION

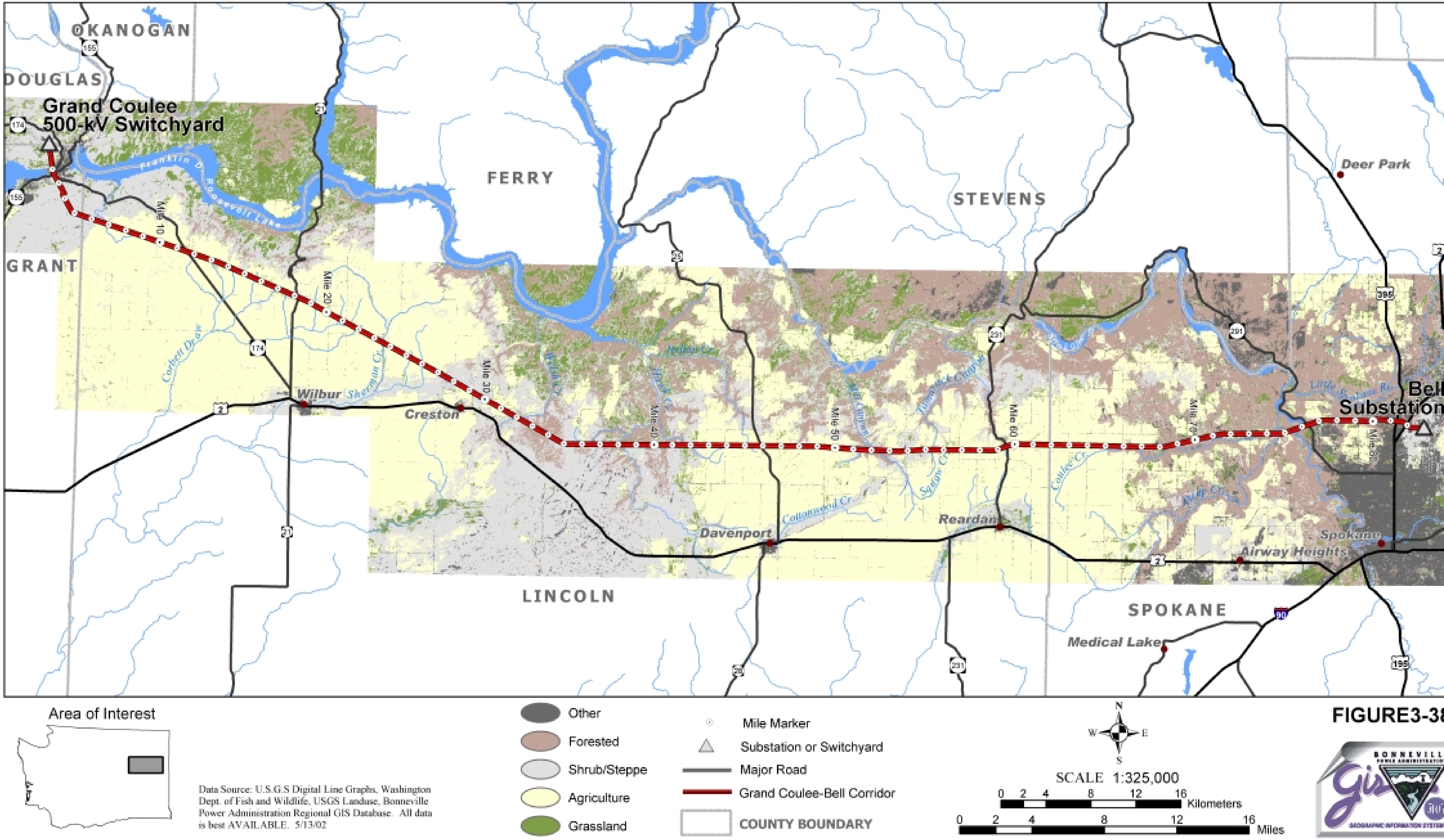

FIGURE3-38

Dominant species within this vegetation type include cheatgrass and other weedy forbs. Other non-native species include brome, crested wheatgrass, knapweed, Russian thistle, Dalmatian toadflax, and common tumblemustard. Native species present in this community include giant wildrye, various buckwheat species, and occasional shrubs including sagebrush and wax current. The scientific name of all species mentioned in the text can be found in Table C-2 in Appendix C.

Lithosols

Lithosol communities occur in areas with rocky soil, usually in areas underlain with basalt. A distinctive plant community develops with few shrubs and a wide diversity of forbs associated with only a few grass species, primarily bluegrass species. Stiff sagebrush is the dominant shrub in lithosol areas. Forbs include the species found in shrub/steppe but with more diversity and at a greater density so that these communities are very attractive during spring blooming period. Weed species are not very abundant in lithosols, with cheat grass as the most common species.

Other rocky areas within the corridor resemble basalt flows, because there is little to no topsoil over the basalt bedrock, which extends over the landscape. The only plant life in these areas survives in cracks in the rock. Very few plant species are able to survive in this harsh environment. Bitterroot is common in some areas. Stonecrop and fameflower were only observed within this plant community. It is difficult to calculate the area of the corridor covered by lithosol and other rocky areas due to their generally small sizes and patchy distribution. However, this community comprises only a small percentage of the proposed project corridor (Table 3-17).

Shrub/Steppe

The shrub/steppe community covers about 807 acres (20 percent) of the of the project area Shrub/steppe communities occur across the western portion of the corridor from the Grand Coulee Switchyard to the corridor section near the town of Creston. This vegetation community is found mainly on channelized scablands and is dominated by shrubs, primarily sagebrush, with a grass and forb understory. Channelized scablands, as described under Soils and Geology, are a unique geologic feature in the Columbia River Basin that supports unique plant communities.

The dominant sage species along the corridor are stiff sagebrush, with lesser amounts of big sagebrush. Other shrubs are present in some areas, such as bitterbrush and a variety of deciduous shrubs, such as snowberry and wax currant. Within shrub/steppe, areas dominated by deciduous shrubs tend to occur in moister areas, such as along waterways, near wetlands, and on north-facing slopes.

A variety of grasses and forbs are found in shrub/steppe. Generally, the diversity of native species is high and the abundance of weed species is low. Native forbs include puccoon, wild onion, various buckwheat species, yarrow, phlox, flax, lupine, penstemon, arnica, various species of biscuit root, daisy, Oregon sunshine, and a variety of other species. Idaho fescue is the dominant native grass in this community although bluebunch wheatgrass and some bluegrass species are also found. Weedy forbs and grasses include diffuse knapweed, St. John's wort, cheat grass, and bulbous bluegrass.

This vegetation type has not been affected very much by corridor maintenance activities, evidenced by the fact the shrub/steppe community within the corridor is similar to that located outside the corridor. Some shrub/steppe areas have been converted to grasslands for grazing. Although cheat grass is fairly uniformly distributed throughout shrub/steppe, the other weedy species found in this community tend to occur more frequently along roadways.

Forest and Deciduous Shrub

The forest and deciduous shrub community covers about 1009 acres (25 percent) of the of the project area, although most trees have been removed within the corridor. In addition to long stretches of forested areas, this vegetation type also occurs as scattered patches within agricultural areas, along drainages and in canyons. Although this vegetation type is referred to as "forest" it appears more as a woodland in the project area, with scattered clumps of trees with intervening open areas, rather than the dense tree cover characteristic of a forest. Areas of shrub/steppe and lithosols occur within forested areas.

In most areas, ponderosa pine is the most abundant tree species. In other areas, some Douglas-fir and aspen trees are associated with ponderosa pine. Although snowberry is the most common shrub species, a large diversity of native shrubs occur within this vegetation type, including rose, red-stem ceanothus, elderberry, wax and golden currant, serviceberry, thimbleberry, chokecherry, and oceanspray. Native forbs in this plant community include sticky geranium, old man's beard, cinquefoil species, pussytoes, desert paintbrush and a diversity of other species. Some open slopes covered with balsamroot and lupine occur within this vegetation type. Dalmatian toadflax and bulbous bluegrass are the main weedy species.

Threatened and Endangered Species

Federally-listed ***threatened*** and ***endangered*** plant species are native plants that have been given special protection status under the federal Endangered Species Act because of concern over their continued existence. Species in danger of extinction are classified as endangered, while species at risk of becoming endangered are classified as threatened. Although the Natural Heritage Database did not identify any federally-listed plant species as occurring within one-eighth mile of the corridor area, the USFWS has identified three federally-listed threatened species, Ute ladies'-tresses (*Spiranthes diluvialis*), Spalding's catchfly (*Silene sapldingii*), and Howellia (*Howellia aquatilis*) as having potential habitat present within the project corridor.

Ute ladies'-tresses is a federally-listed threatened species and a state threatened species. This species is known to occur in eight western states. There are several occurrences of this species in

Washington State, but this species is not known to occur in any of the counties within the project area. Ute ladies'-tresses is a perennial orchid that is generally found in low elevation wetlands in valleys. One of the known Washington State occurrences is within a periodically flooded alkaline, wet meadow that is adjacent to a sagebrush steppe community with big sagebrush, bitterbrush, and rabbitbrush. Ute ladies'-tresses is generally associated with spikerush, sedge species, grasses, and rushes.

Spalding's catchfly is a federally-listed threatened species and state threatened species that occurs with the snowberry/Idaho fescue dominated plant communities. Spalding's catchfly occurs in native grasslands that are in reasonably good ecological condition, although populations have persisted in areas that have had moderate grazing pressure. Populations tend to be quite small and are currently quite fragmented, raising questions about their long-term viability. The species begins to flower in mid- to late July, with some individuals still flowering by early September. Some of these sites occur in a mosaic of grassland and ponderosa pine forest.

Howellia is a federally-listed threatened species and state threatened species that is known to occur in Spokane County. Howellia occurs in small, vernal ponds within the forested portions of the channeled scablands. Howellia requires exposure to air to germinate and inundation for growth in the spring restricting the species to the zone within wetlands that is seasonally inundated, although some portion of the ponds may retain water throughout the year. Howellia is generally associated with aspen, water parsnip (*Sium suave*), bur-reed (*Sparganium* sp.), bladderwort (*Utricularia* sp.), pondweed (*Potamogeton* sp.), and reed canary grass.

During early June 2002, a survey of the corridor identified potential habitat for Ute ladies'-tresses, Howellia, and Spalding's catchfly. Some of the wetlands within the project area are potential habitat for Ute ladies'-tresses. Potential Spalding's catchfly habitat is present within some of the forest/deciduous shrub community, as evidenced by the presence of the species it is normally associated with.

A rare plant survey will be conducted in the summer of 2002 in areas identified as potential habitat in order to determine if these species are present in the corridor. If any waterways or wetlands would be impacted, those areas will be surveyed for Ute ladies'-tresses and Howellia.

Noxious Weeds

Disturbed areas may become infested with noxious plant species without proper vegetation management.

Weeds are plant species designated as such by federal or state law. The detrimental effects of weed species are numerous and the invasion of public and private lands by weed species is a matter of great concern. Noxious weeds can threaten native plant communities by displacing native species, invading farmlands, and injuring humans and animals. Some weed species form monocultures, reducing biodiversity. Weeds reduce the quality of wildlife habitat when they replace native food source and cover species. Some weeds contribute to the rapid spread of fire by providing fuel. Most weeds are not as efficient at binding soil, contributing to soil erosion by water and wind. Washington State law designates some particularly troublesome weeds as "noxious weed" species (Washington's Weed Law, Washington Administrative Code, Chapter 17-10 RCW). The Washington State Noxious Weed List is divided into three classes within each county, based on the state of invasion:

- **Class A Weeds** have a limited distribution in the state and state law requires eradication of these species.
- **Class B Weeds** are established in some regions of the state but are limited in their distribution. The type of control required varies in each region depending on the degree of establishment. When these species are either unrecorded in a region or limited in distribution, they are considered a "Class B Designate" species, which means they are designated for control by state law.
- **Class C Weeds** are widely established and of interest to the agricultural industry. Some of these weeds are controlled on a local basis depending on local threats and the feasibility of control.

County Noxious Weed Control Boards coordinate weed detection and control activities, emphasizing prevention of invasion by noxious weeds, eradication when possible, and containment of established species on state owned and private lands. To accomplish this, counties adopt a county-weed list each year, also divided into Classes A-C, based on the degree of threat they pose to that county. Counties also maintain Education Lists, which include weeds that are not included in Class A-C but that the Weed Board will assist landowners in control efforts.

Not all undesirable plant species are officially designated as state weeds. For example, although land managers are concerned about the spread of non-native grass species such as medusa head and cheatgrass, these species are not on state weed lists. These weedy grass species are fairly widespread and have undesirable effects on plant communities, particularly shrub/steppe.

Some weeds were noted in the project area during the summer of 2002 and a comprehensive weed survey will be conducted prior to construction. The following weeds occur within the transmission line corridor:

Table 3-18. Weeds of Concern in Project Area*

	County Class		
Common Name	Spokane County	Lincoln County	Grant County
Canada thistle	C	C	C
Common tansy		C	
Dalmatian toadflax	B	B	B
Diffuse knapweed	B	B	B
Perennial sowthistle		B	
St. John's wort		C	C

*Species provided by County Weed Boards (NWCB of Grant County, 2002, NWCB of Spokane County 2002, and NWCB of Lincoln County 2002)

Environmental Consequences

The proposed transmission line project would result in both permanent and temporary impacts to vegetation within the project corridor. Permanent impacts occur from actions that would result in the removal and loss of vegetation in such a way that the reestablishment of the preconstruction vegetation community is very unlikely. Four project actions would result in permanent impacts to vegetation within the construction footprint: construction of new towers, new access and spur road construction, widening of existing roads, and the expansion of the Bell Substation.

Temporary impacts occur from actions that would disturb vegetation, but would not permanently prevent the reestablishment of the preconstruction vegetation cover type. Project actions that would result in temporary impacts to vegetation include construction work areas around the tower sites, conductor tensioning, and staging areas sites. With proper best management practices and possible mitigation, some impacts, such as those that occur only during construction, are short term or temporary because over time native revegetation may occur if weed species are controlled. Shrub/steppe is very slow to recover and may never fully recover. Areas dominated by deciduous shrubs are likely to recover more quickly but still take a considerable time to return to pre-disturbance conditions.

Impacts from ongoing disturbances, such as corridor maintenance, could have a long-term effect on plant species composition and plant communities through removal of tall-growing vegetation. These areas would be typically limited to areas that are forested, because corridor maintenance would remove trees and a grass/forb or shrub dominated plant community would dominate.

Impacts can also be categorized as direct or indirect. Direct impacts, such as vegetation clearing and soil compaction, are generally immediate and confined to the project area. This would occur around tower sites, conductor tensioning sites, staging areas, and where access road improvement would occur. Indirect impacts, such as vegetation crushing, sedimentation, and the introduction of weedy plant species, can occur outside the direct impact area and may take a longer period of time before effects become apparent.

Impact Definitions

A **high** impact would occur under the following circumstances:

- Native vegetation with little to no exotic species would be significantly reduced or damaged by altering substrate (soil compaction or rocking), reducing native plant diversity and mitigation cannot provide full compensation.
- Activities would result in impacts to federally-listed species and mitigation cannot provide full compensation.
- Noxious weeds would be introduced into a high quality native plant community and mitigation cannot provide full compensation.

A **moderate** impact would occur under the following circumstances:

- Native plant communities are disturbed by altering substrate, reducing native plant diversity and mitigation might not provide full compensation.
- Activities would result in impacts to federally-listed species and mitigation might not provide full compensation.
- Activities would result in increasing noxious weeds into the area and mitigation might not provide full compensation.

A **low** impact would occur under the following circumstances:

- Plant species or communities affected would be temporarily disturbed but natural recovery to pre-disturbance conditions would be likely and mitigation would provide nearly full compensation.
- Activities would result in impacts to federally listed species and mitigation would provide nearly full compensation.
- Activities resulted in areas where noxious weed densities do not increase substantially within areas where they already exist; mitigation would provide nearly full compensation.

Impacts

Towers and Related Construction

Removal of existing wood pole structures would result in direct and indirect impacts to vegetation. Direct impacts could result from crushing vegetation or soil compaction during accessing the old structures. Approximately 756 existing wood pole structures would be excavated or cut off 2 feet below ground level and holes backfilled with native material. Typically, a 6-foot radius area is excavated around each wood pole structure for removal. The total area that would be disturbed by removal of existing wood pole structures would be approximately 17.4 acres, with about 8.7 acres of this in agricultural fields, 4.4 acres in forested habitat, and 3.5 acres in shrub/steppe habitat. Indirect impacts could occur if vegetation was crushed to the extent that noxious weeds could become introduced. The impact level would be low to moderate.

Construction areas around towers would result in direct and indirect impacts to vegetation. Typically a 0.5-acre radius around each tower would be disturbed for tower installation. About five structures would be constructed within each mile of corridor. The total area disturbed by tower construction would be about 210 acres out of 1,528 acres, with about 52 acres of this in forested habitat and 42 acres in shrub/steppe habitat. Direct impacts would result from temporary removal of vegetation (including roots), excavating and grading, and installing footings. Plants could be broken, uprooted, or trampled by construction vehicles. Indirect impacts could occur if vegetation was crushed to the extent that noxious weeds could become introduced. Where appropriate, topsoil and the seed bank the soil contains would be stockpiled and replaced after construction is completed. Revegetation of the plant community from the seed bank and natural recruitment, or mitigation, if required, along with noxious weed control, would recolonize the disturbed areas. The impact level would be moderate.

Construction of new towers would result in direct and indirect impacts to vegetation. Direct impacts would result from the permanent removal of vegetation in a 2,500 square foot area for footing placements. Installation of 420 towers would result in permanent removal of 24 acres of vegetation, with about 6 acres of this in forested habitat and 5 acres in shrub/steppe habitat. Indirect impacts could occur if noxious weeds could become introduced. The impact level would be low to moderate.

Conductor tensioning sites and staging areas would result in direct and indirect impacts to 42 acres of vegetation. Although the exact locations are unknown, it is assumed that approximately 11 acres of this would be in forested habitat and 8 acres in shrub/steppe habitat. Depending on the location chosen for these sites, direct impacts could result from vegetation being broken, uprooted, or trampled. Indirect impacts could result from noxious weeds becoming established before native species have recovered. With proper mitigation, the impact level would be low to moderate.

Road Construction

Construction of new access roads would have direct and indirect impacts to vegetation. Direct impacts would result from removal of vegetation (including roots) during grading and rocking and soil compaction. Indirect impacts could result from erosion of roads introducing sediments to undisturbed areas, smothering vegetation. The total area disturbed as a result of construction of approximately 4.9 miles of new access roads would be 15.6 acres, with about 7.8 acres in forested habitat and 6.2 acres in shrub/steppe habitat.

Short segments of the access roads would need to be realigned, as new tower placements are too close to the existing road to allow the passage of construction equipment. Proposed realignment of access roads include moving the road to the south of its current location near corridor miles 35/3, 35/5, 35/7, 36/1, and 36/3 and moving the road to the north of its current location near corridor miles 35/9, 37/6, 38/6, and 40/1. In addition, there a few locations where the access road goes under existing steel towers and there is not enough clearance for construction equipment (e.g., corridor mile 36/3 and 38/3). Short segments of new access roads would need to be constructed around the existing towers to allow for the passage of construction equipment. Although the vegetative communities within the proposed new road segments would be impacted due to the removal of vegetation and soil compaction, these impacts could be mitigated by revegetation and eventual natural recolonization of the abandoned segments by plant species. Therefore, low to moderate impacts could be expected from the realignment of access roads within the corridor, unless a federally-listed species is present.

A temporary short road may be constructed just west of Lincoln County Road 913. Most land in this area is agricultural land. Impacts to agricultural lands due to the proposed project are not expected be substantially affected by a new access road because with proper weed control, pre-disturbance conditions would occur shortly after construction is completed. Therefore, impacts would be low.

Within a portion of corridor mile 36, a new access road is proposed within the corridor. Native forb and shrub vegetation within the proposed new road segments would be impacted through vegetation removal and soil compaction. Revegetating the abandoned segments would partially mitigate these impacts. Moderate to high impacts would be expected from the construction of the realignment of access roads within the corridor because this is an area vegetated primarily with native species, with few weed species, and has been identified as potential habitat for a federally-listed plant species.

Construction of spur roads would have direct and indirect impacts to vegetation. Direct and indirect impacts are similar to those described above for compaction. The total area disturbed as a result in construction of approximately 2 miles permanent spur roads would be about 6.3 acres, with about 3.2 acres in forested habitat and 2.5 acres in shrub/steppe habitat. The impact level would be moderate to high because this is an area vegetated primarily with native species, with few weed species.

Improvements to existing access roads would have direct and indirect impacts to vegetation. Direct impacts would result from vegetation removal and/or burying from grading and rocking within the existing road footprint, widening existing roads, and vegetation crushing from vehicle use. Indirect impacts could result from erosion of roads introducing sediments to undisturbed areas, smothering vegetation. The total area disturbed as a result of 16.6 miles of road improvements would be approximately 52.5 acres, with about 26.3 acres in forested habitat and 21 acres in shrub/steppe habitat. Most road improvements would occur within the existing footprint of the road in shrub/steppe or forested communities that have already been disturbed by vehicle use. Based on observation and preliminary information, the impact level would be low to moderate, unless a federally-listed species is present.

There are a few areas where the existing access road would need to be widened to accommodate the large construction equipment needed for construction activities, including some sections of access road outside of the corridor. Widening existing access roads would have direct and indirect impacts similar to those described above. Most of the access roads pass through forest/shrub vegetation that could potentially be cleared to allow widening (i.e., near corridor miles 39/2, 41/5, 52/2, 53/1, 53/4, 73/1, 79/2, and 80/4). Some widening could occur in riparian forest communities (e.g., near corridor mile 41/2 and 43/2). Forest communities are scattered in the project vicinity and impacts to forests can be mitigated. Based on observation and preliminary information on the extent of the areas that would need to be widened, the impact level would be low to moderate unless federally-listed species are present.

Widening the corridor across ravines and canyons, if required, could cause direct and indirect impacts. Direct impacts would result from the removal of tall trees and shrubs that could potentially interfere with transmission lines. However, low-growing vegetation would not be affected. Most of the removal of tall growing vegetation along the corridor would be in the canyons of Hawk Creek, an area east of Welsh Creek Canyon, and the area between Saben and Squaw Creek canyons. Indirect impacts could result from the introduction of plant species, both native and non-native, currently not present. With the removal of tall plants, the canopy would be opened up, allowing more sunlight into the area. Plant species adapted to less shade could out-compete those species that prefer shady areas. It is currently unknown how much, if any, tall growing vegetation would need to be removed to allow for transmission line clearance. Depending upon the amount of land affected, the impact level to ponderosa pine-dominated forests could be low to moderate because most of the habitat losses would occur in this one plant community.

Installing/replacing culverts could result in direct or indirect impacts to vegetation. Direct impacts would result from vegetation removal during installation. Indirect impacts could result from erosion of roads introducing sediments to undisturbed areas, smothering vegetation or if vegetation was crushed to the extent that noxious weeds could become introduced. Most of the area disturbed by installing or replacing culverts would occur within the existing footprint of the road. Based on observation and preliminary information, the impact level would be low to moderate, unless a federally-listed species is present.

Operation and Maintenance

Operation of the new transmission line would not have direct and indirect impacts to vegetation. Therefore, the impact level would be no impact.

Maintenance of the new transmission line would have direct and indirect impacts to vegetation. Direct impacts would result from vegetation that would be periodically cut and maintained to allow access to transmission facilities as well as tall growing vegetation that could interfere with lines. Indirect impacts would result from the continued use of access roads damaging root structures, dust clogging leaf surfaces, and the spread of weed species. Vegetation management would be carried out in accordance with BPA's Vegetation Management Program. Because the maintenance activities would be almost entirely within an existing corridor that has been maintained for nearly 50 years, continued maintenance would have a low impact level.

Noxious Weed Species

All activities associated with the construction and maintenance of the transmission line could have direct impacts to vegetation as a result of noxious weeds. Direct impacts would result from noxious weeds being inadvertently spread when vehicles travel between infested and non-infested areas during construction and maintenance. Indirect impacts to native vegetation can result if noxious weeds take advantage of disturbed soils and lack of competing vegetation to invade areas recently cleared. The impact level would be low to moderate.

BPA would conduct a weed survey prior to construction to determine the occurrence, extent and species of noxious weeds within the project area. BPA would take measures to lessen the spread or introduction of noxious plants during construction including developing a Weed Control Plan and consulting County Weed Control Boards for recommendations (see **Mitigation**).

Threatened and Endangered Species

A survey of potential habitat for listed species identified during the June surveys will be conducted in late July or early August 2002 to determine if these species occur within the corridor. Preliminary assessment of corridor vegetation indicates that although areas have been disturbed, suitable habitat for listed species exists within the corridor.

Although full impacts cannot be addressed until a survey is done of all potential habitat areas that would be impacted by project activities, a Biological Assessment analyzing the effects of the project on federally-listed threatened and endangered species will be conducted pursuant to Section 7 of the Endangered Species Act.

Environmental Consequences of the Alternative Action

Vegetation impacts would be the same for the alternative that would have more double-circuit line.

Cumulative Impacts

Plant species and communities are interdependent parts of a complex system of soil, water, human and animal life, and many other biological resources. The system is weakened when plant communities are destroyed, become fragmented, or when important native habitats are invaded by non-native weeds. During the last century, agricultural development in the project area has had a significant impact on the amount of native plant communities within the landscape and on native plant ***biodiversity***. Due to the high value of some agricultural lands within the Columbia River Basin, the loss of shrub/steppe has accelerated. Within the area, the Department of Natural Resources continues to offer leases to state-owned lands for agricultural uses. In Washington, the continued loss of shrub/steppe in the next 50 years is projected to be high (BPA 2002).

Impacts to rare plant species could occur due to land use such as grazing, but it is likely that federal agencies will prioritize the protection of rare species habitats. Federal agencies are addressing the needs of rare plant species and staff members are assigned to deal with rare plant issues on federal lands. However, rare plant species in private areas receive little to no protection under federal and state rare and endangered species legislation. Rare species would be continued to be impacted by a variety of land uses typical of private lands, including farming, ranching and development.

Many people believe that the invasion by weed species represents the most significant threat to biodiversity within the western United States. Native steppe and shrub/steppe communities have declined substantially in recent years, and such undisturbed plant communities are essentially absent from the corridor. The evidence supporting this conclusion is the presence of a diversity of native species that have persisted in the corridor despite the operation and maintenance of four transmission lines. Therefore, new transmission facilities within an already disturbed existing corridor would affect some habitat, but is not expected to have a substantial impact on plant biodiversity.

Mitigation

Efforts to avoid and minimize impacts to vegetation include the following:

- Locating the proposed project within the existing corridor, where possible.
- Using the existing access road system, with minimal development of new roads.
- Locating staging areas and conduction tensioning sites outside of good quality native habitat areas, where possible.
- Restricting travel to one area where spur roads would traverse lithosols to prevent damage to sensitive plant communities.
- Keeping vegetation clearing to the minimum needed to access construction areas and maintain safety and operational standards.
- Reseeding or revegetating disturbed areas following construction with native vegetation.

- Controlling noxious weed infestations by cleaning equipment traveling in and out of noxious weed-infested areas, using herbicide or biocontrol treatments, and reseeding disturbed areas with native species.

- Conducting a pre-construction noxious weed inventory to gather baseline information and develop a noxious weed control plan.

- BPA would assist and cooperate with concerned landowners and county weed boards, to implement noxious weed control procedures.

- If federally-listed plant species are identified during the plant survey, these areas would be avoided, if possible. A Biological Assessment, as required under the Endangered Species Act, would be prepared that provides detailed actions to reduce or eliminate impacts on listed species, and BPA would implement any reasonable measures recommended the U.S. Fish and Wildlife Service to reduce or avoid impacts.

Environmental Consequences of the No Action Alternative

Current levels of disturbance to vegetation associated with ongoing maintenance activities for the existing transmission line, substations, and right-of-way would continue under the No Action Alternative. This would include breaking, uprooting, trampling and removing vegetation; localized soil disturbance; and potential sedimentation due to vehicular traffic, transmission structure replacement, vegetation management activities, and access road improvements. No new impacts to vegetation are expected under this alternative.

Fish

Affected Environment

The 84-mile corridor crosses 89 streams. However, the majority of these streams (55) are ***ephemeral*** non-fish-bearing streams that contain flowing water only during relatively brief periods following snow melt or rain storms. The remaining 34 streams within the corridor are considered to be ***perennial*** and contain some water year-round during normal rainfall years. The corridor crosses four waterways (Hawk Creek, Coulee Creek, Deep Creek, and the Spokane River) that contain sufficient water flow to support seasonal or year-round fisheries.

Hawk Creek is a perennial stream that flows northward across the corridor between corridor miles 39/1 and 39/2. The section of the creek within the corridor is approximately 7.7 miles upstream of where the creek discharges into Franklin D. Roosevelt (FDR) Lake. Hawk Creek Falls, which is located just upstream of the mouth of the creek, forms an impassible barrier to upstream fish movement. No fish surveys have been published in the recent scientific literature describing habitat or fish populations in the section of creek upstream of Hawk Creek Falls. However, the sections of creek above and below Hawk Creek Falls are thought to support populations of brook trout and rainbow trout (DeLorme 2001). Bull trout may occasionally move into the section of Hawk Creek below Hawk Creek Falls from FDR Lake but the falls prevent bull trout from moving further upstream. Riparian habitat along Hawk Creek has been designated as priority habitat for fish and wildlife by the Washington Department of Fish and Wildlife (WDFW) (Figure 3-39).

Coulee Creek is an ephemeral stream that flows generally eastward, crossing the corridor between corridor miles 75/6 and 75/7. The section of creek within the corridor is approximately 0.6 miles upstream from where the creek discharges into Deep Creek. Deep Creek is an ephemeral stream that flows northeastward, crossing the corridor between corridor miles 75/8 and 76/2. The section of creek within the corridor is approximately 1.3 miles upstream from where the creek discharges into the Spokane River. These creeks may contain pockets of spring water that might seasonally support fish. No recent surveys have been conducted to document fish use of the creeks; however, rainbow trout and brook trout may utilize the creeks during periods of water flow (personal communication, J. Whalen, WDFW, June 12, 2002).

The corridor crosses the Spokane River at the head of Nine Mile Pool Reservoir between corridor miles 77/3 and 77/4. The Spokane River supports fish species adapted to both riverine and ***lacustrine*** environments. Salmonid species include rainbow trout, brown trout, and mountain whitefish. Other fish species may include largemouth sucker, sculpins, dace, redside shiner, and northern pikeminnow. Riparian habitat along the Spokane River has been designated as priority habitat for fish and wildlife by the WDFW (Figure 3-39).

Threatened and Endangered Species

The U.S. Fish and Wildlife Service (***USFWS***) has identified the bull trout as the only Endangered Species Act (ESA) listed fish species that may occur in the vicinity of the project. This species, which was listed as threatened by USFWS in 1999, may occur in lower Hawk Creek downstream of Hawk Creek Falls and in the Spokane River.

The project corridor crosses Hawk Creek approximately 7.7 miles upstream from Hawk Creek Falls, which forms an impassible barrier to upstream fish movement. Thus, bull trout are not present in the vicinity of the corridor in the Hawk Creek watershed.

Bull trout that may occur in the Spokane River in the vicinity of the project are believed to be migrants from the Pend Oreille bull trout stock as water temperatures in the Spokane River are considered to be too high to allow the fish to successfully reproduce. Although the Pend Oreille stock is regulated under ESA, bull trout within FDR Lake or its tributaries are not regulated under ESA (Deeds, 2002).

Environmental Consequences

Routine operation of the transmission line is expected to have no impacts to fish. Construction and maintenance of the new transmission line and access roads, including culvert replacements, could have short- and long-term impacts to fish. Construction could cause short-term and localized increases in turbidity and sediment in fish-bearing streams due to the erosion of exposed soils entering the streams. Increases in turbidity could result in avoidance of immediate work areas by fish. Increases in sediment during the spawning and incubation period (April to June for rainbow and brook trout) could result in sediment deposition over spawning areas, suffocating eggs and fry. Removing riparian vegetation during construction and maintenance could increase water temperatures above those preferred by fish, reduce vegetative cover along stream banks, and reduce rates of wood recruitment into the stream. Implementation of best management practices during construction would greatly reduce the quantity of sediment introduced into streams and avoid low to moderate impacts to fish populations.

Impact Definitions

A **high** impact would occur under the following circumstances:

- Construction activities directly adjacent to or across fish-bearing streams release sediment into the streams during critical spawning and incubation periods for trout.
- Removal or modification of riparian vegetation results in increased water temperatures in fish-bearing streams.
- Removal or modification of riparian vegetation results in substantially reduced rates of large woody debris recruitment or vegetative cover along stream banks.

GRAND COULEE - BELL 500kV TRANSMISSION LINE PROJECT

PRIORITY HABITAT/SPECIES

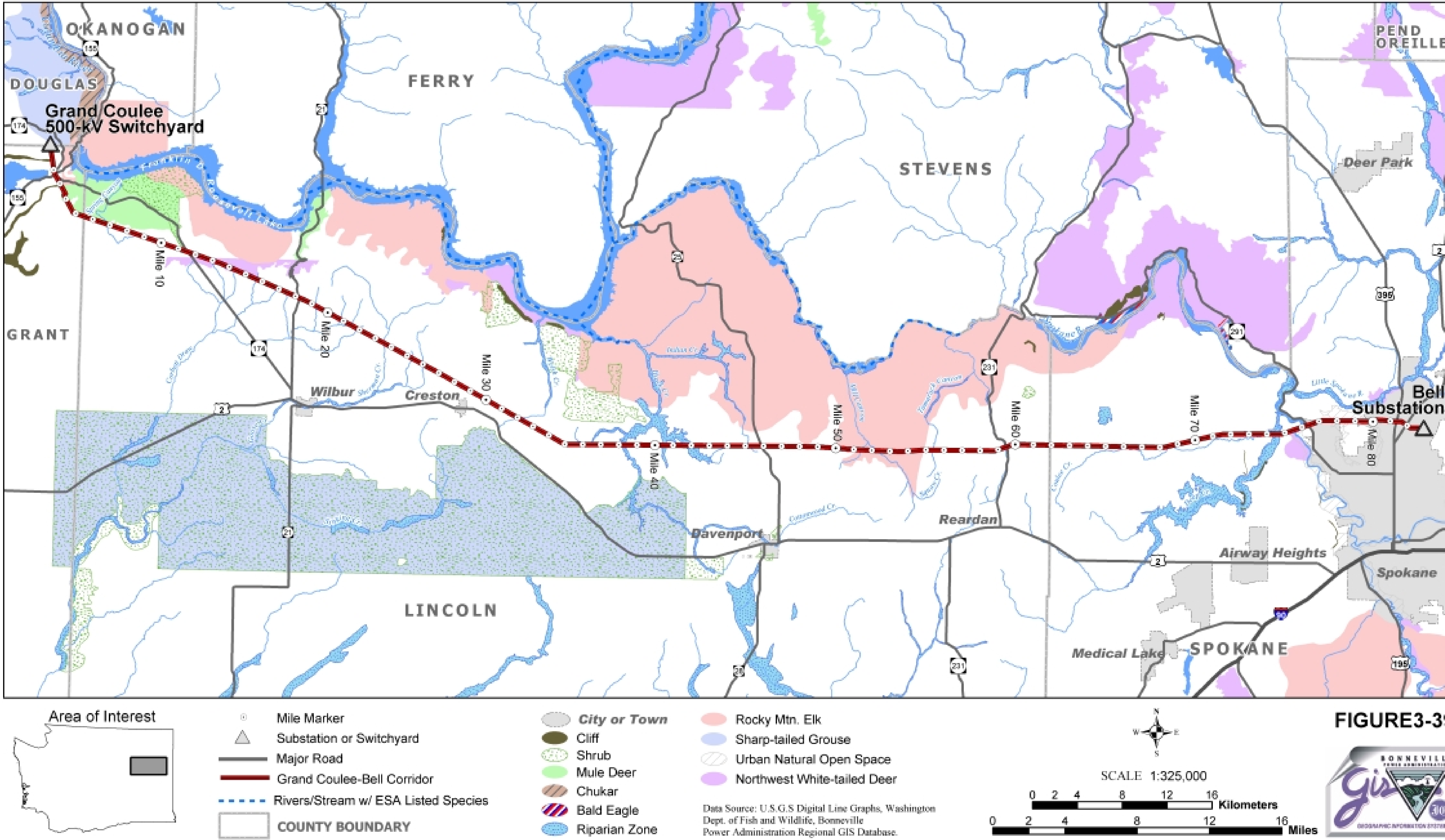

FIGURE3-39

A **moderate** impact would occur under the following circumstances:

- Construction activities release sediment into fish-bearing streams outside of the critical spawning and incubation periods for resident trout.
- Removal or modification of riparian vegetation results in locally reduced vegetative cover along stream banks but does not change stream water temperature. However, fish abundance and distribution may change in the immediate vicinity of modifications to riparian vegetation.
- Removal or modification of riparian vegetation results in reduced rates of large woody debris recruitment or vegetative cover along stream banks.

A **low** impact would occur under the following circumstances:

- Construction activities release small volumes of sediments into spawning streams outside of the critical spawning and incubation periods for resident trout.
- Construction and line maintenance activities result in minor modifications to riparian vegetation but do not affect stream water temperature or fish abundance or distribution.
- Removal or modification of riparian vegetation does not result in reduced rates of large woody debris recruitment or vegetative cover along stream banks.

No impact occurs if fish would not be affected by towers and related construction, access roads, or operation and maintenance of the transmission line.

Impacts

Towers and Related Construction

Removal of existing wood pole structures would not result in direct impacts to fish because no structures are located within streams. The removal of the existing structures would, however, have indirect impacts to fish. Indirect impacts could result from exposed soils eroding into fish-bearing streams or riparian vegetation being damaged during structure removal. Typically, existing wood pole structures would be excavated or cut off two feet below ground level and holes backfilled with native material. However, structures located adjacent to fish-bearing streams would be cut off at ground level. The wood poles in these locations would be dragged out or lifted out by crane to avoid bringing in construction equipment near the stream. Sediment introduced to fish-bearing streams could have a low to high impact level, depending on the amount and timing of sediment entering the stream. To reduce potential impacts due to sedimentation, best management practices, such as the installation of a silt fence or the use of geotextile fabric, would be followed during construction to prevent or reduce the amount of sediment introduced into fish-bearing streams.

Construction areas around towers would not have direct impacts to fish because no towers would be located in streams. These areas could, however, result in indirect impacts to fish. Indirect impacts could result from exposed soils eroding into fish-bearing streams or riparian vegetation being damaged during tower installation. Sediment introduced to fish-bearing streams could have a low to high impact level, depending on the amount and timing of sediment entering the stream. Removal of riparian vegetation within construction areas would have a low to moderate impact level.

Construction of new tower pads would not have direct impacts to fish because no towers would be located in streams. The construction of new tower pads could, however, result in indirect impacts to fish. Indirect impacts could result from exposed soils eroding into fish-bearing streams or riparian vegetation being damaged during tower pad installation. Sediment introduced to fish-bearing streams could have a low to high impact level, depending on the amount and timing of sediment entering the stream. Removal of riparian vegetation within construction areas would have a low to moderate impact level.

Conductor tensioning sites and staging areas would not result in direct or indirect impacts to streams. Although the exact locations are unknown, these areas would not be placed within 400 feet of streams. The impact level from conductor tensioning sites and staging areas would be low.

Road Construction

Construction of new access roads would have indirect impacts to fish. Indirect impacts would result from the removal of riparian vegetation, disturbance of soils and the introduction of sediment into fish-bearing streams. Removal of riparian vegetation and soil disturbance could introduce sediment into streams. Removal of riparian vegetation could also cause increases in stream temperatures. The existing access road between corridor miles 75/1 to 75/8 is located to the south outside of the right-of-way. This section of road, which crosses over Coulee Creek between corridor miles 75/6 and 75/7, may be relocated within the right-of-way. Potential impacts to Coulee Creek fisheries during construction of the new access road would depend on the timing of construction activities. The greatest potential for adverse impacts to fish would occur if construction occurs during periods when water is present in Coulee Creek. Implementation of best management practices for erosion control during access road construction and construction timing would result in low to moderate impact levels to fish in Coulee Creek. No new access roads are proposed in the vicinities of Deep Creek or the Spokane River, therefore no impacts to fish would occur.

Construction of temporary spur roads would not have direct impacts to fish because no spur roads are proposed to be built across fish-bearing streams. Construction of temporary spur roads could have indirect impacts to fish from soil entering fish-bearing streams. Sediment introduced to fish-bearing streams could have a low to high impact level, depending on the amount and timing of sediment entering the stream.

Improvements to existing access roads would not have direct impacts to fish because no access road improvements are proposed across fish-bearing streams. Indirect impacts to fish would result from soil entering fish-bearing streams. The existing access road from corridor miles 39/1 to 39/6 would be improved to reduce existing road runoff and erosion. Improvements may include grade modifications, addition of rock, or construction of drain dips. This section of access road crosses over Hawk Creek between corridor miles 39/1 and 39/2. Potential impacts to Hawk Creek fish during access road improvements would depend on the timing of construction activities. If access road improvements occurred during the April-June spawning and egg incubation interval for trout, impact levels would be high; otherwise impacts would be low to moderate. To reduce potential impacts due to sedimentation, best management practices, such as the installation of a silt fence or the use of geotextile fabric, will be followed during access road improvements to prevent or reduce the amount of sediment introduced into fish-bearing streams. The planned improvements to the access road in this section of the corridor are expected to have long-term beneficial effects on fish populations by reducing the amount of road runoff and erosion that is currently occurring in the vicinity of Hawk Creek.

Installing/replacing culverts could have indirect impacts to fish. Although culverts would be replaced or new culverts installed at a number of locations where access roads cross ephemeral streams, no culverts will be placed in fish-bearing streams. Indirect impacts could result from sediment being introduced into intermittent streams that are tributaries to a fish-bearing stream and transported into the fish-bearing stream. The impacts to fish would depend on the water flows in the intermittent channel, distance from the source of sediment to the fish-bearing stream, and timing of the sediment release. Impacts would likely range from low to moderate as a result of culverts being installed in ephemeral streams.

Operation and Maintenance

Operation of the new transmission line would have no direct or indirect impacts to fish.

Maintenance of the new transmission line would have direct and indirect impacts to fish. Direct impacts would result from culvert replacements that may occur if existing culverts become damaged. Indirect impacts would result from habitat alteration due to cutting of riparian vegetation, use of pesticides, changes in runoff and infiltration patterns (from upland vegetation clearing), sedimentation from cleared areas, and maintenance access across streams. Since riparian areas are extremely important in providing stream shading and cover for fish, and are a source of large woody debris in streams, any clearing of stream-side riparian vegetation would likely cause moderate to high impacts to fish-bearing streams. Impacts would be minimized with the implementation with standard maintenance practices described in Transmission System Vegetation Management Program.

Threatened and Endangered Species

No federally protected stock of bull trout exists within the project area; therefore, no impacts to bull trout would be expected. Although not federally regulated, the Franklin D. Roosevelt Lake stock of bull trout may occur in the Spokane River and lower Hawk Creek. Because no high to moderate impacts to these aquatic systems would occur, no adverse impacts to local stocks of bull trout are expected.

Environmental Consequences of the Alternative Action

Impacts to fish would be the same for the alternative action.

Cumulative Impacts

In the Columbia River Basin ecosystem, fish distribution and population have been reduced by loss, fragmentation, and degradation of streams. Species such as salmon and trout have declined dramatically in the region since the conversion of rivers to reservoirs. Erosion and sedimentation of streams and loss of riparian habitat within the study area has increased over the past 100 years due to land use practices such as grazing, agriculture, road building, land clearing, military operations, and other disturbances. This has contributed to a reduction in the quality and availability of fish habitat in many streams. No fish barriers would result from the project and important migration corridors would not be impacted. Some riparian habitat would be lost as a result of the proposed project, adding cumulatively to the degradation of fish habitat. The planned improvements to the access road in the vicinity of Hawk Creek are expected to have long-term beneficial effects on fish populations by reducing the amount of road runoff and erosion that is currently occurring in the vicinity of this creek.

Mitigation

To reduce potential construction impacts to fish, mitigation recommended by WDFW that minimizes the quantity of sediments deposited into rivers and streams would be implemented, such as:

- Use silt fences and straw bales to separate construction activities from watercourses and drainages.
- Limit disturbance to the minimum necessary when working adjacent to fish-bearing streams.
- Avoid mechanized land clearing within riparian areas to avoid soil compaction from heavy machinery, destruction of live plants, and potential alteration of surface water patterns.

- Deposit and stabilize all excavated material not reused in an upland area. No used material would be deposited in environmentally sensitive areas such as streams, riparian areas, wetlands, and floodplains.
- Apply erosion control measures such as silt fence, straw mulch, straw wattles, straw bale check dams, or other soil stabilizers in the vicinity of fish bearing streams.
- Coordinate with the WDFW on placement or replacement of suitable-sized culverts at all drainage crossings.
- Revegetate all construction-caused, exposed soils with native plants.
- Avoid refueling and/or mixing hazardous materials where accidental spills could enter surface or groundwater.

In addition, construction activities near streams should be avoided to the extent possible when there is water present in the streams and during the April-June period of trout egg incubation.

No mitigation would be implemented for operation or maintenance activities.

Environmental Consequences of the No Action Alternative

Current levels of disturbance to fish resources associated with ongoing maintenance activities for the existing transmission line, substations, and right-of-way would continue under the No Action Alternative. This would include localized soil disturbance and potential sedimentation of streams due to vehicular traffic, transmission structure replacement, vegetation management activities, and access road improvements. The management and clearing of vegetation within riparian areas along the corridor, which could impact fish cover, wood recruitment to streams, and water temperatures, would also continue under this alternative. In addition, vehicle and machinery use and vegetation management practices could contribute minor amounts of pollutants that could be transported to streams. No new impacts to fish resources are expected under this alternative.

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Wildlife

The corridor passes through three major wildlife habitat communities: agricultural, steppe (grass/forb and shrub steppe vegetation communities), and pine forest. In addition, the corridor crosses distinct, localized habitat areas: riparian and riverine habitats along the Spokane River; rock outcroppings and cliff habitats between the Columbia River and Banks Lake; and areas disturbed by urban development north of Spokane. A complete list of wildlife identified as potentially occurring within the corridor is shown in Table C-3 in Appendix C.

Affected Environment

Agricultural Habitat

Approximately 50 percent of the habitat available to wildlife along the corridor is agricultural land. These areas are primarily used for dryland farming and include wheat fields, fields planted to pasture, cover vegetation, or areas allowed to naturally reseed. No native vegetative communities exist on these fields. In general, these monocultural plant communities, such as wheat, are disturbed by plowing, seeding, and harvest annually. Although agricultural land does not support large wildlife populations, it does provide cover for short periods of time while vegetation is maturing, and food sources when there are emerging sprigs and waste grain present. Although pasture land and along fences may not be dominated by native vegetation, pasture land is less frequently disturbed by plowing and harvesting and provides wildlife habitat year round. Agricultural land provides habitat for some wildlife, especially skunks, coyotes, ring-necked pheasants, mallards, and Canada geese. Other wildlife, such as white-tailed deer, likely use the agricultural habitat that is located near other, more preferred, foraging and refuge habitat.

Steppe

Columbia Basin steppe is the second largest wildlife habitat crossed by the corridor and includes grass/forb and shrub/steppe vegetation communities. Over 70 wildlife species are found in Washington steppe habitats (Table C-3). Common species include the turkey vulture, chukar, Washington ground squirrel, and western rattlesnake. Some species such as sage grouse, sage thrasher, Brewer's sparrow, sage sparrow, pygmy rabbit, and the Great Basin pocket mouse are exclusively dependent on shrub steppe habitat to survive.

Approximately 60 percent of the original steppe wildlife habitat has been lost in the Columbia River basin and most of the remaining habitat degraded as a result of farming and livestock grazing (Schroeder et al. 2000 and WDA 2001). Livestock grazing reduces soil productivity and breaks the crust of fungi on the soil. With the soil crust broken, weed species such as cheatgrass and Kentucky bluegrass can invade and out-compete native plants. The loss of native vegetation changes wildlife use and has been attributed to the population decline of species such as the pygmy rabbit and the sage grouse, both of which are dependent upon shrub/steppe habitats

(Schroeder et al. 2000 and WDFW 2001). Any steppe habitat, especially shrub/steppe habitat that retains native species and supports native wildlife is highly valued.

Pine Forest and Deciduous Shrub

The eastern quarter of the corridor passes through mostly grassland and open ponderosa pine forest, with some deciduous shrubland/pine mixes. These second-growth pine forests provide habitat for a variety of wildlife, especially the peregrine falcon, western tanager, Cassin's finch, red crossbill, wild turkey, yellow pine chipmunk, and porcupine. Pine habitats near the Spokane River riparian zone are also heavily used by white-tailed deer and beavers.

Other Habitats

Other habitats include wetlands, the open water of the Spokane River, rock outcroppings near Grand Coulee, and residential areas. Although these habitats do not comprise a significant portion of the corridor, they support unique wildlife populations. Wetlands provide specific habitat for a variety of specially adapted animals, such as amphibians and waterfowl. Wetlands with year-round water provide an important source of water for wildlife in this arid environment (see Chapter 3 Wetlands). The open water of the Spokane River is important habitat for beavers and resting waterfowl and also provides foraging habitat for bald eagles and osprey. Outcrops near Grand Coulee are used for cover, dens, and nests by a wide variety of species normally associated with steppe habitats. It is an especially important habitat for snakes, chukars, cliff swallows, Nutall's cottontails, yellow-bellied marmots, and bushy-tailed woodrats. The corridor itself also provides certain habitat attributes. In residential areas, it provides an unobstructed and safe migration corridor for white-tailed deer, raccoons, and other wildlife. Without the corridor, wildlife would be required to cross numerous fences and possibly encounter harassment from pets such as dogs.

The Washington Department of Fish and Wildlife has designated some habitats as priority habitats for certain wildlife species. Designation is part of a strategy to maintain suitable habitat for priority wildlife. Figure 3-39 shows the corridor crossing six priority habitats. Mule deer priority habitat is located near Grand Coulee and consists primarily of steppe habitat. Two white-tailed deer priority habitats are located east of the mule deer priority habitat, and consist primarily of agricultural and forested habitat near Spokane. Rocky Mountain elk priority habitat is located in the Mill and Tamarack canyons and consists primarily of forest and agricultural habitat. Riparian priority habitats are located along Hawk Creek and its tributaries, Deep Creek, and the Spokane River. Urban Natural Open Spaces are located in Spokane. Other priority habitats and species occur near the corridor. Bald eagle priority habitat occurs along the Spokane River about 8 mile and 17 miles downstream from where the corridor crosses the Spokane River. Sharp-tailed grouse priority habitat occurs about 1.5 miles south of the corridor throughout most of Lincoln County.

