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WASHINGTON WINDPLANT #1

BOTANICAL RESOURCES FIELD SURVEY

PREPARED FOR
KLICKITAT COUNTY PLANNING DEPARTMENT
BONNEVILLE POWER ADMINISTRATION

APPENDIX B to Washington Windplant #1 EIS

DECEMBER 1994

R·W·BECK

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1.0 Introduction

KENETECH Windpower, Inc., has applied to Klickitat County for a conditional use permit to construct and operate a 115 Megawatt windfarm on an approximately 5110 hectare (12,630 acre) site in the Columbia Hills near Goldendale, Washington. A transmission services agreement between the Bonneville Power Administration (BPA) and utilities purchasing the Project's output will also be required. Klickitat County and BPA initiated the preparation of a joint SEPA/NEPA Environmental Impact Statement, under the authority of the Washington State Environmental Policy Act and the National Environmental Policy Act. The EIS addresses, among other issues, the Project's potential impact on rare, threatened or endangered, and sensitive plant species and communities as well as plant species of potential cultural importance.

A field survey along potential impact corridors (turbine strings, roadways, and the transmission line alignment) was conducted between April and June, 1994 in order to identify rare plant species, high-quality native plant communities, and plant species of potential cultural importance present in these corridors. In addition, habitat maps of the entire 5110-ha project area were field verified. This report contains the results of that survey and an assessment of the potential project impacts.

2.0 Study Methods

2.1 Study Objectives and Pre-Survey Investigations

Study objectives and methods were defined in consultation with resource agencies. The objectives of this study were to:

1. Investigate herbaria records, rare plant inventories, available literature and technical reports, and to consult with state, federal, and tribal resource specialists to obtain site and habitat data concerning rare species or species of potential cultural importance likely to occur in the project area, and to use this information to prepare a target plant species list.

2. Locate suitable habitat for target rare plant species within the entire 5110-ha project area and identify target species found in surveys of corridors.

3. Describe and map the habitat types present in the entire project area.

4. Provide information on plant community composition in sufficient detail to determine the abundance and location of plant species of potential cultural importance in surveyed corridors.

5. Observe and document unique botanical habitats and features in surveyed corridors.

6. Report on survey methods, results, and assess project-related effects.

7. Provide recommendations for mitigation.

2.1.1 Pre-survey Investigations

Pre-survey investigations were conducted in order to develop a target list of rare, threatened or endangered, and sensitive plant species; and plant species of potential cultural importance possibly occurring in the entire project area. These investigations included literature review, consultation with the Washington and Oregon Natural Heritage Programs, University herbaria, and knowledgeable individuals. In addition, a list of culturally important plants was provided by the Yakama Indian Nation's botanist. Lists of rare, threatened, endangered, or sensitive plant species, native plant communities, and plants of potential cultural importance with the potential to occur within the project area were developed as a result of these pre-survey investigations.

2.1.2 Special Status Plant Species

After initial visits to the project area in April 1994, the list of target plant species identified in pre-survey investigations was revised in order to reflect the occurrence of particular habitat types within the project area. Robinson's onion (*Allium robinsonii*), Wormskiold's northern wormwood (*Artemisia campestris* spp. *borealis* var. *wormskioldii*), and liverwort monkey-flower (*Mimulus jungermannioides*) were dropped from the list of target species because they are restricted to habitats not occurring within the project area. Palouse milk-vetch (*Astragalus arrectus*), Barnaby's pauper milk-vetch (*Astragalus misellus* var. *pauper*), few-flowered collinsia (*Collinsia sparsiflora* var. *bruciae*), beaked cryptantha (*Cryptantha rostellata*), white meconella (*Meconella oregana*), and marigold navarretia (*Navarretia tagetina*) were added because potentially suitable habitat for these species occurs within the project area. The final list of target plant species is provided in Table 1.

2.1.3 Native Plant Communities

High-quality native plant communities defined in the draft Washington Natural Heritage Plan (Washington Natural Heritage Program, 1993) were identified and mapped in the surveyed corridors. Minimum criteria for the occurrence of a high-quality native community, as described in the Natural Heritage Plan, are:

1. Dominance of native species, with tree layers composed only of native species and at least 80% of shrub and herb layers consisting of native species;

2. Insignificant disturbance to vegetation by human activities that alter within-community processes; and

3. A large enough area to accomodate within-community processes (at least one acre for grasslands).

Prior to field surveys, high-quality examples of the bluebunch wheatgrass-Sandberg's bluegrass (*Agropyron spicatum-Poa secunda*) lithosol, Idaho fescue-houndstongue hawkweed (*Festuca*

idahoensis-Hieraceum cynoglossoides), northern buckwheat/Sandberg's bluegrass (*Eriogonum compositum/P. secunda*), and Douglas' buckwheat/Sandberg's bluegrass (*Eriogonum douglasii/ P. secunda*) associations had been identified in the eastern portion of the project area (Washington Natural Heritage Information System, 1994).

High-quality native plant communities included in the final survey plan are listed in Table 2. Additional high-quality native plant communities and priority wildlife habitats not included in the final survey plan, but identified during the field survey were the thyme-leaved buckwheat/ Sandberg's bluegrass (*Eriogonum thymoides/P. secunda*), stiff sagebrush/Sandberg's bluegrass (*Artemisia rigida/P. secunda*), and the Oregon white oak-ponderosa pine (*Q. garryana-Pinus ponderosa*) associations.

2.1.4 Plant Species of Potential Cultural Importance

Species of potential cultural importance likely to occur in the project area were identified from a list provided in the Hanford Cultural Resources Management Plan and provided by a Yakama Indian Nation botanist (Robson, 1994). When target ethnobotanical species were encountered, their abundance was visually assessed as high (dominant or co-dominant in the community), moderate (abundant but not dominant), or low (present at low density and/or cover).

2.1.5 Habitat Types

During pre-survey investigations, general habitat types occurring within the 5110-ha project area were mapped by from aerial photographs and existing habitat mapping. Habitat types included oak and oak-pine woodlands, agricultural land, rangeland, juniper woodland, native shrub-steppe communities, wetlands, and riparian areas. Wetlands in the project area were mapped using aerial photos, unpublished soil survey, information from the Natural Resources Conservation Service (formerly Soil Conservation Service), and National Wetlands Inventory (U.S. Department of the Interior, 1981) maps.

The Washington Department of Fish and Wildlife, Division of Wildlife Priority Habitats and Species Program has identified a number of priority habitats based on their unique or significant value to wildlife species. Priority habitats occurring within the project area include Oregon white oak (*Quercus garryana*) woodland, juniper savannah (*Junipens occidentalis*), shrub-steppe, and riparian.

