ORIGINAL

Portland General Electric Company
121 SW Salmon Street • Portland, Oregon 97204

May 20, 2003

Honorable Magalie Roman Salas
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Re: Bull Run Hydroelectric Project,
Project No. 477
Additional Information Request- Transmittal of 90-Day Materials and Request for Privileged Treatment of Items B(1) and B(2)

Dear Secretary Salas:

Enclosed for filing with the Commission for Project No. 477 is the information requested in FERC's Additional Information Request (AIR) to PGE dated February 21, 2003. This filing provides an original and 8 copies, unless otherwise noted, of the information to be filed with FERC as specified in Schedule A, paragraph B of your request.

Specifically, the following information is provided:

AIR
Item Response

B (1) In response to your request for an explanation of site eligibility determinations, a report entitled "Evaluation of Three Archaeological Sites in the PGE Bull Run Hydroelectric Project" (Oetting May 2003), is provided. This report contains privileged information and has therefore been send to Mr. Frank Winchell of commission staff. Please let me know if this report does not address your questions. A copy of this report has also been submitted to Oregon SHPO for its concurrence, which shall be forwarded to FERC upon receipt (expected within 30 days).

B (2) A Historic Properties Management Plan (HPMP) has been prepared in accordance with your request (item B (2)). Comments received during its development were also requested. This material contains privileged information and has therefore been sent to Mr. Frank Winchell of commission staff.

PGE requests privileged treatment of the above two documents. The information included in these documents is exempt from the mandatory disclosure requirements of the Freedom of Information Act. 5 U.S.C. 552, and should otherwise be withheld from public disclosure.

B (3) In response to your request for PGE to adjust the notification period for unanticipated discoveries, barring a justified need (item B (3)), the following information is provided. PGE prefers retaining 72 hours as the notification period due to public agency normal business hours and the SHPO's unavailability during weekend hours.

B (4) Survey results from May/June 2000 and amphibian surveys from spring 2000 are presented below. The referenced reports are also enclosed.

Field surveys for threatened, endangered, and sensitive (TES), and survey and manage (S/M) plant species were conducted during May 31-June 2, 2000. Areas with a high probability of supporting TES and S/M species received 100 percent visual coverage. Areas with low probability were surveyed incidentally. Rock outcrops, bluffs, and steep canyons that were difficult to reach safely on foot were surveyed with binoculars. No TES or S/M plant species were found during the 2000 TES surveys (Keany 2001). One TES species, lesser bladderwort (*Utricularia minor*), an ONHP List 2 species, was documented during TES plant surveys conducted in 1999. Two other TES species, *Psuedocyphellaria rainierensis* and *Otidea onotica*, both S/M species under the Northwest Forest Plan, were observed incidentally during mollusk surveys conducted in January 2000. No Federal or State listed threatened or endangered plant species were documented on the Project during any survey conducted in 1999-2000.

The amphibian surveys were conducted during April 4-6 and 24-25 in 2000. A concentration of rough-skinned newts and evidence (egg masses) of breeding by northwestern salamanders (*Ambystoma gracile*) were noted during the surveys in the small side channel (backwater pond) upstream of Marmot dam (Tressler 2001). In general, the water velocity in the pool behind Marmot dam is too high to provide suitable habitat for most stillwater-breeding amphibians. No larval pond- or stream-dwelling amphibians were found during the 2000 surveys in the Little Sandy River below the Little Sandy diversion dam (Tressler 2001). Although portions of this reach have very low flow, there does not appear to be adequate backwater area for pond breeding amphibians. During surveys conducted in 1999, several adult salamanders, including Dunn's (*Plethodon dunni*) and western redback (*P. vehiculum*) salamanders, both fully terrestrial species, and rough-skinned newts (*Taricha granulosa*), were found in the vicinity of the Little Sandy River.

B (5) In response to your request for estimates of the area by habitat type of riparian vegetation in the impounded reaches of the Sandy River upstream of Marmot dam and the Little Sandy River upstream of the Little Sandy diversion dam, the following is provided:

Sandy River upstream of Marmot Dam

Three riparian vegetation cover types were identified along the impounded reach of the Sandy River upstream of Marmot dam during vegetation community mapping surveys conducted in 1999 (Tressler 2001). The three riparian habitat types include 1) riparian mixed deciduous/conifer forest, 2) riparian deciduous forest, and 3) riparian deciduous shrubland. A substantial portion of the impounded reach is also bordered by mid-successional mixed deciduous/conifer forest. These habitat types occur in the following estimated amounts:

Riparian mixed deciduous/conifer forest = 10.5 ac. along 8,400 linear ft. of shoreline.
Riparian deciduous forest = 0.4 ac. along 480 linear ft. of shoreline.
Riparian deciduous shrubland = 1.7 ac. along 1,520 linear ft. of shoreline.
Mid-successional Mixed Deciduous/Conifer Forest = 10.2 ac. along 8,160 linear ft. of shoreline.

Little Sandy River upstream of Little Sandy Diversion Dam

There is no well-defined riparian habitat along the impounded reach of the Little Sandy River above the Little Sandy diversion dam. Much of the impounded area is bordered instead by mid-successional mixed deciduous/conifer forest in the following estimated amount:

Mid-successional Mixed Deciduous/Conifer Forest = 0.5 ac. along 350 linear ft. of shoreline.

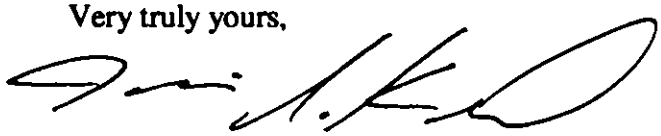
Using the data and information provided by Tressler (2001), the amount of each habitat type listed above was estimated by multiplying the approximate length of the habitat type bordering the impounded reach by the approximate average width of the habitat type.

Also provided with this filing are copies of PGE's Finding of Effect submittal letter to Oregon SHPO, and SHPO's concurrence response. PGE indicated in its March 17, 2003 Additional Information Request response letter that these materials would be provided with this filing.

An additional (ninth) copy of this filing is provided as proof of filing, to be dated, time stamped and returned in the enclosed self-addressed, stamped envelope. We would appreciate it if your would date and time-stamp these letters and return them in this envelope.

If you have any questions regarding this filing, please do not hesitate to contact me directly at (503) 464-8864.

Very truly yours,



Julie A. Keil, Director
Hydro Licensing and Water Rights

Encls.

cc: Mr. Frank Winchell - FERC (w/original and 8 copies of items 1 and 2 materials)
Mr. Alan Mitchnick - FERC (w/ two copies of items 4 and 5 referenced reports)

BULL RUN HYDROELECTRIC PROJECT

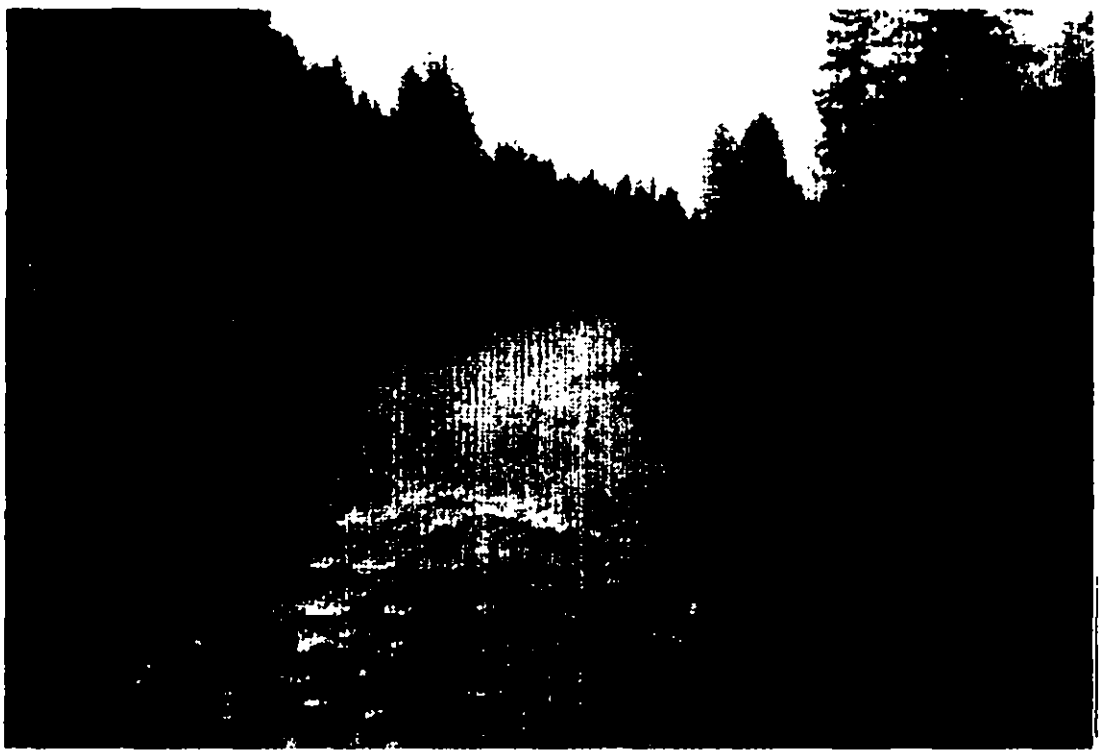
VEGETATION COMMUNITY MAPPING,

RIPARIAN ZONE CHARACTERIZATION,

AND

SNAG/DOWN WOODY MATERIAL SURVEYS

FINAL REPORT



August 2001

Prepared for: Portland General Electric

By: Ron Tressler
EDAW, Inc.

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1.0 INTRODUCTION

Portland General Electric (PGE) is currently collecting information to support a surrender application and Applicant Prepared Environmental Assessment (APEA) to decommission the Bull Run Hydroelectric Project (FERC No. 477). The surrender application and APEA address the effects of decommissioning on environmental resources in the Project vicinity, including vegetation; wildlife habitat; and threatened, endangered, and sensitive (TES) species. In addition, the Terrestrial Resources Sub-Committee for the Bull Run Project is particularly interested in characterizing the composition and structure of the current riparian zone as a baseline for assessing potential future conditions. The U.S. Forest Service (USFS) and Bureau of Land Management (BLM) are also concerned about the effects of Project removal activities on snags and down wood on federal lands bordering the Project.

The purpose of this report is to describe the methods and results of the vegetation community mapping, riparian zone characterization, and snag/down wood surveys conducted for the Bull Run Project. The results of this study are being used to: (1) describe the existing botanical resources and wildlife habitats associated with the Project in the APEA; (2) estimate the direct and indirect effects of Project decommissioning on vegetation (Issue T1, as identified in meetings of the Terrestrial Resources Sub-Committee); (3) assess the potential effects of reestablishment of natural flows and hydrology on wetland and riparian habitats (Issue T2); (4) assist with planning additional field studies; and (5) identify potential protection, mitigation, and restoration measures where necessary. This information is especially important for assessing potential decommissioning effects on wildlife habitats and on TES wildlife and plant species associated with existing riparian habitats.

2.0 STUDY AREA

The Bull Run Hydroelectric Project is located northeast of the city of Sandy, Oregon, on the Sandy, Little Sandy, and Bull Run rivers (Figure 2-1). Elevations in the FERC Project boundary range from between approximately 400 and 750 ft (122 to 229 m) above sea level. The area is within the western Cascades physiographic province and the western hemlock (*Tsuga heterophylla*) vegetation zone (Franklin and Dyrness 1988). This zone is characterized by a wet, mild, maritime climate. Rainfall in the Project vicinity ranges between 70 and 80 in. (178 and 203 cm) per year (Halverson et al. 1986). Land ownership in the study area is a combination of U.S. Forest Service (USFS), Bureau of Land Management (BLM), and private.

The study area for vegetation community mapping and riparian zone characterization included the following:

- Lands within the current FERC Project boundary, including the transmission line right-of-way (ROW);
- Riparian and wetland habitat along the Sandy River from approximately 3 mi (4.8 km) upstream of the Marmot Dam downstream to the confluence with the Bull Run River;
- Riparian and wetland habitat along the Little Sandy River from 1 mi (1.6 km) upstream of the Little Sandy Diversion Dam downstream to the confluence with the Bull Run River;
- Riparian and wetland habitat along the Bull Run River from the confluence with the Little Sandy River downstream to the confluence with the Sandy River; and
- All PGE-owned lands in the Project vicinity in the Sandy, Little Sandy, and Bull Run river drainages.

The study area for down wood and snag surveys was restricted to federal lands in the Project vicinity.

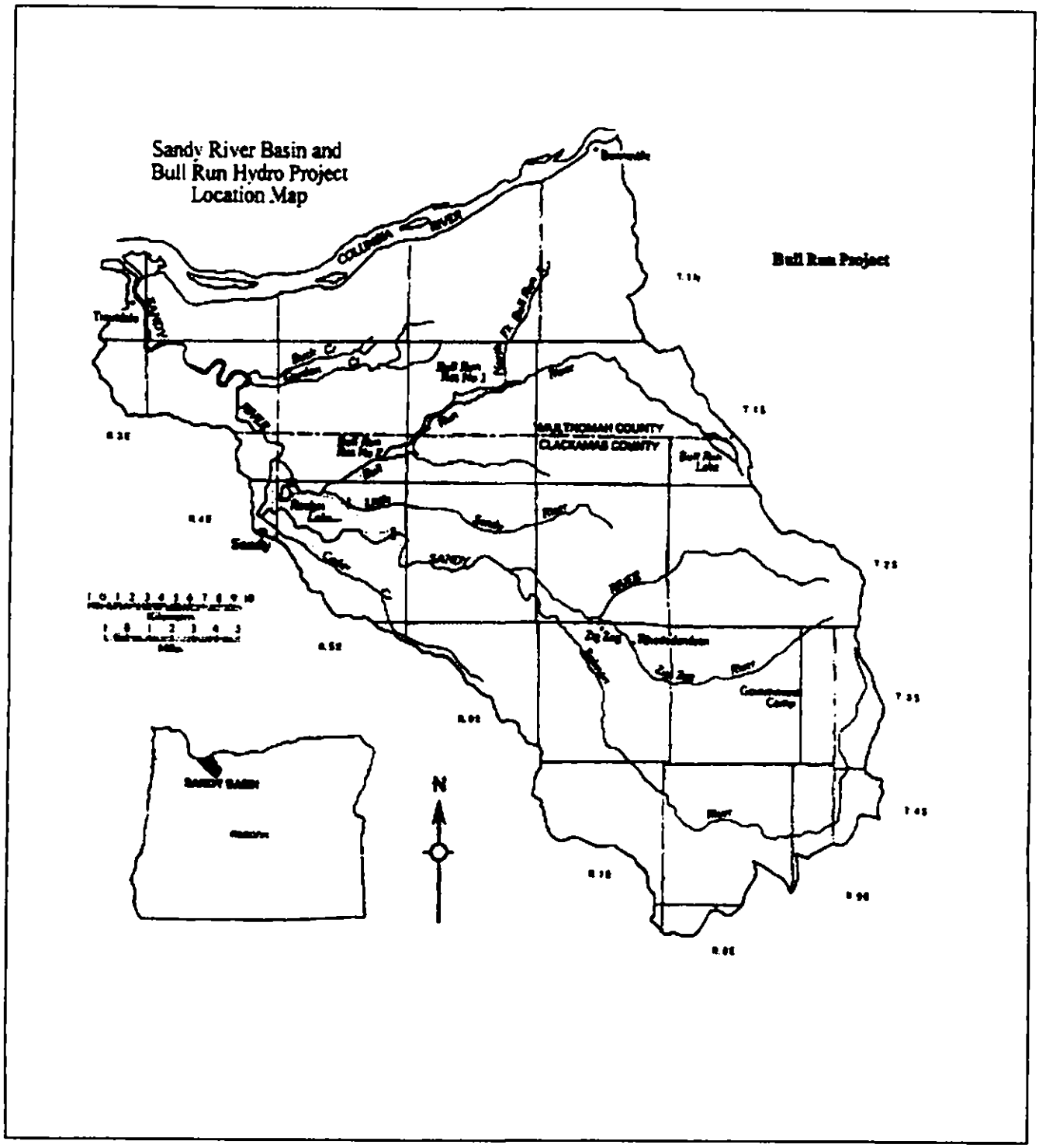


Figure 2-1. Bull Run Hydroelectric Project study area.

3.0 METHODS

The following sections describe the methods used for the vegetation community mapping, riparian zone characterization, and snag and down wood surveys.

3.1 Vegetation Community Mapping

The purpose of the vegetation community mapping is to produce an accurate, up-to-date map for the study area that can be used to describe existing vegetation and assess potential impacts of decommissioning. The vegetation community mapping process consisted of the following seven tasks: (1) acquire and evaluate existing aerial photography; (2) assess existing digital mapping data available for the study area; (3) develop a vegetation classification system and signature key; (4) field delineate vegetation communities; (5) compile and prepare data for digitizing; (6) digitize data into a Geographic Information System (GIS); and (7) produce maps and acreage data. Each of these steps is described in the following sections.

3.1.1 Evaluation of Existing Aerial Photography

Aerial photography typically provides the best source of data for mapping at a scale that accurately estimates the extent and condition of existing vegetation type. There are two sources of existing aerial photos for mapping the vegetation surrounding the Project facilities:

- Mount Hood National Forest color aerial photography (1995), 1:12,000 scale, covering the eastern third of the study area.
- BLM Salem District color aerial photography (1998), 1:12,000 scale, covering the entire study area.

Based on an examination of the existing aerial photography, the BLM aerial photos were selected for mapping the vegetation communities associated with the Bull Run Project. U.S. Geological Survey (USGS) 1:24,000 scale topographic maps were used for compiling vegetation mapping.

3.1.2 Assessment of Digital Mapping Data

Existing digital data included: (1) PGE basemaps; (2) National Wetland Inventory (NWI) maps; (3) USGS Digital Elevation Models (DEM); and (4) USFS GIS coverage. All digital data coverages were obtained and evaluated for use in the vegetation community mapping.

3.1.3 Development of Classification System

The vegetation community classification system forms the basis for mapping and subsequent analyses used for resource description, impact assessment, and restoration planning. The classification system is based on the following criteria: (1) each type is identifiable on the aerial photographs and has a unique photographic signature, (2) the system includes all community types considered unique or critical for TES species or important for other wildlife or disciplines,

and (3) the system is consistent with classification systems being used by resource agencies/tribes in the area for ease of interpretation by reviewers.

Information provided by the USFS and BLM suggested that a classification system based on potential natural communities (PNC) and seral and structural classes would provide the most useful botanical resources information for the Bull Run Project. PNCs represent the climax vegetation that would develop without natural or human-related disturbance and are categorized by either: (1) an ecoclass series and subseries, which are based on life form and dominant plant species; or (2) plant association (PAS), which provides life form, dominant species, and site information (Hall 1998). Maps of PNCs differ from maps of existing vegetation cover where disturbances, primarily fire or timber harvest, have altered plant communities. Most communities are not in mature or climax states, but are rather in early or mid-successional stages. Therefore, PNC designations are typically based on the presence of indicator plant species. Because pre-climax stages can be dominated by species different from those that characterize sites in climax condition, the existing dominant species (comprises at least 20 percent of the stand) was noted, along with the PNC designation. In this way, a map of existing vegetation cover can be produced while also providing information for a PNC map.

A preliminary classification system for the Bull Run Project was developed by evaluating existing vegetation classification systems available for the general area surrounding the Project, including the following:

- Riparian ecological types--Gifford Pinchot and Mt. Hood National Forests, Columbia River Gorge National Scenic Area (Diaz and Mellen 1996).
- Plant association and management guide for the western hemlock zone, Mt. Hood National Forest (Halverson et al. 1986).
- BLM's forest classification system (Dilworth 1964).
- Pacific Northwest ecoclass codes for seral and potential natural communities (Hall 1998).
- Seral categories used in the Mount Hood National Forest Land and Resource Management Plan (USFS 1990).
- U.S. Fish and Wildlife Service's (USFWS) NWI classification system (Cowardin et al. 1979).

In addition to determining the PNCs in the study area, the current vegetation communities, seral stages, and structural classes were recorded using the following definitions:

- **Seral Stage** - The seral stage of a plant community refers to its position on the linear successional gradient that precedes development of a climax community. The current seral stage of each polygon is the result of the effects of disturbance factors such as timber harvest, fire, disease, or drought. For the Bull Run study area, three seral stages were used: early, mid, and late. In general, the early seral stage is dominated by seedling and

sapling trees, shrubs, grasses, and forbs. In the mid seral stage, the overstory is dominated by sun-tolerant species, and shade-tolerant species establish in the understory. Mid-successional forested areas typically have a mixture of conifer and deciduous tree species. Shade-tolerant conifer species dominate the late seral stage stands.

- **Structural Class** - Six structural classes were used to describe the physical development of each plant community:

  (1) grass/forb,
  (2) seedling/sapling (<5-in. [12.7 cm] diameter-at-breast-height [dbh]),
  (3) mid-successional pole (5-in. to 11-in. [12.7 to 27.9 cm] dbh),
  (4) mid-successional small tree (11-in. to 21-in. [27.9 to 53.3 cm] dbh),
  (5) mature (>21-in. [53.3 cm] dbh with relatively even structure), and
  (6) old-growth (>21-in. [53.3 cm] dbh with uneven structure).

This system corresponds to the stand-size classes used by the BLM for timber inventories (pers. comm., J. Irving, BLM, Salem, Oregon, January 9, 2001). In general, the first two classes correspond to early successional stands; classes 3 and 4 typically represent mid-sucessional stands; and classes 5 and 6 encompass late successional stands. In some cases, however, plant species composition may indicate a seral stage different from that expected from structural class. For example, a managed forest stand may have relatively large trees but include only one tree species. Despite a mature structural class, this stand would have a mid-successional seral stage.

Each plant community was given an alpha-numeric modifier designating the following: (1) PNC (i.e., western hemlock/Oregon grape [*Berberis nervosa*]), (2) seral stage (e.g., mid-successional), (3) structural condition (e.g., pole stage), and (4) additional modifiers to adequately characterize current vegetation cover (e.g., Douglas-fir [*Pseudotsuga menziesii*]). Thus, the template for polygon codes was [PNC]-[SERAL STAGE]-[STRUCTURAL CLASS]-[CURRENT VEGETATION]. For example, a mid-successional, pole-dominated western hemlock/Oregon grape stand that is dominated by Douglas-fir would be designated as TSHE/BENE-early-pole–Douglas-fir.

The preliminary classification system is shown in Table 3-1. This system was refined by consulting with agency personnel, examining portions of the study area, and evaluating aerial photos.

3.1.4 Field Interpretation of Vegetation Community Types

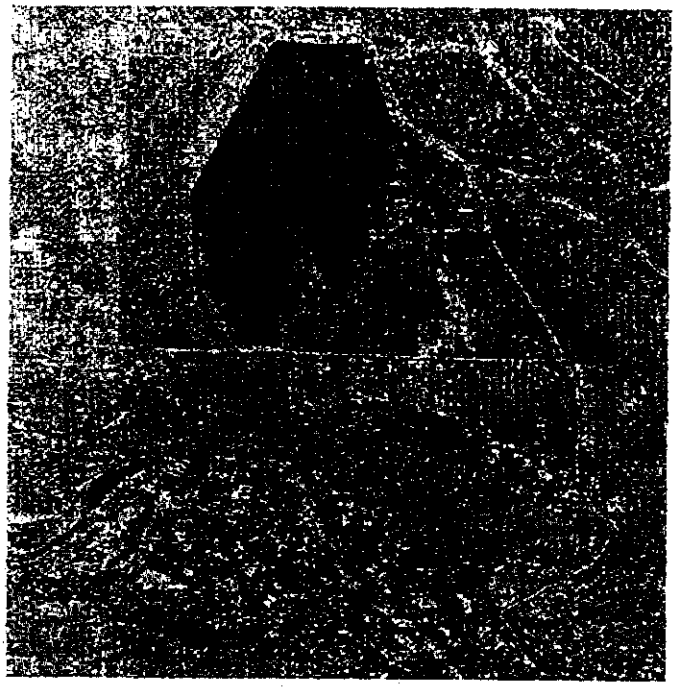
Photo-interpretation and field verification of vegetation communities for the study area were conducted during the summer of 1999 by a team of two biologists. To the extent possible, all portions of the study area were visited to accurately delineate vegetation communities. Use of one team ensured mapping consistency. Vegetation community

Table 3-1. Vegetation communities potentially occurring in the Bull Run Hydroelectric Project study area[1].

Major Types	Vegetation Communities[2]
Upland Forest Types (PASs)	Western hemlock/Pacific rhododendron-salal (TSHE/RHMA-GASH)
	Western hemlock/Pacific rhododendron-Oregon grape (THSE/RHMA-BENE)
	Western hemlock/skunk cabbage (TSHE/LYAM)
	Western hemlock/devil's club/oxalis (TSHE/OPHO/OXOR)
	Western hemlock/Alaska huckleberry-devil's club (TSHE/VAAL-OPHO)
	Western hemlock/Oregon grape (TSHE/BENE)
	Western hemlock/Oregon grape-salal (TSHE/BENE-GASH)
	Western hemlock/Oregon grape/sword fern (TSHE/BENE/POMU)
	Western hemlock/Alaska huckleberry-salal (TSHE/VAAL-GASH)
	Western hemlock/sword fern-oxalis (TSHE/POMU-OXOR) TSHE
	Western hemlock-grand fir/queencup beadlilly (TSHE/ABGR/CLUN)
	Western hemlock/Pacific rhododendron/dogwood bunchberry (TSHE/RHMA/COCA)
	Western hemlock/Alaska huckleberry/dogwood bunchberry (TSHE/VAAL/COCA)
	Western hemlock/sword fern (TSHE/POMU)
	Western hemlock/vanillaleaf (TSHE/ACTR)
	Western hemlock/Pacific rhododendron/beargrass (TSHE/RHMA/XETE)
	Western hemlock/big huckleberry/beargrass (TSHE/VAME/XETE)
	Western hemlock-Douglas-fir/oceanspray (TSHE-PSME/HODI)
	Western hemlock-vine maple/vanillaleaf (TSHE-ACCI/ACTR)
	Western hemlock/Alaska huckleberry/oxalis (TSHE/VAAL/OXOR)
Riparian Types (PASs)	Riparian Hardwood Forest Types[3]
	Riparian Shrub Types[3]
	Riparian Herbaceous Types[3]
Non-Forested Types	Upland Shrubland
	Meadow/Grassland
	Rock Talus
	Rock Outcropping
Wetland/ Deepwater Types	Riverine Unconsolidated Bottom (open water)
	Riverine Unconsolidated Shore (gravel bars)
	Lacustrine Unconsolidated Bottom (lake-limnetic zone)
	Lacustrine Unconsolidated Shoreline (lake-littoral zone)
	Palustrine Unconsolidated Bottom (pond-open water)
	Palustrine Emergent Wetland
	Palustrine Scrub-Shrub Wetland
	Palustrine Forested Wetland
Disturbed/ Modified Types	Transmission Line ROW
	Recreational
	Agriculture
	Developed
	Residential
	Disturbed

[1] Upland forest and riparian types were assigned to plant associations following Halverson et al. (1986) and Diaz and Mellen (1996). Wetland types follow Cowardin et al. (1979). All other types represent non-forested or disturbed communities.
[2] Modifiers were assigned to each polygon to identify current dominant species and seral/structural class.
[3] Types were further divided into PASs listed by Diaz and Mellen (1996).

type polygons were delineated on the aerial photos. Each polygon was classified based on the dominant vegetation species, seral stage, and structural class currently on the site. The data from available digital coverage (e.g., NWI) were used as guides in delineating polygons, if warranted. PNC descriptions provided in Diaz and Mellen (1996), Halverson et al. (1986), and Hall (1998) were used to identify the PNC and vegetation community type of each polygon in the field.



Aerial photo of Roslyn Lake, Bull Run powerhouse, and lower section of flume.

The specific process of delineating vegetation community polygons included the following steps: (1) attach a clear transparent overlay to each aerial photo; (2) establish the fiducial marks and photo number on the transparency for proper registration; and (3) delineate the vegetation communities on the transparency with a 0.5-mm ink pen within the effective area of the photo, using a stereoscope when necessary. The minimum mapping unit for each polygon was 1 ac (0.4 ha) for upland types; wetlands and riparian areas and any other uncommon vegetation types were delineated as small as possible (approximately 0.25 ac [0.1 ha]).

3.1.5 Compilation and Preparation of Data for Digitizing

Once all polygons were delineated on the photos, they were checked by a biologist not involved in the field delineation and transferred onto a transparent overlay registered to 1:24,000 USGS topographic maps.

3.1.6 Digitization of Data

Vegetation community polygons from the orthophotos or USGS maps were digitized into a GIS database with ARC/INFO using digital orthophotos as a background. Once entered, the data were reviewed for errors and check plots produced to confirm digitizing accuracy.

3.1.7 Preparation of Vegetation Community Map and Acreage Data

GIS was used to produce a vegetation community database, working maps, and acreage summaries for the study area. Maps of the study area show vegetation communities and Project facilities. Separate acreage summaries were generated for the vegetation types found within the Project boundary and for PGE-owned lands outside the boundary.

3.2 Riparian Zone Characterization

The riparian zone characterization involved collecting data on the vegetation composition and structure of riparian areas along the Sandy, Little Sandy, and Bull Run rivers. Riparian zone evaluation generally followed the "Intensive Riparian Ecological Site Inventory" vegetation components of the BLM's Riparian Area Management (Myers 1989), and included the following parameters:

- Vegetation community association,
- Vegetation composition and canopy cover,
- Width of riparian zone,
- Slope and aspect, and
- Riparian ecological site delineation.

In addition to evaluating live vegetation characteristics, the riparian zone investigations also included an assessment of snags and down woody material. Snags and logs are used by more than 100 vertebrate species in western Oregon (Nietro et al. 1985; Bartels et al. 1985). In addition, down woody material has important ecological implications in terms of mineral and nutrient cycling. Bartels et al. (1985) provides recommendations for managing down woody material resources. The USFS and BLM have established goals for snag and down woody material abundance on the lands they manage (USFS and BLM 1994). The purpose of the snag and down woody material surveys was to determine the relative abundance and characteristics of snags and down woody material in the riparian zone.

3.2.1 Field Sampling

To evaluate the current health and physical attributes of the riparian zones, vegetation was quantitatively described at 28 sites, with 11, 10, and 7 sites sampled on the Sandy, Little Sandy, and Bull Run rivers, respectively. On each river, sites were distributed upstream and downstream of the diversion dam or tailrace. Site locations were selected randomly while also considering access and safety factors.

At each site, a 330-ft (100 m) transect was established parallel to the river, with transect being centered between the shoreline and the upland boundary of the riparian zone. The canopy cover of shrubs and tall forbs was measured along the transect using the line intercept method (Bonham 1989) and recorded by species. Canopy cover of low forbs, grass, woody debris, and bare ground was estimated every 16.5 ft (5 m) along the transect using a plot frame 1.1 sq ft (0.05 sq m) in size (Bonham 1989), for a total of 20 plots. Other measurements taken at 16.5-ft (5 m) intervals included heights of the shrub, tall forb, and low forb closest to the transect and vegetation height-density using a cover board. The two most dominant species in each layer were recorded, along with the dbh of up to 10 trees at the site. A data form is included in Appendix A.

Transect and vertical cover board.

At each sampling site, belt transects were used to estimate tree density and to record data on snags and down woody material. All snag and log data were recorded on standard data forms (Appendix B). Belt transect length and width were determined in the field and depended on the width of the riparian zone, as well as the amount of down woody material and snags. Data recorded for each snag included: species, dbh, height, and structural class. If species could not be determined, the snag was classified as either conifer or deciduous. Snag structure classification was based on nine stages (Figure 3-1) (Maser et al. 1979; Nietro et al. 1985). Each piece of down wood with a midpoint inside the belt transect was counted. To be counted, a log had to be at least 8 ft (2.4 m) long and 6 in. (15 cm) large-end diameter. Down woody material data recorded included origin (natural log, cut log, natural stump, or cut stump), species, structural class, length, and small- and large-end diameters. Five structural classes for down woody material were used (Figure 3-1) (Maser et al. 1979; Bartels et al. 1985). Snags and pieces of down wood that were hollow or had any wildlife sign (Bull et al. 1997) were also noted.

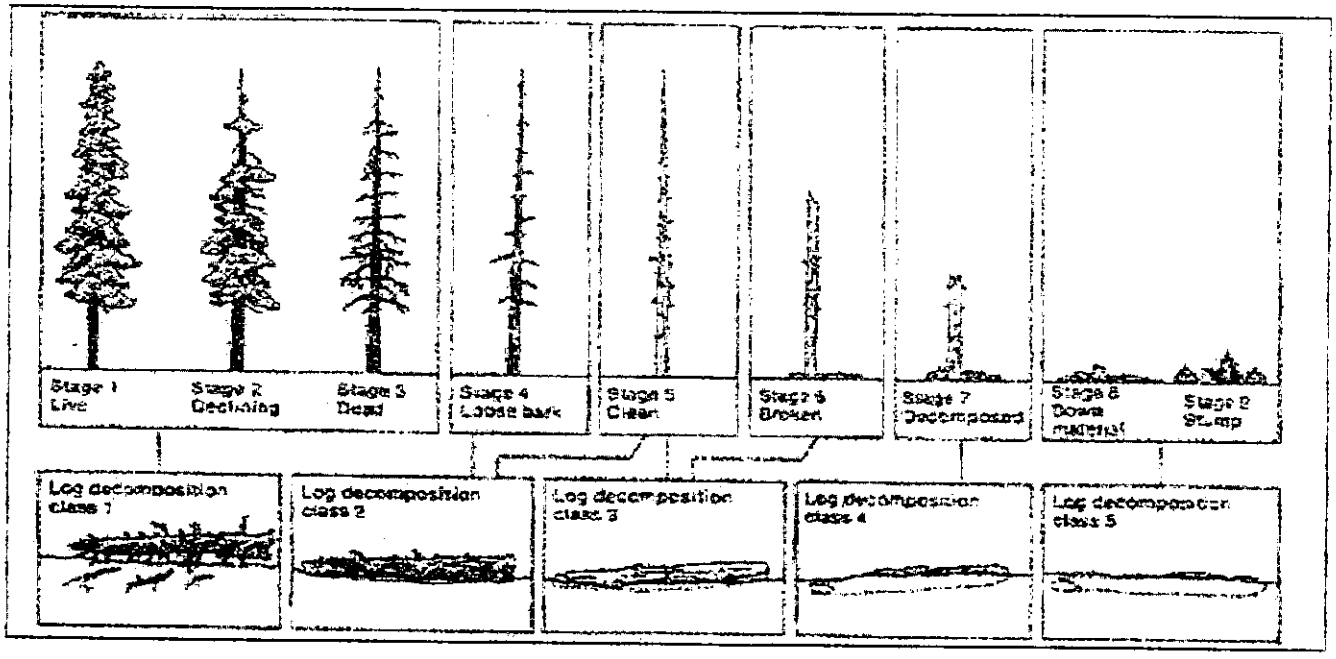


Figure 3-1. Snag and log structural classes (reproduced from Maser et al. 1979).

3.2.2 Data Analysis

All vegetation variables were summarized tabularly for each site and river section (e.g., Sandy River upstream vs. downstream). Snag densities by species, dbh, and structural class were

calculated for each site. Similarly, the density, total length, and volume of down woody material were also calculated (Bull et al. 1997). The mean, standard error, standard deviation, and minimum/maximum were calculated for each parameter; differences in parameters between upstream and downstream sampling sites were compared using analysis of variance (ANOVA) and student's t-test (Zar 1984).