Threatened and Endangered Species

The bald eagle and pygmy rabbit are the only federally-listed threatened and endangered species that may occur in the project area.

Bald eagle – No habitat for bald eagles exists in the corridor, largely because the corridor lacks suitable foraging habitat (fish and waterfowl concentration areas) and nesting trees. Bald eagle use of the majority of the corridor area is likely limited to the occasional fly-over as bald eagles move between roosting sites within Northrup Canyon State Park, about 4.5 miles southwest of the corridor, Banks Lake, and the Columbia River. A potential bald eagle roost site exists along the Spokane River about 1 mile north of where the corridor crosses the river in Riverside State Park, so eagles may occasionally perch on transmission towers within the park.

Pygmy rabbit – Although portions of the corridor are comprised of the shrub/steppe habitat preferred by pygmy rabbits, no documented populations exist within the corridor. The pygmy rabbit is dependent on sage brush plant communities, as sage brush comprises 99 percent of its winter diet (WDFW 1995). Pygmy rabbit populations have been declining since 1997. In 1995, five pygmy rabbit populations were documented as existing in Douglas County and a sixth population was found in 1997. However, between 1997 and 2000 five of the six populations disappeared. By March 2001, only one area, Sagebrush Flat, was known to still have rabbits (Hays 2001). The primary factor contributing to the decline of the pygmy rabbit in Washington has been habitat loss due to agricultural conversion (WDFW 1995). As part of the recovery plan for pygmy rabbits, WDFW has captured the last remaining known population to start a captive breeding program (WDFW 2001). The goal is to develop a captive population to ensure the maintenance of Washington's unique pygmy rabbits and to reintroduce sufficient numbers of captive-bred rabbits to re-establish populations in suitable habitat. Eleven of the remaining pygmy rabbits in Washington have been captured and translocated to Washington State University, where one captive female recently gave birth to five young (Hays 2001).

Environmental Consequences

Construction, operation, and maintenance activities can create short- and long-term impacts to wildlife by disturbing wildlife or damaging their habitat. Short-term impacts would include increased noise and human presence during construction, habitat damage due to temporary vegetation removal and wildlife being unable to use the immediate work areas. Long-term impacts would include increased human access into otherwise inaccessible areas, habitat loss due to conversion of forested areas to grass/shrub areas within the corridor, habitat fragmentation, collision hazards, such as overhead ground wires, and disturbance of wildlife during their breeding seasons.

Impact Definitions

A **high** impact would occur under these conditions.

- Construction and mitigation creates long-term decreases in quality or quantity to a substantial amount of existing habitat.
- Critical habitats are disturbed during breeding or winter stress periods.
- Critical habitats are avoided during the breeding or winter stress periods due to increased noise associated with construction activities.
- Construction activities create extensive short-term damage to native vegetation.
- Threatened or endangered species are directly impacted.
- Heavy, uncontrolled human access is allowed.

A **moderate** impact would occur under these conditions.

- Construction and mitigation creates long-term decreases in quality or quantity to a limited amount of habitat.
- Critical habitat is disturbed outside of breeding or wintering periods.
- Critical habitats are avoided outside of the breeding or winter stress periods due to increased noise associated with construction activities.
- Construction activities create some short-term damage to native vegetation.
- Threatened or endangered species are indirectly impacted.
- Light, uncontrolled human access is allowed.

A **low** impact would occur under these conditions.

- Construction and mitigation creates long-term decreases in quality or quantity to a small amount of habitat.
- Critical habitat is not disturbed.
- Critical habitats are not avoided outside due to increased noise associated with construction activities.
- Construction activities create minimal short-term damage to vegetation.
- Threatened and endangered species are not affected.
- Human access is controlled and limited.

Impacts

Towers and Related Construction

Removal of existing wood pole structures would have direct and indirect impacts to wildlife. Direct impacts would result from temporary removal of vegetation around wood pole structures to be removed. Removal of vegetation would result in the loss of foraging habitat and ground nesting habitat for wildlife. However, impacts to wildlife habitat would be low because the total area of vegetation disturbed would be about 17.4 acre, a small percentage of the 1,528 total acres of available wildlife foraging and refuge habitats along the corridor. Direct impacts would also result from avoidance of immediate work areas caused by construction noise. Noise associated with construction activities occurring during the breeding season (March to August) in shrub/steppe, forested, and riparian habitats, where wildlife abundance and diversity is usually greatest, could have a high impact. In contrast, construction activities occurring during the non-breeding season in agricultural lands and grass/forb habitats, where wildlife abundance and diversity is lower, would have a low impact. Indirect impacts could occur if vegetation was crushed to the extent that noxious weeds could become introduced. With the implementation of the Weed Control Plan (see Chapter 3 **Vegetation**), the impact level would be low.

Construction areas around towers would result in direct and indirect impacts to wildlife. Direct impacts would result from short-term disturbance of 105 acres of agricultural land and 85 acres of native habitat as vegetation is removed, broken, uprooted, or trampled by construction. Direct impacts could also result from increases in noise due to construction. Impacts due to noise would be similar to those described above. Indirect impacts could occur if vegetation was crushed to the extent that noxious weeds could become introduced. The revegetation of disturbed areas, along with noxious weed control, should provide long-term wildlife habitat. The impact level resulting from construction areas around towers would be moderate.

Construction of new towers would result in direct and indirect impacts to wildlife. Direct impacts would result from the permanent removal of 24 acres of habitat (about 12 acres in agricultural land and 10 acres in native habitat) and increases in noise due to construction activities that could cause avoidance of the immediate work areas. Indirect impacts could occur if noxious weeds could become introduced. The impact level resulting from the construction of new tower pads would be low to moderate.

Conductor tensioning sites and staging areas would result in direct and indirect impacts to 42 acres of habitat. Although the exact locations are unknown, it is assumed that approximately half of these areas would be in native habitat. Depending on the location chosen for these sites, direct impacts could result from vegetation being broken, uprooted, or trampled. Indirect impacts could result from noxious weeds becoming established before native species have recovered. If possible, conductor tensioning sites and staging areas would not be placed within 400 feet of sensitive areas, such as wetlands, or State-identified priority habitats. With proper mitigation, the impact level resulting from conductor tensioning sites and staging areas would be low to moderate.

Road Construction

Construction of new access roads would have direct and indirect impacts to wildlife. Direct impacts would result from removal of vegetation and soil compaction and increases in noise due to construction activities that could cause avoidance of the immediate work areas. Indirect impacts could result from erosion of roads introducing sediments to undisturbed areas and the smothering of vegetation. A detailed description of where the new access roads would be constructed is discussed under **Vegetation**. The total area disturbed would be 15.6 acres, with about 2.6 acres in agricultural land and 13 acres in native habitat. Disturbing wildlife breeding in pockets of sagebrush would be the greatest potential impact from new access road construction. Moderate impacts would be expected from the construction of new access roads within the corridor because this is an area vegetated primarily with native species, with few weed species, and has been identified as potential habitat for a federally-listed plant species. However, if construction of new access roads does not occur during the breeding season a low impact would be expected.

Construction of spur roads would have direct and indirect impacts to wildlife. Direct impacts would result from removal of vegetation and soil compaction and increases in noise due to construction activities that could cause avoidance of the immediate work areas. Indirect impacts could result from erosion of roads introducing sediments to undisturbed areas and the smothering of vegetation. The total area disturbed would be 12.6 acres, with about 6.3 acres in agricultural land and 5.1 acres in native habitat. The impact level would be low to moderate.

Improvements to existing access roads would have direct and indirect impacts to wildlife. Direct impacts would result from vegetation removal and/or burying from grading and rocking within the existing road footprint, widening existing roads, vegetation crushing from vehicle use, and increases in noise due to construction activities. Indirect impacts could result from erosion of roads introducing sediments to undisturbed areas and smothering vegetation or from the introduction of noxious species. The total area disturbed would be 52.5 acres, with about 42.5 acres in native habitat. Most road improvements would occur within the existing footprint of the road in native habitat; this footprint has already been disturbed by vehicle use. Road widening would convert some land to access road, resulting in the loss of foraging habitat and ground nesting habitat for wildlife. About 80 percent of this loss would be in shrub/steppe habitat. The impact level resulting from improvements to existing access roads would be low to moderate.

Access road widening could impact wildlife by increasing human access to the corridor. This is especially important for raptors and game species, which are easy targets for illegal shooting. Without access control, impacts of increased human activity would be considered high near Spokane where trespassing within the corridor appears to be prevalent, moderate elsewhere in wildlife habitat areas, and low in agricultural areas. Overall, the impact could be minimized by making sure access gates are locked and authorized use areas are posted. The impact level would be low.

Installing/replacing culverts could result in direct or indirect impacts to wildlife. Direct impacts would result from vegetation removal during installation and avoidance of the immediate work areas due to increased noise. Indirect impacts could result from erosion of roads introducing sediments to undisturbed areas and smothering vegetation or from the introduction of noxious weeds. Most of the area disturbed by culvert installation would occur within the existing footprint of the road, thus reducing direct impacts to habitat. Based on observation and preliminary information, the impact level would be low, unless a federally-listed species is present.

Operation and Maintenance

Operation of the new transmission line would have direct impacts to wildlife, specifically bird species. Direct impacts would result from injury or death caused by collisions with transmission lines. Collisions typically occur in locations where conditions combine to create a high potential for birds striking lines (Avian Power Line Interaction Committee, 1994). Three factors contribute to this potential: the type of power lines, the amount of use of the area by birds, and the inherent tendency of a species to collide with overhead wires.

Type of Power Lines – Because the proposed transmission line would be placed within a corridor with existing lines the potential impact may be less than if the new line were placed where there were no existing lines. Research has shown that location of transmission lines influences bird collision risks, and that installing new transmission lines adjacent to existing lines may reduce the risk of collisions (Thompson, 1978; Avian Powerline Committee, 1994; Bevanger 1994).

When there are multiple lines within a corridor, birds are more likely to strike a conductor if the conductor heights vary. Multiple conductors at different heights create a "fence" effect, a larger area in which birds must avoid obstacles. The proposed line would add to an existing fence effect. The existing two wood pole 115-kV structures are 60 feet tall, each having a flat configuration (the three conductors on the towers are strung at the same height). The double- and single-circuit 230-kV steel towers are 125-feet and 80-feet tall, respectively, and have a stacked configuration (conductors at various heights). For the proposed action, the northern-most 115-kV towers would be replaced with single-circuit steel towers 125 feet tall along most of the transmission line corridor, and the conductors would have a delta configuration (one conductor higher than the other two). Additionally, they would have two overhead ground wires. Double-circuit line would be constructed between corridor mile 73/1 and 73/4, where the steel towers would be 175 feet tall with conductors placed at various heights along the towers. These 175-foot towers would be 50 feet taller than the existing towers and could result in a localized increase in the fence effect. See Chapter 2, Figures 2-5 and 2-6 for tower configurations.

Birds tend to be more likely to strike ground wires. Ground wires are much smaller in diameter than conductors and span the top of the tower to protect the line from lightning strikes. The proposed line would have one or two ground wires the length of the line. These ground wires could increase the fence effect and contribute to potential bird strikes. Fiber optic cable may be used for the ground wire. Although no studies analyzing the risk of avian collisions with fiber optic cable could be found, the cable has similar physical characteristics as ground wire, therefore, impacts would likely be similar.

Amount of Use – In general, the more birds that fly in an area, the greater the risk of collisions with power lines. The areas of highest concern are where lines span bird flight paths, including river valleys, wetland areas, lakes and narrow corridors such as passes that connect two valleys. Transmission lines between waterfowl feeding and roosting areas would also be hazardous (McNeil et al., 1985). The proposed line would cross few areas of open water or wetlands and would run primarily through upland grazed shrub-steppe and croplands. However, a significant potential for collision mortality occurs where the transmission lines cross the Nine Mile Reservoir segment of the Spokane River (between corridor mile 77/3 and 77/4), where waterfowl are known to concentrate. Although waterfowl losses to transmission line collisions are rarely shown to be biologically significant, unmarked ground wire at the Spokane River crossing would result in a moderate impact on waterfowl. If the existing crossing has not been a problem in the past, it is unlikely that the new crossing would be. Since the existing crossing has not been documented to be a problem in the past, it is unlikely that the added line would have an increased adverse effect on waterfowl. Adequate marking or removal of these wires at the crossing would reduce the potential impacts to low.

Species Risk of Collision – Migratory waterfowl have the highest incidence of mortality from collision with transmission lines, particularly near wetlands, feeding areas, or open water (Stout and Cornwell, 1976). Such collisions primarily occur in low visibility conditions (Arend, 1970; Anderson, 1978; Avery et al., 1980; Brown et al., 1985; Fannes, 1987). In a study of waterfowl mortality in Illinois, between 0.2 and 0.4 percent of the maximum number of ducks present near a power plant were killed each fall (Anderson, 1978). Mallards and blue-winged teals were found to be most vulnerable to collisions. Fourteen duck species accounted for 44 percent of the 4,100 birds that collided with power lines in a wetland in Montana (Malcolm, 1982). In a survey of birds flying past a 138-kV power line spanning the Mississippi River, no birds were killed and waterfowl were observed to fly at least 50 feet from the power lines (Fredrickson, 1983). In a survey in Oregon, 60 birds of 13 species were found dead beneath a 230-kV line in 89 days; however, an estimated 354,000 birds moved past the lines in 179 days, of which over 85 percent were observed to fly above the conductors (Lee, 1978).

Raptor collisions with overhead wires would not be expected and collision with overhead transmission line wires is not a major cause of mortality in raptors. Unlike waterfowl, which fly at fast speeds and during inclement weather, raptors keen eyesight and tendency not to fly in inclement weather may contribute to the relatively low numbers of collisions reported (Olendorff et al., 1981; Olendorff and Lehman, 1986; Postovit and Postovit, 1987). Deaths that do occur usually are caused by distribution lines where the distance between ground wires and transmission wires is shorter than the raptor's wing span, making an electrical connection possible if touched. The 500-kV conductors would be too widely spaced for an electrical connection to occur. Therefore, any raptor collisions would not be at levels that would change local breeding populations or distributions.

Some level of ongoing waterfowl, and perhaps raptor, mortality would be expected to occur as a result of the installation of the new transmission lines, however, the mitigation measures discussed below can be applied to minimize that potential impact. Songbird mortality would be expected to be minor. The impact level would be low.

Maintenance of the new transmission line would have direct and indirect impacts to wildlife. Direct impacts would result from removal and prevention of the development of forested habitat and avoidance of the immediate work areas due to increased noise. Indirect impacts could result from erosion of cleared areas introducing sediments to undisturbed areas, smothering vegetation. Since the maintenance activities would be almost entirely within an existing corridor that has been maintained for nearly 50 years, continued maintenance is expected to have a low impact level.

Priority Habitats

Priority Habitats, identified from WDFW's Priority Habitats/ Species database, are crossed by the corridor and access roads. Impacts would be low to moderate if maintenance activities avoid these habitats during times when breeding, fawning, nesting, and other sensitive activities occur.

Construction impacts to Urban Natural Open Space areas crossed by the corridor would be low because little habitat would be permanently removed and disturbed habitat would be revegetated.

Threatened and Endangered Species

The Federally-threatened bald eagle may occur in the vicinity of the corridor at certain times of the year. Bald eagles likely pass through or over the corridor when migrating or when moving between winter foraging areas, especially between Banks Lake and Lake Roosevelt. Unlike waterfowl, which fly at fast speeds and during inclement weather, raptors, like bald eagles, are generally not prone to collision deaths (see Olendorff, et al., 1981; and Postovit and Postovit, 1987). Deaths that do occur usually are caused by distribution lines where the distance between ground wires and transmission wires is shorter than the raptor's wing span, making an electrical connection possible if touched. However, the 500-kV conductors would be too widely spaced for an electrical connection to be expected to occur.

The other potential impact to bald eagle habitat would be the possible removal of a few potential perching trees within the corridor where it crosses the Spokane River (between corridor mile 77/3 and 77/4). Riparian trees, mostly cottonwoods and willows, could be removed to allow for conductor swing. Although the exact number of riparian trees to be removed is unknown, it is expected that a small number perch trees would be removed relative to the number of perch trees in the vicinity.

Presence of the Federally-endangered pygmy rabbit has not been documented in the vicinity of the corridor, although their historic range once occupied Douglas, Grant, Lincoln, Adams, and Benton counties. As part of the recovery effort, WDFW has started a captive breeding program, with the goal of reestablishing viable populations of pygmy rabbits in central Washington. No reintroduction of pygmy rabbit populations is expected to occur within the corridor. Although the sage brush habitat within the corridor, important to pygmy rabbits, would be disturbed during construction, these disturbed areas would likely have recovered before any new populations of pygmy rabbits would be proposed for introduction into the area.

A Biological Assessment analyzing the effects of the project on federally-listed threatened and endangered species will be conducted pursuant to Section 7 of the Endangered Species Act.

Environmental Consequences of the Alternative Action

Wildlife impacts would be the same for the alternative that would have more double-circuit line.

Cumulative Impacts

In the Columbia River Basin ecosystem, biodiversity has been reduced by loss and fragmentation of native habitats, especially shrub/steppe habitat and dependant wildlife communities. Species dependent on shrub/steppe habitat, such as Columbian sharp-tailed grouse and pygmy rabbits, have declined dramatically in the region since conversion of steppe to agriculture land. WDFW has declared the shrub/steppe habitat type as a Priority Habitat and recognizes that preserving large tracts of high quality steppe habitat is important for maintaining populations of these species.

This project is unlikely to contribute to further biodiversity loss. The amount and quality of habitats lost due to access road widening, construction and maintenance of the new right-of-way, and other construction activities is relatively insignificant. Important vegetation corridors connecting key wildlife habitats, such as riparian zones and Urban Natural Opens Space areas, in most cases would not be substantially impacted by the project.

Mitigation

To reduce potential impacts to wildlife, mitigation to be implemented would include:

- Mark with bird flight diverters or remove the ground wire at the span crossing the Spokane River (structures 77/3 through 77/4) and where the line spans wetlands.
- Limit removal of large riparian trees at the Spokane River crossing.
- Limit the removal of forest habitat to only those trees that would directly interfere with transmission lines. Retain or create snags within the corridor at a density of at least 2 snags per 1 acre. This partially compensates for forest characteristics lost during tree removal.

- When possible, avoid construction activities within high-use native habitats, especially riparian, tall sagebrush, and dense pine forest habitats, during the breeding season (March 1 to August 15).

- Gate and lock access to the corridor, especially where the corridor crosses habitats heavily used by wildlife.

- Limit vehicular travel to access roads through sensitive habitat such as shrub/steppe.

- A Biological Assessment, as required under the Endangered Species Act, would be prepared that provides detailed actions to reduce or eliminate impacts on listed species, and BPA would implement any reasonable measures recommended the U.S. Fish and Wildlife Service to reduce or avoid impacts.

Environmental Consequences of the No Action Alternative

Current levels of disturbance to wildlife and wildlife habitat associated with ongoing maintenance activities for the existing transmission line, substations, and right-of-way would continue under the No Action Alternative. Activities could include vehicular traffic, transmission structure replacement, vegetation management activities, and access road improvements. Disturbances to wildlife from unauthorized human access within the corridor could also continue under this alternative. No new impacts to wildlife and wildlife habitat are expected under this alternative.

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Floodplains

Affected Environment

The corridor crosses seven drainages identified on Federal Insurance Rate Maps as ***100-year floodplains.*** The Federal Emergency Management Agency identifies areas that have a 1-percent chance of being flooded in a given year as 100-year floodplains. The 100-year floodplains in the corridor are in the drainages of Sherman Creek, Hawk Creek, Stock Creek, Coulee Creek, Deep Creek, the Spokane River, and Country Homes Canal (see Figure 3-37).

Transmission line structures are currently located within the floodplain areas of Coulee Creek (corridor mile 75/6), Deep Creek (corridor mile 75/8 and 76/1), and the Spokane River (corridor mile 77/3). The floodplain widths for Coulee Creek and the Spokane River are roughly 190 feet and 1,200 feet, respectively. The transmission line crosses the Deep Creek floodplain in two areas (corridor mile 75/7 to 75/9 and 75/9 to 76/2). The Deep Creek floodplain between corridor mile 75/7 and 75/9 is approximately 525 feet wide, whereas the section between corridor mile 75/9 and 76/2 is approximately 600 feet wide. Sherman Creek, in corridor mile 24, lies immediately adjacent to a county road within an agricultural area. This portion of Sherman Creek was straightened sometime in the past and the narrow floodplain (approximately 250 feet) associated with it parallels the road. Hawk Creek, in corridor mile 38, runs through a narrow canyon and has a narrow floodplain (approximately 170 feet) associated with it. The Stock Creek floodplain (170 feet) is not located adjacent to the creek itself; it is located to the north of the creek, within a low-lying meadow. The corridor crosses the narrow floodplain (approximately 65 feet) for the Country Homes Canal in corridor mile 81.

Hawk and Sherman Creeks, as well as the Spokane River, are perennial streams. The floodplains for Deep Creek and the Spokane River have associated wetlands.

Environmental Consequences

Floodplains adjoining creeks and rivers are important because they provide wildlife habitat, agricultural and forest products, and recreation areas, besides providing a channel for flood waters. Protection of floodplains is necessary to prevent damage to these functions, to protect the human and natural features within them, and to comply with Executive Order 11988 (Floodplain Management). Construction within a floodplain has the potential to create obstructions to floodwater and alter flow patterns and floodplain acreage, which may cause additional damage when a flood occurs. In this case, impacts on floodplains would be direct and long term. Sediments could be deposited into floodplains from activities upslope if erosion or sedimentation occurs. These impacts would be indirect and would likely be temporary.

Impact Definitions

A **high** impact would occur when structures or permanent access roads encroach on designated floodplains and the amount of flood storage in a floodplain would be significantly decreased, or the course of flood waters would be altered.

A **moderate** impact would occur when structures or permanent access roads encroach on designated floodplains and the amount of flood storage in a floodplain would be moderately decreased.

A **low** impact would occur when the amount of flood storage in a floodplain would be slightly decreased (e.g., due to erecting a structure in a floodplain).

No impact would occur where direct impacts to floodplains would be avoided.

Impacts

Towers and Related Construction

Removal of existing wood pole structures is not expected to result in direct or indirect impacts to floodplains. Typically, existing wood pole structures would be excavated or cut off two feet below ground level and holes backfilled with native material. However, structures located in or adjacent to floodplains would be cut off at ground level to avoid potential impacts associated with excavation and backfilling. Therefore, removal of existing wood pole structures is expected to have no impact on floodplains.

All floodplains would be spanned and there would be no new structures constructed within any floodplains. However, there is the possibility that vegetation, particularly trees that pose a danger to the transmission lines, could be removed. Additionally, the 500-kV tower on the west span of the Spokane River would be placed approximately 150 feet west of the existing wood structure (corridor mile 77/3), situating it outside of the Spokane River floodplain. Therefore, no impacts are expected to floodplains in the project area due to construction of new towers.

New staging areas and conductor tensioning sites would not be sited in floodplain areas, thus no impacts to floodplains would be expected from these activities.

Road Construction

The construction of new access roads, improvement of existing access roads, and the construction of temporary access roads are expected to have no impact on floodplains (Table 3-19). Road construction activities in or near floodplains are unlikely to alter the amount floodplain storage, local patterns of flooding, or create obstructions to floodwaters.

Table 3-19. Floodplains Identified within the Corridor.

Floodplain	Corridor Mile	Potential Construction Impacts From Access Road	Potential Construction Impacts From Proposed Towers
Sherman Creek	24/3 to 24/4	No Impact: Rock existing road to Improve access to Sherman Draw Road	No Impact: Towers more than 100 ft from floodplain
Hawk Creek	39/1 to 39/2	No Impact: Road improvements to reduce runoff and erosion	No Impact: Towers more than 100 ft from floodplain
Stock Creek	41/3 to 41/4	No Impact: No road improvements proposed	No Impact: Towers more than 100 ft from floodplain
Coulee Creek	75/5 to 75/6	No Impact: Relocating access road to improve access to Pine Bluff Road	No Impact: Towers more than 100 ft from floodplain
Deep Creek	75/7 to 76/2	No Impact: Relocating access road to improve access to Pine Bluff Road	No Impact: Towers more than 100 ft from floodplain
Spokane River	76/8 to 77/5	No Impact: No road improvements proposed	No Impact: Towers more than 100 ft from floodplain
Country Homes Canal	81/9 to 81/10	No Impact: Blading, grading, and installation of drain dips; improve access to Waikiki Road	No Impact: Towers more than 100 ft from floodplain

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Operation and Maintenance

Operation and maintenance activities are expected to have no impact on floodplains as access roads and structures would not be located in floodplains. Potential vegetation management activities, such as removal of danger trees, are expected to be minimal and are also not expected to adversely affect floodplain functions.

Environmental Consequences of the Alternative Action

Floodplain impacts for the alternative action would be the same as those for the proposed action.

Cumulative Impacts

Sherman, Hawk, and Stock creeks are all located within Lincoln County, while Coulee Creek, Deep Creek, the Spokane River, and the Country Homes Canal are located within Spokane County. County governments for both Lincoln and Spokane counties were contacted to inquire about current and future activities within floodplain areas within their respective jurisdictions. Lincoln County is currently in the process of developing its critical area ordinances to regulate activities within critical and environmentally sensitive areas. Spokane County adopted its critical areas ordinance in August 1996.

Spokane County may conduct such activities as vegetation management or storm drain maintenance in some floodplain areas, depending on the classification of a given floodplain. Road and bridge maintenance activities may also occur where county roads cross floodplain areas, such as Coulee Creek. The extent to which these activities may impact floodplain function is unknown, but is expected to be low. Based on information provided by Lincoln and Spokane counties, as well as a review of Spokane County's critical areas ordinance, it appears that cumulative impacts to floodplains would be low to no impact.

Mitigation

Standard mitigation would effectively eliminate or reduce potential impacts within the floodplains of the drainages to be crossed. Mitigation for indirect impacts includes: using appropriate sediment and erosion control measures; leaving vegetative buffers next to all water bodies when possible (as long as it does not interfere with the safe operation of the line); and spanning floodplains wherever possible. Fill used for temporary access road widening will be placed on fabric and removed entirely to an upland site after construction is finished.

The following mitigation activities would reduce impacts:

- Designing the project to locate roads and structures to avoid floodplains completely.
- Locating structures to minimize the potential for creating obstructions to floodwaters.
- Depositing all excavated material near floodplain areas not reused in an upland area and stabilizing it.
- Re-contouring and re-vegetating disturbed areas near floodplains with native and local species.
- Removing debris from construction and clearing within and near floodplains.

Environmental Consequences of the No Action Alternative

No floodplain impacts have been identified under existing conditions. The potential for disturbance to floodplain functions associated with transmission line structures in floodplains would continue under the No Action Alternative. No new impacts to floodplains are expected under this alternative.

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

The affected environment is an existing transmission line corridor for most of the project's length. The proposed action, replacing a 115-kV line with a 500-kV line, is a more productive use of the corridor than the existing condition. With respect to the underlying resources of the corridor, the alternatives would not substantially alter their long-term environmental productivity. For example, the affected environment of the existing lines has generally recovered since it was initially built. While there is never complete recovery, the long-term productivity of the affected environment has not been substantially altered. If the transmission towers and lines were dismantled, it would be possible to restore the corridor to nearly its original condition and uses. The alternative action, building double-circuit towers through the Spokane area, would effectively reserve this portion of the corridor over the long term for additional transmission use at a relatively lower future environmental cost. The proposed action, on the other hand, would result in lower near-term environmental impacts and dollar costs.

Irreversible and Irretrievable Commitment of Resources

The proposed project would result in irreversible commitments associated with loss of vegetation and wildlife habitat for some species and potential degradation of water resources through erosion and sedimentation if not mitigated. Irretrievable commitments associated with foregone production/use of crops and rangeland, or use of the corridor for other purposes (e.g., residential use) during the life of the project would occur. The corridor could revert or change to these uses in future if the transmission facilities were dismantled.

The proposed project would use aluminum, steel, wood, gravel, sand and other non-renewable materials to construct the structures, conductors, insulators, access roads, and other facilities. Vehicles and equipment would consume petroleum-based fuels. These resources would be irreversibly and irretrievable committed.

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:

- Temporary and permanent conversions of land areas to be used for structure sites, access roads, staging areas, tensioning sites, and expansion of Bell Substation.
- Interference with farming operations.
- Temporary disturbances to recreational users, traffic, and residents near the corridor during construction.
- Restriction on commercial land use (RV parking) at a location in the north Spokane area.
- Increased noise levels during construction and operation.
- Potential for health effects from magnetic fields.
- Visual impacts associated with the proposed lattice steel towers.
- Short-term increase in pollutant levels during construction from dust and vehicles.
- Disturbance to historic site at Bell Substation expansion.
- Negligible reduction in agricultural production.
- The elimination of small areas of vegetation, including wetland buffer and riparian vegetation, due to permanent physical developments such as transmission line structures and maintenance roads.
- Short-term soil compaction, erosion, vegetation degradation, and stream sedimentation from construction and maintenance.
- Short-term disturbance to wildlife during construction.
- A reduction in the amount of forested and shrub/steppe vegetation available for wildlife habitat.

Chapter 4
Environmental Consultation, Review, and Permit Requirements

This chapter addresses federal statutes, implementing regulations, and Executive Orders potentially applicable to the proposed project. This Draft EIS is being sent to tribes, federal agencies, and state and local governments as part of the consultation process for this project.

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 84-mile transmission line 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.

Threatened and Endangered Species and Critical Habitat

The Endangered Species Act (***ESA***) of 1973 (16 USC 1536) as amended in 1988, establishes a national program for the conservation of threatened and endangered species of fish, wildlife and plants, and the preservation of the ecosystems on which they depend.

The act is administered by the U.S. Fish and Wildlife Service and, for salmon and other marine species, by the National Marine Fisheries Service. The act defines procedures for listing species, designating critical habitat for listed species, and preparing recovery plans. It also specifies prohibited actions and exceptions.

Section 7(a) requires federal agencies to ensure that the actions they authorize, fund, and carry out do not jeopardize endangered or threatened species or their critical habitats. Section (7c) of the Endangered Species Act and the federal regulations on endangered species coordination (50 CFR Section 402.12) require that federal agencies prepare biological assessments addressing the potential effects of major construction actions on listed or proposed endangered species and critical habitats.

In a letter dated May 3, 2002, the U.S. Fish and Wildlife Service (USFWS) was requested to list the threatened and endangered fish and wildlife species occurring within the vicinity of the proposed project. USFWS listed five species (bald eagle, bull trout, Ute's Ladies Tresses, Spaldings silene, and pygmy rabbit) as potentially occurring within the project vicinity (letter from S. Audet, May 15, 2002; see Appendix C -ESA-letter). No species administered by the National Marine Fisheries Service occur in the project corridor or in the vicinity of the corridor.

USFWS requires that a biological assessment be prepared if threatened or endangered species might be impacted by a Federal action. A Biological Assessment will be prepared for this project.

Field surveys of the project corridor were conducted during June of 2002. A survey will be conducted during August 2002 to determine whether the threatened plants (Ute's Ladies Tresses and Spaldings silene) occur in the proposed project corridor. Potential impacts to Threatened and Endangered plant, animal, and fish species are discussed in Chapter 3 in the sections on **Fish, Vegetation**, and **Wildlife**.

Fish and Wildlife Conservation

Fish and Wildlife Conservation Act and Coordination 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 consult with the USFWS and the state agency responsible for fish and wildlife resources.

Mitigation designed to conserve fish and wildlife and their habitat is provided in the sections on **Fish** and **Wildlife** in Chapter 3. Standard erosion control measures would be used during construction to control sediment movement into streams, protecting water quality and fish habitat.

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). This established new requirements for Essential Fish Habitat descriptions in federal fishery management plans and required federal agencies to consult with National Marine Fisheries Service on activities that may adversely affect Essential Fish Habitat. The National Marine Fisheries Service issued a final rule on January 17, 2002 to revise the regulations implementing the essential fish habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act. (Federal

Register 67, No. 12). The Magnuson-Stevens Act requires all fishery management councils to amend their fishery management plans to describe and identify Essential Fish Habitat for each managed fishery. The Pacific Fishery Management Council has issued such an amendment in the form of Amendment 14 (1999) to the Pacific Coast Salmon Plan. This amendment covers Essential Fish Habitat for all fisheries under NMFS jurisdiction that would potentially be affected by the proposed action. Essential Fish Habitat includes all streams, lakes, ponds, wetlands, and other currently viable water bodies and most of the habitat historically accessible to salmon. Activities above impassible barriers are subject t o consultation provisions of the Magnuson-Stevens Act.

Under Section 305(b)(4) of the act, National Marine Fisheries Service is required to provide Essential Fish Habitat conservation and enhancement recommendations to federal and state agencies for actions that adversely affect Essential Fish Habitat. Whenever possible, National Marine Fisheries Service uses existing interagency coordination processes to fulfill Essential Fish Habitat consultations with federal agencies.

No species administered under the amended Magnuson-Stevens Fishery Conservation and Management Act occurs in the vicinity of the proposed project. Tributaries located east of the City of Creston along the project corridor drain north into the Spokane River and Franklin D. Roosevelt Lake. The Grand Coulee Dam, which formed the Columbia River reservoir that is called Franklin D. Roosevelt Lake, creates an impassable barrier to salmon into these rivers. Tributaries located west of the City of Creston along the project corridor drain to the southwest into Crab Creek and the Columbia River. These tributaries do not support salmon within the project corridor.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act 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 (16 U.S.C. 703-712, July 3, 1918, as amended 1936, 1960, 1968, 1969, 1974, 1978, 1986, AND 1989). Under the act, taking, killing, or possessing migratory birds or the eggs or nests is unlawful. Most species of birds are classified as migratory under the act, except for upland and nonnative birds such as pheasant, chukar, gray partridge, house sparrow, European starling, and rock dove.

The proposed project may impact birds. Potential impacts to birds as a result of the proposed project are discussed in the **Wildlife** section in Chapter 3. BPA would ensure appropriate mitigating measures are employed to minimize the risk of bird mortality.

Bald Eagle and Golden Eagle Protection Act

The Bald Eagle Protection Act prohibits the taking or possessing of and commerce in bald and golden eagles, with limited exceptions (16 U.S.C. 668-668d, June 8, 1940, as amended 1959, 1962, 1972, and 1978). Because a small number of bald eagles reside within foraging distance of the proposed project, there is a remote possibility some mortality could occur to bald eagles. However, the act only covers intentional acts, or acts in "wanton disregard" of the safety of bald or golden eagles. Therefore, this project is not considered to be subject to its compliance.

For further discussion of impacts on eagles, see Chapter 3, **Wildlife**. Potential impacts to bald eagles will be further addressed in the biological assessment prepared for this project under the Endangered Species Act.

Responsibilities of Federal Agencies to Protect Migratory Birds

Executive Order 13186 directs each federal agency that is taking actions that may negatively impact migratory bird populations to work with the U.S. Fish and Wildlife Service to develop an agreement to conserve those birds. The protocols developed by this consultation are intended to guide future agency regulatory actions and policy decisions; renewal of permits, contracts, or other agreements; and the creation of or revisions to land management plans. BPA is part of the Department of Energy, is cooperating with the department in developing a memorandum of understanding with the U.S. Fish and Wildlife Service to comply with this mandate.

Heritage Conservation

Preserving cultural resources allows Americans to have an understanding and appreciation of their origins and history. A cultural resource is an object, structure, building, site or district that provides irreplaceable evidence of natural or human history of national, state or local significance. Cultural resources include National Landmarks, archeological sites, and properties listed (or eligible for listing) on the National Register of Historic Places. Regulations established for the management of cultural resources include:

- Antiquities Act of 1906 (16 U.S.C. 431-433);
- Historic Sites Act of 1935 (16 U.S.C. 461-467);
- National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. 470 et seq.), as amended, inclusive of Section 106;
- Archaeological Data Preservation Act (ADPA) of 1974 (16 U.S.C. 469 a-c);
- Archaeological Resources Protection Act (ARPA) of 1979 (16 U.S.C. 470 et seq.), as amended;
- Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. 3001 et seq.);
- Executive Order 13007 Indian Sacred Sites; and
- American Indian Religions Freedom Act.

BPA has undertaken the Section 106 consultation process for this project with the State Historic Preservation Officer for Washington, the Advisory Council on Historic Preservation, and the affected Native American tribes. The Confederated Tribes of the Colville Reservation and the Spokane Tribe were consulted for this project. BPA's 1996 government-to-government agreement with 13 federally-recognized Native American Tribes of the Columbia River basin identifies the roles and responsibilities of both parties and provides guidance for the Section 106 consultation process with the Tribes.

The NHPA amendments specify that properties of traditional religious and cultural importance to a Native American Tribe (also known as Traditional Cultural Properties) may be determined to be eligible for inclusion on the National Register of Historic Places. In carrying out its responsibilities under Section 106, BPA is required to consult with any Native American Tribe that attaches religious or cultural significance to any such properties. The tribes have prepared traditional property studies for this project.

NAGPRA requires consultation with appropriate Native American Tribal authorities prior to the excavation of human remains or cultural items (including funerary objects, sacred objects, and cultural patrimony) on federal lands or for projects that receive federal funding. NAGPRA recognizes Native American ownership interests in some human remains and cultural items found on federal lands and makes illegal the sale or purchase of Native American human remains, whether or not they derive from federal or Indian land. Repatriation, on request, to the culturally affiliated tribe is required for human remains.

Executive Order 13007 addresses "Indian sacred sites" on federal and tribal land. "Sacred site" means any specific, discrete, narrowly delineated location on federal land that is identified by a Tribe, or a Tribal individual determined to be any appropriately authoritative representative of a Native American religion. The site is sacred by virtue of its established religious significance to, or ceremonial use by, a Native American religion, provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site. This order calls on agencies to do what they can to avoid physical damage to such sites, accommodate access to and ceremonial use of Tribal sacred sites, facilitate consultation with appropriate Native American Tribes and religious leaders, and expedite resolution of disputes relating to agency action on federal lands.

Construction, and operation and maintenance of the transmission line and related facilities could potentially affect historic properties and other cultural resources. A cultural resources survey of the corridor and Bell Substation expansion area has been done to determine if any cultural resources are present and would be impacted (see **Cultural Resources** section in Chapter 3). Several prehistoric and historic sites have been identified to date including possible sacred and traditional sites.

Through the design process, BPA will try to avoid all sites. If some sites cannot be avoided BPA will work with the State Historic Preservation Officer of Washington to determine if those sites are eligible for a listing under the NRHP. If they are, effects will be evaluated and appropriate mitigation applied.

If, during construction, previously unidentified cultural resources that would be adversely 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); the National Environmental Policy Act of 1969 (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).

State, Areawide, and Local Plan and Program Consistency

The Council on Environmental Quality regulations for implementing NEPA require EISs to discuss possible conflicts and inconsistencies of a proposed action with approved state and local plans and laws.

Land Use Planning Framework

Each county and city crossed by the existing corridor has a comprehensive plan and a zoning ordinance. These jurisdictions have comprehensive land use plans that address utility corridors: the City of Grand Coulee, Lincoln County, Spokane County and the City of Spokane. The existing corridor is an allowed land use in these plans. For Douglas and Grant counties, whose plans do not address utility corridors, expansion and upgrading of existing utilities is permitted in the zones crossing the corridor.

Zoning ordinances in some jurisdictions specifically address utility corridors. The corridor is a permitted use in zoning ordinances for these jurisdictions: Lincoln, Grant, and Douglas counties. Spokane County and the City of Spokane zoning ordinances allow transmission line corridors as a permitted use in a variety of zones to a height of 125 feet.

The Agency Preferred Action would use single-circuit structures about 125- to 150-feet tall on most of the route; double-circuit structures about 175-feet tall would be used in two short sections (see **Chapter 2**). The Alternative Action would include all the components of the Preferred Action except additional double-circuit line would be constructed between corridor mile 75-2 and Bell Substation, a distance of about 9 miles. Thus, the proposed action may not be consistent with the height restriction noted above. BPA will work with Spokane County to address the height restriction as much as feasibly possible.

The proposed project would be undertaken solely by BPA, which is a federal entity. Pursuant to the federal supremacy clause of the U.S. Constitution, BPA is not obligated to apply for local development or use permits in such circumstances, or variances from development codes.

Therefore, BPA would not make formal application to any of the local jurisdictions for permits such as conditional use permits or shoreline substantial development permits. However, BPA is committed to plan the project to be consistent or compatible to the extent practicable with state and local land use plans and programs and would provide the local jurisdictions with information relevant to any permits.

Washington Growth Management Act – This 1990 Act requires that most counties and cities in Washington adopt comprehensive plans, including "a utilities element consisting of the general location, proposed location, and capacity of all existing and proposed utilities, including, but not limited to, electrical lines, telecommunication lines, and natural gas lines." The 1991 and subsequent amendments to the Act added more planning requirements.

Douglas County's first Comprehensive Land Use Plan was adopted in 1964. This version of the Comprehensive Plan was replaced with the Douglas County Regional Policy Plan, which was adopted on May 19, 2002.

The City of Grand Coulee Comprehensive Plan and Zoning Ordinance has not been updated since 1986. The City hopes to update these documents in 2003.

Grant County's Comprehensive Plan is currently being updated. The Zoning Code was last revised in October 2000.

The Lincoln County Comprehensive Plan was adopted on January 3, 1983, and a new one is currently being developed. The Zoning Code was amended in January 2000, and will be amended by resolution in July 2002.

The Spokane County Comprehensive Plan was revised in November 2001. The Spokane County Zoning Code was revised in November 1998. However, the County is in the process of incorporating the new Phase 1 Development Regulations and other recent Amendments into the existing Zoning Code.

The City of Spokane revised its Comprehensive Plan on May 21, 2001. The Zoning Code was revised in December 2000.

The existing corridor is an allowed land use in the comprehensive plans for the City of Grand Coulee, Lincoln County, Spokane County and the City of Spokane. For Douglas and Grant counties, whose plans do not address utility corridors, expansion and upgrading of existing utilities is permitted in the zones crossed by the corridor.

Zoning ordinances in some jurisdictions specifically address utility corridors. The corridor is a permitted use in zoning ordinances for Lincoln, Grant, and Douglas counties. Spokane County and the City of Spokane zoning ordinances allow transmission line corridors as a permitted use in a variety of zones to a height of 125 feet. The proposed action would use towers that would nominally be 125 feet tall, except where the corridor narrows between structures 83/1 and 83/6 where 175-foot tall towers would be used. In addition, some locations with longer spans may require taller towers that would exceed 125 feet. The Alternative Action would use towers that are 175 feet tall.

Washington Shoreline Management Act -- The State's Shoreline Management Act (Chapter 90.58 RCW) identifies "Shorelines of the State" and "Shorelines of Statewide Significance" that would be spanned by the proposed project. The existing corridor spans the Spokane River, identified as a "Shoreline of the State." In Grand Coulee, new right-of-way would span the canal that supplies Banks Lake with water pumped from Franklin D. Roosevelt Lake. Banks Lake is identified as a "Shoreline of Statewide Significance."

It is not likely that structures would be placed within the 200-foot jurisdictional areas of the Spokane River. Actual structure locations would not be determined until the detailed design stage of project development (after the Final EIS). Where possible, BPA will place structures out of the 200-foot jurisdictional area.

BPA would take the following measures, where practicable, to assure consistency with the counties' Shoreline Master Plans:

- Towers would be placed in an existing corridor, except on BPA property and where new right-of-way will be acquired next to existing right-of-way in the Grand Coulee area.
- Towers would not be in water bodies.
- Towers would not be within the identified shoreline if possible. If the shoreline area could not be avoided, BPA would consult with the appropriate state and local agencies to determine the best sites for towers.
- In shoreline areas, disturbed land would be restored as closely as possible to pre-project forms and replanted with native and local species.
- Erosion control measures would be implemented to protect the 200-foot shoreline area.

Critical Areas Ordinances

The Growth Management Act (GMA) requires that local jurisdictions designate and protect critical areas, which are defined as wetlands, critical aquifer recharge areas, frequently flooded areas, geologically hazardous areas, and fish and wildlife habitat conservation areas. GMA requires that jurisdictions include the best available science when developing policies and development regulations to protect the functions and values of critical areas and must give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries. The corridor for the proposed project crosses through the jurisdictional areas of three counties (Grant, Lincoln, and Spokane) and two municipalities (Grand Coulee and Spokane). The current status of Critical Area Ordinances (CAO's) for these jurisdictions is described below.

Douglas County adopted development regulations (Douglas County Code Title 19) governing development that is incompatible with critical areas in June 2001 (Douglas County 2002).

Douglas County's CAOs were developed to protect wetlands, fish and wildlife habitat, aquifer recharge areas, and geologically hazardous areas. Activities exempt from the provisions of the CAO include:

- Normal maintenance or repair of existing buildings, structures, roads, or development, including damage by accident, fire, or natural elements
- Emergency construction necessary to protect property from damage by the elements
- Agricultural activities normal or necessary to general farming conducted according to industry-recognized BMPs including the raising of crops or the grazing of livestock
- The normal maintenance and repair of natural drainage which does not involve the use of heavy equipment, and which does not require permit issuance from other local, state, or federal agencies.

The County has established buffer areas around wetlands and fish and wildlife habitat areas ranging between 25 and 100 feet, depending on the classification of the areas in question. Disturbance of critical areas by development requires appropriate mitigation and enhancement measures that will be determined on a site-specific basis.

Specific standards of the Douglas County CAO are:

- No significant adverse impacts to designated critical areas or buffer areas shall result from the repair, maintenance, expansion, or construction of any public or private road
- The functions and water quality of wetlands or buffer shall not be adversely impacted
- Utilities: When no other practical alternative exists, construction of utilities within a critical area buffer may be authorized, subject to the following minimum standards:
    - utility corridors shall be jointly used
    - corridor construction and maintenance shall protect the designated critical area buffer, and shall be aligned to avoid cutting trees greater than six inches in diameter at breast height, when possible
    - no pesticides, herbicides, or other hazardous or toxic substances shall be used
    - utility corridors, including maintenance roads authorized by the review authority, shall be located at least a distance equal to the width of the utility corridor away from the edge of the critical area
    - corridors shall be revegetated to pre-construction densities with appropriate native vegetation immediately upon completion of construction, or as soon thereafter as possible given seasonal growth constraints. The utility purveyor shall provide an assurance device or surety in accordance with DCC Title 14 which ensures that such vegetation survives.

  - Any additional corridor access for maintenance shall be provided as much as possible at specific points rather than by parallel roads. If parallel roads are necessary they shall be not greater than 15 feet in width, and shall be contiguous to the location of the utility corridor on the side opposite the critical area

- All crossings using culverts shall use superspan or oversize culverts
- Crossings shall not diminish flood carrying capacity

See Chapter 3 for a discussion of potential environmental impacts related to construction of the transmission line.

Grant County adopted a resource lands and critical areas ordinance to comply with the requirements of the GMA on May 25, 1993 (Grant County 2002).

Grant County's CAO provides protection of wetlands, fish and wildlife conservation areas, critical aquifer recharge areas, geologically hazardous areas, and frequently flooded areas by enforcing buffer widths ranging from 25 to 300 feet. The County's CAO also provides exemptions to the normal and routine maintenance, repair and operation of existing utilities although all activities are required to use reasonable methods with the least amount of potential impact to critical areas.

All proposed alterations to critical areas or associated buffers require mitigation sufficient to provide for and maintain the functions and values of the critical area or to prevent risk from critical area hazard. Wetland buffer widths range from 25 to 100 feet, depending upon the wetland category.

Road and utility maintenance, repair, and construction may be permitted across critical area buffers under the following conditions:

- It is demonstrated that there are no alternative routes that can be reasonably used to achieve the proposed development
- The activity will have minimum adverse impact to the wetland area
- The activity will not significantly degrade surface water or groundwater
- Road maintenance, repair, and construction shall be the minimum necessary to provide safe traveling surfaces
- Intrusion into a Fish and Wildlife Habitat Conservation Area and its buffers is fully mitigated

The County defines geologically hazardous areas as those areas with:

- Erosion hazards
- Landslide hazards
- Mine hazards

- Seismic

Erosion hazard areas are those areas identified as having high or very high water erosion hazard by the U.S. Department of Agriculture Natural Resources Conservation Service. Landslide hazard areas are those areas potentially subject to landslides based upon the following combination of geologic, topographic, and hydrologic factors:

- Areas of historic failure
- Areas with the following characteristics:
  - a gradient of 15% or greater
  - hillsides intersecting geologic contacts with relatively permeable sediment overlying a relatively impermeable sediment or bedrock
  - springs or groundwater seepage

Protection standards for Erosion and Landslide Hazard Areas are as follows:

- Grading
  - clearing, grading, and other construction activities shall not aggravate or result in slope instability or surface sloughing
  - undergrowth shall be preserved to the extent practicable
  - ground disturbance shall be minimized to the extent practicable
  - no dead vegetation, fill, or other foreign material shall be placed within a landslide hazard area, other than that approved for bulkheads or other methods of stabilization unless a geotechnical report shows that the activity will not exacerbate landslide hazards
- Ground surface erosion control management
  - there shall be a minimum disturbance of vegetation in order to minimize erosion and maintain existing stability of hazard areas
  - vegetation removal on the slopes of banks between the ordinary high water mark and the top of the banks shall be minimized
  - vegetative cover shall be re-established on any disturbed surface to the extent practicable
  - Soil stabilization materials such as filter fabrics, riprap, and similarly designed materials shall be placed on any disturbed surface when future erosion is likely
- Buffers
  - an undisturbed 30-foot buffer, as measured on the top surface, is required from the top, toe, and along all sides on any existing landslide or erosion hazard areas

  - normal non-destructive pruning and trimming of vegetation for maintenance purposes, or thinning of limbs of individual trees to provide a view corridor shall not be subject to these buffer requirements

- Design guidelines

  - foundations shall conform to the natural contours of the slope and foundations should be stepped or tiered where possible to conform to existing topography
  - roads, walkways, and parking areas shall be designed with low gradients or be parallel to the natural contours of the site
  - to the extent practicable, access shall be in the least sensitive area of the site

All work in frequently flooded areas (floodplains) will need to comply with the Grant County Flood Damage and Prevention Ordinance, the Grant County Shoreline Management Mast Plan, the Uniform Building Code, and other pertinent ordinances and codes. Any uses or development in floodplain areas cannot alter the normal movement of surface water in a manner that would cause the unnatural diversion of floodwater to otherwise flood-free areas.