TABLE 1.
SPECIAL STATUS PLANT SPECIES INCLUDED IN THE FINAL SURVEY PLAN

Plant Species	Status		Habitat Associations
	Federal (USFWS)	State (Washington Natural Heritage Program)	
palouse milk-vetch (Astragalus arrectus)	—	S	Grassy, sagebrush flats, river bluffs, and open pine forests
Barnaby's pauper milk-vetch (Astragalus misellus var. pauper)	—	S	Sagebrush zones
few-flowered collinsia [1] (Collinsia sparsiflora var. bruciae)	—	S	Open grassy slopes and swales
beaked cryptantha (Cryptantha rostellata)	—	S	Dry open places
Douglas' draba (Draba douglasii)	—	S	Exposed rocky and shallow soils of dry areas
smooth desert-parsley[1] (Lomatium laevigatum)	—	S	Basalt cliffs
white meconella (Meconella oregana)	C2	T	Open oak groves with bunchgrasses such as Idaho fescue
marigold navarretia (Navarretia tagetina)	—	T	Dry streambeds and gravelly washes near Columbia Gorge
hot-rock penstemon (Penstemon deustus var. variabilis)	—	S	Dry foothills of lowlands and open grassy slopes
obscure buttercup (Ranunculus reconditus)	C1	T	Open meadows associated with phlox, desert parsley, and buckwheat
common blue-cup (Githopsis specularioides)	—	S	Dry open spaces
Suksdorf's desert parsley (Lomatium suksdorfii)	C	S	Dry open slopes
Suksdorf's monkey-flower (Mimulus suksdorfii)	—	S	Open moist to dry areas in valleys and foothills to moderate elevations in mountains

Notes: C1 = Category 1 Candidate (USFWS has substantial evidence to support listing)
C2 = Category 2 Candidate (Conclusive evidence to support listing is lacking)
S = Sensitive (State only)
T = Threatened

TABLE 2.
HIGH-QUALITY NATIVE PLANT COMMUNITIES (MEETING CRITERIA ESTABLISHED IN THE DRAFT WASHINGTON NATURAL HERITAGE PLAN)[1]

bluebunch wheatgrass-Sandberg's bluegrass (Agropyron spicatum-Poa secunda) Lithosolic Phase Community
northern buckwheat/Sandberg's bluegrass (Eriogonum compositum/P. secunda) Community
Douglas' buckwheat/Sandberg's bluegrass (Eriogonum douglasii/P. secunda) Community
Idaho fescue/houndstongue hawkweed (Festuca idahoensis/Hieraceum cynoglossoides) Community
bluebunch wheatgrass-Idaho fescue (A. spicatum-F. idahoensis) Community
Oregon white oak (Quercus garryana) woodland

[1] All of these communities were confirmed on the Project site. Additional native shrub-steppe plant communities were identical during field surveys. They included: thyme-leaved buckwheat/Sandberg's bluegrass, stiff sagebrush/Sandberg's bluegrass, and Oregon white oak-ponderosa pine associations.

2.2 Field Survey Methodology

Field surveys for target plant species and communities were conducted between April and June, 1994. The surveys were timed to coincide with the seasons of flowering and fruiting of target plant species.

After initial reconnaissance of the entire 5110-ha project area to verify habitat mapping, systematic ground surveys were performed by walking meandering 300-foot-wide transects along turbine strings and transmission corridors. In each transect, notes were made of habitat characteristics, species composition, and abundance of plant species of potential cultural importance. Areas considered to be suitable habitat for target rare species (see Table 1) were revisited several times to account for differing flowering and fruiting times among target species. Any unique botanical habitats or features were noted. High-quality native plant communities (Table 2) and their locations with respect to corridors were recorded. At the time of field surveys, proposed turbine string endpoints were staked on the ground, but the transmission corridor alignment was not. Therefore, the location and boundaries of plant communities with respect to the transmission corridor are approximate. In addition, at the time of field surveys, the Applicant had not identified certain roadway alignments. Field surveys of the following entire areas were, therefore, conducted: T3N, R16E (southern 1/2 of the southeast 1/4 of Section 14 and northern 1/2 of Section 23); T3N, R18E (southwest 1/4 of Section 4. Eastern 1/2 of the southwest 1/4 and western 1/2 of the southeast 1/4 of Section 6).

Maps of habitat types within the entire project area were field-verified and corrected. These habitat types were delineated on U.S. Geological Survey 7.5" topographic maps. Wetland locations and types were also field-verified. In addition, any wetlands that were not mapped but were identified during field surveys were noted.

3.0 Field Survey Results

3.1 Habitat Types in the Project Area

Maps of habitat types occurring within the project area are provided in Figure 1. The following habitat types were observed within the project area:

Oak and oak-pine stands. Oregon white oak (*Quercus garryana*) and Oregon white oak-ponderosa pine (*Q. garryana-Pinus ponderosa*) stands occur in drainages, primarily on northern exposures in the project area. Oregon white oak is the dominant overstory species; ponderosa pine is often abundant. Occasionally, western juniper (*Juniperus occidentalis*) is present on drier sites, especially on woodland margins. In more open woodlands that are undisturbed by livestock or wood cutting, Idaho fescue (*Festuca idahoensis*) is an important understory species. Stands of Douglas fir (*Pseudotsuga menziesii*) and ponderosa pine surround several old homesteads in the project area. Oak and oak-pine woodlands consist of areas where tree cover exceeds 25%; "scattered oak and oak-pine" denotes areas of less than 25% tree cover (Figure 1).

Cultivated or recently cultivated land. The project area contains both currently-cultivated and recently-abandoned farmland, including Conservation Reserve Program (CRP) areas seeded with intermediate wheatgrass (*Agropyron intermedium*). Alfalfa and wheat are the primary agricultural crops.

Rangeland. A large proportion of the project area consists of grazed rangeland, including degraded grasslands and improved pasture. Most of these areas are dominated by grazing-tolerant exotic grasses, especially cheatgrass (*Bromus tectorum*) and weedy forbs. This habitat type includes areas where gray rabbitbrush (*Chrysothamnus nauseosus*) is abundant. Although small areas (especially on steep slopes) are dominated by native vegetation, this habitat type generally supports less than 50% cover of native species and the habitat value of remaining small areas of native vegetation is generally low.

Juniper woodland. Scattered western juniper (*Juniperus occidentalis*) occupies many upper south-facing slopes in the project area, primarily on steep slopes immediately below the crest of the Columbia Hills. Bluebunch wheatgrass (*Agropyron spicatum*) frequently dominates the understory, although in many areas cheatgrass (*Bromus tectorum*) and other weedy grasses and forbs are dominant. Juniper woodlands are areas where juniper cover exceeds 25%; "scattered juniper" indicates areas where juniper cover is less than 25% (Figure 1).

Native shrub-steppe communities. High- and moderate-quality native bunchgrass communities dominated by bluebunch wheatgrass (*Agropyron spicatum*) and/or Idaho fescue (*Festuca idahoensis*) occur within a larger matrix of more degraded rangeland throughout the project area. High- and moderate-quality examples of the Douglas' buckwheat/Sandberg's bluegrass (*Eriogonum douglasii/Poa secunda*) community type occur on lithosols (shallow, rocky soils), which are present along the crest and upper north-facing slopes of the Columbia Hills. Smaller areas of the northern buckwheat/Sandberg's bluegrass (*Eriogonum compositum/P. secunda*), thyme-leaved buckwheat/Sandberg's bluegrass (*Eriogonum thymoides/P. secunda*) and stiff sagebrush/Sandberg's bluegrass (*Artemisia rigida/P. secunda*) community types are interspersed within the Douglas' buckwheat/Sandberg's bluegrass type. Bottlebrush squirreltail (*Sitanion hystrix*), gray rabbitbrush (*Chrysothamnus nauseosus*), western yarrow (*Achillea millefolium*), wild buckwheats (*Eriogonum* spp.), and desert-parsleys (*Lomatium* spp.), but not *Lomatium laevigatum* are generally also present. On very exposed sites along the crest of the Columbia Hills, overall plant cover of these shrub-steppe communities is very low because of the harsh environment.