3.3 Snag/Down Woody Material

In addition to being included in the riparian zone characterization, snags and down woody material were sampled on USFS and BLM land within the study area. In total, six transects were sampled on BLM land in riparian and upland habitat near Marmot Dam and the diversion impoundment. Four transects were sampled on USFS land along approximately 0.6 mi (1.0 km) of the Little Sandy River and upland habitat within the FERC Project boundary along 0.6 mi (1.0 km) of the flume. The methods used to assess snag and down woody material on USFS and BLM lands were the same as those described in Section 3.2. The values calculated in the study area were compared to the USFS standards and guidelines under the Northwest Forest Plan (USFS and BLM 1994) and the Mt. Hood National Forest (USFS 1990). The Northwest Forest Plan calls for at least 240 linear ft (73 m) of logs greater than 20 in. (51 cm) diameter and 20 ft (6.1 m) in length per acre (0.4 ha) in matrix lands. The Mt. Hood National Forest standard for down woody material is retention of an average of at least 6 logs per acre (0.4 ha) in decomposition classes 1, 2, and 3 (USFS 1990).

4.0 RESULTS AND DISCUSSION

The following sections summarize the results of: (1) vegetation community mapping, (2) riparian vegetation characterization, and (3) snag/down woody material surveys. Latin plant species names are listed in Appendix C.

4.1 Vegetation Community Mapping

PNCs and vegetation cover were mapped in the 2,739-ac (1,108 ha) study area for terrestrial resources. A total of 4 upland, 6 riparian, 3 wetland, and 2 water-dominated PNCs were mapped in the study area (Hall 1998, Halverson et al. 1986, Diaz and Mellen 1996). The vegetated communities represent plant associations (PAS), while the deepwater types are categorized by an ecocolass. Developed and disturbed areas that are unlikely to support natural vegetative communities were assigned to one of six developed/disturbed land uses. Forty-three combinations of PNC or land use, seral stage, and structural class were mapped in the study area. These 43 combinations were grouped into 20 vegetation community types or cover types, which are based on existing conditions. Cover types in the study area are shown in Figure 4-1. Study area PNCs and land uses are depicted in Figure 4-2. Acreages for cover types and PNC/land uses are provided in Tables 4-1 and 4-2, respectively.

Approximately 1,943 ac (786 ha), or 71 percent, of the study area is composed of upland forest cover types (Table 4-1). Of the 22 PNCs and land uses documented in the study area, the single most dominant was the western hemlock/Oregon grape/sword fern (*Tsuga heterophylla/Berberis nervosa/Polystichum munitum*) PAS, which occupied 1,647 ac (667 ha) or 60 percent of the study area (Table 4-2). No other PNC or land use occupied more than 236 ac (95 ha). Approximately 67 ac (27 ha) of the study area are either developed, used for recreational purposes, or occupied by the transmission line ROW and are not likely to support native plant communities in the near future. The following sections summarize the vegetation communities in the study area.

4.1.1 Conifer Forest Types

Upland conifer forest types cover approximately 343 ac (139 ha) or 13 percent of the study area and include old-growth, mature, and mid-successional stands (Table 4-1). Two PASs were identified for existing conifer forest stands in the study area—western hemlock/Oregon grape/sword fern and western hemlock/Alaska huckleberry (*Vaccinium alaskaense*)-salal (*Gaultheria shallon*). About 272 ac (110 ha) are in the western hemlock/Oregon grape/sword fern PAS, which is widespread below 2,000 ft (610 m) elevation on the Mt. Hood National Forest (Halverson et al. 1986). It typically is found on moderately moist and warm sites that are very well drained. The western hemlock/Alaska huckleberry-salal PAS occurs on sites with moderate moisture on gentle slopes and ridges. In the Bull Run study area, this PAS is represented by 71 ac (29 ha) of conifer just south and east of Roslyn Lake and on the north side of the Bull Run River across from the powerhouse (Table 4-2, Figure 4-2).

About 252 ac (102 ha) or over 73 percent of the conifer forest in the study area are mature stands that are currently dominated by Douglas-fir and western hemlock (Table 4-1). Mature conifer

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Table 4-1. Acres of existing vegetation cover types in the Bull Run Hydroelectric Project study area.

Cover Type	Study Area Segment: Sandy ac (%)	Little Sandy ac (%)	Bull Run ac (%)	Roslyn Lake ac (%)	Line ac (%)	Total ac (%)	FERC Boundary ac (%)
Conifer Forest Types							
Old-growth Conifer Forest	45.7 (3%)					45.7 (2%)	
Mature Conifer Forest	94.1 (7%)	86.5 (15%)	54.1 (13%)	16.7 (5%)		251.6 (9%)	31.7 (5%)
Mid-successional Conifer Forest	16.5 (1%)	2.5 (<1%)		26.9 (8%)		45.8 (2%)	26.9 (5%)
Conifer Forest Total	**156.2 (11%)**	**89.0 15%)**	**54.1 (13%)**	**43.6 (13%)**		**342.9 (13%)**	**58.5 (10%)**
Mixed Deciduous/Conifer Forest Types							
Mature Mixed Deciduous/Conifer Forest	44.3 (3%)					44.3 (2%)	
Mid-successional Mixed Deciduous/Conifer Forest	608.2 (43%)	262.5 (47%)	181.0 (43%)	84.3 (25%)		1,136.0 (42%)	146.8 (25%)
Early-successional Mixed Deciduous/Conifer Forest	65.3 (5%)	18.8 (3%)	39.8 (9%)			123.9 (4%)	27.8 (4.7%)
Mixed Deciduous/Conifer Forest Total	**717.8 (51%)**	**281.3 (50%)**	**220.8 (52%)**	**84.3 (25%)**		**1,304.2 (48%)**	**174.6 (29%)**
Deciduous Forest Types							
Mid-successional Deciduous Forest		85.0 (15%)	46.5 (11%)			131.5 (5%)	33.8 (6%)
Early-successional Deciduous Forest	102.7 (7%)	62.2 (11%)				164.9 (6%)	5.6 (1%)
Deciduous Forest Total	**102.7 (7%)**	**147.2 (26%)**	**46.5 (11%)**			**296.4 (11%)**	**39.4 (7%)**
Upland Non-forest Types							
Shrubland	15.2 (1%)	0.1 (<1%)	8.7 (2%)	9.5 (3%)	3.6 (57)	37.1 (1%)	31.9 (5%)
Grassland	2.0 (<1%)	12 (2%)	2 (1%)	13.6 (4%)		29.6 (1%)	15.1 (3%)
Non-Forest Total	**17.2 (1%)**	**12.1 (2%)**	**10.7 (3%)**	**23.1 (7%)**	**3.6 (57)**	**66.7 (2%)**	**47 (8%)**
Riparian Types							
Riparian Mixed Deciduous/Conifer Forest	88.7 (6%)	2.4 (<1%)	41 (10%)			132.1 (5%)	5.5 (1%)
Riparian Deciduous Forest	44.9 (3%)	14.1 (2%)	5.9 (1%)	13.9 (4%)		78.8 (3%)	20 (3%)
Riparian Deciduous Shrubland	19.0 (1%)	3.0 (1%)	11.0 (3%)		0.1 (1%)	33.0 (2%)	7.7 (1%)
Riparian Total	**152.6 (11%)**	**19.5 (3%)**	**57.9 (14%)**	**13.9 (4%)**	**0.1 (1%)**	**243.9 (9%)**	**33.2 (6%)**

Table 4-1. Acres of existing vegetation cover types in the Bull Run Hydroelectric Project study area (cont'd.).

Cover Type	Study Area Segment						
	Sandy ac (%)	Little Sandy ac (%)	Bull Run ac (%)	Roslyn Lake ac (%)	T-Line ac (%)	Total ac (%)	FERC Bndry ac (%)
Wetland Types							
Palustrine Forested Wetland	1.8 (<1%)			9.6 (3%)		11.4 (<1%)	9.6 (2%)
Palustrine Scrub-shrub Wetland				1.8 (1%)		1.8 (<1%)	1.8 (<1%)
Palustrine Unconsolidated Bottom (Pond)	0.7 (<1%)					0.7 (<1%)	
Wetland Total	**2.5 (<1%)**			**11.4 (3%)**		**13.9 (<1%)**	**11.4 (2%)**
Deepwater Types							
Lacustrine Unconsolidated Bottom (Lake/ Reservoir)	12.4 (1%)	1.9 (<1%)		143.8 (42%)		158 (6%)	155.9 (26%)
Riverine Unconsolidated Shore	7.1 (<1%)					7.1 (<1%)	2.2 (<1%)
Riverine Unconsolidated Bottom (River)	195.6 (14%)	4.4 (1%)	23.6 (6%)		0.1 (2%)	223.8 (8%)	2.7 (1%)
Deepwater Total	**215.1 (15%)**	**6.3 (1%)**	**23.6 (6%)**	**143.8 (42%)**	**0.1 (2%)**	**388.9 (14%)**	**160.8 (27%)**
Developed/Disturbed Types							
Agriculture					2.2 (35%)	2.2 (<1%)	2.2 (<1%)
Developed				12.7 (4%)	0.3 (5%)	13 (1%)	13 (2%)
Disturbed	36.6 (3%)	3.1 (1%)	11.3 (3%)	9.9 (3%)		60.9 (2%)	45.7 (8%)
Disturbed T-line ROW	1.2 (<1%)	6 (1%)				7.2 (<1%)	7.2 (1%)
Developed/Disturbed Total	**37.8 (3%)**	**9.1 (2%)**	**11.3 (3%)**	**22.6 (7%)**	**2.5 (40%)**	**83.3 (3%)**	**68.1 (11%)**
GRAND TOTAL	**1,401.7**	**564.4**	**424.9**	**342.7**	**6.2**	**2,739.8**	**593.02**

Table 4-2. Acres of each PNC/land use by ownership in the Bull Run Hydroelectric Project study area.

PNC/Land Use	BLM (ac)	City of Portland (ac)	POR (ac)	Other Private (ac)	USFS (ac)	Grand Total (ac)
Developed Land Uses						
Agriculture			2.2			2.2
Developed			2.8			2.8
Disturbed	0.4	0.8	28.2	0.0	0.0	29.5
Grassland			15.6			15.6
Recreational Development			10.2			10.2
Transmission Line ROW			7.2			7.2
Total Developed Land Uses	**0.4**	**0.8**	**66.2**	**0.0**	**0.0**	**67.5**
Riparian Plant Associations						
Red alder/thimbleny (ALRU/RUPA)			3.8	0.0		3.8
Red alder/salmonberry/pig-a-back-plant (ALRU/RUSP/TOME)	5.1	3.4	43.6	34.7	0.8	87.7
Black cottonwood (POTR2)			1.0	19.9		20.9
Willow (SASI2)	1.4		7.9	14.1	1.0	24.3
Western red cedar/salmonberry/Oregon oxalis (THPL/RUSP/OXOR)		7.30	6.90	0.89		15.09
Maidenhair fern (ADPE)[1]	0.6	15.2	40.5	32.5	9.7	98.4
Total Riparian Plant Associations	**7.1**	**25.9**	**103.6**	**102.1**	**11.5**	**250.3**
Upland Plant Associations						
Western hemlock/Oregon grape/sword fern (TSHE/BENE/POMU)	81.7	83.8	1365.5	7.5	108.4	1646.9
Western hemlock/Oregon grape-salal (TSHE/BENE-GASH)			65.1			65.1
Western hemlock/sword fern-Oregon oxalis (TSHE/POMU-OXOR)	106.1		88.5	29.0	11.8	235.5
Western hemlock/Alaska huckleberry-salal (TSHE/VAAL-GASH)			70.9			70.9
Total Upland Plant Associations	**187.8**	**83.8**	**1,590.0**	**36.5**	**120.2**	**2,018.4**
Deepwater/Shoreline Ecoclasses						
Lake (WL)	4.5		145.7	7.9		158.0
Riverine (WR)	3.9	8.9	58.7	151.4	0.9	223.8
Riverine Shore (WR)	0.5			6.7		7.1
Total Deepwater/Shoreline Ecoclasses	**8.9**	**8.9**	**204.4**	**165.9**	**0.9**	**388.9**
Wetland Plant Associations						
Alder Wetland (HAM0)	1.8		9.6			11.4
Shrub Wetland (SW)			1.8			1.8
Pond (WL)			0.7			0.7
Total Wetland Plant Associations	**1.8**	**0.0**	**12.0**	**0.0**	**0.0**	**13.9**
Grand Total	**206.0**	**119.5**	**1,976.2**	**304.6**	**132.7**	**2,739.0**

Table 4-3. Comparison of cover type and potential natural community/land use acreage in the Bull Run study area.

COVER TYPE	Potential Natural Communities (PNC) and Land Uses																														Grand Total (ac)
	Disturbed Land Uses (ac)												Riparian PASs (ac)												Upland PASs (ac)												Deepwater/Shore Ecoclasses (ac)						Wetland PASs (ac)						
	Agriculture		Developed		Disturbed		Grassland		Recreational Development		Transmission Line ROW		Red alder/thimbleberry (ALRU/RUPA)		Red alder/salmonberry/pig-a-back-plant (ALRU/RUSP/TOME)		Black cottonwood (POTR2)		Willow (SASI2)		Western red cedar/salmonberry/ Oregon oxalis (THPL/RUSP/OXOR)		Maidenhair fern (ADPE)[1]		Western hemlock/Oregon grape/swordfern (TSHE/BENE/POMU)		Western hemlock/Oregon grape-salal (TSHE/BENE-GASH)		Western hemlock/sword fern-Oregon oxalis (TSHE/POMU-OXOR)		Western hemlock/Alaska huckleberry-salal (TSHE/VAAL-GASH)		Lake		Riverine		Riverine Shore		Alder Wetland		Shrub Wetland		Pond		
Conifer Forest Types																																											
Old-Growth Conifer Forest																									45.7																				45.7
Mature Conifer Forest																									180.5						70.9														251.4
Mid-successional Conifer Forest																									45.9																				45.9
Mixed Deciduous/Conifer Forest Types																																											
Mature Mixed Deciduous/Conifer Forest																									44.3																				44.3
Mid-success. Mixed Decid./Conifer Forest																									841.2		65.1		229.7																1136.0
Early-success. Mixed Decid./Conifer Forest																									118.2				5.8																123.9
Deciduous Forest Types																																											
Mid-successional Deciduous Forest																									131.4																				131.4
Early-successional Deciduous Forest																									164.7																				164.7
Upland Non-forest Types																																											
Upland Shrub																					6.6				29.8																				36.4
Grassland							15.6																		14.0																				29.6
Riparian Types																																												
Riparian Mixed Deciduous/Conifer Forest															33.9						8.5		89.6																				132.0
Riparian Deciduous Forest													3.8		46.7		19.4						8.8																				78.7
Riparian Deciduous Shrubland															7.1		1.6		24.3																								33.0
Wetland Types																																											
PalustrineForested Wetland																																							11.4					11.4
Palustrine Scrub-shrub Wetland																																								1.8			1.8
Palustrine Unconsolidated Bottom (Pond)																																									0.7	0.7
Deepwater Types																																											
Lacustrine Unconsolidtaed Bottom (Lake)																																			158.0								158.0
Riverine Unconsolidated River Bottom/Shore																																				223.8	7.1						230.9
Developed/Disturbed Types																																											
Developed/Disturbed	2.2		2.8		29.5				10.2																31.4																				76.1
Disturbed T-Line ROW											7.2																																		7.2
Grand Total	2.2		2.8		29.5		15.6		10.2		7.2		3.8		87.7		20.9		24.3		15.1		98.4		1647.0		65.1		235.5		70.9		158.0		223.8		7.1		11.4		1.8		0.7	2739.0

[1] Not pure maidenhair fern. About 89.6 ac were mapped as western red cedar/salmonberry/Oregon oxalis with pockets of maidenhair fern; 8.8 ac were mapped as western hemlock/swordfern-Oregon oxalis with pockets of maidenhair fern

forests in the study area occurs in all three river drainages. Only about 32 ac (13 ha) of this type are within the FERC Project boundary (Table 4-1). The largest parcels are found on PGE and BLM lands along the south side of the Little Sandy River and on USFS and PGE lands south of portions of the wooden box flume (Figure 4-1).

The only old-growth conifer forest in the study area is a single 46-ac (19 ha) parcel outside the FERC Project boundary on PGE land along the south side of the Sandy River (Figure 4-1). Currently western hemlock and western red cedar (*Thuja plicata*) are co-dominant in this stand.

Mid-successional conifer forest covers about 46 ac (19 ha) in the study area and occurs mostly near Roslyn Lake (Figure 4-1). About half of this type is within the FERC Project boundary. Most of the parcels were probably harvested about 30 to 60 years ago and are currently dominated by Douglas-fir.

4.1.2 Mixed Deciduous/Conifer Forest Types

Mixed deciduous/conifer forest dominates the study area and includes mature, mid-successional, and early successional stands. Together, these seral stages cover approximately 1,304 ac (528 ha), or about 48 percent of the study area (Table 4-1). The mixed forest type includes three PASs: (1) western hemlock/Oregon grape/sword fern; (2) western hemlock/sword fern-Oregon oxalis (*Oxalis oregana*); and (3) western hemlock/Oregon grape-salal (Diaz and Mellen 1996) (Table 4-3). About 1,004 ac (406 ha) of the mixed conifer type in the study area is in the widespread western hemlock/Oregon grape/sword fern PAS. The western hemlock/sword fern-Oregon oxalis PAS is represented by 236 ac (95 ha) of mixed conifer forest on lands upslope of Marmot Dam on both sides of the river, along approximately 1 mi (1.6 km) of the Sandy River immediately downstream of the Marmot Dam (Table 4-3, Figure 4-2). This PAS is typically associated with low to mid-elevation sites with abundant moisture and productive soils (Halverson et al. 1986). Approximately 65 ac (26 ha) of mixed conifer forest along the Sandy River between the canal and the river and on the ridge east of Roslyn Lake is in the western hemlock/Oregon grape-salal PAS (Table 4-3, Figure 4-1, Figure 4-2). This PAS is found on fine textured soils, often on warm south-facing slopes and frequently has a high cover of sword fern (Halverson et al. 1986).

About 1,136 ac (460 ha) or 87 percent of the mixed deciduous/conifer in the study area are mid-successional stands (Table 4-1). These stands represent about 25 percent of the land within the FERC Project boundary and approximately 44 percent of the entire study area (Figure 4-1). Mid-successional mixed stands appear to have been harvested 30 to 60 years ago and currently consist of a variety of coniferous and deciduous trees, including Douglas-fir, big-leaf maple (*Acer macrophyllum*), western red cedar, and red alder (*Alnus rubra*).

Early successional mixed deciduous/conifer forest covers about 124 ac (50 ha) in the study area and is common within the FERC Project boundary along the entire corridor for the wooden box flume. It is also found on PGE lands along the Marmot Dam service road and east of Roslyn Lake (Figure 4-1). The overstory in this cover type typically consists of young Douglas-fir, red alder, and western hemlock.

There is only one stand of mature mixed deciduous/conifer forest in the study area. Located on PGE land north of the Sandy River (Figure 4-1), this 44-ac (18 ha) parcel is currently dominated by a mixture of large Douglas-fir and red alder.

4.1.3 Deciduous Forest Types

Deciduous forest cover types occupy approximately 296 ac (120 ha) or 11 percent of the study area and include both mid- and early successional stands (Table 4-1). These stands are all within the western hemlock/Oregon grape/sword fern PAS and will eventually be dominated by western hemlock. Most mid-successional stands are currently dominated by a mixture of red alder and Douglas-fir; early successional stands consist primarily of red alder and shrubs.

Mid-successional deciduous forest covers about 132 ac (53 ha) and occurs within the FERC Project boundary along both sides of the corridor for the wooden box flume (Table 4-1, Figure 4-1). Much of this area is crossed by a number of very small streams and seeps. Mid-successional deciduous stands are also found on a large parcel of land owned by the City of Portland along the Bull Run River downstream of its confluence with the Little Sandy River (Figure 4-1). The majority of the 119 ac (48 ha) of Portland-owned land in the study area is a hemlock/Oregon grape/sword fern PAS (Table 4-2). Early successional deciduous stands occupy about 165 ac (67 ha) and are found on PGE lands along part of the Little Sandy Diversion service road and both sides of a portion of the Sandy River (Figure 4-1).

4.1.4 Non-Forested Uplands

Non-forested uplands currently represent only 67 ac (27 ha) or 2 percent of the study area and include shrublands, grasslands, and transmission line ROW (Table 4-1). Upland shrublands cover approximately 37 ac (15 ha) and occur in small patches in the transmission line ROW and along the Sandy canal, wooden box flume, and roads (Figure 4-1). Most of the upland shrubland is within the FERC Project boundary. The PASs for this type are western hemlock/Oregon grape/sword fern and western red cedar/salmonberry (*Rubus spectabilis*)/ Oregon oxalis (Table 4-3), but most areas are dominated by Scot's broom (*Cytisus scoparius*) and blackberry (*Rubus ursinus*, *R. laciniatus*, and *R. discolor*).

Grasslands are also uncommon in the study area, representing about 30 ac (12 ha) (Table 4-1). Grasslands cover much of the dike along the north end of Roslyn Lake; they also occur on a few small patches of PGE land between the Little Sandy and Sandy drainages (Figure 4-1). About half of this type is within the FERC Project boundary. Most of the grasslands in the study area are currently either pastures or part of recreation areas and are dominated by non-native grasses and forbs. About 14 ac (6 ha) of the grasslands in the study area represent the earliest successional stage of the western hemlock/Oregon grape/sword fern PAS.

4.1.5 Riparian Types

Riparian vegetation occupies 244 ac (99 ha) or 9 percent of the study area and includes three cover types: (1) riparian deciduous forest; (2) riparian mixed deciduous/conifer forest; and (3) riparian deciduous shrubland. Riparian types in the study area include six PASs: (1) red alder/thimbleberry (*Rubus parvifolia*); (2) red alder/salmonberry/pig-a-back plant (*Tolmiea*

menziesii); (3) black cottonwood (*Populus trichocarpa*); (4) western red cedar/salmonberry/ Oregon oxalis; (5) maidenhair fern (*Adiantum pedatum*); and (6) willow (*Salix* spp.) (Diaz and Mellen 1996).

Riparian mixed deciduous/conifer forest represents about 54 percent of the riparian vegetation in the study area (Table 4-1). Dominated by western red cedar and red alder, this type borders about 3 mi (5 km) of both sides of the Sandy River below Marmot Dam and about 2 mi (3 km) along one side upstream of the dam. It also borders most of the Bull Run River below the confluence with the Little Sandy River (Figure 4-1). Riparian mixed deciduous/conifer forests include the red alder/salmonberry/pig-a-back plant, western red cedar/salmonberry/Oregon oxalis, and maidenhair fern PASs (Table 4-1). There was over 103 ac (42 ha) of riparian PASs on PGE land in the study area, with an additional 102 ac (41 ha) occurring on other privately owned land (Table 4-2). There was 7, 26, and 1 ac (3, 11, 0.4 ha) of riparian PASs mapped on BLM, Portland, and USFS land, respectively.

Riparian deciduous forest represents about 32 percent of the riparian vegetation in the study area (Table 4-1) and is characterized primarily by red alder, although black cottonwood and big-leaf maple also occur. Small patches of maidenhair fern are found on bedrock outcroppings among the deciduous riparian habitat in the steep canyons of the Sandy and Bull Run rivers. The riparian deciduous forests that were mapped in the study area included four PASs: (1) red alder/thimbleberry, (2) red alder/salmonberry/pig-a-back plant, (3) black cottonwood, and (4) maidenhair fern (Table 4-3).

Riparian deciduous shrublands are relatively uncommon, representing about 33 ac (13 ha) or 14 percent of the riparian vegetation in the study area. This type occurs in a few patches along all three rivers and consists of willow and small red alder. Three PASs were associated with the riparian shrub habitats: (1) red alder/salmonberry/pig-a-back plant, (2) black cottonwood, and (3) willow (Table 4-3).

Riparian deciduous forest and shrub along lower Little Sandy River

The following sections provide additional information on the riparian PASs.

Red alder/thimbleberry PAS

Approximately 4 ac (1.6 ha) or 1.5 percent of the riparian vegetation in the study area were in the red alder/thimbleberry PAS (Table 4-2, Table 4-3). This PAS was found along the Sandy River downslope of the Sandy Canal on PGE land. This PAS has dense shrub and forb layers and occurs on well-drained sites that have experienced intense high flows in the past (Diaz and Mellen 1996). The shrub layer is dominated by thimbleberry, while the forb layer includes miner's lettuce (*Montia sibirica*), nettle (*Stachys cooleyae*), and pig-a-back plant. Regenerating red cedar, hemlock, and Douglas-fir also occur in the understory.

Red alder/salmonberry/pig-a-back plant

About 88 ac (36 ha) or 36 percent of riparian vegetation in the study area were mapped as the red alder/salmonberry/pig-a-back plant PAS (Table 4-2, Table 4-3). This PAS occurs along large sections of the Sandy River upstream of Revenue Bridge and along the Bull Run River. It was mapped on all ownerships in the study area (Table 4-2). Most of these areas are dominated by red alder but often have some coverage of big-leaf maple, hemlock, or red cedar. This PAS has an overstory of alder and big-leaf maple 75 to 100 ft (23 to 30 m) tall and a dense layer of salmonberry and a forb layer dominated by pig-a-back plant, stinkcurrant (*Ribes bracteosum*), ladyfern (*Athyrium filix-femina*), nettle, miner's lettuce, and bedstraw (*Galium trifolium*) (Diaz and Mellen 1996). These sites usually occur between 1 and 6 ft (0.3 to 2 m) above the normal high-water line, have long growing seasons, and experience high flows every few decades.

Black cottonwood

Riparian vegetation in the black cottonwood PAS was limited to approximately 21 ac (8 ha) in scattered patches along the Sandy and Bull Run rivers, almost entirely on other private land (Table 4-2, Figure 4-2). This represents about 9 percent of the riparian vegetation in the study area. The black cottonwood PAS occurs on coarse substrate (gravel and cobble) on landforms that experience periodic flooding (Diaz and Mellen 1996). It usually occurs within 1 ft (0.3 m) above the mean high water line, often on islands. Cottonwood shrubs and small trees dominate the stands; willow and Douglas-fir may occur as well. Forbs include pearly everlasting (*Anaphalis margaritacea*), white hawkweed (*Hieracium albiflorum*), and blue wildrye (*Elymus glaucus*). Approximately 93 percent of the cottonwood PAS is currently forested; the remainder is dominated by shrubs (Table 4-3).

Western red cedar/salmonberry/Oregon oxalis

Approximately 9 ac (4 ha) of mixed deciduous/conifer riparian habitat is classified as western red cedar/salmonberry/Oregon oxalis PAS (Table 4-3). This PAS was found at two locations along the Bull Run River and usually occurs 1 to 5 ft (0.3 to 1.5 m) above the normal high water level, on flat to sloping terraces (Diaz and Mellen 1996). Most of this PAS was mapped on PGE and other privately owned land in the study area (Table 4-2). The large conifers provide important coarse woody material to stream systems. Red cedar dominates the overstory, with western hemlock and red alder also occurring in many stands. Shrubs include salmonberry and stinkcurrant while dominate forms include oxalis, ladyfern, and Scouler's corydalis (*Corydalis scouleri*).

Western red cedar/salmonberry/Oregon oxalis understory

Maidenhair fern

The maidenhair fern PAS occurs as small patches among other riparian communities and is most often associated with wet, shady environments on bedrock or very steep slopes. It was found along all three rivers in the study area. There were about 98 ac (49 ha) of riparian habitat mapped as hemlock or red cedar PASs with pockets of maidenhair fern PAS on all ownerships

within the study area, although very little occurred on BLM land (Figure 4-2, Table 4-2). This PAS is typified by dense maidenhair fern with goatsbeard (*Aruncus sylvester*) and ladyfern. These sites are not favorable for development of woody vegetation.

Maidenhair fern community

Willow

About 24 ac (10 ha) or 10 percent of the riparian habitat in the study area are in the willow PAS (Table 4-2). Most of this PAS occurs along the Bull Run and Sandy rivers, as well as near the confluence of the Little Sandy and Bull Run rivers. Approximately 58 percent of the willow was on other private land, while 33 percent was on PGE land; a small amount also occurred on BLM and USFS lands in the study area (Table 4-2). The willow PAS is a deciduous shrub type that has a meager to moderate development of forbs and grasses under a canopy of willow less than 15 ft (5 m) tall (Diaz and Mellen 1996). Willow is dominant with varying amounts of shrub forms of red alder and black cottonwood. Horsetail (*Equisetum arvense*) and miner's lettuce are dominant forbs. This PAS occurs at sites that are within 2 ft (0.6 m) above the normal high water line (Diaz and Mellen 1996). All of the willow PAS is mapped as riparian shrub cover type (Table 4-3).

Willow community in Little Sandy River

4.1.6 Wetland Types

Wetlands in the study area are rare, occupying only 14 ac (6 ha) and occurring in nine locations (Table 4-1). Most of the wetland acreage, including two palustrine forest and five palustrine scrub-shrub wetlands (Cowardin et al. 1979), are associated with Roslyn Lake and are on land owned by PGE (Figure 4-1). In fact, the only wetlands not on PGE land are two forested wetland seeps southwest of Marmot Dam on BLM land that total 1.8 ac. (0.7 ha) (Table 4-2, Figure 4-1). The 2 ac (0.8 ha) of scrub-shrub wetlands scattered along the shores of Roslyn Lake currently consist of dense stands of willow, red alder, and red-osier dogwood (*Cornus stolonifera*). The 11 ac (4 ha) of forested wetlands near Roslyn Lake are dominated by red alder and support a shrub layer of red-osier dogwood, salmonberry, and willow. One of these forested wetlands is maintained by water from a small tributary stream on the east side of the lake. The other receives water from a drainage ditch that carries seepage from the dikes on the south and west sides on the lake.

The two forested wetlands south of Marmot Dam are supported by seeps and characterized by western red cedar, red alder, and big-leaf maple, with an understory of salmonberry and skunk cabbage (*Lysichitum americanum*). The single pond in the study area is a small artificial impoundment downstream of Marmot Dam that was created as a fish holding facility (Figure 4-1).

4.1.7 Deepwater Types

Deepwater occupies approximately 389 ac (157 ha) or 14 percent of the study area and includes riverine and lacustrine types (Table 4-1). Riverine types represent 59 percent of the deepwater and include the Little Sandy River upstream of the diversion, and the Bull Run and Sandy rivers (Figure 4-1). Lacustrine types include Roslyn Lake (144 ac [58 ha]) and the small impoundments behind Marmot Dam and the Little Sandy Diversion.

Roslyn Lake and surrounding scrub-shrub and forested wetland

4.1.8 Developed/Disturbed Types

Developed and disturbed cover types include recreational areas, Project facilities, and lands used for agriculture. These types represent about 83 ac (34 ha) or 3 percent of the entire study area and 68 ac (28 ha) or 11 percent of the FERC Project area. Most of the disturbed and developed lands are within the FERC Project boundary on PGE land; a small amount of disturbed land occurs on BLM and City of Portland land within the study area (Table 4-2, Figure 4-1).

Disturbed habitats along flume

4.2 Riparian Zone Characterization

Data were collected from 28 plots in the following locations: upstream (3) and downstream (4) of the Bull Run powerhouse; upstream (4) and downstream (6) of the Little Sandy Diversion Dam; and upstream (7) and downstream (4) of Marmot Dam. The plot transects were placed parallel to the shoreline and were approximately midway between the river and the riparian-upland vegetation boundary. Thus, in most cases, the data were collected within about 10 to 15 ft (3 to 5 m) of the water's edge.

On the Sandy River, a comparison of the up- and downstream segments indicates no significant differences in any of the measured vegetation characteristics. There were, however, differences in several tree, shrub, and herbaceous characteristics on the Little Sandy and Bull Run rivers, suggesting that varying landform characteristics and altered flows may be influencing vegetation communities. On the Bull Run River, differences in topography and substrate appear to contribute to the vegetation differences more than altered flows. On the Little Sandy River, reduced flows in the bypass reach appear to result in more dramatic differences in herbaceous cover and tree and shrub heights. The following sections summarize the vegetative characteristics. Appendix D presents raw data.

4.2.1 Tree Canopy Cover

Total tree cover at the 28 riparian sites averaged 71.7±40.8 percent and ranged from 0 to 155 percent at individual sites. The mean total tree cover measured on the lower Bull Run River and upper Bull Run River differed significantly ($P<0.1$, t-test) (Table 4-4, Figure 4-3). In this case, the lower tree canopy cover upstream of the powerhouse was likely because the narrow, bedrock-dominated riparian zone supported fewer trees compared to the somewhat wider zone downstream of the powerhouse. Total tree cover also tended to be greater downstream of Marmot Dam and the Little Sandy Diversion Dam than above these structures, but the large variation resulted in non-significant statistical comparisons at $p=0.1$.

Most of the tree cover was comprised of species characterized as facultative species, indicating that they can occur at sites ranging from wet to dry. Overall, facultative tree canopy cover averaged 47.7±39.5 percent. Facultative species were dominant in all river segments except the Bull Run River upstream of the powerhouse. Red alder was the most common tree species, occurring in over 82 percent of the plots and averaging 50 percent cover (Table 4-5). Big-leaf maple was the second-most common species, occurring in 64 percent of the plots and averaging 22 percent cover. Conifer trees occurred in 39 percent of the plots and covered less than 10 percent (Table 4-5). Western red cedar was the most common conifer species, followed by Douglas-fir, Pacific yew (*Taxus brevifolia*), and western hemlock. Conifer tree cover was extremely variable but was greatest in the downstream segment of the Little Sandy River, where flows have been substantially reduced (Figure 4-4).

4.2.2 Shrub Canopy Cover

Total shrub canopy cover in riparian sites was high, averaging 100.3±38.9 percent across all sampling sites. Because shrub cover was recorded by species, total shrub cover can exceed 100 percent where the canopies of several shrub species overlap. Shrub cover at individual sampling sites ranged from 22 to 158 percent. Mean shrub cover by river segment ranged from 77 percent downstream of the Sandy River Diversion Dam to 141 percent on the Bull Run River upstream of the powerhouse (Table 4-4). There was no significant difference in riparian area shrub cover between any of the river segments, although the upstream Bull Run segment did have shrub cover 34 percent greater than the downstream segment; the other two rivers had differences of less than 8 percent (Figure 4-5).

As with trees, facultative species comprised the greatest percentage of the shrub canopy cover, averaging 46.2±26.6 percent overall. The facultative shrub cover on the Sandy and Little Sandy rivers was similar between upstream and downstream segments, ranging from 35 to 51 percent (Table 4-4). The upstream Bull Run segment had the highest mean facultative shrub cover—nearly 72 percent—which was substantially greater than the cover downstream of the powerhouse. High variability resulted in a lack of significant differences between means. Riparian areas along the Bull Run River exhibited significantly different means ($P<0.1$) for

Table 4-4. Riparian vegetation characteristics along river segments of the Bull Run study area (mean ± st. dev.)[1].