See Chapter 3 for a discussion of potential environmental impacts related to construction of the transmission line.

Lincoln County is currently in the process of developing CAO's to comply with the requirements of the GMA. The County expects to complete the process by 2003 (personal communication, J. DeGraffenreid, Director, Lincoln County Planning, June 24, 2002).

No information is available on Lincoln County CAOs.

Spokane County adopted a critical areas ordinance (Spokane County Code 11.20) on August 1, 1996 (Spokane 2002).

Spokane County's CAOs were developed to protect wetlands, fish and wildlife habitat, and geologically hazardous areas. Under Spokane County's CAO, an application can be made for a reasonable use exception. The applicant must provide documentation demonstrating all of the following to the satisfaction of the County:

- Applications of the ordinance would deny all reasonable use of the property
- There is no reasonable use with less impact on the critical area
- The requested use or activity will not result in damage to other property and will not threaten the public health, safety, or welfare on or off the property
- Any alteration to a critical area is the minimum necessary to allow for reasonable use of the property

- The inability of the applicant to derive reasonable use is not the result of actions by the applicant in subdividing the property or adjusting boundary lines thereby creating the undevelopable condition after the effective date of the ordinance

When a regulated use or activity is proposed on a property which is within a wetland or wetland buffer area, a wetland report is required. The applicant or proponent shall, provide a wetland report prepared by a Qualified Wetland Specialist. Wetland buffer areas range between 25 and 200 feet, depending upon the classification of the wetland.

Regulated activities shall not be allowed in a buffer area except for the following:

- Activities having minimal adverse impacts on buffers and no adverse impacts on wetlands. These may include low intensity, passive recreational activities such as pedestrian/bike trails which should be setback 50' from the wetland boundary if possible and shall be a maximum of 14' in width, nonpermanent wildlife watching blinds, short-term scientific or education activities, and sports fishing or hunting.
- Stormwater management facilities including biofiltration swales, if designed according to the Spokane County Stormwater Management Guidelines, if sited and designed so that the buffer area as a whole provides the necessary biological, chemical and physical protection to the wetland in question, taking into account the scale and intensity of the proposed land use.
- Motorized vehicles shall not be allowed in wetland buffer areas except as part of an approved mitigation plan or non-regulated activity such as agriculture.

As a condition of any permit allowing alteration of wetlands, the applicant will engage in the restoration, creation or enhancement of wetlands in order to offset the impacts resulting from the applicant's or violator's actions.

For fish and wildlife conservation areas, Spokane County may restrict uses and activities that lie within a priority habitat by definition or within ¼ mile of a point location (den or nest site) of a non-game priority species. A management plan, if required, will be used by the County to evaluate the impact of a use or activity on a priority habitat or species and may require mitigating measures to protect fish and wildlife based on the management plan recommendations.

Buffer areas around priority habitat areas extend from 25 to 250, depending upon the classification of the area. Except as otherwise specified, riparian areas shall be retained in their natural condition. Riparian vegetation in buffer areas shall not be removed except in the case of fire or disease unless there is no alternative. Roads within riparian buffer areas shall be kept to a minimum and shall not run parallel to the water body. Crossings, where necessary, shall cross riparian areas at as near right angles as possible. If no alternative exists to placement of a roadway within a riparian area, mitigation may be required. Mitigation measures shall be specified in a management plan.

A habitat management plan will need to be prepared for regulated uses or activities which are located in a priority habitat or within 1/4 mile of a nongame priority species point location if it is determined that a proposed activity is likely to have a significant adverse impact on the priority habitat or species.

The City of Grand Coulee adopted development regulations (Ordinance 755) to regulate development that is incompatible with critical areas and ensure the conservation of agricultural, forest, and mineral lands on February 18, 1992.

No information was found for the City of Grand Coulee.

City of Spokane adopted development regulations (Spokane Municipal Code Title 11) to regulate development that is incompatible with critical areas on December 2, 1991 (City of Spokane 2002).

The City of Spokane's CAO provides protection of wetlands, fish and wildlife conservation areas, and geologically hazardous areas by enforcing buffer widths ranging from 25 to 250 feet. The construction, operation, and maintenance of utilities are subject to the provisions of the City's CAO. See Chapter 3 for a discussion of potential environmental impacts related to construction, operation, and maintenance of the transmission line.

The proposed action would be generally consistent with the provisions of the CAOs described above because BPA would avoid critical areas to the maximum extent possible. Because final design has not been completed, it is unclear whether conflicts might occur in a few locations. BPA would maximize attempts to avoid critical areas and critical area buffers at such locations; if unable to avoid these areas, potential inconsistencies could occur.

Transportation Permits

The construction contractor and transmission line facilities manufacturers would consult with the Washington Department of Transportation and with City and County public works departments to secure necessary permits for the transportation of large loads on the roadways.

Coastal Zone Management Consistency

As an agency of the federal government, BPA follows the guidelines of the Coastal Zone Management Act of 1972 (CZM) (16 U.S.C. Sections 1451-1464) and would ensure that projects would be, to the maximum extent practicable, consistent with the enforceable policies of the state management programs. Washington's coastal zone management program is implemented through the provisions of the State Shoreline Management Act, including shoreline management programs developed and administered by counties. The Coastal Zone Act Reauthorization Amendments of 1990 also require that proposed Federal facilities fully comply with Federal consistency requirements as determined by and through consultation with a designated coastal zone management agency. The proposed project is not in the coastal zone, nor would it directly affect the coastal zone.

Floodplains and Wetlands Protection

The Department of Energy mandates that impacts to floodplains and wetlands be assessed and alternatives for protection of these resources be evaluated in accordance with Compliance with Floodplain/ Wetlands Environmental Review Requirements (10 CFR 1022.12), and Federal Executive Orders 11988 and 11990. Evaluation of project impacts on floodplains and wetlands is included in Chapter 3 of the Draft EIS. Should the project affect floodplains and wetlands, BPA will publish a notice of floodplain/wetlands involvement for this project in the Federal Register.

A portion of the project falls within the 100-year floodplain of Sherman, Hawk, Stock, Coulee, and Deep creeks, the Spokane River, and Country Holmes Canal as determined from Flood Insurance Rate Maps published by the Federal Emergency Management Agency, U.S. Department of Housing and Urban Development. Based on preliminary engineering design, no structures would be placed within the 100-year floodplains of the Spokane River. Wooden structures currently in the floodplain would be removed by cutting the pole off at elevation, thus avoiding impacts that would be caused by excavation and backfilling. Access roads cross the floodplains of Sherman, Hawk, Stock, Coulee, and Deep creeks, the Spokane River, and Country Holmes Canal. Although road improvements would be designed to reduce existing erosion and runoff problems, low to moderate impacts may occur in floodplains if erosion and runoff were to occur during and immediately after active road work.

Wetlands that could be affected by the proposed project were identified from National Wetlands Inventory maps prepared by the U.S. Fish and Wildlife Service, and from field inspections.

Wetlands that would be crossed by the proposed project between Grand Coulee and Spokane are discussed in Chapter 3, **Wetlands**. Several pothole wetlands and wetlands associated with riparian areas and springs would be crossed by the line. These wetlands vary from less than 0.05 acre to several acres in size. All would be spanned by the transmission line. If wetlands or waterways would be impacted by the project, appropriate permits from the Corps of Engineers would be sought.

Farmlands

The Farmland Protection Policy Act (7 USC 4201 et seq.) directs Federal agencies to identify and quantify adverse impacts of Federal programs on farmlands. The Act's purpose is to minimize the number of Federal programs that contribute to the unnecessary and irreversible conversion of agricultural land to non-agricultural uses.

Construction of the project would remove from production a maximum of 765 acres of agricultural land, including 209 acres of prime agricultural land. This impact would be spread over two growing seasons with approximately one-half of the impact occurring each growing season. This is a worse case scenario. Removing the existing wood-pole structures, and placing new steel towers will create a permanent net loss of production from 12 acres of agricultural land. A maximum of 3.8 acres would potentially be prime agricultural land. U.S. Soil Conservation Service county soil surveys were used to identify prime farmland.

Recreation Resources

BPA used the Wild and Scenic River inventory of listed and proposed rivers (16 USC Sec. 1273 (b)) qualifying for Wild, Scenic, or Recreation River to evaluate recreational resources and impacts. The corridor will not cross any listed segments.

The Northwest Power Planning Council's Protected Area Amendments to the Pacific Northwest Electric Power Planning Council Designation Act of 1980 are not applicable to the project.

No National Recreation or National Scenic Trails identified in the National Trail System (16 U.S.C. Sec. 1242-1245) either cross or are in the vicinity of the right-of-way. The Centennial Trail crosses the corridor in Riverside State Park. The trail is managed by Washington State Parks.

No designated wilderness or other areas of national environmental concern are found on or around the right-of-way.

Global Warming

Gasses that absorb infrared radiation and prevent heat loss to space are called greenhouse gases. Greenhouse gases are thought to be connected to global warming. Greenhouse gases include: water vapor, carbon dioxide, methane, nitrous oxide, nitrogen oxides, non-methane volatile organic compounds and stratospheric ozone depleting substances such as chlorofluorocarbons. Without greenhouse gases some believe the mean temperature on earth would be around 5 degrees Fahrenheit.

The atmosphere, plants, oceans, rocks and sediments act as reservoirs for carbon. A finite amount of carbon is available, most stored in non-atmospheric sinks. This carbon balance has been upset in industrial times through activities such as burning fossil fuels and logging old growth forests. Plants uptake carbon dioxide from the atmosphere during photosynthesis and use the carbon to construct leaves and branches, in effect, storing carbon.

In a worst-case scenario, proposed construction would clear about 97 acres of forest, releasing about 97 tons of carbon dioxide to the atmosphere through decay (no burning is planned). This carbon release would be partially mitigated by replanting cleared areas with native vegetation and by using harvested logs for timber.

Permit for Structures in Navigable Waters

Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) regulates all work done in or structures placed below the ordinary high water mark of navigable waters of the U.S. No work associated with the proposed project would occur in such water bodies. However, the conductors would span the navigable waters of the Spokane River; overhead utility lines constructed over Section 10 waters require a Section 10 permit.

Permit for Discharges into Waters of the United States

The Clean Water Act regulates discharges into waters of the United States. Field delineation may be necessary to fulfill permitting requirements.

Section 401 – A Federal permit to conduct an activity that causes discharges into navigable waters is issued only after the affected state certifies that existing water quality standards would not be violated if the permit were issued. The state of Washington would review permits for compliance.

Section 402 – This section authorizes storm water discharges under the National Pollution Discharge Elimination System. The Environmental Protection Agency, Region 10, has a general permit for Federal facilities for discharges from construction activities. BPA would issue a Notice of Intent to obtain coverage under the EPA general permit and would prepare a Storm Water Pollution Prevention Plan. The SWPP Plan will address stabilization practices, structural practices, stormwater management, and other controls (see Chapter 3, **Water Quality**).

Section 404 – Wetland management, regulation, and protection is related to several sections of the CWA, including Sections 401, 402, and 404, as well as to a combination of other laws originally written for other uses. Other laws are the Coastal Zone Management Act, the Endangered Species Act, Historic Preservation Act, Rivers and Harbors Act, and the Wild and Scenic Rivers Act. Section 404 of the CWA (33 CFR 320-330) requires either review by the managing agencies or certification of consistency.

The following nationwide permits (33 CFR 330) could be applicable to activities proposed by this project:

- NWP No. 14 - Road Crossings
- NWP No. 25 - Structural Discharges
- NWP No. 33 - Temporary Construction and Access.

All conditions for these permits would be met. See the Floodplain/Wetlands Assessment section of this chapter.

The Safe Drinking Water Act

The Safe Drinking Water Act (42 U.S.C. Section 200f et seq.) protects the quality of public drinking water and its source. In the State of Washington, the Department of Health is responsible for implementing the rules and regulations of the Safe Drinking Water Act (WAC 246-290). This proposed project would cross the Spokane Valley-Rathdruin Prairie Sole Source Aquifer and the East Columbia Plateau Aquifer System, the principal sources of drinking water in the region. BPA would comply with state and local public drinking water regulations and will not degrade the quality of aquifers or jeopardize their usability as a drinking water source. The proposed project would not affect any sole source aquifers or other critical aquifers, or adversely affect any surface water supplies.

Energy Conservation at Federal Facilities

The proposed changes at Bell Substation and Grand Coulee Switchyard would not require adding new buildings. The changes at Creston Substation would include a new control house that would meet federal energy conservation design standards.

Permits for Right-of-Way on Public Lands

Building a transmission line across Federally-owned lands requires the approval of the agency administering the lands. The Bureau of Reclamation is a cooperating agency on this EIS and owns the Grand Coulee Switchyard and some land surrounding the Switchyard BPA is working with BOR representatives to gain their approval for building a transmission line across BOR land. The approval will be a supplement to the 1944 Memorandum of Understanding BPA has with BOR.

Air Quality

The Federal Clean Air Act, as revised in 1990 (PL 101-542 (42 USC 7401), requires the EPA and individual states to carry out a wide range of regulatory programs intended to assure attainment of the National Ambient Air Quality Standards. In the state of Washington, EPA has delegated authority to the Department of Ecology, who in most areas, has delegated authority to local air pollution control agencies. Each of those agencies has regulations requiring all industrial activities (including construction projects) to minimize windblown fugitive dust. Chapter 70.94 RCW-Washington Clean Air Act and Chapter 173-400 WAC require owners and operators of fugitive dust sources to prevent fugitive dust from becoming airborne and to maintain and operate sources to minimize emissions.

The General Conformity Requirements of the Code of Federal Regulations require that federal actions do not interfere with state programs to improve air quality in non-attainment areas. Portions of the Spokane area have been designated as non-attainment areas for particulate matter (PM-10). The proposed project would not interfere with air quality improvement programs because the project would contribute a low level of pollutants that would not violate air quality standards.

Chapter 173-425 WAC applies to open burning in Washington and thus applies to material burned from the cleared portions of the transmission right-of-way. The purpose of this rule is to eliminate open burning during periods of impaired air quality, in PM-10 and carbon monoxide non-attainment areas, and in populated regions. The rule also requires permits for all open burning and prohibits burning where reasonable alternatives exist. Burning permits must be obtained for each distinct burn area. Permitting agencies will be different along different sections of the line. No burning of cleared material is proposed.

Noise

The Federal Noise Control Act of 1972 (42 USC 4901) requires that Federal entities, such as BPA, comply with state and local noise requirements. Environmental noise limits relevant to this proposed project are regulated by the Washington State Department of Ecology Maximum Environmental Noise Levels (WAC 1 73-60) regulations. The regulation establishes limits on levels and duration of noise. Allowable maximum sound levels depend on the land use of the noise source and receiving property.

Nighttime noise limitations in residential neighborhoods are 50 dBA; in commercial areas the limitation is 55 dBA; and in industrial areas the limitation is 60 dBA (WAC 1 73-60-040-2b). BPA designs to a nighttime residential level of 50 dBA. Noise from electrical substations is exempt (WAC 1 73-60-050-2a). BPA imposes its own 50 dBA limit at substation boundaries. Sound created by the installation or repair of essential utility services are exempt from the sound level limits during daytime hours (WAC 1 73-60-050-le).

The proposed action would operate at or below existing state nighttime noise limits for residential property, commercial areas, and industrial areas. The facilities would be designed to meet these limits for the worst case, that is, at night, at the edge of the right-of-way, during rainy weather. During fair weather, noise levels are typically 25 dBA or less. Noise also decreases with distance from the right-of-way.

Hazardous Materials

Several pollution control acts apply to this project. The Spill Prevention Control and Countermeasures Act, Title III of the Superfund Amendments and Reauthorization Act, and the Resource Conservation and Recovery Program potentially apply to the proposed project, depending upon the exact quantities and types of hazardous materials stored on-site. Regulations would be enforced by the Washington Department of Ecology. In addition, development of a Hazardous Materials Management Plan in accordance with the Uniform Fire Code may be required by local fire districts.

The Resource Conservation and Recovery Act (RCRA), 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.

The proposed project would not generate large amounts of solid waste. Most of the poles and crossarms removed from the 115-kV line were likely treated with a wood preservative (creosote or pentachlorophenol), listed as hazardous waste under RCRA. These materials would be disposed of according to state law and RCRA.

The Toxic Substances Control Act is intended to protect human health and the environment from toxic chemicals. Section 6 of the Act regulates the use, storage, and disposal of PCB's. BPA adopted guidelines to ensure that PCB's are not introduced into the environment. Equipment used for this project will not contain PCB's. Any equipment removed that may have PCB's will be handled according to the disposal provisions of this Act.

The Federal Insecticide, Fungicide and Rodenticide Act registers and regulates pesticides. BPA uses herbicides (a kind of pesticide) only in a limited fashion and 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 are recorded and reported to state government officials. Herbicide containers are disposed of according to RCRA standards.

If a hazardous material, toxic substance, or petroleum product is discovered, and may pose an immediate threat to human health or the environment, BPA requires that the contractor notify the Contracting Officer's Technical Representative (COTR) immediately. Other conditions such as large dump sites, drums of unknown substances, suspicious odors, stained soil, etc. shall also be reported immediately to the COTR. The COTR will coordinate with the appropriate personnel within BPA. In addition, the contractor will not be allowed to disturb such conditions until the COTR has given the notice to proceed.

Environmental Justice

In February 1994, Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations, was released to federal agencies. This order states that federal agencies shall identify and address as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income population. (Minority populations are considered members of the following groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic Origin; or Hispanic if the minority population of the affected area exceeds 50%, or is meaningfully greater than the minority population in the project area.)

The proposed project has been evaluated for disproportionately high environmental effects on minority and low-income populations; see the **Socioeconomics** section, Chapter 3 of this EIS. There would not be disproportionately high and adverse impacts on minority and low income populations as result of the proposed project.

Notice to the Federal Aviation Administration

As part of transmission line design, BPA seeks to comply with Federal Aviation Administration (FAA) procedures. Final locations, structures, and structure heights would be submitted to FAA for the project. The information includes identifying structures taller 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 tower locations. The FAA then conducts its own study of the project, and makes recommendations to BPA for airway marking and lighting. General BPA policy is to follow FAA recommendations.

Federal Communications Commission

Federal Communications Commission (FCC) regulations require that transmission lines be operated so that radio and television reception would not be seriously degraded or repeatedly interrupted. Further, the FCC regulations require that the operators of these devices mitigate such interference. It is expected that there would be no interference with radio, television, or other reception as a result of the proposed project (see the **Noise** section in Chapter 3). BPA would comply with FCC requirements relating to radio and television interference from the proposed project if any such interference occurs.

Chapter 5
List of Preparers

EDWARD ARTHUR, Archaeologist, Confederated Tribes of the Colville Reservation History/Archaeology Department. Served as the contracted Crew Chief for the archaeological survey portion of the cultural resources study. Education: B.A. Anthropology. Experience: thirteen years of fieldwork experience in the Northwest and eastern United States.

WILLIAM H. BAILEY, Ph.D., Principal Scientist and Health Practice Group Manager, E[x]ponent. Contributor to Appendix B-2, *Assessment of Research Regarding EMF and Health and Environmental Effects*. Education: Ph.D. Neuropsychology; M.B.A. Post-doctorate neurochemistry. Experience: Thirty years experience in laboratory and epidemiologic research, health risk assessment, comprehensive exposure analysis, and research on potential health effects of electromagnetic fields.

T. DAN BRACKEN, Principal, T. Dan Bracken Inc. Responsible for preparing electrical effects of proposed action, and alternatives. Education: B.S., M.S., and Ph.D. Physics. Experience: Twenty-seven years experience undertaking research on and characterization of electric and magnetic field effects from transmission lines. With BPA from 1973 to 1980, and since then as a consultant.

ROBERT CHASE, Principal, Huckell/Weinman Associates. Responsible for: Socioeconomics, Environmental Justice. Education: B.A. Geography; M.S. Regional Economics; Ph.D. studies in Regional Economics. Experience: 20 years experience in application of economics to regional and natural resource issues; real estate and land use; industry sectors; and strategic planning, programs, and policies; 1 year with Huckell/Weinman Associates, Inc.

MARIA DeJOSEPH, Epidemiologist, E[x]ponent. Contributor to *Appendix B-2, Assessment of Research Regarding EMF and Health and Environmental Effects*. Education: M.S. Epidemiology, B.S. Biological Sciences. Experience: Primary investigator for epidemiologic and biological studies, phytochemical analysis of medicinal plants, ethnobotanical and zoopharmocological field researcher. Formerly served as a Research Assistant at Stanford University Medical School, Division of Epidemiology.

STEVE ELLIS, Principal, MCS Environmental, Inc. Responsible for EIS project management of Geology and Soils, Water Quality, Wetlands, Vegetation, Fish, Wildlife, and Floodplain sections. Responsible for Geology and Soils and Fish sections of EIS. Education: B.A. Biology, M.S. and Ph.D. Biological Oceanography. Experience: Over 22 years experience in natural resource injury assessments, ecological and human health risk assessments, remediation planning, aquatic biota studies, and regulatory support for NEPA and SEPA documents.

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LINDA S. ERDREICH, Ph.D., Epidemiologist/Managing Scientist, E^{x}ponent. Contributor to *Appendix B-2, Assessment of Research Regarding EMF and Health and Environmental Effects.* Education: Ph.D. Epidemiology, M.S. Biostatistics and Epidemiology. Experience: Principal investigator for public and occupational health impacts of electric and magnetic fields. Formerly served as Acting Section Chief and Group Leader of the Methods Evaluation and Development Staff, and Senior Epidemiologist of the Environmental Criteria and Assessment Office for the U.S. Environmental Protection Agency.

AIMEE A. FINLEY, M.S. Historic Preservation specialist and Laboratory Director with AAR. Responsible for co-Field Director for the initial survey and conducted the background research for the project. Experience: Formal training in architectural history, and historic preservation law. She has authored or co-authored numerous National Register Registration forms. Nine years experience as an archaeologist. Member of the National Trust for Historic Preservation and the Preservation Resource Center.

GRACE GARLAND, Office Manager, Huckell/Weinman Associates. Responsible for: Document coordination and production. Experience: Over 18 years of experience with all aspects of office administration, document coordination and production; 6 years with Huckell/Weinman Associates, Inc.

JEFF GILMOUR, (Student) Geographer. Responsible for providing geographical data analysis and cartographic products. Education: B.S. Geography. Experience: Geographical Information Systems and Map Design. With BPA since 2000.

INEZ GRAETZER, Environmental Coordinator. Responsible for EIS coordination and development. Education: B.A. English Literature. Experience: Natural resource management, public involvement, environmental analysis, pollution prevention and abatement. With BPA since 1986.

BRENT HICKS, Project Archaeologist, Confederated Tribes of the Colville Reservation History/Archaeology Department. Responsible for project management and administration, reporting and editing all deliverables. Education: M.A. Anthropology. Experience: Over 10 years in private and self-employed cultural resources management consulting; over six year with the Colville Tribe.

JULIUS HORVATH, Electrical Engineer, BPA. Responsible for technical network planning studies. Education: B.S. Electrical Engineering. Experience: Electrical transmission grid planning. With BPA since 2000.

DUANE A HUCKELL, President and Senior Principal, Huckell/Weinman Associates. Responsible for: EIS Project Management. Education: B.S. Forestry; M.S. Forestry Economics; Ph.D. studies in Forestry Economics. Experience: 30 years experience in environmental planning, economics consulting, and project management; 16 years with Huckell/Weinman Associates, Inc. Formerly a Principal with Dames & Moore consultants.

MARK KORSNESS, PE, Project Manager. Responsible for project management of overall project. Education: B.A. Geology, B.S. Civil Engineering. Experience: Site investigation, line design, project management. With BPA since 1991.

MIKE KREIPE, Process Manager, Network Planning. Responsible for technical system planning studies. Education: B.S. Electrical Engineering. Experience: electrical transmission grid planning. With BPA since 1968.

CHRIS LAWSON, Senior Planner, Huckell/Weinman Associates. Responsible for: Assistant EIS Project Management, Technical Review. Education: B.S. Geography, M.A. Geography. Experience: 21 years experience in socioeconomics, land use and recreation planning, and project management; 5 years with Huckell/Weinman Associates, Inc.

KERRIE McARTHUR, Aquatic Biologist, MCS Environmental, Inc. Responsible for Wetlands, Vegetation, and Wildlife sections of EIS. Education: B.S. Biological Oceanography. Experience: Over eight years experience including wildlife research projects, field surveys of endangered species, and wetland reconnaissance and delineations using the US Army Corps of Engineers Wetland Delineation Manual (1987 and 1989), plant and animal identification, habitat evaluation.

JUDITH H. MONTGOMERY, Ph.D., Judith H. Montgomery Communications. Technical editor for *Appendix B-1, Electrical Effects*. Education: B.A., English Literature. Ph.D., American Literature. Experience: Over 20 years providing writing, editing, and communications services for government and industry. Preparation of NEPA documents and technical papers on transmission-line environmental impact assessment and other utility-related activities.

GUY MOURA, Traditional Cultural Property Coordinator, Confederated Tribes of the Colville Reservation History/Archaeology Department. Responsible for planning and implementing the Traditional Cultural Property portion of the cultural resources study. Education: B.A. Anthropology; B.A. Education. Experience: over 30 years in the field, including site supervision, materials analysis, and reporting; over six years with the Colville Tribe.

5 List of Preparers

DAVID NEMENS, AICP, Principal, Huckell/Weinman Associates. Responsible for: Environmental Consultation, Review, and Permit Requirements. Education: B.A. English Literature; M.U.P. & Master of Landscape Architecture. Experience: 24 years experience in land use and environmental planning, permitting, and zoning; 1 year with Huckell/Weinman Associates, Inc.

LEROY SANCHEZ, Visual Information Specialist. Responsible for graphic design. Education: Graphics Design, University of Nevada, Las Vegas 1970-1973. Portland State University 1983-1985. Experience: EIS graphics coordination, cartographic technical studies. With BPA since 1978.

BRIAN SILVERSTEIN, PE, Electrical Engineer. Manager for Network Planning. Education: B.Eng. Electrical Engineering, M.Eng. Electric Power. Experience: Electrical transmission grid planning. With BPA since 1979.

RICHARD STEARNS, Electrical Engineer. Responsible for engineering aspects of public health and safety data. Education: B.S. Electrical Engineering, M.S. Electrical Engineering. Experience: Transmission line design issues related to corona and electrical field effects. With BPA since 1978.

KATHY STEPHENSON, Forester. Responsible for all clearing aspects and timber appraisal associated with the proposed project. Education: B.S. Forest Management. Experience: Timber cruising, timber appraisal, danger tree identification, developing clearing contract specifications. With BPA since 1991.

KIMBERLY ST. HILAIRE, Environmental Protection Specialist, BPA. Responsible for Vegetation, Wetlands/Floodplains section review and preparation. Education: J.D. Environmental Law, M.S. Teaching Biology, B.S. Biology. Experience: Ten years experience as a natural resources consultant. With BPA since April 2001.

ROBERT STUART, Fisheries Biologist, MCS Environmental, Inc. Responsible for Water Quality and Floodplain sections of EIS. Education: B.A. Chemistry, B.S. Zoology, M.S. Fisheries. Experience: Over 22 years of experience in fisheries, environmental assessment, environmental chemistry and toxicology, aquatic habitat degradation due to chemical and physical impacts, ecological risk assessment, and project management encompassing marine, estuarine, and freshwater habitats.

ALBERT TORRICO, JR, Project Planner, Huckell/Weinman Associates. Responsible for: Land Use and Visual Resources. Education: B.A. Sociology, Master of Urban Planning. Experience: 7 years experience in land use planning; 1 year with Huckell/Weinman Associates, Inc.

IVY TYSON, P.E., Mechanical Engineer, Project Engineer. Responsible for transmission line engineering including line siting, tower spotting, tower siting and conductor sagging. Education: B.S. Mechanical Engineering. Experience: six years experience of facilities engineering, four years of transmission line design engineering and project management. With BPA since 1990.

BILL R. ROULETTE, M.A., RPA, served as Principal Investigator for cultural resources analysis. Responsible for overall management and administration, technical oversight of research and fieldwork, and report writing and editing. Experience: Professional archaeologist for 20 years with more than 15 years of experience as a manager of archaeological projects; written, co-authored, or edited more than 300 technical reports.

JULIA J. WILT, M.S. Project Archaeologist for AAR. Responsible for co-Field Director for the initial survey and Field Director for the subsurface survey, conducted background research for the project and was senior author of both the initial survey and subsurface survey technical reports. Experience: 15 years experience as an archaeologist, mostly in the Pacific Northwest. She also has written or co-authored more than 100 technical cultural resource reports.

MARIAN WOLCOTT, Realty Specialist. Responsible for property value analysis. Education: B.S. Forest Management. Experience: forestry appraisal and Land Branch project coordination. With BPA as a contractor and employee since 1985.

JUDITH WOODWARD, Principal, Crossing Borders Communications. Responsible for writing Chapter 1 and part of Chapter 2 and editing portions of the EIS. Education: B.A. Geography and Arts & Letters. Experience: 25 years experience writing environmental documents for BPA.

Chapter 6
Agencies, Organizations, and Persons Receiving this EIS

This project mailing list contains about 1200 potentially interested or affected landowners; tribes; local, state, and federal agencies; utilities; public officials; interest groups; businesses; special districts; libraries and the media. They have directly received or have been given instructions on how to receive all project information made available so far, and they have an opportunity to review the Draft and Final EIS.

Federal Agencies

Corps of Engineers
Bureau of Indian Affairs
Bureau of Land Management
Bureau of Reclamation
Fish & Wildlife Service
US Forest Service
USAF Fairchild Air Force Base

Tribes or Tribal Groups

Coeur D'Alene Tribe
Confederated Tribes of the Colville
Kalispel Indian Community
Spokane Tribe

State Agencies, Montana

Legislative Service Division
Public Service Commission Utility Division
Department of Environmental Quality

6 Agencies, Organizations, and Persons Receiving this EIS

State Agencies, Washington

Department of Ecology SEPA Review Section
Department of Fish & Wildlife
Department of Natural Resources
Department of Transportation
Environmental Council
Highway Commission

Public Officials, Washington

Federal Congressional

US House of Representatives, Richard Hastings
US House of Representatives, Greg R. Nethercutt Jr.
US Senate, Maria Cantwell
US Senate, Patty Murray

Governor

Gary Locke

State Senator and Representatives

Brad Benson
Larry Crouse
Mike Armstrong
J. Clyde Ballard
Joyce Mulliken
Cathy McMorris
Bob Sump

Local Government

Cities

Airway Heights
Cheney
Chewelah
Creston
Davenport
Electric City

Grand Coulee
Plummer
Reardan
Spokane

Counties

Douglas
Grant
Lincoln
Spokane

Special Districts

Consolidated Irrigation District #19
Vera Water & Power District

Businesses

Avista Corporation
Burlington Northern Santa Fe Railroad
CH2M Hill
Northwest Pacific Pipeline Corporation
US West Communications
Wareco Inc.
Weyerhaeuser Company

Utilities

Big Bend Electric Coop
Ferry County PUD No. 1
Grant County PUD No. 2
Kittitas County PUD No. 1
Kootenai Electric Coop Inc.
Modern Electric & Water Company
Northern Lights Inc.
Pend Oreille County PUD No. 1
Vera Water & Power
Puget Sound Energy Inc.

6 Agencies, Organizations, and Persons Receiving this EIS

Libraries

Cooperative Academic Library System (CALS)
Grand Coulee Public Library
JFK Library
State of Washington Federal Depository Library
Spokane Public Library
Spokane Valley Branch Library

Interest Groups

AG Bureau
Central Basin Audubon
Earth First
Earth Justice
Friends of Centennial Trail
Loyal Order of Moose #504
MGLLC
National Audubon Society
Nature Conservancy
Pacific Forest Trust
Public Lands Council
Rotary Club Spokane North
Rotary Club Spokane West
Sierra Club
Snap
Spokane Audubon Society
Spokane Aurora Northwest
Trout Unlimited
Washington Audubon
Washington Trout
Wilderness Society of Washington

Media

Colville Statesman Examiner (Colville, WA)
Davenport Times (Davenport, WA)
Journal of Business (Spokane, WA)
KEYG Radio (Grand Coulee, WA)
Spokesman Review (Spokane, WA)
Star Newspaper (Grand Coulee, WA)

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Chapter 8
Glossary & Acronyms

APE – Area of Potential Effect.

Access road – Roads and road spurs that provide vehicular access to the corridor and structure sites. 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 even after construction, except where they pass through cultivated land. There, the road is restored for crop production after construction is completed.

Airshed – An air supply of a given geographic area, usually defined by topographic barriers or atmospheric conditions that confine air emissions.

Alluvium – Sediments deposited by flowing water.

Alternating current (AC) – An electric current or voltage that reverses direction of flow periodically and has alternately positive and negative values.

Alternatives – Refers to different choices available for a project. Alternative plans usually differ from each other in where they begin and end.

Ambient noise – Noise from sources such as a substation that occur over a longer period of time.

Aquatic bed – Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Aquatic beds generally occur in water less than 2 meters (6.6 feet) deep and are placed in the Littoral Subsystem (if in Lacustrine System).

Aquifer – Water-bearing rock or sediments below the surface of the earth.

Average megawatts (aMW) – The unit of energy output over a year, equivalent to the energy produced by the continuous operation of one megawatt of capacity over a period of time.

Backdropped – Landscape elements behind facilities; a background setting.

Bay – An area set aside in a substation for special equipment.

Biodiversity – A measure of the number of different species in a given area; species richness.

8 Glossary & Acronyms

BOR – U.S. Department of Interior, Bureau of Reclamation

BPA – Bonneville Power Administration

Breakers – See Power circuit breakers.

Bridge – The uppermost portion of the tower that serves as the attachment point for the insulators, which in turn supports the conductors.

Bundle – (Used with conductor, as in "bundled conductor.") Two, three, or four conductors (wires) put together to act as a single conductor to carry electricity.

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.

Cairn – A mound of stones erected as a memorial or landmark.

Capacity – A measure of the ability of a transmission line, groups of lines (path) or transmission system to carry electricity. (See Transfer Capacity.)

Cataracts – Large waterfalls.

Circuit breakers – see power circuit breakers.

Colluvium – Soil material, rock fragments, or both accumulated at the base of steep slopes.

Conductor – The wire cable strung between transmission towers through which electric current flows.

Configuration – A physical and electric description of the transmission lines in a corridor.

Congestion pricing – Pricing that works to reduce congestion by allowing generation on the surplus side of the constraint to shut down and purchase replacement power on the deficit site.

Corona – Corona occurs in regions of high electric field strength on conductors, insulators, and hardware when sufficient energy is imparted to charged particles to cause ionization (molecular breakdown) of the air.

Crossarms – The horizontal supports on a wood pole or steel tower, that support the insulators.

Crossdrains – Channels or dips constructed across a road to intercept surface water runoff and divert it before erosive runoff volumes and concentrations occur.

Counterpoise – Wires that route the lightening energy to the ground.

Culvert – A corrugated metal or concrete pipe used to carry or divert runoff water from a drainage; usually installed under roads to prevent washouts and erosion.

Current – The amount of electrical charge flowing through a conductor (as compared to voltage, which is the force that drives the electrical charge).

Curtail – To temporarily reduce or stop electric power delivery tinder emergency conditions. Cut and fill – The process where a road is cut or filled on a side slope. The term refers to the amount of soil that is removed (cut) or added (fill).

Cutplane – The point where insufficient transmission capacity exists to transmit all available power any farther

CWA – Clean Water Act. A Federal law intended to restore and maintain the chemical, physical, and biological integrity of the nation's waters and secure water quality.

Danger trees – Trees (or high growing brush) in or alongside the right-of-way, which are hazardous to the transmission line. These trees are identified by special crews and must be removed to prevent tree-fall into the line or other interference with the wires. The owner of danger trees off the right-of-way is compensated for their value. BPA's Construction Clearing Policy requires that trees be removed that meet either one of two technical categories: Category A is any tree that within 15 years will grow within about 18 feet of conductors with the conductor at maximum sag (212 ° F) and swung by 6 lb per sq/ft. of wind (58 mph); Category B is any tree or high-growing brush that after a years of growth will fall within about 8 feet of the conductor at maximum sag (176 ° F) and in a static position.

dBA – The first two letters (dB) are an abbreviation for "decibel," the unit in which sound is most commonly measured. The last letter (A) is an abbreviation for the scale (A scale) on which the sound measurements were made. 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.

Dead ends – Heavy towers designed for use where the transmission line loads the tower primarily in tension rather than compression, such as in 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.

Demand-side management – The strategies that focus on influencing when and how customers use electricity, with an emphasis on reducing or leveling load peaks, such as conservation measures and rate incentives for shifting peak loads, and energy storage schemes for reducing, redistributing, shifting, or shaping electrical loads.

Direct service industries (DSIs) – A group of high-electricity use manufacturers. The DSIs purchase their power directly from the Bonnevile Power Administration, rather than from utilities.

Discharge reactor – A device that is used during removal of capacitors from service (bypassing) to control currents to safe levels.

DNR – State of Washington, Department of Natural Resources

Double-circuit – The placing of two separate electrical circuits on the same tower.

Drain dips – Dips in secondary roads to reduce road surface and fill slope erosion by intercepting storm and seasonal runoff and diverting it to a safe disposal area.

Easement – A grant of certain rights to the use of a piece of land (which then 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 are included in the negotiation process for acquiring easements over private land.

EFSEC – Washington State Energy Facility Site Evaluation Council

Electromagnetic interference (EMI) – Interference caused by corona.

Electromagnetic noise – The noise generated in the frequency bands used for radio and television signals caused by corona on transmission line conductors.

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.

Emergent – Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.

Endangered species – Those species officially designated by the U.S. Fish and Wildlife Service that are in danger of extinction throughout all or a significant portion of their range.

Environmental Impact Statement (EIS) – A detailed statement of environmental impacts caused by an action, written as required by the National Environmental Policy Act.

EPA – Environmental Protection Agency.

Ephemeral – Streams filled with water for a brief time during the spring.

Equivalent sound level (L_{eq}) – Generally accepted as the average sound level.

Erosion susceptibility – A qualitative rating based on the of the erosion factor of the soils and slope. For example, a highly erosive soil on steep slopes would have high erosion susceptibility, whereas a low erosive soil on flat areas would have low erosion susceptibility.

ESA – Endangered Species Act

Exceedence levels (L levels) – Refers to the A-weighted sound level that is exceeded for a specified percentage of the time during a specified period.

Exposure assessments – Estimates of the magnetic field levels that people are and will be potentially exposed to.

FAA – Federal Aviation Administration

FCC – Federal Communications Commission

Fiber optics – 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 that 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.

Foreground – The viewed landscape from 0 to 0.5 mi. from an observer.

Forested— Characterized by woody vegetation that is 20 feet tall or taller.

Generation – The power that is produced through some type of power plant.

GIS – Geographic Information System. A computer system that analyzes graphical map data.

Glacial outwash – Materials deposited by glacial meltwaters.

GMA – Washington State Growth Management Act of 1990. This Act requires most counties and cities in Washington to adopt comprehensive plans.

Ground – A connection from electrical equipment to a ground mat or to the earth, used to insure that the equipment (housing or structure) will be at the same potential (voltage) as the earth.

Groundwire (overhead) – Wire that is strung from the top of one tower to the next; it shields the line against lightning strikes

H-Frame – Refers to a type of structure usually made of wood, with vertical poles and horizontal crossarms. When erected, it resembles a capital letter "H."

Herbaceous – A plant having the characteristics of an herb, not woody; or having a green color and a leafy texture.

Hertz (Hz) – The unit of frequency in cycles per second

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 creeks or streams.

Isolated wetland – a wetland that is not connected to other surface water bodies; although adjacent wetlands may be interconnected during high precipitation years.

Kilovolt (kV) – One thousand volts. (See Volt.)

Lacustrine – Includes wetlands and deepwater habitats with all of the following characteristics: situated in a topographic depression or a dammed river channel; lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent areal coverage, and total area exceeds 8 hectares (20 acres).

Lattice steel – Refers to a transmission tower constructed of multiple steel members that are connected together to make tip the frame.

Lithic – Relating to stone tools.

Load – The amount of electric power or energy delivered or required at any specified point or points on a system. Load originates primarily at the energy-consuming equipment of customers.

Load growth – Increase in demand for electricity. (See Load.)

Locational pricing – A method of establishing prices that is discriminatory with respect to location and the characteristics of a location (e.g., greater demand).

Loess – Sediment composed of mostly silt-sized particles, deposited by the wind.

Long-term firm transmission agreements – Agreements that obligate sellers/buyers of electrical power to sell/buy a stated amount on a long-term basis.

Mass movement – The dislodgment and downhill transport of soil and rock materials tinder the direct influence of gravity. Includes movements such as creep, debris torrents, rock slides, and avalanches.

Megawatts (MW) – A megawatt is one million watts, or one thousand kilowatts; an electrical unit of power.

Metal oxide varistor – A device designed to protect electric equipment from high-transient voltage by diverting a momentary over voltage (lightning or switching) to the ground.

Metric ton – Equivalent to 1000 kilograms or 2,205 pounds.

mG – Milligauss – A unit used to measure magnetic field strength. One-thousandth of a gauss

Middle ground – From the foreground to about five miles from the viewer.

Mills/kWh – The common expression of the cost of electricity; one mill per kilowatt-hour equals one dollar per megawatt-hour.

Mitigation – Steps taken to lessen the effects predicted for each resource, as potentially caused by the transmission project. They may include reducing the impact, avoiding it completely, or compensating for the impact. Some mitigation, such as adjusting the location, of a tower to avoid a special resource, is taken during the design and location process. Other mitigation, such as reseeding access roads to desirable grasses and avoiding weed proliferation, is taken after construction.

Multiplier effects – The total increase in income and employment that occurs in the local economy for each dollar of local project expenditure.

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).]

NESC – National Electrical Safety Code

Non–attainment – An area which does not meet air quality standards set by the Clean Air Act for specified localities and periods.

Nonfirm – Used to differentiate from "firm" power; may be interrupted.

Nonrenewable – Not capable of replenishing.

Non-spectural – Non-reflecting.

Noxious weeds – Plants that are injurious to public health, crops, livestock, land or other property.

NPDES – National Pollutant Discharge Elimination System.

NRHP – National Register of Historic Places

NWP – Nationwide Permit

Obligations – Capacity and energy BPA provides under contract to public agencies and private

Oil spill containment – Units installed in a substation to collect oil spilled from equipment.

100-year Floodplain – Areas that have a 1 percent chance of being flooded in a given year. (See Floodplain.)

Open water – Water covers the surface at a mean annual depth of grater than 6.6 ft or areas less than 6.6 ft in depth that do not support rooted-emergent or woody plant species.

Operations and Maintenance – see other documents.

Outage – Events caused by a disturbance on the electrical system, that requires BPA to remove a piece of equipment or a portion or all of a line from service. The disturbances can be either natural or human-caused.

Overloaded – Too much current trying to flow over transmission facilities. Equipment has safeguards: in the event of overloading of the system, switches will disconnect sensitive equipment from the flow of electricity.

Palustrine – Includes all nontidal wetlands dominated by trees, shrubs, emergents, mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 parts per thousand.

Particulate matter (PM) – Airborne particles including dust, smoke, fumes, mist, spray, and aerosols.

Perennial – Streams or creeks with year-round water flow.

Permeable – Capable of transporting liquids.

Permanently Flooded – Water covers the land surface throughout the year in all years.

Phase – A conductor or conductors or piece of electrical equipment that is associated with one of three separate phases of an alternating-current power system, designated A-phase, B-phase, and C-phase.

PM-10 – Particulate matter having a nominal aerodynamic diameter less than or equal to 10 microns.

Power circuit breakers – A switch, installed at a substation, which breaks or restores the flow of current through the line.

Prime and unique farmland – Prime farmland is land with the best combination of physical and chemical characteristics for producing food and other agricultural crops. Unique farmland is land other than prime farmland that is used to produce specific high-value food and fiber crops. It also has special characteristics to economically produce sustained high quality or high yields of specific crops.

Proposed RTO West – A proposed future Regional Transmission Organization.

Pulling site – The site where the machinery used to string the conductors is staged.

Record of Decision (ROD) – The document notifying the public of a decision taken on a Federal action, together with the reasons for the choices entering into that decision. The Record of Decision is published in the Federal Register

Relay – An electrical device that responds to a change of current or voltage in one circuit by making or breaking a connection in another..

Remedial action scheme – A set of fast, automatic control actions used to ensure acceptable power system performance following disturbances.

Resource protection area – A designation given to a stream reach by Washington State if the reach flows through a State Park, or is a component of the Washington State Scenic Rivers System, or if the reach has been designated as a component of the federal Wild and Scenic Rivers System or is being studied for potential designation.

Revegetate – Reestablishing vegetation on a disturbed site.

Right-of-way (ROW) – 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.

Riparian – Of, on, or relating to the bank of a natural course of water.

Riprap – Broken stones put in areas to prevent erosion, especially along river and stream banks.

Regional Transmission Organizations (RTOs) – An organization comprised of public and private entities that coordinates the sales and purchases of electricity.

Scabland – Areas scoured by Ice Age floods characterized by shallow soils and rock outcrops.

Scoping – A part of the NEPA process where significant issues to be analyzed in detail in the environmental document are identified.

Scrub/shrub – Includes areas dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions.

Seasonally flooded – Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface.

Semipermanently flooded – Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land's surface.

Sensitive/hydropower opportunity area – A designation given to a stream reach by Washington State if the reach is of statewide or regional significance for recreation, or is a candidate for the Washington State Scenic Rivers System, or if the reach flows through or abuts a Washington State Parks Conservation Area.

Series capacitors – Electrical devices that can increase loading on a transmission line. Used to increase the capability of interconnections and to achieve the most advantageous and economical division of loading between lines.

Shunt reactor – An electrical device connected to a bus or to a line and used to reduce voltage.

Single-circuit - A line with one electrical circuit on the same tower.

Slash windrows – Rows of slash or cut vegetation placed on the side of an access road to control erosion.

Sole source aquifer – An aquifer designated by the Environmental Protection Agency which provides at least half of an area's drinking water.

Staging area – The area cleared and used by BPA/BPA's contractor to store and assemble materials or structures.

Structure – Refers to a type of support used to hold up transmission or substation equipment.

Subsoiling – Breaking up compacted soils, without inverting them, using a plow or blade

Substation – The fenced site that contains the terminal switching and transformation equipment needed at the end of a transmission line.

Substation dead ends – 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 – An 8-cm (3-in.) 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.

Switchyard – An installation of equipment where several transmission lines are interconnected. Specifically, the 500-kV substation near Grand Coulee Dam owned by the Bureau of Reclamation, which is the eastern end of the Grand Coulee–Bell No.1, 115-kV line.

SWPP – Stormwater Pollution Prevention Plans

System reliability – The ability of a power system to provide uninterrupted service, even while that system is tinder stress.

Tackifiers – A water-based agent used to bind soil particles together to provide erosion protection. Talus – Rock debris that has accumulated at the base of a cliff or steep slope.

Talus – A sloping mass of rocky fragments at the base of a cliff.

Tapped – See Tap point.

Tap point – The point at which a transmission line is connected to a substation or other electrical device to provide service to a local load.

Temporarily flooded— Surface water is present for brief periods during growing season, but the water table usually lies well below the soil surface. Plants that grow both in uplands and wetlands may be characteristic of this water regime.

Terminus – Either end of the transmission line.

Thermal limit – The maximum current that can flow in a transmission line conductor, device or electrical machine without a failure or damage caused by excessive temperature.

Thermal overload – When the thermal limit is exceeded. (See Thermal limit.)

Threatened species – Those species officially designated by the U.S. Fish and Wildlife Service that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Tie line – A transmission line connecting two or more power systems.

Time of use rates – Rates that are discriminatory with respect to time of use (e.g., higher rates for peak use times).

Tower – See Structure.

Transfer capacity – The capability of a transmission line, group of transmission lines (path) or system to transfer a specified amount of power in a direction, assuming that no major facilities are out of service. (See Capacity.)

Transformers – Electrical equipment usually contained in a substation that is needed to change voltage on a transmission system.

Transient noise – Noise from sources such as passing aircraft or motor vehicles that is usually of short duration.

Transmission dead end towers – The last transmission line towers on both the incoming and outgoing sides of the substation. These towers are built extra strong to reduce conductor tension on substation dead ends and provide added reliability to the substation.

Transmission line – The structures, insulators, conductors, and other equipment used to transmit electrical power from one point to another.

Transmission system – A system to transmit electrical energy from one point to another.

USFWS – U.S. Fish and Wildlife Service

Volt – The international system unit of electric potential and electromotive force. Vortex – Fluid flow involving rotation about a single point.

Vortex – A whirling mass of water.

Water bars – Smooth, shallow ditches excavated at an angle across a road to decrease water velocity and divert water off and away from the road surface.

WDFW – Washington State Department of Fish and Wildlife

Wetlands – An area where the soil experiences anaerobic conditions because of inundation of water during the growing season. Indicators of a wetland include types of plants, soil characteristics and hydrology of the area.

Woodlands – Lands having a cover of trees and shrubs.

WSCC – Western Systems Coordinating Council, A utility group that self-regulates the transmission system in the western United States.

WWP – Washington Water Power

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GRAND COULEE– BELL 500-kV TRANSMISSION LINE PROJECT

APPENDIX A:

PUBLIC INVOLVEMENT

Department of Energy

Bonneville Power Administration
P.O. Box 61409
Vancouver, WA 98666-1409

January 14, 2002

In reply refer to: TNP-TPP-3

To: People Interested in the Grand Coulee-Bell 500-kV Transmission Line Project (Eastern Washington Reinforcement)

Bonneville Power Administration (BPA) is proposing to replace approximately 84 miles of an existing 115-kilovolt (kV) transmission line with a 500-kV transmission line between Grand Coulee and Spokane, Washington. This letter briefly explains what is being proposed, outlines our process and schedule, and invites you to meetings where you can comment and learn more. Please pass this letter on to anyone occupying your property such as renters or lessees. You can also call us with the names and addresses so we can mail a copy of the letter and add these people to our mailing list. If you cannot attend these meetings, other ways to be involved and provide input are described below.

Proposal

The proposed 500-kV transmission line would connect from BPA's existing Bell Substation in Spokane to the Bureau of Reclamation's existing Grand Coulee Switchyard at Grand Coulee Dam. The new line would be located primarily on BPA's existing right-of way. The project also would involve expanding Bell Substation and developing Grand Coulee Switchyard within the fenced area.