Wetlands. Wetlands constitute a very minor part of the project area. Most wetlands mapped by the National Wetland Inventory actually consist of excavated stockponds, are heavily used by livestock, and are very degraded. Many are entirely devoid of vegetation. In less heavily utilized areas, and where water is semipermanent, willows (*Salix* spp.), common cat-tail (*Typha latifolia*), western serviceberry (*Amelanchier alnifolia*), and chokecherry (*Prunus emarginata*) are occasionally present.

Riparian areas. Riparian areas are very limited in extent within the project area. Oregon white oak (*Quercus garryana*) and black cottonwood (*Populus trichocarpa*) occur along several intermittent streams. These occur occasionally at low elevations or on southern exposures. Most (but not all) riparian areas on the south-facing side of the project area are eroded and low in vegetation cover because of heavy livestock use.

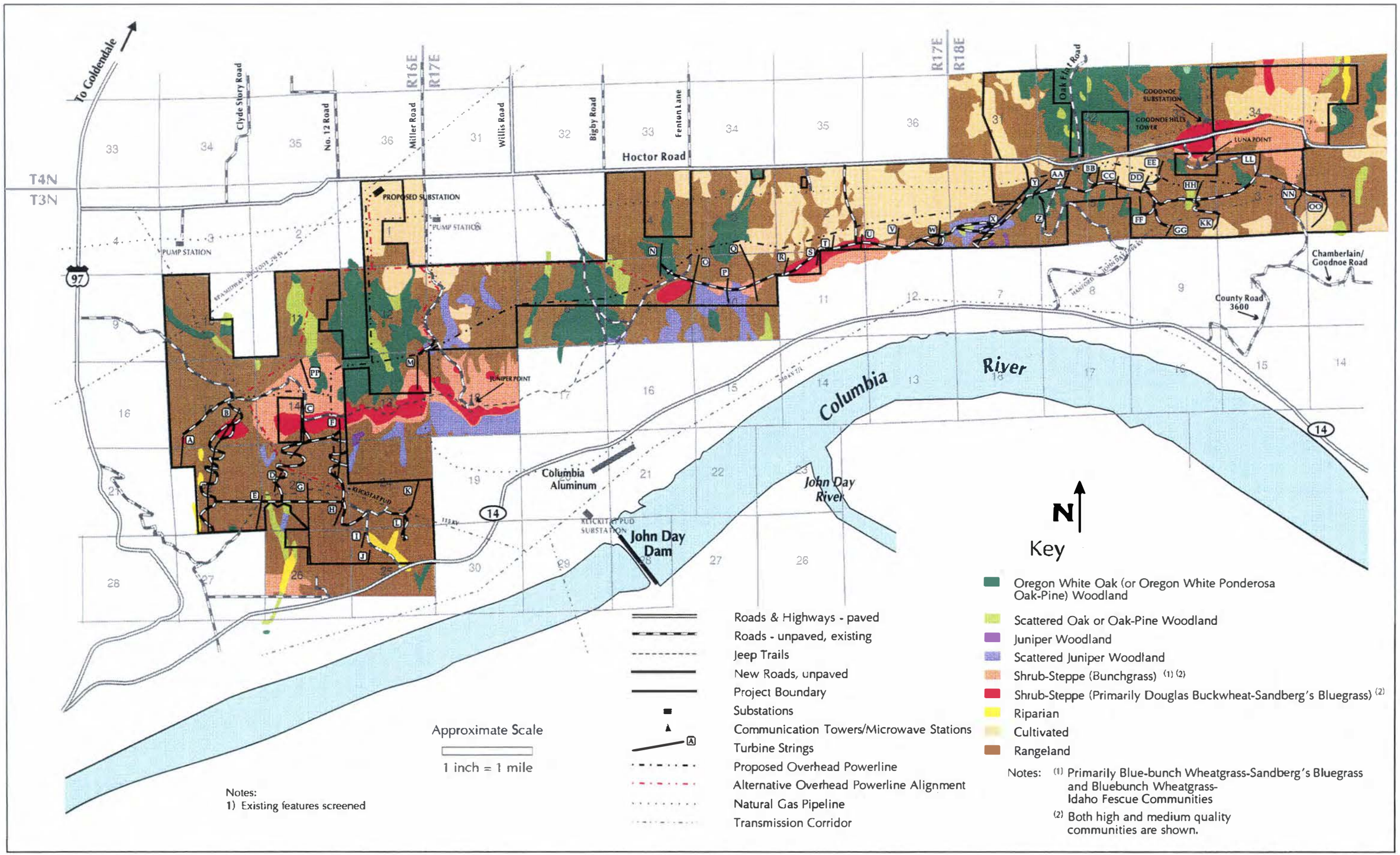

Figure 1 — Plant Communities/Habitat Map

3.2 Special-Status Plant Species in Surveyed Corridors

No target rare plant species (Table 1) were encountered during field transect surveys.

3.3 High-Quality Native Plant Communities in Surveyed Corridors

Field transect surveys confirmed the presence of several high-quality native plant communities in the surveyed areas. The locations of these communities are shown in Table 3 and Figure 1. Areas of communities within surveyed corridors potentially impacted by the proposed Project were calculated on the assumption of 100-foot disturbance width along turbine strings and 20-foot disturbance width along transmission lines. High-quality native plant communities encountered include:

3.3.1 Douglas' buckwheat/Sandberg's bluegrass (Eriogonum douglasii/Poa secunda) Community

This community type is characterized by a low shrub layer dominated by Douglas' buckwheat and a carpet of Sandberg's bluegrass. The association contains a diversity of native species, including many of potential cultural importance. A conspicuous feature of this native community is the cryptobiotic crust, composed of lichens, mosses, and cyanobacteria, which forms a layer on the soil surface. Within the surveyed corridors, this community occupies lithosols (shallow, rocky soils) which occur primarily in a narrow band along the crest of the Columbia Hills. Elevated mounds of deeper soils, dominated by bluebunch wheatgrass (*Agropyron spicatum*), Sandberg's bluegrass, and scattered clumps of gray rabbitbrush (*Chrysothamnus nauseosus*), often occur. Species characteristic of the bluebunch wheatgrass-Sandberg's bluegrass community (see section 3.3.2) are generally associated with these mounds.

3.3.2 Bluebunch wheatgrass-Sandberg's bluegrass (Agropyron spicatum-Poa secunda) Lithosolic Phase Community

This community is characterized by the dominance of bluebunch wheatgrass and Sandberg's bluegrass. Bluebunch wheatgrass grows as a dense bunchgrass layer, Sandberg's bluegrass typically forms a layer within 5 cm of the soil surface, and gray rabbitbrush (*Chrysothamnus nauseosus*) is often present. Some areas have an intact cryptobiotic crust, however, this community occurs on deeper, more productive soils than the Douglas' buckwheat/Sandberg's bluegrass community. This community supports high diversity of native shrub-steppe species, including many of potential cultural importance. Within the surveyed corridors, this community occurs along a narrow band of lithosols along the crest of the Columbia Hills, and extends downward slightly on both south and north facing slopes.