Shrub Canopy Cover (%)						
Conifer Shrubs	0.0±0.0	3.9±4.3	0.5±0.9	3.0±3.8	7.0±3.9	3.7±4.4
Facultative Shrubs[5]	40.8±16.5	35.5±30.6	44.8±28.8	51.3±29.0	71.6±21.6	45.3±26.1
Facultative Upland Shrubs[5]	24.0±19.9	17.5±24.5	12.4±15.5	26.4±9.6	17.0±11.7	46.0±29.8
Facultative Wetland Shrubs[5]	19.3±10.7	15.2±21.6	39.8±20.8	26.9±20.9	35.5±7.5	8.2±5.5
Upland Shrubs[5]	1.6±2.2	5.3±6.0	5.9±11.2	2.3±2.2	10.1±4.7	3.9±3.3
Total Shrub Cover[6]	85.7±8.8	77.5±51.0	103.4±49.5	109.8±18.0	141.2±18.9	107.0±41.1
Tree Canopy Cover (%)						
Conifer Trees	5.5±11.1	9.7±25.6	3.4±5.3	19.2±19.9	0.4±0.7	13.5±15.9
Facultative Trees	34.8±51.0	76.6±52.1	51.5±27.5	42.9±23.8	3.6±6.2	46.9±11.0
Facultative Upland Trees	10.8±16.6	6±10.6	5.8±6.5	18.9±24.3	23.8±28.1	25.5±30.3
Total Tree Cover[6]	51.2±59.3	92.4±51.6	60.8±29.3	81.0±29.2	27.7±25.2	85.9±25.6
Ground Cover						
Grass Cover (%)	10.7±11.1	7.1±6.6	11.2±8.0	3.5±2.1	4.0±4.3	1.3±1.2
Forb Cover (%)	25.6±20.9	31.3±22.2	43.7±8.0	29.5±16.2	19.8±2.5	10.5±5.8
Moss Cover (%)	13.3±12.1	20.3±26.7	12.0±3.5	32.8±8.2	36.0±6.2	36.1±13.3
Bare Ground Cover (%)	44.5±17.8	35.5±26.0	31.0±12.3	29.9±10.6	38.7±8.9	53.3±18.1
Woody Debris Cover (%)	4.3±3.5	7.5±9.8	3.2±3.7	8.5±5.3	0.8±1.4	2.5±2.9
Tree and Shrub Height and Tree DBH						
Tall Shrub Height (ft)	7.4±1.6	7.6±2.0	8.4±1.6	8.7±1.2	8.0±1.5	9.3±1.8
Low Shrub Height (ft)	3.9±1.1	3.7±1.4	6.9±1.5	4.0±1.3	5.8±1.8	2.3±0.6
Tree Height (ft)	42.3±13.1	42.5±18.9	35.2±7.9	61.2±25.3	42.9±10.7	40.5±10.8
Tree dbh (in.)	8.9±3.3	11.9±9.4	6.4±2.3	15.8±9.2	7.9±0.5	10.3±2.1

[1] Shaded cells indicate significantly different means ($P<0.1$, two-tail t-test) up- and downstream within the same river.

[2] 6 of the 7 upstream sites along the Sandy River were within 1.5-mi upstream of Marmot Dam; the 7th was about 3 mi upstream. Downstream sites (4) were between Marmot Dam and Dodge Park.

[3] Upstream sites (4) along the Little Sandy River were within 1 mi upstream of the diversion; downstream sites (6) were between the diversion and the confluence with the Bull Run.

[4] Upstream sites (3) along the Bull Run River were between the powerhouse and the confluence with the Little Sandy River; downstream sites (4) were between the powerhouse and the confluence with the Sandy River.

[5] Wetland Indicator Status (http://plants.usda.gov/plants/cgi_bin/topics.cgi?earl=wetland.html; January 10, 2001): **Facultative Wetland** = Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands; **Facultative** = Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%); **Facultative Upland** = Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%); **Upland** = Occurs almost always (estimated probability 99%) under natural conditions in non-wetlands.

[6] Shrub and tree canopies occur in layers that often overlap, resulting in totals potentially greater than 100%.

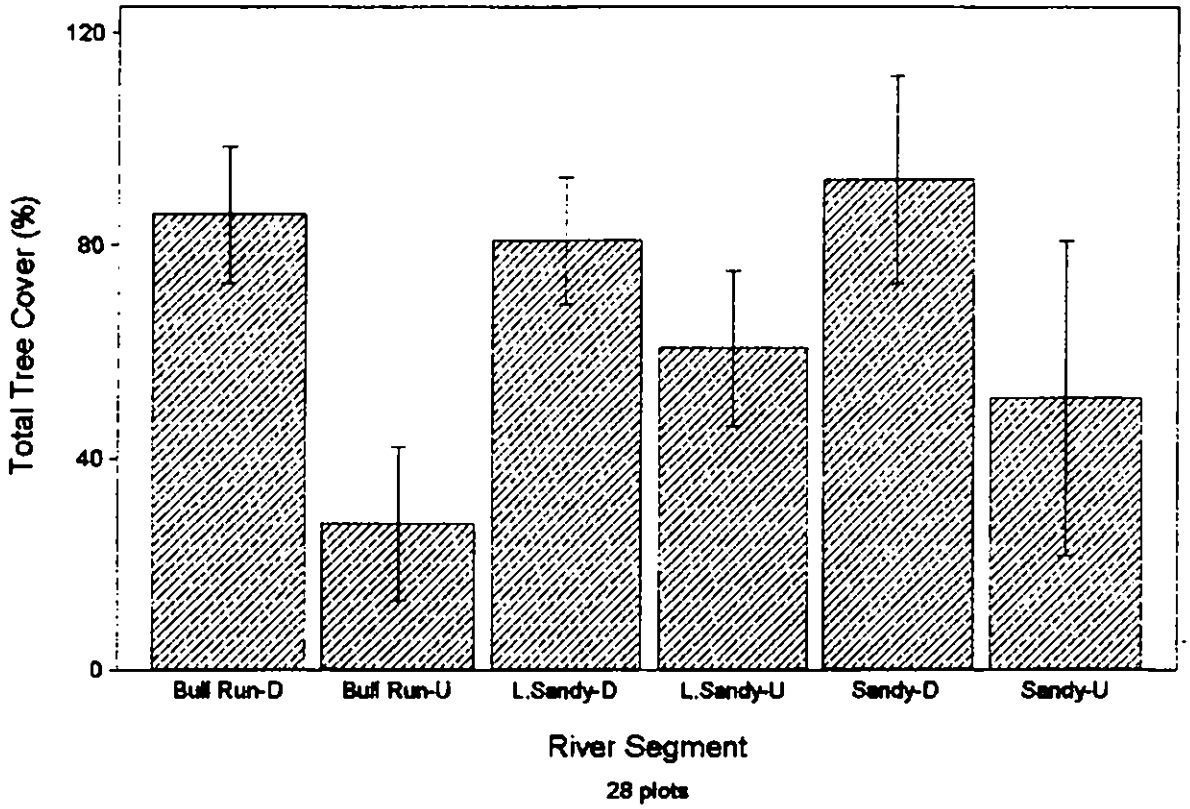


Figure 4-3. Mean (and standard error) tree canopy cover along river segments in the Bull Run study area.

facultative wetland and upland shrub cover between up- and downstream (Table 4-4 and Figures 4-6 and 4-7). In both cases, the means were greater upstream than downstream.

Shrub conifer occurred in 54 percent of the plots but averaged only 3 percent coverage (Table 4-5). Western red cedar was the most common conifer in the shrub layer; Douglas-fir, western hemlock, Pacific yew, and Pacific silver fir (*Abies amabilis*) also occurred.

4.2.3 Herbaceous Vegetation Canopy Cover

Grass and forb canopy cover was relatively low in riparian zones along all river segments. Mean grass cover ranged from 1.3 to 11.2 percent. Grass cover was greatest along the upstream segments of the Sandy and Little Sandy rivers—10.7 and 11.2 percent, respectively (Table 4-4). Grass canopy cover in the riparian zone upstream of the Little Sandy Diversion Dam was over three times the amount downstream and was significantly different ($P < 0.05$). Forb cover ranged from

Lower Little Sandy River

Table 4-5. Constancy and percent cover of plant species in riparian plots (N=28) in the Bull Run study area.

Species	Constancy[1]	Cover[2]	SD	Min	Max
Pacific silver fir	3.6	0.5	--	0.5	0.5
Douglas-fir	17.9	3.2	3.1	0.1	7.5
Pacific yew	7.1	5.1	3.7	2.4	7.7
Western red cedar	35.7	5.5	4.2	0.1	11.5
Western hemlock	7.1	0.75	0.2	0.6	0.9
Conifer Shrub Total	**53.6**	**3.0**	**3.8**	**0.0**	**11.5**
Red alder	75.0	18.7	15.9	0.2	63.7
Giant knotweed[3]	7.1	0.4	0.1	0.3	0.4
Black cottonwood	14.3	12.7	7.9	3.3	19.7
Stinkcurrant	35.7	4.1	3.3	0.4	11.2
Clustered wild rose	3.6	12.9	--	12.9	12.9
Wild rose sp.	21.4	7.1	6.4	0.5	16.4
Unknown shrub 1	3.6	11.1	--	11.1	11.1
Vine maple	64.3	10.4	9.4	0.6	33.2
Cascara	60.7	8.1	6.4	0.4	20.1
Thimbleberry	32.1	2.3	2.4	0.3	6.5
Unknown shrub 2	3.6	1.8	--	1.8	1.8
Salmonberry	92.9	15.2	17.2	0.4	75.6
Facultative Shrub Total	**96.4**	**46.2**	**26.6**	**0.0**	**93.1**
Big-leaf maple	75.0	8.6	9.5	0.2	29.3
Serviceberry	32.1	4.9	5.8	0.3	18.8
Chokecherry	7.1	8.4	6.5	3.8	13.0
Hazelnut	64.3	18.8	10.6	1.4	39.2
Salal	10.7	6.2	7.1	1.2	14.4
Indian plum	28.6	3.6	3.4	0.4	10.6
Himalayan blackberry	17.9	5.7	5.3	0.8	11.9
Pacific trailing blackberry	35.7	3.2	3.7	0.1	13.0
Red elderberry	17.9	4.5	4.7	1.0	12.3
Snowberry	50.0	4.2	5.2	0.3	19.3
Evergreen huckleberry	7.1	0.2	0.0	0.2	0.2
Facultative Upland Shrub Total	**92.9**	**23.1**	**21.1**	**0.0**	**79.8**
Red-osier dogwood	64.3	11.8	11.5	0.5	38.4
Crab apple	7.1	3.9	4.6	0.7	7.2
Willow spp.	67.9	11.5	14.0	0.3	45.0
Willow/alder	3.6	16.9	--	16.9	16.9
Spirea	10.7	1.1	0.6	0.4	1.6
Pacific ninebark	71.4	9.2	10.7	0.3	44.6
Facultative Wetland Shrub Total	**96.4**	**23.0**	**19.1**	**0.0**	**62.8**
Oregon grape	3.6	0.6	--	0.6	0.6
Pacific dogwood	7.1	12.9	13.9	3.1	22.7
Oceanspray	46.4	4.5	3.4	0.2	11.6
Holly	3.6	1.5	--	1.5	1.5
English ivy	3.6	0.2	--	0.2	0.2
Scot's broom	25.0	1.7	2.0	0.4	6.0
Red huckleberry	21.4	4.5	6.7	0.6	17.9
Upland Shrub Total	**82.1**	**4.5**	**5.7**	**0.00**	**22.7**
Shrub Total	**100.0**	**99.7**	**38.9**	**22.6**	**158.1**
Douglas-fir	10.7	27.9	18.7	12.4	48.6
Pacific yew	10.7	10.1	8.5	1.2	18.1
Western red cedar	25.0	14.8	8.3	2.6	25.3
Western hemlock	7.1	28.1	26.7	9.2	46.9
Conifer Tree Total	**39.3**	**9.8**	**17.4**	**0.0**	**67.7**
Red alder	82.1	49.5	25.9	6.9	100.0
Black cottonwood	14.3	39.3	26.8	2.2	63.2
Vine maple	3.6	3.3	--	3.3	3.3
Cascara	17.9	7.5	5.7	3.8	17.6
Facultative Tree Total	**85.7**	**47.8**	**39.5**	**0.0**	**155.2**
Big-leaf maple	64.3	21.8	21.2	1.5	69.3
Serviceberry	3.6	0.6	--	0.6	0.6
Hazelnut	3.6	0.7	--	0.7	0.7
Indian plum	3.6	0.8	--	0.8	0.8
Red elderberry	7.1	0.7	0.4	0.4	0.9
Facultative Upland Tree Total	**67.9**	**14.1**	**19.8**	**0.0**	**69.3**
Pacific ninebark	3.6	2.3	--	2.3	2.3
Facultative Wetland Tree Total	**3.6**	**2.3**	**--**	**2.3**	**2.3**
Tree Total	**92.9**	**72.0**	**42.4**	**0.00**	**155.2**

[1] Percent of plots in which a species occurs. Total number of plots = 28.

[2] Calculated for those plots in which the species found occurs.

[3] Giant knotweed was considered a shrub due to its tall dense growth form.

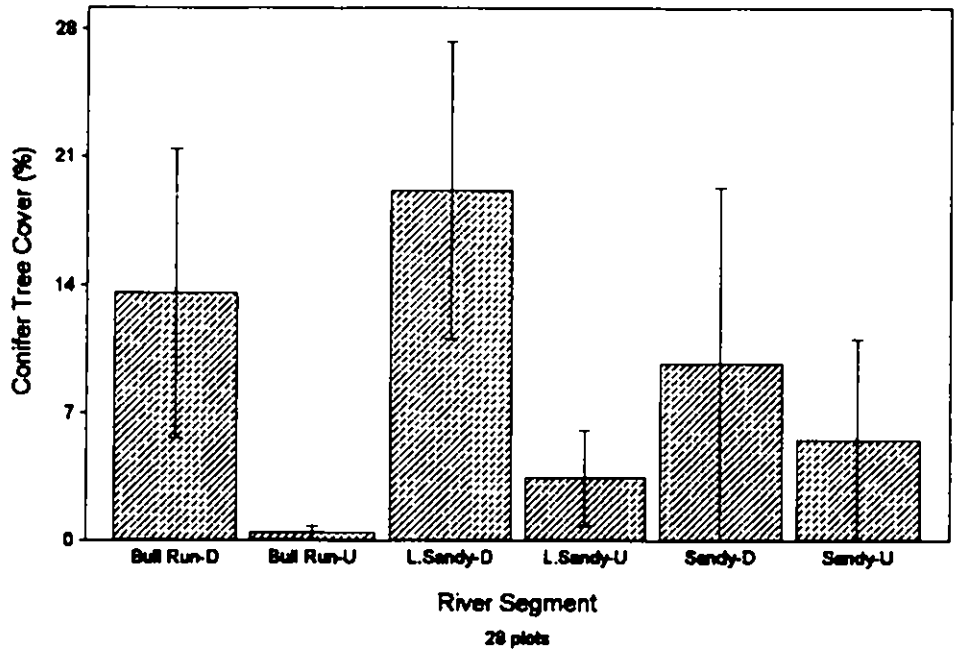


Figure 4-4. Mean (and standard error) conifer tree canopy cover along river segments in the Bull Run study area.

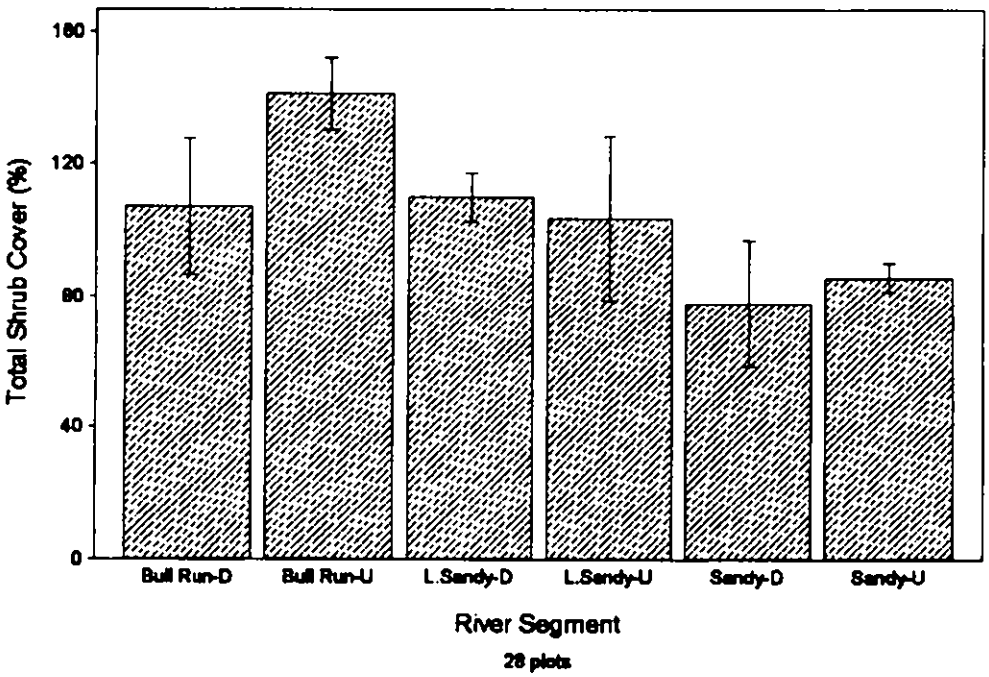


Figure 4-5. Mean (and standard error) shrub canopy cover along river segments in the Bull Run study area.

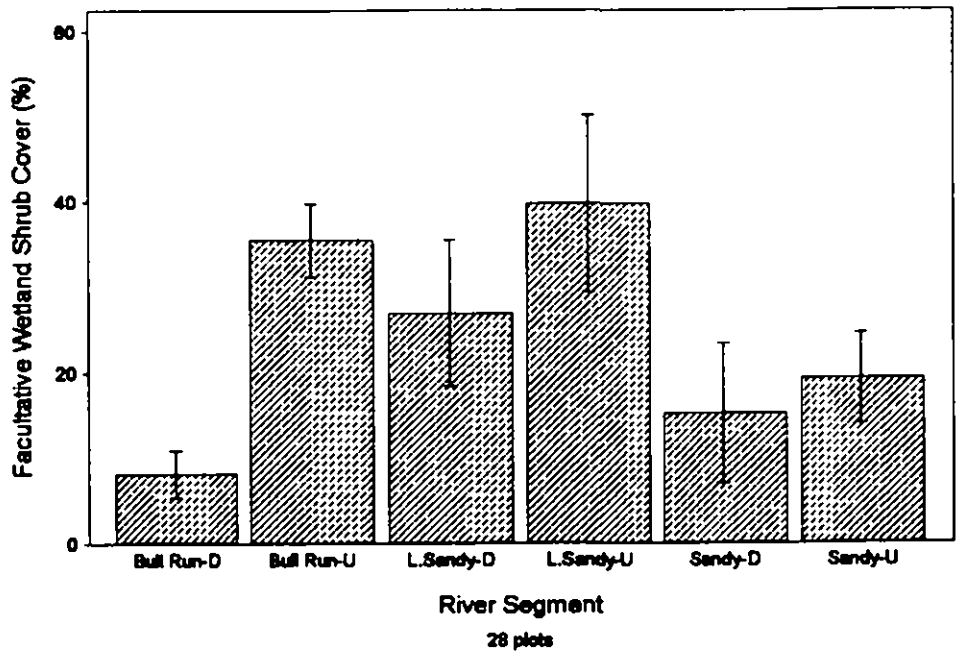


Figure 4-6. Mean (and standard error) facultative wetland shrub canopy cover along river segments in the Bull Run study area.

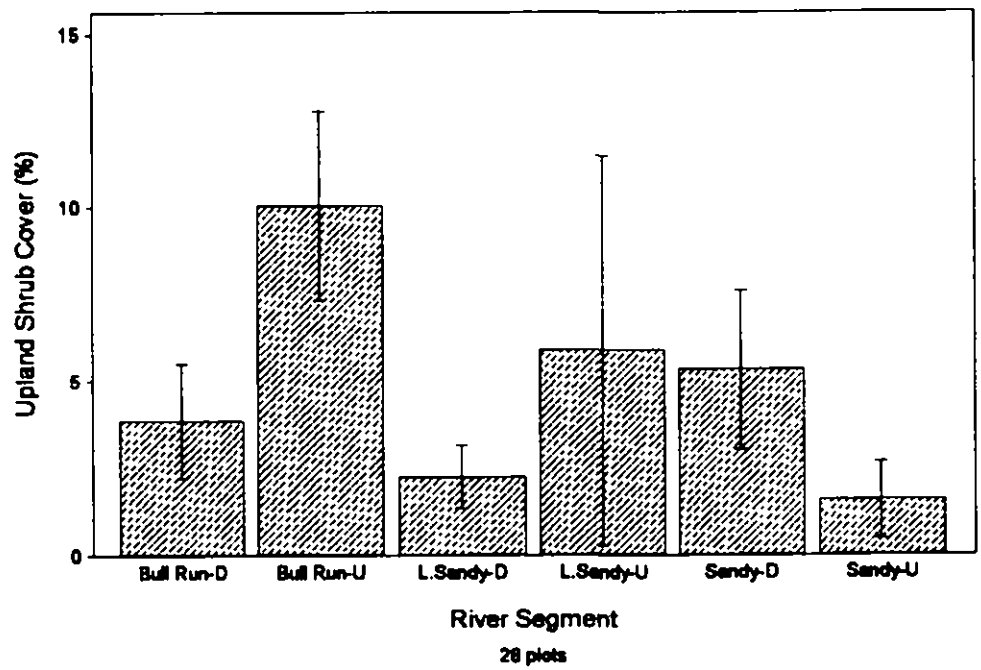


Figure 4-7. Mean (and standard error) upland shrub canopy cover along river segments in the Bull Run study area.

10.5 percent along the downstream Bull Run segment to 44 percent upstream of the Little Sandy Diversion Dam. Forb cover differed significantly ($P<0.1$, t-test) between the up- and downstream segments of the Bull Run River. Moss cover was greatest in riparian areas along the Bull Run River—36 percent—and lowest along the upstream segment of the Little Sandy River—12 percent (Table 4-4).

Overall, salmonberry was the most common shrub species in riparian zones in the study area, occurring at 93 percent of the sampling sites with an average canopy cover of 15 percent. Red alder and big-leaf maple shrubs were also common, occurring at 75 percent of the sites, with an average canopy cover of 19 and 9 percent, respectively (Table 4-5). Other common species were vine maple (*Acer circinatum*), cascara (*Rhamnus purshiana*), hazelnut (*Corylus cornuta*), red-osier dogwood, willow, and ninebark (*Physocarpus capitatus*) (Table 4-5).

The only significant difference in moss cover was in riparian areas along the Little Sandy River, where the downstream mean of 32.8 percent was substantially greater than the upstream mean of 12 percent.

4.2.4 Tree and Shrub Heights and Tree Diameter

Mean tree height for all riparian sampling sites was 45.4±16.6 ft (14±5 m). Mean tree heights along the up- and downstream segments were similar for the Sandy and Bull Run—ranging from 40.5 to 42.9 ft (12 to 13 m) (Table 4-4, Figure 4-8).

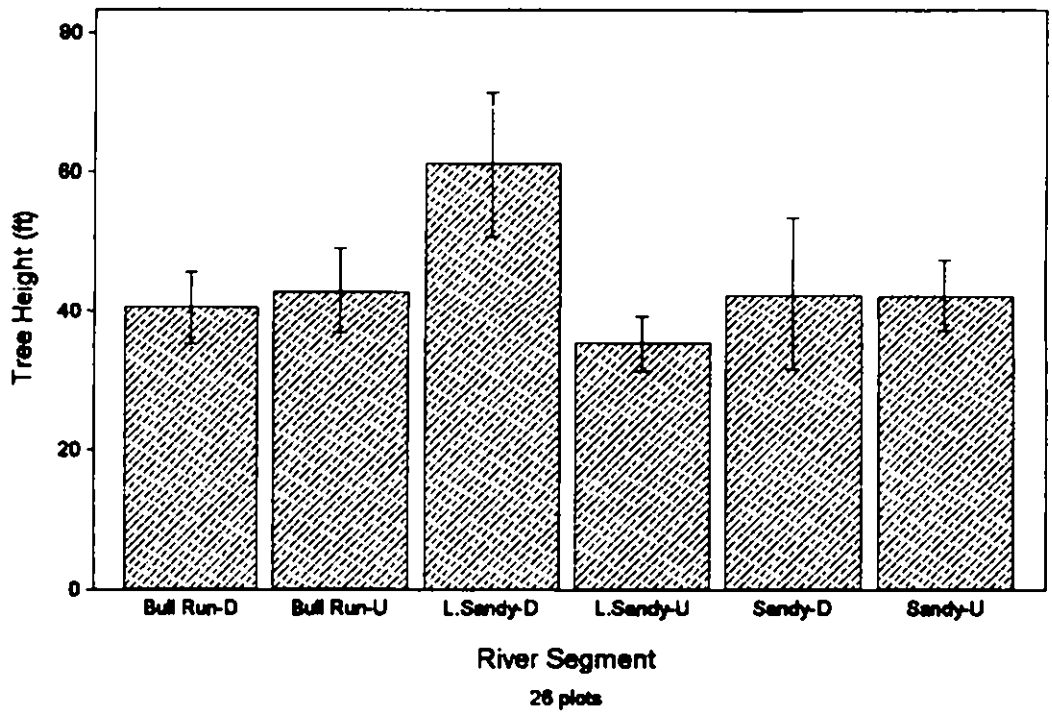


Figure 4-8. Mean (and standard error) tree height along river segments in the Bull Run study area.

On the Little Sandy River, however, the mean riparian tree height was 35.2±7.9 ft (11±2 m) upstream of the diversion compared to 61.2±25.3 ft (19±8 m) downstream. These means are significantly different (P<0.1, t-test). The overall mean dbh of trees in riparian zones was estimated to be 10.5±5.8 in. (27±15 cm). As with height, mean dbh of trees along individual river segments were similar, except for the up- and downstream segments of the Little Sandy River (Table 4-4, Figure 4-9). Trees in riparian areas upstream of the Little Sandy Diversion had a mean dbh of 6.4 in. (16 cm); trees downstream averaged 15.8 in. (40 cm) and were significantly larger (P<0.1, t-test). It is apparent that reduced flows in the bypass reach of the Little Sandy have allowed trees to encroach into the channel and to attain greater sizes over time, compared to upstream sites.

Tall shrub height in riparian zones was extremely uniform for all river segments (Figure 4-10) and averaged 7.7±1.7 ft (2±0.5m). Hazelnut, Indian plum (*Omeleria cerasiformis*), red alder, and cascara were common tall shrub species. Low shrub height averaged 4.1±1.2 ft (1.2±0.4m) overall and varied greatly among the river segments (Figure 4-11). Low shrub height in riparian zones was significantly different between up- and downstream segments of both the Little Sandy and Bull Run rivers (Table 4-4).

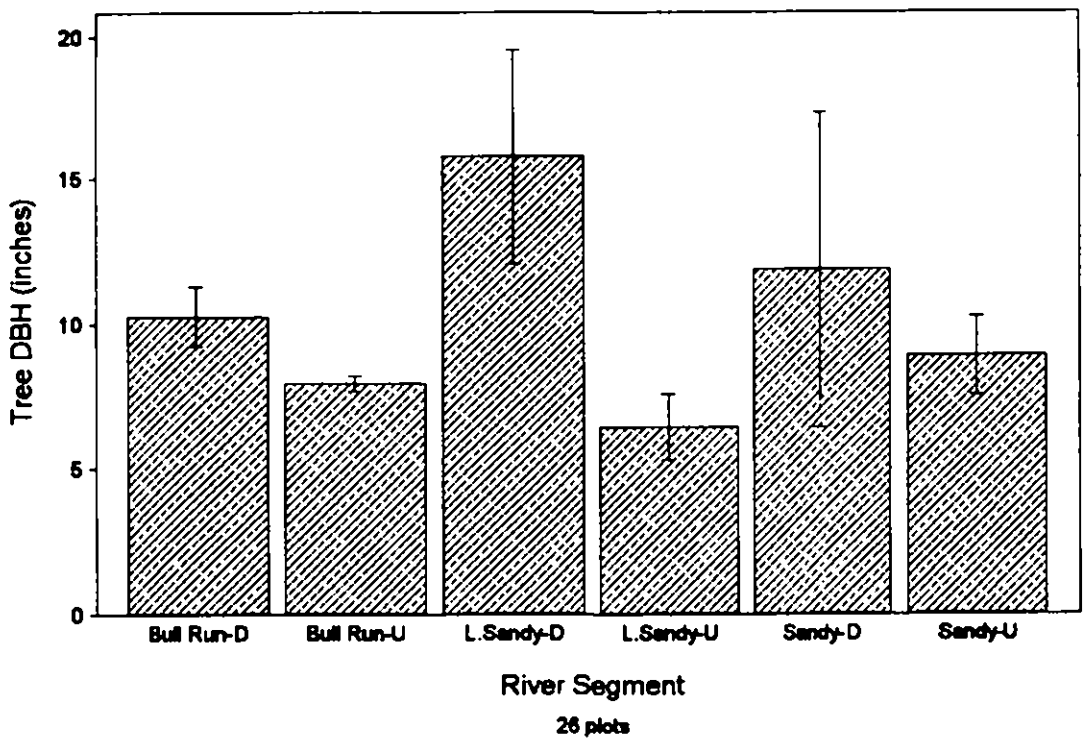


Figure 4-9. Mean (and standard error) tree dbh along river segments in the Bull Run study area.

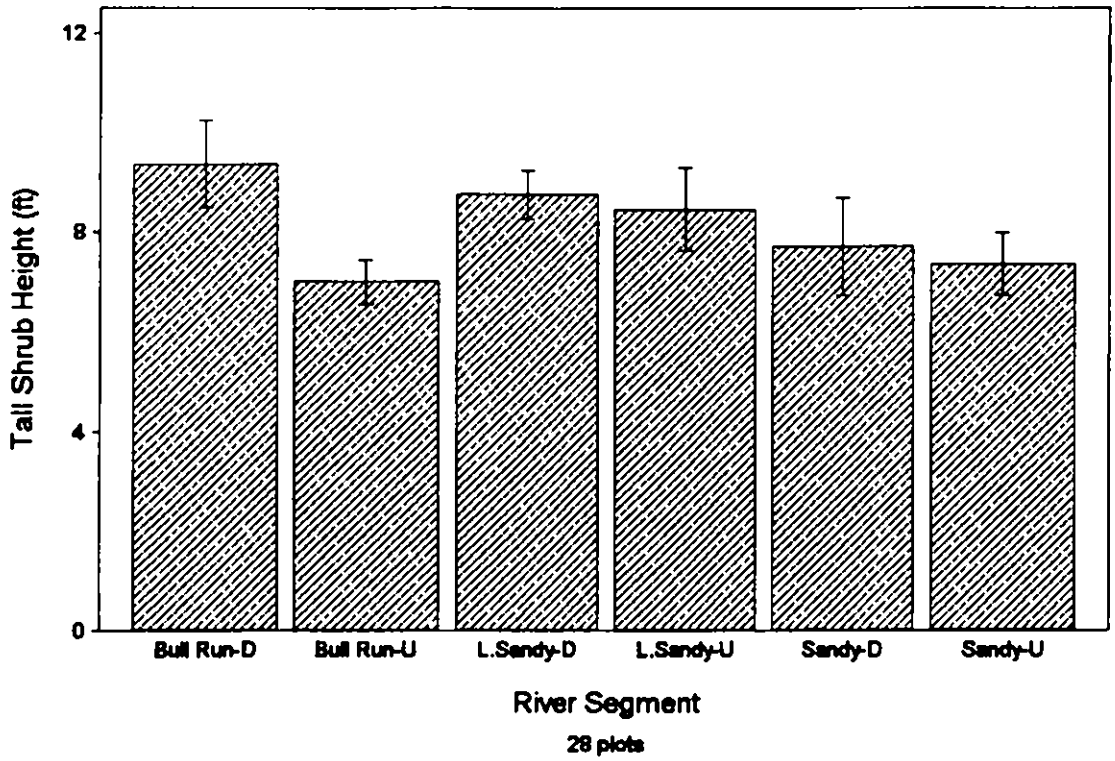


Figure 4-10. Mean (and standard error) tall shrub height along river segments in the Bull Run study area.

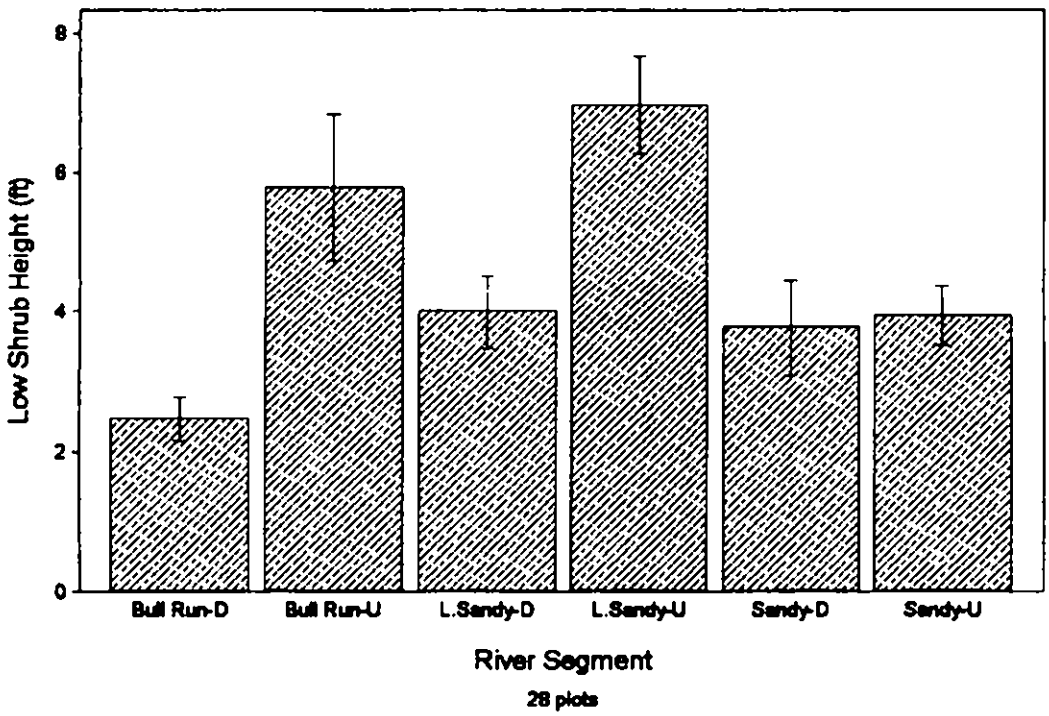


Figure 4-11. Mean (and standard error) low shrub height along river segments in the Bull Run study area.

4.2.5 Horizontal Cover

Horizontal cover boards were used to characterize the degree of visual obscurity within each riparian sampling site, as an index to vegetation density at different heights above the ground. Measurements were recorded for five 1.6-ft (0.5 m) zones from the ground level up to 8.2 ft (2.5 m).

Results document the generally dense vegetation within the riparian communities. Overall, within the lowest 3.2 ft (1 m), vegetation concealment averages between approximately 75 and 86 percent (Table 4-6). Within each zone, there was little variability among the river segments, although riparian zones along the Bull Run River tended to have slightly lower concealment values (Table 4-6). Variability was greatest on the Bull Run River, possibly due to the variety of landform and substrate in both the up- and downstream segments of the river.

Table 4-6. Horizontal cover board mean visual concealment (%) (± st. dev.).

