The site area is sufficiently distant from the CSZ, the intraplate zone, and Cascade volcanoes that earthquakes on these sources would likely be felt at the plant site, but ground motion would be less than that from large earthquakes on shallow crustal faults (Figure 3.1-1) closer to the site. The closest of these faults is the Arlington-Shutler Buttes and Luna faults approximately 50 miles to the west. The Service anticline is considered to be potentially active and is located about 10 miles to the east (Figure 3.1-1). The site is located in seismic risk zone 2b in the 1997 Uniform Building Code, whereas western Washington is located in higher seismic risk zone 3. According to seismic hazard maps published by the U.S. Geological Survey (1997) and included in the 2000 International Building Code, the site is located in the area of Washington with the lowest probabilistic ground motions used for the seismic design criteria.

Volcanic Hazards

Mount Adams is the closest volcanic source to the plant site and is located approximately 80 miles to the west. As one of the largest volcanoes in the Cascade Range, Mount Adams dominates the volcanic field in Skamania, Yakima, Klickitat, and Lewis Counties and the Yakama Indian Reservation of south-central Washington. Mount Hood is farther away to the southwest. Even though Mount Adams has been less active during the past few thousand years than neighboring Mounts St. Helens, Rainier, and Hood, it is likely to erupt again. Future eruptions will probably occur more frequently from vents on the summit and upper flanks of Mount Adams than from vents scattered in the volcanic fields beyond.

Figure 3.1-8 shows the locations of major Cascade volcanoes and principal eruptive hazard zones for each. Large landslides and debris and mudflows that need not be related to eruptions probably represent the most destructive, far-reaching hazard of Mount Adams. The plant site is sufficiently distant from Mount Adams and drainages susceptible to debris flows that it would not be affected. However, the site is located in an area susceptible to airfall ash deposition in the unlikely event of an eruption during the PGF lifetime. The site is located beyond the principal area of ash deposition shown on Figure 3.1-8, and a U.S. Geological Survey (USGS) report (USGS 1997) indicates that the site area has a 0.02 percent annual probability of 4 inches or more of airfall ash accumulation from Cascade volcanoes.

Soil Erosion Hazards

Based on the U.S. Department of Agriculture (USDA) soil erosion factors for the site area, the potential for erosion is moderate and vegetation has difficulty becoming established within the native soils. Wind erosion is influenced by the climate, vegetative cover, soil texture, soil moisture, length of the unprotected soil surface, topography, and frequency of soil disturbances. March to May is the most critical period for wind erosion in the area, although high winds can be expected year-round within the region.

3.1.1.2 Proposed Action

The topography, soils, and geology of the plant site and infrastructure corridors are described in the following sections.

3.1.1.2.1 Plant Site

Topography

The plant site is located on relatively flat ground, with a surface elevation ranging from approximately 310 to 320 feet above mean sea level. A shallow 20 percent slope borders the site on the north.

Soils and Geology

The taxonomic soil unit occupying the plant site is the Burbank loamy fine sand (Figure 3.1-3). This unit consists of excessively drained, coarse-textured soils formed in glaciofluvial deposits, mapped as outburst flood deposits [Qfg] on Figure 3.1-2. The Burbank soil typically has a 0 to 35 percent soil volume of fines (silts and clay), a low corrosivity on untreated steel pipe (7.4-8.4 pH), and a high permeability value (greater than 10 inches-per-hour).

A site reconnaissance conducted in March 2002 by a professional geologist showed that the plant site is located on medium to coarse sands that could be hand augured to depths of 2 to 3 feet before encountering gravels and cobbles. Tilling of soils in the past have brought cobbles and boulders to the surface, which have been stockpiled to the side of past agricultural fields (Figure 3.1-9A). A limited number of wells in the site area are completed through the underlying unconsolidated soils into basaltic bedrock. Bedrock elevations appear to vary significantly in the site area. Groundwater well borings encountered basalt between approximately 30 to 90 feet below ground surface (Ecology 2002; see Figure 3.3-3).

No visible rock outcrops were seen during the site reconnaissance. The existing Williams Co. compressor station located directly south of the plant site has a large excavated pit approximately 20 feet in depth to accommodate their facilities. Bedrock was not encountered during pit excavation.