3.3.3 Bluebunch wheatgrass-Idaho fescue (Agropyron spicatum-Festuca idahoensis Community

This community type typifies moister grassland sites in the vicinity of Goldendale and abuts Oregon white oak woodland (Franklin and Dyrness 1973). Bluebunch wheatgrass and Idaho fescue dominate this type. In some areas, an intact cryptobiotic crust exists; however, soils are deeper and more productive than the Douglas' buckwheat/Sandberg's bluegrass community. Native forbs are also present, including several of potential cultural importance. Large areas of this type are found in the western part of the project area.

3.3.4 Oregon white oak (Quercus garryana) and Oregon white oak-ponderosa pine (Q. garryana-Pinus ponderosa) Woodland Communities

These are savannah-to-woodland community types dominated by Oregon white oak in the overstory. Within the surveyed corridors, oak canopy cover ranges from 10% to 100%. ponderosa pine (*P. ponderosa*) is generally also present, but in much lower abundance. Pine reaches its greatest abundance in the western part of the project area. The grassy understory of the oak woodlands is generally dominated by native shrub-steppe species and non-native grasses. Western juniper (*Juniperus occidentalis*) occurs on drier woodland margins.

The upper part of the corridor of turbine string Y supports a high-quality example of an Oregon white oak/Antelope Bitterbrush (*Purshia tridentata*)/Native Bunchgrass association. The understory is dominated by Thurber's needlegrass (*Stipa thurberiana*), Idaho fescue (*Festuca idahoensis*), and bluebunch wheatgrass (*Agropyron spicatum*). Due to the dominance and diversity of native understory species, this association is unique in the project area and is a high-quality example of an intact Oregon white oak woodland.

3.3.5 Other Communities

No areas of one or more acres of the high-quality northern buckwheat/Sandberg's bluegrass (*Eriogonum compositum/Poa secunda*) community type were found within the surveyed corridors, although small areas are scattered throughout the project area. High-quality examples of the Idaho fescue-houndstongue hawkweed (*Festuca idahoensis-Hieraceum cynoglossoides*) community type were observed on both the western eastern ends of the project area, but none were located within the surveyed corridors. High-quality examples of the stiff sagebrush/Sandberg's bluegrass (*Artemisia rigida/P. secunda*) and the thyme-leaved buckwheat/Sandberg's bluegrass (*Eriogonum thymoides/P. secunda*) community types occur along the crest of the Columbia Hills, especially in the central and eastern portions of the project area, but neither was found within surveyed corridors.

TABLE 3.
EXTENT (IN ACRES) AND LOCATION OF HIGH-QUALITY PLANT COMMUNITIES POTENTIALLY IMPACTED WITHIN SURVEYED CORRIDORS

	COMMUNITY TYPE			
	Erdo/Pose[1]	Agsp-Feid[1]	Agsp-Pose[1]	Quga[1]
Turbine String[3]				
C	2.1	2.3		
PP		4.4		
M	1.6	1.3		
N				5.5
O	1.0			
P			1.4	
Q			2.5	
S	0.5			
T	0.7			
U	0.7			
V			1.1	
Y				3.2
Z				0.9
LL			0.5	
Transmission Corridor				
A–M	0.5	3.7		2.4
M–Q				3.9
Total Acres[2]	7.1	11.7	5.5	15.9

[1] Codes for communities are: "Agsp-Pose" = bluebunch wheatgrass-Sandberg's bluegrass (Agropyron spicatum-Poa secunda); "Agsp-Feid" = bluebunch wheatgrass-Idaho fescue (A. spicatum-Festuca idahoensis); "Erdo/Pose" = Douglas' buckwheat/Sandberg's bluegrass (Eriogonum douglasii/P. secunda); and "Quga" = Oregon white oak (Quercus garryana) and Oregon white oak-ponderosa pine (Q. garryana-Pinus ponderosa).

[2] Impact area estimates are based on 100-foot construction disturbance corridors along turbine strings and 20-foot disturbance corridors along power lines.

[3] Turbine strings not listed did not pass through high-quality communities.

3.4 Plant Species of Potential Cultural Importance

A number of plant species of potential cultural importance occur throughout the project area (Table 4) and in the surveyed corridors. Western yarrow (*Achillea millefolium*), bluebunch wheatgrass (*Agropyron spicatum*), Carey's balsamroot (*Balsamorhiza careyana*), wild buckwheat (*Eriogonum* spp.), lupine (*Lupinus* spp.), and phlox (*Phlox* spp.) are the most abundant and ubiquitous taxa of potential cultural importance encountered in the surveyed corridors. Appendix B indicates the relative abundance of species of potential cultural importance along the surveyed corridors.

Plants of potential cultural importance were most abundant and diverse in areas containing moderate- or high-quality native plant communities, particularly within T3N, R16E, sections 12-15, and 22 (encompassing turbine strings A, B, C, PP, and M, and a segment of the transmission line). This area lies immediately west of the proposed CARES project site.

Other parts of the project area supporting an abundant and/or diverse array of potentially culturally important species are located in parts of T3N, R17E, sections 1, 2, 4, and 9–11

(encompassing turbine strings N through Z). This area contains a mixture of moderate- to high-quality native shrub-steppe communities intermixed with more degraded areas. Abundance and diversity of culturally important species is low in the portions of the project area encompassing turbine strings D through L and GG through OO. These areas are heavily grazed southern exposures and support few native species with low abundance and diversity.

3.5 Wetlands

Although some wetlands do occur within the project area (see section 3.1), none were found within the surveyed corridors. All areas mapped as wetlands in the project area receive heavy use by livestock, and in many cases, have been modified for livestock use.

4.0 Project Impacts

This section addresses the potential impacts of the proposed project on the plant communities present in surveyed corridors. No project impacts on special-status (threatened, endangered, or candidate) plant species (see section 3.2) or natural wetlands (see section 3.5) are anticipated. Impacts of the project on plant species of potential cultural importance will be addressed in a separate report (Historical Research Associates, Inc., 1994).

Potential impacts include both direct and indirect impacts. Direct impacts involve the destruction of vegetation caused by construction of access roads, turbine strings, transmission lines, and staging areas; and by ongoing maintenance of these facilities. Indirect impacts include environmental changes such as increased soil erosion or compaction that may:

(1) inhibit reestablishment of native vegetation;
(2) facilitate the invasion of exotic, weedy species that reduce native vegetation through competition; or
(3) otherwise alter within-community processes.

4.1 Impacts on Plant Communities

4.1.1 Overview

Approximately 280 acres of vegetation would be removed or disturbed during construction of turbine strings and transmission lines. Additional vegetation would be disturbed by road construction. Approximately 78% of the 280-acre area lies within agricultural and degraded rangeland vegetation. Direct impacts on a total of 40.2 acres of high-quality native plant communities would result from the current alignment of the turbine strings and transmission line, assuming that development occurs along the center line of the surveyed corridor (Table 3). An estimated 7.1 acres of high-quality Douglas' buckwheat/Sandberg's bluegrass, 11.7 acres of high-quality bluebunch wheatgrass-Idaho fescue, 5.5 acres of high-quality bluebunch wheatgrass-Sandberg's bluegrass, and 15.9 acres of high-quality Oregon white oak and Oregon white oak-ponderosa pine woodland communities would be disturbed (Table 3).