Sandy River—Upstream	83.3% ± 12.7	72.2% ± 20.4	64.1% ± 21.1	54.9% ± 19.1	52.1% ± 19.0
Sandy River—Downstream	97.1% ± 1.9	87.6% ± 7.1	75.7% ± 12.8	60.1% ± 11.8	57.6% ± 14.0
Little Sandy River—Upstream	97.4% ± 2.0	91.3% ± 5.7	80.5% ± 2.4	72.4% ± 8.7	70.6% ± 8.9
Little Sandy River—Downstream	87.3% ± 5.4	75.1% ± 12.1	70.1% ± 11.8	61.3% ± 13.9	57.0% ± 16.3
Bull Run River—Upstream	75.3% ± 19.9	64.0% ± 27.5	63.3% ± 27.3	51.3% ± 18.4	52.7% ± 13.6
Bull Run River—Downstream	71.3% ± 17.3	57.9% ± 22.8	53.7% ± 17.9	51.4% ± 19.3	56.0% ± 19.2
Total	**85.5% ± 11.3**	**74.8% ± 17.2**	**67.8% ± 17.0**	**58.6% ± 15.9**	**57.2% ± 16.2**

4.2.6 Snags and Down Woody Material

An average of 1.7±3.2 snags per ac (4.2±7.9/ha) were estimated in the 28 riparian plots sampled in the Bull Run study area. Significantly greater snag densities ($P<0.0001$, ANOVA) were recorded on the 10 plots on BLM uplands near Marmot Dam and USFS uplands between the box flume and the Little Sandy River than in the riparian habitat in the study area (Table 4-7). The BLM and USFS lands had a combined snag density of 10.5±9.4 snags/ac (25.9±23.2 snags/ha). No snags were detected in the riparian sites along the Sandy River or the downstream segment of the Little Sandy River. The snags in most of the riparian plots were deciduous species—red alder or big-leaf maple—while snags in the upland plots on federal land were a mixture of deciduous and conifer species. The snags in riparian areas along the Little Sandy River and the upstream segment of the Bull Run River were quite small in size, averaging about 5 in. (13 cm) in diameter and 26 ft (8 m) in height (Table 4-7). The snags in riparian areas downstream of the Bull Run powerhouse were substantially larger in size. The snags on uplands managed by the BLM were particularly large in diameter and height and were predominantly conifer. Ten of the 27 snags documented in the riparian communities had been excavated by woodpeckers.

Down woody material (logs) were encountered in riparian sites along all river segments except upstream of the Bull Run powerhouse. Overall, an average of 18.4±13.7 logs/ac (45.4±33.8/ha) were sampled in riparian sites along all three rivers. The total length of down wood was

calculated to 593.8±696.1 ft/ac (446.9±525.2 m/ha). Of all six river segments, the riparian zone downstream of the Little Sandy Diversion Dam had by far the greatest total log length per unit area, with nearly 1,800 ft (549 m) (Table 4-7). This is over twice the amount measured upstream of the diversion, although the substantial variability resulted in a nonsignificant difference ($p>0.1$). Nonetheless, it seems reduced flows eliminate the movement of most coarse woody material in the system downstream of the diversion. Similarly, the total length of logs along the lower Sandy River is substantially greater than the amount along the upstream segment ($P<0.1$), again suggesting that the diversion reduces the movement of most wood downstream of Marmot Dam. Four logs along the Sandy River upstream of the diversion dam had been cut by beavers.

The BLM uplands near Marmot Dam had an exceptional amount of down woody material, especially on the south side of the river where numerous large trees had recently blown down. The area averaged 1,340 ft/ac (1,008 m/ha) and nearly 30 individual logs/ac (74/ha) (Table 4-7). Most of the logs on BLM land were conifer species. The USFS land between the flume and the Little Sandy River had approximately 345 ft/ac (260 m/ha), with an average of about 18 logs/ac (44/ha). More of the logs on USFS were deciduous species. None of the logs on either the BLM or USFS uplands met the 20 in. (51 cm) diameter and 20 ft (6.1 m) length requirements stated in the Northwest Forest Plan (USFS and BLM 1994). However, there were logs that met the minimum criteria in riparian plots downstream of Marmot Dam on private property (4 logs), upstream of Marmot Dam on private property (2 logs), along the bypass reach of the Little Sandy River (9 logs), and upstream of the Little Sandy River diversion (4 logs).

Table 4-7. Snag and log data for riparian communities and uplands on federal lands in the Bull Run study area (mean ± st. dev.).

Snags								
dbh (in.)	-	-	4.8±0.0	-	5.6±0.6	14.3±13.5	21.1±10.5	13.2±12.5
Height (ft)	-	-	26.2±0.0	-	26.2±9.3	73.8±34.8	41.3±37.2	22.7±6.0
Density (number/ac)	0.0±0.0	0.0±0.0	5.4±4.7	0.0±0.0	8.1	2.4±3.6	12.1±11.2	8.1±6.6
Down Wood								
Mean Large Diameter (in.)	13.3±12.0	21.6±11.5	20.4±15.3	17.5±11.5	--	5.9±1.3	14.3±6.2	13.5±70
Mean Length (ft)	28.4±17.8	23.5±7.7	37.5±11.9	37.2±33.2	--	24.8±11.1	45.2±29.2	21.3±11.1
Density (number/ac)	20.2±9.6	14.2±9.6	18.9±12.4	43.2±30.4	0.0	8.1±5.7	29.7±36.4	18.2±10.2
Length (ft)/ac	574.7±144.4	285.1±256.8	708.2±272.5	1,798.0±1894.2	0.0	191.2±178.7	1340±2024.9	344.6±366.4

5.0 LITERATURE CITED

Bartels, R., J.D. Dell, R.L. Knight, and G. Schaefer. 1985. Dead and down woody material. Pp. 171-186 *In*: E.R. Brown, Tech. Ed., U.S. Dept. Agric., Forest Service, Pacific Northwest Region. Publ. No. R6-F&WL-192-1985. 332pp.

Bonham, C.D. 1989. Measurements for terrestrial vegetation. John Wiley and Sons. New York, New York.

Bull, E.L, C.G. Parks, and T.R. Torgersen. 1997. Trees and logs important to wildlife in the interior Columbia River basin. U.S. Dept. Agric., Forest Service, Pacific Northwest Research Station, Gen. Tech. Rept. PNW-GTR-391. 55pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service Publ. FWS/OBS-79/31.

Diaz, N.M. and T.K. Mellen. 1996. Riparian ecological types Gifford Pinchot and Mt. Hood National Forests Columbia River Gorge National Scenic Area. USDA Forest Service, Pacific Northwest Region. R6-NR-TP-10-96.

Dilworth, J.R. 1964. Log scaling and timber cruising. Oregon State University Book Stores, Inc. Corvallis.

Franklin, J.F. and C.T. Dyrness. 1988. Natural vegetation of Oregon and Washington. Oregon State Univ. Press, Corvallis. 452pp.

Hall, F.C. 1998. Pacific Northwest ecoclass codes for seral and potential natural communities. USDA, Forest Service, Pacific Northwest Research Station. PNW-GTR-418.

Halverson, N.M., C. Topik, and R. Van Vickle. 1986. Plant association and management guide for the western hemlock zone Mt. Hood National Forest. USDA Forest Service, Pacific Northwest Region. R6-ECOL-232A-1986.

Maser, C., R.G. Anderson, K. Cromack, Jr., J.T. Williams, and R.E. Martin. 1979. Dead and down woody material, pp. 78-95 *In*: J.W. Thomas, Tech. Ed., Wildlife habitats in managed forests the Blue Mountains of Oregon and Washington. U.S. Dept. Agric., Forest Service. Agric. Handbook No. 553. 512pp.

Myers, L.H. 1989. Riparian area management: inventory and monitoring riparian areas. Technical Reference 1737-3. USDI, Bureau of Land Management, Denver, Colorado. 79pp.

Nietro, W.A., V.W. Binkley, S.P. Cline, R.W. Mannan, B.G. Marcot, D. Taylor, and F.F. Wagner. 1985. Snags (wildlife trees). Pp. 129-169 *In*: E.R. Brown, Tech. Ed., U.S. Dept. Agric., Forest Service, Pacific Northwest Region. Publ. No. R6-F&WL-192-1985. 332pp.

USFS (U.S. Forest Service) and BLM (U.S. Bureau of Land Management). 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl.

USFS (U.S. Forest Service). 1990. Final environmental impact statement, land and resource management plan, Mount Hood National Forest. USDA, Forest Service, Pacific Northwest Region.

Zar, J.H. 1984. Biostatistical analysis. Second Edition. Prentice-Hall, Inc. Englewood Cliffs, New Jersey. 718pp.

Appendix A

Riparian Habitat Characterization Data Form

Portland General Electric
Vegetation Characterization Datasheet

General Location: ______________
Plot Number: ______________
No. of Canopy Layers: ______________

Date: ______________
Team: ______________
Habitat Type: ______________
Slope: ______________
Aspect: ______________
Riparian Band Width:

Shrub Cover			Herbaceous Cover		Herbaceous Cover		Shrub Height	
Species	Start	Stop	Species	% Cover	Species	% Cover	Species	Height (m)
			Grass		Grass			
			Forb		Forb			
			Bare ground		Bare ground			
			Woody debris		Woody debris			
			Grass		Grass			
			Forb		Forb			
			Bare ground		Bare ground			
			Woody debris		Woody debris			
			Grass		Grass			
			Forb		Forb			
			Bare ground		Bare ground			
			Woody debris		Woody debris			
			Grass		Grass			
			Forb		Forb			
			Bare ground		Bare ground			
			Woody debris		Woody debris			
			Grass		Grass			
			Forb		Forb			
			Bare ground		Bare ground			
			Woody debris		Woody debris			
			Grass		Grass		**Herb. Height**	
			Forb		Forb		Species	Height (m)
			Bare ground		Bare ground			
			Woody debris		Woody debris			
			Grass		Grass			
			Forb		Forb			
			Bare ground		Bare ground			
			Woody debris		Woody debris			
			Grass		Grass			
			Forb		Forb			
			Bare ground		Bare ground			
			Woody debris		Woody debris			
			Grass		Grass			
			Forb		Forb			
			Bare ground		Bare ground			
			Woody debris		Woody debris			
			Grass		Grass			
			Forb		Forb			
			Bare ground		Bare ground			
			Woody debris		Woody debris			

Bull Run Hydroelectric Project
Vegetation Characterization Datasheet--Page 2

Tree Ht:	Tree DBH:	Comments

Dominant Species:			
Shrubs	**Dominant Overstory**	**Subdominant Trees**	**Forbs**

Cover Board Height	Cover Board Profile (Daubenmire Classes)[1]		
Major Species			
0.0-0.5m			
0.5-1.0m			
1.0-1.5m			
1.5-2.0m			
0.0-0.5m			
0.5-1.0m			
1.0-1.5m			
1.5-2.0m			
0.0-0.5m			
0.5-1.0m			
1.0-1.5m			
1.5-2.0m			
0.0-0.5m			
0.5-1.0m			
1.0-1.5m			
1.5-2.0m			
0.0-0.5m			
0.5-1.0m			
1.0-1.5m			
1.5-2.0m			

Appendix B

Snag and Down Woody Material Data Form

Snag/Down Woody Material Study

Transect Length (ft.): _____ Transect Width (ft.): _____

Plot No: _____ Sub-plot No: _____

Date: _____

Site Plant Association: _____

Stand Comments: _____

Wildlife Observed: _____

Crew: _____

Log No.	Snag No.	Snag DBH (in)	Snag Ht (ft)	Log Class	Log/Snag Species	Log/Snag Structural Code	Diameter (in)		Length (ft.)	Hollow Log	Wildlife Use	Comments
							Small	Large				

Log Class:	1=Natural Log 2=Cut Log 3=Natural Stump 5=Cut Stump
Log Species:	1=Ponderosa pine 2=Western white pine 3=Douglas-fir 4=Grand/White fir 5=Western larch 6=Lodgepole pine 7=Western hemlock 8=Western red cedar 9=Cottonwood 10=Mountain hemlock 11=Sugar pine 12=Other
Log/Trees Structural Code:	see back
Hollow Log/Tree:	0=No 1=Yes
Wildlife Use:	0=No exavations 1.0" diameter or larger 1=Woodpecker foraging (sapwood) 2=Woodpecker foraging (heartwood) 3=Bear foraging 4=Bear den 5=Squirrel cache 6=Other
Measurements:	*Large diameter of log is taken just above butt-swell at "stump" height. *Use "Length" column to record stump height. *Use "Large Diameter" column to record stump diameter.

Appendix C

Common and Latin Plant Species Names

Appendix C. Common and Latin Names of Plant Species noted in the text and in Appendix D.

Alaska huckleberry	*Vaccinium alaskaense*
American holy	*Ilex opaca*
beargrass	*Xerophyllum tenax*
bedstraw	*Galium trifolium*
big-leaf maple	*Acer macrophyllum*
black cottonwood	*Populus trichocarpa*
blue wildrye	*Elymus glaucus*
cascara	*Rhamnus purshiana*
chokecherry	*Prunus virginiana*
clustered wild rose	*Rosa pisocarpa*
crab apple	*Pyrus fusca*
currant species	*Ribes* sp.
dogwood bunchberry	*Cornus canadensis*
Douglas-fir	*Pseudotsuga menziesii*
English Ivy	*Hedera helix*
evergreen blackberry	*R. laciniatus*
giant knotweed	*Polygonum sachalinense*
goatsbeard	*Aruncus sylvester*
grand fir	*Abies grandis*
hazelnut	*Corylus cornuta*
Himalyan blackberry	*Rubus discolor*
horsetail	*Equisetum arvense*
Indian plum	*Omeleria cerasiformis*
ladyfern	*Athyrium filix-femina*
maidenhair fern	*Adiantum pedatum*
miner's lettuce	*Montia sibirica*
nettle	*Stachys cooleyae*
ninebark	*Physocarpus capitatus*
Nootka rose	*Rosa nutkana*
oceanspray	*Holodiscus discolor*
Oregon grape	*Berberis nervosa*
oxalis	*Oxalis oregana*

Pacific rhododendron	*Rhododendron macrophyllum*
Pacific silver fir	*Abies amabilis*
Pacific yew	*Taxus brevifolia*
pearly everlasting	*Anaphalis margaritacea*
pig-a-back plant	*Tolmiea menziesii*
queencup beadlilly	*Clintonia uniflora*
red alder	*Alnus rubra*
red elderberry	*Sambucus racemosa*
red huckleberry	*Vaccinium parvifolium*
red-osier dogwood	*Cornus stolonifera*
salal	*Gaultheria shallon*
salmonberry	*Rubus spectabilis*
Scot's broom	*Cytisus scoparius*
Scouler's corydalis	*Corydalis scouleri*
serviceberry	*Amelanchier alnifolia*
skunk cabbage	*Lysichitum americanum*
snowberry	*Symphoricarpos albus*
stinging nettle	*Urtica dioica*
stinkcurrant	*Ribes bracteosum*
sword fern	*Polystichum munitum*
thimbleberry	*Rubus parvifolia*
trailing blackberry	*Rubus ursinus*
vanillaleaf	*Achlys triphylla*
vine maple	*Acer circinatum*
western flowering dogwood	*Cornus nuttallii*
western hemlock	*Tsuga heterophylla*
western red cedar	*Thuja plicata*
white hawkweed	*Hieracium albiflorum*
willow	*Salix* spp.

Appendix D

Raw Data

BR-OS-1	Bull Run-down	150 yds upstream from Dodge Park	2	8/10/00	SB, RT	Riparian Mixed	10	300	30	Steve's roll 2-1 and 2. Relatively flat floodplain	100
BR-OS-2	Bull Run-down	1/4 mile upstream of Dodge Park	1	8/10/00	RT, SB	RMX (ALRU/Acer)	6	40	35	30 M TRANSECT. PHOTOS # 3-4. Steve's Roll. UNK: low-lying, trailing, 3-leaved, in clump-like rocks, yellow flower. Seeps @~20m	80
BR-OS-3	Bull Run-down		2	8/10/00	RT/SB	ALRU/RVBP	30	8	30	Forb/Bryoph; UNK COMP = Douglas Aster P	100
BR-OS-4	Bull Run-down	Bull Run	2	8/10/00	RT/SB	ALRU(+SALIX shrubs)	0	8	40	below big pool est. 100m; flood plain boulders; 80m Transect; 5:30pm - 6:30; 1 log, 10cm x 8cm diam 2.8m long, class 2 not ALRU; 7-cone = hazelnut	80
BRU-1	Bull Run-up	75m downstream of L. sandy confluence on BR River	1	8/13/00	RM/JK	Riparian	0	0	33		100
BRU-2	Bull Run-up	1/4 mile upstream of powerhouse	2	8/13/00	RM/JK	Riparian	0	0	33		100
BRU-3	Bull Run-up	100m above powerhouse on Bull Run	1	8/13/00	JK/RM	Riparian	0	0	16		100
DPU-1	Sandy-down	Upstream of Dodge Park on sandy R	2	8/10/00	JK/RM	Riparian	5	0	60		100
DPU-2	Sandy-down	Dodge Park-upstream island-Sand River	1	8/10/00	JK/RB	Riparian	6	0	33	no trees	100
LSD-1	Lsandy-down	on Lower Little Sand River	3	8/12/00	JK/RM	Riparian	2	150	33		100
LSD-2	Lsandy-down	Downstream of 28 div. Est. 100m dstream of LSD-1	1	8/12/00	RM/JK	Riparian	6	0	33		100
LSD-3	Lsandy-down	About 1/4m upstream of Bull Run confluen LSRiver	2	8/12/00	JK/RM	Riparian	0	0	66		100
LS-OS-1	Lsandy-down	100 yds downstrm of Div Dam, after flume cross riv	1	8/11/00	RT/SB	RMX, Willow/Alder	10	40	20	No logs in 10m wide plot - no datasheet; Photo #'s: 9 + 10(Steve's film); Forb Bryoph	100
LS-OS-2	Lsandy-down	@ bank, horseshoe in flume	1	8/11/00	SB/RT	willow, Alder	2	100	30	extensive willow thickets; photos: 12 willow; @20m, transect moves out of willow & crosses side channel to sidebank, in & out @ 30m	100
LS-OS-3	Lsandy-down	upstream from "canyon"	3	8/11/00	RT/SB	RMX (ACMA, ALRU, THPL)	8	40	30		100
LSU-1	Lsandy-up	Upstream of L. Sandy Diversion	2	8/11/00	JK/RM	Riparian	3	0	66		100
LSU-2	Lsandy-up	upstream of Little Sandy diversion	1	8/11/00	JK/RM	Riparian	0	0	82		100
LSU-3	Lsandy-up	above L Sandy diversion	1	8/11/00	RM/JK	Riparian	3	0	50		100
LSU-4	Lsandy-up	above L Sandy diversion	1	8/11/00	RM/JK	Riparian	0	0	50	adjacent to old gaging station (downstream)	100
SAS-1	Sandy-up	Sandy River - below Marmot Dam	2	8/10/00	RM/JK	Riparian - Dgs	8	0	33		100
SAS-2	Sandy-up	Sandy River - downstream of dam	1	8/10/00	RM/JK		8	0	40	[illegible]	100
SAU - 1	Sandy-up	upstream Sandy	1	8/9/00	RT/JK/SB/RM	Riparian	8	0	62	Bull Forbs, vascular vs nonvascular	100
SAU - 2	Sandy-up	Above sandy diversion - Marmot Dam	2	8/9/00	JK/RM	Riparian	6	0	66	70m Transect	75
S-OS-5	Sandy-down		2	8/13/00	SB/RT	RMX(ACMA,ALRU,THPL)	45	40	50	Rain; VASC/Bryoph; Photos 22,23,24	100
SR-OS-6	Sandy-down	Left bank up from Revenue Bridge		8/2/00	RT/RM	SALIX	2	100	40	new mostly dry side channel with large boulders/cobble	100
SR-US-3	Sandy-up			8/9/00	SB, RT	THPL/ACMA/ACCI ACE	40	300	10	15' above river, 45 degree slope, primarily moisture conifer	100
SR-US-4	Sandy-up	Below Road bridge plot	2	8/13/00	SB/RT	RMX(1-deg ALRU)	2	220	80	Photos 24 & 25 (Steve's)	100
SR-US-5	Sandy-up	Old river channel		8/2/00	RT/RM	ALRU/RUSP	8	0	100		100

Bull Run Tree and Shrub Cover Raw Data

BR-DS-1	S	ACCI	1.8
BR-DS-1	S	ACMA	0.4
BR-DS-1	S	ALRU	5.5
BR-DS-1	S	AMAL	2.9
BR-DS-1	S	COCO	28.6
BR-DS-1	S	COST	0.6
BR-DS-1	S	HODI	4.8
BR-DS-1	S	OECE	10.6
BR-DS-1	S	PHCA	5.5
BR-DS-1	S	POSA	0.3
BR-DS-1	S	RHPU	2.6
BR-DS-1	S	RIBR	2.9
BR-DS-1	S	ROSA	10.4
BR-DS-1	S	RUPA	2.9
BR-DS-1	S	RUSP	7.2
BR-DS-1	S	RUUR	0.1
BR-DS-1	S	SHRUB1	11.1
BR-DS-1	S	SYAL	19.3
BR-DS-1	S	THPL	0.1
BR-DS-1	T	ACMA	17.8
BR-DS-1	T	ALRU	33.2
BR-DS-1	T	AMAL	0.6
BR-DS-1	T	PSME	12.4
BR-DS-1	T	TABR	18.1
BR-DS-2	S	ACCI	17.2
BR-DS-2	S	ACMA	29.0
BR-DS-2	S	ALRU	6.4
BR-DS-2	S	AMAL	8.6
BR-DS-2	S	COCO	39.2
BR-DS-2	S	HODI	7.8
BR-DS-2	S	IVY	0.2
BR-DS-2	S	OECE	0.4
BR-DS-2	S	PHCA	5.0
BR-DS-2	S	RHPU	1.0
BR-DS-2	S	RUSP	11.0
BR-DS-2	S	SYAL	2.6
BR-DS-2	S	THPL	9.0
BR-DS-2	T	ACMA	14.2
BR-DS-2	T	ALRU	44.0
BR-DS-2	T	THPL	14.4
BR-DS-2	T	TSHE	9.2
BR-DS-3	S	ACCI	7.5
BR-DS-3	S	ALRU	4.4
BR-DS-3	S	CHER	1.8
BR-DS-3	S	CHER	2.0
BR-DS-3	S	COCO	1.4
BR-DS-3	S	COST	4.4
BR-DS-3	S	HODI	2.2
BR-DS-3	S	OECE	2.7
BR-DS-3	S	PHCA	0.9
BR-DS-3	S	ROSA	2.2
BR-DS-3	S	RULA	0.2
BR-DS-3	S	RUSP	3.9
BR-DS-3	S	RUUR	12.4
BR-DS-3	T	ACMA	69.3
BR-DS-3	T	ALRU	46.0
BR-DS-3	T	RHPU	5.3
BR-DS-3	T	RUUR	0.6
BR-DS-4	S	ALRU	8.8
BR-DS-4	S	AMAL	2.8
BR-DS-4	S	CHER	13.0
BR-DS-4	S	COCO	4.8
BR-DS-4	S	COST	7.0
BR-DS-4	S	PHCA	7.0
BR-DS-4	S	RHPU	8.8
BR-DS-4	S	ROSA	16.4
BR-DS-4	S	RUSP	47.4
BR-DS-4	S	SALI	2.4
BR-DS-4	S	SCOT	0.4
BR-DS-4	S	SYAL	2.0
BR-DS-4	S	THPL	5.6
BR-DS-4	T	ALRU	59.0
BRU-1	S	ACCI	6.4
BRU-1	S	ACMA	8.6
BRU-1	S	ALRU	23.3
BRU-1	S	AMAL	0.5
BRU-1	S	COCO	10.8
BRU-1	S	CONU	3.1
BRU-1	S	COST	38.4
BRU-1	S	HODI	11.6
BRU-1	S	RHPU	7.0
BRU-1	S	RIBR	8.3
BRU-1	S	ROSA	11.1
BRU-1	S	RUPA	0.5
BRU-1	S	RUSP	15.0
BRU-1	S	SALI	5.1
BRU-1	S	TABR	7.7
BRU-1	S	VAPA	0.7
BRU-1	T	ACMA	55.6

Bull Run Tree and Shrub Cover Raw Data

BRU-1	T	TABR	1.2
BRU-2	S	ACMA	21.6
BRU-2	S	ALRU	32.7
BRU-2	S	COCO	3.0
BRU-2	S	COST	8.4
BRU-2	S	HODI	6.5
BRU-2	S	PHCA	24.0
BRU-2	S	PSME	2.8
BRU-2	S	ROPI	12.9
BRU-2	S	RUSP	4.4
BRU-2	S	SALI	2.0
BRU-2	S	SYAL	2.4
BRU-2	T	ACMA	2.3
BRU-2	T	ALRU	6.9
BRU-2	T	RHPU	3.8
BRU-3	S	ACCI	13.3
BRU-3	S	ACMA	4.1
BRU-3	S	ALRU	63.7
BRU-3	S	COST	11.0
BRU-3	S	HODI	8.3
BRU-3	S	PHCA	7.4
BRU-3	S	RHPU	12.3
BRU-3	S	ROSA	2.1
BRU-3	S	RUSP	1.7
BRU-3	S	SALI	10.2
BRU-3	S	THPL	10.6
BRU-3	T	ACMA	13.4
DPU-1	S	ACCI	1.1
DPU-1	S	ACMA	0.4
DPU-1	S	BENE	0.6
DPU-1	S	COCO	12.3
DPU-1	S	GASH	14.4
DPU-1	S	HOLY	1.5
DPU-1	S	PHCA	10.3
DPU-1	S	RHPU	7.8
DPU-1	S	RUDI	2.5
DPU-1	S	RUSP	10.6
DPU-1	S	RUUR	4.4
DPU-1	S	SCOT	2.7
DPU-1	S	SYAL	9.3
DPU-1	T	ACMA	7.8
DPU-1	T	ALRU	37.7
DPU-1	T	COCO	0.7
DPU-1	T	POTR	53.6
DPU-1	T	RHPU	17.6
DPU-2	S	ALRU	38.8
DPU-2	S	ASLI	0.2
DPU-2	S	POTR	19.7
DPU-2	S	ROSA	0.5
DPU-2	S	SALI	19.3
DPU-2	S	SCOT	0.5
LS-DS-1	S	ACMA	10.8
LS-DS-1	S	ALRU	22.7
LS-DS-1	S	COCO	8.0
LS-DS-1	S	COST	3.6
LS-DS-1	S	HODI	0.2
LS-DS-1	S	OECE	1.3
LS-DS-1	S	PHCA	5.1
LS-DS-1	S	RHPU	0.6
LS-DS-1	S	RUDI	11.9
LS-DS-1	S	RULA	0.2
LS-DS-1	S	RUPA	0.3
LS-DS-1	S	RUSP	8.7
LS-DS-1	S	RUUR	3.2
LS-DS-1	S	SALI	32.9
LS-DS-1	S	SPDO	1.6
LS-DS-1	S	SYAL	7.1
LS-DS-1	T	ACMA	1.5
LS-DS-1	T	ALRU	40.1
LS-DS-1	T	SALI	7.3
LS-DS-1	T	THPL	7.5
LS-DS-2	S	ACCI	8.2
LS-DS-2	S	ACMA	8.7
LS-DS-2	S	AMAL	2.2
LS-DS-2	S	COCO	11.4
LS-DS-2	S	COST	20.0
LS-DS-2	S	GASH	1.2
LS-DS-2	S	HODI	4.5
LS-DS-2	S	OECE	2.6
LS-DS-2	S	PHCA	0.4
LS-DS-2	S	POSA	0.4
LS-DS-2	S	RUPA	0.5
LS-DS-2	S	RUSP	0.8
LS-DS-2	S	RUUR	1.3
LS-DS-2	S	SALI	35.1
LS-DS-2	T	ACMA	8.3
LS-DS-2	T	ALRU	68.4
LS-DS-2	T	RHPU	6.4
LS-DS-3	S	ACCI	28.2
LS-DS-3	S	ALRU	4.7

Bull Run Tree and Shrub Cover Raw Data

LS-DS-3	S	COCO	10.9
LS-DS-3	S	OECE	4.4
LS-DS-3	S	RHPU	1.0
LS-DS-3	S	RIBR	3.3
LS-DS-3	S	RUSP	35.4
LS-DS-3	S	RUUR	1.2
LS-DS-3	S	SALI	2.9
LS-DS-3	S	SARA	5.7
LS-DS-3	S	VAPA	0.6
LS-DS-3	T	ACCI	3.3
LS-DS-3	T	ACMA	5.8
LS-DS-3	T	ALRU	45.1
LS-DS-3	T	OECE	0.8
LS-DS-3	T	SARA	0.9
LS-DS-3	T	THPL	25.3
LSD-1	S	ACCI	8.5
LSD-1	S	ALRU	20.5
LSD-1	S	AMAL	2.9
LSD-1	S	COCO	22.7
LSD-1	S	COST	11.6
LSD-1	S	HODI	2.0
LSD-1	S	PSME	7.5
LSD-1	S	RHPU	9.2
LSD-1	S	RIBR	3.8
LSD-1	S	RUPA	6.1
LSD-1	S	RUSP	23.3
LSD-1	S	SARA	1.0
LSD-1	S	SYAL	0.4
LSD-1	S	VAPA	2.5
LSD-1	T	ACMA	65.3
LSD-1	T	ALRU	16.7
LSD-1	T	PSME	48.6
LSD-2	S	ACCI	33.2
LSD-2	S	ALRU	12.5
LSD-2	S	COCO	8.8
LSD-2	S	COST	35.3
LSD-2	S	RHPU	16.0
LSD-2	S	RUDI	2.3
LSD-2	S	RUSP	22.2
LSD-2	S	SALI	0.7
LSD-2	S	SARA	1.8
LSD-2	S	TABR	2.4
LSD-2	T	ACMA	4.7
LSD-2	T	ALRU	15.7
LSD-2	T	PSME	22.7
LSD-2	T	TABR	10.9
LSD-3	S	ACCI	1.4
LSD-3	S	ACMA	2.1
LSD-3	S	COCO	19.3
LSD-3	S	COST	0.5
LSD-3	S	PHCA	11.0
LSD-3	S	RHPU	15.4
LSD-3	S	RUPA	2.3
LSD-3	S	RUSP	19.2
LSD-3	S	SALI	0.9
LSD-3	S	SYAL	4.4
LSD-3	S	THPL	7.8
LSD-3	S	VAPA	3.7
LSD-3	T	ACMA	26.3
LSD-3	T	ALRU	61.5
LSU-1	S	ACCI	16.6
LSU-1	S	ACMA	0.4
LSU-1	S	ALRU	32.3
LSU-1	S	COST	26.7
LSU-1	S	CRAB	7.2
LSU-1	S	PHCA	17.0
LSU-1	S	RHPU	10.4
LSU-1	S	RIBR	11.2
LSU-1	S	RUSP	11.2
LSU-1	S	SALI	2.1
LSU-1	S	THPL	1.8
LSU-1	T	ALRU	14.0
LSU-1	T	PHCA	2.3
LSU-1	T	SARA	0.4
LSU-1	T	THPL	11.1
LSU-2	S	ACCI	8.7
LSU-2	S	ACMA	1.4
LSU-2	S	AMAL	5.5
LSU-2	S	COCO	6.3
LSU-2	S	CONU	22.7
LSU-2	S	COST	4.7
LSU-2	S	CRAB	0.7
LSU-2	S	PHCA	21.5
LSU-2	S	RHPU	20.1
LSU-2	S	RIBR	3.4
LSU-2	S	RUSP	14.1
LSU-2	S	SALI	0.3
LSU-2	S	SYAL	1.8
LSU-2	T	ACMA	11.9
LSU-2	T	ALRU	77.9

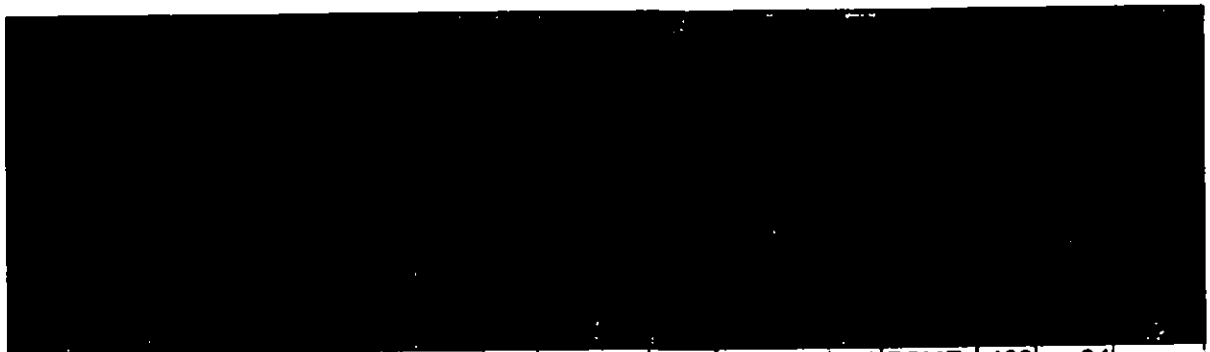
Bull Run Tree and Shrub Cover Raw Data

LSU-2	T	THPL	2.6
LSU-3	S	ACCI	1.9
LSU-3	S	ACMA	8.1
LSU-3	S	ALRU	11.3
LSU-3	S	AMAL	18.8
LSU-3	S	COCO	6.4
LSU-3	S	COST	16.8
LSU-3	S	PHCA	44.6
LSU-3	S	RHPU	17.2
LSU-3	S	RIBR	4.0
LSU-3	S	RUPA	1.1
LSU-3	S	RUSP	4.0
LSU-3	T	ACMA	11.0
LSU-3	T	ALRU	64.2
LSU-4	S	ACMA	0.7
LSU-4	S	COST	4.6
LSU-4	S	HODI	0.9
LSU-4	S	PHCA	6.3
LSU-4	S	RHPU	2.8
LSU-4	S	RIBR	0.6
LSU-4	S	RUSP	8.3
LSU-4	S	SALI	6.2
LSU-4	S	SPDO	0.4
LSU-4	S	SYAL	0.3
LSU-4	T	ALRU	50.0
S-DS-5	S	ACCI	1.8
S-DS-5	S	ACMA	21.1
S-DS-5	S	ALRU	0.5
S-DS-5	S	BAMB	1.8
S-DS-5	S	COCO	5.6
S-DS-5	S	COST	13.1
S-DS-5	S	OECE	5.8
S-DS-5	S	RHPU	0.4
S-DS-5	S	RIBR	2.6
S-DS-5	S	RUSP	38.9
S-DS-5	S	RUUR	4.1
S-DS-5	S	SYAL	0.4
S-DS-5	T	ACMA	35.0
S-DS-5	T	ALRU	23.7
S-DS-5	T	RHPU	4.4
S-DS-5	T	THPL	22.1
SAB-1	S	ACMA	29.3
SAB-1	S	ALRU	36.0
SAB-1	S	AMAL	0.3
SAB-1	S	COCO	28.6
SAB-1	S	GASH	3.1
SAB-1	S	HODI	2.2
SAB-1	S	PHCA	5.8
SAB-1	S	RHPU	4.9
SAB-1	S	RUPA	6.5
SAB-1	S	RUSP	11.1
SAB-1	S	SALI	0.5
SAB-1	S	SARA	1.9
SAB-1	S	SCOT	0.6
SAB-1	S	SYAL	2.1
SAB-1	S	THPL	11.5
SAB-1	S	VAPA	1.8
SAB-1	T	ALRU	50.0
SAB-2	S	ACCI	0.6
SAB-2	S	ACMA	7.1
SAB-2	S	ALRU	4.0
SAB-2	S	COST	4.4
SAB-2	S	HODI	1.9
SAB-2	S	PHCA	3.7
SAB-2	S	RUDI	0.8
SAB-2	S	RUSP	8.0
SAB-2	S	SALI	7.2
SAB-2	S	SPDO	1.4
SAB-2	S	SYAL	0.5
SAB-2	T	ACMA	16.6
SAB-2	T	ALRU	89.0
SAU - 1	S	ALRU	27.7
SAU - 1	S	COST	0.9
SAU - 1	S	POTR	3.3
SAU - 1	S	RUSP	0.4
SAU - 1	S	SAAL	16.9
SAU - 1	S	SALI	45.0
SAU - 2	S	ACCI	15.4
SAU - 2	S	ACMA	17.1
SAU - 2	S	HODI	6.0
SAU - 2	S	PHCA	5.0
SAU - 2	S	PSME	5.0
SAU - 2	S	RIBR	0.4
SAU - 2	S	RUSP	75.6
SAU - 2	S	SARA	12.3
SAU - 2	S	SYAL	6.7
SAU - 2	T	ALRU	100.0
SR-DS-6	S	ACMA	3.5
SR-DS-6	S	ALRU	16.5
SR-DS-6	S	PHCA	2.7