The project is needed to improve reliability and to support current and future demand for electricity in Washington State and the Pacific Northwest. The transmission line corridor between the Grand Coulee and Bell substations currently contains two 115-kV wood pole and three 230-kV steel lattice transmission lines. Two of the 230-kV lines are double circuited on one set of steel towers. Together, these transmission lines can no longer efficiently move power from generation sources east of Spokane to areas west of Spokane. Replacing one of the 115-kV lines with a 500-kV line will relieve congestion, provide for future growth, and enhance service reliability to the community.

As part of the project, BPA will consult with affected Tribes, conduct environmental studies, and collect public comments. Community input is an integral part of the process, and BPA will seek comments throughout the project.

Public Open House Meetings

We will soon start to assess the project's environmental impacts. But before we do, we would like to hear from you. What questions do you have? What resources should we analyze? We have scheduled three open house public meetings to hear your ideas and questions.

Tuesday, January 29, 2002	**Wednesday, January 30, 2002**	**Wednesday, February 6, 2002**
4:00 p.m. to 7:00 p.m.	**4:00 p.m. to 7:00 p.m.**	**4:00 p.m. to 7:00 p.m.**
Old Center School Building	Davenport Elementary School	Inland Northwest Wildlife
(Big Bend Community College)		Council Auditorium
317 Spokane Way	1101 7th Street	6116 N. Market Street
Grand Coulee, Washington	Davenport, Washington	Spokane, Washington

We do not plan to give a formal presentation at the meetings, so please stop by anytime between 4:00 p.m. and 7:00 p.m. Several members of the project team will be available to describe the project, answer questions, and take your comments.

Other Ways to Comment

If you cannot come to one of the meetings, you can still comment. If you comment by **February 15, 2002,** we will be able to incorporate your ideas into our environmental studies. **Please reference the Grand Coulee-Bell project in all communications.** To comment,

- Call BPA's toll-free comment line at 1-800-622-4519, and leave a message;
- Send an e-mail to: comment@bpa.gov; or
- Mail comments to Bonneville Power Administration, Public Affairs Office - KC-7, P.O. Box 12999, Portland, Oregon 97212. You can use the enclosed form to submit comments if you like.

Process and Schedule

The planning process will occur over the next several months and will consist of environmental studies and community involvement. The information we gather in our environmental analysis will be published in a Draft Environmental Impact Statement that will be available for review and comment in the spring. If you would like to receive a copy, please return the enclosed postcard and note whether you would like to receive it by regular or electronic mail. If you do not return the postcard, you will still receive notice when the study is available.

Once we have completed the environmental review, BPA will decide whether and how to proceed with the project. If BPA decides to proceed, construction would likely begin in 2003. Based on this schedule, the new 500-kV transmission line would be operating in Fall 2004.

For More Information

If you have any questions about this proposal, please call me toll-free at 1-800-282-3713, at my direct number 1-360-619-6326, or send an e-mail to makorsness@bpa.gov.

Thank you for your interest in our work.

Sincerely,

/s/ Mark Korsness 1/11/02
Mark Korsness
Project Manager

3 Enclosures:
Map
Post Card
Comment Form

Department of Energy

Bonneville Power Administration
P.O. Box 61409
Vancouver, WA 98666-1409

TRANSMISSION BUSINESS LINE

March 22, 2002

In reply refer to: Grand Coulee-Bell (TNP-TPP-3)

To: People Interested in the Grand Coulee-Bell 500-kV Transmission Line Project (Eastern Washington Reinforcement)

In January 2002, Bonneville Power Administration (BPA) wrote to tell you about a proposed transmission line that could affect you. We asked for your comments on the project and held three public meetings in eastern Washington. Response was good; we had over 200 comments. Thank you for taking the time to tell us your ideas.

After reviewing your comments, we have added an alternative to consider in the Draft Environmental Impact Statement. At this point, the alternatives we are considering for the project involve alternative structure designs. We will continue to study the originally proposed 500-kilovolt (kV) transmission line, which would use single-circuit structures from Grand Coulee for most of the 75 miles east and then would use double-circuit structures for the remaining nine miles to Bell Substation in Spokane. In addition to this alternative, we have added an alternative to consider using single-circuit structures for most of the last nine miles to Bell substation also. For the single-circuit alternative, the new 500-kV single-circuit structures would be approximately the same height as the existing 230-kV double-circuit structures. We also will consider the alternative of not building a line.

This letter briefly summarizes the public comments, outlines our next steps, and tells where to call if you have questions.

Proposal

BPA still proposes to construct a new 500-kV transmission line in eastern Washington. The project is needed to improve reliability and to support current and future demand for electricity in Washington State and the Pacific Northwest.

The proposed 500-kV transmission line would connect from BPA's existing Bell Substation in Spokane to the Bureau of Reclamation's existing Grand Coulee Switchyard at Grand Coulee Dam. The new line would be located primarily on BPA's existing right-of way. The project also would involve expanding Bell Substation on BPA property and developing Grand Coulee Switchyard within the fenced area.

The transmission line corridor between the Grand Coulee and Bell substations currently contains two 115-kV wood poles and three 230-kV steel lattice transmission lines. Two of the 230-kV lines are double circuited on one set of steel towers. Together, these transmission lines can no longer efficiently move power from generation sources east of Spokane to areas west of Spokane. Replacing one of the 115-kV lines with a 500-kV line will relieve congestion, provide for future growth, and enhance service reliability to the community.

Public Comments

In January and February, BPA received public comments on the proposed transmission line. Many of these comments were from public meetings. Public scoping meetings were held in Grand Coulee, Davenport, and Spokane. We also received comments in briefings with key stakeholders, by telephone, mail, and e-mail.

The comments focused on:

- Potential impacts to farming practices (erosion, noxious weeds, distance between structures, crop damage, and construction schedule)
- Double-circuit vs. single-circuit structures (removing both 115-kV wood pole structures and replacing them with one steel structure; using single-circuit for the entire transmission line route)
- Land use (crossing Riverside State Park, Whitworth College, and residential areas)

Other impact comments were on noise, public health and safety, and visual. We also received questions on why we need to build the line and about Avista's plans to expand its transmission system.

This is just a summary of the comments that we received. All of the comments will be posted on our web site at *www.efw.bpa.gov.* Please look for the Grand Coulee-Bell project under environmental planning/analysis, Active Projects.

Next Steps

You will see crews working along the line through the following months. These people are conducting on-the-ground environmental surveys and staking possible tower locations. In addition, to address noxious weed concerns, we will conduct a weed survey along the right-of-way and will follow weed control measures when working in the field. If we need to access property along the proposed route but off of our existing right-of-way, we will contact property owners for permission.

We are analyzing the possible environmental impacts of the project. Your comments are helping us know where to focus our efforts. The information that we gather will be published in a Draft Environmental Impact Statement that will be available for review and comment this summer.

Once we have completed the environmental review, BPA will decide whether and how to proceed with the project. If BPA decides to proceed, construction would likely begin in 2003.

For More Information

If you have any questions about this proposal, please call me toll-free at 1-800-282-3713, at my direct number 1-360-619-6326, or send an e-mail to makorsness@bpa.gov.

Thank you for your interest in our work.

Sincerely,

/s/ Inez Graetzer for *3-22-2002*
Mark Korsness
Project Manager

GRAND COULEE– BELL 500-kV TRANSMISSION LINE PROJECT

APPENDIX B:

B-1: ELECTRICAL EFFECTS

B-2: ASSESSMENT OF RESEARCH REGARDING EMF AND HEALTH AND ENVIRONMENTAL EFFECTS

GRAND COULEE – BELL 500-kV TRANSMISSION LINE PROJECT

APPENDIX B-1

ELECTRICAL EFFECTS

June 2002

Prepared by

T. Dan Bracken, Inc.

for

Bonneville Power Administration

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ELECTRICAL EFFECTS FROM THE PROPOSED GRAND COULEE – BELL 500-kV TRANSMISSION LINE PROJECT

1.0 Introduction

The Bonneville Power Administration (BPA) is proposing to build an approximately 84-mile (mi.) (135-kilometer [km]) 500-kilovolt (kV) transmission line from the existing BPA Grand Coulee Substation near the Grand Coulee Dam on the Columbia River, to the existing BPA Bell Substation near Spokane, Washington. The proposed line is designated the Grand Coulee – Bell 500-kV line. The proposed line would be built on new and existing right-of-way entirely in the state of Washington. For most of its length the proposed line would replace the existing Bell – Grand Coulee #1 115-kV transmission line in a corridor with several other existing BPA lines. In one short section of the route, the proposed line would parallel an existing 500-kV line; in another short section there would be no parallel lines. The parallel-line configurations and their lengths are given in Table 1. The purpose of this report is to describe and quantify the electrical effects of the proposed Grand Coulee – Bell 500-kV transmission line. 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 those 500-kV lines already present in the area of the proposed route for the Grand Coulee – Bell line. Therefore, the levels of these quantities for the proposed line are computed and compared with those from the existing lines in Washington and elsewhere.

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 and existing lines 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 Grand Coulee – Bell 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 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, 1987). 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 (98% of maximum voltage) and with the average line height over a span: 540 kV and about 45 ft. (13.7 m) clearance for the proposed 500-kV line. 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 Spokane area of the proposed route, such conditions are expected to occur about 15% of the time during a year based on hourly precipitation records from the Spokane International Airport during 2000 – 2001. At the western end of the proposed route, the percentage of time with foul weather would decrease. Corona activity also increases with altitude. For purposes of evaluating corona effects from the proposed line, an altitude of 2000 ft. (610 m) was assumed, except in the area immediately east of the Grand Coulee Substation, where an elevation of 1500 ft. (457 m) was assumed.

2.0 Physical Description

2.1 Proposed Line

The proposed 500-kV transmission line would be a three-phase, single-circuit line placed on either single-circuit or double-circuit structures. The single-circuit towers would have the three phases arranged in a delta (triangular) configuration: the double-structure towers would have two sets of three phases arranged vertically on either side of the structure. 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 550 kV; the average voltage would be 540 kV. The maximum electrical current on the line would be 1800 A per phase, based on the BPA projected normal system annual peak load with 2005 as the base year. The load factor for this load would be about 0.50 (average load = peak load x load factor). BPA provided the physical and operating characteristics of the proposed and existing lines.

The electrical characteristics and physical dimensions for the configurations of the proposed and existing lines in the corridor are shown in Figure 1, and summarized in Table 2. For most of the proposed route, each phase of the proposed 500-kV line would have three 1.3-inch (in.) (3.30-centimeter [cm]) diameter conductors (ACSR: steel-reinforced aluminum conductor) arranged in an inverted triangle bundle configuration, with 17-in. (43.3-cm) spacing between conductors. In some sections with double-circuit structures, the conductors would be 1.602 inches (4.07 cm) in diameter and 19.75 inches (50.2 cm) apart.

For the single-circuit configurations the horizontal phase spacing between the lower conductor positions would be 48 ft. (14.6 m). The vertical spacing between the conductor positions would be 34.5 ft. (10.5 m). For the double-circuit configurations, the horizontal spacing between conductor positions would be 36.5 ft. (11.1 m), 56.5 ft. (17.2m), and 36.5 ft. (11.1 m); the vertical spacing would be 36 ft. (11.0 m). The spacing between conductor locations would vary slightly where special towers are used, such as at angle points along the line.

Minimum conductor-to-ground clearance would be 35 ft. (10.7 m) at a conductor temperature of 122°F (50°C); clearances above ground would be greater under normal operating temperatures. The average clearance above ground along a span would be approximately 45 ft. (13.7 m); this value was used for corona calculations. At road crossings, the ground clearance would be at least 54 ft. (16.5 m). The 35-ft. (10.7-m) minimum clearance provided by BPA is greater than the minimum distance of the conductors above ground required to meet the National Electrical Safety Code (NESC) (IEEE, 2002). The final design of the proposed line could entail larger clearances. The right-of-way width for the proposed line would vary, depending on location and the presence of parallel lines. For most of the proposed corridor, the line would be placed between existing lines and would not abut the edge of the existing right-of-way.

The electrical phasing of the proposed line was selected to ensure that BPA criteria for electric-field and audible-noise levels would be met. During the design process, BPA will verify that any changes from the phasing described here continue to meet design criteria.

2.2 Existing Lines

Ten possible corridor configurations were identified for analyzing electrical effects along the route from Grand Coulee Substation to Bell Substation (Table 1). These configurations are:

1. the proposed line parallel to and east of the existing Grand Coulee – Hanford 500-kV line;
2 the proposed line with no parallel lines;

3. the proposed line on single-circuit structures parallel to four existing BPA lines in the Grand Coulee – Bell corridor;
4. the proposed line on a double-circuit structure with an existing 115-kV line and parallel to two existing BPA lines;
5. the proposed line on double-circuit structures parallel to four existing BPA lines;
6. the proposed line on single-circuit structures parallel to four existing BPA lines and two Avista lines (north);
7. the proposed line on double-circuit structures parallel to four existing BPA lines and two Avista lines (north);
8. the proposed line on single-circuit structures parallel to four existing BPA lines and two Avista lines (south);
9. the proposed line on double-circuit structures parallel to four existing BPA lines and two Avista lines (south); and
10. the proposed line on double-circuit structures parallel to one existing BPA lines and two Avista lines (south).

The physical and electrical characteristics of the corridor configurations that were analyzed are given in Table 2; cross-sections of the corridors are shown in Figure 1. Short sections of the proposed line where transitions between configurations would occur and where the line would enter the substations were not analyzed.

Changes in the electrical phasing of the existing lower-voltage lines occur along the proposed corridor. The phasing scheme in place for the first 12 mi. (19.3 km) west of the Bell Substation was used for calculations. Further west along the corridor the different phasing schemes would produce very similar electric and magnetic fields and corona effects.

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.

3. the proposed line on single-circuit structures parallel to four existing BPA lines in the Grand Coulee – Bell corridor;
4. the proposed line on a double-circuit structure with an existing 115-kV line and parallel to two existing BPA lines;
5. the proposed line on double-circuit structures parallel to four existing BPA lines;
6. the proposed line on single-circuit structures parallel to four existing BPA lines and two Avista lines (north);
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10. the proposed line on double-circuit structures parallel to one existing BPA lines and two Avista lines (south).

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Changes in the electrical phasing of the existing lower-voltage lines occur along the proposed corridor. The phasing scheme in place for the first 12 mi. (19.3 km) west of the Bell Substation was used for calculations. Further west along the corridor the different phasing schemes would produce very similar electric and magnetic fields and corona effects.

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 needed information for calculating electric and magnetic fields from the proposed transmission lines: the maximum operating voltage, the estimated peak current in 2004, and the minimum conductor clearances.

There are standard techniques for measuring transmission-line electric fields (IEEE, 1987). 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. For the parallel-line configurations considered here, minimum conductor clearances were assumed to occur along the same lateral profile for both lines. This condition will not necessarily occur in practice, because the towers for the parallel lines may be offset or located at different elevations. **The assumption of simultaneous 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. The triangular arrangement of the conductor bundles for the proposed line reduces the electric- and magnetic field levels below what they would be for a flat conductor arrangement.

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 Grand Coulee – Bell 500-kV transmission-line configurations. The peak value on the right-of-way and the value at the edge of the right-of-way are given for the ten proposed configurations at minimum conductor clearances and at the estimated average clearances over a span. Figure 2 shows lateral profiles for the electric field for both existing and proposed configurations. Electric fields for the minimum and average line heights for the proposed line with no parallel lines (Configuration 2) are shown in Figure 2b.

The calculated peak electric field expected on the right-of-way of the proposed line is 8.9 kV/m or less, depending on the configuration. For average clearance, the peak field would be 6.0 kV/m or less. As shown in Figure 2, the peak values would be present only at locations directly under the 500-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 the existing corridors are 8.9 kV/m, 3.4 kV/m, and 1.4 kV/m for 500-kV, 230-kV, and 115-kV lines, respectively.

The largest value expected at the edge of the right-of-way of the proposed line would be 2.5 kV/m, which occurs when the proposed line abuts the edge of the right-of-way (Configurations 1 and 2 only). For other configurations where the proposed line is in the center of the corridor, the electric field at the edge of the right-of-way would be about the same with or without the proposed line present (Table 3b).

3.4 Environmental Electric Fields

The electric fields associated with the Grand Coulee – Bell 500-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 500 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 Grand Coulee – Bell 500-kV transmission line are consistent with the levels reported for other 500-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

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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. 644-1987 (IEEE, 1987). 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. 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 Grand Coulee - Bell 500-kV transmission-line configurations. Field values on the right-of-way and at the edge of the right-of-way are given for projected maximum currents during system annual peak load in 2005, for minimum and average conductor clearances. The maximum currents are 1800 A on each of the three phases of the proposed line. For double-circuit Configurations 5, 7, 9, and 10, the current would be split between the two sets of conductors, resulting in 900 A per conductor bundle.

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 50% of the maximum values. The levels shown in the figures represent the highest magnetic fields expected for the proposed Grand Coulee – Bell 500-kV line. Average fields over a year would be considerably reduced from the peak values, as a result of increased clearances above the minimum value and reduced currents from the maximum value.

Figure 3 shows lateral profiles of the magnetic field under maximum current and minimum clearance conditions for the existing corridor and for configurations with the proposed 500-kV transmission line. A field profile for average height under Configuration 2 is included in Figure 2b.

For the proposed 500-kV line, the maximum calculated 60-Hz magnetic field expected at 3.28 ft. (1 m) above ground is 333 mG in Configuration 1. This field is calculated for the maximum current of 1800 A, with the conductors at a height of 35 ft. (10.7 m). The maximum field would decrease for increased conductor clearance. For an average conductor height over a span of 45 ft. (13.7 m), the maximum field would be 229 mG. Maximum fields under the proposed line configurations range from 119 to 333 mG for minimum clearance and from 82 to 229 mG for average clearance. For the existing lines, the peak magnetic fields on the rights-of-way are 339 mG and 199 mG, for the 500-kV and 230-kV lines, respectively.

The magnetic field at the edge of the right-of-way depends on the width of the right-of-way, which varies considerably for the proposed line. For maximum current conditions, the calculated magnetic field at the edge of the right-of-way is 83 mG for Configuration 2 (where the proposed line is at the edge of the right-of-way). For Configurations 3 to 10 (where the proposed line does not abut the edge of the right-of-way), the magnetic fields at the edge of the right-of-way are generally comparable to or less than the existing fields there. The absence of an increase in edge-of-right-of-way fields is due to the distance of the proposed line from the edge of the right-of-way and to the reduction in currents in the existing lines that would occur with the introduction of the proposed line.

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 Grand Coulee – Bell 500-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.

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 500-kV lines in Oregon, Washington, and elsewhere. On and near the right-of-way of the proposed line, magnetic fields would be well above average residential levels. However, the fields from the line would decrease rapidly and approach common ambient levels at distances greater than a few hundred feet from the edge of the right-of-way. 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 Grand Coulee – Bell 500-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 Grand Coulee – Bell 500-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 500-kV line when making contact with ungrounded conducting objects such as vehicles or equipment. However, such occurrences are anticipated to be very infrequent. Shocks, when they occur under the 500-kV line, are most likely to be below the nuisance level. Induced currents are extremely unlikely to be perceived off the right-of-way where the proposed line abuts the edge of the right-of-way (Configurations 1 and 2).

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 500-kV lines in Oregon, Washington, and elsewhere. On and near the right-of-way of the proposed line, magnetic fields would be well above average residential levels. However, the fields from the line would decrease rapidly and approach common ambient levels at distances greater than a few hundred feet from the edge of the right-of-way. 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 Grand Coulee – Bell 500-kV transmission line.

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Induced currents would not be perceived off the right-of-way in Configurations 3 to 10 where lower-voltage lines are at the edge of 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, BPA routinely grounds metal objects that are located on or near 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 (50°C conductor temperature) would be increased to at least 54 ft. (16.6 m) over major road crossings along the route, resulting in a maximum field of 4.4 kV/m or less at the 3.28 ft. (1 m) height. The largest truck allowed on roads in Washington 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 4.4 kV/m (at 3.28-ft. height) would be less than 4.0 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 500-kV line at a road crossing would be less than 3.8 mA.) Thus, the NESC 5-mA criterion would be met for perpendicular road crossings of the proposed line. These large vehicles are not anticipated to be off highways or oriented parallel to the proposed line. As discussed below, these are worst-case estimates of induced currents at road crossings; conditions for their occurrence are rare. The conductor clearance at each road crossing would be checked during the design stage of the line to ensure that the NESC 5-mA criterion is met. Furthermore, it is BPA policy to limit the maximum induced current from vehicles to 2 mA in commercial parking lots. Line clearances would also be increased in accordance with the NESC, such as over railroads and water areas suitable for sailboating.

Several factors tend to reduce the levels of induced current shocks from vehicles:

(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. Based on the low frequency of complaints reported by Glasgow and Carstensen (1981) for 500-kV alternating current transmission lines (one complaint per year for each 1,500 mi. or 2400 km of 500-kV line), nuisance shocks, which are primarily spark discharges, do not appear to be a serious impediment to normal activities under 500-kV lines.

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 areas under the conductors at midspan, the fields at ground level would exceed the levels where field perception normally occurs. In these instances, field perception could occur on the right-of-way of the proposed line. It is unlikely that the field would be perceived beyond the edge of the right-of-way in Configurations 1 and 2; perception of the field off the right-of-way would not occur in Configurations 3 to 10. 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 500-kV line would be comparable to those from existing 500-kV lines in the project area and elsewhere. Potential impacts of electric fields can be mitigated through grounding policies, adherence to the NESC, and increased clearances above the minimums specified by 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 500-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 VDTs and computer monitors. 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). Generally, the problem arises when computer monitors are in use near electrical distribution facilities in large office buildings. Fields from the proposed line alone (Configuration 2) would fall below this level at approximately 225 ft. (69 m) from the centerline. In Configurations 3 to 10, fields beyond the right-of-way would be the same or reduced by the introduction of the proposed line and the potential for interference with monitors would remain the same or even be reduced.

Interference from magnetic fields 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 500-kV transmission line.

The magnetic fields from the proposed line would be comparable to those from existing 500-kV lines in the area of the proposed 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.

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The proposed line would be designed to meet the NESC (IEEE, 2002), 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. The intent of magnetic-field limits has been to limit exposures to existing levels, given the uncertainty of their potential for health effects.

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. The state of Washington does not have guidelines for electric or 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 electric fields from the proposed 500-kV line would meet the ACGIH 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 electric fields in limited areas on the right-of-way would exceed the ICNIRP guideline for public exposure. The magnetic fields from the proposed line would be below the ACGIH limits, as well as below those of ICNIRP. The electric fields present on the right-of-way could induce currents in ungrounded vehicles that exceeded the ICNIRP level of 0.5 mA.

The estimated peak electric fields on the right-of-way of the proposed transmission line would meet the limits of Oregon, Florida, New York, and Montana, but not those of Minnesota (see Table 5). The BPA maximum allowable electric field-limit would be met for all configurations of the proposed line. The edge-of-right-of-way electric fields from Configurations 1 and 2 of the proposed line would be below limits set in New Jersey, but above those in Florida, Montana, and New York. For Configurations 3 to 10, all edge-of-right-of-way limits would be met.

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 amount of sound attenuation (reduction) provided by buildings is given in Table 7. Assuming that residences along the line route fall in the "warm climate, windows open" category, the typical sound attenuation provided by a house is about 12 dBA.

The BPA design criterion for corona-generated audible noise (L_{50}, foul weather) is 50 ±2 dBA at the edge of the ROW (Perry, 1982). The Washington Administrative Code provides noise limitations by class of property, residential, commercial or industrial (Washington, State of, 1975). Transmission lines are classified as industrial and may cause a maximum permissible noise level of 60 dBA to intrude into residential property. During nighttime hours (10:00 p.m. to 7:00 a.m.), the maximum permissible limit for noise from industrial to residential areas is reduced to 50 dBA. This latter level applies to transmission lines that operate continuously. The state of Washington Department of Ecology accepts the 50 dBA level at the edge of the right-of-way for transmission lines, but encouraged BPA to design lines with lower audible noise levels (WDOE, 1981).

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. The proposed 500-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 15% of the time during the year in the Spokane area and less at the western end of the proposed corridor.

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. The proposed line has been designed with three 1.3-inch (3.30-cm) diameter conductors per phase, which will yield acceptable corona levels. The use of three 1.602-inch (4.07) diameter conductors per phase in Configurations 5, 7, and 9 would reduce AN levels below what they would be with the smaller 1.3-inch conductors.

7.3 Predicted Audible Noise Levels

Audible-noise levels are calculated for average voltage and average conductor heights for fair- and foul-weather conditions. The predicted levels of corona-generated audible noise for the proposed line operated at a voltage of 540 kV are given in Table 8 and plotted in Figure 4 for the proposed configurations. For comparison, Table 8 also gives the calculated levels for the existing parallel lines.

The calculated median level (L_{50}) during foul weather at the edge of the proposed Grand Coulee – Bell 500-kV line right-of-way with no parallel lines (75 ft. from centerline) is 49 dBA; the calculated maximum level (L_5) during foul weather at the edge of the right-of-way is 52 dBA. These levels are comparable with levels at the edges of some existing 500-kV lines in Washington and slightly lower than the levels from the existing Grand Coulee – Hanford 500-kV line in the Configuration 1 corridor. (See Table 8.) At the edge of the right-of-way adjacent to the existing 500-kV line in Configuration 1, the foul weather L_{50} AN level would change by an indiscernible 1 dBA with the addition of the proposed line. Thus, AN levels for Configurations 1 and 2 would be comparable to those for existing 500-kV lines in Washington.

For Configurations 3 to 9 with multiple parallel lines, the foul weather L_{50} AN level at the edge of the right-of-way would be 42 to 49 dBA. For these configurations, AN from the proposed 500-kV line during foul weather would add +3 to +10 dBA to existing levels at the edges of the right-of-way. The response to such increases would range from barely perceptible to a perceived doubling of the sound level. The AN level increase for a double-circuit configuration would be slightly more (+1 - 2 dBA) than for a single-circuit configurations at the same location. For Configuration 10, which abuts commercial property, the edge-of-right-of-way AN levels would be 51 and 48 dBA at the north and south edges of the right-of-way, respectively.

During fair-weather conditions, which occur about 85% of the time in the Spokane area, audible noise levels at the edge of the right-of-way would be about 20 dBA lower than the foul weather levels (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 with no parallel lines would be comparable to, or less than, those from existing 500-kV lines in Washington. During fair weather, noise from the conductors might be perceivable on the right-of-way; however, beyond the right-of-way it would likely be masked or so low as not to be perceived. During foul weather, when ambient noise is higher, it is also likely that noise off the right-of-way would be masked to some extent. Where the proposed line is located in the center of a corridor with multiple existing lines, the increase of 10 dBA or less due to the addition of the 500-kV line would be perceived as at most a doubling of AN level at the edge of the right-of-way and beyond.

No transformers are being added to the existing Grand Coulee and Bell substations. Noise from the existing substation equipment and transmission lines would remain the primary source of environmental noise at these locations. The large-diameter tubular conductors in the station do not generate corona noise during fair weather; any noise generated during foul weather would be masked by noise from the transmission lines entering and leaving the station. During foul weather, the noise from the proposed and existing lines would mask the substation noise at the outer edges of the rights-of-way.

Off the right-of-way, the levels of audible noise from the proposed line during foul weather would be below the 55-dBA level that can produce interference with speech outdoors. Since residential buildings provide significant sound attenuation (-12 dBA with windows open; -24 dBA with windows closed), the noise levels off the right-of-way would be well below the 45 dBA level required for interference with speech indoors and below the 35 dBA level where sleep interference can occur (EPA, 1973; EPA, 1978). Since corona is a foul-weather phenomenon, people tend to be inside with windows possibly closed, providing additional attenuation when corona noise is present. In addition, ambient noise levels can be high during such periods (due to rain hitting foliage or buildings), and can mask corona noise.

The 49-dBA level for the proposed line would meet the BPA design criterion and, hence, the Washington Administrative Code limits for transmission lines.

The computed annual L_{dn} level for transmission lines operating in areas with about 15% foul weather is about $L_{dn} = L_{50}$ - 1 dBA (Bracken, 1987). Therefore, assuming such conditions in the area of the proposed Grand Coulee – Bell 500-kV line, the estimated L_{dn} at the edge of the right-of-way would be approximately 42 to 50 dBA, which is below the EPA L_{dn} guideline of 55 dBA.

7.5 Conclusion

Along the proposed line route where no parallel lines are present, there would be increases in the perceived noise above ambient levels during foul weather at the edges of the right-of-way. Where the proposed line parallels an existing 500-kV line (Configuration 1), the incremental noise contributed by the proposed line would be less than 5 dBA at the edge of the proposed new right-of-way and beyond, and would barely be discernible from existing noise levels. Where the proposed line is located in the center of the existing Grand Coulee – Bell multi-line corridor, changes in AN at the edges of the right-of-way would be perceived as a doubling or less of the existing sound levels.

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 the Washington state noise regulations.

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 bundle of three 1.3-inch (or 1.602-inch) diameter conductors used in the design of the proposed 500-kV line would mitigate corona generation and thus keep radio and television interference levels at acceptable levels.

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 providing additional attenuation when corona noise is present. In addition, ambient noise levels can be high during such periods (due to rain hitting foliage or buildings), and can mask corona noise.

The 49-dBA level for the proposed line would meet the BPA design criterion and, hence, the Washington Administrative Code limits for transmission lines.

The computed annual L_{dn} level for transmission lines operating in areas with about 15% foul weather is about $L_{dn} = L_{50}$ - 1 dBA (Bracken, 1987). Therefore, assuming such conditions in the area of the proposed Grand Coulee – Bell 500-kV line, the estimated L_{dn} at the edge of the right-of-way would be approximately 42 to 50 dBA, which is below the EPA L_{dn} guideline of 55 dBA.

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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 the Washington state noise regulations.

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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

Table 9 gives the predicted fair- and foul-weather RI levels at 100 ft. (30 m) from the outside conductor nearest the edge of the right-of-way for the proposed 500-kV line in the ten configurations. Median foul-weather RI levels would be about 17 dB higher than the fair-weather levels. The predicted L_{50} fair-weather level at 100 ft. (30 m) from the outside conductor of the proposed line with no parallel lines (Configurations 2) is 38 dBμV/m for 540-kV line operation. The predicted levels in Table 9 indicate that fair-weather RI will meet the IEEE 40 dBμV/m criterion at distances greater than about 100 ft. (30 m) from the outside conductor of the corridor for all configurations. Predicted fair-weather L_{50} levels are comparable with or lower than those for the existing Grand Coulee – Hanford 500-kV line (39 dBμV/m at 100 ft. [30 m]).

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.

8.5 Predicted TVI Levels

Table 10 shows TVI levels predicted at 100 ft. (30 m) from the outside conductor of the line nearest the edge of the right-of-way. TVI levels are shown for the ten configurations with existing lines and with the addition of the proposed line operating at 540 kV. At 100 ft. (30 m) from the outside conductor of the proposed line, the predicted foul-weather TVI level is 25 dBμV/m (Configuration 2). This is comparable with TVI levels from the existing Grand Coulee - Hanford 500-kV line (26 dBμV/m at 100 ft. [30 m] from the outside conductor). For Configurations 3 to 10, where the proposed line would be in a corridor with lower-voltage lines, the TVI level at 100 feet (30 m) from the outside conductor in the corridor would range from 6 to 18 dBμV/m. Although these would be increases above existing levels due to the proposed line, the TVI levels would still be well below those near existing 500-kV lines.

There would be a potential for interference with television signals at locations very near Configurations 1 and 2 in fringe reception areas. However, several factors reduce the likelihood of occurrence. Corona-generated TVI occurs only in foul weather; consequently, signals would not be interfered with most of the time, which is characterized by fair weather. Because television antennas are directional, the impact of TVI is related to the location and orientation of the antenna relative to the transmission line. If the antenna were pointed away from the line, then TVI from the line would affect reception much less than if the antenna were pointed towards the line. Since the level of TVI falls off with distance, the potential for interference becomes minimal at distances greater than several hundred feet from the centerline of the proposed 500-kV line. Where the proposed line parallels the existing 500-kV line with higher TVI levels, interference issues may have already been addressed and the potential for impacts would be less than where a new line with no parallel lines is built. These same mitigative factors also apply to Configurations 3 to 10, except that, in these cases, the possible sites for TV receivers are farther from the proposed line than when under those circumstances when it abuts the edge of the right-of-way.

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. Television systems that operate at higher frequencies, such as satellite receivers, are not affected by corona-generated TVI. Cable television systems are similarly unaffected.

Interference with television reception can be corrected by any of several approaches: improving the receiving antenna system; installing a remote antenna; installing an antenna for TV stations less vulnerable to interference; connecting to an existing cable system; or installing a translator (cf. USDOE, 1977). BPA has an active program to identify, investigate, and mitigate legitimate RI and TVI complaints. It is anticipated that any instances of TVI caused by the proposed line could be effectively mitigated.

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 about 900 MHz, 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.

8.7 Conclusion

Predicted EMI levels for the proposed 500-kV transmission line are comparable to, or lower, than those that already exist near 500-kV lines; no impacts of corona-generated interference on radio, television, or other reception 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 visible as a bluish glow or as bluish plumes. On the proposed 500-kV line with 3-conductor bundles, corona levels would be very low, so that 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 national primary ambient air quality standard for photochemical oxidants, of which ozone is the principal component, is a one-hour average not to exceed 235 micrograms/cubic meter or 120 parts per billion. The maximum incremental ozone levels at ground level produced by corona activity on the proposed transmission line during foul weather would be much less than 1 part per billion. This level is insignificant when compared with natural levels and fluctuations in natural levels.

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 500-kV lines in Washington, and elsewhere. The expected magnetic-field levels from the proposed line would be comparable to, or less than, those from other 500-kV lines in Washington, and elsewhere.

The peak electric field expected under the proposed line would be less than 9.0 kV/m; the maximum value at the edge of the right-of-way would be about 2.5 kV/m. Clearances at road crossings would be increased to reduce the peak electric-field value to 4.4 kV/m or less. Along the multi-line Grand Coulee – Bell corridor, electric fields at the edges of the right-of-way would remain very comparable with existing levels and would range from 0.1 to 1.4 kV/m.

Under maximum current conditions, the maximum magnetic fields under the proposed line would be 333 mG; at the edge of the right-of-way of the proposed line the maximum magnetic field would be 83 mG. However, along the multi-line Grand Coulee – Bell corridor, the magnetic field at the edges of the right-of-way would be comparable with, or less than, existing levels and would range from 3 to 41 mG.

The electric fields from the proposed line would meet regulatory limits for public exposure in most other states that have limits, but could exceed the regulatory limits or guidelines for peak fields established in one other state and by ICNIRP. 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

8.7 Conclusion

Predicted EMI levels for the proposed 500-kV transmission line are comparable to, or lower, than those that already exist near 500-kV lines; no impacts of corona-generated interference on radio, television, or other reception are anticipated. Furthermore, if interference should occur, there are various methods for correcting it: BPA has a program to respond to legitimate complaints.

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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 national primary ambient air quality standard for photochemical oxidants, of which ozone is the principal component, is a one-hour average not to exceed 235 micrograms/cubic meter or 120 parts per billion. The maximum incremental ozone levels at ground level produced by corona activity on the proposed transmission line during foul weather would be much less than 1 part per billion. This level is insignificant when compared with natural levels and fluctuations in natural levels.

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The electric fields from the proposed line would meet regulatory limits for public exposure in most other states that have limits, but could exceed the regulatory limits or guidelines for peak fields established in one other state and by ICNIRP. 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

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The electric fields from the proposed line would meet regulatory limits for public exposure in most other states that have limits, but could exceed the regulatory limits or guidelines for peak fields established in one other state and by ICNIRP. 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. The state of Washington does not have limits for electric fields or 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 would be perceivable during foul weather. In Configuration 2 (where there are no parallel lines), the proposed line would increase levels above ambient but would still meet the BPA noise criterion at the edge of the right-of-way. In Configuration 1 (with a parallel 500-kV line), the increase at the edge of the right-of-way would be barely perceptible. For most configurations in the multiple-line corridor (Configurations 3 to 9), the increase in audible noise during foul weather caused by the proposed line would be perceived as a doubling of existing levels, or less. For Configuration 10 in a commercial area, the increase at the edge of the right-of-way would be more substantial (+24 dBA), but the levels would still not exceed the BPA noise criterion. The levels would be comparable with, or less than, those near existing 500-kV transmission lines in Washington, would be in compliance with noise regulations in Washington, 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 500-kV lines in Washington. Radio interference levels would be below limits identified as acceptable. Television interference, a foul-weather phenomenon, is anticipated to be comparable to or less than that from existing 500-kV lines in Washington; if legitimate complaints arise, BPA has a mitigation program.

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Table 1: Possible configurations for proposed Grand Coulee – Bell 500-kV transmission-line corridor. (2 pages)

Configur-ation	Location	Description of other lines in corridor with proposed Grand Coulee – Bell 500-kV line (north to south)	Miles (length)
1	Just south of Grand Coulee (GC) Substation. Includes area on plateau north of City of Grand Coulee and area across valley west of City of Grand Coulee.	Proposed line single-circuit GC – Hanford 500-kV	2.5
2	South of GC Substation going southeast from GC – Hanford ROW to GC – Bell #1/#2 right-of-way (ROW) at Tower 3/8. Includes area on plateau south of City of Grand Coulee.	Proposed line single-circuit only	.70
3	Single-circuit alternative from point east of GC Substation where proposed line joins GC – Bell #1/#2 ROW (Tower 3/8) on plateau south of City of Grand Coulee to where Avista lines enter ROW (Tower 78/6) at a point 600 feet west of Indian Trail Road. (Excludes mile 73 with Configuration 4)	GC – Bell #5 230-kV, Westside – GC /GC – Bell #3 double-circuit 230-kV, Proposed line single-circuit GC Bell #2 115-kV	73.2
4	Double-circuit adjacent to escarpment in Mile 73 of GC – Bell #1/#2 ROW (Towers 72/7-73/5). Includes cliff area adjacent to Coulee-Hite Road just west of Springhill Substation.	Westside - GC /GC – Bell #3 double-circuit 230-kV, Proposed line double-circuit with GC - Bell #2 115-kV	.68
5	Double-circuit alternative to eastern portion of Configuration 3 from GC – Bell #1/#2 Tower 75/1 about 0.25 mile west of Riverside State Park to Tower 78/6 about 600 feet west of Indian Trail Road. Includes Spokane River crossing in Mile 77.	GC – Bell #5 230-kV, Westside – GC /GC – Bell #3 double-circuit 230-kV, Proposed double-circuit configuration with phases tied together. GC - Bell #2 115-kV	4.9
6	Single-circuit alternative from 600 feet west of Indian Trail Road (GC – Bell #1/#2 Tower 78/6) to about 0.5 mile west of Waikiki Road (Tower 81/7) where Avista lines cross ROW.	Beacon – Francis &Cedar 115-kV (Avista) Bell – Waikiki 115-kV (Avista) GC – Bell #5 230-kV, Westside – GC /GC – Bell #3 double-circuit 230-kV, Proposed line single-circuit GC - Bell #2 115-kV	3.1

Table 1, continued

Configur-ation	Location	Description of other lines in corridor with proposed Grand Coulee – Bell 500-kV line (north to south)	Miles (length)
7	Double-circuit alternative to Configuration 6 from 600 feet of Indian Trail Road (GC – Bell #1/#2 Tower 78/6) to about 0.5 mile west of Waikiki Road (Tower 81/7) where Avista lines cross ROW.	Beacon – Francis &Cedar 115-kV (Avista) Bell – Waikiki 115-kV (Avista) GC – Bell #5 230-kV, Westside – GC /GC – Bell #3 double-circuit 230-kV, Proposed double-circuit configuration with phases tied together. GC - Bell #2 115-kV	3.1
8	Single-circuit alternative from about 0.5 miles west of Waikiki Road (Tower 81/7) to about 0.25 miles east of U.S. Highway 395 (Tower 83/1). This section is adjacent to Whitworth College and residential areas. Avista lines on the south edge of the ROW.	GC – Bell #5 230-kV, Westside – GC /GC – Bell #3 double-circuit 230-kV, Proposed line single-circuit GC - Bell #2 115-kV Beacon – Francis &Cedar 115-kV (Avista) Bell – Waikiki 115-kV (Avista)	1.45
9	Double-circuit alternative to Configuration 8 from about 0.5 miles west of Waikiki Road to about 0.25 miles east of U.S. Highway 395.	GC – Bell #5 230-kV, Westside – GC /GC – Bell #3 double-circuit 230-kV, Proposed double-circuit configuration with phases tied together. GC - Bell #2 115-kV Beacon – Francis &Cedar 115-kV (Avista) Bell – Waikiki 115-kV (Avista)	1.45
10	Double-circuit from about 0.25 miles east of U.S. Highway 395 (Tower 83/1) to about 0.25 miles east of U.S. Highway 2 (Tower 83/6). This segment crosses the Hico Village Northpointe facility.	GC – Bell #2 115-kV, Proposed double-circuit configuration with phases tied together. Beacon – Francis &Cedar 115-kV (Avista) Bell – Waikiki 115-kV (Avista)	0.6

Table 2: Physical and electrical characteristics of lines in corridor for the proposed Grand Coulee – Bell 500-kV transmission-line corridor. See Table 1 for descriptions of corridors and Figure 1 for physical layout of configurations. (3 pages)

	Proposed Line in Corridor				
Line Description	**Grand Coulee – Bell 500-kV Single-circuit**	**Grand Coulee – Bell 500-kV Double-circuit**		**Grand Coulee – Bell 500-kV/Bell-Grand Coulee #2 115-kV Double-circuit**	
Configurations	**1, 2, 3, 6, 8**	**5, 7, 9**	**10**	**4**	
Voltage, kV Maximum/Average[1]	550/540	550/540		550/540	121/118
Peak current, A Existing/Proposed	- /1800	- /900 per bundle		- /1800	380/260
Electric phasing (north -- south)	B C A	C A B B A C		C A B B A C	
Clearance, ft. Minimum/Average[1]	35/45	35/45		35/45	
Tower configuration	Delta	Vertical DC		Vertical DC	
Phase spacing, ft.[2]	48H, 34.5V	36.5/56.5H, 36V		36.5/56.5H, 36V	
Conductor: #/diameter, in.; spacing, in.	3/1.300; 17.04	3/1.602; 19.75	3/1.300; 17.04	3/1.300; 17.04	1/1.300

1 Average voltage and average clearance used for corona calculations.
2 H = horizontal feet; V = vertical feet

Table 2, continued

<table>
<tr><th></th><th colspan="6">Existing Lines in Corridor</th></tr>
<tr><th>Line Description</th><th>Grand Coulee – Hanford 500-kV</th><th>Bell – Grand Coulee #5 230-kV</th><th colspan="2">Bell – Grand Coulee #3/ Bell – Westside – Grand Coulee 230-kV Double-circuit</th><th>Bell – Grand Coulee #1 115-kV</th></tr>
<tr><td>Configurations</td><td>1</td><td>3, 5, 6, 7, 8, 9</td><td colspan="2">3, 4, 5, 6, 7, 8, 9</td><td>3, 4, 5, 6, 7, 8, 9, 10</td></tr>
<tr><td>Voltage, kV Maximum/Average[1]</td><td>550/540</td><td>242/237</td><td colspan="2">242/237</td><td>121/118</td></tr>
<tr><td>Peak current, A Existing/Proposed</td><td>-1990/-1840</td><td>840/520</td><td>870/540</td><td>830/510</td><td>360/ -</td></tr>
<tr><td>Electric phasing (north – south)</td><td>B
C A</td><td>A B C</td><td colspan="2">A A
C B
B C</td><td>A B C</td></tr>
<tr><td>Clearance, ft. Minimum/Average[1]</td><td>33/43</td><td>30/40</td><td colspan="2">30/40</td><td>25/35</td></tr>
<tr><td>Tower configuration</td><td>Delta</td><td>Horizontal</td><td colspan="2">Vertical DC</td><td>Horizontal</td></tr>
<tr><td>Phase spacing, ft.[2]</td><td>40H, 27.5V</td><td>27H</td><td colspan="2">38/31H, 20.25V</td><td>12H</td></tr>
<tr><td>Conductor: #/diameter, in.; spacing, in.</td><td>3/1.302; 17.04</td><td>1/1.382</td><td colspan="2">1/1.345</td><td>1/0.679</td></tr>
</table>

Average voltage and average clearance used for corona calculations.
[2] H = horizontal feet; V = vertical feet

Table 2, continued

	Existing Lines in Corridor		
Line Description	**Bell – Grand Coulee #2 115-kV**	**Beacon-Francis – Cedar 115-kV (Avista)**	**Bell – Waikiki 115-kV (Avista)**
Configurations	**3, 4, 5, 6, 7, 8, 9, 10**	**6, 7, 8, 9, 10**	**6, 7, 8, 9, 10**
Voltage, kV Maximum/Average[1]	121/118	121/118	121/118
Peak current, A Existing/Proposed	380/260	120/120	170/170
Electric phasing (north – south)	A B C	A B C	A B C
Clearance, ft. Minimum/Average[1]	25/35	25/35	25/35
Tower configuration	Horizontal	Horizontal	Horizontal
Phase spacing, ft.[2]	12H	10H	10H
Conductor: #/diameter, in.; spacing, in.	1/0.679	1/0.574	1/0.574

1 Average voltage and average clearance used for corona calculations.
2 H = horizontal feet; V = vertical feet

Table 3: Calculated peak and edge-of-right-of-way electric fields for the proposed Grand Coulee – Bell 500-kV line operated at maximum voltage by configuration. Configurations are described in Tables 1 and 2 and shown in Figure 1. (2 pages)

a) Peak electric field on right-of-way, kV/m

Location	Proposed Corridor		Existing Corridor	
Line Clearance	Minimum	Average	Minimum	Average
Configuration 1	8.9	5.8	8.9	5.7
Configuration 2	8.6	5.8	-	-
Configuration 3	8.9	6.0	3.4	2.1
Configuration 4	8.6	5.7	2.9	1.9
Configuration 5	7.7	4.8	3.4	2.1
Configuration 6	8.9	5.9	3.3	2.1
Configuration 7	7.7	4.8	3.3	2.1
Configuration 8	8.9	5.9	3.4	2.1
Configuration 9	7.7	4.8	3.4	2.1
Configuration 10	7.4	4.7	1.4	0.8

Table 3, continued

b) Edge-of-right-of-way electric field, kV/m

Location	**Proposed Line**[1]		**Existing Corridor**[1]	
Line Clearance	Minimum	Average	Minimum	Average
Configuration 1	2.5, 2.1	2.5, 2.1	2.0, 2.0	2.0, 2.0
Configuration 2	2.5, 2.5	2.4, 2.4	-	-
Configuration 3	1.4, 0.2	1.3, 0.1	1.5, 0.4	1.3, 0.4
Configuration 4	0.1, 0.2	0.1, 0.2	0.1, 0.3	0.1, 0.3
Configuration 5	1.4, 0.2	1.3, 0.3	1.5, 0.4	1.3, 0.4
Configuration 6	0.1, 0.2	0.1, 0.1	0.1, 0.4	0.1, 0.4
Configuration 7	0.1, 0.2	0.1, 0.3	0.1, 0.4	0.1, 0.4
Configuration 8	1.4, 0.3	1.3, 0.3	1.5, 0.3	1.3, 0.3
Configuration 9	1.4, 0.3	1.3, 0.3	1.5, 0.3	1.3, 0.3
Configuration 10	0.1, 0.3	0.1, 0.3	0.1, 0.4	0.2, 0.4

1 Electric field at east edge of right-of-way is given first for Configuration 1 and at north edge for Configurations 2 – 10.

Table 4: Calculated peak and edge-of-right-of-way magnetic fields for the proposed Grand Coulee – Bell 500-kV line operated at maximum current by configuration. Configurations are described in Tables 1 and 2. (2 pages)

a) Peak magnetic field on right-of-way, mG

Location	**Proposed Corridor**		**Existing Corridor**	
Line Clearance	Minimum	Average	Minimum	Average
Configuration 1	333	223	339	221
Configuration 2	300	205	-	-
Configuration 3	325	229	198	138
Configuration 4	231	155	116	75
Configuration 5	121	84	199	138
Configuration 6	325	229	196	136
Configuration 7	119	82	196	136
Configuration 8	325	229	198	137
Configuration 9	121	83	198	137
Configuration 10	222	151	77	43

Table 4, continued

b) Edge-of-right-of-way magnetic field, mG

Location	Proposed Corridor[1]		Existing Corridor[1]	
Line Clearance	Minimum	Average	Minimum	Average
Configuration 1	77, 62	67, 55	76, 76	67, 67
Configuration 2	83, 83	72, 72	-	-
Configuration 3	37, 19	32, 19	68, 23	59, 19
Configuration 4	3, 31	3, 29	4, 22	4, 18
Configuration 5	41, 19	35, 15	68, 23	59, 19
Configuration 6	3, 19	3, 19	7, 23	6, 19
Configuration 7	5, 19	5, 16	7, 23	6, 19
Configuration 8	37, 5	32, 5	68, 9	59, 8
Configuration 9	41, 8	35, 7	68, 9	59, 8
Configuration 10	16, 10	16, 8	11, 9	10, 7

[1] Magnetic field at east edge of right-of-way is given first for Configuration 1 and at north edge for Configurations 2 - 10.

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: Typical sound attenuation (in decibels) provided by buildings

	Windows opened	Windows closed
Warm climate	12	24
Cold climate	17	24

Source: EPA, 1978.

Table 8: **Predicted foul-weather audible noise (AN) levels at edge of right-of-way (ROW) for the proposed Grand Coulee – Bell 500-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. Configurations are described in Tables 1 and 2 and are shown in Figure 1.

	Foul-weather AN			
	Proposed Corridor[1]		Existing Corridor[1]	
Configuration[1]	L_{50}, dBA	L_5, dBA	L_{50}, dBA	L_5, dBA
1	50, 51	54, 55	50, 50	54, 54
2	49, 49	52, 52	-	-
3	45, 47	49, 51	42, 39	45, 42
4	44, 48	47, 52	37, 39	41, 43
5	47, 49	50, 52	42, 39	45, 42
6	42, 47	46, 51	38, 39	41, 42
7	44, 49	47, 52	38, 39	41, 42
8	46, 43	49, 47	42, 37	45, 41
9	47, 45	50, 49	42, 37	45, 41
10	51, 48	54, 52	27, 32	31, 36

[1] AN level at east edge of right-of-way is given first for Configuration 1 and at north edge for Configurations 2 - 10.