Table 4.
PLANTS OF POTENTIAL CULTURAL IMPORTANCE ENCOUNTERED IN SURVEYED CORRIDORS

Achillea millefolium	western yarrow
Agropyron spicatum	bluebunch wheatgrass
Allium sp.	wild onion
Apocynum androsaemifolium	spreading dogbane
Artemisia rigida	big sagebrush
Astragalus spp.	milk-vetch
Balsamorhiza careyana	Carey's balsamroot
Balsamorhiza hookeri	Hooker's balsamroot
Brodiaea howellii	Howell's brodiaea
Castilleja hispida	harsh paintbrush
Chaenactis douglasii	hoary false-yarrow
Chrysothamnus nauseosus	gray rabbitbrush
Claytonia lanceolata	western springbeauty
Comandra umbellata	bastard toad-flax
Crocidium multicaule	spring-gold
Dodecatheon pulchellum	few-flowered shooting star
Eriogonum spp.	wild buckwheat
Erigeron spp.	fleabane
Fritillaria pudica	yellow bell
Hydrophyllum capitatum	ballhead waterleaf
Juniperus occidentalis	western juniper
Lewisia rediviva	bitterroot
Lomatium spp.	desert-parsley
Lupinus spp.	lupine
Phlox spp.	phlox
Pinus ponderosa	ponderosa pine
Purshia tridentata	antelope bitterbrush
Quercus garryana	Oregon white oak
Ribes cereum	wax currant

The two most important complexes of high-quality native plant communities are located in the western and eastern ends of the project area. The western habitat complex, over 1,700 acres in extent, including area outside of the Project boundary, encompasses much of T3N, R16E, sections 11, 12, 13, and 14. This area supports a mixture of minimally disturbed Oregon white oak woodland, oak-pine woodland, bluebunch wheatgrass-Idaho fescue, bluebunch wheatgrass-Sandberg's bluegrass, and Douglas' buckwheat/Sandberg's bluegrass communities. This area is contiguous with the CARES project site. The eastern area (T3N, R18E, sections 2 and 3; T4N, R18E, sections 33, 34, and 35) exceeds 800 acres in extent and lies partially outside of the project area. High-quality examples of bluebunch wheatgrass-Sandberg's bluegrass, Idaho fescue-houndstongue hawkweed, northern buckwheat/Sandberg's bluegrass, and Douglas' buckwheat/Sandberg's bluegrass communities have been identified by the Washington Natural Heritage Information System (1994) as occurring within this area.

A third area of native communities occurs in the central portion (T3N, R17E, sections 1, 2, 11, and 12) of the project area. This area supports high-quality Douglas' buckwheat/Sandberg's bluegrass and bluebunch wheatgrass-Sandberg's bluegrass communities. This area is of lesser quality than the previous two areas, as it is smaller and contains patches of disturbed vegetation.

Estimates of area impacted were calculated on the basis of 100-foot corridor width along turbine strings and 20-foot corridor width along transmission lines. Anticipated impacts specific to each community type are addressed below.

4.1.2 Douglas' buckwheat/Sandberg's bluegrass (Eriogonum douglasii/Poa secunda) Community

An estimated 7.1 acres of high-quality Douglas' buckwheat/Sandberg's bluegrass community would be directly impacted within proposed turbine string corridors C, M, O, S, T, and U; and the transmission corridor segment (south branch) between PP and M (Table 3). Construction disturbances within turbine corridors C, M, S, T, and U could fracture the continuity of this community and cause indirect impacts, such as facilitating invasion of non-native weeds (S. Norwood, pers. comm.).

The Douglas' buckwheat/Sandberg's bluegrass community type is characterized by shallow soils, low vegetation cover, and low productivity. A conspicuous feature of undisturbed soils in this community is the presence of a cryptobiotic soil crust, composed of mosses, lichens, fungi, and nitrogen-fixing bacteria. This crust reduces erosion, increases water- and nutrient-holding capacities, and is crucial to the establishment of native vegetation. The crust is readily destroyed by trampling and vehicle use, and natural recovery times following small disturbances may range from 40 to several hundred years (Belnap, 1993). Damage is aggravated when large areas are disturbed, because wind and water erosion result in destruction of nearby crusts through burial by transported sediment. Thus, construction activities which destroy this crust may have long-term impacts on soil stability, nutrient availability, water-holding capacity, and integrity of the native vegetation. Efforts to restore native vegetation in areas of cryptobiotic crusts have generally not been successful (Belnap, 1993), and restoration methods have apparently have not been developed for this community type. The genus *Eriogonum* is currently being evaluated for suitability for revegetation in the Intermountain area (Zamora, 1994).

Disturbed soils in this community type are highly susceptible to invasion by annual weeds such as cheatgrass (*Bromus tectorum*) (Franklin and Dyrness, 1973; S. Norwood, pers. comm.). Both cheatgrass and another weedy annual, medusa-head (*Taeniatherum caput-medusae*) are locally abundant in heavily grazed areas in the project area. Invasion of cheatgrass has been shown to permanently alter the vegetation composition of native communities in the Intermountain region (Pellant, 1990). Once established on a site, cheatgrass has proven difficult to control or eradicate (Roberts, 1990). In addition, areas dominated by cheatgrass and medusahead undergo increased wildfire frequencies, and fueled extensive fires throughout the Intermountain area (Pellant 1990). Frequent fires exacerbate soil erosion, resulting in the need for reseeding and fire control measures. Frequent wildfires also favor cheatgrass over native species, reducing plant community diversity.

4.1.3 Bluebunch wheatgrass-Sandberg's bluegrass (Agropyron spicatum-Poa secunda and bluebunch wheatgrass-Idaho fescue (A. spicatum-Festuca idahoensis) Communities

An estimated 5.5 acres of high-quality bluebunch wheatgrass-Sandberg's bluegrass would be directly impacted within proposed turbine string corridors P, Q, V, and LL; an estimated 11.7 acres of high-quality bluebunch wheatgrass-Idaho fescue community would be directly affected in corridors PP, M, and C; and in the transmission line corridor between turbine strings B and M (Table 3).

These bunchgrass-dominated community types are located on deeper, more productive soils than is the Douglas' buckwheat/Sandberg's bluegrass type (see section 4.1.2). Because of their higher productivity, the potential for reestablishment of native vegetation following disturbance is higher than in the Douglas' buckwheat community. These types are also, however, subject to invasion by exotic weeds (Norwood, pers. comm.). Establishment rates of native bunchgrasses are slow (Goebel et al., 1988; Miller et al. 1986) and reestablishment of native vegetation in these communities requires reseeding and livestock exclusion during the early stages of recovery (Pellant 1990). Without such measures, native species will reestablish slowly, if at all, and the threat of invasion by cheatgrass (*Bromus tectorum*) or other weeds is high .

4.1.4 Oregon white oak (Quercus garryana) and Oregon white oak-ponderosa pine (Q. garryana-P. ponderosa) Woodland Communities

An estimated 15.9 acres of oak and oak-pine woodland would be directly impacted by proposed turbine strings N, Y, and Z, and by the segments of the transmission line between PP and M, and M and Q (Table 3).

These woodland communities are defined by the presence of two long-lived woody species, Oregon white oak and ponderosa pine. Once the tree canopy is removed, its reestablishment requires many decades, and soil disturbances may alter environmental conditions to the extent that regeneration is inhibited. Overstory loss will result in associated changes in understory shrub and herb composition, with a shift away from forest-woodland species. Soil disturbances caused by construction activities may facilitate the invasion non-native plant species onto bared soils.