Bull Run Tree and Shrub Cover Raw Data

SR-DS-6	S	POTR	18.7
SR-DS-6	S	RUDI	11.0
SR-DS-6	S	RUSP	3.6
SR-DS-6	S	RUUR	1.3
SR-DS-6	S	SALI	31.6
SR-DS-6	S	SCOT	1.0
SR-DS-6	T	POTR	2.2
SR-US-3	S	ACCI	16.1
SR-US-3	S	ACMA	4.4
SR-US-3	S	ALRU	0.2
SR-US-3	S	COCO	2.7
SR-US-3	S	OECE	0.8
SR-US-3	S	RUPA	0.8
SR-US-3	S	RUSP	8.2
SR-US-3	S	RUUR	2.0
SR-US-3	S	THPL	1.5
SR-US-3	S	VAPA	17.9
SR-US-3	T	ACMA	25.7
SR-US-3	T	ALRU	33.8
SR-US-3	T	THPL	20.8
SR-US-3	T	TSHE	46.9
SR-US-4	S	ABAM	0.5
SR-US-4	S	ACMA	0.2
SR-US-4	S	ALRU	19.5
SR-US-4	S	PHCA	0.3
SR-US-4	S	POTR	9.1
SR-US-4	S	PSME	0.1
SR-US-4	S	RUSP	0.6
SR-US-4	S	SALI	8.7
SR-US-4	S	SCOT	0.9
SR-US-4	S	THPL	0.7
SR-US-4	S	TSHE	0.9
SR-US-4	T	ALRU	70.1
SR-US-4	T	POTR	38.4
SR-US-5	S	ACMA	1.1
SR-US-5	S	PHCA	0.5
SR-US-5	S	PSME	0.6
SR-US-5	S	RUUR	1.4
SR-US-5	S	SALI	6.2
SR-US-5	S	SCOT	6.0
SR-US-5	S	THPL	6.2
SR-US-5	S	TSHE	0.6
SR-US-5	T	ALRU	92.0
SR-US-5	T	POTR	63.2

Bull Run Shrub and Tree Height Data



BR-DS-1	1	ROSA	0.3	OECE	3.5	THOC	0.2	THOC	0.9	PSME	130	84
BR-DS-1	2	SYAL	0.4	OECE	3.5	MOSI	0.1	MOSI	0.1	PSME	125	73
BR-DS-1	3	RIBR	0.8	RIBR	1.4					ALRU	60	37
BR-DS-1	4	SYAL	1.1	ROSA	2.1	MOSI	0.1	GRASS	0.2	ALRU	35	23
BR-DS-1	5	PHCA	0.9	PHCA	2.3					TABR	25	19
BR-DS-1	6	SYAL	0.5	AMAL	3.6							
BR-DS-1	7	RUPA	0.3	OECE	3.2	GRASS	0.1	URDO	0.5			
BR-DS-1	8	SYAL	0.3	SYAL	1.2	THOC	0.5	POMU	0.7	ALRU	45	17
BR-DS-1	9	RUPA	0.5	COCO	3.8	TOME	0.2	THOC	0.6	ACMA	40	11
BR-DS-1	10	RUSP	0.4	HODI	3.3	THOC	0.1	HELA	0.3	ALRU	45	18
BR-DS-1	11	SYAL	0.5	COCO	3.7	VAHE	0.3	HELA	2.3	ALRU	25	17
BR-DS-1	12	SHRUB1	1	COCO	3.5					ACMA	40	29
BR-DS-1	13	RUPA	0.5	SHRUB1	4	TOME	0.05	POMU	0.4			
BR-DS-1	14	UNK	0.6	COCO	5	VAHE	0.1	VAHE	0.3	ACMA	45	31
BR-DS-1	15	SYAL	0.5	COCO	4	MOSI	0.1	MOSI	0.8	ALRU	40	26
BR-DS-1	16	ROSA	0.7	OECE	2.7	VAHE	0.05	VAHE	0.3	TABR	40	32
BR-DS-1	17	SYAL	0.4	COCO	2.7	VAHE	0.1	ATFE	0.7			
BR-DS-1	18	COST	1.2	COCO	4	VAHE	0.3	PTAQ	1.7			
BR-DS-1	19	RUUR	0.2	COST	0.8	VAHE	0.1	VAHE	0.1	ALRU	30	35
BR-DS-1	20	ROSA	0.3	COCO	0.7	THOC	0.2	THOC	0.2	ACMA	35	16
BR-DS-2	1	PHCA	2.1	COCO	5	LAMU	0.1	MAID	0.3	ACMA	60	25
BR-DS-2	2	PHCA	0.9	PHCA	5	UNK	0.1	PEFR	0.5	ALRU	35	20
BR-DS-2	3	RUSP	0.8	RUSP	1.6	TOME	0.2	MAID	1.4	THPL	25	6
BR-DS-2	4	ACCI	1.2	ACCI	4.5	UNK	0.05	ATFE	1.3	ALRU	50	45
BR-DS-2	5	RUSP	0.4	RUSP	1.6	OAFE	0.2	POMU	0.3	ACMA	20	4
BR-DS-2	6	SYAL	0.3	COCO	5	TOME	0.1	MAID	1.4	ALRU	75	41
BR-DS-2	7	IVY	0.1	COCO	5	LAMU	0.1	MAID	0.4			
BR-DS-2	8	RUSP	1.2	THPL	2.7	LAMU	0.1	LAMU	0.1			
BR-DS-2	9	NONE	0	NONE	0	TOME	0.2	ARSY	1.2	ACMA	75	60
BR-DS-2	10	SYAL	0.3	SYAL	0.8	MAID	0.05	MAID	0.1			
BR-DS-3	1	RUUR	0.2	RUUR	0.4	ATFE	0.2	LAMU	0.7	ACMA	30	9
BR-DS-3	2	RUUR	0.1	PHCA	2	NONE	0	NONE	0	ALRU	30	34
BR-DS-3	3	RUUR	0.1	RUUR	0.5	GALI	0.05	EQAR	0.9	NONE		
BR-DS-3	4	RUUR	0.4	COCO	1.8	PEFR	0.4	EQAR	0.9	ALRU	37	37
BR-DS-3	5	OECE	0.9	OECE	2.5	TOME	0.1	MINT	0.8	NONE		
BR-DS-3	6	RUUR	0.1	RUSP	1.5	SAXI	0.01	LAMU	0.4	NONE		
BR-DS-3	7	OECE	1	ALRU	2	NONE	0	NONE	0	NONE		
BR-DS-3	8	HODI	1.5	HODI	3	COMP	0.3	COMP	0.8	ACMA	35	13
BR-DS-3	9	NONE	0	NONE	0	GALI	0.01	GRAS	0.1	NONE		
BR-DS-3	10	OECE	2	ACCI	2.5	ARSY	0.9	ATFE	1.6	ALRU	45	34
BR-DS-3	11	ROSA	1.1	ALRU	2.1	NONE	0	NONE	0	NONE		
BR-DS-3	12	COST	0.5	COST	1.5	LAMU	0.1	ARSY	1.3	ALRU	35	36
BR-DS-3	13	RUSP	0.1	RUSP	2.5	UNK	0.3	UNK	0.6	NONE		
BR-DS-3	14	NONE	0	HODI	3.6	NONE	0	EQAR	0.6	NONE		

Bull Run Shrub and Tree Height Data

[redacted]

BR-DS-3	15	RUUR	0.1	HODI	2.5	ATFE	0.4	GRAS	0.9	NONE		
BR-DS-3	16	RUUR	0.1	OECE	2.7	URDO	0.2	URDO	0.7	ALRU	25	12
BR-DS-3	17	RUUR	0.3	ALMA	3.3	ATFE	0.3	GRAS	1.2	ALRU	35	16
BR-DS-3	18	NONE	0	NONE	0	GRAS	0.1	URDO	0.6	NONE		
BR-DS-3	19	NONE	0	NONE	0	TOME	0.1	NONE	0	NONE		
BR-DS-3	20	NONE	0	NONE	0					NONE		
BR-DS-4	1	ROSA	0.8	ALRU	3	ATFE	0.6	NONE	0	ALRU	35	28
BR-DS-4	2	PHCA	1	CHER	3.5	MAID	0.5	NONE	0	NONE		
BR-DS-4	3	ROSA	0.6	NONE	0	LAMU	0.1	NONE	0	ALRU	30	18
BR-DS-4	4	ROSA	1.2	RHPU	1.3	NONE	0	GRAS	0.6	ALRU	25	15
BR-DS-4	5	SYAL	1	COST	2.5	TOME	0.1	NONE	0	ALRU	25	16
BR-DS-4	6	RUSP	0.9	COST	1.4	PYRO	0.1	GRAS	0.4	NONE		
BR-DS-4	7	SYAL	0.5	RUSP	1.2	GALI	0.1	ATFE	0.5	NONE		
BR-DS-4	8	ROSA	1.5	CHER	3.5	NONE	0	GRAS	0.6	NONE		
BR-DS-4	9	ROSA	1.5	PHCA	4	NONE	0	NONE	0	NONE		
BR-DS-4	10	ROSA	0.5	COCO	4.5	NONE	0	NONE	0	NONE		
BRU-1	1	CONU	1.9	CONU	1.9	URDO	0.1	ATFE	0.9	TABR	23	17
BRU-1	2	RIBR	0.9	RIBR	0.9	ATFE	0.9	ATFE	0.9	THPL	39	22
BRU-1	3	AMAL	0.8	AMAL	0.8	NONE	0	NONE	0			
BRU-1	4	AMAL	0.9	AMAL	0.9	RUUR	0.1	RUUR	0.1			
BRU-1	5	SYAL	0.4	AMAL	0.9	UNK	0.05	GRAS	0.4			
BRU-1	6	CONU	4	CONU	4	NONE	0	NONE	0			
BRU-1	7	CONU	2.2	CONU	2.2	UNK	0.1	GRAS	0.2			
BRU-1	8	RUSP	0.7	SALI	1.3	ATFE	1.1	ATFE	1.1			
BRU-1	9	RUSP	1.4	RUSP	1.4	TOME	0.1	ATFE	1			
BRU-1	10	RUSP	1.1	RUSP	1.1	ATFE	1	ATFE	1			
BRU-1	11	CONU	2.2	CONU	2.2	NONE	0	NONE	0			
BRU-1	12	CONU	4.5	CONU	4.5	ATFE	0.8	ATFE	0.8			
BRU-1	13	ALRU	2.5	ALRU	2.5	RUUR	0.1	GRAS	0.2			
BRU-1	14	CONU	2	CONU	2	MAID	0.4	MAID	0.4			
BRU-1	15	RHPU	1.9	PHCA	2.1	POMU	0.4	POMU	0.4			
BRU-1	16	HODI	1.1	SALI	3.2	VHEX	0.1	VHEX	0.1			
BRU-1	17	RUSP	1.4	HODI	3.3	RUUR	0.1	RUUR	0.1			
BRU-1	18	HODI	1.8	HODI	1.8	VHEX	0.1	GRAS	0.7			
BRU-1	19	CONU	1.7	CONU	1.7	NONE	0	NONE	0			
BRU-1	20	TABR	2	TABR	2	NONE	0	NONE	0			
BRU-2	1	PHCA	2.3	PHCA	2.3	EQAR	2	EQAR	2	ALRU	43	16
BRU-2	2	HODI	1.3	PHCA	2.8	EQAR	2	LAMU	0.6	RHPU	72	28
BRU-2	3	HODI	0.6	COST	1.8	STRA	0.1	EQAR	0.3	ALRU	23	11
BRU-2	4	RUUR	0.5	PHCA	3.8	RUUR	0.1	POMU	0.3	ALRU	46	21
BRU-2	5	POTR	0.1	PHCA	2.1	COLU	0.1	GRAS	0.3			
BRU-2	6	ROPI	1	PHCA	2.2	COLU	0.1	GRAS	0.4			
BRU-2	7	COST	1	ALRU	2.3	STRA	0.1	GRAS	0.5			
BRU-2	8	ALRU	0.3	ACMA	2.2	GRAS	0.2	GRAS	0.2			

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BRU-2	9	RUSP	1.2	SALI	2.2	COLU	0.1	GRAS	0.7			
BRU-2	10	ALRU	2.2	ALRU	2.2	LAMU	0.6	LAMU	0.6			
BRU-2	11	SALI	1.2	PHCA	1.9	LAMU	1	LAMU	1			
BRU-2	12	ALRU	2.2	ALRU	2.2	LAMU	0.1	GRAS	0.2			
BRU-2	13	ROPI	0.7	HODI	2.2	LAMU	0.12	GRAS	0.2			
BRU-2	14	PHCA	2.3	PHCA	2.3	NONE	0	NONE	0			
BRU-2	15	HODI	1.8	ALRU	3.5	CLEM	0.3	CLEM	0.3			
BRU-2	16	ROPI	0.9	ACMA	2	STRA	0.1	CLEM	0.3			
BRU-2	17	AMAL	1.3	PHCA	2.2	UNK	0.1	ALLI	0.2			
BRU-2	18	AMAL	0.8	PHCA	3	GRAS	0.3	GRAS	0.3			
BRU-2	19	HODI	2	HODI	2	LAMU	0.1	GRAS	0.5			
BRU-2	20	ROPI	0.7	PHCA	2	COLU	0.1	GRAS	0.3			
BRU-3	1	SALI	2	SALI	2	NONE	0	NONE	0	ALRU	26	17
BRU-3	2	SALI	2.2	SALI	2.2	MAID	0.1	MAID	0.1	ALRU	49	18
BRU-3	3	NONE	0	NONE	0	NONE	0	NONE	0	ALRU	59	42
BRU-3	4	NONE	0	NONE	0	UNK	0.1	POSA	0.5	ALRU	62	26
BRU-3	5	NONE	0	NONE	0	ASTR	0.4	CARA	0.5	ALRU	30	16
BRU-3	6	NONE	0	NONE	0	UNK	0.1	ASTR	0.3	THPL	85	8
BRU-3	7	NONE	0	NONE	0	UNK	0.2	UNK	0.2			
BRU-3	8	RHPU	3.5	RHPU	3.5	UNK	0.1	ASTR	0.8			
BRU-3	9	RHPU	1.1	COST	4.5	ASTR	0.3	ASTR	0.3			
BRU-3	10	COST	2.2	COST	2.2	UNK	0.1	ATFE	0.2			
BRU-3	11	ROSA	0.6	PHCA	3.3	ASTR	0.8	ASTR	0.8			
BRU-3	12	PHCA	3	PHCA	3	RUUR	0.1	MHFE	0.2			
BRU-3	13	ACCI	1.7	ACCI	1.7	TOME	0.1	TOME	0.1			
BRU-3	14	ACMA	3.4	ACMA	3.4	UNK	0.1	UNK	0.1			
BRU-3	15	NONE	0	NONE	0	NONE	0	NONE	0			
BRU-3	16	NONE	0	NONE	0	UNK	0.1	GRAS	0.2			
BRU-3	17	ACCI	3.4	ACCI	3.4	MHFE	0.4	MHFE	0.4			
BRU-3	18	NONE	0	NONE	0	NONE	0	NONE	0			
BRU-3	19	NONE	0	NONE	0	ATFE	0.1	ATFE	0.1			
BRU-3	20	NONE	0	NONE	0	ATFE	0.1	ATFE	0.1			
DPU-1	1	SCOT	1.6	ACCI	3.1	RUUR	0.3	EQAR	0.7	ALRU	32	21
DPU-1	2	SCOT	1.7	PHCA	2.2	IVY	0.4	EQAR	1.1	POTR	43	31
DPU-1	3	HOLY	0.9	PHCA	3.1	RUPA	0.1	EQAR	0.6	POTR	52	23
DPU-1	4	SYAL	1.6	PHCA	1.6	RUPA	0.1	POMU	0.2	ALRU	23	8
DPU-1	5	SYAL	1.2	SYAL	1.2	RUPA	0.3	PTAQ	1.6	POTR	46	22
DPU-1	6	SYAL	0.6	SYAL	0.6	RUPA	0.3	PTAQ	1.2	ALRU	46	23
DPU-1	7	SYAL	1	SYAL	1	RUPA	0.1	PTAQ	1.5	ALRU	30	19
DPU-1	8	RUSP	1.1	RUSP	1.1	RUPA	0.2	EQAR	1.1	POTR	66	57
DPU-1	9	ROSA	1.4	ROSA	1.4	RUPA	0.4	EQAR	1.1	ALRU	30	13
DPU-1	10	GASH	0.6	COCO	2	EQAR	1.1	EQAR	1.1			
DPU-1	11	GASH	0.4	RUSP	1.3	RUUR	0.1	EQAR	1.1			
DPU-1	12	GASH	0.5	RHPU	5	EQAR	1.1	EQAR	1.1			

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DPU-1	13	GASH	0.6	RHPU	2.1	RUUR	0.1	EQAR	1.1				
DPU-1	14	RUUR	0.3	GASH	0.4	ROBE	0.1	EQAR	1.1				
DPU-1	15	PHCA	0.8	ALRU	1.7	PTAQ	0.2	GRAS	0.8				
DPU-1	16	RUDI	0.9	RUDI	0.9	RUUR	0.3	PHAR	1.1				
DPU-1	17	RUDI	0.4	SCOT	2.5	VIMA	0.1	VIMA	0.1				
DPU-1	18	SCOT	1	SCOT	1	VIMA	0.1	RUUR	0.4				
DPU-1	19	POTR	0.3	POTR	0.3	PHAR	0.1	POMU	0.3				
DPU-1	20	SYAL	0.3	SCOT	0.6	GRAS	0.2	GRAS	0.2				
DPU-2	1	POTR	0.6	ALRU	5	NONE	0	NONE	0				
DPU-2	2	POTR	0.5	POTR	1.4	UNK	0.2	PHAR	0.6				
DPU-2	3	SALI	2.5	SALI	2.5	GRAS	0.1	HYFO	0.3				
DPU-2	4	SALI	0.4	SALI	0.4	GRAS	0.2	GRAS	0.2				
DPU-2	5	SALI	0.5	SALI	0.5	GRAS	0.3	GRAS	0.3				
DPU-2	6	SALI	0.9	SALI	0.9	GRAS	0.1	POSA	2				
DPU-2	7	POTR	0.3	ALRU	5.5	UNK	0.1	GRAS	0.4				
DPU-2	8	POTR	0.2	ALRU	5.5	NONE	0	NONE	0				
DPU-2	9	POTR	2	POTR	2	NONE	0	NONE	0				
DPU-2	10	ALRU	5	ALRU	5	NONE	0	NONE	0				
DPU-2	11	SALI	1.5	SALI	1.5	NONE	0	NONE	0				
DPU-2	12	POTR	1.4	POTR	1.4	GRAS	0.1	GRAS	0.1				
DPU-2	13	SALI	1.5	ALRU	2.8	EQAR	0.1	EQAR	0.1				
DPU-2	14	ALRU	5	ALRU	5	GRAS	0.2	GRAS	0.2				
DPU-2	15	POTR	0.2	ALRU	4	EQAR	0.2	EQAR	0.2				
DPU-2	16	POTR	0.6	ALRU	2.8	PHAR	0.6	PHAR	0.6				
DPU-2	17	SALI	0.9	ALRU	5	GRAS	0.1	GRAS	0.1				
DPU-2	18	ALRU	2.8	ALRU	2.8	GRAS	0.1	GRAS	0.1				
DPU-2	19	ALRU	2.8	ALRU	2.8	EQAR	0.2	EQAR	0.2				
DPU-2	20	SALI	1.5	SALI	1.5	GRAS	0.2	GRAS	0.2				
LS-DS-1	1	RUDI	0.7	SPDO	3.1	LAMU	0.2	ATFE	0.8	NONE			
LS-DS-1	2	RUDI	0.3	SALI	3.3	GRAS	0.3	THOC	1.2	ALRU	30	11	
LS-DS-1	3	RUUR	0.3	PHCA	3.1	GRAS	0.2	GRAS	0.6	ALRU	25	9	
LS-DS-1	4	RUSP	0.6	SALI	3.8	EQAR	0.3	GRAS	0.8	ALRU	25	9	
LS-DS-1	5	PHCA	1	SALI	2.8	MOSI	0.2	GRAS	0.9	NONE			
LS-DS-1	6	ALRU	0.6	SALI	4.7	LAMU	0.6	GRAS	0.8	ALRU	30	14	
LS-DS-1	7	PHCA	0.3	SALI	2.3	GRAS	0.6	GRAS	0.6	ALRU	25	11	
LS-DS-1	8	RUUR	0.2	SALI	2.8	GRAS	0.3	GRAS	0.3	ALRU	25	7	
LS-DS-1	9	RUUR	0.4	COST	2.6	GRAS	0.5	UNKT	0.8	ALRU	25	6	
LS-DS-1	10	SALI	1.6	SALI	4.8	MOSI	0.3	GRAS	0.7	SALI	25	5	
LS-DS-1	11	RUSP	0.8	PHCA	2	GRAS	0.3	GRAS	0.3	ALRU	30	16	
LS-DS-1	12	RUUR	0.1	RHPU	0.9	LAMU	0.1	MOSI	0.4	ALRU	45	25	
LS-DS-1	13	RUUR	0.3	OECE	1.5	ATFE	0.3	ATFE	0.4	NONE			
LS-DS-1	14	RUSP	0.6	SALI	3	PRVU	0.1	GRAS	0.2	NONE			
LS-DS-1	15	RUDI	0.3	SALI	2.9	NONE	0	NONE	0	NONE			
LS-DS-1	16	RUSP	0.6	RUSP	0.6	NONE	0	NONE	0	NONE			

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LS-DS-1	17	SYAL	0.9	RUPA	1.1	LAMU	0.3	LAMU	1.4	ACMA	90	52
LS-DS-1	18	SYAL	0.3	SYAL	0.8	POMU	0.2	THOC	0.4	THPL	130	124
LS-DS-1	19	COCO	1	COCO	5	POMU	0.7	CORY	1	NONE		
LS-DS-1	20	COCO	1	COCO	2	POMU	0.4	POMU	0.5	ALRU	30	15
LS-DS-2	0	NONE	0	NONE	0							
LS-DS-2	1	SALI	2.4	SALI	3.1	GRAS	0.2	GRAS	0.2	NONE		
LS-DS-2	2	SALI	1.7	SALI	2.8	UNK	0.1	GRAS	0.1	NONE		
LS-DS-2	3	SALI	1.3	SALI	2.8	NONE	0	NONE	0	NONE		
LS-DS-2	4	SALI	1.9	SALI	5	NONE	0	NONE	0	ALRU	45	30
LS-DS-2	5	SALI	1	SALI	2.6	OXOR	0.1	MOSI	0.1	NONE		
LS-DS-2	6	SALI	0.4	SALI	2.7	UNK	0.3	UNKF	0.3	NONE	35	18
LS-DS-2	7	SALI	0.4	SALI	2.9	UNK	0.1	UNKF	0.1	ALRU		
LS-DS-2	8	ALRU	3	ACCI	4.7	UNK	0.3	ATFE	1.2	ALRU	35	14
LS-DS-2	9	SALI	1.6	COCO	5.5	NONE	0	NONE	0	NONE		
LS-DS-2	10	RUUR	0.1	COST	5.5	ATFE	0.1	UNK2	0.3	NONE		
LS-DS-2	11	RUUR	0.1	SALI	1.6	ADPE	0.4	ATFE	1.5	ALRU	45	18
LS-DS-2	12	COST	0.4	HODI	4.5	ATFE	0.7	ATFE	0.7	ALRU	55	26
LS-DS-2	13	HODI	0.7	COST	2.5	ADPE	0.5	ATFE	0.7	ALRU	40	25
LS-DS-2	14	RUUR	0.3	COCO	1.3	ADPE	0.4	POMU	0.6	ALRU	35	14
LS-DS-2	15	COST	1	COCO	2.2	TOME	0.1	TOME	0.5	ALRU	30	17
LS-DS-2	16	COCO	1.5	COCO	4.5	POMU	0.3	NONE	0	ALRU	35	17
LS-DS-2	17	GASH	1.2	GASH	1.5	LAMU	0.1	POMU	0.7	ALRU	25	6
LS-DS-2	18	RUPA	0.2	COCO	4.4	GALI	0.1	LAMU	0.1	ALRU	25	15
LS-DS-2	19	SALI	1.2	SALI	2.9	COLT	0.1	GRAS	0.4	ALRU	25	15
LS-DS-2	20	RUUR	0.1	SALI	3	NONE	0	NONE	0	ALRU	25	10
LS-DS-3	1	RUSP	0.8	OECE	2.2	CORY	1	OXOR	0.1	ALRU	35	18
LS-DS-3	2	RUSP	1.5	RUSP	2.5	TOME	0.1	ATFE	0.7	ALRU	35	16
LS-DS-3	3	RUSP	1.2	RUSP	2.3	TOME	0.1	TOME	0.3	ALRU	40	24
LS-DS-3	4	RIBR	1.2	SALI	2.4	TOME	0.1	LAMU	0.2	THPL	40	38
LS-DS-3	5	RUSP	1.3	RUSP	2.4	TOME	0.1	TOME	0.2	NONE		
LS-DS-3	6	ACCI	0.9	OECE	3.3	GALI	0.1	MOSI	0.1	NONE		
LS-DS-3	7	RUSP	0.7	RUSP	0.7	CARE	0.3	ATFE	0.1	NONE		
LS-DS-3	8	ACCI	0.8	ACCI	2.7	CORY	0.5	ATFE	0.8	THPL	110	96
LS-DS-3	9	ACCI	1.3	ACCI	2.8	TOME	0.3	CORY	1.2	ALRU	50	35
LS-DS-3	10	RUSP	1.8	ACCI	5.2	OXOR	0.1	ARSY	1	NONE		
LS-DS-3	11	RUUR	0.1	ACCI	1.5	MIDI	0.1	POMU	0.7	NONE		
LS-DS-3	12	ACCI	0.6	ACCI	2.4	TOME	0.1	ATFE	0.6	THPL	95	45
LS-DS-3	13	RUSP	1.4	COCO	2	OXOR	0.1	POMU	1.2	NONE		
LS-DS-3	14	RUSP	1.4	COCO	2	TOME	0.2	MAID	0.5	NONE		
LS-DS-3	15	RUSP	1	COCO	3	GALI	0.1	MAID	0.2	NONE		
LS-DS-3	16	RUSP	1	RUSP	1.8	NONE	0	NONE	0	NONE		
LS-DS-3	17	RUSP	1.3	RUSP	2	MINT	0.1	NONE	0	NONE		
LS-DS-3	18	RUSP	0.9	RUSP	3.5	OXOR	0.1	TOME	0.3	NONE		
LS-DS-3	19	NONE	0	NONE	0	MOSI	0.1	NONE	0	NONE		

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LS-DS-3	20	COCO	1	COCO	4					NONE		
LSD-1	0	NONE	0	NONE	0	NONE						
LSD-1	1	RUSP	1.2	COCO	5.5	WFER	0.4	WFER	0.4	ALRU	39	17
LSD-1	2	COCO	2.1	COCO	2.1	TOME	0.1	ATFE	0.6	PSME	164	110
LSD-1	3	RUPA	1.6	ALRU	3	OXOR	0.1	UNK	1.1	ALRU	30	10
LSD-1	4	RUSP	1.4	RUSP	1.4	TOME	0.1	RUUR	1.3	PSME	131	95
LSD-1	5	HODI	2.4	HODI	2.4	TOME	0.1	POMU	0.9	ACMA	125	42
LSD-1	6	HODI	2	HODI	2	POMU	1	POMU	1	ALRU	52	13
LSD-1	7	RUSP	1.2	RUSP	1.2	GRAS	0.2	POSA	1	ALRU	33	7
LSD-1	8	RUSP	0.8	RIBR	0.9	OXOR	0.1	ATFE	0.5	PSME	131	70
LSD-1	9	RIBR	1.3	RIBR	1.3	CLAY	0.2	GRAS	0.7	ALRU	52	15
LSD-1	10	COCO	5	COCO	5	ATFE	2.1	ATFE	2.1			
LSD-1	11	RHPU	1.2	COCO	5.5	CORY	0.5	ATFE	0.6			
LSD-1	12	RUSP	0.5	ACCI	2.8	CLAY	0.2	GRAS	0.5			
LSD-1	13	RHPU	1.2	RHPU	1.2	MAID	0.3	ATFE	1.1			
LSD-1	14	COCO	1.6	COCO	1.6	NONE	0	NONE	0			
LSD-1	15	RUPA	0.6	RUPA	0.6	MAID	0.1	MAID	0.4			
LSD-1	16	RUSP	0.9	RHPU	4	VAHE	0.1	POSA	0.4			
LSD-1	17	RHPU	3.8	RHPU	3.8	OXOR	0.1	ATFE	1.5			
LSD-1	18	COST	4	COST	4	NONE	0	NONE	0			
LSD-1	19	COST	0.5	COST	0.5	TOME	0.1	POMU	0.5			
LSD-1	20	RUSP	0.4	RHPU	1.8	TOME	0.1	ATFE	1.2	ALRU		
LSD-2	1	SALI	0.1	COST	1.4	CLAY	0.1	GRAS	0.6	PSME	196	150
LSD-2	2	RUSP	0.4	ACCI	5.5	TOME	0.2	GRAS	0.6	ALRU	56	23
LSD-2	3	RHPU	2.2	RHPU	2.2	TOME	0.1	GRAS	0.4	ACMA	46	75
LSD-2	4	RUSP	0.9	ACCI	2.8	TOME	0.1	POMU	0.6			
LSD-2	5	RUSP	1.4	ACCI	4	TOME	0.1	ATFE	1			
LSD-2	6	RUSP	2	ACCI	3.5	TOME	0.1	ATFE	0.7			
LSD-2	7	COST	1	ACCI	3.5	NONE	0	NONE	0			
LSD-2	8	COST	4	COST	4	NONE	0	NONE	0			
LSD-2	9	RUSP	1.1	COCO	2.4	TOME	0.1	ATFE	1.3			
LSD-2	10	COCO	2	COCO	2	ATFE	1	ATFE	1			
LSD-2	11	COST	2.2	COST	2.2	URDO	0.2	URDO	0.2			
LSD-2	12	COST	2.8	COST	2.8	TOME	0.3	MAID	0.5			
LSD-2	13	RUSP	1.4	RHPU	2.3	OXOR	0.1	MAID	0.4			
LSD-2	14	RUSP	0.7	RHPU	1.8	TOME	0.1	MAID	0.5			
LSD-2	15	RUSP	0.5	RUSP	0.5	UNK	0.1	POMU	0.6			
LSD-2	16	ALRU	2.1	ALRU	2.1	UNK	0.1	POSA	0.8			
LSD-2	17	COST	0.6	ALRU	1.9	OXOR	0.1	OXOR	0.1			1
LSD-2	18	RUSP	0.9	COST	2.5	TOME	0.1	TOME	0.1			
LSD-2	19	COST	3.2	COST	3.2	MAID	0.1	MAID	0.1			
LSD-2	20	RUSP	0.8	RHPU	2.6	GRAS	0.2	MAID	0.3			
LSD-3	1	RUSP	1.3	RHPU	3.2	CORY	0.4	ATFE	0.8	ACMA	82	85
LSD-3	2	PHCA	1.4	PHCA	1.4	TOME	0.1	ATFE	1	ALRU	66	23

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LSD-3	3	RUSP	1.1	PHCA	2.3	LAMU	1	ATFE	1.1	ALRU	43	15
LSD-3	4	RUSP	1.2	RIBR	1.8	TOME	0.1	ATFE	1.4	ALRU	26	15
LSD-3	5	RUSP	1.2	RUSP	1.2	MAID	0.1	ATFE	1	ALRU	39	17
LSD-3	6	RUSP	0.4	PHCA	3.3	TOME	0.1	ATFE	0.9	ALRU	82	38
LSD-3	7	RUSP	0.9	RUSP	0.9	ATFE	0.8	ATFE	0.8	ALRU	59	15
LSD-3	8	COCO	2.9	COCO	2.9	TOME	0.1	ATFE	0.7	ALRU	30	10
LSD-3	9	RUSP	0.7	COCO	1.8	CLAY	0.2	ATFE	0.6	ALRU	46	35
LSD-3	10	RUSP	0.9	ACCI	2	TOME	0.1	GRAS	0.5			
LSD-3	11	VAPA	0.9	PHCA	3	UNK	0.1	ATFE	1.1			
LSD-3	12	RUSP	1.9	RUSP	1.9	URDO	0.3	ATFE	0.9			
LSD-3	13	RUSP	1.8	RUSP	1.8	TOME	0.1	ATFE	0.9			
LSD-3	14	COCO	1.4	RHPU	3.5	UNK	0.2	ATFE	1.1			
LSD-3	15	RUSP	0.4	SALI	2.8	TOME	0.1	POMU	0.7			
LSD-3	16	PHCA	2.2	PHCA	2.2	CLAY	0.1	GRAS	0.7			
LSD-3	17	RHPU	2.3	VAPA	3.1	CLAY	0.1	ATFE	1.3			
LSD-3	18	SYAL	0.5	RHPU	2	UNK	0.1	UNK	0.1			8
LSD-3	19	PHCA	1.4	PHCA	1.4	VHEX	0.3	POMU	0.5			
LSD-3	20	COST	2.2	COST	2.2	GRAS	0.1	POMU	0.4	ACMA	25	85
LSU-1	0	NONE	0	NONE	0							
LSU-1	1	RIBR	1.4	RIBR	1.4	OESA	0.2	SCIR	0.9	ALRU	46	19
LSU-1	2	RUSP	1.7	RUSP	1.7	URDO	0.2	GRAS	0.6	ALRU	26	9
LSU-1	3	PHCA	2.8	PHCA	2.8	TOME	0.1	URDO	0.5	ALRU	46	6
LSU-1	4	RUSP	0.4	ACCI	3.8	URDO	0.2	GRAS	0.3	ALRU	30	17
LSU-1	5	COST	3.3	COST	3.3	TOME	0.1	URDO	0.6	ALRU	26	19
LSU-1	6	RUSP	0.4	RHPU	5	UNK	0.1	POMU	0.6	ALRU	26	13
LSU-1	7	PHCA	0	PHCA	6	COLT	0.4	ATFE	0.8	ALRU	30	15
LSU-1	8	CRAB	5	CRAB	5	NONE	0	NONE	0			
LSU-1	9	RIBR	1.3	RIBR	1.3	ATFE	0.7	ATFE	0.7			
LSU-1	10	PHCA	4.5	PHCA	4.5	NONE	0	NONE	0			
LSU-1	11	PHCA	1.1	PHCA	4.5	NONE	0	NONE	0			
LSU-1	12	ACCI	1.4	ACCI	1.4	ATFE	1.4	ATFE	1.4			
LSU-1	13	RUSP	2	RUSP	2	URDO	0.3	ATFE	0.7			
LSU-1	14	PHCA	2.4	PHCA	2.4	TOME	0.1	ATFE	1.2			
LSU-1	15	PHCA	2.7	PHCA	2.7	TOME	0.1	TOME	0.1			
LSU-1	16	ALRU	2.1	ALRU	2.1	NONE	0	NONE	0			
LSU-1	17	RUSP	2.6	RUSP	2.6	TOME	0.1	TOME	0.1			
LSU-1	18	RIBR	2.2	RIBR	2.2	MOSS	0.1	ATFE	0.2			
LSU-1	19	NONE	0	NONE	0	TOME	0.1	TOME	0.1			
LSU-1	20	RHPU	3.9	RHPU	3.9	UNK	0.1	UNK	0.1	ALRU		
LSU-2	1	RUSP	1.5	RUSP	1.5	OXOR	0.1	ATFE	1.3	ALRU	52	22
LSU-2	2	RIBR	1.2	RIBR	1.2	OXOR	0.1	ATFE	1.6	ALRU	39	19
LSU-2	3	RUSP	1.8	RUSP	1.8	TOME	0.3	ATFE	1.7	ALRU	43	15
LSU-2	4	RUSP	1.8	RUSP	1.8	RUUR	0.1	ATFE	1.2	ALRU	23	12
LSU-2	5	NONE	0	NONE	0	TOME	0.1	URDO	0.7	ALRU	46	13