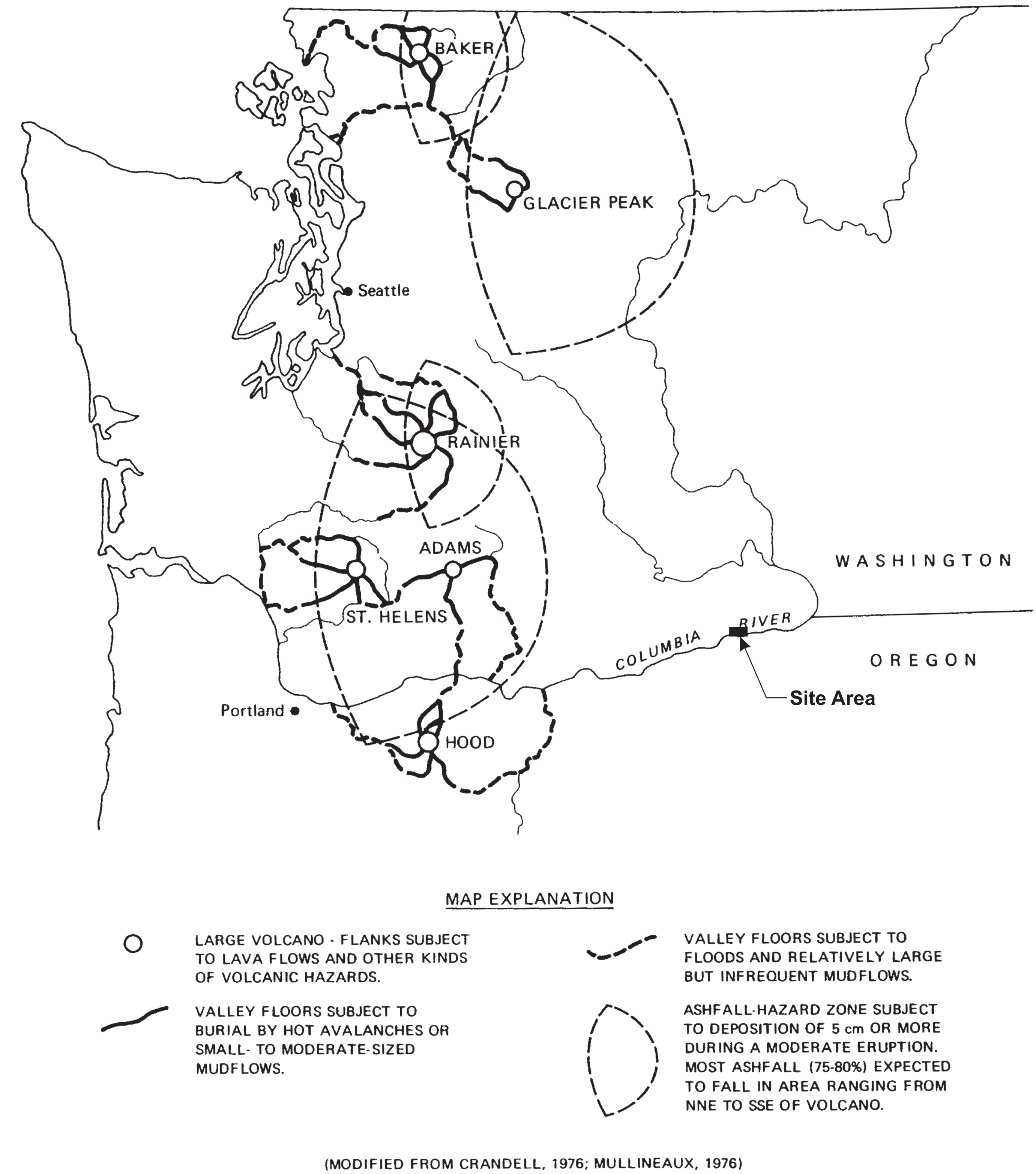
3.1.1.2.2 Transmission Interconnection

Topography

The existing topography along the proposed transmission interconnection route from the plant site to the BPA transmission right-of-way corridor is relatively flat.