4.2 Regional Cumulative Impacts

A total of 40.2 acres of vegetation in high-quality native plant communities would be directly destroyed as a result of the current proposed alignment of the turbine strings and transmission line, assuming that development occurs along the center line of the corridor. Additional impacts to the Douglas' buckwheat/Sandberg's bluegrass, bluebunch wheatgrass-Idaho fescue, and bluebunch wheatgrass-Sandberg's bluegrass communities could result from encroachment of

weeds, increased erosion, and increased fire hazard resulting from development of turbine string corridors C, PP, M, P, Q, S, T, U, and V.

According to the Washington Natural Heritage Program (S. Norwood, pers. comm., 1994), the greatest threat to the quality of these high-quality native communities is the invasion of exotic plants. Such invasion would be facilitated by soil disturbance, grazing, road or tower construction, and ORV (off-road vehicle) use.

Over the last 100 or more years, much of the native vegetation of the Columbia Basin Province has been substantially altered. The historic extent of Washington's shrub-steppe is thought to be approximately 10.5 million acres (Jones and Stokes Associates, 1994). Today, an estimated 5% of the original area remains in relatively undisturbed condition. Factors contributing to this loss include introduction of livestock, historic overgrazing, conversion to agriculture, and introduction of exotic species. The project area supports two large habitat complexes of native vegetation in relatively undisturbed condition. Project activities would contribute to the continuing loss of high-quality native shrub-steppe communities in the region. Potential mitigation measures would also reduce cumulative effects.

5.0 Mitigation Measures

Potential mitigation measures to reduce project impacts on native plant communities include:

1. Realignment or shortening of turbine strings within surveyed corridors to avoid areas of high-quality native plant communities,

2. Reduction of construction and maintenance disturbances within corridors,

3. Revegetation of disturbed areas, and

4. Control of noxious weeds.

5.1 Realignment or Shortening of Turbine Strings Within Surveyed Corridors

Potential mitigation measures for specific impact corridors are addressed below. Recommended distances are general estimates only; high-quality native communities should be staked on the ground to avoid disturbance.

Turbine string C. The northern one-half of the surveyed corridor runs through the middle of high-quality bluebunch wheatgrass-Idaho fescue and Douglas' buckwheat/Sandberg's bluegrass communities (Figure 1), directly impacting 4.4 acres (Table 3). To avoid these communities, development could be restricted to roughly the southern one-half of the turbine string. Temporarily disturbed areas in the bluebunch wheatgrass-Idaho fescue community could be reseeded with native species and restored in accordance with guidelines outlined in Sections 5.2-5.4. As noted in section 4.1.2, successful methods for restoration of the Douglas' buckwheat/Sandberg's bluegrass community are not known.

Turbine string PP. Nearly all of this corridor passes through a high-quality bluebunch wheatgrass-Idaho fescue community (Figure 1), directly impacting 4.4 acres (Table 3). The corridor cannot be readily shifted to avoid this area. Therefore, mitigation could include reseeding of temporarily disturbed areas with native species and restoration in accordance with guidelines outlined in Sections 5.2-5.4.

Turbine string M. The south end of the corridor runs through high-quality examples of the bluebunch wheatgrass-Idaho fescue and Douglas' buckwheat/Sandberg's bluegrass communities (Figure 1), directly impacting 2.9 acres (Table 3). To avoid impacts, the southern end of the string could be restricted to the eastern one-half of the surveyed corridor, or development could be restricted to roughly the northern two-thirds of the string. If avoidance is not feasible, mitigation could include reseeding of temporarily disturbed areas with native species and restoration in accordance with guidelines outlined in Sections 5.2-5.4. As noted in section 4.1.2, successful methods for restoration of the Douglas' buckwheat/Sandberg's bluegrass community are not known.

Turbine string N. The entire corridor passes along the west edge of a large Oregon White Oak Woodland (Figure 1), directly impacting 5.5 acres. This turbine string could be shifted to the west edge of the surveyed corridor to avoid the oak habitat area.

Turbine string O. The west-central portion of this corridor runs along the eastern edge of a high-quality Douglas' buckwheat/Sandberg's bluegrass community (Figure 1), directly impacting about 1.0 acres (Table 3). To avoid impacts, development within the central portion of the corridor could be restricted to the eastern one-half. As noted in section 4.1.2, successful methods for restoration of the Douglas' buckwheat/Sandberg's bluegrass community are not known. As noted in Section 4.1.1, the overall habitat in this area is more disturbed than in the eastern and western habitat complexes.

Turbine string P. Most of the southern one-half of this corridor runs through a high-quality bluebunch wheatgrass-Sandberg's bluegrass community (Figure 1), directly impacting 1.4 acres (Table 3). To avoid impacts, development could be restricted to the northern one-half of the surveyed corridor, or temporarily disturbed areas reseeded with native species and restored in accordance with guidelines outlined in Sections 5.2-5.4.

Turbine string Q. The south one-third of the corridor runs through a high-quality bluebunch wheatgrass-Sandberg's bluegrass community (Figure 1), directly impacting 2.5 acres (Table 3). To avoid impacts, development could be restricted to the northern one-third of the surveyed corridor, or, if the area cannot be avoided, temporarily disturbed areas could be reseeded with native species and restored in accordance with guidelines outlined in Sections 5.2-5.4. As noted in Section 4.1.1, the overall habitat in this area is more disturbed than is vegetation in the western and eastern habitat complexes.

Turbine strings S, T, U. These corridors lie partly or entirely within a high-quality Douglas' buckwheat/Sandberg's bluegrass community (Figure 1), directly impacting 1.9 acres (Table 3). To avoid impacts, development in turbine string T could be restricted to the northern one-half. Impacts in surveyed corridors of turbine strings S and U could not be avoided. As noted in section 4.1.2, successful methods for restoration of the Douglas' buckwheat/Sandberg's bluegrass community are not known. As noted in Section 4.1.1, habitat in this area is more disturbed than is vegetation in the western and eastern habitat complexes.

Turbine string V. Roughly the southern two-thirds of the corridor crosses a high-quality bluebunch wheatgrass-Sandberg's bluegrass community (Figure 1), directly impacting 1.1 acres. To avoid impacts, development could be restricted to the northern one-half of the surveyed corridor, or temporarily disturbed areas could be reseeded with native species and restored in accordance with guidelines outlined in Sections 5.2-5.4.

Turbine string Y. Nearly all of the corridor passes through Oregon oak woodland (Figure 1), part of which supports a unique example of an intact native understory (see section 3.3.4). Approximately 3.2 acres would be directly impacted (Table 3). Impacts could not be avoided without relocating the turbine string.

Turbine string Z. The northern one-fifth of the corridor passes through Oregon white oak woodland. To avoid impacts, development of this turbine string could be restricted to roughly the southern 75% of the surveyed corridor.

Turbine string LL. The north end of this corridor impacts 0.5 acre of high-quality bluebunch wheatgrass-Sandberg's bluegrass community (Table 3). To avoid impacts, development of the turbine string could be limited to the southern 90% of the surveyed corridor, or temporarily disturbed areas could be reseeded with native species and restored in accordance with guidelines outlined in Sections 5.2-5.4.