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LSU-2	6	RUSP	1.8	RUSP	1.8	TOME	0.1	ATFE	1.2	ALRU	59	24
LSU-2	7	RUSP	1.3	RUSPI	1.3	TOME	0.1	ATFE	1.1	ALRU	23	9
LSU-2	8	COST	1.2	COST	1.2	OXOR	0.1	ATFE	1.6	ALRU	23	6
LSU-2	9	RUSP	2.4	RUSP	2.4	OXOR	1.1	URDO	0.6	ALRU	59	21
LSU-2	10	RUSP	2	RUSP	2	TOME	0.1	ATFE	1.6			
LSU-2	11	CONU	3	CONU	3	NONE	0	NONE	0			
LSU-2	12	AMAL	0.8	PHCA	0.9	UNK	0.2	UNK	0.2			
LSU-2	13	RHPU	2.5	RHPU	2.5	UNK	0.1	GRAS	0.4			
LSU-2	14	RUPA	1.2	RUPA	1.2	UNK	0.1	UNK	0.1			
LSU-2	15	SYAL	1.3	CONU	2.1	UNK	0.1	ARSY	1.1			
LSU-2	16	CONU	3.2	CONU	3.2	UNK	0.1	GRAS	0.8			
LSU-2	17	CONU	1	CONU	2.2	ATFE	1.2	ATFE	1.2			
LSU-2	18	PHCA	3.1	PHCA	3.1	TUUT	1	RUUR	1			
LSU-2	19	RHPU	1.4	ACCI	5	TOME	0.1	TOME	0.1			
LSU-2	20	SYAL	1.4	CONU	2	TOME	0.1	THOC	0.7	ALRU	16	22
LSU-3	1	RIBR	1.2	SYAL	2.3	UNK	0.1	ATFE	0.8	ALRU	33	13
LSU-3	2	RUSP	1.1	SYAL	2	UNK	0.1	ATFE	0.8	ALRU	52	22
LSU-3	3	RHPU	1.4	RHPU	1.4	ASCA	0.1	ATFE	1.1	ALRU	23	7
LSU-3	4	PHCA	3	PHCA	3	CORY	0.2	ATFE	1.3	ALRU	49	12
LSU-3	5	AMAL	2.3	AMAL	2.3	TOME	0.1	POMU	0.4	ALRU	56	55
LSU-3	6	SYAL	2.2	SYAL	2.2	NONE	0	NONE	0	ACMA	82	72
LSU-3	7	AMAL	1	PHCA	1.3	COLT	0.4	COLT	0.4	ALRU	23	7
LSU-3	8	AMAL	1.6	PHCA	2.2	NONE	0	NONE	0	ALRU	26	9
LSU-3	9	COST	2.2	COST	2.2	OXOR	0.1	ATFE	0.4	ALRU	52	17
LSU-3	10	COCO	3.2	COCO	3.2	ATFE	0.4	ATFE	0.4			
LSU-3	11	PHCA	4	PHCA	4	MAID	0.2	MAID	0.2			
LSU-3	12	PHCA	4.5	PHCA	4.5	UNK	0.1	GRAS	3			
LSU-3	13	PHCA	4.5	PHCA	4.5	NONE	0	NONE	0			
LSU-3	14	PHCA	2.1	PHCA	2.1	URDO	1.4	URDO	1.4			
LSU-3	15	PHCA	4.5	PHCA	4.5	EQAR	0.1	UNK	0.4			
LSU-3	16	PHCA	2.2	PHCA	2.2	NONE	0	NONE	0			
LSU-3	17	PHCA	5	PHCA	5	LYAM	0.3	LYAM	0.3			
LSU-3	18	PHCA	3	PHCA	3	TOME	0.1	TOME	0.1			
LSU-3	19	ALRU	1.8	ALRU	1.8	ATFE	0.3	ATFE	0.3			
LSU-3	20	PHCA	4	OHCA	4	NONE	0	NONE	0			
LSU-4	1	PHCA	2.2	PHCA	2.2	NONE	0	NONE	0	ALRU	23	9
LSU-4	2	SALI	3.5	SALI	3.5	COLT	0.4	COLT	0.4	ALRU	26	11
LSU-4	3	RUSP	0.8	RUSP	0.8	GRAS	0.2	ATFE	1.4	ALRU	33	11
LSU-4	4	SALI	0.8	PHCA	1.4	GRAS	0.2	GRAS	0.2	ALRU	23	8
LSU-4	5	PHCA	0.7	SALI	1.7	UNK	0.1	GRAS	0.2	ALRU	20	11
LSU-4	6	COST	1.2	PHCA	2.8	RUUR	0.1	PTAQ	1.1	ALRU	20	5
LSU-4	7	RUSP	3.2	RUSP	3.2	TOME	0.1	TOME	0.1	ALRU	26	15
LSU-4	8	ALRU	1.1	PHCA	1.8	TOME	0.1	GRAS	0.5	ALRU	39	16
LSU-4	9	PHCA	2.4	PHCA	2.4	UNK	0.1	GRAS	0.3	ALRU	20	7

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LSU-4	10	NONE	0	NONE	0	TOME	0.1	EMOL	0.4	ALRU		
S-DS-5	1	RUUR	0.1	RUSP	1.8	UNK1	0.2	POMU	0.8	THPL	45	15
S-DS-5	2	RUSP	0.3	RUSP	2.3	UNK1	0.1	ATFE	1.3	NONE		
S-DS-5	3	RUSP	0.3	COCO	3.3	UNK1	0.1	ATFE	1.1	ACMA	75	70
S-DS-5	4	RIBR	1.3	BAMB	3	MOSI	0.1	ATFE	1.3	NONE		
S-DS-5	5	SYAL	0.7	RUSP	2.1	ATFE	0.6	ATFE	1	ACMA	35	47
S-DS-5	6	RUUR	0.4	RUSP	1.7	UNK1	0.5	ATFE	1	ACMA	70	62
S-DS-5	7	RUSP	0.8	COST	2.5	LAMU	0.2	ATFE	0.9	ALRU	55	30
S-DS-5	8	RUSP	0.5	RUSP	1.2	LAMU	0.5	ATFE	1	NONE		
S-DS-5	9	ALRU	1.5	ALRU	1.5	OXAL	0.1	CORY	0.7	ACMA	70	80
S-DS-5	10	RUSP	0.2	COST	2.3	ATFE	0.1	ATFE	1.2	ALRU	60	27
S-DS-5	11	RUSP	0.7	RUSP	4.5	TOME	0.1	ATFE	1.3	THPL	70	65
S-DS-5	12	SARA	1.5	SARA	1.5	POMU	0.1	ATFE	1.5	NONE		
S-DS-5	13	NONE	0	NONE	0	LAMU	0.1	PUMU	0.6	NONE		
S-DS-5	14	RUSP	1.5	RUSP	1.5	ATFE	0.2	ATFE	0.5	THPL	85	95
S-DS-5	15	RUUR	0.1	RUSP	0.6	TOME	0.1	ATFE	0.6	NONE		
S-DS-5	16	RUSP	0.8	OECE	1.4	TOME	0.1	ATFE	1.1	NONE		
S-DS-5	17	RUUR	0.1	RUSP	1.6	UNK	0.1	ATFE	0.3	ALRU	60	83
S-DS-5	18	RUSP	1.3	COST	2.5	ATFE	0.3	POMU	0.7	ACMA	60	38
S-DS-5	19	RUUR	0.3	RUSP	0.8	POMU	0.2	ATFE	0.5			
S-DS-5	20	RUSP	0.7	RUSP	1.4	ATFE	0.4	ATFE	1.1			
S-US-4	1	SALI	1.3	SALI	1.3	GRAS	0.1	GRAS	0.6	POTR	25	9
S-US-4	2	ALRU	1.7	ALRU	3.3	UNKF	0.1	GRAS	0.4	POTR	20	11
S-US-4	3	ACMA	0.5	ALRU	1.3	GRAS	0.3	GRAS	0.3	ALRU	25	11
S-US-4	4	SALI	0.7	ALRU	1.5	GRAS	0.3	GRAS	0.3	ALRU	30	10
S-US-4	5	ABAM	0.5	POTR	1.7	GRAS	0.2	GRAS	0.5	POTR	30	9
S-US-4	6	VAPA	0.3	SALI	0.7	GRAS	0.2	GRAS	1	POTR	40	17
S-US-4	7	TSHE	0.3	SCOT	1.3	GRAS	0.3	GRAS	0.3	ALRU	25	11
S-US-4	8	ALRU	0.3	ALRU	2.8	GRAS	0.2	GRAS	0.9	POTR	25	16
S-US-4	9	PSME	0.3	SALI	0.7	GRAS	0.2	GRAS	0.6	ALRU	30	17
S-US-4	10	ALRU	1.2	POTR	2.9	GRAS	0.2	GRAS	0.6	ALRU	35	18
S-US-4	11	ALRU	0.5	ALRU	4.1	GRAS	0.2	GRAS	0.4	ALRU	30	11
S-US-4	12	POTR	1.4	SALI	3	GRAS	0.2	GRAS	0.4	ALRU	35	22
S-US-4	13	ALRU	0.9	ALRU	4.1	GRAS	0.6	PEAR	0.8	ALRU	20	10
S-US-4	14	SALI	1.3	SALI	1.3	GRAS	0.3	GRAS	0.4	ALRU	25	11
S-US-4	15	SALI	0.2	SALI	1.2	GRAS	0.3	PEAR	0.5	ALRU	30	16
S-US-4	16	ALRU	0.3	SALI	1.5	GRAS	0.3	GRAS	0.6	NONE		
S-US-4	17	TSHE	0.5	SALI	1.3	GRAS	0.4	PEAR	0.6	ALRU	30	15
S-US-4	18	SALI	1.3	SALI	4	GRAS	0.3	GRAS	0.5	ALRU	25	18
S-US-4	19	POTR	1.5	POTR	2.2	GRAS	0.2	GRAS	0.2	ALRU	25	15
S-US-4	20	SCOT	1.5	ALRU	2.5	GRAS	0.1	GRAS	0.5	POTR	25	14
SAB-1	1	RUSP	0.3	RUSP	2	EQAR	0.1	RUUR	0.2	ALRU	46	22
SAB-1	2	RUPA	0.3	RUSP	1.9	RUUR	0.1	ATFE	0.5	ALRU	46	23
SAB-1	3	RUSP	0.9	RHPU	4.8	PHAR	0.4	UROO	0.6	ALRU	46	22

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SAB-1	4	RUUR	0.9	RHPU	2.2	RUUR	0.2	POMU	0.4	ALRU	43	20
SAB-1	5	SYAL	1.3	RHPU	2.8	RUUR	0.2	GRAS	0.8	ALRU	33	17
SAB-1	6	SYAL	1	HODI	2.7	RUUR	0.1	GRAS	0.5	ALRU	46	32
SAB-1	7	COCO	1.8	COCO	1.8	RUUR	0.1	GRAS	0.4	ALRU	30	19
SAB-1	8	ACMA	2.2	ACMA	2.2	RUUR	0.3	LAMU	0.8	ACMA	43	14
SAB-1	9	ACMA	1.2	ACMA	1.2	RUUR	0.1	POMU	0.5	ALRU	52	21
SAB-1	10	RUUR	0.3	PHCA	1.5	RUUR	0.1	GRAS	0.2			
SAB-1	11	ALRU	1.4	ALRU	1.4	UNKH	0.8	UNK	0.8			
SAB-1	12	ALRU	0.3	ACMA	6	RUUR	0.1	GRAS	0.6			
SAB-1	13	SCOT	1.1	ACMA	3.8	RUUR	0.1	NONE	0			
SAB-1	14	ACMA	1.1	ACMA	5.5	GRAS	0.2	GRAS	0.2			
SAB-1	15	COCO	4.5	COCO	4.5	UNKH	0.1	POMU	0.3			
SAB-1	16	ACMA	2.3	ACMA	2.3	UNK	0.1	LAMU	0.4			
SAB-1	17	COCO	3.8	COCO	3.8	NONE	0	NONE	0			
SAB-1	18	SCOT	1.1	VAPA	2.1	CARE	0.2	SMRA	0.4			
SAB-1	19	GASH	0.9	COCO	5	NONE	0	NONE	0			
SAB-1	20	RUSP	1.7	RUSP	0.2	RUUR	0.1	GRAS	0.4			
SAB-2	1	RUSP	0.6	SALI	2	GRAS	0.1	HYFO	0.1	ALRU	33	11
SAB-2	2	HODI	1.8	HODI	1.8	RUUR	0.1	GRAS	0.3	ALRU	39	18
SAB-2	3	SYAL	0.8	SYAL	0.8	RUUR	0.1	GRAS	0.4	ALRU	36	14
SAB-2	4	SALI	0.8	RHPU	2.7	GRAS	0.2	GRAS	0.2	ALRU	39	17
SAB-2	5	ALRU	1.4	ALRU	1.4	GRAS	0.8	GRAS	0.8	ALRU	39	16
SAB-2	6	PHCA	1.9	PHCA	1.9	GRAS	0.8	GRAS	0.8	ALRU	43	19
SAB-2	7	PHCA	0.8	ALRU	0.8	GRAS	0.1	GRAS	0.1	ALRU	26	10
SAB-2	8	RUSP	1.2	RUSP	1.2	GRAS	0.2	POSA	2.5	ALRU	33	18
SAB-2	9	RUDI	0.3	RUDI	0.3	RUUR	0.1	PHAR	1.2	ALRU	49	19
SAB-2	10	NONE	0	NONE	0	GRAS	0.3	GRAS	0.3			
SAB-2	11	ACMA	2.4	ACMA	2.4	RUUR	0.3	ARSY	0.7			
SAB-2	12	SPDO	1.7	SPDO	1.7	RUUR	0.1	RUUR	0.1			
SAB-2	13	ACMA	1.4	ACMA	1.4	GRAS	1.1	GRAS	1.1			
SAB-2	14	ACMA	1.1	ACMA	1.1	EQAR	0.1	EQAR	0.1			
SAB-2	15	AMAL	1.2	AMAL	1.2	EQAR	0.1	EQAR	0.1			
SAB-2	16	NONE	0	NONE	0	EQAR	0.1	EQAR	0.1			
SAB-2	17	RUSP	0.9	RUSP	0.9	EQAR	0.1	EQAR	0.1			
SAB-2	18	SALI	1.5	SALI	1.5	EQAR	0.1	EQAR	0.1			
SAB-2	19	PHCA	2.5	FORG	1	EQAR	0.1	EQAR	0.1			
SAB-2	20	NONE	0	NONE	0	RUUR	0.1	RUUR	0.1			
SAU - 1	1	ALRU	2	ALRU	2	GRAS	0.2	COMP	0.3			
SAU - 1	2	SALI	1.3	ALRU	1.8	GRAS	0.2	HYFO	0.3			
SAU - 1	3	POTR	0.7	ALRU	2.7	UNK	0.1	HYFO	0.3			
SAU - 1	4	ALRU	1.5	ALRU	4	UNK	0.5	GRAS	0.4			
SAU - 1	5	SALI	0.9	SALI	5	UNK	0.1	GRAS	0.3			
SAU - 1	6	SALI	1.8	ALRU	3.5	UNK	0.2	UNK	0.2			
SAU - 1	7	ALRU	1.6	ALRU	3.5	GRAS	0.1	GRAS	0.5			

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SAU - 1	8	SALI	1.2	SALI	3.3	GRAS	0.1	HYFO	0.3			
SAU - 1	9	ALRU	1.3	ALRU	2.3	UNK	0.1	PHAR	0.3			
SAU - 1	10	SALI	1.2	SALI	3	UNK	0.1	UNK	0.5			
SAU - 1	11	ALRU	0.8	SALI	2.3	GRAS	0.1	UNK	0.2			
SAU - 1	12	SALI	1.2	SALI	1.7	GRAS	0.1	GRAS	0.1			
SAU - 1	13	SALI	1.2	SALI	3.5	GRAS	0.2	GRAS	0.2			
SAU - 1	14	SALI	1.3	SALI	2.4	UNK	0.1	UNK.1				
SAU - 1	15	SALI	1.8	SALI	2.6	UNK	0.2	UNK	0.2			
SAU - 1	16	SALI	0.5	SALI	1.8	UNK	0.1	GRAS	0.6			
SAU - 1	17	UNK	0.3	SALI	0.8	GRAS	0.2	GRAS	0.3			
SAU - 1	18	SALI	1.6	ALRU	2.3	HOKU	0.4	UNKF	1			
SAU - 1	19	SALI	1.8	SALI	1.8	UNKF	0.1	UNKF	0.2			
SAU - 1	20	SALI	0.8	SALI	1.8	NONE	0	NONE	0			
SAU - 2	1	RUSP	1.6	HODI	2.8	ROBE	0.1	ROBE	0.1	ALRU	49	65
SAU - 2	2	RUSP	1.5	ACCI	3.8	EQAR	0.1	EQAR	0.1	ALRU	66	31
SAU - 2	3	RUSP	1.7	HODI	3.2	EQAR	0.1	EQAR	0.1	ALRU	36	14
SAU - 2	4	RUSP	1.2	RUSP	1.9	EQAR	0.2	EQAR	0.2	ALRU	30	12
SAU - 2	5	RUSP	1.7	ACCI	2	EQAR	0.1	EQAR	0.1	ALRU	46	24
SAU - 2	6	RUSP	1.5	HODI	3.2	ROBE	0.3	ROBE	0.3	ALRU	56	32
SAU - 2	7	RUSP	0.8	RUSP	2.6	ROBE	0.3	ROBE	0.3	ALRU	30	15
SAU - 2	8	RUSP	2	RUSP	2	EQAR	0.2	EQAR	0.2	ALRU	49	29
SAU - 2	9	SARA	2.6	SARA	2.6	GRAS	0.2	EQAR	0.6	ALRU	59	32
SAU - 2	10	RUSP	1.9	RUSP	1.9	EQAR	0.1	URDO	0.9			
SAU - 2	11	ACCI	2.2	ACCI	2.2	EQAR	0.1	URDO	1.2			
SAU - 2	12	RUSP	1.3	ACCI	3.3	TOME	0.2	TOME	0.2			
SAU - 2	13	RUSP	2.7	RUSP	2.7	TOME	0.1	ATFE	0.7			
SAU - 2	14	ACCI	2	ACCI	2	TOME	0.1	ATFE	1.7			
SR-DS-6	1	SALI	1.4	SALI	1.4	UNK	0.1	EQAR	0.4	NONE		
SR-DS-6	2	POTR	0.5	ALRU	2.6	UNK	0.1	EQAR	0.3	NONE		
SR-DS-6	3	POTR	0.6	ALRU	3	UNK	0.3	GRAS	0.4	NONE		
SR-DS-6	4	SCOT	1.2	ALRU	2	UNK	0.1	PHAR	0.5	NONE		
SR-DS-6	5	POTR	2.2	POTR	2.2	GRAS	0.3	GRAS	0.3	NONE		
SR-DS-6	6	POTR	0.6	POTR	1.9	PHAR	0.3	PHAR	0.3	NONE		
SR-DS-6	7	ALRU	3	ALRU	3	PHAR	0.4	PHAR	0.4	NONE		
SR-DS-6	8	POTR	1.1	POTR	2	ASTR	0.1	PHAR	0.3	NONE		
SR-DS-6	9	ALRU	1.1	POTR	3.2	GRAS	0.3	GRAS	0.3	NONE		
SR-DS-6	10	ALRU	3.5	ALRU	3.5	PHAR	0.6	PHAR	0.6	NONE		
SR-DS-6	11	POTR	5	POTR	5	POSA	1.4	POSA	1.4	NONE		
SR-DS-6	12	RUSP	1.6	POTR	2.1	GRAS	0.1	GRAS	0.1	NONE		
SR-DS-6	13	RUSP	1.1	SALI	1.9	PHAR	0.8	POSA	2.3	NONE		
SR-DS-6	14	RUDI	1	SALI	2.4	EQAR	0.1	PHAR	0.8	NONE		
SR-DS-6	15	RUDI	0.2	SALI	2.3	PHAR	1.1	PHAR	1.1	POTR	23	8
SR-DS-6	16	RUDI	0.3	POTR	5	PHAR	0.8	PHAR	0.8	POTR	26	11
SR-DS-6	17	RUUR	0.1	SALI	2.3	POSA	1.9	POSA	1.9	NONE		

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SR-DS-6	18	RUSP	1.3	SALI	4	NONE	0	NONE	0	NONE		
SR-DS-6	19	NONE	0	NONE	0	ANEN	0.1	GRAS	0.4	NONE		
SR-US-3	1	OECE	0.9	VAPA	1.8	VAHE	0.2	POMU	0.8	ALRU	60	17
SR-US-3	2	VAPA	0.3	VAPA	0.8	OXOR	0.1	VAHE	0.2	THPL	35	22
SR-US-3	3	VAPA	0.7	VAPA	2.2	OXOR	0.1	POMU	0.7	TSHE	150	76
SR-US-3	4	RUSP	1	COCO	3.5	OXOR	0.2	POMU	0.7	ACMA	45	15
SR-US-3	5	ACCI	1.8	HODI	2.3	OXOR	0.1	POMU	0.8	ALRU	50	14
SR-US-3	6	RUUR	0.3	OECE	0.8	UNK	0.2	POMU	0.8	ALRU	30	13
SR-US-3	7	RUUR	0.2	UNK	3.6	UNK	0.2	POMU	0.7	ALRU	40	16
SR-US-3	8	RUSP	1.3	OECE	2.8	UNK	0.1	ATFE	1.2	ALRU	50	20
SR-US-3	9	RUUR	0.2	ALRU	2.8	UNK	0.2	ATFE	1	ALRU	40	22
SR-US-3	10	RUPA	0.3	RUSP	1.8	UNK	0.3	POMU	0.6	ALRU	45	34
SR-US-3	11	ARSY	0.3	RUSP	1	UNK	0.2	ATFE	1	ALRU	45	37
SR-US-3	12	RUSP	0.8	RUSP	1.3	POMU	0.4	ATFE	1.1	ALRU	25	11
SR-US-3	13	RUSP	0.5	RUSP	1	OXOR	0.05	ATFE	0.7	ALRU	45	29
SR-US-3	14	VAPA	0.4	VAPA	1	ATFE	0.3	ATFE	1.5	TSHE	100	71
SR-US-3	15	VAPA	0.5	RUSP	0.9	OXOR	0.1	LAMU	0.7	TSHE	180	138
SR-US-3	16	VAPA	1.7	VAPA	3.5	LAMU	0.05	MAID	0.3	ALRU	65	18
SR-US-3	17	RUSP	1	VAPA	2.1	ATFE	0.3	POMU	0.9	ACMA	85	75
SR-US-3	18	VAPA	1	VAPA	1.8	OXOR	0.1	POMU	0.8	TSHE	115	42
SR-US-3	19	ACCI	1.4	ACCI	6	OXOR	0.05	MAID	0.5	ALRU	35	12
SR-US-3	20	ALRU	0.7	ALRU	0.7	MAID	0.3	POMU	0.6			
SR-US-5	1	RUSP	1.3	PHCA	1.9	ROBE	0.1	POSA	1	POTR	40	29
SR-US-5	2	RUUR	0.1	SALI	0.5	ROBE	0.1	GRAS	0.3	ALRU	35	16
SR-US-5	3	SALI	1.6	SALI	1.6	ROBE	0.1	POSA	0.5	ALRU	30	13
SR-US-5	4	NONE	0	NONE	0	UNK	0.1	GRAS	0.6	ALRU	24	12
SR-US-5	5	NONE	0	NONE	0	UNK	0.1	GRAS	0.6	ALRU	20	9
SR-US-5	6	SALI	0.7	SALI	0.7	UNK	0.1	PHAR	0.8	ALRU	35	16
SR-US-5	7	SALI	1.4	SALI	1.4	ROBE	0.1	PHAR	0.6	POTR	40	30
SR-US-5	8	SALI	1	SALI	1	ROBE	0.1	PHAR	0.4	ALRU	30	11
SR-US-5	9	SALI	2.2	ALRU	3.5	PHAR	0.5	PHAR	0.5	POTR	45	27
SR-US-5	10	RHPU	0.7	SALI	1.1	ROBE	0.1	GRAS	0.4	POTR	45	25
SR-US-5	11	SCOT	1	PHPU	2	UNK	0.1	PHAR	1.1	ALRU	24	8
SR-US-5	12	SCOT	0.9	THPL	1.4	ROBE	0.1	PHAR	0.8	POTR	45	28
SR-US-5	13	SALI	1.4	SALI	1.4	UNK	0.1	GRAS	0.3	POTR	50	33
SR-US-5	14	ALRU	1.1	ALRU	5	UNK	0.1	GRAS	0.2	POTR	35	24
SR-US-5	15	TSHE	0.8	ALRU	6	GRAS	0.1	POSA	0.2	ALRU	23	8
SR-US-5	16	PHPU	1.1	ALRU	2.4	GRAS	0.3	GRAS	0.3	POTR	30	21
SR-US-5	17	SCOT	1	SCOT	1	POSA	0.1	GRAS	0.3	POTR	35	24
SR-US-5	18	SALI	1	SCOT	1.4	GRAS	0.2	PHAR	0.8	ALRU	20	8
SR-US-5	19	SALI	1.6	SCOT	1.7	GRAS	0.3	QUEE	1.9	POTR	35	23
SR-US-5	20	SALI	0.1	SCOT	2	GRAS	0.1	GRAS	0.2			

Bull Run Herbaceous, bryophyte, and woody material percent cover.

Plot Number	Station[1]					
BR-DS-1	1	0.00	35.00	60.00	20.00	25.00
BR-DS-1	2	0.00	0.00	15.00	25.00	30.00
BR-DS-1	3	0.00	0.00	0.10	100.00	0.00
BR-DS-1	4	0.00	0.10	50.00	50.00	0.00
BR-DS-1	5	0.00	0.00	0.00	100.00	10.00
BR-DS-1	6	0.00	0.00	50.00	20.00	0.00
BR-DS-1	7	0.00	0.00	50.00	20.00	0.00
BR-DS-1	8	0.00	0.00	40.00	10.00	0.00
BR-DS-1	9	0.00	20.00	90.00	0.00	5.00
BR-DS-1	10	0.00	5.00	5.00	95.00	0.00
BR-DS-1	11	0.10	20.00	40.00	15.00	25.00
BR-DS-1	12	0.10	0.00	45.00	65.00	10.00
BR-DS-1	13	0.10	25.00	25.00	50.00	0.10
BR-DS-1	14	10.00	20.00	30.00	35.00	0.10
BR-DS-1	15	0.10	25.00	35.00	30.00	5.00
BR-DS-1	16	0.10	0.10	85.00	0.10	0.10
BR-DS-1	17	0.00	15.00	80.00	0.00	5.00
BR-DS-1	18	0.00	80.00	20.00	0.00	20.00
BR-DS-1	19	0.00	30.00	65.00	0.00	0.00
BR-DS-1	20	10.00	20.00	20.00	75.00	0.00
BR-DS-2	1	0.00	0.10	0.10	100.00	0.00
BR-DS-2	2	0.00	0.10	0.10	100.00	10.00
BR-DS-2	3	0.00	0.10	0.10	100.00	10.00
BR-DS-2	4	0.00	20.00	85.00	10.00	0.00
BR-DS-2	5	0.00	10.00	75.00	25.00	0.00
BR-DS-2	6	0.00	50.00	30.00	20.00	0.00
BR-DS-2	7	0.00	0.00	95.00	5.00	0.00
BR-DS-2	8	0.10	15.00	95.00	5.00	0.00
BR-DS-2	9	10.00	25.00	75.00	20.00	0.00
BR-DS-2	10	0.00	0.00	75.00	20.00	0.10
BR-DS-3	1	0.00	0.00	30.00	60.00	0.00
BR-DS-3	2	0.00	0.00	5.00	95.00	0.00
BR-DS-3	3	0.00	0.00	0.10	100.00	0.00
BR-DS-3	4	0.00	5.00	50.00	50.00	0.00
BR-DS-3	5	0.00	90.00	10.00	35.00	0.00
BR-DS-3	6	0.10	5.00	5.00	95.00	0.00
BR-DS-3	7	0.00	0.10	10.00	95.00	0.00
BR-DS-3	8	0.00	0.00	10.00	90.00	0.00
BR-DS-3	9	0.10	10.00	65.00	25.00	0.00
BR-DS-3	10	0.10	5.00	65.00	30.00	0.00
BR-DS-3	11	5.00	10.00	85.00	10.00	0.00
BR-DS-3	12	0.10	0.00	40.00	25.00	0.00
BR-DS-3	13	0.00	95.00	45.00	5.00	0.00
BR-DS-3	14	0.00	10.00	10.00	85.00	0.00
BR-DS-3	15	0.00	0.00	5.00	95.00	0.00
BR-DS-3	16	0.00	0.00	5.00	95.00	0.00
BR-DS-3	17	0.00	30.00	60.00	20.00	0.00
BR-DS-3	18	0.00	0.00	5.00	95.00	0.00
BR-DS-3	19	0.00	5.00	5.00	90.00	0.00
BR-DS-3	20	0.00	0.00	10.00	90.00	0.00
BR-DS-4	1	0.00	0.00	20.00	85.00	15.00
BR-DS-4	2	0.00	0.00	0.00	100.00	0.00
BR-DS-4	3	0.00	0.00	50.00	50.00	0.00
BR-DS-4	4	0.10	0.00	15.00	85.00	0.00
BR-DS-4	5	0.00	0.00	65.00	35.00	0.00
BR-DS-4	6	5.00	10.00	5.00	85.00	0.10
BR-DS-4	7	20.00	10.00	65.00	20.00	0.00
BR-DS-4	8	5.00	0.10	20.00	80.00	0.00
BR-DS-4	9	0.00	0.00	0.00	100.00	0.00
BR-DS-4	10	0.00	0.00	10.00	90.00	0.00
BRU-1	1	0.00	0.00	0.00	100.00	0.00
BRU-1	2	0.00	100.00	0.00	0.00	0.00
BRU-1	3	0.00	0.00	100.00	0.00	0.00
BRU-1	4	0.00	0.00	100.00	0.00	0.00
BRU-1	5	0.00	5.00	80.00	15.00	0.00
BRU-1	6	0.00	0.00	0.00	100.00	0.00
BRU-1	7	30.00	25.00	45.00	0.00	0.00
BRU-1	8	10.00	60.00	20.00	10.00	0.00
BRU-1	9	0.00	0.00	0.00	100.00	0.00
BRU-1	10	25.00	25.00	25.00	25.00	0.00
BRU-1	11	0.00	0.00	0.00	100.00	0.00
BRU-1	12	0.00	0.00	85.00	15.00	0.00
BRU-1	13	5.00	5.00	90.00	0.00	0.00
BRU-1	14	0.00	25.00	65.00	10.00	0.00
BRU-1	15	0.00	0.00	55.00	45.00	0.00
BRU-1	16	0.00	0.00	80.00	20.00	0.00
BRU-1	17	0.00	100.00	0.00	0.00	0.00
BRU-1	18	0.00	100.00	0.00	0.00	0.00
BRU-1	19	0.00	0.00	0.00	100.00	0.00
BRU-1	20	0.00	0.00	0.00	100.00	0.00

[1] Station placed every 5 m along transect.

Bull Run Herbaceous, bryophyte, and woody material percent cover.

BRU-2	1	0.00	0.00	25.00	75.00	0.00
BRU-2	2	0.00	0.00	0.00	100.00	0.00
BRU-2	3	0.00	15.00	85.00	0.00	0.00
BRU-2	4	0.00	35.00	30.00	35.00	0.00
BRU-2	5	0.00	5.00	70.00	25.00	0.00
BRU-2	6	55.00	10.00	35.00	0.00	0.00
BRU-2	7	0.00	25.00	25.00	50.00	0.00
BRU-2	8	0.00	0.00	35.00	65.00	0.00
BRU-2	9	0.00	0.00	60.00	15.00	25.00
BRU-2	10	0.00	35.00	65.00	0.00	0.00
BRU-2	11	0.00	0.00	25.00	50.00	25.00
BRU-2	12	0.00	5.00	85.00	10.00	0.00
BRU-2	13	0.00	0.00	55.00	45.00	0.00
BRU-2	14	0.00	0.00	0.00	100.00	0.00
BRU-2	15	0.00	100.00	0.00	0.00	0.00
BRU-2	16	0.00	75.00	25.00	0.00	0.00
BRU-2	17	25.00	25.00	30.00	20.00	0.00
BRU-2	18	55.00	5.00	40.00	10.00	0.00
BRU-2	19	20.00	0.00	65.00	15.00	0.00
BRU-2	20	15.00	10.00	75.00	0.00	0.00
BRU-3	1	0.00	0.00	65.00	35.00	0.00
BRU-3	2	0.00	5.00	25.00	70.00	0.00
BRU-3	3	0.00	0.00	0.00	100.00	0.00
BRU-3	4	0.00	25.00	25.00	0.00	0.00
BRU-3	5	0.00	80.00	0.00	20.00	0.00
BRU-3	6	0.00	35.00	65.00	0.00	0.00
BRU-3	7	0.00	15.00	0.00	85.00	0.00
BRU-3	8	0.00	30.00	70.00	0.00	0.00
BRU-3	9	0.00	0.00	5.00	95.00	0.00
BRU-3	10	0.00	80.00	0.00	20.00	0.00
BRU-3	11	0.00	0.00	15.00	85.00	0.00
BRU-3	12	0.00	0.00	25.00	75.00	0.00
BRU-3	13	0.00	100.00	0.00	0.00	0.00
BRU-3	14	0.00	0.00	100.00	0.00	0.00
BRU-3	15	0.00	0.00	75.00	25.00	0.00
BRU-3	16	0.00	0.00	85.00	15.00	0.00
BRU-3	17	0.00	0.00	30.00	70.00	0.00
BRU-3	18	0.00	0.00	0.00	100.00	0.00
BRU-3	19	0.00	0.00	0.00	100.00	0.00
BRU-3	20	0.00	30.00	0.00	70.00	0.00

DPU-1	1	30.00	30.00	0.00	40.00	0.00
DPU-1	2	0.00	100.00	0.00	0.00	0.00
DPU-1	3	0.00	70.00	0.00	0.00	30.00
DPU-1	4	0.00	75.00	0.00	25.00	0.00
DPU-1	5	0.00	100.00	0.00	0.00	0.00
DPU-1	6	0.00	100.00	0.00	0.00	0.00
DPU-1	7	0.00	75.00	0.00	25.00	0.00
DPU-1	8	0.00	55.00	0.00	15.00	30.00
DPU-1	9	0.00	75.00	0.00	25.00	0.00
DPU-1	10	0.00	25.00	0.00	75.00	0.00
DPU-1	11	0.00	45.00	0.00	55.00	0.00
DPU-1	12	0.00	0.00	0.00	10.00	90.00
DPU-1	13	0.00	10.00	0.00	70.00	20.00
DPU-1	14	0.00	0.00	0.00	0.00	100.00
DPU-1	15	0.00	60.00	0.00	15.00	25.00
DPU-1	16	25.00	5.00	0.00	0.00	95.00
DPU-1	17	0.00	100.00	0.00	0.00	0.00
DPU-1	18	0.00	100.00	0.00	0.00	0.00
DPU-1	19	10.00	50.00	0.00	40.00	0.00
DPU-1	20	65.00	5.00	0.00	10.00	20.00
DPU-2	1	0.00	0.00	0.00	100.00	0.00
DPU-2	2	35.00	0.00	0.00	65.00	0.00
DPU-2	3	0.00	10.00	0.00	0.00	95.00
DPU-2	4	55.00	0.00	0.00	45.00	0.00
DPU-2	5	0.00	0.00	0.00	100.00	0.00
DPU-2	6	75.00	0.00	0.00	25.00	0.00
DPU-2	7	0.00	0.00	0.00	100.00	0.00
DPU-2	8	0.00	0.00	0.00	100.00	0.00
DPU-2	9	0.00	0.00	0.00	100.00	0.00
DPU-2	10	0.00	0.00	0.00	100.00	0.00
LSD-1	1	0.00	45.00	25.00	30.00	0.00
LSD-1	2	0.00	100.00	0.00	0.00	0.00
LSD-1	3	0.00	30.00	70.00	0.00	0.00
LSD-1	4	25.00	25.00	50.00	0.00	0.00
LSD-1	5	0.00	25.00	0.00	45.00	30.00
LSD-1	6	0.00	75.00	25.00	0.00	0.00
LSD-1	7	75.00	25.00	0.00	0.00	0.00
LSD-1	8	0.00	100.00	0.00	0.00	0.00
LSD-1	9	0.00	35.00	0.00	65.00	0.00
LSD-1	10	0.00	25.00	0.00	50.00	25.00

[1] Station placed every 5 m along transect.