Soils and Geology

The transmission interconnection route traverses both the Burbank soil underlying the plant and the Finley soil to the north (USDA 1971) (Figure 3.1-3). The Burbank soil, which consists of excessively drained, coarse-textured soils formed in glaciofluvial deposits, are mapped as outburst flood deposits [Qfg] (Figure 3.1-2), and typically have 0 to 35 percent fines, a low corrosivity on untreated steel pipe (7.4-8.4 pH), and a high permeability value (greater than 10 inches per hour). The Finley soil typically forms in deposits with the same depositional history as the Burbank soil but contains 10 to 45 percent fines, a low corrosivity on untreated steel pipe (7.4-8.4 pH), and a high permeability value (2.5 to 5 inches per hour).



0 50 100

Approximate Scale in Kilometers

Figure 3.1-8

Locations of Major Cascade Volcanoes and Principal Eruptive Hazard Zones for Each

URS

Plymouth Generating Facility
Plymouth, Washington

Figure 3.1-8 (Continued)

A. Cobbles and boulders stockpiled adjacent to plant site.

B. Christy Road borrow pit.

Figure 3.1-9A and B

Subsurface Soils

URS

Plymouth Generating Facility
Plymouth, Washington

Figure 3.1-9 (Continued)

No subsurface investigation was conducted along the transmission interconnection route, but subsurface geologic conditions are expected to be similar to those beneath the plant site. The transmission towers would be founded in soils similar to soils underlying the plant site (glaciofluvial deposits of sands and gravel).

3.1.1.2.3 Access Road

Topography

The construction and operation access road would involve extending an existing industrial access road that intersects State Route (SR) 14 approximately 1.85 miles west of its intersection with Interstate 82 (I-82). The route from SR 14 is relatively flat before descending 50 feet into and across Fourmile Canyon. The route is flat from Fourmile Canyon to the plant site.

Fourmile Canyon is an intermittent drainage, which flows to the south and is tributary to the Columbia River. Fourmile Canyon is aligned north-south and located approximately 2,000 feet northeast of the plant site. During a site reconnaissance in March 2002, a professional geologist noted that the canyon has a flat base confined within gently rolling sides. The mouth of Fourmile Canyon is located 1,000 feet northeast of the plant site and is relatively level with no visible channel present. However, surface flows further south of the canyon mouth are concentrated in a shallow flat channel directly east of the plant site. This channel is more developed as it reaches the Burlington Northern Santa Fe (BNSF) railroad tracks. Estimated maximum heights of the channel bank range from 5 to 10 feet, with channel widths ranging from 60 to 70 feet along its length.

Soils and Geology

The access road would traverse both the Burbank taxonomic soil on the flat area near the plant, and the Finley soil within Fourmile Canyon prior to connecting with SR 14 (Figure 3.1-3). These soils have characteristics as described in Section 3.1.1.2.2.

The channel floor of Fourmile Canyon was dry at the time of inspection (March 2002). The floor consists of recent alluvial sands, gravel, and cobbles with stockpiled boulders from tilled fields on the west side of the Fourmile Canyon.

As shown in Figure 3.1-2, loess soil is present along 80 percent of the access road alignment, starting at SR 14. Loess is unconsolidated, wind-deposited sediment composed largely of silt-sized quartz particles that show little or no stratification. In some places, this soil structure allows vertical or near-vertical cuts exceeding 50 feet in height (Galster 1989) to remain stable provided the soil water content of the soil remains low. Conversely, when it becomes wet, loess becomes relatively unstable, and slump failures (instability features) can occur.

3.1.1.3 Alternate 230-kV Transmission Interconnection

The existing condition for the alternate 230-kV transmission interconnection is the same as for the proposed transmission interconnection because the 230-kV line is located in the same physical location as the proposed 500-kV line.

3.1.1.4 Alternate Benton PUD/BPA Transmission Interconnection

The geology for the alternate Benton Public Utility District (PUD)/BPA transmission interconnection is essentially the same as the plant site except where field observations indicate differences in the surficial deposits as described.