Table 9: Predicted fair-weather radio interference (RI) levels at 100 feet (30.5 m) from the outside conductor of the proposed Grand Coulee – Bell 500-kV line corridor. RI levels given in decibels above 1 microvolt/meter (dBµV/m) at 1.0 MHz. L_{50} denotes level exceeded 50 percent of the time. Configurations are described in Tables 1 and 2 and are shown in Figure 1.

Configuration	Fair-weather RI	
	Proposed Corridor [1]	Existing Corridor[1]
	L_{50}, dBµV/m	L_{50}, dBµV/m
1	37, 39	39, 39
2	38, 38	-
3	23, 30	23, 21
4	30 [2] ,37	21 [2] , 23
5	30, 34	23, 21
6	26 [2] , 32	26 [2] , 21
7	27 [2] , 34	26 [2], 21
8	27, 25	23, 20
9	30, 27	23, 20
10	39, 34	13, 20

[1] RI level at 100 ft. from outside conductor at east edge of corridor is given first for Configuration 1 and at north edge for Configurations 2 - 10.

[2] RI value at edge of right-of-way because a point 100 ft. from the outside conductor is still on the right-of-way.

Table 10: Predicted maximum foul-weather television interference (TVI) levels at 100 feet (30.5 m) from the outside conductor of the proposed Grand Coulee – Bell 500-kV line corridor. TVI levels given in decibels above 1 microvolt/meter (dBμV/m) at 75 MHz. Configurations are described in detail in Tables 1 and 2 and are shown in Figure 1.

Configuration	Foul-weather TVI	
	Proposed Corridor[1]	Existing Corridor[1]
	Maximum (foul), dBμV/m	Maximum (foul), dBμV/m
1	24, 26	27, 27
2	25, 25	-
3	9, 14	11, 2
4	6 [2], 18	2 [2], 4
5	11, 14	11, 2
6	15 [2], 16	15 [2], 2
7	16 [2], 14	15 [2], 2
8	11, 8	11, 8
9	11, 8	11, 8
10	19, 8	2, 8

[1] TVI level at 100 ft. from outside conductor at east edge of corridor is given first for Configuration 1 and at north edge for Configurations 2 - 10.

[2] TVI value at edge of right-of-way because a point 100 ft. from the outside conductor is still on the right-of-way.

Figure 1: **Configurations for the proposed Grand Coulee – Bell 500-kV line: a) Configuration 1; b) Configuration 2; c) Configuration 3; d) Configuration 4; e) Configuration 5; f) Configuration 6; g) Configuration 7; h) Configuration 8; i) Configuration 9; and j) Configuration 10.** Configurations are described in Tables 1 and 2. (10 pages)

a) Configuration 1: Proposed line parallel to existing 500-kV line (not to scale)

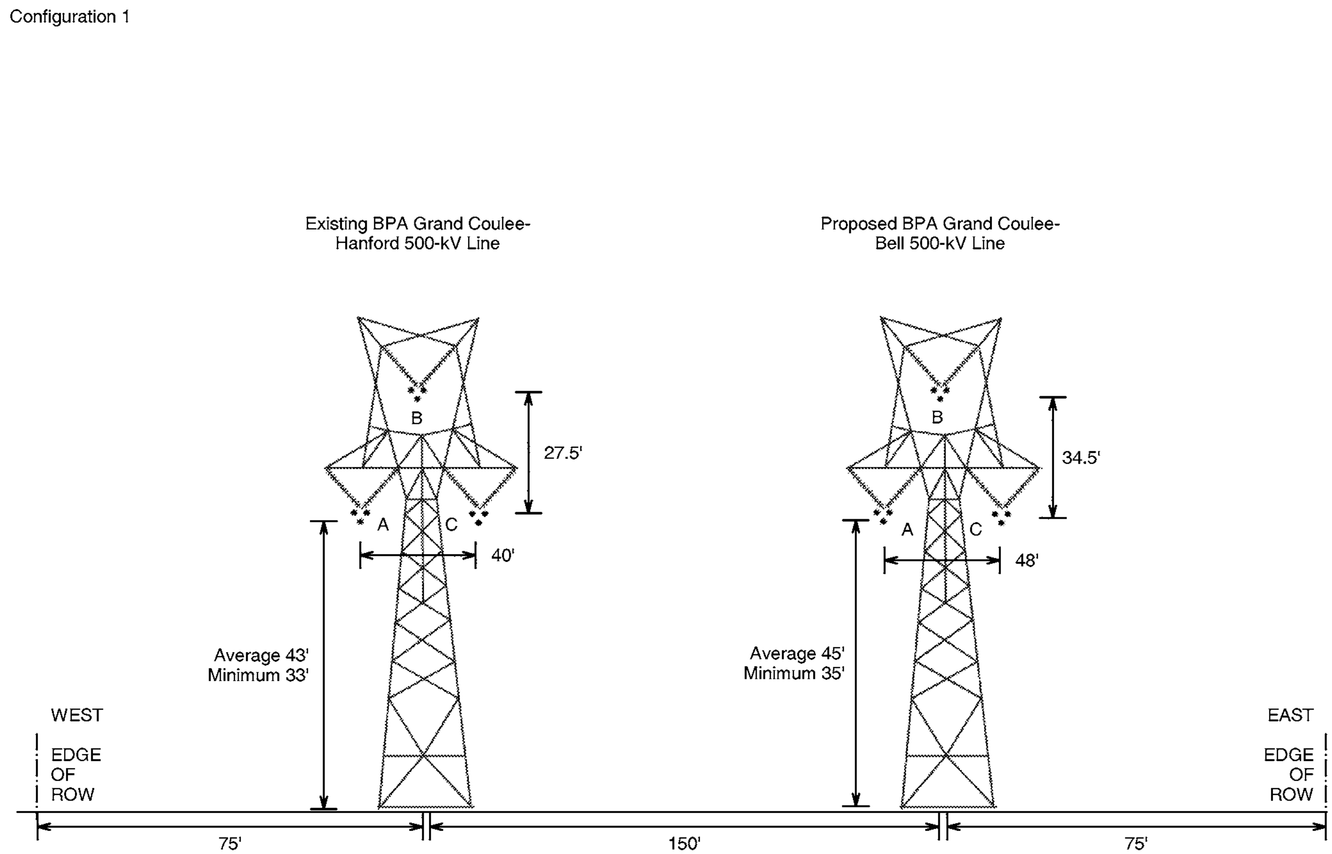


Figure 1, continued

b) Configuration 2: Proposed line with no parallel lines. (not to scale)

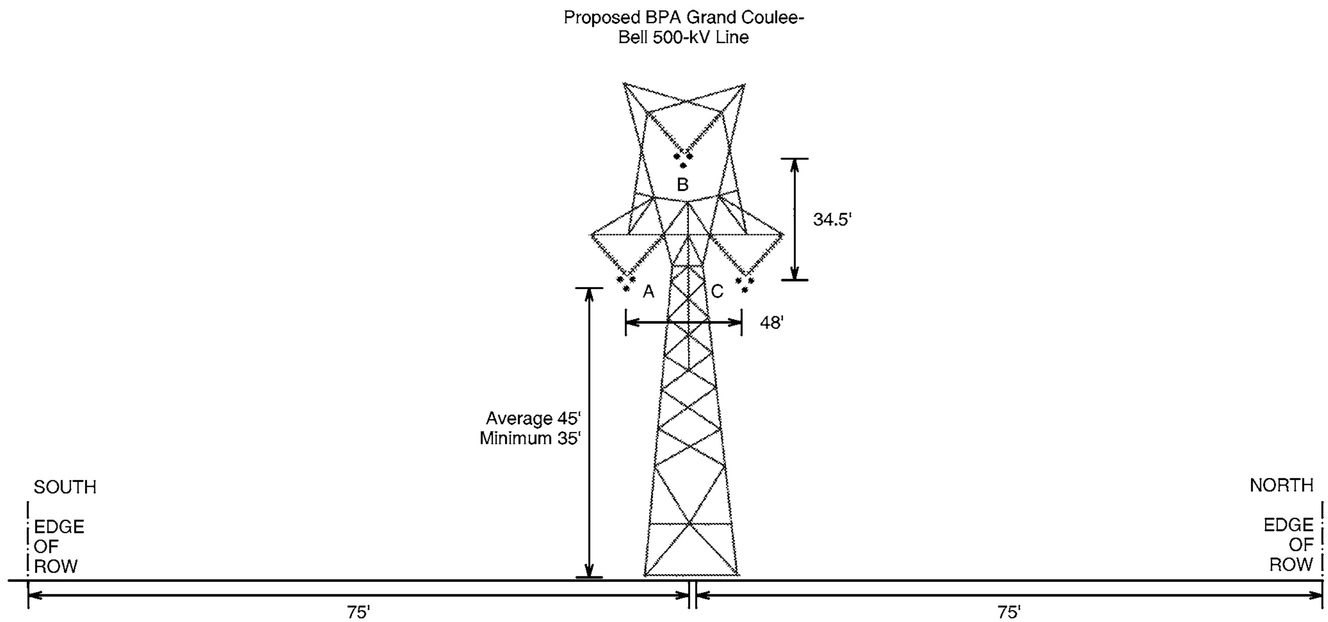


Figure 1, continued

c) Configuration 3: Proposed line on single-circuit tower parallel to existing 230-kV and 115-kV lines. (not to scale)

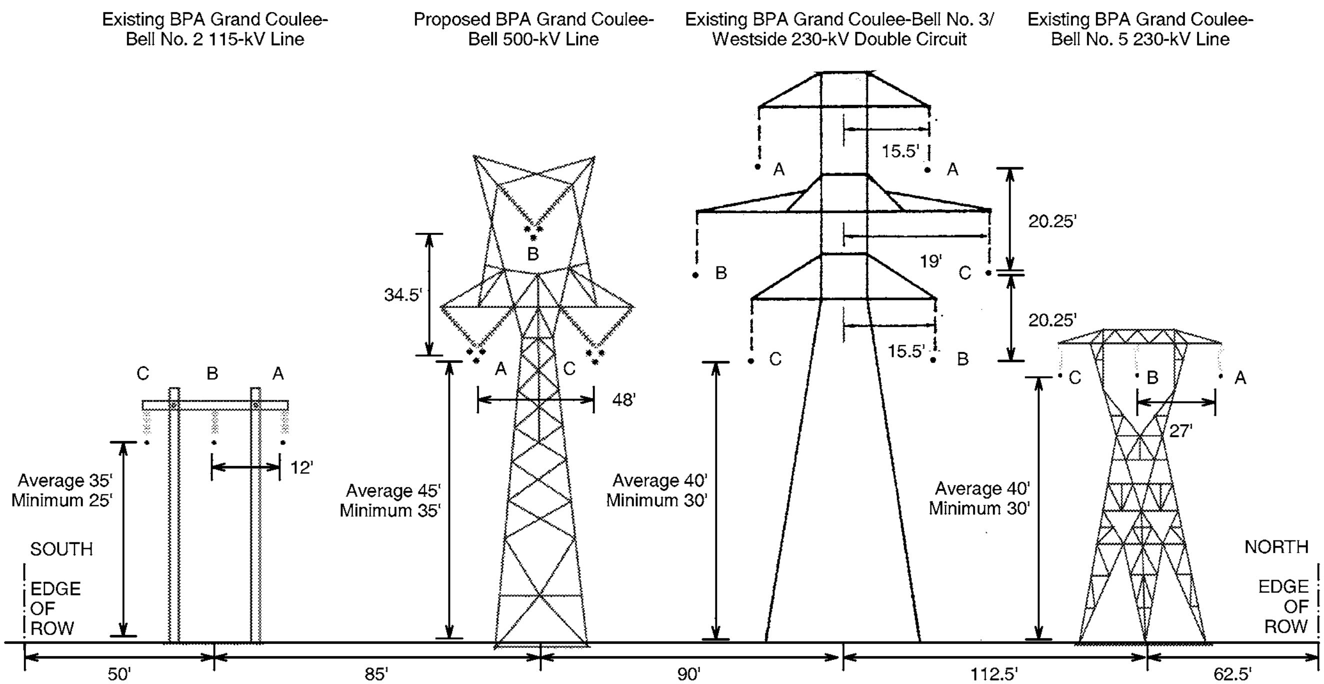


Figure 1, continued

d) Configuration 4: Proposed line on double-circuit tower with 115-kV line and parallel to existing 230-kV lines. (not to scale)

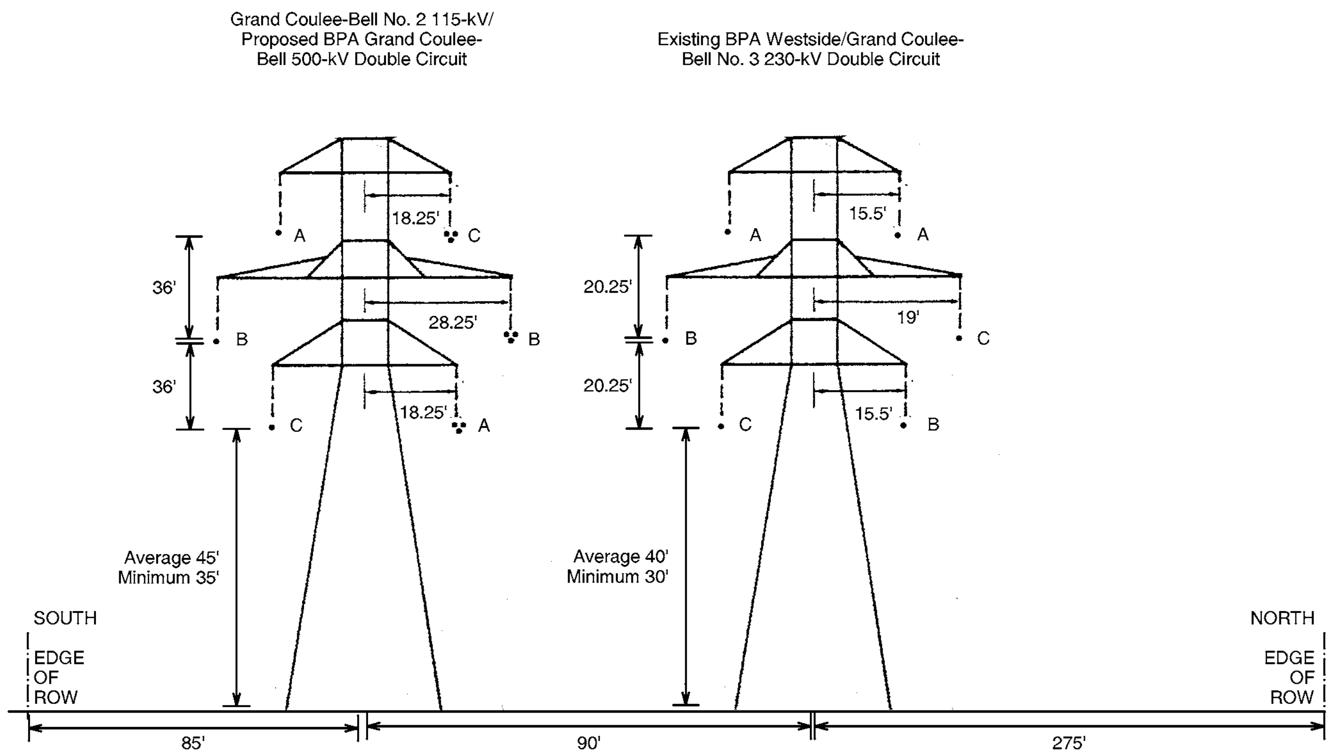


Figure 1, continued

e) Configuration 5: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines. (not to scale)

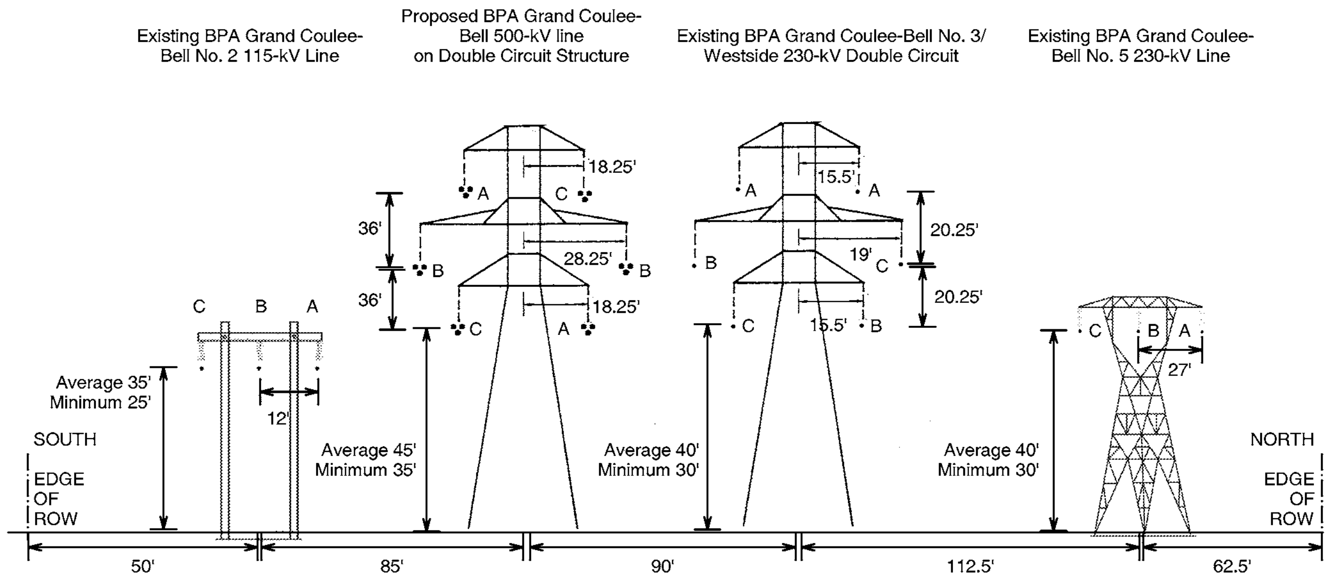


Figure 1, continued

f) Configuration 6: Proposed line on single-circuit tower and parallel to existing 230-kV and 115-kV lines. (not to scale)

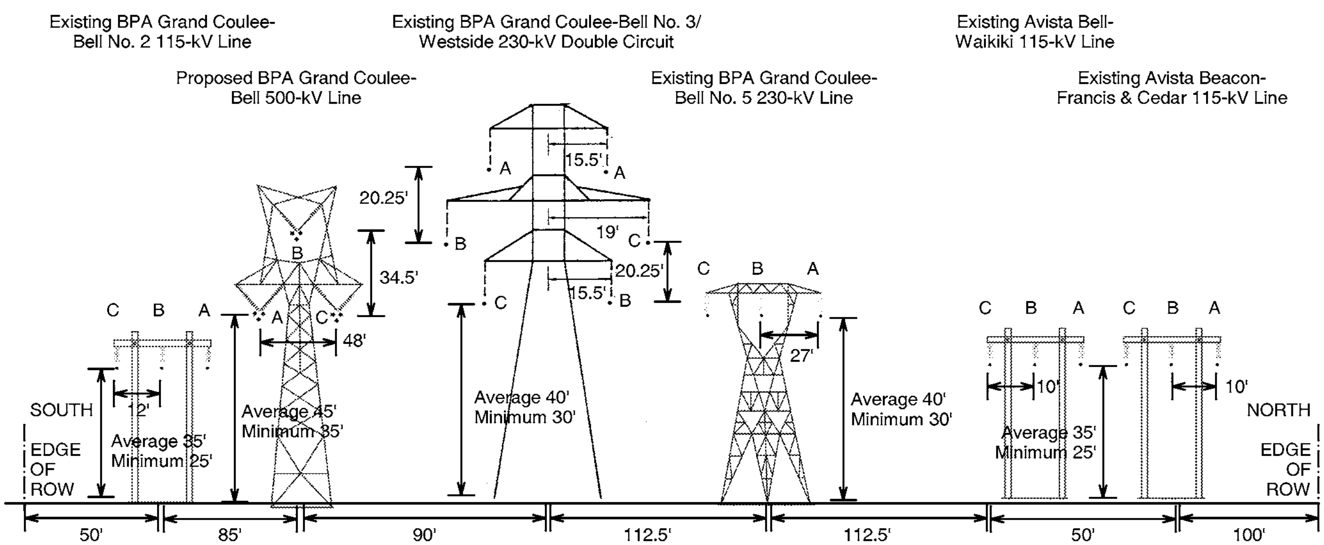


Figure 1, continued

g) Configuration 7: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines. (not to scale)

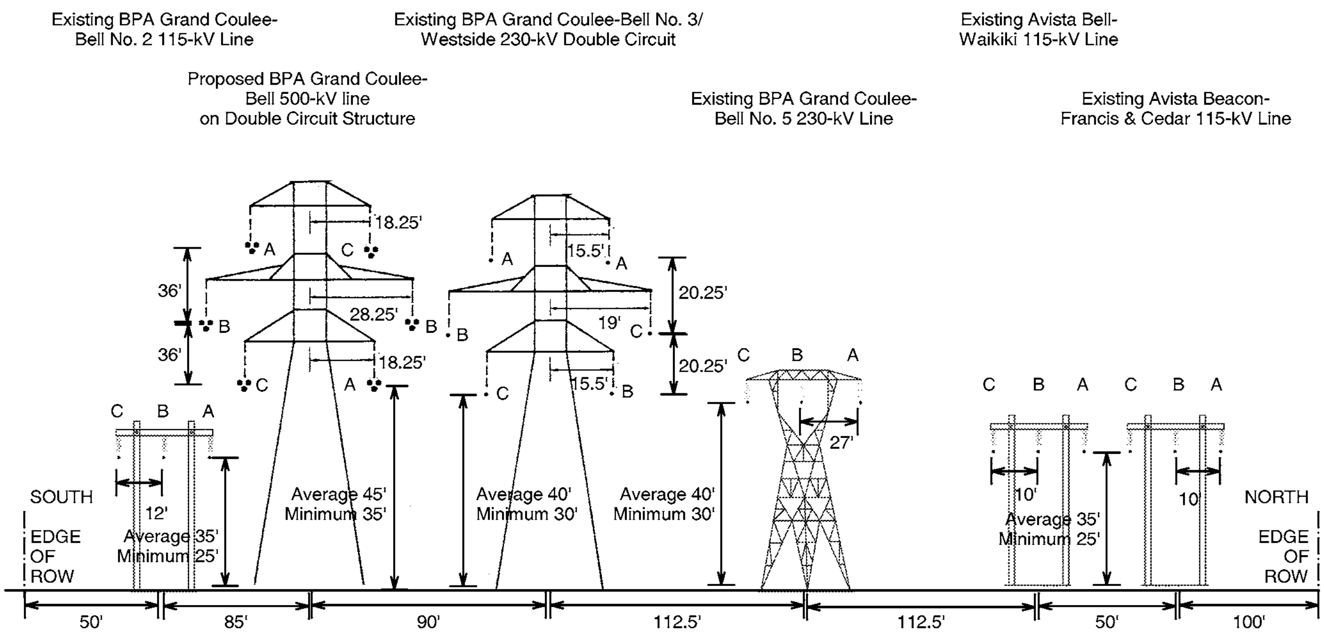


Figure 1, continued

h) Configuration 8: Proposed line on single-circuit tower and parallel to existing 230-kV and 115-kV lines. (not to scale)

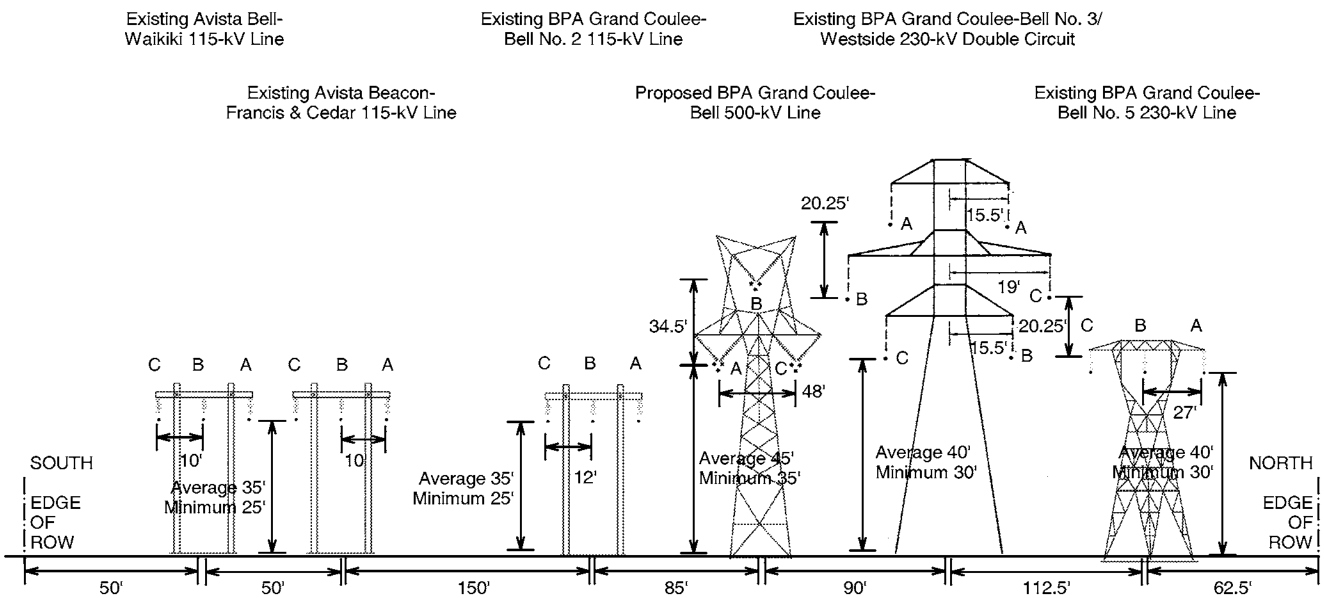


Figure 1, continued

i) Configuration 9: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines. (not to scale)

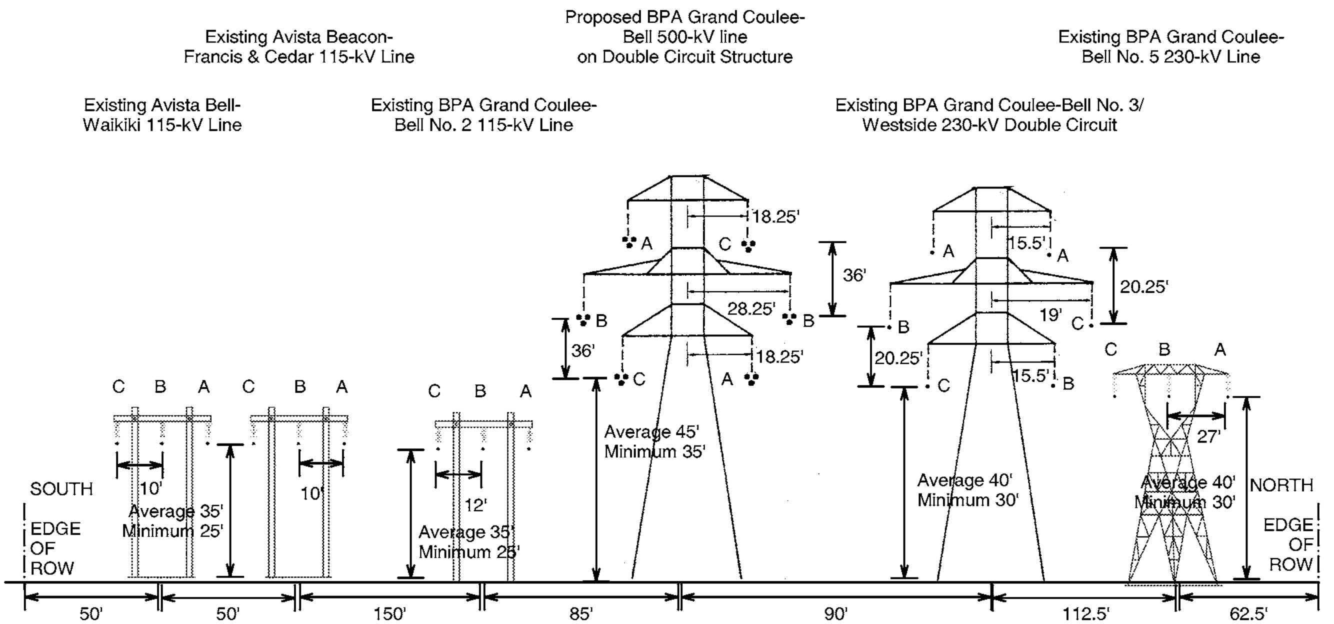


Figure 1, continued

j) Configuration 10: Proposed line on double-circuit tower and parallel to existing 115-kV lines. (not to scale)

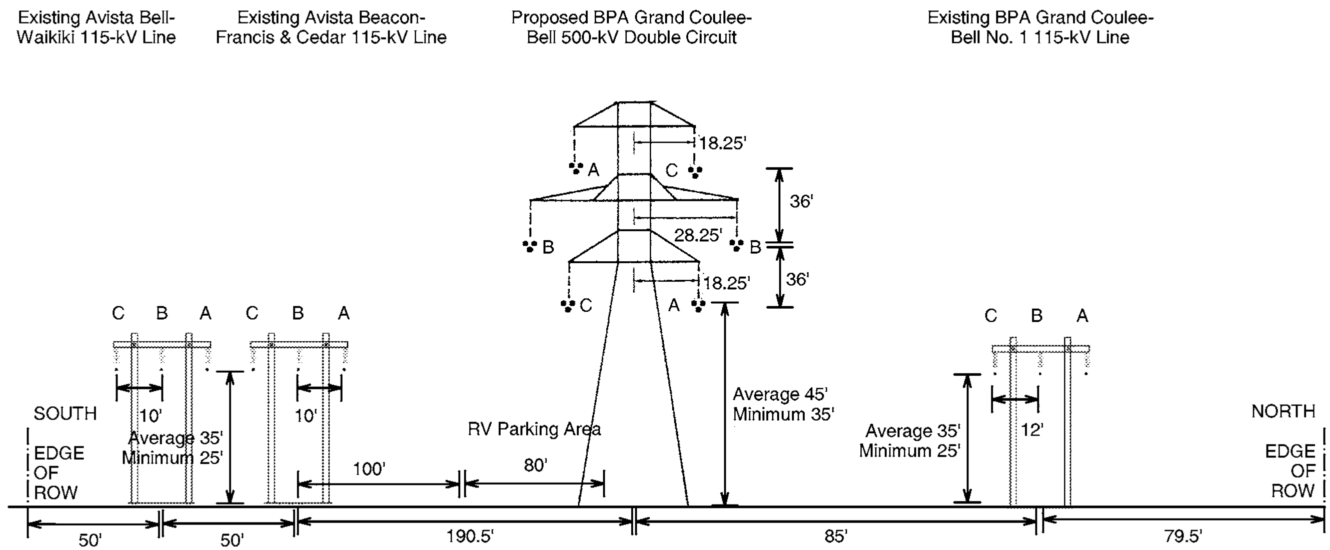
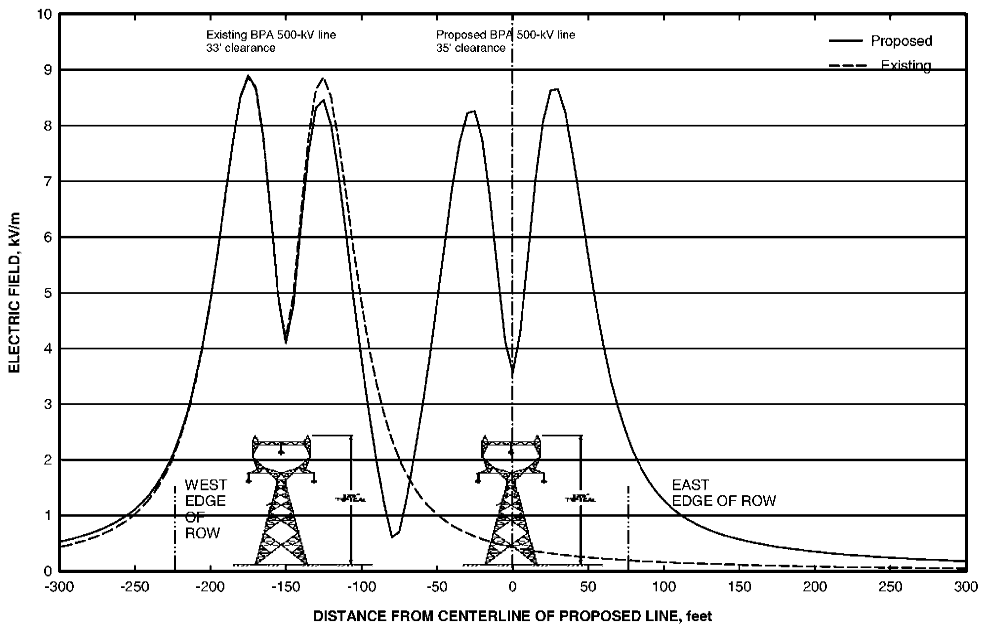


Figure 2: Electric-field profiles for configurations of the proposed Grand Coulee – Bell 500-kV line under maximum voltage conditions: a) Configuration 1; b) Configuration 2; c) Configuration 3; d) Configuration 4; e) Configuration 5; f) Configuration 6; g) Configuration 7; h) Configuration 8; i) Configuration 9; and j) Configuration 10. Configurations are described in Tables 1 and 2. (5 pages)

a) Configuration 1: Proposed line parallel to existing 500-kV line



b) Configuration 2: Proposed line with no parallel lines.

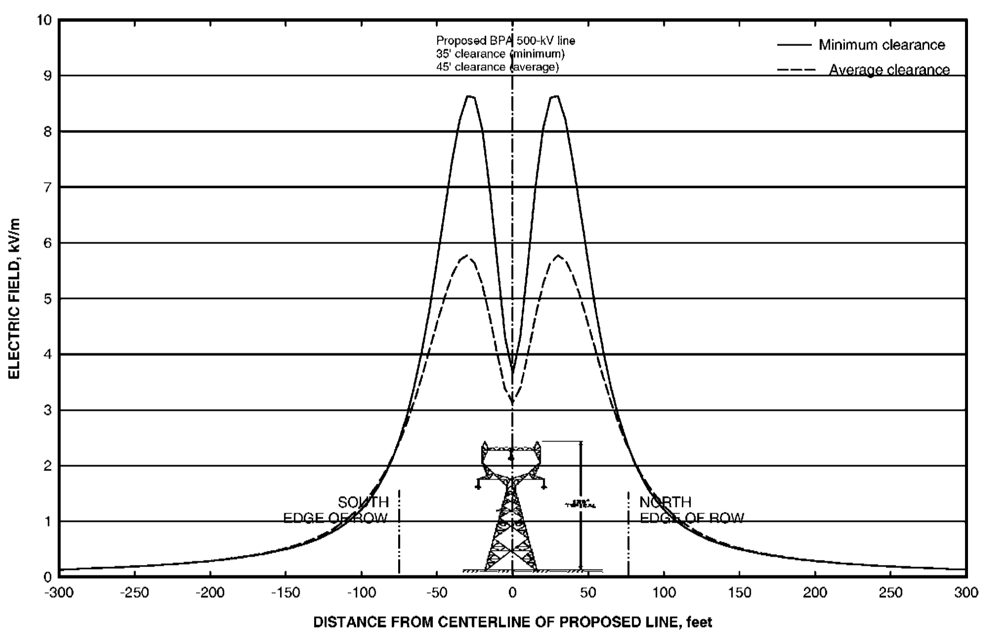
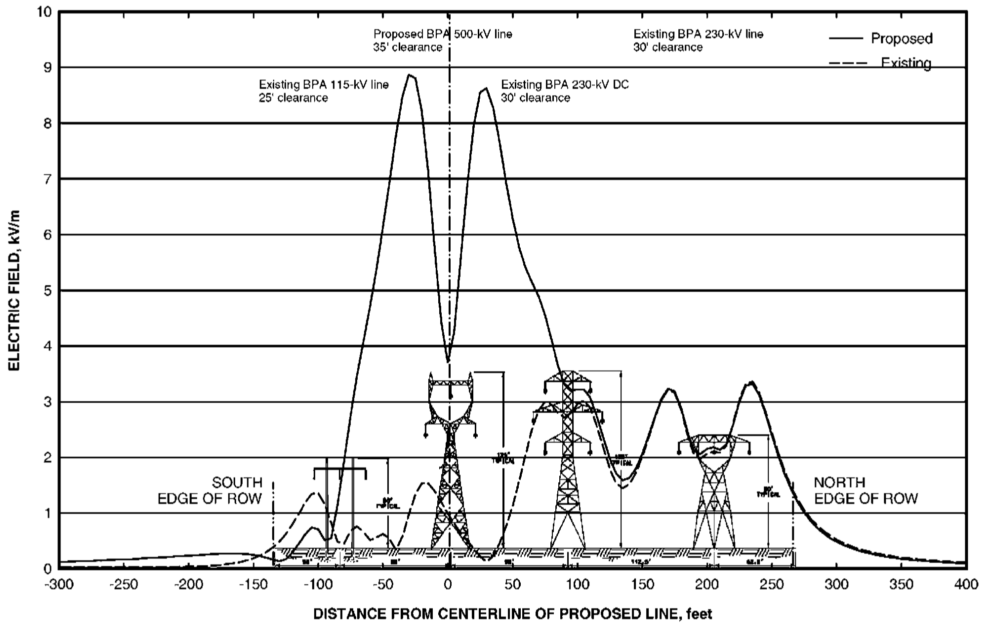


Figure 2, continued

c) Configuration 3: Proposed line on single-circuit tower parallel to existing 230-kV and 115-kV lines



d) Configuration 4: Proposed line on double-circuit tower with 115-kV line and parallel to existing 230-kV lines

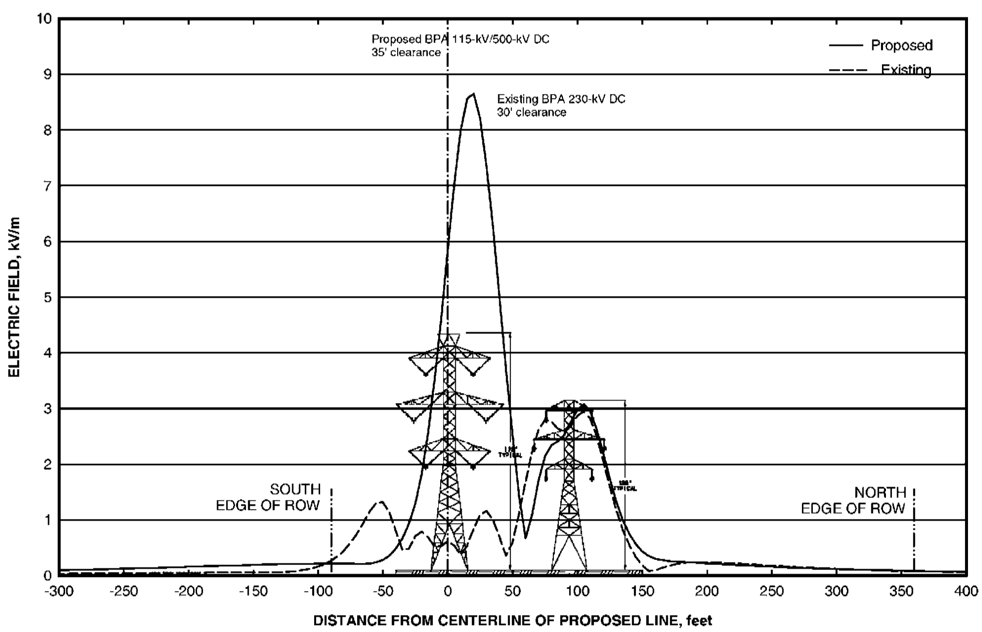
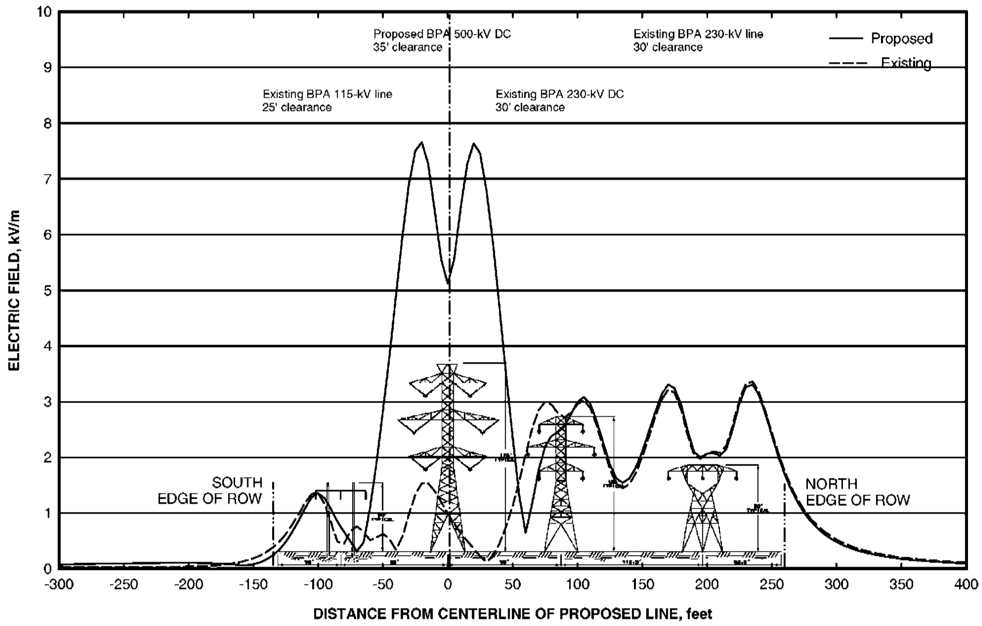


Figure 2, continued

e) Configuration 5: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines



f) Configuration 6: Proposed line on single-circuit tower and parallel to existing 230-kV and 115-kV lines

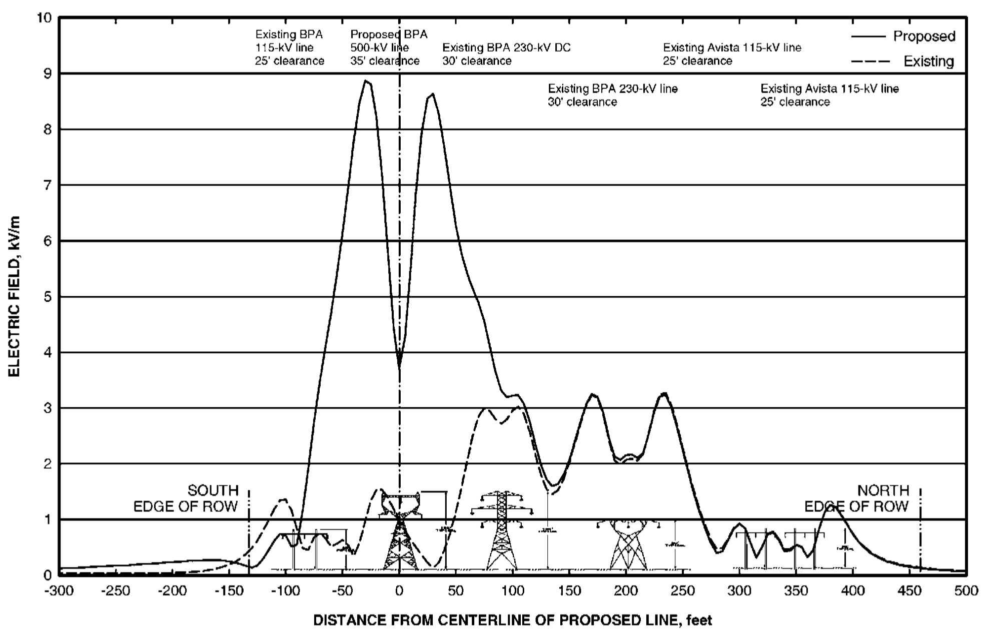
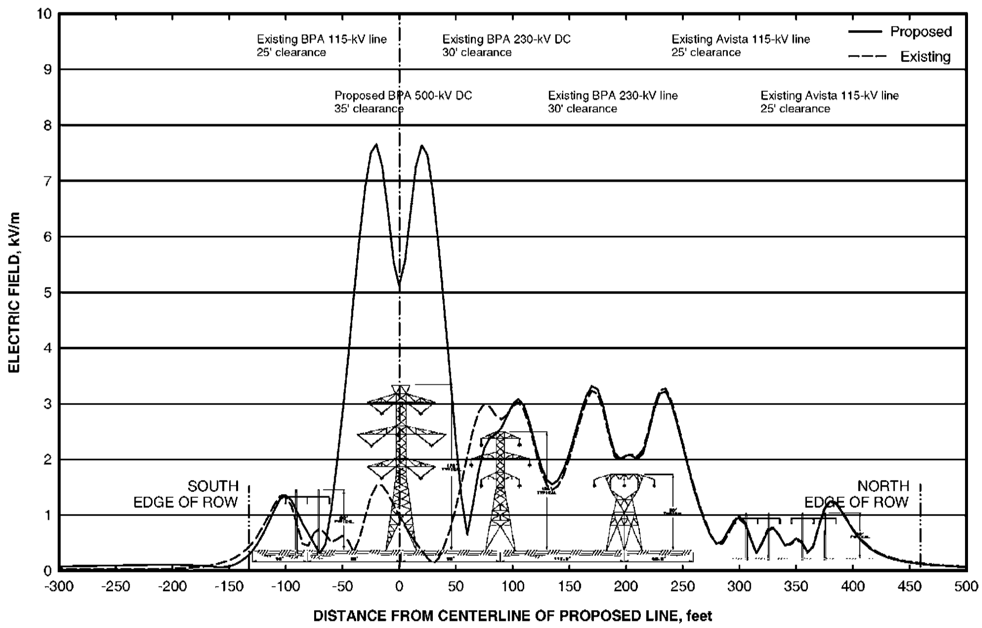


Figure 2, continued

g) Configuration 7: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines



h) Configuration 8: Proposed line on single-circuit tower and parallel to existing 230-kV and 115-kV lines

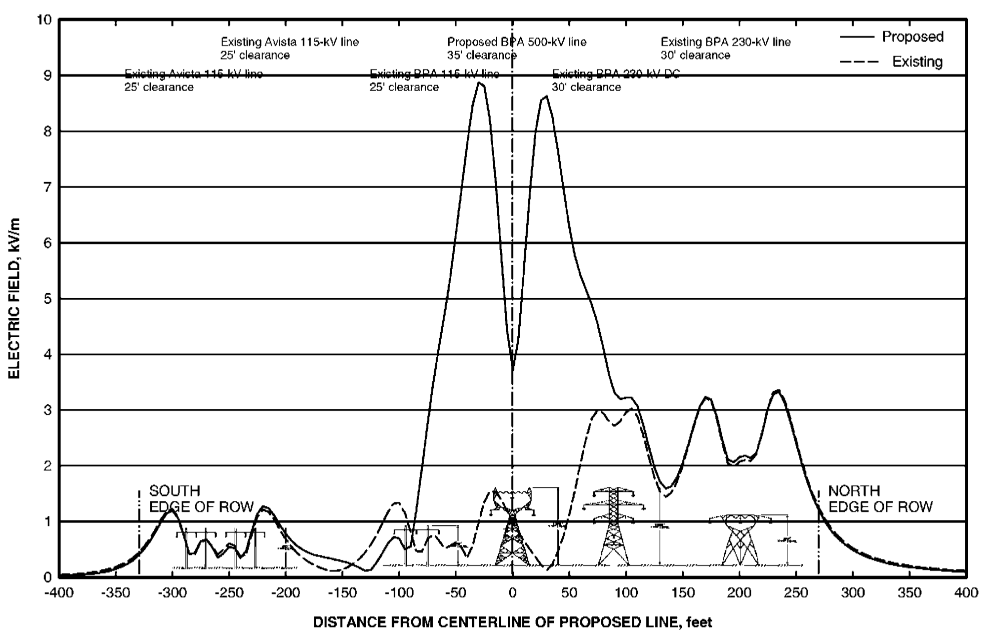
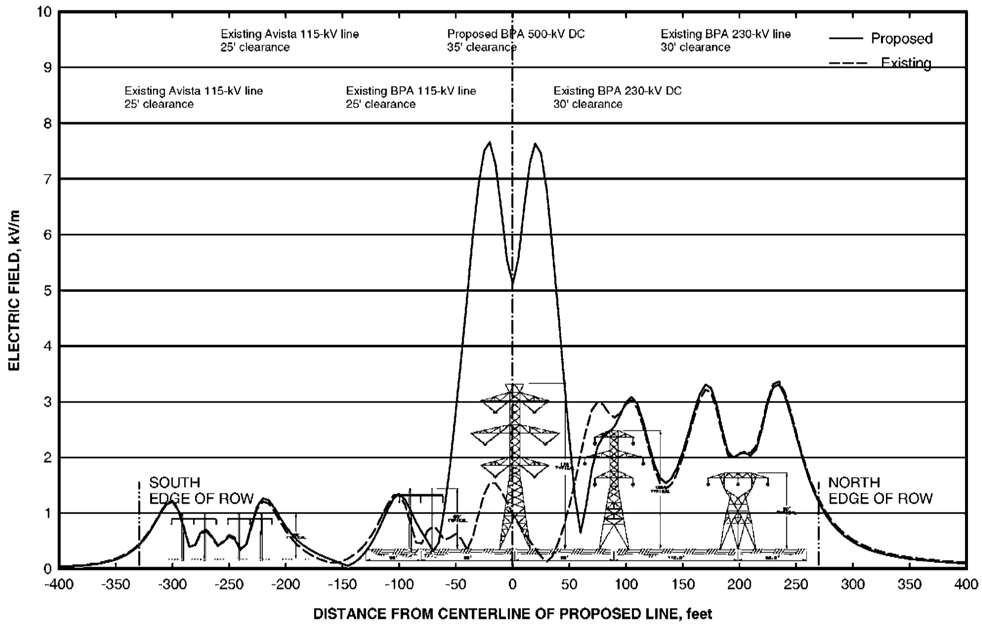


Figure 2, continued

i) Configuration 9: Proposed line on double-circuit tower and parallel to existing 230-kV and 115 kV lines



j) Configuration 10: Proposed line on double-circuit tower and parallel to existing 115-kV lines

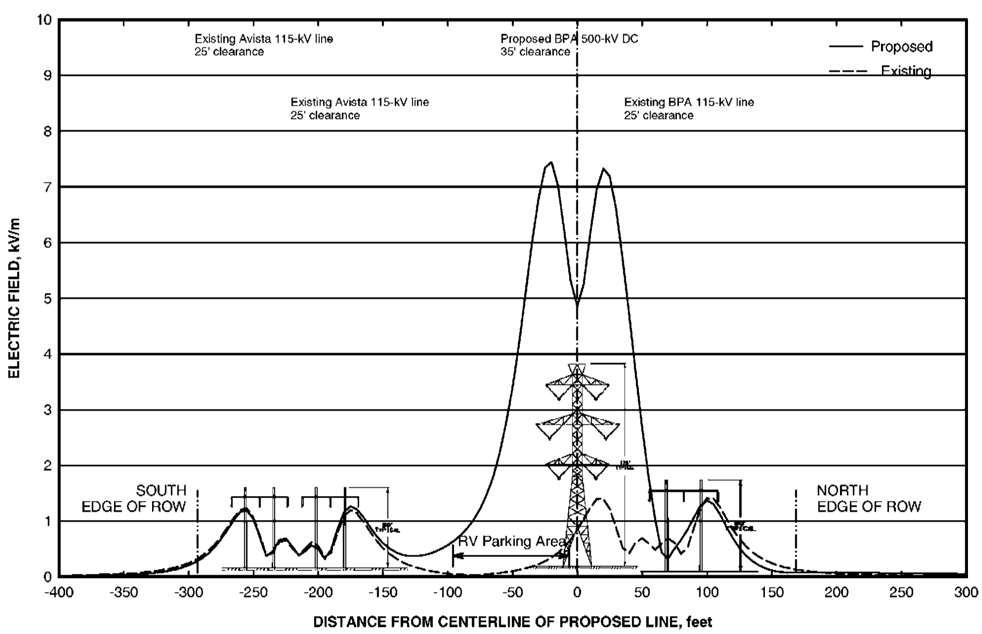
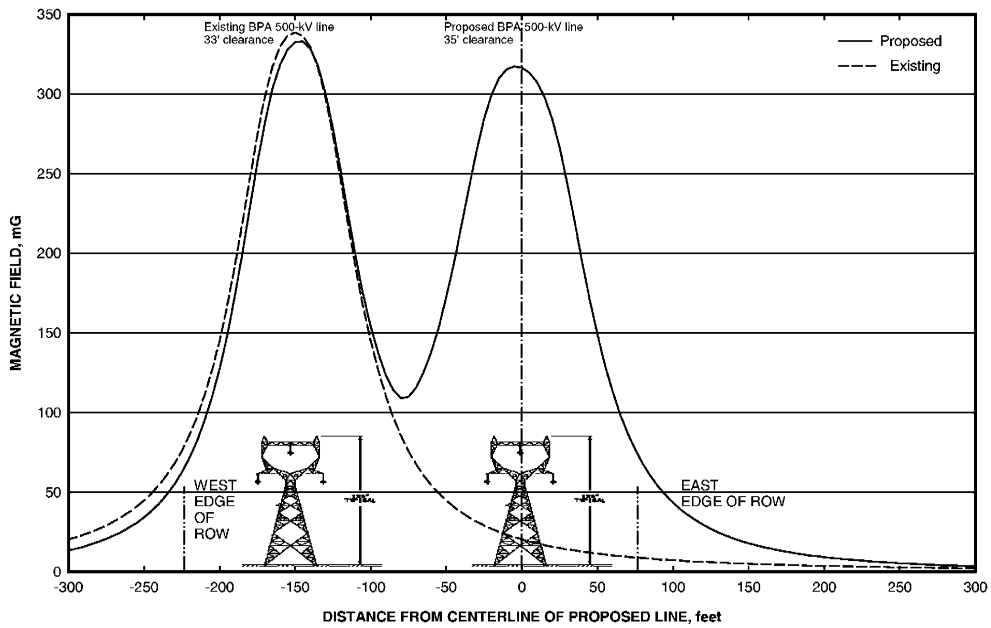


Figure 3: **Magnetic-field profiles for configurations of the proposed Grand Coulee – Bell 500-kV line under maximum current conditions: a) Configuration 1; b) Configuration 2; c) Configuration 3; d) Configuration 4; e) Configuration 5; f) Configuration 6; g) Configuration 7; h) Configuration 8; i) Configuration 9; an j) Configuration 10.** Configurations are described in Tables 1 and 2. (5 pages)

a) Configuration 1: Proposed line parallel to existing 500-kV line



b) Configuration 2: Proposed line with no parallel lines.