Bull Run Herbaceous, bryophyte, and woody material percent cover.

LSD-1	11	0.00	100.00	0.00	0.00	0.00
LSD-1	12	15.00	0.00	85.00	0.00	0.00
LSD-1	13	0.00	65.00	0.00	35.00	0.00
LSD-1	14	0.00	0.00	0.00	100.00	0.00
LSD-1	15	0.00	5.00	20.00	0.00	75.00
LSD-1	16	0.00	25.00	75.00	0.00	0.00
LSD-1	17	0.00	75.00	25.00	0.00	0.00
LSD-1	18	0.00	0.00	0.00	100.00	0.00
LSD-1	19	0.00	65.00	35.00	0.00	0.00
LSD-1	20	0.00	100.00	0.00	0.00	0.00
LSD-2	1	0.00	25.00	50.00	25.00	0.00
LSD-2	2	10.00	90.00	0.00	0.00	0.00
LSD-2	3	20.00	80.00	0.00	0.00	0.00
LSD-2	4	10.00	55.00	0.00	35.00	0.00
LSD-2	5	0.00	100.00	0.00	0.00	0.00
LSD-2	6	0.00	100.00	0.00	0.00	0.00
LSD-2	7	0.00	0.00	75.00	25.00	0.00
LSD-2	8	0.00	0.00	0.00	75.00	25.00
LSD-2	9	0.00	25.00	60.00	15.00	0.00
LSD-2	10	0.00	25.00	75.00	0.00	0.00
LSD-2	11	0.00	0.00	75.00	25.00	0.00
LSD-2	12	0.00	75.00	0.00	15.00	10.00
LSD-2	13	0.00	75.00	0.00	25.00	0.00
LSD-2	14	0.00	25.00	75.00	0.00	0.00
LSD-2	15	0.00	25.00	60.00	15.00	0.00
LSD-2	16	30.00	45.00	0.00	25.00	0.00
LSD-2	17	0.00	55.00	35.00	10.00	0.00
LSD-2	18	0.00	10.00	60.00	30.00	0.00
LSD-2	19	0.00	50.00	50.00	0.00	0.00
LSD-2	20	0.00	65.00	35.00	0.00	0.00
LSD-3	1	0.00	60.00	0.00	35.00	0.00
LSD-3	2	0.00	100.00	0.00	0.00	0.00
LSD-3	3	0.00	0.00	0.00	100.00	0.00
LSD-3	4	0.00	65.00	0.00	35.00	50.00
LSD-3	5	0.00	100.00	0.00	0.00	0.00
LSD-3	6	0.00	0.00	0.00	25.00	75.00
LSD-3	7	0.00	0.00	95.00	5.00	0.00
LSD-3	8	0.00	0.00	0.00	100.00	0.00
LSD-3	9	0.00	15.00	5.00	80.00	0.00
LSD-3	10	0.00	65.00	25.00	10.00	0.00

LSD-3	11	0.00	0.00	25.00	25.00	70.00
LSD-3	12	0.00	25.00	75.00	0.00	0.00
LSD-3	13	0.00	80.00	20.00	20.00	0.00
LSD-3	14	0.00	20.00	0.00	80.00	0.00
LSD-3	15	0.00	0.00	100.00	0.00	100.00
LSD-3	16	5.00	0.00	95.00	0.00	0.00
LSD-3	17	0.00	100.00	0.00	0.00	0.00
LSD-3	18	5.00	0.00	55.00	40.00	0.00
LSD-3	19	0.00	55.00	45.00	0.00	0.00
LSD-3	20	25.00	50.00	25.00	0.00	0.00
LS-DS-1	1	25.00	10.00	15.00	5.00	0.00
LS-DS-1	2	0.00	0.00	100.00	0.00	0.00
LS-DS-1	3	0.01	0.00	85.00	15.00	0.00
LS-DS-1	4	0.10	5.00	85.00	5.00	5.00
LS-DS-1	5	10.00	5.00	90.00	0.00	20.00
LS-DS-1	6	20.00	0.00	50.00	15.00	15.00
LS-DS-1	7	5.00	0.00	100.00	0.00	0.00
LS-DS-1	8	0.10	0.10	50.00	50.00	10.00
LS-DS-1	9	10.00	10.00	10.00	5.00	15.00
LS-DS-1	10	5.00	0.00	25.00	0.00	75.00
LS-DS-1	11	5.00	0.00	65.00	35.00	0.00
LS-DS-1	12	0.10	10.00	75.00	25.00	0.00
LS-DS-1	13	5.00	35.00	10.00	75.00	25.00
LS-DS-1	14	5.00	5.00	10.00	80.00	0.00
LS-DS-1	15	0.00	0.00	15.00	85.00	0.10
LS-DS-1	16	0.00	0.00	10.00	80.00	0.00
LS-DS-1	17	0.00	5.00	0.00	100.00	0.00
LS-DS-1	18	0.00	10.00	5.00	90.00	0.00
LS-DS-1	19	0.00	50.00	90.00	10.00	10.00
LS-DS-1	20	0.00	0.10	10.00	90.00	0.00
LS-DS-2	1	0.00	0.00	15.00	100.00	20.00
LS-DS-2	2	0.10	0.10	60.00	40.00	0.00
LS-DS-2	3	0.00	0.00	0.10	20.00	40.00
LS-DS-2	4	0.00	0.00	5.00	95.00	10.00
LS-DS-2	5	0.00	0.00	25.00	75.00	0.00
LS-DS-2	6	0.00	0.00	80.00	20.00	0.00
LS-DS-2	7	0.00	0.00	5.00	95.00	0.00
LS-DS-2	8	0.10	75.00	10.00	10.00	5.00
LS-DS-2	9	0.00	0.00	0.10	100.00	0.00
LS-DS-2	10	0.00	0.00	90.00	5.00	5.00

[1] Station placed every 5 m along transect.

Bull Run Herbaceous, bryophyte, and woody material percent cover.

LS-DS-2	11	0.10	85.00	0.10	30.00	0.00
LS-DS-2	12	0.10	25.00	5.00	35.00	0.00
LS-DS-2	13	0.00	30.00	80.00	5.00	0.00
LS-DS-2	14	5.00	10.00	20.00	80.00	0.00
LS-DS-2	15	5.00	20.00	30.00	40.00	5.00
LS-DS-2	16	0.10	0.00	95.00	5.00	0.00
LS-DS-2	17	30.00	20.00	30.00	30.00	5.00
LS-DS-2	18	60.00	20.00	10.00	15.00	5.00
LS-DS-2	19	0.10	5.00	70.00	30.00	0.00
LS-DS-2	20	0.00	0.00	40.00	60.00	0.00
LS-DS-3	1	0.10	30.00	10.00	60.00	0.10
LS-DS-3	2	0.00	40.00	15.00	20.00	20.00
LS-DS-3	3	0.00	5.00	0.00	90.00	5.00
LS-DS-3	4	0.00	10.00	5.00	0.00	40.00
LS-DS-3	5	0.00	10.00	0.10	90.00	0.00
LS-DS-3	6	0.00	10.00	0.10	90.00	0.00
LS-DS-3	7	5.00	95.00	10.00	0.00	0.00
LS-DS-3	8	0.10	10.00	35.00	60.00	0.10
LS-DS-3	9	0.00	0.10	100.00	0.00	100.00
LS-DS-3	10	0.00	60.00	10.00	10.00	20.00
LS-DS-3	11	0.00	30.00	30.00	30.00	10.00
LS-DS-3	12	0.00	25.00	65.00	0.00	30.00
LS-DS-3	13	0.00	35.00	15.00	65.00	0.00
LS-DS-3	14	0.00	50.00	30.00	20.00	50.00
LS-DS-3	15	0.10	95.00	30.00	0.00	0.00
LS-DS-3	16	0.10	0.10	70.00	10.00	10.00
LS-DS-3	17	0.00	25.00	100.00	0.00	10.00
LS-DS-3	18	0.00	0.10	80.00	20.00	0.10
LS-DS-3	19	0.10	10.00	40.00	60.00	0.00
LS-DS-3	20	0.00	0.00	90.00	10.00	0.00
LSU-1	1	0.00	100.00	0.00	0.00	0.00
LSU-1	2	90.00	90.00	0.00	0.00	0.00
LSU-1	3	40.00	40.00	20.00	0.00	0.00
LSU-1	4	65.00	15.00	0.00	20.00	0.00
LSU-1	5	0.00	10.00	0.00	90.00	0.00
LSU-1	6	0.00	0.00	0.00	100.00	0.00
LSU-1	7	0.00	0.00	0.00	100.00	0.00
LSU-1	8	0.00	0.00	10.00	90.00	0.00
LSU-1	9	0.00	0.00	0.00	100.00	0.00
LSU-1	10	0.00	0.00	0.00	100.00	0.00

LSU-1	11	0.00	100.00	0.00	0.00	0.00
LSU-1	12	0.00	100.00	0.00	0.00	0.00
LSU-1	13	0.00	75.00	0.00	25.00	0.00
LSU-1	14	15.00	0.00	75.00	10.00	0.00
LSU-1	15	0.00	0.00	0.00	100.00	0.00
LSU-1	16	0.00	0.00	0.00	100.00	0.00
LSU-1	17	0.00	50.00	50.00	0.00	0.00
LSU-1	18	0.00	50.00	10.00	40.00	0.00
LSU-1	19	0.00	75.00	25.00	0.00	0.00
LSU-1	20	0.00	65.00	35.00	0.00	0.00
LSU-2	1	5.00	90.00	0.00	5.00	0.00
LSU-2	2	0.00	95.00	5.00	0.00	0.00
LSU-2	3	0.00	100.00	0.00	0.00	0.00
LSU-2	4	75.00	25.00	0.00	0.00	0.00
LSU-2	5	0.00	100.00	0.00	0.00	0.00
LSU-2	6	0.00	100.00	0.00	0.00	0.00
LSU-2	7	0.00	100.00	0.00	0.00	0.00
LSU-2	8	0.00	100.00	0.00	0.00	0.00
LSU-2	9	50.00	50.00	0.00	0.00	0.00
LSU-2	10	0.00	100.00	0.00	0.00	0.00
LSU-2	11	0.00	0.00	60.00	40.00	0.00
LSU-2	12	0.00	0.00	80.00	20.00	0.00
LSU-2	13	75.00	25.00	0.00	0.00	0.00
LSU-2	14	0.00	0.00	0.00	100.00	0.00
LSU-2	15	0.00	65.00	35.00	0.00	0.00
LSU-2	16	50.00	0.00	30.00	20.00	0.00
LSU-2	17	0.00	35.00	0.00	65.00	0.00
LSU-2	18	0.00	0.00	25.00	75.00	0.00
LSU-2	19	0.00	45.00	0.00	65.00	0.00
LSU-3	1	0.00	75.00	0.00	0.00	25.00
LSU-3	2	0.00	85.00	0.00	15.00	0.00
LSU-3	3	0.00	100.00	0.00	0.00	0.00
LSU-3	4	0.00	100.00	0.00	0.00	0.00
LSU-3	5	15.00	75.00	10.00	0.00	0.00
LSU-3	6	0.00	0.00	0.00	100.00	0.00
LSU-3	7	0.00	100.00	0.00	0.00	0.00
LSU-3	8	0.00	0.00	0.00	100.00	0.00
LSU-3	9	0.00	0.00	0.00	0.00	100.00
LSU-3	10	0.00	0.00	0.00	100.00	0.00
LSU-3	11	0.00	0.00	0.00	100.00	0.00

[1] Station placed every 5 m along transect.

Bull Run Herbaceous, bryophyte, and woody material percent cover.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LSU-3	12	0.00	95.00	5.00	0.00	0.00
LSU-3	13	0.00	25.00	0.00	75.00	0.00
LSU-3	14	0.00	100.00	0.00	0.00	0.00
LSU-3	15	0.00	10.00	0.00	90.00	0.00
LSU-3	16	0.00	0.00	0.00	100.00	0.00
LSU-3	17	0.00	100.00	0.00	0.00	0.00
LSU-3	18	0.00	35.00	65.00	0.00	0.00
LSU-3	19	0.00	15.00	80.00	5.00	0.00
LSU-3	20	0.00	0.00	0.00	100.00	0.00
LSU-4	1	0.00	0.00	0.00	100.00	0.00
LSU-4	2	0.00	95.00	5.00	0.00	0.00
LSU-4	3	0.00	100.00	0.00	0.00	0.00
LSU-4	4	20.00	0.00	0.00	40.00	40.00
LSU-4	5	15.00	5.00	35.00	45.00	0.00
LSU-4	6	0.00	55.00	45.00	0.00	0.00
LSU-4	7	10.00	45.00	45.00	0.00	0.00
LSU-4	8	75.00	15.00	10.00	0.00	0.00
LSU-4	9	15.00	15.00	25.00	20.00	25.00
LSU-4	10	65.00	35.00	0.00	0.00	0.00
SAB-1	1	0.00	5.00	0.00	0.00	0.00
SAB-1	2	0.00	85.00	0.00	15.00	0.00
SAB-1	3	0.00	100.00	0.00	0.00	0.00
SAB-1	4	0.00	100.00	0.00	0.00	0.00
SAB-1	5	5.00	95.00	0.00	0.00	0.00
SAB-1	6	0.00	60.00	0.00	40.00	0.00
SAB-1	7	0.00	90.00	0.00	10.00	0.00
SAB-1	8	0.00	100.00	0.00	0.00	0.00
SAB-1	9	0.00	15.00	0.00	15.00	70.00
SAB-1	10	10.00	20.00	0.00	70.00	0.00
SAB-1	11	0.00	100.00	0.00	0.00	0.00
SAB-1	12	0.00	15.00	80.00	5.00	0.00
SAB-1	13	0.00	10.00	50.00	20.00	20.00
SAB-1	14	25.00	0.00	50.00	25.00	0.00
SAB-1	15	5.00	55.00	0.00	40.00	0.00
SAB-1	16	0.00	10.00	90.00	0.00	0.00
SAB-1	17	0.00	0.00	100.00	0.00	0.00
SAB-1	18	0.00	100.00	0.00	0.00	0.00
SAB-1	19	0.00	0.00	0.00	100.00	0.00
SAB-1	20	80.00	20.00	0.00	0.00	0.00
SAB-2	1	0.00	0.00	0.00	100.00	0.00

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SAB-2	2	0.00	20.00	5.00	55.00	20.00
SAB-2	3	0.00	35.00	0.00	65.00	0.00
SAB-2	4	0.00	10.00	70.00	5.00	15.00
SAB-2	5	0.00	0.00	50.00	50.00	0.00
SAB-2	6	0.00	0.00	0.00	100.00	0.00
SAB-2	7	25.00	0.00	15.00	60.00	0.00
SAB-2	8	5.00	0.00	15.00	80.00	0.00
SAB-2	9	15.00	0.00	80.00	5.00	0.00
SAB-2	10	100.00	0.00	0.00	0.00	0.00
SAB-2	11	75.00	0.00	25.00	0.00	0.00
SAB-2	12	35.00	65.00	0.00	0.00	0.00
SAB-2	13	50.00	50.00	0.00	0.00	0.00
SAB-2	14	15.00	0.00	15.00	70.00	0.00
SAB-2	15	0.00	0.00	0.00	100.00	0.00
SAB-2	16	0.00	0.00	0.00	100.00	0.00
SAB-2	17	0.00	0.00	0.00	100.00	0.00
SAB-2	18	0.00	15.00	0.00	85.00	0.00
SAB-2	19	0.00	0.00	0.00	100.00	0.00
SAB-2	20	0.00	100.00	0.00	0.00	0.00
SAU - 1	1	5.00	25.00	0.00	50.00	20.00
SAU - 1	2	0.10	5.00	0.00	95.00	0.00
SAU - 1	3	0.00	5.00	0.00	95.00	0.00
SAU - 1	4	0.00	0.10	0.00	100.00	0.00
SAU - 1	5	0.00	0.00	0.00	10.00	90.00
SAU - 1	6	0.10	0.10	0.00	100.00	0.00
SAU - 1	7	0.10	0.00	15.00	85.00	0.00
SAU - 1	8	10.00	0.10	15.00	75.00	0.00
SAU - 1	9	10.00	30.00	5.00	0.00	55.00
SAU - 1	10	0.10	35.00	0.00	65.00	0.00
SAU - 1	11	15.00	0.00	20.00	65.00	0.00
SAU - 1	12	0.10	0.00	10.00	90.00	0.00
SAU - 1	13	0.10	0.10	0.10	55.00	5.00
SAU - 1	14	5.00	0.00	0.10	95.00	0.00
SAU - 1	15	0.00	0.00	0.00	100.00	0.00
SAU - 1	16	0.00	0.00	0.10	100.00	0.00
SAU - 1	17	0.10	0.00	5.00	95.00	0.00
SAU - 1	18	30.00	70.00	0.00	0.00	0.00
SAU - 1	19	25.00	0.00	0.00	75.00	0.00
SAU - 1	20	0.00	0.00	0.00	100.00	0.00
SAU - 2	1	0.00	0.10	0.00	100.00	0.00

[1] Station placed every 5 m along transect.

Bull Run Herbaceous, bryophyte, and woody material percent cover.

SAU - 2	2	0.00	3.00	0.00	100.00	0.00
SAU - 2	3	0.00	0.00	0.00	100.00	0.00
SAU - 2	4	0.00	5.00	0.00	95.00	0.00
SAU - 2	5	0.00	90.00	0.00	10.00	0.00
SAU - 2	6	0.00	100.00	0.00	0.00	0.00
SAU - 2	7	0.00	20.00	0.00	80.00	0.00
SAU - 2	8	0.00	0.00	0.00	100.00	0.00
SAU - 2	9	0.00	40.00	0.00	0.00	0.00
SAU - 2	10	0.00	25.00	0.00	70.00	5.00
SAU - 2	11	0.00	95.00	0.00	5.00	0.00
SAU - 2	12	5.00	55.00	0.00	40.00	0.00
SAU - 2	13	0.00	100.00	0.00	0.00	0.00
S-DS-5	1	0.00	70.00	20.00	10.00	0.00
S-DS-5	2	0.00	10.00	25.00	20.00	0.00
S-DS-5	3	0.00	20.00	65.00	20.00	0.00
S-DS-5	4	0.00	100.00	20.00	0.00	0.00
S-DS-5	5	0.00	0.00	10.00	90.00	0.00
S-DS-5	6	5.00	15.00	80.00	0.00	0.00
S-DS-5	7	0.00	15.00	100.00	0.00	0.00
S-DS-5	8	5.00	10.00	100.00	0.00	0.00
S-DS-5	9	0.00	25.00	70.00	20.00	0.00
S-DS-5	10	0.00	40.00	70.00	20.00	0.00
S-DS-5	11	0.10	25.00	85.00	15.00	0.00
S-DS-5	12	0.00	50.00	75.00	15.00	0.00
S-DS-5	13	0.00	10.00	50.00	50.00	0.00
S-DS-5	14	0.00	5.00	85.00	5.00	0.00
S-DS-5	15	10.00	50.00	70.00	20.00	0.00
S-DS-5	16	0.00	100.00	20.00	10.00	0.00
S-DS-5	17	0.10	10.00	65.00	35.00	0.00
S-DS-5	18	0.00	80.00	20.00	20.00	0.00
S-DS-5	19	0.00	90.00	20.00	0.00	0.00
S-DS-5	20	0.10	40.00	75.00	0.00	0.00
SR-DS-6	1	0.00	30.00	50.00	20.00	0.00
SR-DS-6	2	0.00	75.00	0.10	25.00	0.00
SR-DS-6	3	10.00	0.00	30.00	6.00	0.00
SR-DS-6	4	0.00	0.00	65.00	35.00	0.00
SR-DS-6	5	15.00	0.00	25.00	60.00	0.00
SR-DS-6	6	0.00	0.00	15.00	85.00	0.00
SR-DS-6	7	0.00	0.00	100.00	0.00	0.00
SR-DS-6	8	25.00	35.00	30.00	10.00	0.00
SR-DS-6	9	0.00	0.00	80.00	20.00	0.00
SR-DS-6	10	0.00	0.00	75.00	25.00	0.00
SR-DS-6	11	0.00	100.00	0.00	0.00	0.00
SR-DS-6	12	25.00	0.00	15.00	60.00	0.00
SR-DS-6	13	0.00	100.00	0.00	0.00	0.00
SR-DS-6	14	0.00	100.00	0.00	0.00	0.00
SR-DS-6	15	0.00	100.00	0.00	0.00	0.00
SR-DS-6	16	0.00	100.00	0.00	0.00	0.00
SR-DS-6	17	0.00	0.00	15.00	85.00	0.00
SR-DS-6	18	0.00	0.00	0.00	100.00	0.00
SR-DS-6	19	15.00	0.00	0.00	85.00	0.00
SR-DS-6	20	0.00	0.00	0.00	0.00	0.00
SR-US-3	1	0.00	20.00	20.00	60.00	0.00
SR-US-3	2	0.00	15.00	5.00	85.00	0.00
SR-US-3	3	0.00	25.00	15.00	80.00	0.00
SR-US-3	4	0.00	40.00	0.00	15.00	0.00
SR-US-3	5	0.00	80.00	5.00	10.00	0.00
SR-US-3	6	0.00	85.00	0.00	0.00	0.00
SR-US-3	7	0.00	85.00	0.10	5.00	5.00
SR-US-3	8	0.00	50.00	10.00	20.00	0.00
SR-US-3	9	0.00	85.00	0.10	10.00	0.00
SR-US-3	10	0.00	90.00	20.00	5.00	0.00
SR-US-3	11	0.00	100.00	0.00	0.00	0.00
SR-US-3	12	0.10	75.00	0.00	80.00	5.00
SR-US-3	13	0.10	80.00	0.10	10.00	0.00
SR-US-3	14	0.00	10.00	75.00	90.00	0.00
SR-US-3	15	0.10	50.00	0.10	20.00	0.10
SR-US-3	16	0.00	30.00	40.00	20.00	0.00
SR-US-3	17	0.00	10.00	0.00	95.00	0.00
SR-US-3	18	0.10	5.00	10.00	80.00	10.00
SR-US-3	19	0.10	20.00	5.00	75.00	0.10
SR-US-3	20	0.00	90.00	10.00	30.00	0.10
SR-US-5	1	0.00	25.00	0.00	75.00	0.00
SR-US-5	2	5.00	60.00	0.00	25.00	5.00
SR-US-5	3	0.00	65.00	0.00	10.00	25.00
SR-US-5	4	95.00	0.00	0.00	5.00	0.00
SR-US-5	5	75.00	10.00	0.00	15.00	0.00
SR-US-5	6	65.00	5.00	0.00	30.00	0.00
SR-US-5	7	15.00	15.00	0.00	10.00	0.00
SR-US-5	8	20.00	0.00	0.00	80.00	0.00

[1] Station placed every 5 m along transect.

Bull Run Herbaceous, bryophyte, and woody material percent cover.

SR-US-5	9	0.00	0.00	0.00	100.00	0.00
SR-US-5	10	0.00	5.00	0.00	80.00	15.00
SR-US-5	11	25.00	0.00	0.00	75.00	0.00
SR-US-5	12	65.00	0.00	10.00	10.00	15.00
SR-US-5	13	30.00	0.00	0.00	60.00	30.00
SR-US-5	14	95.00	0.00	0.00	5.00	0.00
SR-US-5	15	5.00	0.00	25.00	70.00	0.00
SR-US-5	16	0.00	0.00	55.00	45.00	0.00
SR-US-5	17	25.00	0.00	25.00	50.00	0.00
SR-US-5	18	100.00	0.00	0.00	0.00	0.00
SR-US-5	19	0.00	0.00	80.00	15.00	5.00
SR-US-5	20	0.00	0.00	0.00	100.00	0.00
S-US-4	0	0.00	0.00	0.00	0.00	0.00
S-US-4	1	50.00	5.00	50.00	0.00	0.00
S-US-4	2	0.00	75.00	50.00	5.00	0.00
S-US-4	3	15.00	0.00	95.00	5.00	0.00
S-US-4	4	10.00	0.00	70.00	10.00	20.00
S-US-4	5	30.00	0.00	65.00	35.00	0.00
S-US-4	6	0.10	0.00	50.00	40.00	20.00
S-US-4	7	0.00	0.00	10.00	90.00	0.00
S-US-4	8	10.00	0.00	60.00	35.00	0.00
S-US-4	9	5.00	0.00	90.00	10.00	0.00
S-US-4	10	20.00	0.10	30.00	40.00	0.00
S-US-4	11	0.10	0.00	35.00	65.00	0.10
S-US-4	12	5.00	5.00	5.00	20.00	60.00
S-US-4	13	40.00	10.00	30.00	30.00	0.00
S-US-4	14	60.00	0.00	10.00	30.00	0.00
S-US-4	15	10.00	0.00	5.00	50.00	30.00
S-US-4	16	80.00	0.00	0.00	20.00	0.00
S-US-4	17	0.00	0.00	15.00	40.00	10.00
S-US-4	18	0.10	0.10	50.00	0.00	50.00
S-US-4	19	0.00	0.00	25.00	75.00	0.00
S-US-4	20	0.00	0.10	30.00	70.00	0.00

[1] Station placed every 5 m along transect.

Bull Run Dominant Species Data

BR-DS-1	1	SYAL	OECE	ROSA	PSME			ALRU			OXOR	SMRA	MOSI	
BR-DS-1	2	RIBR	ROSA		PSME			ALRU			MOSI			
BR-DS-1	3	OECE	AMAL	PHCA	ALRU									
BR-DS-1	4	SYAL			ALRU						THOC	SMRA		
BR-DS-1	5	HODI	COCO		ALRU						THOC			
BR-DS-1	6	COCO	B1		ACMA						MOSI			
BR-DS-1	7	COCO	SYAL		ACMA						VAHE	THOC		
BR-DS-1	8	OECE	ROSA	SYAL	TABR			ACMA			THOC	VAHE		
BR-DS-1	9	COST	OECE	ROSA	ACMA			ALRU			VAHE			
BR-DS-1	10	COCO	OECE	ROSA	ACMA			ALRU			VAHE			
BRU-1	1	RIBR	COCO		ALRU						ATFE			
BRU-1	2	COST			ACMA						ATFE			
BRU-1	3	ROSA			ACMA						ATFE			
BRU-1	4	ROSA			ACMA						ATFE			
BRU-1	5	RUSP									GRAS			
BRU-1	6	COST			ACMA						MOSS			
BRU-1	7	COST	SALI		ALRU						MOSS			
BRU-1	8	COCO	SYAL		ACMA						MOSS			
BRU-1	9	HODI	ACCI								VAHA			
BRU-1	10	ACCI	TABR		PSME									
BRU-2	1	PHCA	SYAL								EQAR	RUUR		
BRU-2	2	PHCA									COLU	HYFO		
BRU-2	3	ALRU	ACMA								COLU			
BRU-2	4	HODI									MOSS			
BRU-2	5	ALRU			ACMA			ALRU			MOSS			
BRU-2	6	ALRU			ACMA						MOSS			
BRU-2	7	ACMA			ACMA						MOSS			
BRU-2	8	ROPI			PSME						CLEM			
BRU-3	1	SALI									MOSS			
BRU-3	2	HODI												
BRU-3	3				ACMA						ASTR			
BRU-3	4	ALRU	RHPU		ALRU						ASTR			
BRU-3	5	AMAL									ASTR			
BRU-3	6	ALRU	PHCA		ALRU						ASTR			
BRU-3	7	ACMA	PHCA								ATFE			
BRU-3	8				ALRU						MOSS			
BRU-3	9	ACCI			ALRU						MOSS			
BRU-3	10				THPL			ALRU			MAID			
D.S.-3	1	RUUR	PHCA		ACMA			ALRU			POMU			
D.S.-3	2	RUUR			ALRU						GALI	EQAR		
D.S.-3	3	ALRU	RUSP		ACMA			RHPU			MINT			
D.S.-3	4	CHER	HODI		ACMA			RHPU						
D.S.-3	5	ACCI	OECE		ACMA						COMP	MAID		
D.S.-3	6	COST			ACMA									

[1] Station sampled every 5 m along transect.

Bull Run Dominant Species Data

D.S.-3	7	COST			ALRU	ACMA					MAID	ATFE	ARSY
D.S.-3	8	OECE			ALRU			ACMA			ATFE		
D.S.-3	9	RHPU	OECE		ALRU			ACMA			URDO		
D.S.-3	10	RHPU			ALRU			ACMA			URDO		
2	1	COCO	RVSP		ACMA			COCO			LAMU	MAID	
2	2	COCO	RVSP		ALRU						PEFR	ARSY	UNK3
2	3	ARSY	PHCA	ACCI	ALRU			THPL			MAID	ATFE	URDO
2	4	AMAL	ACMA	THPL	ALMA						MAID	ARSY	VAHE
2	5	ACCI	SYAL		THPL						MAID		
DPU-1	1	PHCA	SCOT		ALRU	POTR					RUUR	IVY	
DPU-1	2	PHCA	HOLY		POTR	ALRU					RUUR	EQAR	
DPU-1	3	SYAL			ALRU						RUUR	EQAR	
DPU-1	4	RUSP	RUDI		POTR	ALRU					RUUR	EQAR	
DPU-1	5	RUSP			POTR	ALRU		RHPU			RUUR	EQAR	
DPU-1	6	GASH	RUSP		POTR	ALRU		RHPU	COCO		RUUR	EQAR	
DPU-1	7	COCO			POTR	ALRU		RHPU			RUUR	EQAR	
DPU-1	8	RHPU	RUDI		POTR	ALRU					RUUR	EQAR	
DPU-1	9	RUSP	RHPU		POTR	ALRU		ACMA			GASH	SYAL	
DPU-2	1	POTR	SALI								PHAR	UNK	
DPU-2	2	POTR	POSA								EQAR		
DPU-2	3	POTR	SALI										
DPU-2	4	ALRU											
DPU-2	5	SALI									GRAS		
DPU-2	6	ALRU									GRAS		
DPU-2	7	ALRU	SALI								GRAS		
DPU-2	8	ALRU	SALI								GRAS		
DPU-2	9	ALRU									GRAS		
DPU-2	10	SALI									GRAS		
LS - DS - 1	1	RUDI	SALI	ACCI	ALRU						THOC		
LS - DS - 1	2	SALI	COST		ALRU						GRAS	EQAR	
LS - DS - 1	3	SALI	ALRU	PHCA	ALRU						GRAS	LAMU	
LS - DS - 1	4	SALI	PHCA	RUSP	ALRU						GRAS		
LS - DS - 1	5	SALI	ALRU		SALI						GRAS	MOSI	LAMU
LS - DS - 1	6	SALI	PHCA		ALRU						POMU	MOSI	ATFE
LS - DS - 1	7	SALI	RUSP								GRAS	PRVU	
LS - DS - 1	8	ALRU	SALI	RUSP									
LS - DS - 1	9	COCO			ALRU						POMU		
LS - DS - 2	1	SALI									GRAS		
LS - DS - 2	2	SALI											
LS - DS - 2	3	SALI			ALRU						UNKF		
LS - DS - 2	4	ALRU	ACCI		ALRU						UNKF	ATFE	
LS - DS - 2	5	COST	SALI		ALRU						MAID		
LS - DS - 2	6	HODI	COST		ALRU						ATFE		
LS - DS - 2	7	ACCI	COCO	COST	ALRU						ATFE	ADPE	

[1] Station sampled every 5 m along transect.

Bull Run Dominant Species Data

LS - DS - 2	8	COCO			ALRU						POMU		
LS - DS - 2	9	COCO			ACMA			ALRU			LAMU		
LS - DS - 2	10	PHCA	SALI	RUUR	ALRU			ACMA					
LS - DS - 2	11												
LS - DS - 2	12												
LS - DS - 3	1	RVSP	SALI	RIBR	ALRU						TOME	ASAR	OXOR
LS - DS - 3	2	SALI	ALRU	RIBR	ALRU	THPL					TOME		
LS - DS - 3	3	ACCI	OECE								GALI	TOME	ATFE
LS - DS - 3	4	ACCI	OECE		THPL						POMU	MAID	
LS - DS - 3	5	ACCI	OECE								ATFE	MAID	POMU
LS - DS - 3	6	ACCI			THPL						ATFE	OXOR	
LS - DS - 3	7	COCO	ACCI	RUSP							MAID	TOME	
LS - DS - 3	8	RUSP	SARA	COCO	ALRU								
LS - DS - 3	9	COCO									GALI		
LSD-1	1	COCO			PSME			ALRU			ATFE		
LSD-1	2	RUSP	COCO		PSME			ALRU			GALI	TOME	
LSD-1	3	HODI	RUSP		ACMA						TOME		
LSD-1	4	RUSP	PHCA		ACMA						ATFE	OXOR	
LSD-1	5	ALRU			PSME						ATFE		
LSD-1	6	RUSP			ACMA			ALRU			ATFE		
LSD-1	7	ALRU			ACMA			ALRU			MAID		
LSD-1	8	RHPU			ACMA						MOSS		
LSD-1	9	COST			ACMA			ALRU					
LSD-1	10	RUSP	RHPU		ALRU						GRAS		
LSD-2	1	RUSP									TOME		
LSD-2	2	ACCI	ALRU		PSME						TOME		
LSD-2	3	ACCI	ALRU		PSME						ATFE		
LSD-2	4	ACCI	COST		PSME						MOSS		
LSD-2	5	COCO									TOME		
LSD-2	6	COST			ALRU						TOME		
LSD-2	7	RUSP			ACMA						MAID		
LSD-2	8	ALRU			ACMA			PSME			ATFE		
LSD-2	9	ALRU	COST		ACMA						TOME		
LSD-2	10	COST	RUSP		PSME						MOSS		
LSD-3	1	RUSP			ACMA						TOME		
LSD-3	2	RIBR			ACMA						MOSS		
LSD-3	3	ALRU			ALRU						ATFE		
LSD-3	4	COCO			ALRU						MOSS		
LSD-3	5	ACCI	RUSP		ALRU						TOME		
LSD-3	6	RUSP			ALRU						MOSS		
LSD-3	7	COCO	ALRU		ALRU						MOSS	TOME	
LSD-3	8	SYAL			THPL						MOSS		
LSD-3	9	COST			THPL						MOSS		
LSD-3	10												

[1] Station sampled every 5 m along transect.