Topography

The existing topography along the alternate Benton PUD/BPA transmission interconnection route from the plant site east is relatively flat.

Soils

The alternate Benton PUD/BPA transmission interconnection would traverse both the Burbank soil underlying the plant and the Finley soil to the south. Small pockets of the Pasco series and Dune land taxonomic soil units are also crossed (Figure 3.1-3).

The Burbank and Finley soil units are described in Section 3.1.1.2.2. The Dune sand unit consists of excessively drained, very deep, loose fine sand that shifts in the wind. The Pasco soils formed on recent alluvium deposited in ponded areas. These soils are classified as silt loam containing 65 to 75 percent fines, a high corrosivity on untreated steel pipe (6.6-8.4 pH), and a low permeability value (0.8 to 2.5 inches-per-hour).

During the site reconnaissance in March 2002, a professional geologist noted that the alternate Benton PUD/BPA transmission interconnection route west of Plymouth is located on medium to coarse sands that could be hand augured to depths greater than 4 feet without encountering gravels or cobbles. Dune sand is exposed in a borrow pit located 1,000 feet west of where the Benton PUD right-of-way turns north from Christy Road (see Figures 3.1-2 and 3.1-9B). East of Plymouth, surficial soils consisting of wet silty sand and silt deposits were encountered with a hand auger at depths of 2 to 3 feet below the ground surface.

3.1.1.5 Access Alternative

The geology for the access alternative is essentially the same as the plant site except where field observations indicate differences in the surficial deposits as described.

Topography

The alternate construction and operation access road alignments are relatively flat along their entire lengths.

Soils and Geology

Alternate Construction Access Road

During the March 2002 site reconnaissance, a professional geologist noted the section of the alternate construction access road alignment from the plant to Christy Road is located on fine to medium sands that could be hand augured to depths greater than 4 feet without encountering gravels or cobbles. Surficial soils and subsurface geology are expected to be similar to the plant site. The construction access road would then travel west along the paved Christy Road before traveling north to meet SR-14.

The north trending section of the alignment is along an existing unpaved road that crosses the Finley and the Quincy soil units (Figure 3.1-3). These soils are classified as loamy sands. The Finley soil is described in Section 3.1.1.2.2. Quincy soils are excessively drained, coarse-textured soils (loamy fine sand) on an elongate, narrow ridge of windblown soils at the base of the terrace slope north of the plant site. These soils have a severe erosion potential.

Alternate Operation Access Road

The alternate operation access road would traverse both the Burbank soil underlying the plant and the Finley soil (Figure 3.1-3) to the south near where it connects with Christy Road. These soils are described in Section 3.1.1.2.2.

As noted in Chapter 2, Project Description, the alternate operation access road would follow the route of an existing unpaved road before it connects with Christy Road. During installation of the existing transmission towers along the existing unpaved road, bedrock was not encountered; these poles are installed to a depth of approximately 6 feet below the ground surface.

3.1.2 ENVIRONMENTAL CONSEQUENCES

3.1.2.1 Methodology

Impacts to earth resources were assessed by first assessing potential impacts from regional geologic and seismic hazards on the PGF and alternatives. Second, the level of potential impact to the geologic environment attributable to construction and operation of the PGF and alternatives was determined. Potential impacts of the first type would include impacts from unique geologic features (earthquakes and volcanoes). Impacts of the second type would include erosion, topographic modification and depletion of mineral or petroleum resources.

Four factors were considered in the evaluation of the level of earth impacts: magnitude, geographic extent, duration/frequency, and likelihood. The magnitude of impact reflects relative size or amount of an impact. The geographic extent of an impact considers how widespread the project impact might be. The duration and frequency of an impact (whether the impact is a one-time event, intermittent, or chronic) also helps define its limits. The likelihood of an impact is the final evaluation factor. By considering each of these factors, the evaluation of impacts was kept uniform and systematic. The following impact ratings were used in this section: high (significant), moderate, low, and no impact. Table 3.1-1 shows significance criteria and the methodology for assigning ratings.