Transmission corridor segment A-M. The western part of this segment passes through an area of the high-quality bluebunch wheatgrass-Idaho fescue community, potentially impacting 3.7 acres (Table 3, Figure 1). It will also potentially impact 0.5 acres of high-quality Douglas' buckwheat/Sandberg's bluegrass community and 4.8 acres of Oregon white oak and oak-pine woodland. This area is one of the two most important areas of native plant communities within the project area (see section 4.1.1). Potential mitigation measures depend on decisions regarding the placement of turbine string corridors C and PP. If these corridors are relocated, the transmission line corridor may also be relocated to reduce impacts to these communities. If the oak woodland community is to be avoided completely, rights-of-way will need to be negotiated with adjacent landowners to the north and south, so that the transmission line does not pass through the narrow section of project area in the northwest corner of section 13 (Figure 1). If high-quality communities cannot be readily avoided, the impacts could be partially mitigated by reducing construction disturbance areas and reseeding disturbed areas with native grass species.

Transmission corridor segment M-Q. This segment passes through several Oregon white oak stands, and would directly impact about 3.9 acres (Table 3, Figure 1). Wherever feasible, the line should be shifted south of woodlands located in sections 8, 9, and 10.

Transmission corridor segment Q-OO. In this eastern segment of the project area, the transmission line corridor passes primarily through farmland and degraded rangeland. It runs across the edge of Oregon white oak woodland just west of turbine string corridor Y.

5.2 Reduction of Construction Disturbances

Careful restriction of vehicular corridors, staging areas, and turnarounds during construction phase of the project will minimize the disturbance area. Unnecessary soil disturbance could be

avoided by limiting the area impacted during construction. During project operation, site access by maintenance crews could be controlled to avoid additional soil disturbance. A restrictive site access plan could be prepared, designating roads, staging areas, and turnarounds, and directing construction and maintenance workers to utilize existing roads. Such a plan should ensure that intact native plant communities are avoided, where feasible. Vehicle access should be highly restricted during wet periods and the early growing season (through May) to minimize soil disturbance and mechanical damage to plants. Temporary construction staging areas should be located in rangeland areas outside of high-quality plant communities and wooded areas.

5.3 Revegetation of Temporarily Disturbed Areas

In all areas of potential development impact, roadsides and areas that are temporarily disturbed by construction activities should be revegetated after construction disturbance, because weed invasion is highly likely. Introduction of plants that are potentially invasive in adjacent, undamaged habitat should be avoided. Erosion control materials should be certified weed-free.

A detailed reseeding and restoration plan could be developed for temporarily disturbed areas such as roadsides in the bunchgrass and Douglas' Buckwheat communities. Revegetation should utilize species native to the communities, especially dominant species. Livestock should be excluded from reseeded areas during the vegetation establishment phase (a minimum of 2-3 years). There have been no published records of success in restoring *Eriogonum*-dominated community types in the region, although the genus *Eriogonum* shows potential as a colonizer of disturbed sites (Zamora, 1994). Areas of deeper soils might be reseeded with native species, but constraints include high costs and low availability of seeds, slow establishment rates, grazing intolerance, and suppression by weeds (Goebel et al., 1988; Miller et al., 1986).

5.4 Control of Noxious Weeds

Because of the high threat of weed invasion and the long-term effects of weeds on these communities, a plan should be developed for the control of noxious weeds in the project area. The components of such a plan should include provisions for a) reduction of soil disturbance and other activities which promote dissemination of weeds during the construction phase of the project and b) long term control of noxious weeds during the operation phase of the project. This plan should be reviewed by the Washington Noxious Weed Control Board.

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7.0 Glossary

Cryptobiotic crust refers to a layer of mosses, lichens, fungi, and bacteria on the soil surface; characteristic of many arid and semi-arid grassland communities; and performing important ecosystem functions.

High-quality native plant communities are dominated by native vegetation and have been little-disturbed by human activities. Sites must be large enough for the community to function as a unit (at least 1 acre for native grasslands; Washington Natural Heritage Program, 1993).

Lithosols are very stony, shallow soils without well-developed horizons and having partially weathered rock fragments; typically occurring on ridgecrests and upper slopes in the project area.

Project area refers to the 5110-ha area controlled by Kenetech Windpower in the Columbia Hills (see Figure 1).

Plant species of potential cultural importance refers to those species listed in the Hanford Cultural Resources Management Plan occurring in surveyed corridors.

Priority habitat has unique or significant value to many wildlife species (Washington Department of Fish and Wildlife, 1993).

Shrub-steppe refers to a vegetation type co-dominated by native bunchgrasses and shrubs; historically wodespread throughout the Intermountain region of the Pacific Northwest.

Surveyed corridors are those areas along proposed turbine string alignments and the proposed transmission line alignment.

Target rare species are those rare, threatened/endangered, or sensitive plant species identified during pre-survey review and field reconnaissance as having a high probability of occurring within the project area.

APPENDIX A
SPECIES ENCOUNTERED IN SURVEYED CORRIDORS

Achillea millefolium	western yarrow
Agoseris sp.	false dandelion
Agropyron intermedium	intermediate wheatgrass
Agropyron repens	couchgrass
Agropyron spicatum	bluebunch wheatgrass
Allium sp.	wild onion
Amelanchier alnifolia	western serviceberry
Amsinckia retrorsa	rigid fiddleneck
Antennaria dimorpha	pussy-toes
Antennaria geyeri	narrow-leaf pussy-toes
Antennaria stenophylla	pinewoods pussy-toes
Apocynum androsaemifolium	spreading dogbane
Artemisia rigida	stiff sagebrush
Artemisia tridentata	big sagebrush
Astragalus purshii	Pursh's milk-vetch
Astragalus sp.	milk-vetch
Balsamorhiza careyana	Carey's balsamroot
Balsamorhiza hookeri	Hooker's balsamroot
Brodiaea howellii	Howell's brodiaea
Bromus tectorum	cheatgrass
Castilleja hispida	harsh paintbrush
Chaenactis douglasii	hoary false-yarrow
Chrysothamnus nauseosus	gray rabbitbrush
Clarkia pulchella	elkhorns clarkia
Claytonia lanceolata	western springbeauty
Collinsia parviflora	small-flowered collinsia
Crocidium multicaule	spring-gold
Cryptantha sp.	white forget-me-not
Dodecatheon pulchellum	few-flowered shooting star
Draba verna	spring whitlow-grass
Eriogonum caespitosum	mat buckwheat
Eriogonum compositum	northern buckwheat
Eriogonum douglasii	Douglas' buckwheat
Eriogonum heracleoides	parsnip-flowered buckwheat
Eriogonum thymoides	thyme-leaved buckwheat
Eriogonum sp.	wild buckwheat
Eriophyllum lanatum	eriophyllum
Elymus cinereus	giant wildrye
Erigeron linearis	desert yellow daisy
Erigeron poliospermus	cushion fleabane
Erodium cicutarium	filaree
Erysimum sp.	wallflower
Festuca idahoensis	Idaho fescue
Frasera albicaulis	white-stemmed frasera