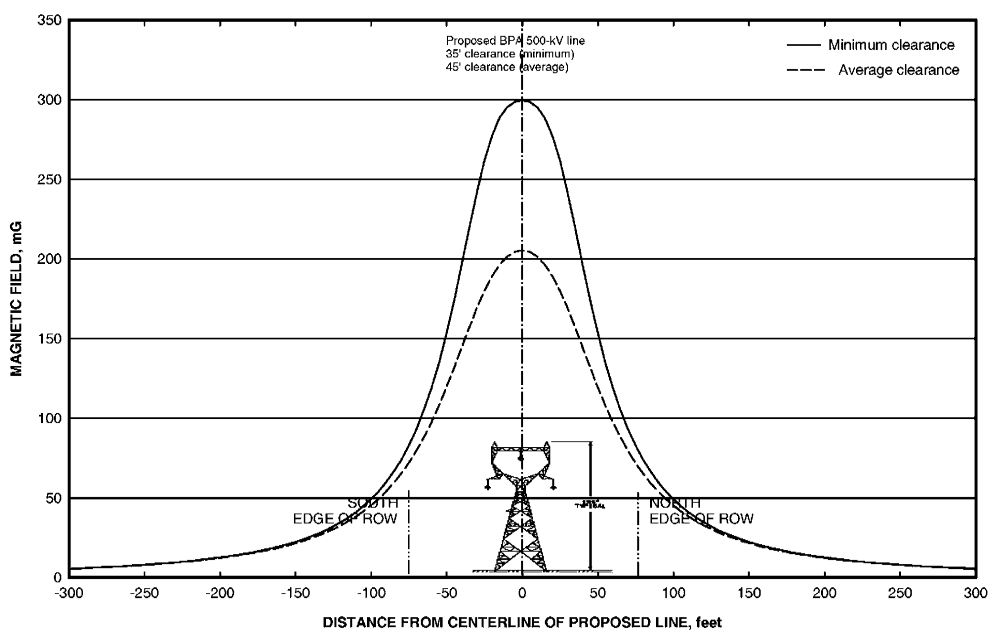
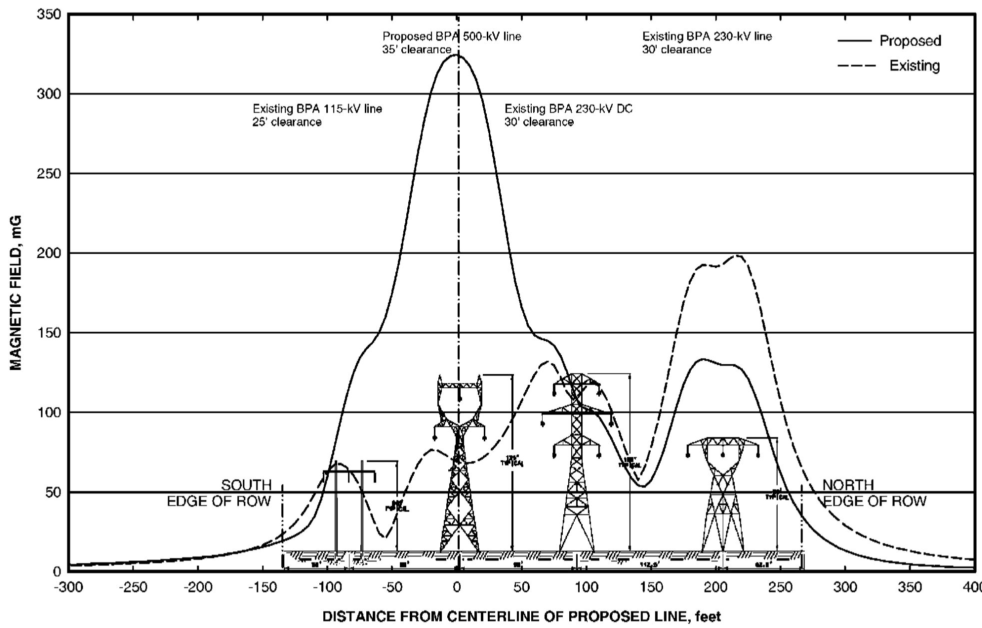


Figure 3, continued

c) Configuration 3: Proposed line on single-circuit tower parallel to existing 230-kV and 115-kV lines



d) Configuration 4: Proposed line on double-circuit tower with 115-kV line and parallel to existing 230-kV lines

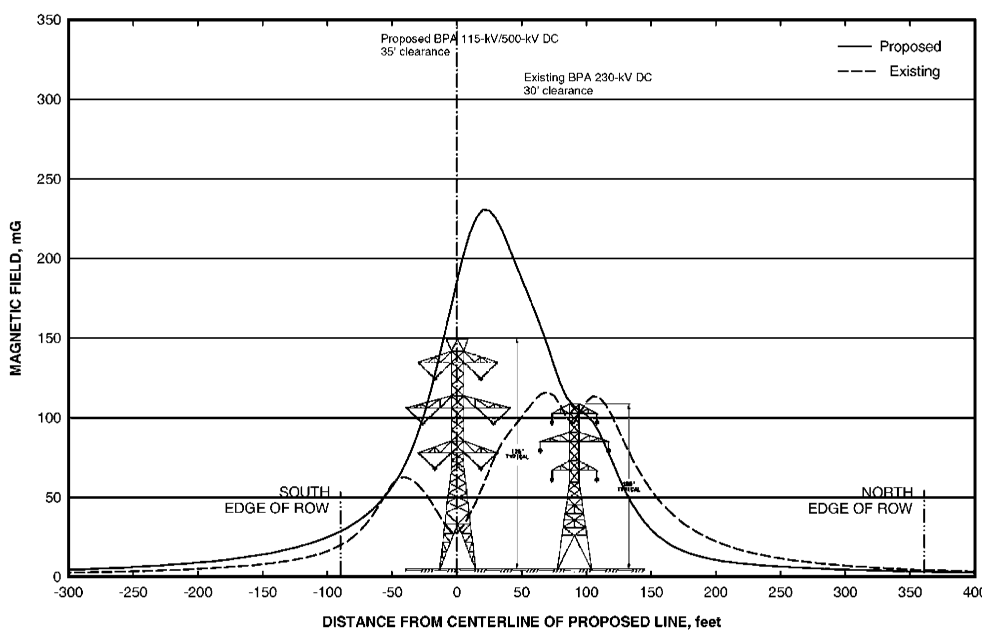
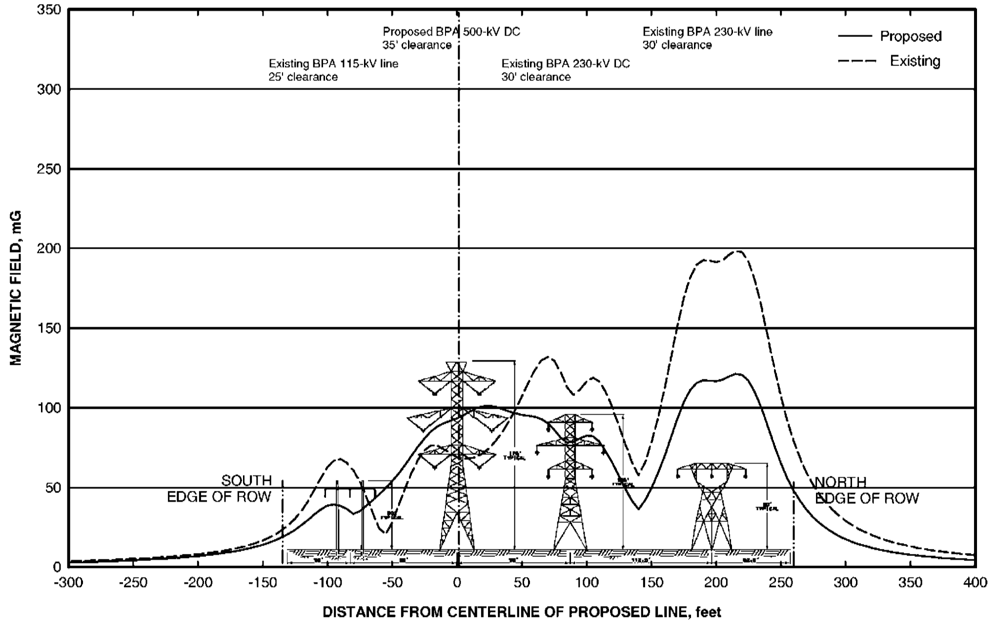


Figure 3, continued

e) Configuration 5: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines



f) Configuration 6: Proposed line on single-circuit tower and parallel to existing 230-kV and 115-kV lines

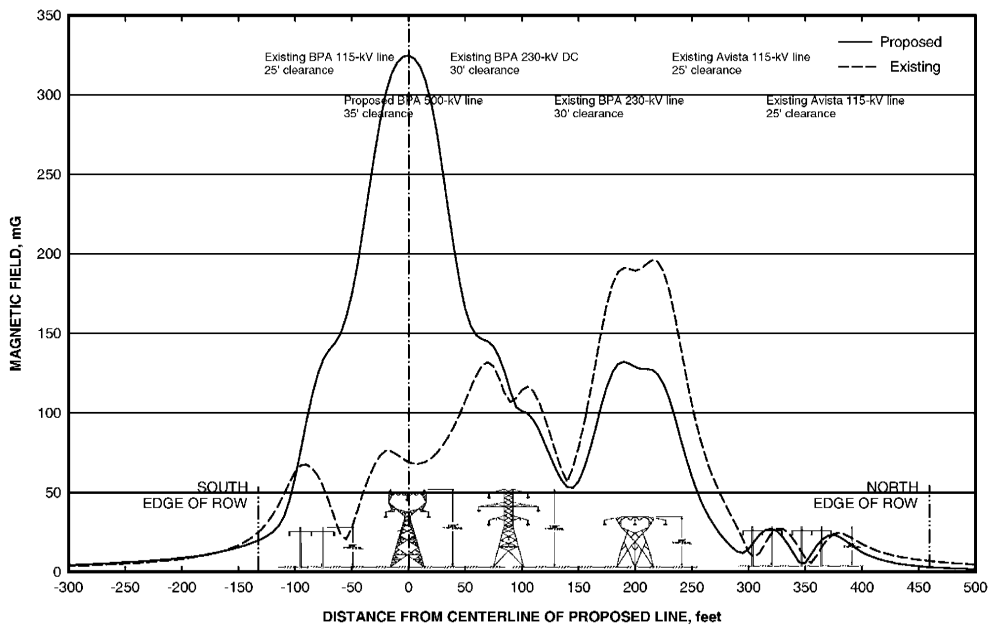
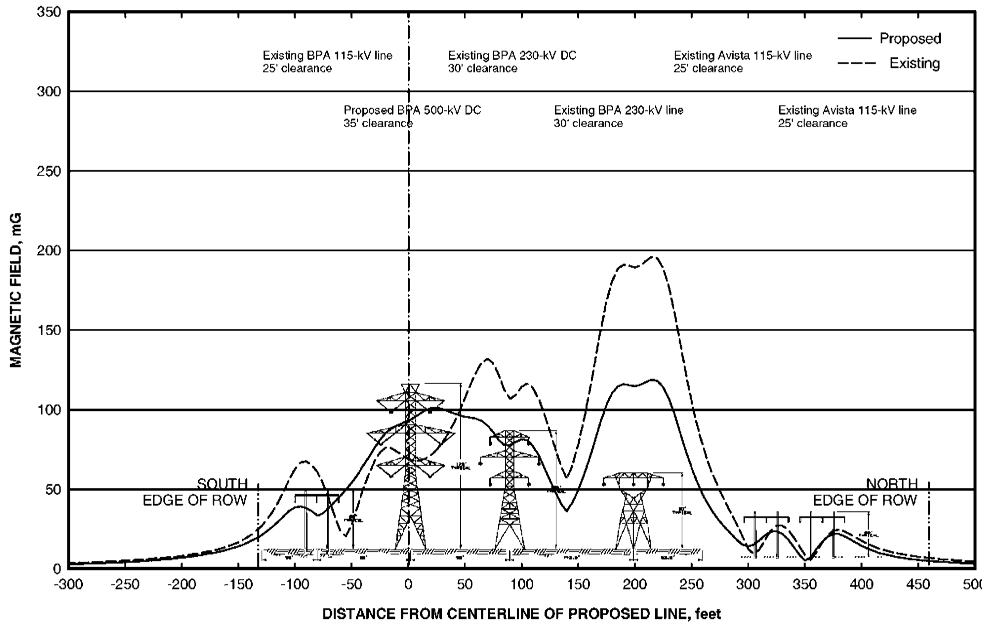


Figure 3, continued

g) Configuration 7: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines



h) Configuration 8: Proposed line on single-circuit tower and parallel to existing 230-kV and 115-kV lines

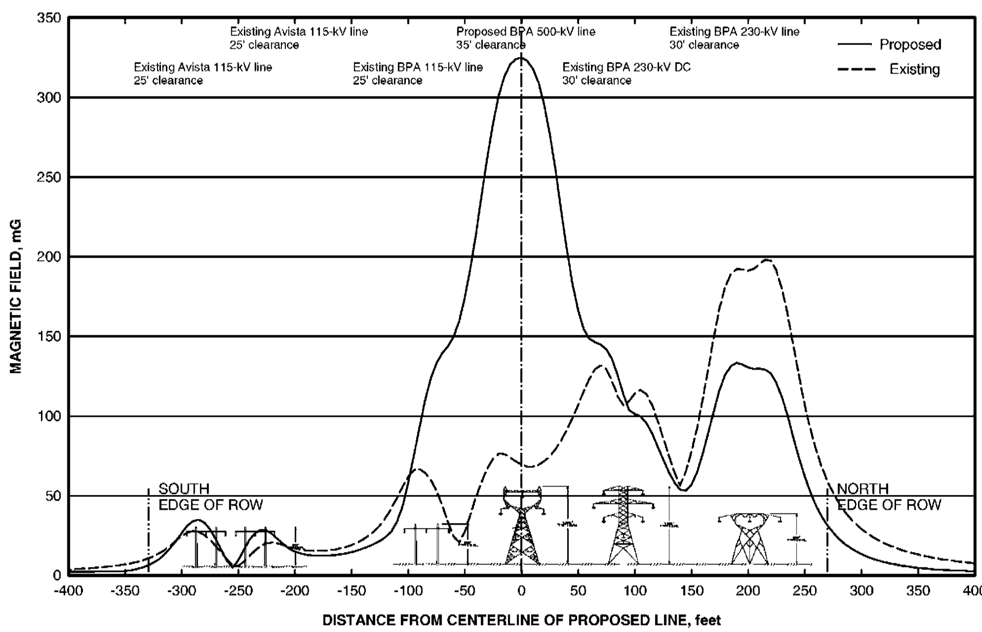
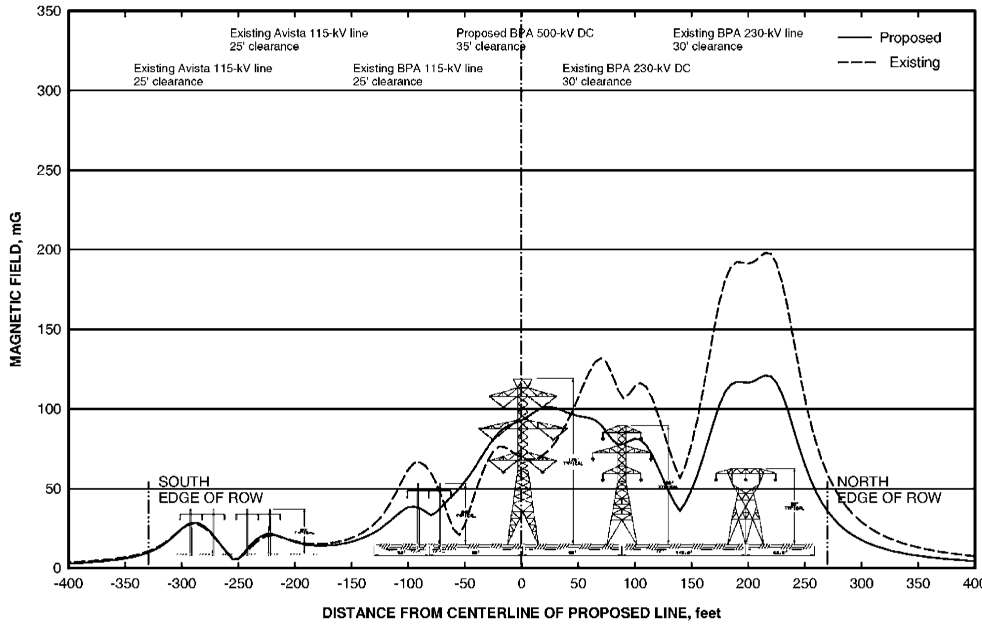


Figure 3, continued

i) Configuration 9: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines



j) Configuration 10: Proposed line on double-circuit tower and parallel to existing 115-kV lines

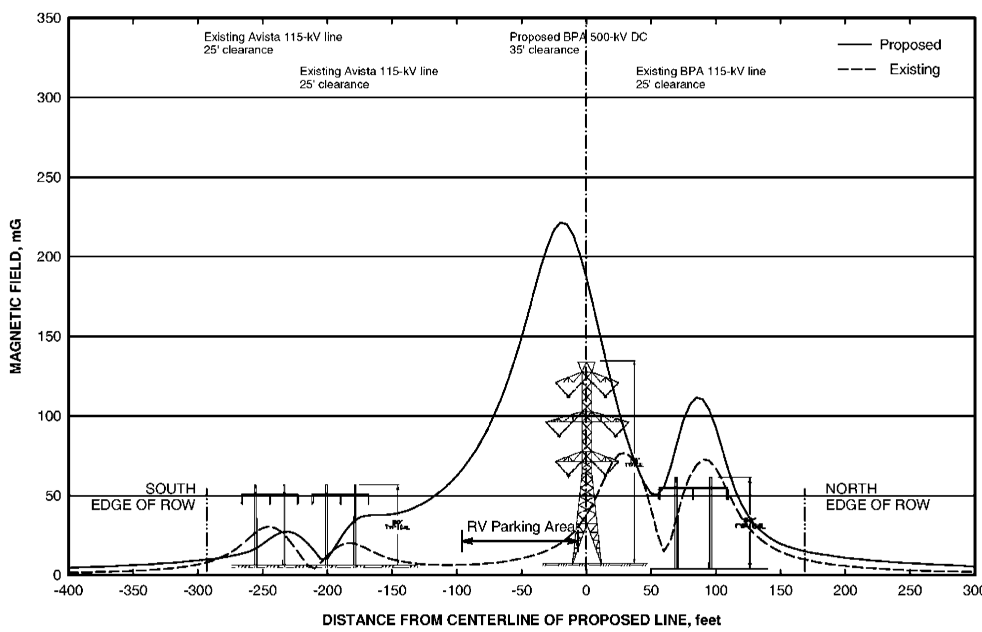
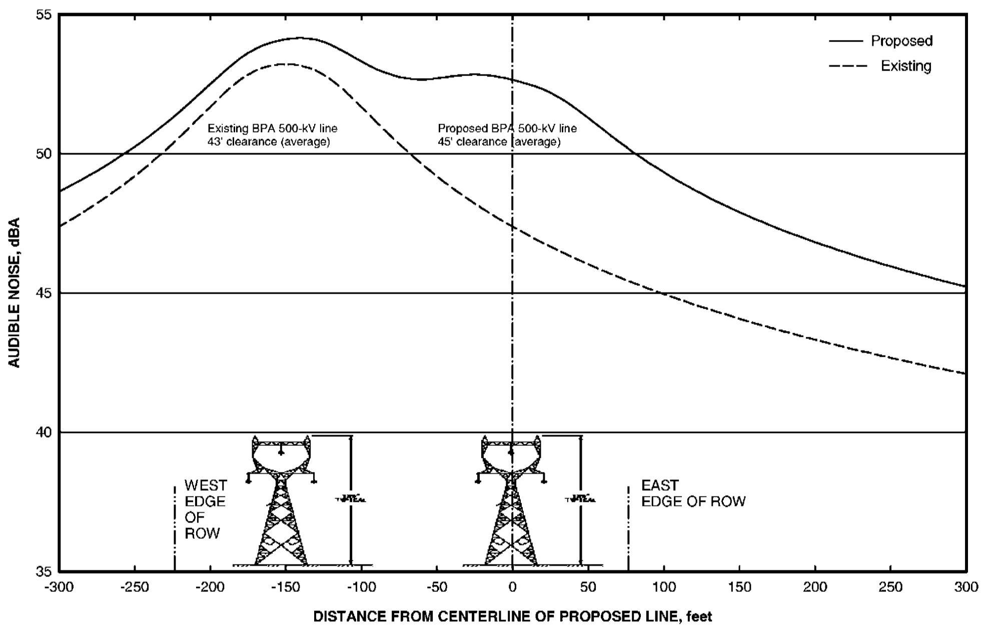


Figure 4: **Predicted foul-weather L_{50} audible noise levels from configurations of proposed Grand Coulee – Bell 500-kV line: a) Configuration 1; b) Configuration 2; c) Configuration 3; d) Configuration 4; e) Configuration 5; f) Configuration 6; g) Configuration 7; h) Configuration 8; i) Configuration 9; and j) Configuration 10.** Configurations are described in Tables 1 and 2. (5 pages)

a) Configuration 1: Proposed line parallel to existing 500-kV line



b) Configuration 2: Proposed line with no parallel lines

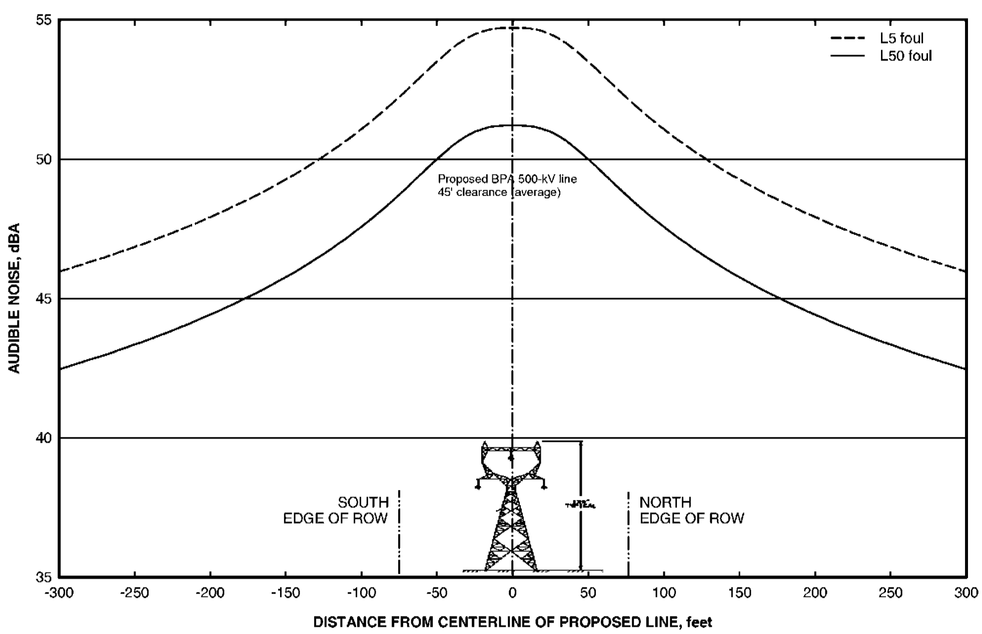
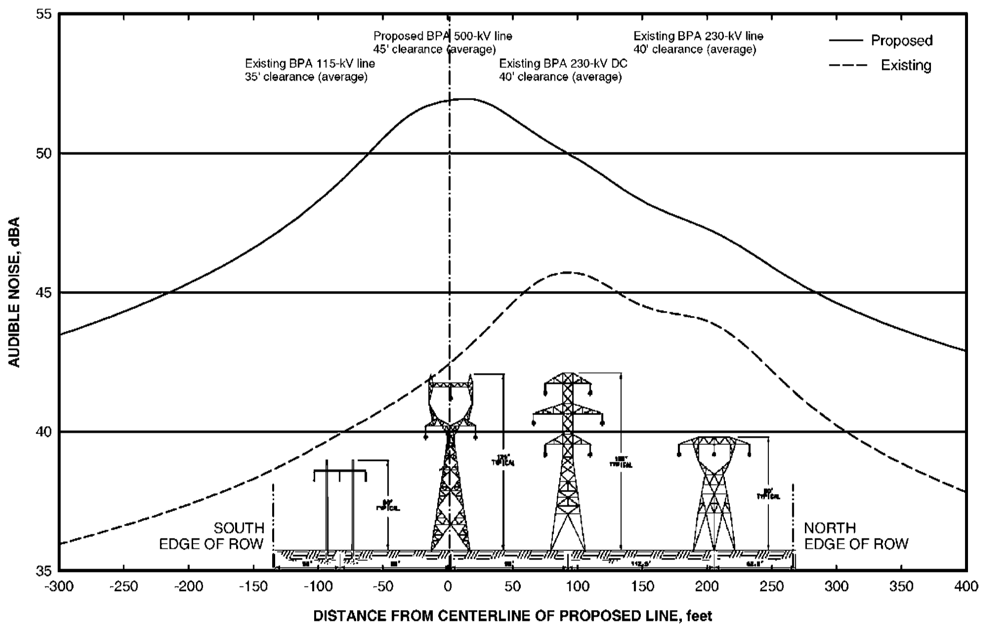


Figure 4, continued

c) Configuration 3: Proposed line on single-circuit tower parallel to existing 230-kV and 115-kV lines



d) Configuration 4: Proposed line on double-circuit tower with 115-kV line and parallel to existing 230-kV lines

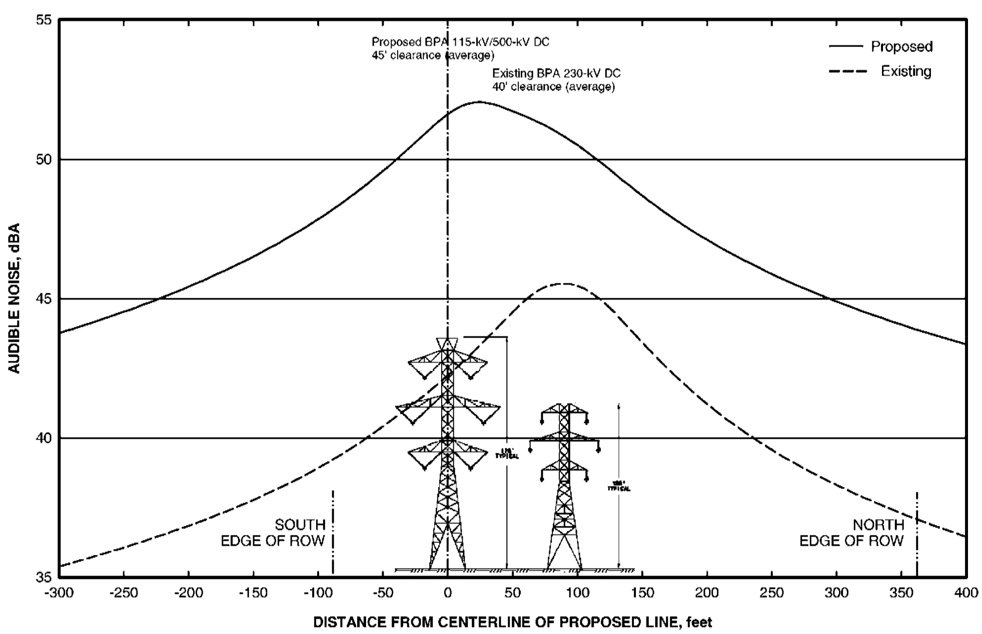
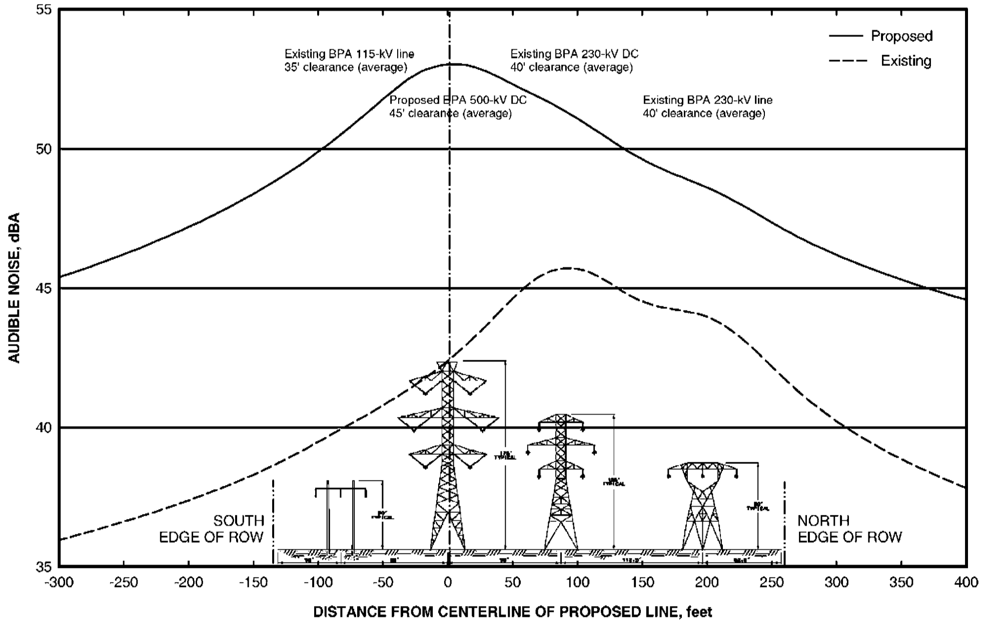


Figure 4, continued

e) Configuration 5: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines



f) Configuration 6: Proposed line on single-circuit tower and parallel to existing 230-kV and 115-kV lines

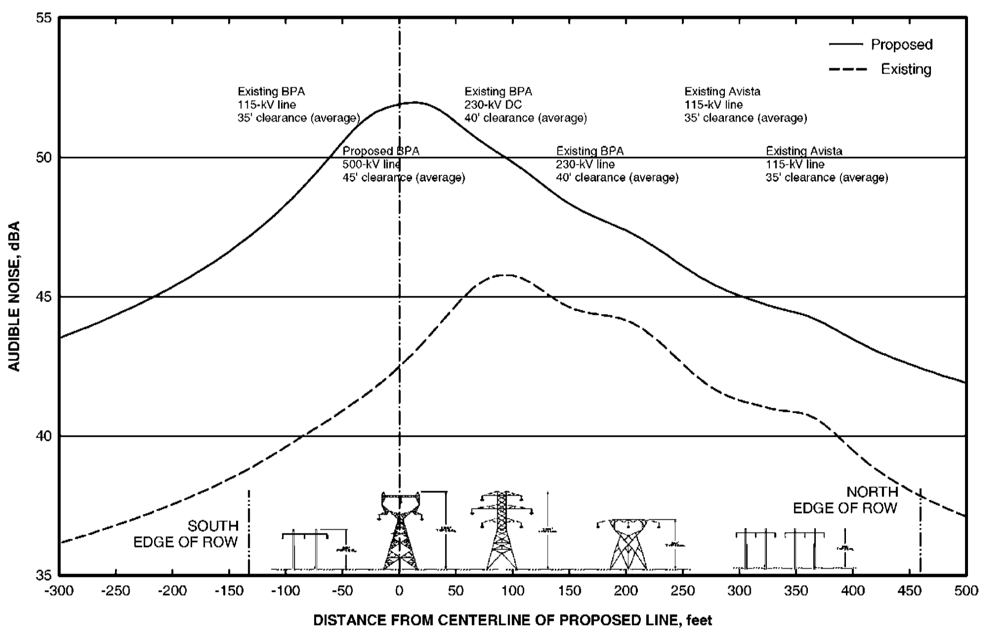
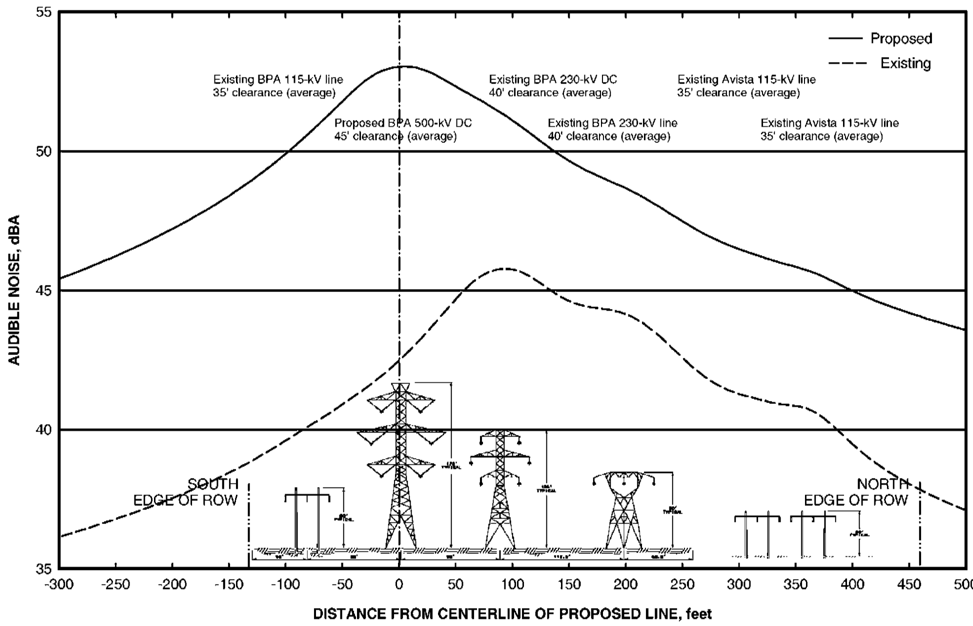


Figure 4, continued

g) Configuration 7: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines



h) Configuration 8: Proposed line on single-circuit tower and parallel to existing 230-kV and 115-kV lines

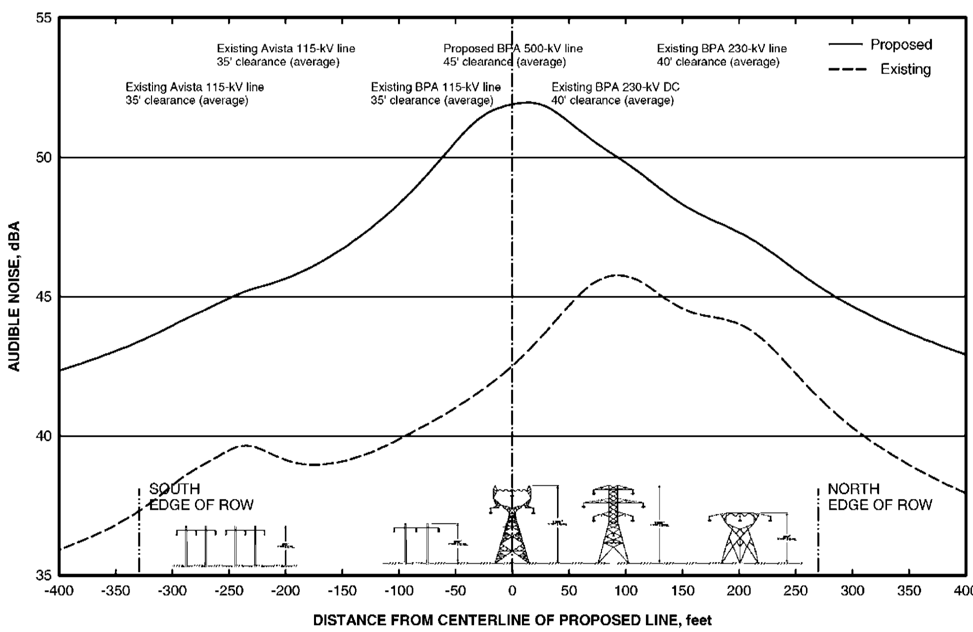
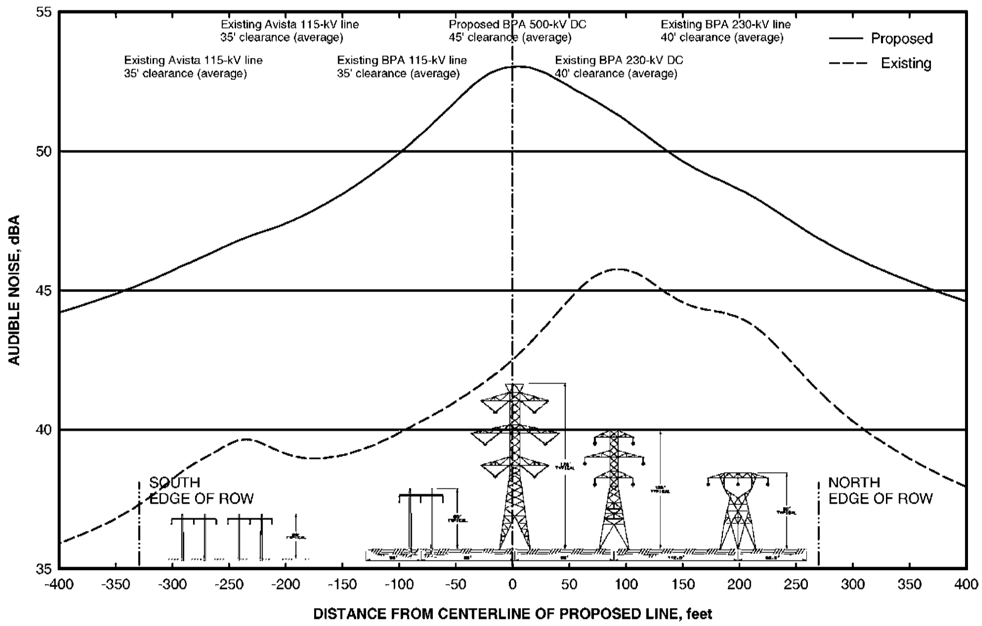
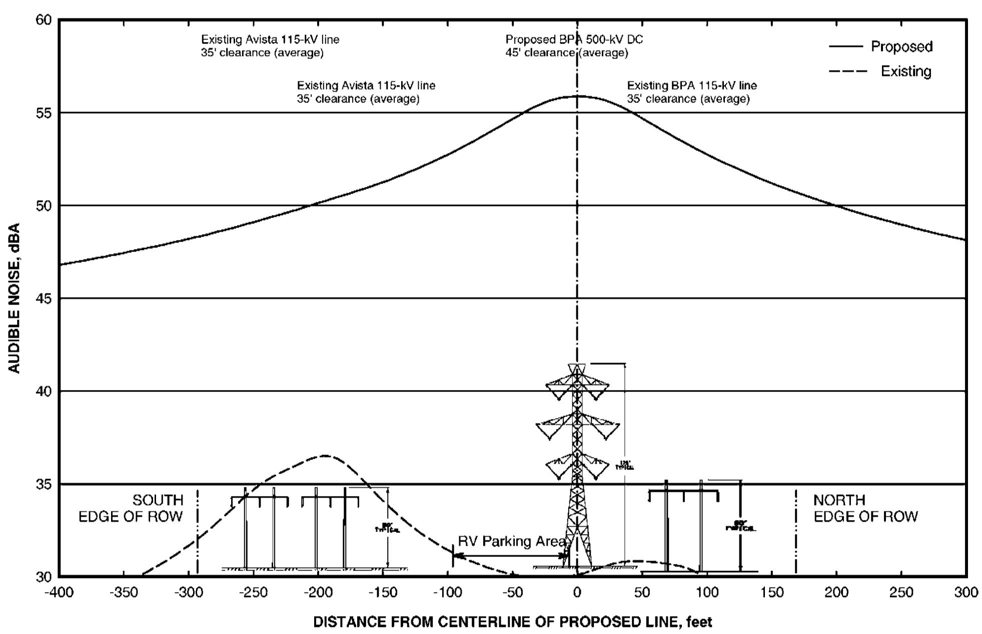


Figure 4, continued

i) Configuration 9: Proposed line on double-circuit tower and parallel to existing 230-kV and 115-kV lines



j) Configuration 10: Proposed line on double-circuit tower and parallel to existing 115-kV lines



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GRAND COULEE– BELL 500-kV TRANSMISSION LINE PROJECT

APPENDIX B-2:

ASSESSMENT OF RESEARCH REGARDING EMF AND HEALTH AND ENVIRONMENTAL EFFECTS

June, 2002

Prepared by

Exponent™

for

T. Dan Bracken, Inc.

and

Bonneville Power Administration

Table of Contents

APPENDIX B-2: ASSESSMENT OF RESEARCH REGARDING EMF AND HEALTH AND ENVIRONMENTAL EFFECTS

1.0 Introduction

Over the last 20 years, research has been conducted in the United States 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 are 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, and the earth itself produces a static (0 Hz) magnetic field—it is this field that is used for compass navigation.

By contrast, electricity provided to homes and offices produces EMF that change direction and intensity 60 times, or cycles, per second—a frequency of 60 Hz. Fields at this frequency differ significantly from fields at the higher frequencies characteristic of radio and television signals, microwaves from ovens, cellular phones, and radar (which can have frequencies up to billions of Hz). Man-made EMF are 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 a person moves away from the source. This effect is similar to the diminishment of heat from a candle or campfire as a person walks away. However, electric fields and magnetic fields have different characteristics. For instance, ordinary objects do not block magnetic fields, but special materials and techniques can provide shielding. In contrast, such objects, especially those that can conduct electricity, can reduce the electric fields. For example, a typical house may block up to 90% of the electric field from outside sources. Because of this characteristic, exposure to electric fields is more difficult to calculate than exposure to magnetic fields. Magnetic fields have been more widely studied in the last 20 years than electric fields, in part because structures and vegetation reduce indoor electric-field exposures.

Among the large number of studies conducted are a number of epidemiology studies that suggested a link with childhood leukemia for some types of exposures, as well as a number of other epidemiology studies that did not. The research also included lifetime animal studies, which showed no evidence of adverse health effects. Comprehensive reviews of the research conducted by governmental and scientific agencies in the U.S. and in the United Kingdom (UK) have examined the research, and have found no basis for imposing restrictions on exposures (NIEHS, 1999; IEE, 2000; IARC, 2002).

The Bonneville Power Administration (BPA) asked Exponent to update BPA on research on EMF and health and environmental effects in relation to exposures that might occur near the proposed Grand Coulee – Bell 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 could 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 those studies of effects from residential or environmental exposures to EMF that became available through May 2002.

2.0 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 had been managing 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 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).

The director of the NIEHS prepared a health-risk assessment of EMF and submitted his report to Congress in June 1999 (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).

Although the results of the RAPID research are described in some detail in the 1998 report, many 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* (Radiation Research, 153[5], 2000).[1]

2.2 Research Related to Cancer

This update includes studies of residential or occupational exposures to EMF and leukemia that became available through May 2002, including several epidemiology studies of childhood cancer and meta-analyses. The California Department of Health Services (CDHS) conducted a workshop in 1999 to discuss epidemiologic research on EMF and health. The reports presented at this workshop were published in January 2001 as a supplement to the journal, *Bioelectromagnetics*. Many of the papers were technical discussions of methodology issues in epidemiologic studies of EMF, including discussions of how to better understand the conflicting results reported in previous studies (Neutra and Del Pizzo, 2001). For example, one study evaluates the extent to which systematic errors (known in epidemiology as *selection bias* or *information bias*) occurred in EMF studies, and, if those errors occurred, whether the effect on results could be evaluated (Wartenberg, 2001a). Other researchers discuss epidemiologic approaches to study how possible confounding factors, such as the age and type of home and traffic

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[1] See, for instance, the articles cited in the **List of References** under first author Balcer-Kubiczek, Boorman, Loberg, or Ryan.

density, might affect the interpretation of studies of EMF and childhood cancer (Langholz, 2001; Reynolds et al., 2001).

For this update, we reviewed epidemiology and laboratory studies of cancer and reproduction. Several of the studies are "meta-analyses," an approach that incorporates statistical methods to analyze differences among studies and aggregate the results of smaller studies. The sections below include a review of meta-analyses of the studies of childhood leukemia, and a meta-analysis of studies of breast cancer in adults (Erren, 2001).

2.2.1 Epidemiology Studies of Children

The question of the relationship between power lines and childhood cancer has been based on the assumption 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. The magnetic field in the vicinity of a power line results from the flow of current; higher currents result in higher levels of magnetic fields.

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). Despite the larger sample size, these studies usually had a limited number of cases exposed over 2 or 3 milligauss (mG).

Epidemiology Studies

The following discussion briefly describes major studies.

- A study from Germany included 514 children with leukemia and 1,301 control children (Schuz et al., 2001). Measurements of magnetic-field intensity (50 Hz) were taken for 24 hours in each child's bedroom. The results were calculated separately for daytime or nighttime levels in the bedroom, rather than for a child's overall 24-hour exposure. The authors report an association with leukemia for mean daytime magnetic-field exposures that might have been due to chance. They reported an association between mean nighttime magnetic-field levels and leukemia for the highest exposed group (4 mG or higher; 9 cases). The assessment of exposure by mean field levels in the bedroom did not link magnetic-field levels to any specific source. The authors note in their conclusions that " . . . fewer than one-third of all stronger magnetic fields were caused by high-voltage powerlines . . . . " (Schuz et al., 2001:734).

  Several aspects of the study detract from the validity of the results: the estimate included a broad margin of error because only a small number of cases were exposed at the higher levels, and many eligible cases and controls did not participate. If the cases and controls were not sampled from similar populations, differences in their exposures could be biased. Another concern is that these magnetic-field measurements were taken in 1997, long after the relevant exposure period for cases diagnosed in 1990-1994. Magnetic-field levels might have changed over time, as electricity usage changed.

- A study from British Columbia, Canada, included 462 children who had been diagnosed with leukemia and an equal number of children without leukemia, for comparison (McBride et al., 1999). Magnetic-field exposure was assessed for each of the children in several ways: personal monitors were worn in a backpack for 48 hours, a monitor took measurements in the bedroom for

24 hours, the wiring outside the house was rated by potential exposure level (wire codes), and measurements were taken around the outside perimeter of the homes. (Wire codes are a method of estimating relative exposure intensity based on the configuration of the power lines.) Regardless of the method used to estimate magnetic-field exposure, the magnetic-field exposure of children who had leukemia was not greater than that of the children in the comparison group.