Table 3.1-1
Significance Criteria

Impact Rating	Level of Impact			
	Magnitude	Geographic Extent	Duration and Frequency	Likelihood
High (Significant)	High	High	Any level	High
Low to Moderate	Low	High	Low	Low
	Low	High	Low	High
No impact	Low	Any Level	Any level	Low

3.1.2.2 No Action Alternative

There would be no earth-related impacts associated with the No Action Alternative.

3.1.2.3 Proposed Action

As discussed in Section 3.1.1.1.4, of the potential geologic hazards, only erosion, volcanism, and earthquake-induced ground shaking are considered to be potential hazards at the plant site. These are described in the following sections.

3.1.2.3.1 Site Area

Erosion

Erosion is considered a site-specific hazard and therefore is discussed in detail below for each project component. The potential for erosion resulting from the PGF would primarily occur during construction. Based on the USDA soil erosion factors for the plant site, the potential for erosion is classified as "moderate," and establishing vegetation within the native soils after site grading could be difficult without adding topsoil or other amendments.

Once soil in the site area is disturbed, the most critical time for wind erosion is from March to May, although high winds can be expected year-round. Erosion by stormwater runoff would be greatest during the rainy season (October to May). The location and size of disturbed areas vary among project components. Generally, impacts associated with erosion are considered significant. However, with proper mitigation and implementation of best management practices (BMPs) prescribed in the Stormwater Pollution Prevention Plan (SWPPP) and National Pollutant Discharge Elimination System (NPDES) permit, the overall impact would be low to moderate, and therefore less than significant.

Volcanism

Figure 3.1-8 shows the locations of major Cascade volcanoes and the principal eruptive hazard zones for each. A USGS report (USGS 1995) notes that the site area has a 0.02 percent annual probability of 4 inches or more of tephra accumulation (volcanic rock and glass fragments generated by explosive eruptions) from Cascade volcanoes. Given the low probability of an eruption and small predicted ash accumulation, the potential hazard from volcanism is considered to be low, and therefore less than significant.

Earthquakes

As discussed in Section 3.1.1.1.4, the site area is subject to periodic ground shaking from earthquakes. The intensity of the shaking is dependent upon three factors: the magnitude of the earthquake, the distance between the earthquake epicenter and the site, and the response of the onsite soils to the motions induced by the earthquake. Based on the 1997 Uniform Building Code, the site is classified in seismic risk zone 2b. The 2000 International Building Code indicates the lowest probabilistic derived design ground motions in the state for the site area. Although the potential for earthquake-induced strong ground motion would exist at the plant site during the project lifetime, the hazard is lower than in western Washington and similar to other sites in the region. Potential impacts from strong ground motion would be reduced by project design features (discussed in Section 3.1.3) to low and therefore less than significant levels.

Due to the dense condition of the granular soils, the likelihood that liquefaction would occur (the transformation of a soil from a solid to a liquid state as the result of increased pore pressure) during an earthquake event would be low.

3.1.2.3.2 Plant Site

Construction

The following types of grading and excavation would be performed during project construction:

- General grading to prepare for construction and for a construction lay-down area
- Grading the footprint areas for project facilities
- Foundation excavations for the combustion turbine, heat recovery steam generator (HRSG), stream turbine, transformers, tanks, and other project facilities
- Excavation for the wastewater pond and stormwater pond
- Excavation of trenches for the water supply/wastewater pipeline and gas pipeline

All onsite grading would be designed to achieve a balanced cut and fill. A minimal amount of fill material would be imported to the site, and no excavated material would be exported from the site. Material excavated to construct the stormwater and wastewater ponds would be used to construct a berm around the pond areas.

Excavation of foundations for the plant and stormwater/wastewater ponds would increase the potential for wind and water erosion. The duration of the impact would be relatively short, but the intensity could be high, based on the native soils onsite and their “moderate” erosion potential (based on USDA soil erosion factors).

Trench excavations would extend approximately 4 feet below the ground surface and would be backfilled after pipeline installations. Implemented project design features (discussed in Section 3.1.3) would reduce the impact to low and therefore less than significant.

Operation

After completion of construction and revegetation, erosion impacts during project operation are expected to be low and therefore less than significant.