Fritillaria pudica	yellow bell
Grindelia sp.	gumweed
Hieraceum cynoglossoides	houndstongue hawkweed
Holcus lanatus	velvetgrass
Hydrophyllum capitatum	ballhead waterleaf
Juniperus occidentalis	western juniper
Lewisia rediviva	bitterroot
Lithophragma tenella	slender fringecup
Lomatium grayi	gray's desert-parsley
Lomatium macrocarpum	large-fruited desert-parsley
Lomatium nudicaule	barestem desert-parsley
Lomatium triternatum	nine-leaf lomatium
Lupinus leucophyllus	velvet lupine
Lupinus sericeus	silky lupine
Marah oreganus	manroot
Phacelia heterophylla	varileaf phacelia
Phlox hoodii	Hood's phlox
Phlox longifolia	long-leaf phlox
Phoenicaulis cheiranthoides	daggerpod
Pinus ponderosa	ponderosa pine
Poa bulbosa	bulbous bluegrass
Poa secunda (= P. sandbergii)	Sandberg's bluegrass
Purshia tridentata	antelope bitterbrush
Quercus garryana	Oregon white oak
Ribes cereum	wax currant
Saxifraga integrifolia	swamp saxifrage
Schoenocrambe linifolia	plainsmustard
Sedum stenopetalum	wormleaf stonecrop
Sisymbrium altissimum	tumblemustard
Sisyrinchium douglasii	grass-widows
Sitanion hystrix	bottlebrush squirreltail
Stipa thurberiana	Thurber's needlegrass
Taeniatherum caput-medusae	medusahead
Thysanocarpus curvipes	lacepod
Trifolium macrocephalum	big-head clover
Viola trinervata	sagebrush violet
Vulpia sp.	vulpia

APPENDIX B

Plant species of potential cultural importance encountered in surveyed corridors, showing abundance of species in turbine string corridors and transmission corridor segments. Abundance of individual species was visually assessed as "H" (very abundant or among the dominant species), "M" (moderately abundant or frequently encountered), or "L" (present, but rare or very low in cover). *Eriogonum* spp. include *E. caespitosum, E. compositum, E. douglasii* (predominantly), *E. heracleoides*, and an unidentified *Eriogonum* sp. *Erigeron* spp. include *E. linearis* and *E. poliospermus*. *Lomatium* spp. include *L. grayi, L. macrocarpum, L. nudicaule*, and *L. triternatum*. *Lupinus* spp. include *L. leucophyllus* and *L. sericeus*. *Phlox* spp. include *P. hoodii* (predominantly) and *P. longifolia*. (See Table 4 for common names of species.)

	Turbine String												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Achillea millefolium	M	M	M	L	L	L	L	L	L	L	L	M	M
Agropyron intermedium	M	M	M			L		L	L	L	L	L	M
Allium sp.	L	L											L
Apocynum androsaemifolium													
Artemisia rigida			L			L							
Astragalus spp.	M	L	L			L							L
Balsamorhiza careyana	M	M	M			L							M
Balsamorhiza hookeri			L										L
Brodiaea howellii		L											L
Castilleja hispida													L
Chaenactis douglasii			L										
Chrysothamnus nauseosus	M	L	L			L							M
Claytonia lanceolata													
Comandra umbellata			L			L							L
Crocidium multicaule	L		L										L
Dodecatheon pulchellum													
Eriogonum spp.	M	L	M	L	L	L	L	L	L	L	L	L	M
Erigeron spp.	L		M										
Fritillaria pudica													L
Hydrophyllum capitatum													
Juniperus occidentalis													
Lewisia rediviva			L										L
Lomatium spp.	M	M	L	L	L	L	L	L	L	L	L	L	M
Lupinus spp.	M	L	L	L	L	L	L	L	L	L	L	L	
Phlox spp.			M			L							L
Pinus ponderosa													
Purshia tridentata													
Quercus garryana													
Ribes cereum													

	Turbine String												
	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Achillea millefolium	L	L	L	L	M	L	L	M	M	L	L	L	M
Agropyron intermedium	M	M	M	M	M	L	L	M	M	L	M	M	M
Allium sp.		L	L	L		L	L	L	L		L		
Apocynum androsaemifolium											L		L
Artemisia rigida	L		M	L	H	L	L						
Astragalus spp.			L	L		L	L	L		L	L		L
Balsamorhiza careyana		M	M	M			M				L	L	M
Balsamorhiza hookeri						M	M	L			L		L
Brodiaea howellii	L												
Castilleja hispida			L						L				
Chaenactis douglasii		L	L										
Chrysothamnus nauseosus	M	M	M	M	M	L	M	M	M	M	M	H	M
Claytonia lanceolata	L										L	L	
Comandra umbellata													
Crocidium multicaule	L	L	L	L	L	L	L	L	L	L	L	L	
Dodecatheon pulchellum	L												
Eriogonum spp.	M	M	M	L	M	H	H	H	M	M	M	M	M
Erigeron spp.											L		
Fritillaria pudica	L												
Hydrophyllum capitatum												L	
Juniperus occidentalis		L	L	L					L			L	
Lewisia rediviva		L										L	
Lomatium spp.	L	L	L	L	M	L		L	L	M	M	M	M
Lupinus spp.	L	L	L		L	L	L	L	L	L	L	M	L
Phlox spp.	L		L	L		M	L	M	M		M	L	M
Pinus ponderosa													
Purshia tridentata												L	L
Quercus garryana	M											M	M
Ribes cereum											L	L	

	Turbine String												
	AA	BB	CC	DD	EE	FF	GG	HH	KK	LL	NN	OO	PP
Achillea millefolium		L	L	L	L	L	L	L	L	L	L		L
Agropyron intermedium	L		L				L					L	H
Allium sp.	L					L	L		L				
Apocynum androsaemifolium													
Artemisia rigida													
Astragalus spp.	L	L			L	L		L	L	L			L
Balsamorhiza careyana	M			M	M	M							M
Balsamorhiza hookeri					L	L	L	L		L			L
Brodiaea howellii													L
Castilleja hispida													L
Chaenactis douglasii							L	L					
Chrysothamnus nauseosus	H	H	H		M	M	L	L	L	L			L
Claytonia lanceolata													
Comandra umbellata													
Crocidium multicaule	L			L	L	L	L	L		L			L
Dodecatheon pulchellum													L
Eriogonum spp.	M	L	L	M	L	L	L	L	L			L	L
Erigeron spp.													
Fritillaria pudica													L
Hydrophyllum capitatum													
Juniperus occidentalis													
Lewisia rediviva													
Lomatium spp.	M	L	L									L	
Lupinus spp.	L	L	H		L	L	L	L	L	L			L
Phlox spp.	L	L			L	L						L	
Pinus ponderosa													
Purshia tridentata		M											
Quercus garryana	L												
Ribes cereum													

	Transmission Line Segment			
	A–PP	M–N	N–Y	Y–LL
Achillea millefolium	L	L	L	L
Agropyron intermedium	M	L		L
Allium sp.				
Apocynum androsaemifolium				
Artemisia rigida				
Astragalus spp.				
Balsamorhiza careyana		L		L
Balsamorhiza hookeri				
Brodiaea howellii	L			
Castilleja hispida				
Chaenactis douglasii				
Chrysothamnus nauseosus		L	L	L
Claytonia lanceolata	L	L		
Comandra umbellata				
Crocidium multicaule				
Dodecatheon pulchellum	L	L		
Eriogonum spp.		L	L	L
Erigeron spp.				
Fritillaria pudica	L	L		
Hydrophyllum capitatum	L	L		
Juniperus occidentalis	L			
Lewisia rediviva				
Lomatium spp.				L
Lupinus spp.	L	L	L	L
Phlox spp.				
Pinus ponderosa	L			
Purshia tridentata			L	
Quercus garryana	H	L	L	L
Ribes cereum				