- A study conducted in Ontario, Canada reported on the magnetic-field exposure of a smaller group of children than that in other recent studies (Green et al., 1999a). No increased risk estimates were found with the average magnetic fields in the bedroom or the interior, or with any of the three methods of estimating exposure from wire-configuration codes. A still smaller group of 88 children with leukemia and children who served as controls wore personal monitors to measure magnetic fields (Green et al., 1999b). Associations with magnetic fields were reported in some of the analyses, but most of the risk estimates had a broad margin of error, and major methodological problems in the study preclude any clear interpretation of the findings.
- The United Kingdom Childhood Cancer Study, the largest study to date, included a total of 1073 childhood leukemia cases (UKCCS, 1999). Exposure was assessed by spot measurements in the home (bedroom and family room) and school, and summarized by averaging these over time. No evidence was found to support the idea of an increased risk of leukemia from exposures to magnetic fields inside or outside of the home.
- The UKCCS investigators had obtained magnetic-field measurements on only a portion of the childhood cancer cases in their study (UKCCS, 1999). To obtain additional information, they used a method to assess exposure to magnetic fields without entering homes; they were thus able to analyze 1331 child leukemia cases (UKCCS, 2000). For these children, they measured distances to power lines and substations. This information 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 and 2 mG, 2 mG and 4 mG, or 4 mG or greater at the residence, in contrast to the weak association reported for measured fields of 4 mG or greater in the first report (UKCCS, 1999).

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. However, more recent studies do not support this possibility. Reynolds et al. (2001) found no evidence of an association with traffic density in a study of 90 cases of childhood leukemia. In a larger study that included 986 cases of childhood leukemia, no association was found with high traffic-density exposure during pregnancy or childhood (Raaschou-Nielsen et al., 2001).

Meta-analyses of Studies of Leukemia

Recently, researchers re-analyzed the data from previous epidemiology studies of magnetic fields and childhood leukemia (Ahlbom et al., 2000; Greenland et al., 2000). The researchers pooled the data on individuals from each of the studies, in effect creating a study with a larger number of subjects and therefore with greater statistical power than any single study. A pooled analysis is preferable to other types of meta-analyses in which the results from several studies are combined from grouped data obtained from the published studies. These 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. Both Ahlbom et al. and Greenland et al. used exposure categories of <1 mG (<0.1 microtesla [µT]) as a reference category. The statistical results of these analyses can be summarized as follows:

- The pooled analyses provided no indication that wire codes are more strongly associated with leukemia than measured fields.
- Pooling these data corroborates an absence of an association between childhood leukemia and magnetic fields for exposures below 3 mG (0.3 µT).
- Pooling these data results in a statistical association with leukemia for exposures greater than 3-4 mG (0.3 or 0.4 µT).

The authors are appropriately cautious in the interpretation of their analyses, and they identify the limitations in their evaluation of the original studies. Limitations include sparse data (few cases) to adequately characterize a relationship between magnetic fields and leukemia, uncertainties related to pooling different magnetic-field measures without evidence that all of the measures are comparable, and the incomplete and limited data on important confounders such as housing type and traffic density. Magnetic fields above 3 mG (0.3 µT) in residences are estimated to be rather rare, about 3% in the U.S. (Zaffanella, 1993).

A meta-analysis of the data from epidemiologic studies of childhood leukemia studies was presented at the California Workshop and recently published (Wartenberg, 2001b). 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). Instead of using individual data, Wartenberg (2001b) used an approach that extracted the published results, reported as grouped data from several published studies. He used 19 studies overall, after excluding 7 studies that had insufficient data on individuals or deficiencies in the exposure assessment data. 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 characteristics or on spot magnetic-field measurements. The results show more cases than controls exposed to measured or calculated fields above 2 mG. The author concludes that the analysis supports an association, although the size of the effect is small to moderate, but also notes "limitations due to design, confounding, and other biases may suggest alternative interpretations" (Wartenberg, 2001b:S-100).

The results of this meta-analysis are not directly comparable to previous ones regarding fields of 3 or 4 mG because the analysis was not based on individual data. The comparison of grouped data used different exposure cut points for the analysis and different criteria for the comparison group. None of these three analyses (Ahlbom et al., 2000; Greenland et al., 2000; Wartenberg, 2001b) included the results of the latest UK analysis (UKCCS, 2000) of 1331 child leukemia cases based on calculated fields, which found no association between EMF and childhood leukemia or other cancers, regardless of the exposure level.

2.2.2 Epidemiology Studies of Adults

Studies of adults with certain types of cancer, such as brain cancer, breast cancer, or leukemia, have reported associations with exposure to magnetic fields at residences, but results have not been consistent across studies. Contradictory results among studies argue against a conclusion that the association reflects a cause-and-effect relationship. In their assessments of risk, scientists give most weight to studies that include more people, obtain more detailed and individual exposure assessments, and/or include people who have higher exposures.

Brain Cancer

A study of 492 adult cases of brain cancer in California included measurements of magnetic fields taken in the home and at the front door, and considered the types of power-line wiring (Wrensch et al., 1999).

The authors report no evidence of increased risk with higher exposures, no association with type of power line, and no link with levels measured at the front door.

Breast Cancer

A number of recent studies of breast cancer focused on electric blankets as a source of high exposure. Electric blankets are assumed to be one of the strongest sources of EMF exposure in the home. Three studies of electric-blanket use found no evidence that long-term use increased the risk of breast cancer. Women who developed breast cancer reported no difference in total use of electric blankets, use in recent years, or use many years in the past:

- Gammon et al. (1998) reported that, even for those who kept the blanket on most of the time, no increase in risk was found for those who had longer duration of use (measured in months).
- A study of 608 breast cancer cases found no evidence of increased use of electric blankets or other home appliances in cases compared to controls, and no indication of increasing risk with a longer time of use (Zheng et al., 2000).
- In a cohort of over 120,000 female nurses, data were obtained on known risk factors for breast cancer as well as electric-blanket use (Laden et al., 2000). For a large subset of this group, the questions about exposure were asked before the disease occurred, a step taken to eliminate bias in recalling exposure. No associations with electric-blanket use were found.

Erren (2001) reported the results of a meta-analysis of the studies of breast cancer, in which the results of 24 different studies in women were statistically aggregated. When the results of all 24 studies, including studies of workplace exposures, were pooled, the estimate indicated an association between EMF and a small excess breast cancer risk. The pooled results for exposure to EMF in the vicinity of *electrical facilities such as power lines* did not show an association with breast cancer, nor did the results for exposure to EMF from appliance use. However, the meta-analysis also showed a lack of consistency among the results of the individual studies, a broad variation in the designs, and a wide range of methods used to assess exposure. No adjustments were made to the data to give increased weight to studies based on more comprehensive exposure assessments. The author also noted that the weak statistical association might be an artifact (a result of chance or unforeseen error) rather than an indication of a cause-and-effect relationship (Erren, 2001).

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 or heat). 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 leukemia and lymphoma, or mammary cancer (e.g., Boorman et al., 1999; McCormick et al., 1999; Boorman et al., 2000 a, b; Anderson et al., 2001).

2.2.4 Summary Regarding Cancer

Epidemiology studies do not support the idea that EMF from power lines increase the risk of cancers in adults. The latest epidemiologic studies of childhood cancer, considered in the context of the other 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 on pregnancy, including miscarriages[2] in relation to exposures to magnetic fields. Previous epidemiologic studies reported no association with birth weight 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).

- Belanger et al. provided results of a prospective study in 1998. They assessed the magnetic field exposure of 2967 women during their pregnancy in two different ways. Exposure to magnetic fields from electric bed-heating (electric blankets and water beds), sources of relatively strong magnetic fields, was estimated from the women's responses in an interview. In general, electric bed-heating results in higher magnetic field exposures than those from residential fields. Wire codes were assessed for each woman to estimate the contribution, to residential fields, of transmission and distribution lines within 150 feet of house. No evidence of an association between miscarriage and exposure to magnetic fields from living in a residence with "high wire code," or from using electric blankets or a waterbed around the time of conception or during pregnancy (at time of interview) was found. There was no indication of an increased risk with daily exposure, or longer hours, or using the electric bed at the high setting.
- Another study also focused on exposures from electric bed heating (electric blankets, heated waterbeds and mattress pads (Lee et al., 2000). The researchers assessed the women's exposure prior to the birth and included information to control for potential confounding factors. This study had a large number of cases and high participation rates. Miscarriage rates were lower among users of electric bed heating.

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[2] The medical term for miscarriage is spontaneous abortion.

- The data collected in the large, prospective, epidemiology study by Belanger et al. had been analyzed previously for other endpoints. The results of this analysis showed no evidence of reduced birth weight in the infants, or slower fetal growth 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).

Two recent 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 associations were found with higher average magnetic field levels during the day, the typical way of assessing exposure. In these studies women wore magnetic-field monitors for a 24-hour period to assess exposure. Magnetic field levels similar to the peak levels are routinely found near electric devices such as hairdryers, photocopy machines, electric tools, shavers; in or near electric trains; and under some types of power lines. 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, or peak, exposure during the day are due to cause-and-effect. First, despite years of research, there is no biological basis to indicate that EMF increases the risk of miscarriage. Second, 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 participate may differ from those who decline (selection bias). Third, these studies found no association with higher daily average exposure, that is, the average of the measurements recorded throughout the day.

Studies of laboratory animals exposed to pure 60-Hz fields have shown no increase in birth defects, no multigenerational effects, and no changes that would indicate an increase in miscarriage or loss of fertility (e.g., Ryan et al., 1999; Ryan et al., 2000). Exposed and unexposed litters were no different in the amount of fetal loss and the number and type of birth defects, indicating no reproductive effect of EMF.

In summary, the recent evidence from epidemiology and laboratory studies do not support the hypothesis 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 with 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 (e.g., 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 in 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 that for pacemakers. The American Conference of Governmental Industrial Hygienists (ACGIH, 1999) 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 Recent Reviews by Scientific Advisory Groups

Reviews of the scientific research regarding EMF and health by the Health Council of the Netherlands (HCN) were published in 2000 and updated in May 2001. The NRPB Advisory Group on Non-Ionising Radiation (AGNIR) published the most recent review in 2001. That review includes research published in 2000, and includes the most comprehensive discussion of the individual research studies. The most recent peer review was conducted by the International Agency for Research on Cancer (IARC) and published in 2002.

2.5.1 National Radiological Protection Board of Great Britain (NRPB) Advisory Group on Non-Ionising Radiation

The conclusions from the report prepared by the NRPB's Advisory Group on Non-Ionising Radiation (AGNIR) on ELF-EMF and the risk of cancer are consistent with those of previous reviews. Members from universities, medical schools, and cancer research institutes reviewed the reports of experimental and epidemiological studies, including reports in the literature in 2000. Their general conclusions are as follows:

> Laboratory experiments have provided no good evidence that extremely low frequency electromagnetic fields are capable of producing cancer, nor do human epidemiological studies suggest 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 leukaemia in children. In practice, such levels of exposure are seldom encountered by the general public in the UK [or in the U.S.] (NRPB, 2001: 164).

The group further recognizes that the scientific evidence suggesting that exposure to power-frequency electromagnetic fields poses an increased risk of cancer is very weak. Virtually all of the cellular, animal and human laboratory evidence provides no support for an increased risk of cancer incidence following such exposure to power frequencies, although sporadic positive findings have been reported. In addition, the epidemiological evidence is, at best, weak.

These conclusions of the Advisory Group are consistent with previous reviews by the NIEHS (1999) and the Health Council of the Netherlands (HCN, 2000). The NRPB response to the Advisory Group report states that "the review of experimental studies by [the Advisory Group] AGNIR gives no clear support for a causal relationship between exposure to ELF-EMFs and cancer" (NRPB, 2001: 1).

2.5.2 Health Council of the Netherlands (HCN)

The Health Council of the Netherlands has prepared updates of its 1992 Advisory Report on exposure to electromagnetic fields (0 Hz to 10 MHz) (HCN, 2000; 2001). Members of the Expert Committee who prepared the report include specialists in physics, biology, and epidemiology. The Expert Committee based its analysis on the review and summaries of the studies provided in the NIEHS (1998) and concurred with the views of the director of the NIEHS (1999). For the update, the Committee evaluated a number of publications that appeared after these reports, e.g., McBride et al., (1999) and Green et al. (1999a), and wrote:

> The committee thinks that the quality of the relevant epidemiological research has improved considerably since the publication of the advisory report in 1992. Even so, this research has not resulted in unequivocal, scientifically reliable conclusions (HCN, 2000: 15).

The Council emphasizes that the associations with EMF reported in epidemiologic studies are strictly statistical and do not demonstrate a cause-and-effect relationship. In their view, experimental research does not demonstrate a causal link or a mechanism to explain EMF as a cause of disease in humans. They concluded that there is no reason to recommend measures to limit residence near overhead power lines (HCN, 2000).

The 2001 update (HCN, 2001) includes three major studies (described above) published in 2000 and 2001 (Ahlbom et al., 2000; Greenland et al., 2000; Wartenberg 2001b). The Council concludes:

> Because the association is only weak and without a reasonable biological explanation, it is not unlikely that [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, 2001: 40).

2.5.3 International Agency for Research on Cancer (IARC)

The International Agency for Research on Cancer sponsored a review of EMF research by a Working Group of scientific experts from 10 countries. This multidisciplinary group reviewed health effects of ELF-EMF. The 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. Overall, ELF-EMF were evaluated as "possibly carcinogenic to humans" (Group 2B), based on the statistical association of higher-level residential ELF magnetic fields and increased risk for childhood leukemia. IARC reviewers also evaluated the animal data and concluded that it was "inadequate" to support a risk for cancer. Their summary states that the EMF data does not merit the category "carcinogenic to humans" or the category "probably carcinogenic to humans," nor did they find that "the agent is probably not carcinogenic to humans." Many hypotheses have been suggested to explain possible carcinogenic effects of ELF electric or magnetic fields; however, no scientific explanation for carcinogenicity of ELF-EMF fields has been established (IARC, 2002; 338).

2.5.4 California Department of Health Services (CDHS)

As part of a project mandated by the California Public Utilities Commission, the California Department of Health Services (CDHS) was asked to review and evaluate the scientific research regarding EMF and health. A small panel of only three scientists from the department's EMF Program conducted the review. The CDHS released their fourth and final draft in April 2002 (CDHS, 2002).

The CDHS used two different approaches to conduct their evaluation. One of these approaches was characterized as following the IARC approach, described above, in which reviewers summarize the "quality of evidence." The other approach was a set of guidelines developed by the California EMF Program, which calls for each reviewer to express a degree of confidence that the disease may be caused by high EMF exposures. However, the term "high" is not defined. For example, a reviewer who was certain, or thought it highly probable, that observed statistical associations indicated causality would present their judgment as "90-98% confident."

The CDHS evaluated data regarding 13 health conditions. Using their own method, EMF was not judged to be a highly probable cause of any of these health conditions, that is, none received a rating of 90%-98% confident. For five of the health effects (childhood leukemia, adult leukemia, adult brain cancer, miscarriage, and ALS [amyotropic lateral sclerosis]), the reviewers thought that it is "more than 50% possible" that residential or occupation EMF could cause the disease. However, for each of these evaluations, the CDHS included the caveat "…there is a chance that EMF have no effect at all" (CDHS, 2002:1).

Using the IARC classification, the CDHS reviewers rated EMF as a "possible carcinogen" for adult leukemia, childhood leukemia, and adult brain cancer. EMF was also rated a possible causal factor in miscarriage and ALS. None of the three agencies discussed above— the IARC, HCN, and the NRPB— concluded that EMF was a possible cause of adult brain cancer, miscarriage, or ALS. The CDHS comments that animal studies do not suggest that a problem may exist; however, this had little effect on their overall evaluation. The assessment of miscarriage was based on the studies by Li et al. (2002) and Lee et al. (2002) (discussed above in Section 2.3). Studies in animals and previous studies in humans show little evidence that EMF could increase the rate of miscarriage.

The Scientific Advisory Panel that reviewed the final CDHS report expressed a

> . . . consensus among the SAP members that different evaluators with the same or different professional backgrounds may use the DHS guidelines and arrive at different numerical confidence estimates, perhaps substantially different. . . . A minority of SAP members, while endorsing the integrity of the DHS evaluation process, was not sufficiently persuaded by the extensive discussions in the document on issues of biophysics, mechanistic research, and animal physiology to arrive at the same conclusions as the three DHS evaluators. These members believe. . . they might come to somewhat different conclusions and arrive at lower estimates of risks from EMFs" (Winkelstein and McKone, 2002: 2).

3.0 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 May 2002 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 United States 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 power 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).

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).

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 were identified in the literature.

Bees, like birds, are able to detect the earth's direct-current (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 alternating-current (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 and Brannon, 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; however, a study with honeybees suggests 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 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 beyond the right-of-way of the proposed 500-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 500-kV transmission line, no adverse effects on wildlife or plants are expected.

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GRAND COULEE– BELL 500-kV TRANSMISSION LINE PROJECT

APPENDIX C:

BIOLOGICAL DATA

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Table C-1. Wetlands Identified within the Project Area.

Wetland Number	Near or Between Existing Line Mile	Wetland Description	Potential Construction Impacts From Access Roads	Potential Construction Impacts From Towers
Wetland 1*	1	Palustrine, emergent	No Impact: existing access road through this wetland will be closed	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 2*	3.3	Palustrine, emergent, seasonally flooded	No Impact: existing access road is 25 ft. from wetland and no road improvements are proposed	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 3*[b]	4.7-4.8	Palustrine, emergent, seasonally flooded	No Impact: wetland is 75 ft. from south side of access road and 100 ft. from north side of access road; no road improvements are proposed	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 4[c]	5.2-5.3	Palustrine emergent, seasonally flooded	Low to Moderate: wetland is 5 ft. from north side of road; sediments could enter wetland from road widening along the south side of the road	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 5*	5.4-5.5	Palustrine emergent, seasonally flooded	No Impact: wetland is 75 ft. from north side of access road; no road improvements proposed	No Impact: wetland is more than 100 ft. from proposed tower footprint.
Wetland 6*	5.4-5.5	Palustrine emergent, seasonally flooded	No Impact: wetland is 75 ft. from south side of access road; no road improvements proposed.	No Impact: wetland is more than 100 ft. from proposed tower footprint.
Wetland 7	5.7-5.8	Palustrine emergent, seasonally flooded	No Impact: wetland is 50 ft. from north side of road; no road improvements are proposed	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 8	5.7-5.8	Palustrine, emergent, open water, semipermanently flooded	Low: wetland is 10 ft from south side of road and sediments from road use could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint

Table C-1 (cont'd)

Wetland Number	Near or Between Existing Line Mile	Wetland Description	Potential Construction Impacts From Access Roads	Potential Construction Impacts From Towers
Wetland 9	6.2-6.3	Palustrine, emergent with scrub/shrub edge, seasonally flooded	Low to Moderate: wetland extends to road edge; sediments from road use could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 10*	32.5-32.6	Palustrine, emergent with forested portions near access road	Low to Moderate: wetland is adjacent to existing road; sediments from road improvements and road use could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 11 [c]	32.6-32.7	Palustrine, emergent, semipermanently flooded	Low to Moderate: wetland is adjacent to existing road in several areas; sediments from road improvements and road use could enter wetland	No Impact: location of proposed structure was moved to avoid wetland; proposed location is at least 50 ft. from wetland Low: existing wood pole is in wetland; to remove pole, cut rather than excavate
Wetland 12 [c]	33.5-33.6	Palustrine, emergent, seasonally flooded	Low: wetland is adjacent to existing road; sediments from road use could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 13*	33.7–33.8	Palustrine, emergent	Low: no road improvements proposed; wetland adjacent to existing road; sediments from road use could enter wetland	No to Low Impact: wetland is 70 ft. from proposed structure
Wetland 14[c]	33.8-33.9	Palustrine, emergent, seasonally flooded	Low to Moderate: wetland adjacent to existing road; sediments from road improvements and road use could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 15[c]	34.1-34.2	Palustrine, emergent, seasonally flooded	Low to Moderate: no road improvements proposed; wetland is adjacent to existing road; sediments from road improvements and road use could enter wetland	No Impact: wetland is more than 100 ft from proposed tower footprint. Low: existing pole is within 50 ft. of wetland so cut rather than excavate pole

Table C-1 (cont'd)

Wetland Number	Near or Between Existing Line Mile	Wetland Description	Potential Construction Impacts From Access Roads	Potential Construction Impacts From Towers
Wetland 16*	35.1	Palustrine, emergent	No Impact: wetland greater than 100 ft. from road	No Impact: wetland is more than 100 ft. from proposed tower
Wetland 17*	35.3	Palustrine, emergent	No Impact: wetland within 10 ft. north of existing road; new road will be constructed away from wetland to avoid impacts	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 18*[bc]	37.3-37.4	Palustrine, emergent, temporarily flooded	Moderate: culvert replacement will introduce a small amount of fill into wetland	No Impact : wetland is more than 100 ft. from proposed tower footprint
Wetland 19*[bc]	38.2-38.3	Palustrine, emergent, seasonally flooded	Low: wetland adjacent to existing road; sediments from road use could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 20[c]	38.3-38.4	Palustrine, emergent, temporarily flooded	No Impact : wetland is more than 100 ft. from road	No Impact : wetland is more than 100 ft. from proposed tower footprint
Wetland 21*	38.6-38.7	Palustrine, emergent and scrub shrub, permanently flooded	Low to Moderate: wetland adjacent to existing road; sediments from road improvements and road use could enter wetland	No Impact: wetland is more than 100 ft from proposed tower footprint Low: existing pole is within 50 ft. of wetland so cut rather than excavate pole
Wetland 22	39.6-39.7	Palustrine, emergent, seasonally flooded	Low to Moderate: wetland adjacent to existing road; sediments from road improvements and road use could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 23*	39.6-39.7	Palustrine, emergent, seasonally flooded	None: wetland is more than 100 ft. from road	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 24	39.7–39.8	Palustrine, emergent, seasonally flooded	No Impact: existing road though this area will be closed	No to Low Impact: proposed structure is on a cliff above this wetland; BMPs should prevent any materials from falling into wetland

Table C-1 (cont'd)

Wetland Number	Near or Between Existing Line Mile	Wetland Description	Potential Construction Impacts From Access Roads	Potential Construction Impacts From Towers
Wetland 25[c]	39.7–39.8	Palustrine, emergent, semipermanently flooded	No Impact: existing road though this area will be closed	No Impact: proposed structure is on a cliff above this wetland; BMPs should prevent any materials from falling into wetland
Wetland 26[c]	40.2-40.3	Palustrine, emergent, seasonally flooded, open water	No Impact: wetland is 75 ft. from south side of access road. No road improvements proposed	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 27*	40.2-40.3	Palustrine scrub/shrub	Low: wetland adjacent to existing road; sediments from road use could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 28*	40.3-40.4	Palustrine, scrub/shrub, forested, seasonally flooded in bottom of 50 ft. deep hole	No Impact: wetland is more than 100 ft. from existing access road	No Impact: edge of hole is about 70 ft. from proposed tower footprint
Wetland 29	40.3-40.4	Palustrine, scrub/shrub, forested, seasonally flooded in bottom of 50 ft. deep hole	No Impact: wetland is more than 100 ft from existing access road	No Impact: top of hole is more than 100 ft. from proposed tower footprint
Wetland 30[c]	40.4-40.6	Palustrine, emergent, temporarily flooded	Low: one portion of wetland crossed by road; no road improvements proposed but sediments could enter road from road use	Low: proposed structure will be relocated about 30 ft. from wetland so sediments may enter wetland
Wetland 31	40.6-40.7	Palustrine, emergent fringed with scrub/shrub and forest, temporarily flooded	No Impact: wetland is 75 ft .from south of road and n road improvements proposed	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 32	40.8-40.9	Palustrine, emergent with scrub/shrub fringe, semipermanently flooded	No to Low Impact: wetland adjacent to existing road; sediments from road improvements and use could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint

Table C-1 (cont'd)

Wetland Number	Near or Between Existing Line Mile	Wetland Description	Potential Construction Impacts From Access Roads	Potential Construction Impacts From Towers
Wetland 33	55.4-55.5	Palustrine, emergent, seasonally flooded	No Impact: wetland is at least 100 ft. from road	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 34	68.7-68.8	Palustrine, emergent, seasonally flooded	Low to Moderate: road goes through wetland, which is 10 ft from road; sediments from road improvements within existing road footprint could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 35	69.2	Palustrine, emergent, seasonally flooded	Low to Moderate: wetland 50 ft. from road; sediments from road improvements within existing road footprint could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 36	69.3-69.4	Palustrine, emergent, seasonally flooded	Low to Moderate: road crosses wetland; sediments from road improvements within existing road footprint could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 37*	69.3-69.4	Palustrine, emergent, seasonally flooded	Low to Moderate: road crosses wetland; sediments from road improvements within existing road footprint could enter wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 38	70.8-70.9	Palustrine, forested, open water	No Impact: wetland 75 ft. from road and road improvements proposed will avoid wetland.	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 39	71.4-71.5	Palustrine, emergent, seasonally flooded	Low to Moderate Impact: wetland is 10 ft. from road; road improvements may introduce sediments into wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint

Table C-1 (cont'd)

Wetland Number	Near or Between Existing Line Mile	Wetland Description	Potential Construction Impacts From Access Roads	Potential Construction Impacts From Towers
Wetland 40[c]	71.4-71.5	Palustrine, emergent, semipermanently flooded	No to Low Impact: wetland is 25 ft. from road; road improvements may introduce sediments into wetland	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 41[b]	75.8-76.2	Riverine, intermittent streambed, temporarily flooded (Deep Creek)	No Impact: existing road system will not be improved at creek crossings	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 42[b]	77.2-77.4	Lacustrine, open water, permanently flooded (Spokane River)	No Impact: portion of access road within wetland, leading to existing wood pole structure will no longer be used once the pole is removed	No Impact: wetland is more than 100 ft. from proposed tower footprint
Wetland 43	82.5-82.6	Palustrine, aquatic bed, permanently flooded (sewage treatment pond)	No Impact: road is more than 50 ft. from pond edge	No Impact: wetland is more than 100 ft. from proposed tower footprint

users\steve\Projects\BPA\Coulee EIS\Revision based on 7-02-02 comments\Wetland Table C-1 (7-8-02).doc

[a] Wetland descriptions based on NWI classification scheme, modified as needed based on filed verification.
[b] Wetland located or extended outside of the corridor
[c] Wetland larger than NWI mapped
* Wetland not identified on NWI

Table C-2. Vegetation Species Identified within the Corridor

Common Name	*Scientific Name*	Non-native Species
Grass		
Agoseris	*Agoseris* sp.	
Bluebunch wheatgrass	*Agropyron spicatum* or *Pseudoroegneria spicata*	
Bluegrass	*Poa* sp.	
Bottlebrush squirreltail	*Sitanium hystrix*	
Bulbous bluegrass	*Poa bulbosa*	√
Cheatgrass	*Bromus tectorum*	√
Crested wheatgrass	*Agropyron cristatum*	
Giant wildrye	*Elymus cinereus*	
Idaho fescue	*Festuca idahoensis*	
Meadow barley	*Hordeum brachyantherum*	
Medusahead	*Taeniatherum caput-medusae*	√
Needle-and-thread grass	*Stipa comata*	
Reed canarygrass	*Phalaris arundinacea*	√
Ripgut brome	*Bromus ridigus*	√
Sandberg's bluegrass	*Poa sandbergii* or *Poa secunda*	
Wheat	*Triticum aestivum*	
Forbs		
Alumroot	*Heuchera cylindrica*	
Balsamroot	Various species of *Balsamorhiza*	
Baltic rush	*Juncus balticus*	
Basalt daisy	*Erigeron basalticus*	
Biscuitroot	Various species of *Lomatium*	
Bitterroot	*Lewisia rediviva*	
Buckwheat	Various species of *Eriogonum*	
Camas	*Camassia quamash*	
Canada thistle	*Circium arvense*	√
Cat-tail	*Typha latifolia*	
Cinquefoil	Various species of *Potentilla*	
Clarkia	*Clarkia pulchella*	
Clover-fern	*Marsilea vestita*	
Common larkspur	*Delphinium nuttallianum*	
Common silverweed	*Potentilla anserina*	
Common tansy	*Tanacetum vulgare*	√
Cushion daisy	*Erigeron poliospermus*	
Cushion phlox	*Phlox hoodii*	

Table C-2 (cont'd)

Common Name	*Scientific Name*	Non-native Species
Daisy	Various species of *Erigeron*	
Dalmatian toadflax	*Linaria dalmatica* ssp. *dalmatica*	√
Dandelion	*Taraxacum officinale*	√
Death camas	*Zygadenus venosus*	
Delphinium	*Delphinium* sp.	
Desert buckwheat	Various species of *Eriogonum*	
Desert paintbrush	*Castilleja chromosa*	
Diffuse knapweed	*Centaurea diffusa*	√
Dogbane	*Apocynum* sp.	
Fameflower	*Talinum spinescens*	
Fern-leaved lomatium	*Lomatium dissectum*	
Fiddleneck	*Amsinckia* sp.	
Flax	*Linum perenne*	
Geranium	*Geranium* sp.	
Globe mallow	*Sphaeralcea* sp.	
Goatsbeard	*Tragopogon* sp.	√
Groundsel	*Senecio foetidus*	
Leafy spurge	*Euphorbia esula*	
Linear-leaf daisy	*Erigeron linearis*	
Line-leaf Indian lettuce	*Montia linearia*	
Long-leaf Phlox	*Phlox longifolia*	
Longstalk starwort	*Stellaria longipes*	
Lupine	*Lupinus* sp.	
Milk-vetch	*Astragalus* sp.	
Mint	*Mentha arvensis*	
Mouse-tail	*Myosurus* sp.	
Mullein	*Verbascum thapsus*	
Navarretia	*Navaretia* sp.	
Oregon sunshine	*Eriophyllum lanatum*	
Owl-clover	*Orthocarpus* sp.	
Penstemon	*Penstemon* sp.	
Pepperweed	*Lepidium* sp.	
Perennial sowthistle	*Sonchus arvensis*	√
Phacelia	*Phacelia* sp.	
Phlox	*Phlox* sp.	
Piper's daisy	*Erigeron piperianus*	
Pondweed	*Potamogeton* sp.	
Popcorn flower	*Plagiobothrys sp.*	
Prairie smoke	*Geum triflorum*	

Table C-2 (cont'd)

Common Name	*Scientific Name*	Non-native Species
Prairie star flower	*Lithophragma sp.*	
Puccoon	*Lithospermum ruderale*	
Pussy-toes	*Antennaria sp.*	
Rushes	Various species of *Juncus*	
Scarlet gilia	*Gilia aggregata*	
Sedge	Various species of *Carex*	
Shore buttercup	*Ranunculus cymbalaria*	
Showy milkweed	*Asclepias speciosus*	
Slender cinquefoil	*Potentilla gracilis*	
Spikerush	Various species of *Eleocharis*	
St. John's wort	*Hypericum perforatum*	√
Sticky geranium	*Geranium viscossisimum*	
Stonecrop	*Sedum* sp.	
Teasel	*Dipsacus sylvestris*	√
Thyme desert buckwheat	*Eriogonum thymoides*	
Tule	*Scirpus* sp.	
Tumble mustard	*Sisymbrium altissimum*	√
Utah thistle	*Circium utahense*	
Western blue flag iris	*Iris missouriensis*	
Wild lettuce	*Lactuca* sp.	√
Wild onion	*Allium* sp.	
Yarrow	*Achillea millefolium*	
Yellow bell	*Fritillaria pudica*	
Shrubs		
Big sagebrush	*Artemesia tridentata*	
Bitterbrush	*Purshia tridentata*	
Blanket-flower	*Gaillardia aristata*	
Blue elderberry	*Sambucus cerulea*	
Chokecherry	*Prunus virginiana*	
Golden currant	*Ribes aureum*	
Douglas' maple	*Acer douglasii*	
Hawthorn	*Crataegus monogyna*	
Mock orange	*Philadelphus lewisii*	
Nootka rose	*Rosa nutkana*	
Oceanspray	*Holodiscus discolor*	
Poison oak or ivy	*Rhus radicans*	
Red osier dogwood	*Cornus stolonifera*	
Rose	Various species of *Rosa*	
Serviceberry	*Amelanchier alnifolia*	

Table C-2 (cont'd)

Common Name	*Scientific Name*	Non-native Species
Snowberry	*Symphoricarpus albus*	
Stiff sagebrush	*Artemesia rigida*	
Thimbleberry	*Rubus parviflorus*	
Wax or white currant	*Ribes cereum*	
Wood's rose	*Rosa woodsii*	
Trees		
Aspen	*Populus tremuloides*	
Black cottonwood	*Populus trichocarpa*	
Douglas fir	*Pseudotsuga menziesii*	
Pacific willow	*Salix lasiandra*	
Ponderosa pine	*Pinus ponderosa*	
Spring birch	*Betula occidentalis*	
Willow	Various species of *Salix*	

Table C-3. Wildlife species identified as potentially occurring within the corridor.

Common Name	Species Name	Associated Habitat Type
Mammals		
Badger	*Taxidea taxus*	Agricultural Steppe Ponderosa pine forest
Black-tailed jackrabbit	*Lepus californicus*	Steppe
Bobcat	*Lynx rufus*	Steppe Ponderosa pine forest
Bushy-tailed woodrat	*Neotorna cinerea*	Steppe Ponderosa pine forest
Columbian ground squirrel	*Spermophilus columbianus*	Ponderosa pine forest
Coyote	*Canis latrans*	Agricultural Steppe Ponderosa pine forest
Deer mouse	*Peromyscus maniculatus*	Agricultural Steppe Ponderosa pine forest
Elk	*Cervus elaphus*	Ponderosa pine forest
Great Basin pocket mouse	*Perognathus parvus*	Agricultural Steppe
Least chipmunk	*Eutamias minimus*	Steppe
Little brown myotis	*Myotis lucifugus*	Ponderosa pine forest
Long-tailed weasel	*Mustela frenata*	Ponderosa pine forest
Mantled ground squirrel	*Spermophilus lateralis*	Ponderosa pine forest
Mountain lion	*Felis concolor*	Ponderosa pine forest
Mule deer	*Odocoileus hemionus*	Agricultural Steppe Ponderosa pine forest
Northern flying squirrel	*Glaucomys sabrinus*	Ponderosa pine forest
Northern grasshopper mouse	*Onychomys leucogaszer*	Steppe
Northern pocket gopher	*Thomomys talpoides*	Agricultural Steppe Ponderosa pine forest
Nuttall's cottontail	*Sylvilagus nuttallii*	Steppe
Ord's kangaroo rat	*Dipodomys ordii*	Steppe
Porcupine	*Erethizon dorsatum*	Ponderosa pine forest
Pygmy rabbit	*Brachylagus idahoensis*	Steppe
Red squirrel	*Tamiasciurus hudsonicus*	Ponderosa pine forest
Sagebrush vole	*Lagurus curtarus*	Steppe
Silver-haired bat	*Lasionycteris noctivagans*	Ponderosa pine forest
Striped skunk	*Mephitis mephitis*	Agricultural Steppe

Table C-3 (cont'd)

Common Name	Species Name	Associated Habitat Type
Mammals		
Washington ground squirrel	*Spermophilus washingtoni*	Steppe
Western harvest mouse	*Reithrodontomys megalotis*	Steppe
Western jumping mouse	*Zapus princeps*	Ponderosa pine forest
White-tailed deer	*Odocoileus virginianus*	Agricultural Steppe Ponderosa pine forest
White-tailed jackrabbit	*Lepus townsendii*	Steppe
Yellow pine chipmunk	*Eutamias amoenus*	Ponderosa pine forest
Yellow-bellied marmot	*Marmota flaviventris*	Steppe
Birds		
American goldfinch	*Carduelis tristis*	Steppe
American kestrel	*Falco sparverius*	Steppe Ponderosa pine forest
American robin	*Turdus migratorius*	Steppe Ponderosa pine forest
Bald eagle	*Haliaeetus leucocephalus*	Ponderosa pine forest
Barn swallow	*Hirundo rustica*	Steppe
Black-billed magpie	*Pica pica*	Steppe Ponderosa pine forest
Black-throated gray warbler	*Dendroica nigrescens*	Ponderosa pine forest
Blue grouse	*Dendragapus obscurus*	Ponderosa pine forest
Brewer's blackbird	*Euphagus cyanocephalus*	Steppe Ponderosa pine forest
Brewer's sparrow	*Spizella breweri*	Steppe
Brown creeper	*Certhia familiaris*	Ponderosa pine forest
Brown-headed cowbird	*Molothrus ater*	Steppe
Burrowing owl	*Speotyto cunicularia*	Steppe
California quail	*Callipepla californica*	Steppe
Canada goose	*Branta canadensis*	Agricultural
Cassin's finch	*Carpodacus cassinii*	Ponderosa pine forest
Chipping sparrow	*Spizella passerina*	Steppe Ponderosa pine forest
Chukar	*Alectoris chukar*	Steppe
Cliff swallow	*Hirundo pyrrhonota*	Steppe
Common flicker	*Colaptes auratus*	Ponderosa pine forest
Common nighthawk	*Chordeiles minor*	Steppe Ponderosa pine forest
Common raven	*Corvus corax*	Steppe Ponderosa pine forest
Cooper's hawk	*Accipiter cooperii*	Ponderosa pine forest

Table C-3 (cont'd)

Common Name	Species Name	Associated Habitat Type
Dark-eyed junco	*Junco hyemalis*	Ponderosa pine forest
Dusky flycatcher	*Empidonax oberholseri*	Ponderosa pine forest
European starling	*Sturnus vulgaris*	Steppe
Flammulated owl	*Otus flammeolus*	Ponderosa pine forest
Golden eagle	*Aquila chrysaetos*	Steppe Ponderosa pine forest
Grasshopper sparrow	*Ammodramus savannarum*	Steppe
Gray partridge	*Perdix perdix*	Agricultural Steppe
Great horned owl	*Bubo virginianus*	Ponderosa pine forest
Hairy woodpecker	*Dendrocopos villosus*	Ponderosa pine forest
Horned lark	*Eremophila alpestris*	Agricultural Steppe
Killdeer	*Charadrius vociferus*	Steppe
Lark sparrow	*Chondestes grammacus*	Steppe
Lewis' woodpecker	*Asyndesmus lewis*	Ponderosa pine forest
Loggerhead shrike	*Lanius ludovicianus*	Steppe
Long-billed curlew	*Numenius americanus*	Steppe
Mallard	*Arias platyrhynchos*	Agricultural
Mountain bluebird	*Sialia currucoides*	Ponderosa pine forest
Mountain chickadee	*Parus gambeli*	Ponderosa pine forest
Mourning dove	*Zenaida macroura*	Steppe
Northern flicker	*Colaptes auratus*	Steppe
Northern harrier	*Circus cyaneus*	Steppe
Northern oriole	*Icterus galbula*	Steppe
Olive-sided flycatcher	*Nuttallornis borealis*	Ponderosa pine forest
Osprey	*Pandion haliaetus*	Ponderosa pine forest
Pileated woodpecker	*Drycopus pileatus*	Ponderosa pine forest
Pine siskin	*Spinus pinus*	Ponderosa pine forest
Poorwill	*Phalaenoptilus nuttallii*	Ponderosa pine forest
Prairie falcon	*Falco mexicanus*	Steppe
Pygmy nuthatch	*Sirra pygmaea*	Ponderosa pine forest
Pygmy owl	*Glaucidium gnoma*	Ponderosa pine forest
Red crossbill	*Loxia curvirostra*	Ponderosa pine forest
Red-tailed hawk	*Buret jamaicensis*	Steppe Ponderosa pine forest
Red-winged blackbird	*Agelaius phoniceus*	Steppe
Ring-billed gull	*Larus delawarensis*	Steppe
Ring-necked pheasant	*Phasianus colchicus*	Agricultural Steppe
Rough-legged hawk	*Buteo lagopus*	Steppe
Ruffed grouse	*Bonasa umbellus*	Ponderosa pine forest

Table C-3 (cont'd)

Common Name	Species Name	Associated Habitat Type
Sage grouse	*Centrocercus urophasianus*	Steppe
Sage sparrow	*Amphispiza belli*	Steppe
Sage thrasher	*Oreoscoptes montanus*	Steppe
Savannah sparrow	*Passerculus aandwichensis*	Steppe
Saw-whet owl	*Aegolius acadicus*	Ponderosa pine forest
Say's phoebe	*Sayornis saya*	Steppe Ponderosa pine forest
Sharp-tailed grouse	*Tympanuchus phasianellus*	Steppe
Short-eared owl	*Asio flammeus*	Steppe
Solitary vireo	*Vireo solitarius*	Ponderosa pine forest
Steller's jay	*Cyanocitta stelleri*	Ponderosa pine forest
Swainson's hawk	*Buret Swainsoni*	Steppe
Wild Turkey	*Meleagris gallopavo*	Ponderosa pine forest
Turkey vulture	*Cathartes aura*	Steppe Ponderosa pine forest
Vesper Sparrow	*Pooecetes gramineus*	Steppe
Violet-green swallow	*Tachycineta thalassina*	Steppe Ponderosa pine forest
Western bluebird	*Sialia mexicana*	Ponderosa pine forest
Western flycatcher	*Empidonax difftcilis*	Ponderosa pine forest
Western kingbird	*Tyrannus verticalis*	Steppe
Western meadowlark	*Sternella neglecta*	Agricultural Steppe
Western tanager	*Piranga ludoviciana*	Ponderosa pine forest
Western wood peewee	*Contopus sordidulus*	Ponderosa pine forest
White-breasted nuthatch	*Sitta carolinensis*	Ponderosa pine forest
White-crowned sparrow	*Zonotrichia leucophrys*	Steppe
White-headed woodpecker	*Dendrocopos albularvatus*	Ponderosa pine forest
Williamson's sapsucker	*Sphyrapicus thyroideus*	Ponderosa pine forest
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	Steppe
Reptiles/Amphibian		
Common garter snake	*Thamnophis sirtalis*	Ponderosa pine forest
Gopher snake	*Pituophis melanoleucus*	Steppe Ponderosa pine forest
Great Basin spade-foot toad	*Scaphiophus intermontanus*	Steppe
Pacific tree frog	*Hyla regilla*	Ponderosa pine forest
Racer	*Coluber constrictor*	Steppe
Sagebrush lizard	*Sceloporus graciosus*	Steppe
Short-horned lizard	*Phrynosoma douglassi*	Steppe Ponderosa pine forest
Tiger salamander	*Ambystoma tigrinum*	Ponderosa pine forest

Table C-3 (cont'd)

Common Name	Species Name	Associated Habitat Type
Western rattlesnake	*Crotalus viridis*	Steppe
Western skink	*Eumeces skiltonianus*	Steppe Ponderosa pine forest
Western toad	*Bufo boreas*	Ponderosa pine forest

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Source: WDFW (Washington Department of Fish and Wildlife). 2002.
Washington GAP Data Products [online database]. WDFW, Olympia.
URL http://www.wa.gov/wdfw/wlm/gap/vdm.htm.

ESA Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Upper Columbia Fish and Wildlife Office
11103 East Montgomery Drive
Spokane, Washington 99206

May 15, 2002

Ms. Kerrie McArthur
6405 216th SW, Suite 100
Mountlake Terrace, WA 98043

Subject: Species List for the Bonneville Power Administration Proposed New Transmission Line Project, Grant, Lincoln, and Spokane Counties, Washington (File #501.2900)

Reference Number: 1-9-02-SP-362

Dear Ms. McArthur:

This responds to your April 24, 2002 request for a list of threatened and endangered species that may occur in the vicinity of the Bonneville Power Administration Proposed New Transmission Line Project, located in Grant, Lincoln, and Spokane Counties, Washington. We understand that the project involves the construction of a new 550 MW electrical transmission line between Grand Coulee Dam and Spokane. Please use the above reference number for all future correspondence regarding this project.

We have reviewed the information you provided. Our records indicate that the following listed and candidate species may occur in the vicinity of the project and could potentially be affected by it:

Listed Species

Endangered
Pygmy rabbit *(Brachylagus idahoensis)*

Threatened
Bald eagle *(Haliaeetus leucocephalus)*
Bull trout *(Salvelinus confluentus)*
Ute ladies'-tresses *(Spiranthes diluvialis)*, plant
Spalding's silene *(Silene spaldingii)*, plant

Candidate Species

Washington ground squirrel *(Spermophilus washingtoni)*
Western sage grouse *(Centrocercus urophasianus phaios)*

Federal agencies must meet their responsibilities under section 7 of the Endangered Species Act of 1973, as amended (Act), as outlined in Enclosure A. Enclosure A includes a discussion of the contents of a Biological Assessment (BA), which provides an analysis of the impacts of the project on listed and proposed species, and designated and proposed critical habitat. Preparation of a BA is required for all major construction projects. Even if a BA is not prepared, potential project effects on listed and proposed species should be addressed in the environmental review for this project. Federal agencies may designate, in writing, a non-federal representative to prepare a BA. However, the involved federal agency retains responsibility for the BA, its adequacy, and ultimate compliance with section 7 of the Act.

Preparation of a BA would be prudent when listed or proposed species, or designated or proposed critical habitat, occur within the project area. Should the BA determine that a listed species is likely to be affected by the project, the involved federal agency should request section 7 consultation with the U.S. Fish and Wildlife Service (Service). If a proposed species is likely to be jeopardized by the project, regulations require conferencing between the involved federal agency and the Service. If the BA concludes that the project will have no effect on any listed or proposed species, we would appreciate receiving a copy for our information.

Candidate species receive no protection under the Act, but are included for your use during planning of the project. Candidate species could be formally proposed and listed during project planning, thereby falling within the scope of section 7 of the Act. Protection provided to these species now may preclude possible listing in the future. If evaluation of the subject project indicates that it is likely to adversely impact a candidate species, we encourage you to modify the project to minimize/avoid these impacts.

If you would like information concerning state listed species or species of concern, you may contact the Washington Department of Fish and Wildlife, at (360) 902-2543, for fish and wildlife species; or the Washington Department of Natural Resources, at (360) 902-1667, for plant species.

This letter fulfills the requirements of the Service under section 7 of the Act. Should the project plans change significantly, or if the project is delayed more than 90 days, you should request an update to this response.

Thank you for your efforts to protect our nation's species and their habitats. If you have any questions concerning the above information, please contact Robert Newman at (509) 893-8017.

Sincerely,

Suzanne Audet

for Supervisor

Enclosure

cc: WDFW, Region 1,2
WNHP, Olympia
FWS, Ephrata

Enclosure A

Responsibility of Federal Agencies under Section 7 of the Endangered Species Act

Section 7(a) - Consultation/Conferencing

Requires: 1) Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2) Consultation with the U.S. Fish and Wildlife Service (Service) when a federal action may affect a listed species to ensure that any action authorized, funded, or carried out by a federal agency will not jeopardize the continued existence of listed species, or result in destruction or adverse modification of critical habitat. The process is initiated by the federal agency after determining that the action may affect a listed species; and

3) Conferencing with the Service when a federal action may jeopardize the continued existence of a proposed species, or result in destruction or adverse modification of proposed critical habitat.

Section 7(c) - Biological Assessment for Major Construction Activities

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for major construction activities[1]. The BA analyzes the effects of the action, including indirect effects and effects of interrelated or interdependent activities, on listed and proposed species, and designated and proposed critical habitat. The process begins with a request to the Service for a species list. If the BA is not initiated within 90 days of receipt of the species list, the accuracy of the list should be verified with the Service. The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable between the Service and the involved federal agency).

We recommend the following for inclusion in a BA: an onsite inspection of the area to be affected by the proposal, which may include a detailed survey of the area to determine if listed or proposed species are present; a review of pertinent literature and scientific data to determine the species' distribution, habitat needs, and other biological requirements; interviews with experts, including those within the Service, state conservation departments, universities, and others who may have data not yet published in scientific literature; an analysis of the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; and an analysis of alternative actions considered. The BA should document the results of the impacts analysis, including a discussion of study methods used, any problems encountered, and other relevant information. The BA should conclude whether or not any listed species may be affected, proposed species may be jeopardized, or critical habitat may be adversely modified by the project. Upon completion, the BA should be forwarded to the Service.

Major concerns that should be addressed in a BA for listed and proposed animal species include:

1. Level of use of the project area by the species, and amount or location of critical habitat;

2. Effect(s) of the project on the species' primary feeding, breeding, and sheltering areas;

3. Impacts from project construction and implementation (*e.g.*, increased noise levels, increased human activity and/or access, loss or degradation of habitat) that may result in disturbance to the species and/or their avoidance of the project area or critical habitat.

Major concerns that should be addressed in a BA for listed or proposed plant species include:

1. Distribution of the taxon in the project area;

2. Disturbance (*e.g.*, trampling, collecting) of individual plants or loss of habitat; and

3. Changes in hydrology where the taxon is found.

<u>Section 7(d) - Irreversible or Irretrievable Commitment of Resources</u>

Requires that, after initiation or reinitiation of consultation required under section 7(a)(2), the Federal agency and any applicant shall make no irreversible or irretrievable commitment of resources with respect to the action which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternatives which would avoid violating section 7(a)(2). This prohibition is in force during the consultation process and continues until the requirements of section 7(a)(2) are satisfied.