The stormwater/wastewater ponds would be constructed by ground excavation and lined to protect against seepage of water into the soils. However, no liner is totally impermeable and the ponds can be expected to seep small amounts of water over a long period of time. This seepage has the potential to erode and transport the soils, and cause sloughing and instability of the pond sideslopes. Given the shallow depths of these ponds, the large time duration over which these impacts would occur, and the ability to repair and mitigate this erosion impact were it to occur, the overall impact would be considered low and therefore less than significant.

3.1.2.3.3 Transmission Interconnection

A new transmission interconnection would be built in a northerly direction from the plant site to intersect with the existing BPA transmission right-of-way corridor. This new interconnection would include the construction of four to six towers. It is expected that subsurface soils down to 6 feet would be excavated using an auger drill.

Impacts associated with construction of the transmission interconnection would include wind erosion and surface erosion, which would last until construction is complete. The disturbed areas necessary for construction are small and the duration short. Therefore, the impact is considered less than significant with implementation of BMPs for erosion control in accordance with the SWPPP and stormwater permit.

Following completion of construction and revegetation, erosion impacts on the earth during operation of the transmission interconnection are expected to be low and therefore less than significant.

3.1.2.3.4 Access Road

The total volume of soil that would be removed due to the alternate access road construction is 5,837 cy, of which 4,997 cy would be used for fill. The remaining 840 cy would be used in construction of the wastewater storage pond or the temporary rail offload platform.

The construction of the earthfill road with culverts for seasonal flows down Fourmile Canyon would provide capacity for all anticipated flow conditions. Embankments constructed for the earthfill road crossing and for the portion of the access road traversing the east side of Fourmile Canyon would create the potential for wind and water erosion, which is considered a high and significant impact; however, implementation of BMPs in accordance with the SWPPP and NPDES would reduce this impact to low to moderate and therefore less than significant levels.

Following completion of construction and implementation of project design features (see Section 3.1.3), impacts on the earth during operation of the access road are expected to be low and therefore less than significant.

3.1.2.4 Alternate 230-kV Transmission Interconnection

Impacts would be the same as for the proposed transmission interconnection because the 230-kV and the proposed 500-kV lines have the same physical location.

3.1.2.5 Alternate Benton PUD/BPA Transmission Interconnection

The alternate Benton PUD/BPA transmission interconnection would require rebuilding the existing Benton PUD 115-kV line, which is located along Christy Road and extends to the Columbia River crossing where it interconnects to the BPA McNary Substation. Rebuilding would involve the excavation of a small amount of soil adjacent to the existing towers.

Impacts associated with construction of the alternate Benton PUD/BPA transmission interconnection would include wind erosion. This impact would be considered low and therefore less than significant due to the short duration of construction and small amount of excavated soils involved. Impacts would be reduced through the implementation of standard construction erosion control. BMPs would be implemented in accordance with the NPDES and SWPPP.

Following completion of construction of the alternate Benton PUD/BPA transmission interconnection and implementation of project design features (see Section 3.1.3), impacts on the earth during operation are expected to be low and therefore less than significant.

3.1.2.6 Access Alternative

3.1.2.6.1 Alternate Construction Access Road

In order to construct the alternate construction access road, road improvements would be completed along portions of farm roads to connect the site to Christy Road and SR 14. Currently, 70 percent of the alternate construction access road alignment is paved. Impacts associated with the improvements would include wind and water erosion. Due to the short section that would be improved, these impacts are considered to be low and therefore less than significant. Impacts would be reduced through the implementation of standard construction erosion control measures.

3.1.2.6.2 Alternate Operation Access Road

Construction of the alternate operation access road (i.e., paving of the unpaved portion of the road), revegetation and operation of the road would result in low to moderate and therefore less than significant impacts on the earth.

3.1.3 SUMMARY OF IMPACTS

The impact assessment for earth resources is based on the criteria outlined in Section 3.1.2.1, Methodology. Based on the criteria used for this analysis, high or significant impacts to earth resources are not expected as a result of the proposed project or project alternatives. Generally, construction-related activities would result in higher potential impacts when compared to operation, because the magnitude and extent of area of disturbance would be greater. Impacts