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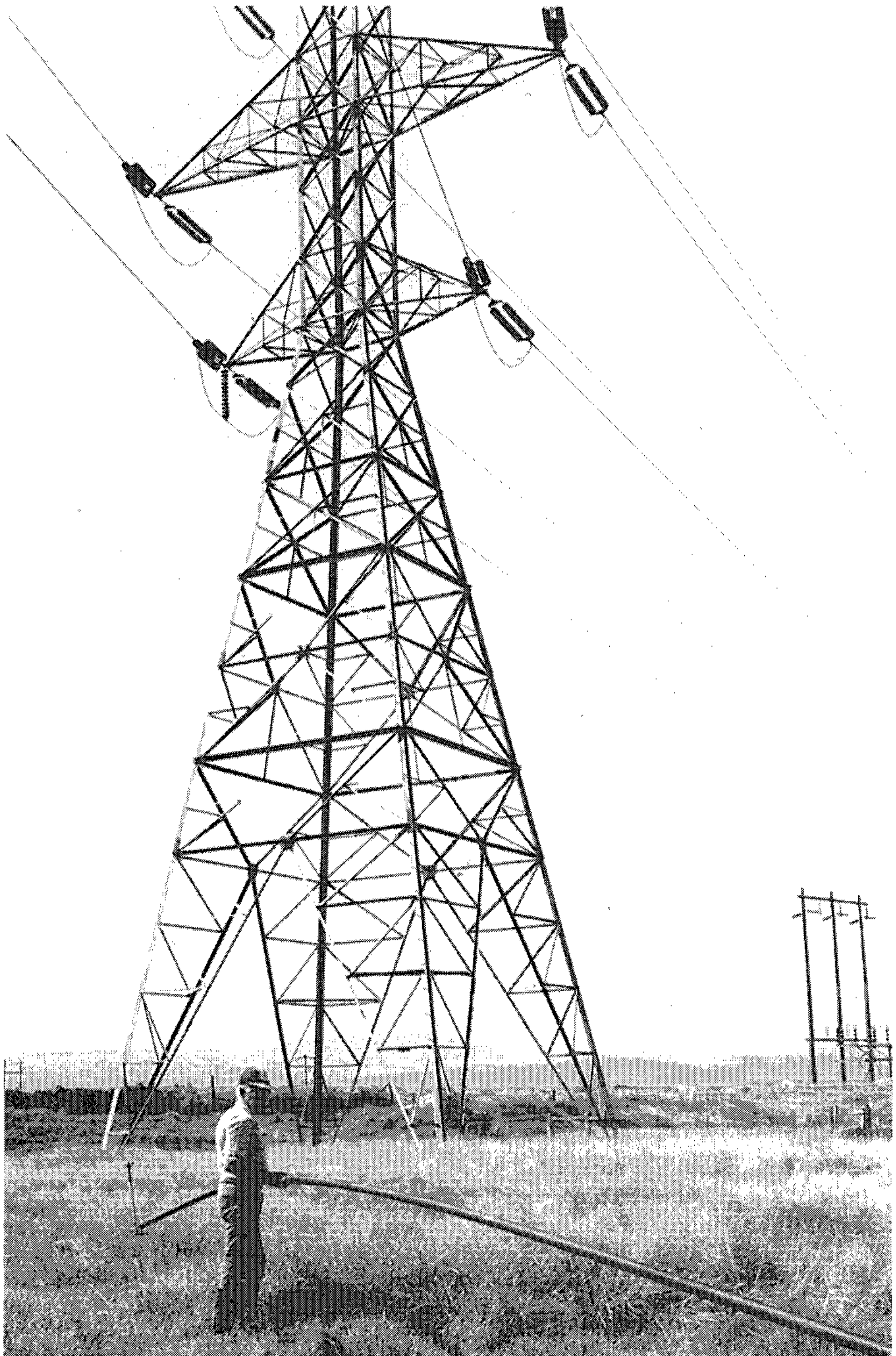
[1] A major construction activity is a construction project, or other undertaking having similar physical impacts, which is a major action significantly affecting the quality of the human environment as referred to in the National Environmental Policy Act [42 U.S.C. 4332 (2)(c)].

<u>GRAND COULEE– BELL 500-kV TRANSMISSION LINE PROJECT</u>

APPENDIX D:

LIVING AND WORKING SAFELY AROUND HIGH-VOLTAGE POWER LINES

LIVING AND WORKING SAFELY AROUND HIGH-VOLTAGE POWER LINES



BONNEVILLE
POWER ADMINISTRATION

Dear Neighbor,

BPA, along with your local electric utility, is continually looking for ways to improve safety awareness and practices around electrical lines and equipment. We feel our efforts are best spent in reaching people like yourself — those most likely to be living and working around high-voltage power lines.

This booklet presents safe practices for work and recreation activities near high-voltage transmission lines.

Please take this opportunity to reacquaint yourself, members of your family, and others that use or have access to your property, with these safety precautions. If you have other questions, please feel free to contact your nearest BPA office (listed on page 1), or your local utility.

Thank you for taking the time to let us share how "working smarter" near power lines can save lives — even your own.

Sincerely,

Fred M. Johnson

FRED JOHNSON, CHAIRPERSON
Central Safety and Health Committee
Bonneville Power Administration

Table of Contents

Preface

High-voltage transmission lines can be just as safe as the electrical wiring in our homes — or just as dangerous. The crucial factor is ourselves: we must learn to behave safely around them.

This booklet is a basic safety guide for those who live and work around power lines. It deals primarily with nuisance shocks due to induced voltages, and with potential electric shock hazards from contact with high-voltage lines.

In preparing this booklet, the Bonneville Power Administration has drawn on more than 60 years of experience with high-voltage transmission. BPA operates one of the world's largest networks of long-distance, high-voltage lines. This system has more than 300 substations and more than 15,000 miles of transmission lines, almost 4,400 miles of which are operated at 500,000 volts.

BPA's lines make up the main electrical grid for the Pacific Northwest. The grid delivers large blocks of power to substations located near load centers. Public and investor-owned utilities and rural cooperatives take delivery of the power at these points and deliver it to the ultimate customers.

BPA's lines cross all types of property: residential, agricultural, industrial, commercial and recreational. They traverse hundreds of miles of irrigated and non-irrigated farmlands.

The magnitude of an induced voltage depends on the voltage of the transmission line, distance from the conductor, size or length of the object, and its orientation to the line. Shocks caused by an induced voltage do not usually present a hazard; for this reason we refer to them as nuisance shocks. However, mitigation methods to remove the possibility of hazards are identified in sections of the booklet that follow.

Irrigation Systems

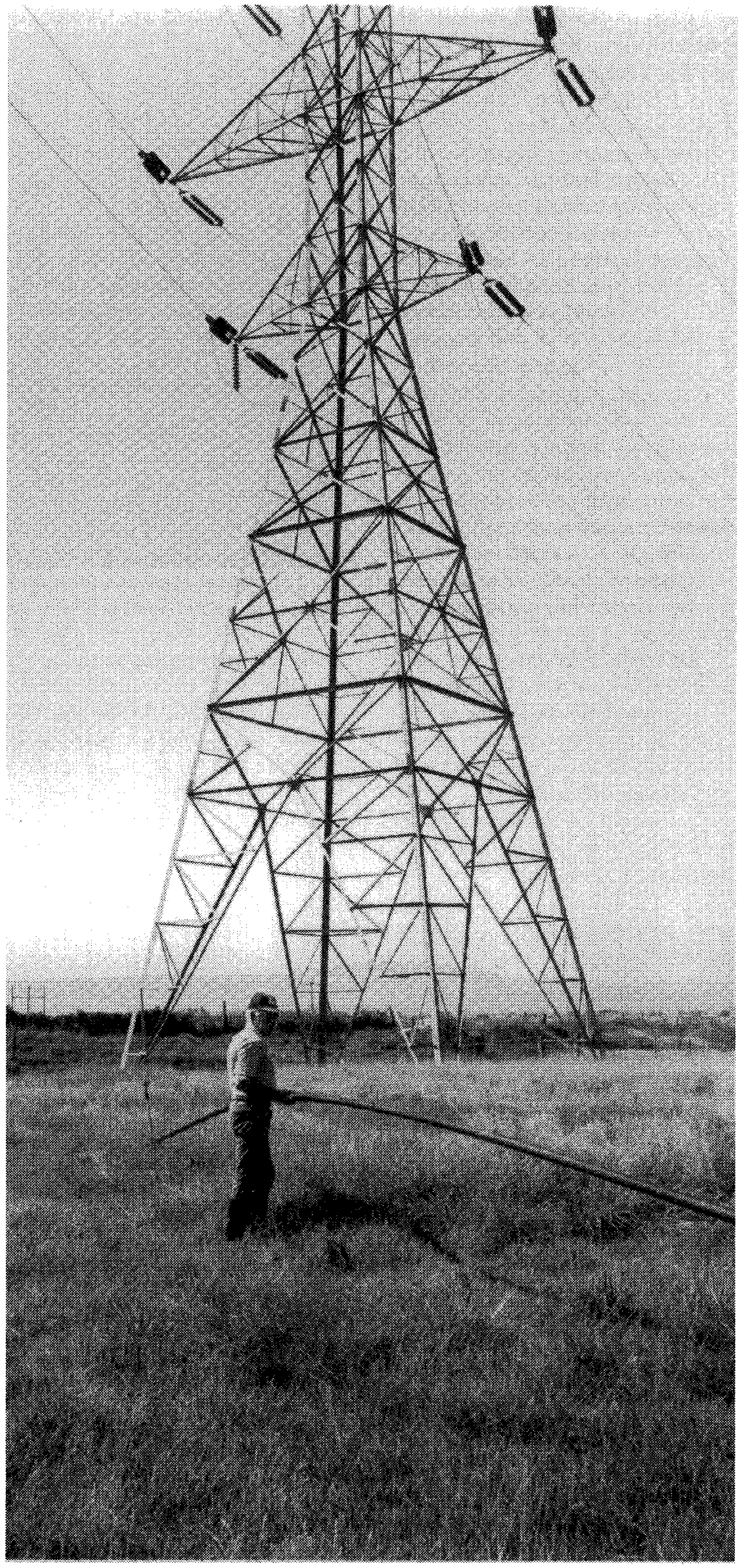
All types of irrigation systems have been operated safely near BPA power lines for years. Nonetheless, caution should be used in storing, handling, and installing irrigation pipe, and in operating spray irrigation systems near power lines.

Irrigation pipe should be moved in a horizontal position under and near all power lines to keep it away from conductors overhead.

Again, we stress that the one critical hazard from overhead lines is the danger of bringing an object — in this case, a length of irrigation pipe — into close proximity to a conductor. One purpose of this booklet is to repeatedly make this warning.

As a precautionary measure, equipment used to install irrigation systems should be kept away from transmission lines. If you wish to, contact one of BPA's transmission offices about your particular situation. If you are working near a line, it is wise to supplement normal precautions by assigning one person to act as a "safety watcher." This person simply stands by, watches, and warns the other workers against unsafe moves.

Great caution should be used when moving a high-pressure irrigation system under a transmission line. The small



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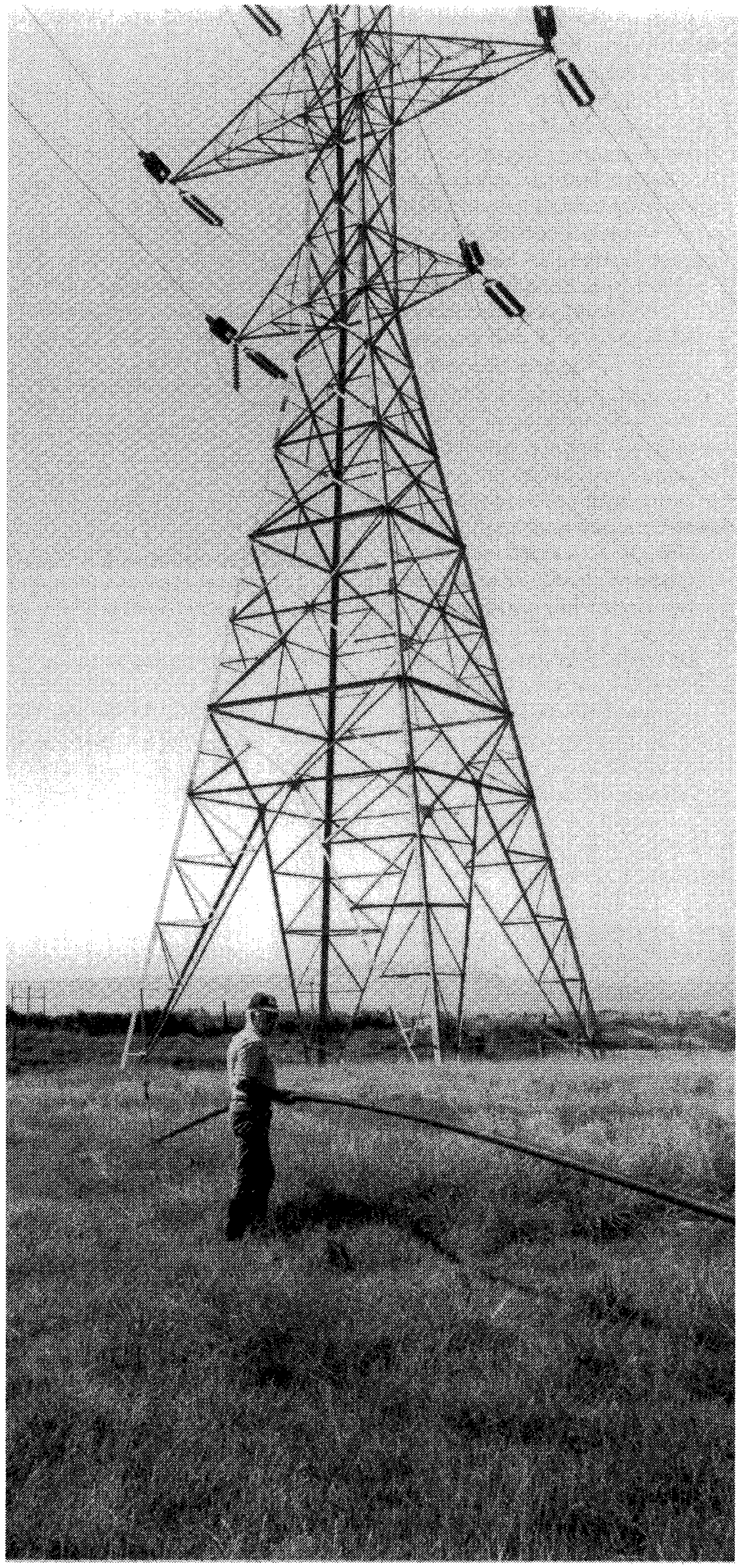
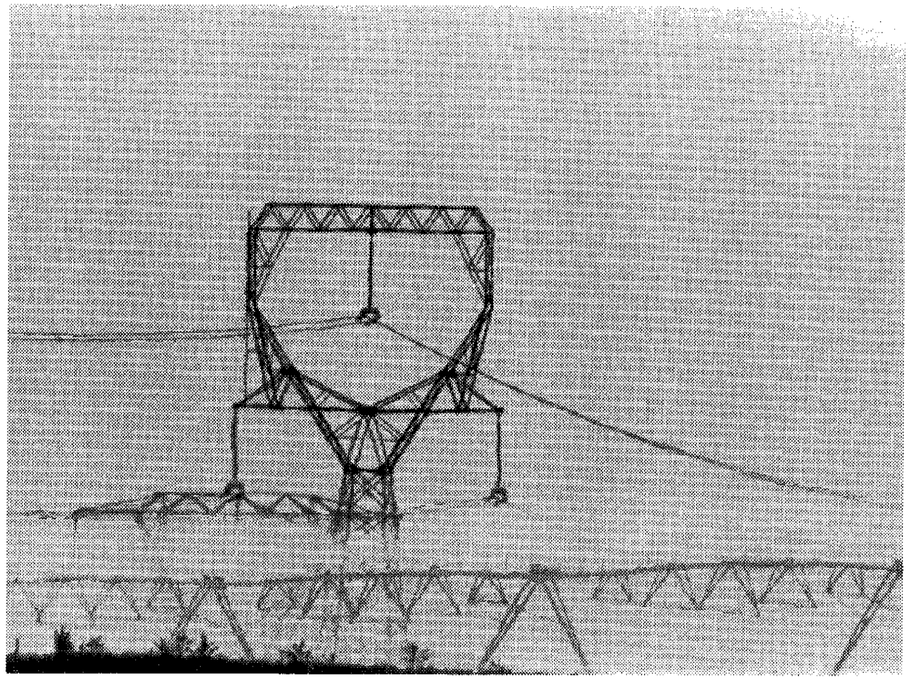


Irrigation pipe should be moved in a horizontal position under and near all power lines to keep it away from the conductors overhead.

wheel bases of some of these systems tend to make them unstable. If one should tip while under a line, its boom could be lifted into a conductor.

You may notice some nuisance shocks when unloading irrigation pipe near a transmission line. It can be reduced greatly or eliminated entirely by unloading the pipe at least 50 feet away from the line. This also tends to reduce the risk that the pipe will get too close to the conductors. Even if pipe stacked on a rubber-tired vehicle is unloaded under a transmission line, the possibility of nuisance shocks can be eliminated by grounding. The grounding is done by clipping one end of a wire to a metal rod driven into the ground and the other end to a pipe on the bottom of the stack.

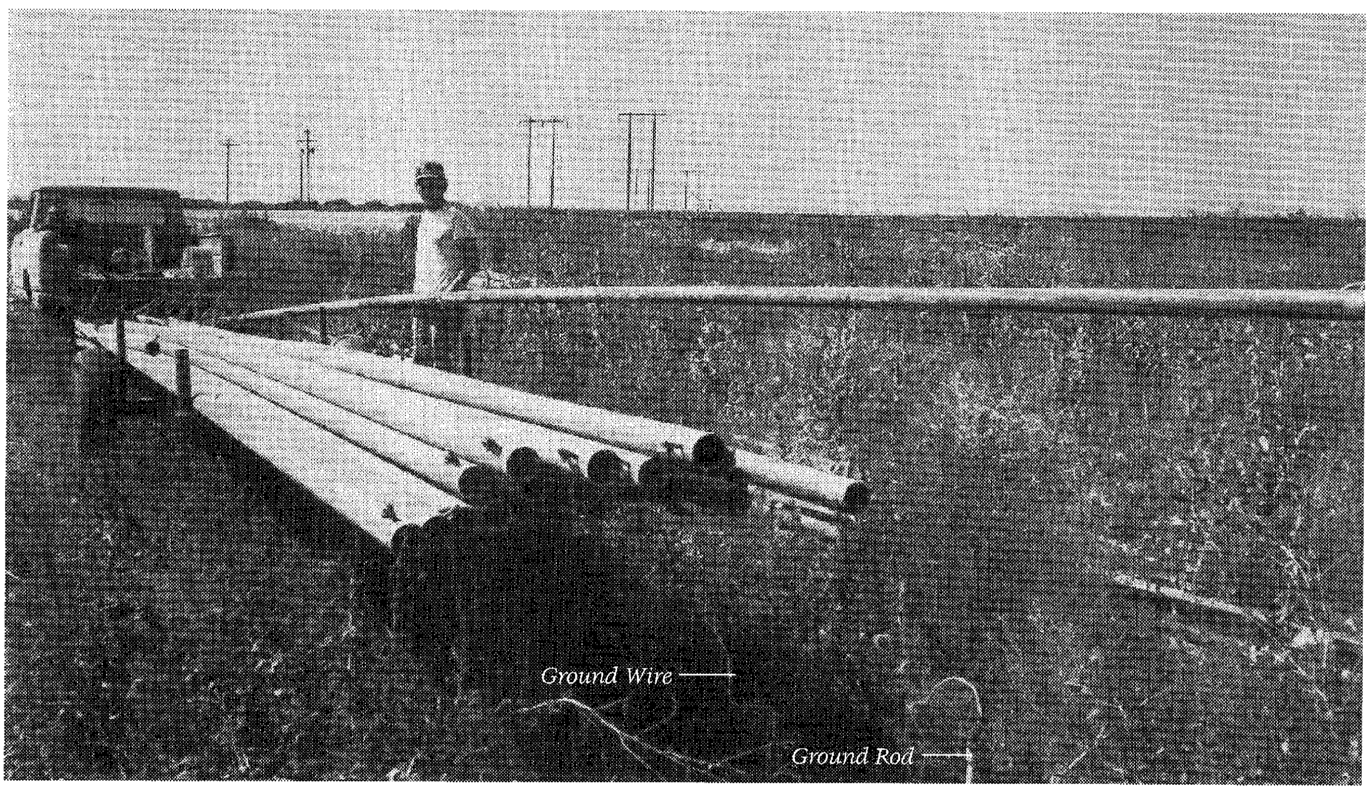
All types of irrigation systems, including center pivot systems, can be operated safely near or on a right-of-way. However, irrigators should avoid situations where a solid stream of water can come in contact with a conductor, even if the possibility is remote. Should this occur, a person in contact with the irrigation system, or standing very near it, say 5 feet or so, may receive a severe shock. When asked, BPA will provide assistance as to the proper installation or operation of an irrigation system to avoid hazardous situations.



Irrigation around BPA lines is safe when proper precautions are taken on the rights-of-way.

If a sprinkler malfunctions and a solid stream of water reaches a conductor, turn off the water at its source — by switching off the pump — before attempting to correct the problem.

All nozzle risers in the vicinity of a transmission line should be equipped with spoilers or automatic shutoffs. This will



The possibility of nuisance shocks can be eliminated by grounding metal pipe when unloading near BPA lines.

prevent a solid stream from striking a conductor if a nozzle breaks or falls off.

Equipment with smaller diameter or fine mist spray nozzles do not usually present a problem. Ordinarily, a broken spray will not conduct a significant amount of current. However, spray containing fertilizer is much more conductive. Therefore, additional precautions should be taken to avoid spraying water with fertilizer into contact with transmission line conductors.

High-volume irrigation systems which use large nozzles and high pressure to sprinkle big areas are of special concern. Nozzle diameters vary from 3/4 inch to 1-15/16 inches and water pressures range from 80 to 100 psi. Thus, a solid stream discharged from one of these nozzles may reach heights of 30 to 35 feet and go as far as 200 feet. When such a system is in operation, a safe distance must be kept between it and a transmission line. If requested, BPA will gladly help you determine what a safe distance is for your equipment. Contact the nearest BPA office, listed on page 1, if you want help.

Nuisance shocks may be experienced when touching mobile pipe-type and wheel-type irrigation systems located near transmission lines. These shocks can occur when soil conditions are dry and there is a long section of irrigation pipe parallel to and within 50 feet of the transmission line centerline. Simple grounding procedures can prevent nuisance shocks on these types of systems. Contact BPA for assistance or information about your particular situation.

Central pivot circular irrigation systems installed near or under transmission lines can develop hazardous shock potentials during operation and maintenance. To eliminate these hazards:

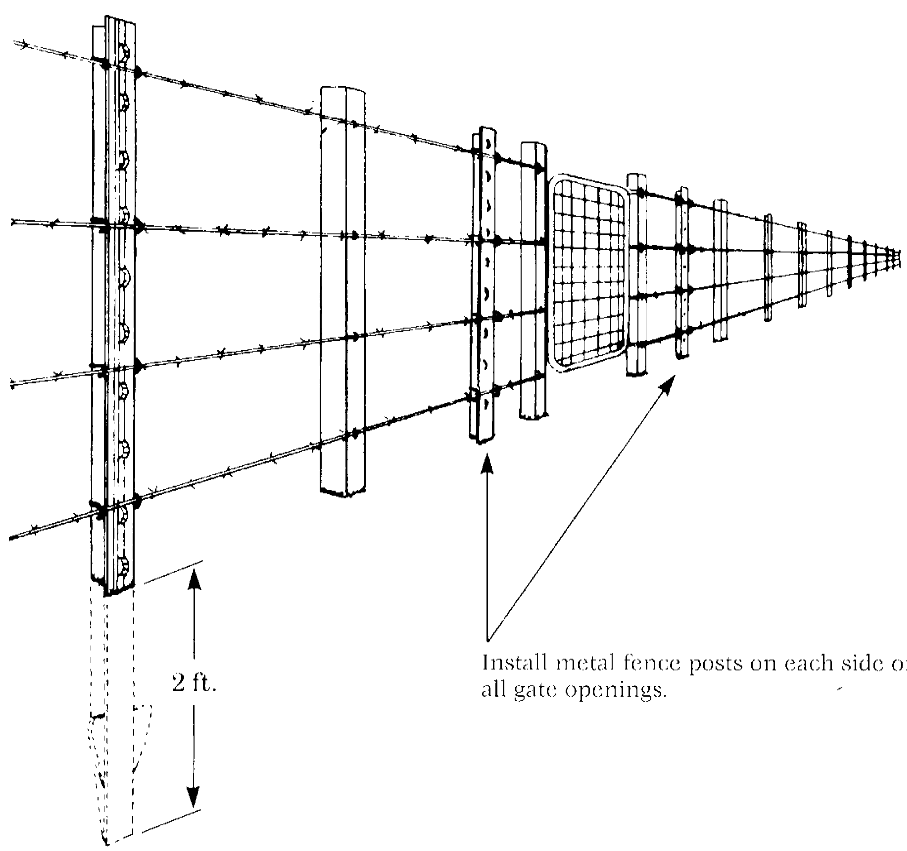
- Provide a good electrical ground for the pivot point.
- Do not touch the sprinkler pipe or its supporting structures when the system is operating under or parallel to and near a transmission line.
- Perform repairs/maintenance of the system with the sprinkler pipe perpendicular to the transmission line.

BPA has prepared a guideline for the installation and operation of irrigation systems near high-voltage transmission lines. A copy will be provided when you contact BPA for approval and assistance in safely locating, operating and maintaining irrigation systems near trans-mission lines.

Underground Pipes, Telephone Cables and Electric Cables

Underground pipes and cables are compatible with transmission lines providing installation and maintenance are properly done. However, they should be installed at an angle of 60 degrees or more to the transmission line centerline (a perpendicular crossing is best). Normally, pipes and cables should not be installed closer than 50 feet to a BPA structure or the buried grounding system. These systems are long buried wires that are sometimes attached to the structures and can run up to 300 feet along the right-of-way. Since these grounding systems are not visible above ground they must be located by BPA. Contact BPA before installing any pipe or cable which crosses a BPA transmission line right-of-way.

Proper orientation of the line with respect to underground pipes, telephone cables and electric cables is required to prevent an accident in an extreme case when a fault on the transmission line might cause electricity to arc from the conductor to the tower and go to ground. This could produce a dangerous voltage on an underground piping or cable system.



Install metal fence posts on each side of all gate openings.

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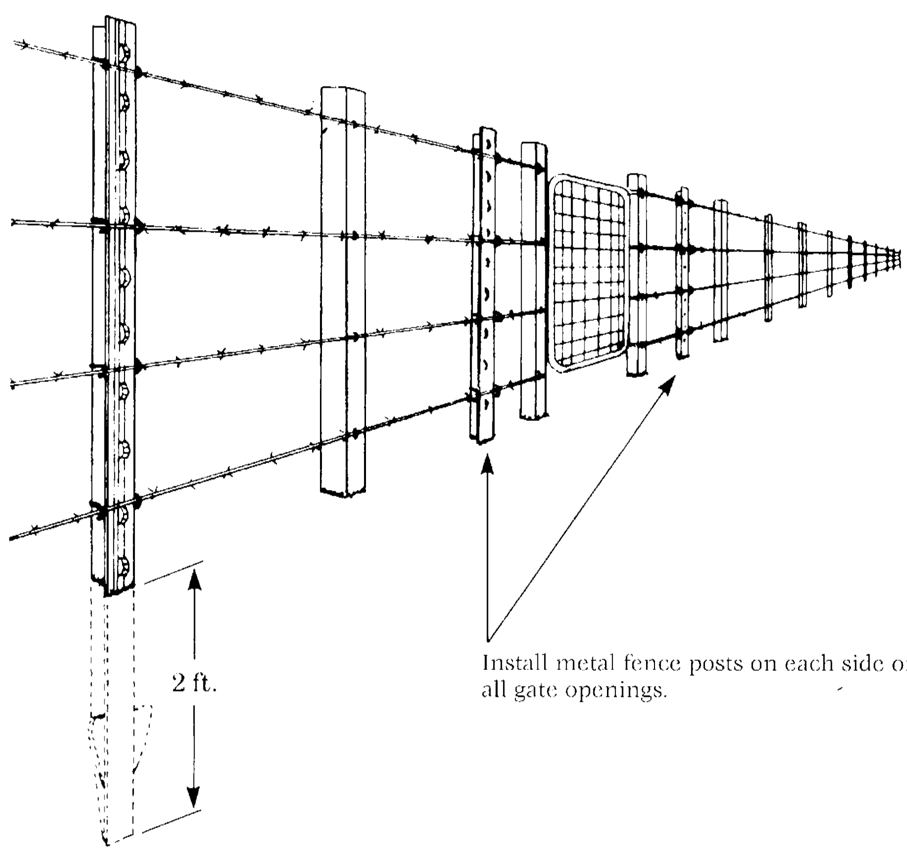


Wire Fences

Barbed wire and woven wire fences insulated from ground on wood posts can assume an electrostatic voltage when located near transmission lines. Normally, the voltage will not be noticeable. If you are having a problem, call BPA for an investigation. The fence may need to be grounded if it:

- crosses the right-of-way;
- parallels the line within 125 feet of the outside conductor and is longer than 150 feet; or
- parallels the line 125 to 250 feet from the conductor and is longer than 6,000 feet.

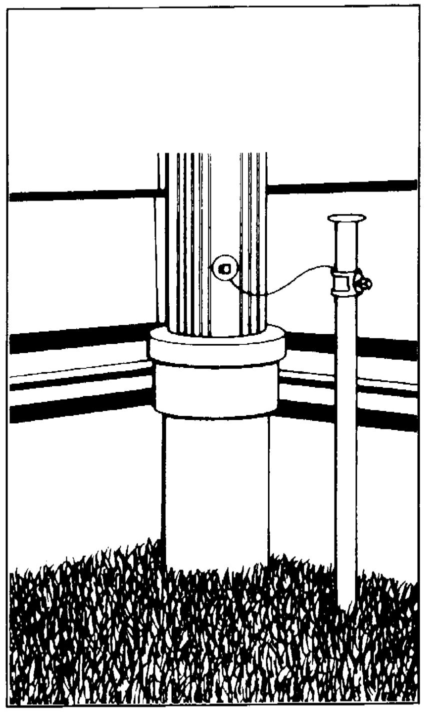
These fences should be grounded at each end and every 200 feet with a metal post driven at least 2 feet into the ground. Attach all wire strands of the fence to the metal post. Install the grounding posts at least 50 feet from the nearest transmission tower. If nuisance shocks are experienced when contacting a fence or gate, or if you have any questions about the need for grounding, call BPA.

Electric Fences

In certain situations, BPA provides electric filters to ground 60-Hz voltages induced by a power line. These filters will allow the charging voltage on the fence to be effective. BPA provides these filters if the electric fence:

- crosses the right-of-way;
- parallels the line within 60 feet of the outside conductor and is longer than 1,000 feet; or
- parallels the line within 125 feet of the outside conductor and is longer than 2,500 feet.

Do not use fence chargers that are not approved by Underwriters' Laboratories, Inc. They may carry voltages and currents that are hazardous to anyone touching the fence — even if transmission lines are not present. For more information about fences, fence chargers or filters, call the nearest BPA transmission office.



Example of grounding a metal building at a down spout.

Buildings

This section applies to buildings outside BPA's rights-of-way, since BPA prohibits buildings within a right-of-way.

Metal buildings are buildings whose frame, roof or walls consist of substantial amounts of metal. A voltage induced on a metal building is usually drained away through the building's plumbing, electrical service, metal sheeting or metal frame. Nonetheless, BPA's present practice is to ground any metal building near a 500,000-volt line when:

- it is within 100 feet of the outside conductor;
- it has more than 2,000 square feet of metal surface and is within 100 to 150 square feet of the outside conductor; or
- it is used to store flammable materials and is within 250 feet of the outside conductor.

One grounding rod is adequate for a building with less than 2,000 square feet of metal surface. Two grounding rods are used if a building's metal surface exceeds 2,000 square feet. Even if the metal surface is less than 2,000 square feet, an extra grounding rod is useful in case one is damaged or develops a high-resistance contact.

Aluminum windows, downspouts, gutters or other metal parts on buildings constructed of wood or other insulating materials may also require gounding as shown above.

Again, call BPA if you have any questions about grounding a building.

Vehicles

Under some high-voltage lines, vehicles can carry a nuisance shock. This is particularly true if the vehicle is parked on a nonconductive surface such as dry rock. You can drain the shock from your vehicle to the ground by attaching a chain that reaches the ground to the vehicle or by leaning a metal bar against your vehicle. The only way to be sure you won't get shocked is to park your car away from the power line.

Theoretically, it is possible that an electric spark from an induced voltage could ignite a gasoline vapor that is created during refueling of a vehicle. In practice, the chances for all the right conditions to exist at the same time for such an accident are remote. BPA has never had a report of a refueling accident near our lines.

However, because such an accident is theoretically possible, BPA recommends that you not refuel your vehicle in close proximity to a transmission line.

Lightning

Lightning will usually strike the highest nearby object. In rural areas, this may be a power line tower or conductor. Transmission facilities are designed to withstand lightning strikes by channeling them to ground at the tower. When lightning strikes a tower, the damage is usually much less than if a barn or tree had been hit.

Play it safe. Stay away from power lines and other tall objects during electrical storms. Lightning is dangerous if you are standing near where it enters the ground.

Fires

Smoke and hot gases from a large fire can create a conductive path for electricity. When a fire is burning under a transmission line, electricity could arc from the conductor to the ground, endangering people and objects near the arc.

Field burning and other large fires in and around transmission lines can damage transmission lines and cause power outages. Water and other chemicals used to extinguish those fires should never be directed toward a transmission line.

Kite Flying and Model Airplanes

BPA discourages anyone from flying a kite or model airplane anywhere near a power line. However, if your kite or model airplane is about to touch a power line, drop the string or handline instantly, before it touches the line. Do not try to pull the kite or airplane down or climb up after it. Call the nearest electric utility.

Vandalism and Shooting

When hunting in remote areas, do not shoot at transmission lines.

Insulators are, for the most part, made of porcelain or glass and are easily broken. Not only can broken insulators cause flashovers, an insulator string hit by gunfire could pull apart and let the conductor fall to the ground. This could be a serious hazard to anyone close to the line. It could also cause a power outage and possible a fire in dry areas.

Unfortunately, most insulator damage from gunfire is the result of simple vandalism.

Hunters sometimes assume that the land under a transmission line belongs to the federal government and is therefore public property. This is rarely the case. Most land beneath power lines — except in national forests or on Bureau of Land Management lands — is privately owned.

Those who cause willful damage to BPA transmission facilities or property along easements can be prosecuted by the federal government, the property owner, or both.

Remember, insulators and conductors are not fair game. Do not use them for target practice. To do so is illegal and can be extremely hazardous.

Please report broken insulators and conductors, or any other damage you see, to BPA's Crime Witness program by calling **1-800-437-2744**. Crime Witness allows you to report, confidentially, an illegal activity that you witness against BPA's transmission system, property or personnel. This includes:

- Shooting at power lines, transmission towers or substation equipment.
- Dumping of any waste or material on BPA property.
- Vandalism to BPA property, buildings and vehicles.
- Theft of BPA equipment, supplies, tools or materials.

The program offers rewards of up to $1,000 for information leading to the arrest and conviction of the persons causing the damage.

Metal Objects

As a precautionary practice, do not raise any metal object more than 14 feet in the air underneath a transmission line.

When you mount an antenna on a large vehicle that you plan to operate on a BPA easement, do not let it extend more than 14 feet above the ground.

Before you sail a boat on a lake or river, check the allowable clearance under any transmission line. We recommend that all masts or guy wires above the deck be connected electrically to an underwater metallic part such as the keel or centerboard. This precaution, which protects against lightning or accidental contact with a power line, may save your life.

Swimming pool skimmers should not be raised vertically under any power line. BPA strongly discourages the building of swimming pools within BPA easements because of the possibility of an accident.

Climbing

Climbing on power line poles, towers or guy wires can be extremely hazardous. Don't do it under any circumstance.

Pacemakers

Under some circumstances, voltages and currents from power lines, and household and other electrical devices may interfere with the operation of some implanted cardiac pacemakers. However, we know of no case where a BPA line has harmed a pacemaker patient.

As a precaution, persons who may have reason to be very near high-voltage facilities should consult with a physician to determine whether their particular implant may be susceptible to 60-Hz interference.

If a person with a pacemaker is in an electrical environment and the pacemaker begins to produce a regularly spaced pulse that is not related to a normal heartbeat, the person should leave the environment and consult a physician.

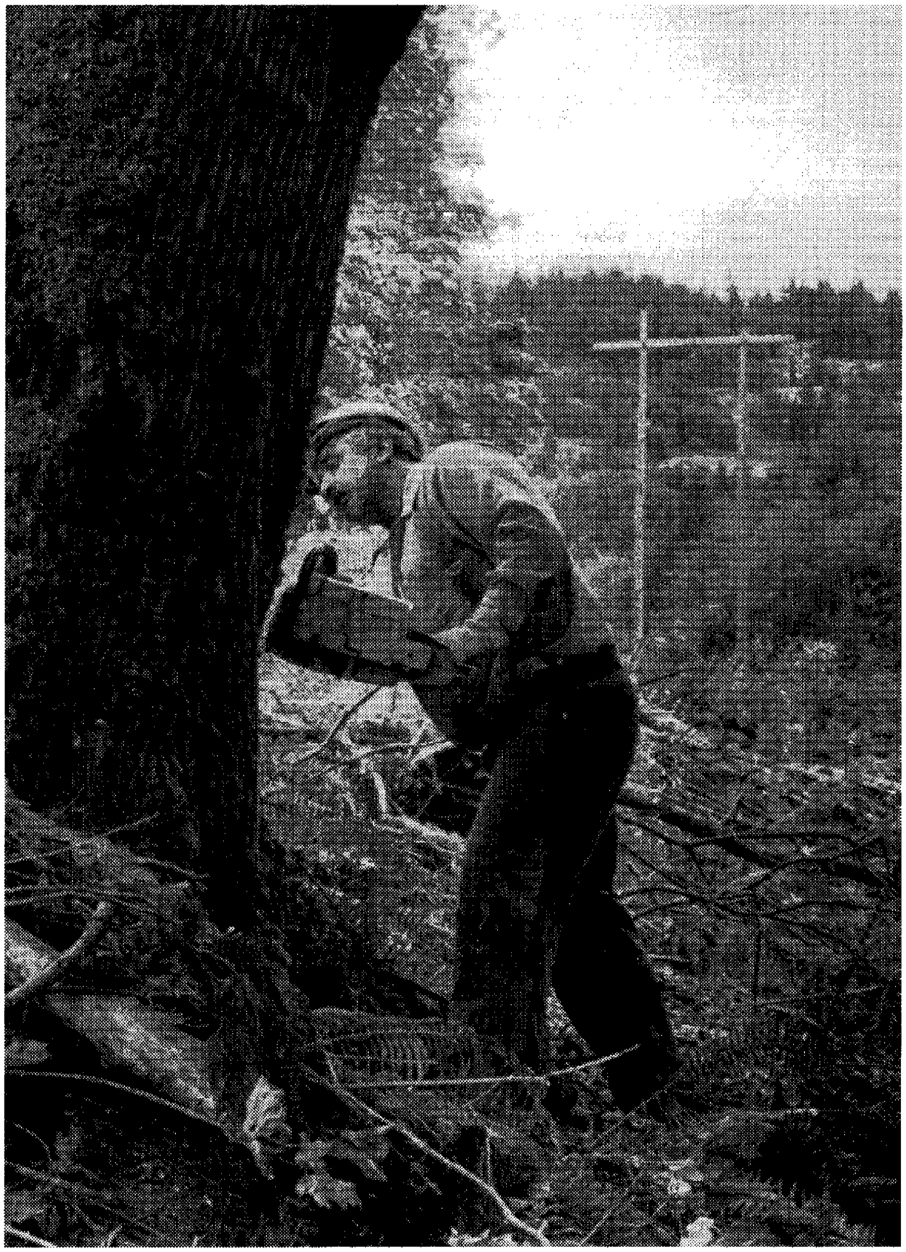
Trees and Logging

No logging or tree cutting should be done within BPA's easement without first contacting the nearest BPA transmission office. In many cases BPA owns the timber within its easements. Additionally, logging near transmission lines can be very hazardous and and requires special caution. Since trees conduct electricity, if one should fall into or close to a line, the current could follow the tree trunk to the ground and endanger anyone standing near its base. Here are two simple rules: If you should come upon a tree which has fallen into a power line, stay away from it. If you should accidentally cause a tree to fall into a line, run for your life! Do not go back to retrieve your saw or equipment. Call BPA or your local utility immediately.

We suggest if you have trees either on or close to the easement which need to be cut and could fall on or close to a transmission line, that you contact BPA. It may be safer to have BPA remove the trees than to do it yourself.

Since transmission line rights-of-way are usually not owned by BPA, but are acquired through easements from landowners, trees or logs stacked within or alongside them are not public property. People removing trees and logs without permission are stealing and can be prosecuted.

In addition, there are special considerations for growing Christmas trees, orchards and other tall-growing vegetation. Ask for the *"Landowner's Guide to Trees and Transmission Lines"* and the *"Landowners Guide to Use of BPA Rights-of-Way."*



Cutting trees within power line rights-of-way can be dangerous. It may be safer to have BPA do it for you.

Explosives

If you plan to detonate explosives near a BPA transmission line, notify BPA well in advance. See the list at the front of this booklet for the address and telephone number of the BPA office nearest you. BPA will tell you if any special precautionary measures must be taken at a particular blasting site.

As a general rule, do not use electric detonating devices when blasting within 1,000 feet of a power line. Nonelectric methods of detonation will avoid the danger of accidentally discharging an electric blasting cap.

If you are blasting within 1,000 feet of a power line and there is no reasonable alternative to the use of an electronic detonating device, you must clear the layout of the electric detonation circuit with BPA.

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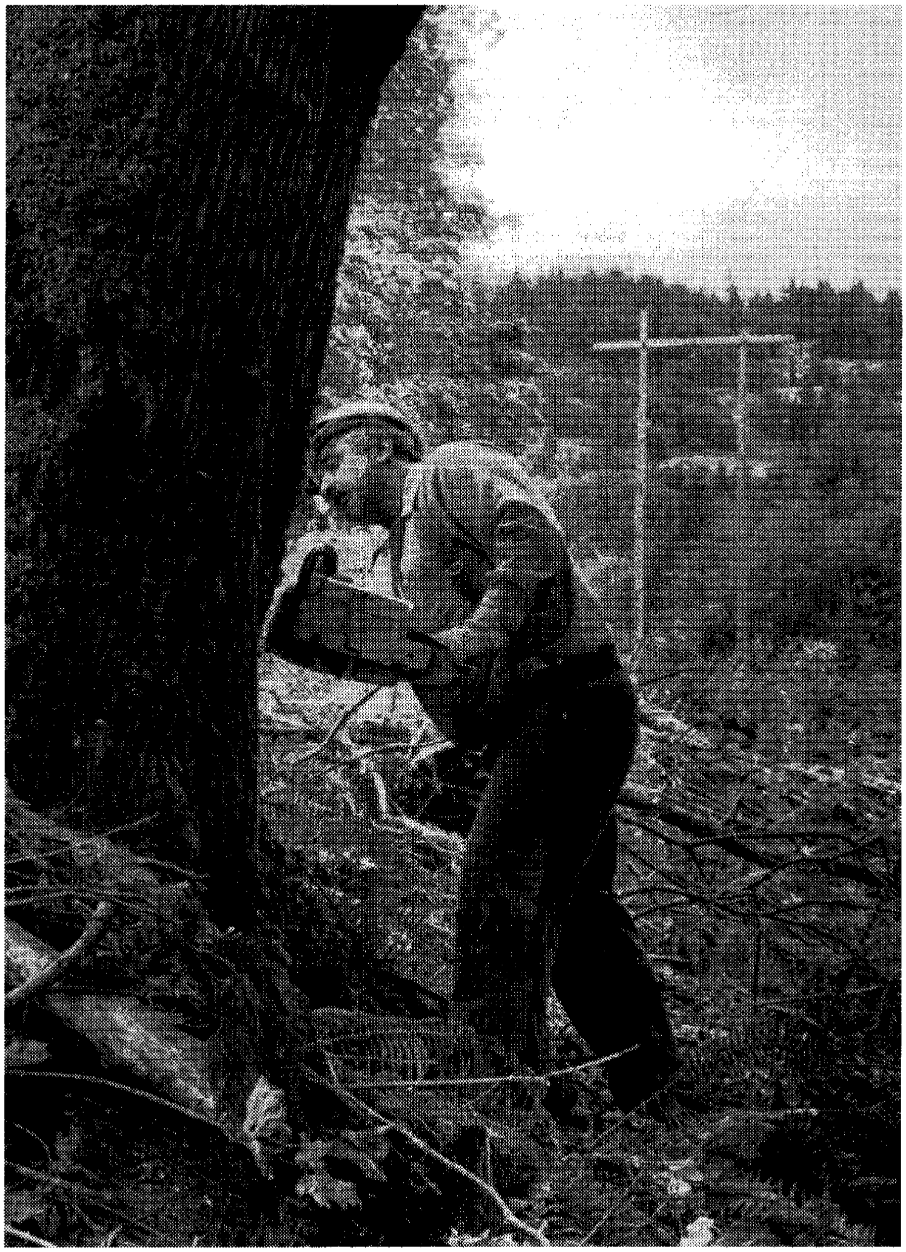

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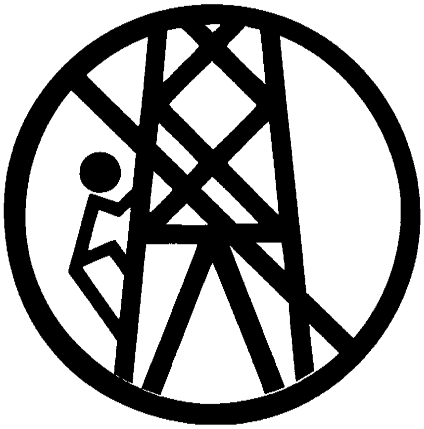

NEVER
climb towers or poles.

Concerning Towers and Conductors

- Do not climb towers.
- Do not shoot or otherwise damage insulators.
- Never touch a fallen line.
- Do not attempt to dismantal tower steel members.
- Do not apply additional loads to tower members for temporary support of a structure or vehicle.
- Stay away from towers and lines during extreme wind storms, thunder storms, ice storms or under other extreme conditions.

Preventive measures include:
- Stay away from and report broken or damaged insulators to BPA or your nearest electrical utility.
- Stay away from and report broken, damaged or abnormally low-hanging lines to BPA or your nearest electrical utility.

Conclusion

We live in an age of electric power. Almost everything we do requires it. Consequently, high-voltage power lines have become about as commonplace as the wiring in our homes — and just as safe. Nevertheless, every year people are killed or seriously injured by power lines and wiring. In almost every case, lives could have been saved and injuries avoided if the basic safety practices outlined in this booklet had been followed. BPA and your local utilities make every effort to design and build power lines that are safe to live and work around. Ultimately, however, the safety of high-voltage lines depends upon people behaving safely around them. No line can practicably be made safe from a person who, through ignorance or foolishness, violates the basic principles of safety. So, please, take time now to learn the practices outlined in this booklet. And share your knowledge with your family, friends and colleagues. Your own life, or that of a loved one, might well hang in the balance.

Related BPA Publications

Call BPA's Public Information center at **1-800-622-4520** and ask for the following publications:

1) For information on using the land within a BPA right-of-way: *"Landowner's Guide to Use of BPA Rights-of-Way"* (DOE/BP-3025)

2) For information on growing trees on a BPA right-of-way: *"Landowner's Guide to Trees and Transmission Lines"* (DOE/BP-3076)

3) For information on BPA's Danger Tree Program: *"Keeping the Way Clear for Better Service"* (DOE/BP-2816)

Bonneville Power Administration

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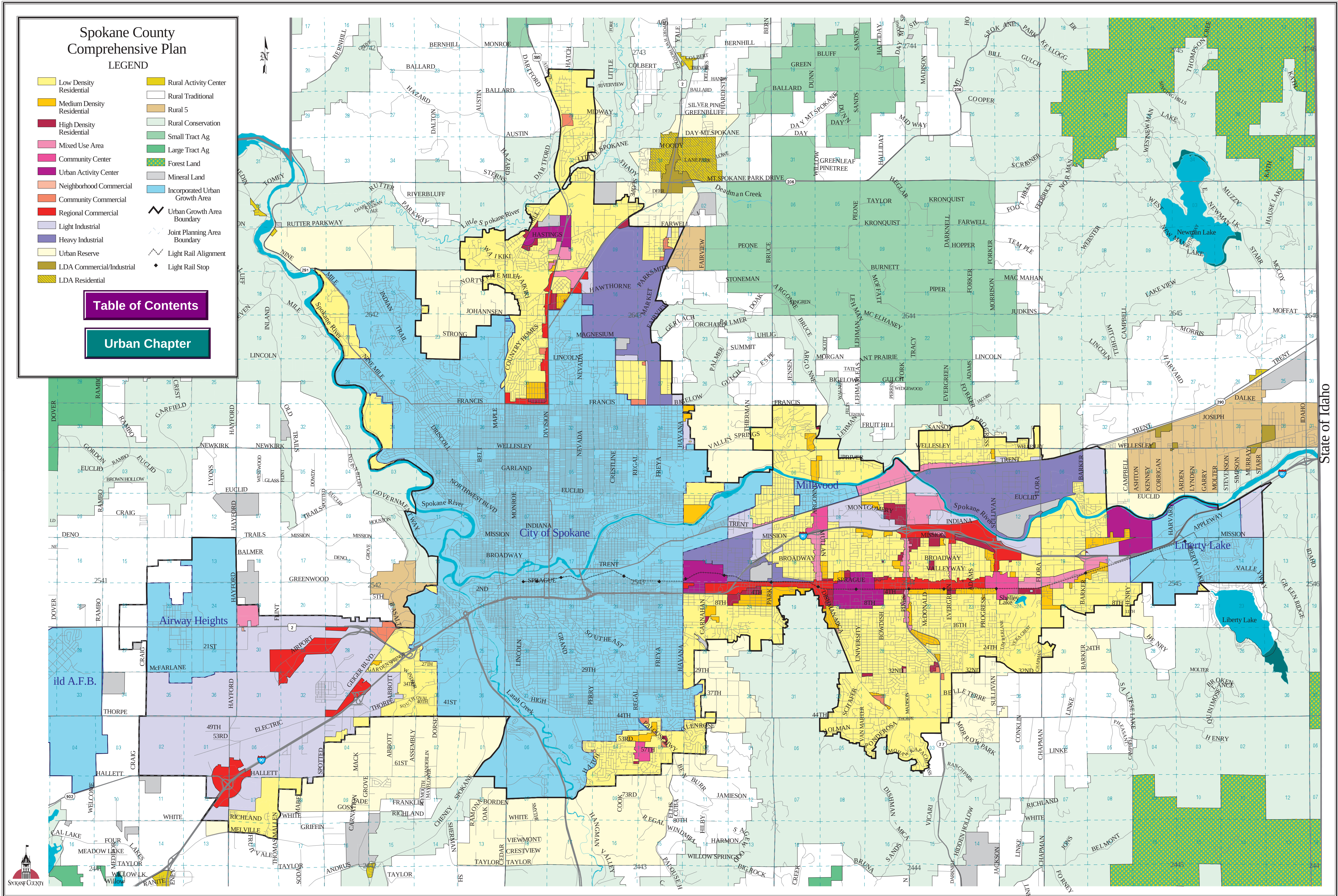
SECOND PRINTING, REVISED

GRAND COULEE– BELL 500-kV TRANSMISSION LINE PROJECT

APPENDIX E:

SPOKANE AREA ZONING MAP



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Spokane County Division of Planning

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