Bull Run Dominant Species Data

LSU-1	1	RUSP	RIBR					ALRU			GRAS		
LSU-1	2	RUSP	ACCI					ALRU			GRAS		
LSU-1	3	RUSP						ALRU			TOME		
LSU-1	4	RUSP						ALRU					
LSU-1	5	PHCA						ALRU					
LSU-1	6	RUSP						ALRU			ATFE		
LSU-1	7	PHCA						ALRU					
LSU-1	8	RUDI						ALRU					
LSU-1	9	CRAB						ALRU			ATFE		
LSU-1	10	RHPU									ATFE		
LSU-2	1	RUSP		ALRU							OXOR	ATFE	
LSU-2	2	RUSP		ALRU							GRAS	ATFE	
LSU-2	3	RUSP		ALRU							ATFE	POMU	
LSU-2	4	RUSP		ALRU							ATFE		
LSU-2	5	RUSP	COST	ALRU							ATFE	OESA	
LSU-2	6	RUSP	COST	ALRU							MOSS		
LSU-2	7	ACCI	PHCA	ALRU							UNKF		
LSU-2	8	COST		ALRU							ATFE		
LSU-2	9	SALI		ALRU							MOSS	THOC	
LSU-2	10												
LSU-3	1	SYAL	RUSP	ALRU							ATFE		
LSU-3	2	RUSP		ALRU							ATFE	THOC	
LSU-3	3	SYAL	RHPU	ALRU							ATFE		
LSU-3	4	PHCA	SYAL	ALRU							ATFE	URDO	
LSU-3	5	PHCA		ALRU							ATFE		
LSU-3	6	PHCA		ALRU							THOC		
LSU-3	7	PHCA	COST			ALRU						ATFE	URDO
LSU-3	8	PHCA	RHPU	ALRU							ATFE	THOC	
LSU-3	9	PHCA		ALRU							ATFE	TOME	
LSU-3	10	PHCA		ALRU									
LSU-4	1	ALRU	SALI	ALRU							ATFE		
LSU-4	2	RUSP	SALI	ALRU							MOSS	GRAS	
LSU-4	3	ALRU	RUSP	ALRU							MOSS	GRAS	
LSU-4	4	PHCA	ALRU	ALRU							MOSS	GRAS	
LSU-4	5	SALI	PHCA	ALRU							CARE	GRAS	
SAB-1	1	RUSP		ALRU							ATFE	RUUR	
SAB-1	2	RUUR		ALRU							POMU	URDO	
SAB-1	3	RUSP		ALRU							PTAQ		
SAB-1	4	ACMA		ALRU							PTAQ		
SAB-1	5	ACMA									RUUR	LAMU	
SAB-1	6	ACMA	ALRU								RUUR		
SAB-1	7	COCO									RUUR		
SAB-2	1	HODI		ALRU							POMU	RUUR	
SAB-2	2	RHPU		ALRU							UNKG		

[1] Station sampled every 5 m along transect.

Bull Run Dominant Species Data

SAB-2	3	PHCA			ALRU						UNKG			
SAB-2	4	RUSP			ALRU						UNKG			
SAB-2	5				ALRU						PHAR			
SAB-2	6	SALI			ALRU						RUUR			
SAB-2	7	ACMA			ALRU						UNKG			
SAB-2	8				ALRU						EQAR			
SAB-2	9	PHCA									EQAR			
SAB-2	10				ALRU						EQAR			
Sandy - D - 6	1	SALI	POTR								GRAS			
Sandy - D - 6	2	SCOT	ALRU								PHAR			
Sandy - D - 6	3	POTR	HODI	SALI							PHAR			
Sandy - D - 6	4	POTR	SALI								PHAR	ASTER		
Sandy - D - 6	5	ALRU	SALI	POTR										
Sandy - D - 6	6	POTR	SALI	RUDI							POSA	GRAS		
Sandy - D - 6	7	SALI	ALRU	RUDI							POSA			
Sandy - D - 6	8	SALI	POTR	RUDI	POTR						POSA			
Sandy - D - 6	9	POTR									POSA			
Sandy - D - 6	10	SALI	ACMA	RUSP	POTR						ANEM			
Sandy - U -5	1	SALI			ALRU			POTR			ROBE	LAMU	GRAS	
Sandy - U -5	2				ALRU			POTR			GRAS	PHAR		
Sandy - U -5	3				ALRU			POTR			PHAR			
Sandy - U -5	4	SALI			ALRU						PHAR	ROBE		
Sandy - U -5	5	SALI	IVY		ALRU			POTR			PHAR	ROBE		
Sandy - U -5	6	SALI	THPL	SCOT	ALRU			POTR			PHAR	LAMU		
Sandy - U -5	7	ALRU			POTR			ALRU			GRAS			
Sandy - U -5	8	THPL	PHPU	SCOT	ALRU									
Sandy - U -5	9	SALI	ALRU		POTR	ALRU					PHAR	GRAS		
Sandy - U -5	10	SCOT	SALI		POTR	ALRU					PHAR	TOUC		
Sandy-U-3	1	VAPA	OECE		THPL			TSHE	ALRU	COCO	VAHE	POMU	OXOR	
Sandy-U-3	2	COCO			TSHE			THPL	ACMA		POMU			
Sandy-U-3	3	RUSP	COCO		ALRU	THPL	ACMA				POMU			
Sandy-U-3	4	RUSP	COCO		ALRU						POMU	ATFE	UNK	
Sandy-U-3	5	RUSP			ALRU			HODI	ACMA		UNK			
Sandy-U-3	6	RUSP			ACMA	ALRU		TSHE			POMU	ATFE		
Sandy-U-3	7	VAPA	RUSP		TSHE	ALRU	THPL				ATFE			
Sandy-U-3	8	VAPA			TSHE			ACMA			ATFE	POMU		
Sandy-U-3	9	VAPA			TSHE						POMU			
Sandy-U-3	10	ALRU			TSHE			ACMA	ALRU		POMU	MAID	OXOR	
SAU - 1	1	SALI	ALRU								HYFO			
SAU - 1	2	SALI	POTR											
SAU - 1	3	PTRI	ALRU								HYFO	UNKF		
SAU - 1	4	ALRU	SALI								UNKF	UNKG		
SAU - 1	5	SALI	ALRU								UNKG	UNK		
SAU - 1	6	SALI	ALRU								UNK			

[1] Station sampled every 5 m along transect.

Bull Run Dominant Species Data

SAU - 1	7	SALI	ALRU								GRAS		
SAU - 1	8	SALI	ALRU								UNKF	GRAS	
SAU - 1	9	ALRU	SALI								UNKF	PHAR	
SAU - 1	10	SALI	ALRU								UNKF	UNKF	
SAU - 1	11	ALRU	SALI								UNKF	GRAS	
SAU - 1	12	ALRU	SALI								GRAS		
SAU - 1	13	ALRU	SALI										
SAU - 1	14	SALI	ALRU								GRAS		
SAU - 1	15	SALI	ALRU								INKF		
SAU - 1	16	SALI											
SAU - 1	17	SALI											
SAU - 1	18	SALI	ALRU								GRAS	UNKF	
SAU - 2	1	RUSP	HODI		ALRU						ROBE		
SAU - 2	2	RUSP	ACCI		ALRU						EQAR		
SAU - 2	3	RUSP			ALRU						EQAR		
SAU - 2	4	RUSP	SYAL		ALRU								
SAU - 2	5	RUSP	SYAL		ALRU						EQAR		
SAU - 2	6	RUSP			ALRU	ACMA							
SAU - 2	7	SARA			ALRU						EQAR		
SAU - 2	8	SARA	RUSP		ALRU						EQAR		
SAU - 2	9	RUSP	ACCI		ALRU						TOME		
SAU - 2	10	RUSP	ACCI		ALRU						TOME	ATFE	
SAU - 2	11	ACCI	RUSP								EQAR		
SAU - 2	12	ACCI	RUSP								EQAR		
SAU - 2	13	ACCI			ALRU								
SAU - 2	14												
S-DS-5	1	RHPU	RUSP	COCO	ACMA			ALRU			UNK1	ATFE	
S-DS-5	2	BAMB	RUSP		ACMA						ATFE		
S-DS-5	3	RUSP	RUUR	ACCI	ACMA			ALRU	THPL		ATFE		
S-DS-5	4	RUSP	COST		ACMA						ATFE		
S-DS-5	5	RUSP	COST		ALRU	ACMA		THPL			ATFE		
S-DS-5	6	ACMA	SARA	COST	ACMA	THPL					ATFE	POMU	
S-DS-5	7	OECE	RUSP	COST							ATFE		
S-DS-5	8	OECE	RUSP	COST	ALRU						POMU	ATFE	
S-DS-5	9	RUSP			ACMA						ATFE		
S-US-4	1	ALRU			POTR			ALRU			LAMU	GRAS	
S-US-4	2	ALRU	SALI		ALRU						GRAS		
S-US-4	3	ALRU	SALI	NAPA	POTR	ALRU					GRAS	POMU	
S-US-4	4	ALRU	SCOT		POTR	ALRU					GRAS		
S-US-4	5	ALRU	POTR	SALI	POTR	ALRU					GRAS		
S-US-4	6	POTR	SALI		ALRU						GRAS		
S-US-4	7	SALI	ALRU	POTR	ALRU						GRAS		
S-US-4	8	ALRU	SALI	SCOT	ALRU						GRAS		
S-US-4	9	SALI			ALRU						GRAS		

[1] Station sampled every 5 m along transect.

Bull Run Dominant Species Data

S-US-4	10	POTR	SCOT		POTR	ALRU					GRAS		
S-US-4	11												
S-US-4	12												
S-US-4	13												
S-US-4	14												
S-US-4	15												
S-US-4	16												
S-US-4	17												
S-US-4	18												
S-US-4	19												
S-US-4	20												

[1] Station sampled every 5 m along transect.

Bull Run Cover Board Raw Data

BR-DS-1	1	100.00	100.00	100.00	100.00	100.00
BR-DS-1	2	75.00	65.00	50.00	5.00	10.00
BR-DS-1	3	100.00	95.00	75.00	95.00	95.00
BR-DS-1	4	100.00	95.00	95.00	100.00	85.00
BR-DS-1	5	45.00	45.00	35.00	50.00	85.00
BR-DS-1	6	90.00	80.00	60.00	100.00	95.00
BR-DS-1	7	100.00	100.00	50.00	80.00	100.00
BR-DS-1	8	90.00	75.00	70.00	80.00	95.00
BR-DS-1	9	100.00	100.00	100.00	100.00	100.00
BR-DS-1	10	100.00	100.00	50.00	1.00	1.00
BR-DS-2	1	95.00	50.00	45.00	40.00	35.00
BR-DS-2	2	100.00	95.00	60.00	70.00	55.00
BR-DS-2	3	100.00	95.00	80.00	15.00	40.00
BR-DS-2	4	10.00	25.00	65.00	95.00	100.00
BR-DS-2	5	5.00	10.00	5.00	15.00	45.00
BR-DS-3	1	60.00	10.00	20.00	10.00	20.00
BR-DS-3	2	85.00	10.00	0.00	30.00	35.00
BR-DS-3	3	25.00	10.00	5.00	10.00	20.00
BR-DS-3	4	40.00	30.00	30.00	25.00	30.00
BR-DS-3	5	20.00	20.00	75.00	35.00	40.00
BR-DS-3	6	100.00	95.00	75.00	10.00	45.00
BR-DS-3	7	85.00	50.00	50.00	85.00	100.00
BR-DS-3	8	5.00	10.00	5.00	10.00	0.00
BR-DS-3	9	95.00	65.00	35.00	50.00	15.00
BR-DS-3	10	5.00	0.00	0.00	0.00	0.00
BR-DS-4	1	20.00	10.00	5.00	5.00	20.00
BR-DS-4	2	90.00	5.00	30.00	25.00	20.00
BR-DS-4	3	100.00	100.00	100.00	100.00	100.00
BR-DS-4	4	95.00	100.00	100.00	85.00	75.00
BR-DS-4	5	100.00	90.00	95.00	90.00	95.00
BRU-1	1	100.00	100.00	75.00	0.00	0.00
BRU-1	2	100.00	100.00	90.00	90.00	100.00
BRU-1	3	100.00	100.00	100.00	75.00	10.00
BRU-1	4	100.00	100.00	80.00	60.00	10.00
BRU-1	5	100.00	100.00	100.00	80.00	60.00
BRU-1	6	100.00	100.00	75.00	25.00	60.00
BRU-1	7	80.00	75.00	75.00	60.00	60.00
BRU-1	8	75.00	75.00	90.00	95.00	100.00
BRU-1	9	70.00	70.00	95.00	70.00	95.00
BRU-1	10	100.00	100.00	100.00	100.00	100.00
BRU-2	1	65.00	65.00	35.00	0.00	0.00
BRU-2	2	95.00	80.00	80.00	50.00	75.00
BRU-2	3	100.00	100.00	100.00	100.00	95.00

[1] Station sampled every 5 m along transect.

Bull Run Cover Board Raw Data

BRU-2	4	75.00	35.00	50.00	50.00	75.00
BRU-2	5	95.00	95.00	65.00	50.00	50.00
BRU-2	6	55.00	45.00	55.00	60.00	55.00
BRU-2	7	100.00	10.00	90.00	85.00	85.00
BRU-2	8	100.00	95.00	80.00	80.00	70.00
BRU-2	9	15.00	5.00	25.00	15.00	15.00
BRU-2	10	100.00	100.00	100.00	90.00	95.00
BRU-3	1	100.00	100.00	100.00	100.00	100.00
BRU-3	2	0.00	0.00	0.00	0.00	0.00
BRU-3	3	95.00	15.00	0.00	0.00	0.00
BRU-3	4	85.00	25.00	0.00	0.00	10.00
BRU-3	5	95.00	95.00	20.00	20.00	80.00
BRU-3	6	95.00	10.00	20.00	20.00	20.00
BRU-3	7	65.00	100.00	100.00	65.00	60.00
BRU-3	8	0.00	0.00	0.00	0.00	0.00
BRU-3	9	0.00	25.00	100.00	100.00	100.00
BRU-3	10	0.00	0.00	0.00	0.00	0.00
DPU-1	1	80.00	65.00	85.00	95.00	90.00
DPU-1	2	95.00	60.00	50.00	50.00	55.00
DPU-1	3	100.00	85.00	85.00	40.00	0.00
DPU-1	4	100.00	100.00	85.00	20.00	0.00
DPU-1	5	100.00	50.00	65.00	35.00	85.00
DPU-1	6	100.00	90.00	90.00	90.00	90.00
DPU-1	7	100.00	85.00	85.00	90.00	90.00
DPU-1	8	100.00	100.00	95.00	85.00	60.00
DPU-2	1	100.00	95.00	10.00	10.00	0.00
DPU-2	2	100.00	100.00	100.00	75.00	75.00
DPU-2	3	50.00	55.00	0.00	0.00	0.00
DPU-2	4	95.00	75.00	75.00	85.00	75.00
DPU-2	5	100.00	100.00	95.00	95.00	95.00
DPU-2	6	100.00	100.00	100.00	50.00	0.00
DPU-2	7	100.00	100.00	90.00	80.00	80.00
DPU-2	8	100.00	100.00	95.00	70.00	75.00
DPU-2	9	100.00	80.00	70.00	55.00	10.00
DPU-2	10	100.00	95.00	90.00	60.00	60.00
LSD-1	1	90.00	75.00	60.00	25.00	5.00
LSD-1	2	95.00	85.00	20.00	20.00	20.00
LSD-1	3	95.00	60.00	40.00	0.00	0.00
LSD-1	4	90.00	20.00	10.00	30.00	30.00
LSD-1	5	90.00	45.00	35.00	0.00	0.00
LSD-1	6	100.00	100.00	85.00	35.00	35.00
LSD-1	7	30.00	0.00	0.00	0.00	0.00
LSD-1	8	25.00	25.00	40.00	75.00	100.00

[1] Station sampled every 5 m along transect.

Bull Run Cover Board Raw Data

LSD-1	9	95.00	95.00	95.00	85.00	85.00
LSD-1	10	100.00	100.00	100.00	75.00	75.00
LSD-2	1	95.00	95.00	55.00	55.00	0.00
LSD-2	2	75.00	95.00	75.00	60.00	60.00
LSD-2	3	100.00	100.00	100.00	100.00	100.00
LSD-2	4	100.00	90.00	90.00	80.00	60.00
LSD-2	5	85.00	85.00	65.00	75.00	100.00
LSD-2	6	100.00	90.00	80.00	70.00	50.00
LSD-2	7	100.00	90.00	75.00	75.00	50.00
LSD-2	8	5.00	10.00	0.00	0.00	0.00
LSD-2	9	90.00	90.00	95.00	75.00	60.00
LSD-2	10	100.00	100.00	100.00	95.00	90.00
LSD-3	1	95.00	55.00	40.00	20.00	0.00
LSD-3	2	100.00	100.00	100.00	75.00	0.00
LSD-3	3	100.00	100.00	100.00	0.00	20.00
LSD-3	4	75.00	75.00	65.00	85.00	40.00
LSD-3	5	100.00	100.00	100.00	90.00	90.00
LSD-3	6	100.00	100.00	65.00	35.00	100.00
LSD-3	7	100.00	100.00	95.00	95.00	95.00
LSD-3	8	100.00	100.00	100.00	85.00	6.00
LSD-3	9	100.00	100.00	75.00	75.00	70.00
LSD-3	10	100.00	75.00	75.00	35.00	35.00
LS-DS-1	1	100.00	100.00	95.00	100.00	100.00
LS-DS-1	2	90.00	35.00	50.00	85.00	70.00
LS-DS-1	3	95.00	85.00	85.00	75.00	95.00
LS-DS-1	4	100.00	95.00	80.00	80.00	75.00
LS-DS-1	5	65.00	45.00	75.00	75.00	75.00
LS-DS-1	6	90.00	85.00	40.00	50.00	30.00
LS-DS-1	7	60.00	50.00	75.00	75.00	75.00
LS-DS-1	8	95.00	10.00	15.00	15.00	35.00
LS-DS-1	9	100.00	60.00	60.00	15.00	0.00
LS-DS-1	10	80.00	70.00	95.00	80.00	15.00
LS-DS-2	1	65.00	45.00	78.00	85.00	85.00
LS-DS-2	2	100.00	100.00	100.00	100.00	100.00
LS-DS-2	3	95.00	75.00	55.00	65.00	55.00
LS-DS-2	4	95.00	65.00	45.00	55.00	95.00
LS-DS-2	5	90.00	95.00	100.00	100.00	100.00
LS-DS-2	6	95.00	50.00	55.00	20.00	65.00
LS-DS-2	7	85.00	30.00	65.00	95.00	60.00
LS-DS-2	8	100.00	100.00	70.00	50.00	100.00
LS-DS-2	9	80.00	70.00	70.00	95.00	85.00
LS-DS-2	10	80.00	75.00	70.00	70.00	80.00
LS-DS-3	1	100.00	90.00	100.00	95.00	100.00

[1] Station sampled every 5 m along transect.

Bull Run Cover Board Raw Data

LS-DS-3	2	100.00	100.00	85.00	50.00	65.00
LS-DS-3	3	85.00	85.00	95.00	100.00	95.00
LS-DS-3	4	50.00	25.00	65.00	35.00	50.00
LS-DS-3	5	100.00	100.00	60.00	60.00	70.00
LS-DS-3	6	100.00	100.00	100.00	60.00	85.00
LS-DS-3	7	100.00	100.00	75.00	70.00	25.00
LS-DS-3	8	95.00	95.00	100.00	100.00	85.00
LS-DS-3	9	100.00	99.00	90.00	85.00	50.00
LS-DS-3	10	15.00	20.00	20.00	10.00	25.00
LSU-1	1	100.00	100.00	85.00	60.00	75.00
LSU-1	2	100.00	100.00	85.00	80.00	80.00
LSU-1	3	100.00	100.00	100.00	100.00	100.00
LSU-1	4	100.00	100.00	100.00	100.00	100.00
LSU-1	5	100.00	100.00	100.00	95.00	95.00
LSU-1	6	95.00	25.00	25.00	10.00	10.00
LSU-1	7	95.00	100.00	100.00	95.00	90.00
LSU-1	8	100.00	100.00	100.00	100.00	95.00
LSU-1	9	75.00	50.00	10.00	50.00	10.00
LSU-2	1	100.00	95.00	25.00	25.00	70.00
LSU-2	2	100.00	100.00	100.00	0.00	0.00
LSU-2	3	100.00	65.00	35.00	10.00	0.00
LSU-2	4	100.00	65.00	65.00	60.00	65.00
LSU-2	5	100.00	100.00	90.00	80.00	35.00
LSU-2	6	80.00	75.00	95.00	75.00	100.00
LSU-2	7	100.00	90.00	90.00	95.00	100.00
LSU-2	8	100.00	90.00	90.00	85.00	100.00
LSU-2	9	100.00	100.00	95.00	75.00	80.00
LSU-2	10	100.00	100.00	100.00	100.00	25.00
LSU-3	1	100.00	80.00	20.00	10.00	0.00
LSU-3	2	100.00	90.00	50.00	50.00	30.00
LSU-3	3	100.00	100.00	100.00	95.00	90.00
LSU-3	4	95.00	95.00	95.00	100.00	100.00
LSU-3	5	100.00	90.00	90.00	90.00	85.00
LSU-3	6	100.00	100.00	100.00	100.00	100.00
LSU-3	7	100.00	100.00	95.00	90.00	100.00
LSU-3	8	100.00	100.00	100.00	95.00	90.00
LSU-3	9	85.00	75.00	85.00	100.00	100.00
LSU-3	10	75.00	90.00	85.00	75.00	75.00
LSU-4	1	100.00	100.00	75.00	85.00	100.00
LSU-4	2	100.00	100.00	100.00	80.00	80.00
LSU-4	3	100.00	100.00	85.00	60.00	60.00
LSU-4	4	100.00	95.00	65.00	60.00	60.00
LSU-4	5	100.00	100.00	90.00	75.00	75.00

[1] Station sampled every 5 m along transect.

Bull Run Cover Board Raw Data

SAB-1	1	75.00	50.00	40.00	30.00	10.00
SAB-1	2	90.00	70.00	40.00	30.00	50.00
SAB-1	3	70.00	45.00	25.00	55.00	15.00
SAB-1	4	95.00	95.00	80.00	70.00	60.00
SAB-1	5	100.00	95.00	50.00	20.00	5.00
SAB-1	6	95.00	80.00	20.00	20.00	20.00
SAB-1	7	100.00	100.00	95.00	95.00	85.00
SAB-1	8	85.00	50.00	50.00	40.00	90.00
SAB-1	9	80.00	80.00	100.00	90.00	75.00
SAB-1	10	100.00	100.00	85.00	60.00	60.00
SAB-2	1	95.00	75.00	90.00	90.00	70.00
SAB-2	2	25.00	35.00	35.00	25.00	25.00
SAB-2	3	100.00	25.00	10.00	0.00	0.00
SAB-2	4	10.00	100.00	85.00	75.00	60.00
SAB-2	5	100.00	100.00	100.00	95.00	90.00
SAB-2	6	95.00	70.00	60.00	60.00	20.00
SAB-2	7	95.00	70.00	60.00	60.00	20.00
SAB-2	8	95.00	70.00	20.00	30.00	10.00
SAB-2	9	75.00	100.00	100.00	100.00	100.00
SAU - 1	1	100.00	100.00	100.00	90.00	75.00
SAU - 1	2	90.00	95.00	100.00	90.00	95.00
SAU - 1	3	100.00	90.00	50.00	75.00	95.00
SAU - 1	4	100.00	95.00	90.00	60.00	80.00
SAU - 1	5	100.00	100.00	95.00	90.00	90.00
SAU - 1	6	95.00	85.00	85.00	60.00	40.00
SAU - 1	7	100.00	95.00	85.00	60.00	80.00
SAU - 1	8	100.00	100.00	100.00	95.00	90.00
SAU - 1	9	100.00	95.00	90.00	10.00	10.00
SAU - 1	10	100.00	100.00	95.00	75.00	35.00
SAU - 2	1	100.00	100.00	95.00	85.00	65.00
SAU - 2	2	100.00	100.00	95.00	80.00	60.00
SAU - 2	3	100.00	95.00	95.00	40.00	40.00
SAU - 2	4	95.00	100.00	100.00	100.00	85.00
SAU - 2	5	85.00	70.00	100.00	100.00	100.00
SAU - 2	6	100.00	100.00	85.00	95.00	100.00
SAU - 2	7	100.00	100.00	100.00	100.00	100.00
S-DS-5	1	100.00	95.00	65.00	85.00	100.00
S-DS-5	2	100.00	100.00	100.00	100.00	100.00
S-DS-5	3	100.00	95.00	85.00	55.00	65.00
S-DS-5	4	100.00	55.00	35.00	45.00	45.00
S-DS-5	5	100.00	100.00	50.00	15.00	15.00
S-DS-5	6	90.00	15.00	10.00	10.00	0.00
S-DS-5	7	100.00	100.00	75.00	45.00	40.00

[1] Station sampled every 5 m along transect.

Bull Run Cover Board Raw Data

S-DS-5	8	99.00	95.00	20.00	10.00	10.00
S-DS-5	9	95.00	95.00	85.00	75.00	80.00
S-DS-5	10	100.00	100.00	75.00	15.00	20.00
SR-DS-6	1	100.00	90.00	90.00	65.00	50.00
SR-DS-6	2	100.00	95.00	30.00	20.00	15.00
SR-DS-6	3	100.00	95.00	90.00	45.00	50.00
SR-DS-6	4	100.00	90.00	100.00	50.00	95.00
SR-DS-6	5	100.00	100.00	95.00	80.00	100.00
SR-DS-6	6	85.00	90.00	100.00	90.00	85.00
SR-DS-6	7	100.00	100.00	100.00	100.00	100.00
SR-DS-6	8	100.00	100.00	100.00	100.00	100.00
SR-DS-6	9	100.00	100.00	100.00	100.00	95.00
SR-DS-6	10	100.00	100.00	100.00	90.00	80.00
SR-US-3	1	95.00	95.00	15.00	10.00	50.00
SR-US-3	2	85.00	35.00	35.00	5.00	10.00
SR-US-3	3	100.00	95.00	80.00	25.00	80.00
SR-US-3	4	90.00	50.00	95.00	85.00	75.00
SR-US-3	5	100.00	100.00	35.00	10.00	50.00
SR-US-3	6	80.00	75.00	50.00	40.00	40.00
SR-US-3	7	90.00	80.00	40.00	70.00	50.00
SR-US-3	8	40.00	30.00	35.00	60.00	90.00
SR-US-3	9	70.00	90.00	100.00	100.00	100.00
SR-US-3	10	100.00	100.00	100.00	100.00	95.00
SR-US-4	1	50.00	5.00	5.00	5.00	5.00
SR-US-4	2	45.00	45.00	65.00	15.00	5.00
SR-US-4	3	65.00	20.00	5.00	0.00	0.00
SR-US-4	4	50.00	65.00	75.00	45.00	55.00
SR-US-4	5	50.00	20.00	5.00	5.00	5.00
SR-US-4	6	80.00	40.00	35.00	85.00	50.00
SR-US-4	7	70.00	45.00	55.00	50.00	50.00
SR-US-4	8	95.00	60.00	70.00	5.00	20.00
SR-US-4	9	90.00	90.00	100.00	100.00	100.00
SR-US-4	10	65.00	75.00	65.00	60.00	80.00
SR-US-5	1	10.00	10.00	10.00	10.00	10.00
SR-US-5	2	75.00	30.00	20.00	5.00	5.00
SR-US-5	3	50.00	10.00	5.00	0.00	0.00
SR-US-5	4	80.00	75.00	80.00	70.00	50.00
SR-US-5	5	90.00	70.00	20.00	5.00	0.00
SR-US-5	6	85.00	55.00	40.00	10.00	0.00
SR-US-5	7	40.00	15.00	5.00	0.00	0.00
SR-US-5	8	90.00	15.00	5.00	5.00	10.00
SR-US-5	9	85.00	70.00	85.00	95.00	90.00
SR-US-5	10	100.00	100.00	100.00	100.00	90.00

[1] Station sampled every 5 m along transect.

Bull Run Cover Board Raw Data

[1] Station sampled every 5 m along transect.

Bull Run Snag and Down Wood Raw Data

PORT-1	50	10	1	0				DECIDUOUS	3	15.00	22.00	2.10			
PORT-2	50	10	0	1	50.00	10.70	1	PSME	3					Excavate	
PORT-2	50	10	0	2	25.00	3.70		ACMA	3					EXCAVATION	
PORT-2	50	10	1	0			1	CONIFER	3	50.00	60.00	3.00			
PORT-2	50	10	2	0			1	CONIFER	3	25.00	30.00	4.60			
PORT-2	50	10	3	0			1	UNKNOWN	3	15.00	20.00	4.00			
PORT-3	50	10	0	1	16.00	10.70		ALRU	2					No	
PORT-3	50	10	0	2	56.00	12.20		ALRU	1					EXCAVATION	
PORT-3	50	10	1	0				CONIFER	3	13.00	15.00	2.30			
PORT-3	50	10	2	0				ALRU	2	3.00	15.00	6.20			
PORT-3	50	10	3	0				ALRU	1	16.00	8.50				Leaner
PORT-3	50	10	4	0				ACMA	3	23.00	30.00	4.50		None	
PORT-3	50	10	5	0				ALRU	2	25.00	37.00	3.70			
PORT-4	50	10	0	1	24.00	7.60		ACMA	2					No Excavation	
PORT-4	50	10	0	2	16.00	9.10		ACMA	1						
PORT-4	50	10	0	3	21.00	12.20		ACMA	1						
PORT-4	50	10	0	4	25.00	7.60		ACMA	1						
PORT-4	50	10	1	0				DECIDUOUS	3	25.00	30.00	2.30			
BR-D-1	100	10	0	1	12.00	30.00	1	ALRU	2				No	No	
BR-D-1	100	10	1	0			1	THPL	3	7.00	18.00	9.60	No	No	
BR-D-1	100	10	2	0			1	ALRU	1	1.00	18.00	12.00	No	No	
BR-D-1	100	10	3	0			1	ALRU	1	10.00	11.00	5.50			
BR-D-1	100	10	4	0			1	ALRU	1	10.00	13.00	6.50			
BR-DS-1	100	10	0	2	60.00	15.00	1	PSME	4					woodpecker	not long to fall
BR-DS-2	50	10	1	0			1	ALRU	1	3.00	17.00	11.00			
BR-DS-3	50	10	1	0			2	ALRU	1	8.00	16.00	5.40			
BR-DS-4	50	10	1	0			2	ALRU	3	6.00	10.00	2.80			
BRU-1	100	10	0	1	15.00	10.00		ACMA	3					yes	Burnt
BRU-1	100	10	0	2	13.00	6.00		ACMA	3					yes	BURNT
DPU-1	100	10	1	0			1	UNKNOWN	3	40.00	60.00	3.50			
DPU-1	100	10	3	0			2	UNKNOWN	3	40.00	60.00	7.00			
DPU-1	100	10	4	0			1	UNKNOWN	3	26.00	70.00	4.50			Root Wad
DPU-1	100	10	5	0			1	12-ALRU	2	30.00	60.00	8.00			
DPU-2	100	10	2	0			1	CONIFER	3	60.00	110.00	5.50			
LSD-3	50	10	1	0			1	12 BL ACMA	1	1.00	65.00	24.00	No	No	
LSD-3	50	10	2	0			1	UNKNOWN	2	40.00	50.00	6.00	No	No	
LSD-3	50	10	3	0			1	UNKNOWN	3	40.00	60.00	14.00	No	No	
LSD-3	50	10	4	0			1	UNKNOWN	3	20.00	40.00	6.00	No	No	
LSD-3	50	10	5	0			1	UNKNOWN	3	30.00	60.00	12.00	No	No	
LSD-3	50	10	6	0			1	UNKNOWN	3	20.00	50.00	14.00	No	No	
LSD-3	50	10	7	0			1	UNKNOWN	3	40.00	70.00	15.00	No	No	
LSD-3	50	10	8	0			1	ACMA	3	40.00	60.00	50.00	No	No	
LSD-3	50	10	9	0			1	ACMA	3	40.00	60.00	5.00	No	No	

Bull Run Snag and Down Wood Raw Data

LS-DS-2	100	10	1	0			1	THPL	2	10.00	15.00	5.24	No		
LS-DS-2	100	10	2	0			1	ALRU	3	18.00	20.00	3.10	No		
LS-DS-2	100	10	3	0			1	THPL	3	17.00	20.00	4.50			
LS-DS-3	100	10	1	0				UNKNOWN	4	31.00	38.00	11.80			
LS-DS-3	100	10	2	0				UNKNOWN	4	21.00	25.00	3.50			
LS-DS-3	100	10	3	0				UNKNOWN	4	40.00	170.00	21.50			
LS-DS-3	100	10	4	0				UNKNOWN	4	26.00	50.00	7.40			
LS-DS-3	100	10	5	0			1	ALRU	2	1.00	15.00	9.50			
LS-DS-3	100	10	6	0			1	ALRU	2	6.00	18.00	9.30			
LS-DS-3	100	10	7	0			1	UNKNOWN	4	6.00	37.00	13.30			
LS-DS-3	100	10	8	0			1	UNKNOWN	4	18.00	25.00	4.60			
LS-DS-3	100	10	9	0			1	UNKNOWN	4	22.00	25.00	4.50			
LS-DS-3	100	10	#	0			1	UNKNOWN	4	12.00	27.00	10.70			
LS-DS-3	100	10	#	0			1	UNKNOWN	2	2.00	9.00	5.30			
LSU-1	50	10	1	0			1	UNKNOWN	3	70.00	70.00	18.00	yes		Amphibian
LSU-2	50	10	0	1	0.12	8.00		ALRU	2						
LSU-2	50	10	1	0			1	UNKNOWN	3	50.00	75.00	7.00	yes		Pile
LSU-2	50	10	2	0			1	UNKNOWN	3	70.00	90.00	9.00	yes		Pile
LSU-2	50	10	3	0			1	UNKNOWN	3	15.00	25.00	10.00	yes		Pile
LSU-2	50	10	4	0			1	UNKNOWN	3	5.00	90.00	12.00	yes		Pile
LSU-3	50	10	0	1	1.20	8.00		UNKNOWN	3				yes		Burnt-hollow
LSU-3	50	10	1	0			1	UNKNOWN	3	3.00	5.00	14.00			
LSU-3	50	10	2	0			1	UNKNOWN	3	3.00	5.00	10.00			
Marmot	50	10	0	1	6.00	7.60		ACMA	4						
D-1	50	10	0	1	50.00	40.00		CONIFER	2					Excavation	
D-1	50	10	0	2	55.00	12.20	1	CONIFER	2					EXCAVATION	
D-1	50	10	0	3	26.00	4.00	1	CONIFER	3						
D-1	50	10	1	0			1	CONIFER	2	30.00	50.00	12.20			
D-1	50	10	2	0			1	CONIFER	2	29.00	38.00	11.60			
D-1	50	10	3	0			1	CONIFER	3	20.00	40.00	25.90			
D-1	50	10	4	0			1	CONIFER	4	8.00	16.00	6.40			
D-1	50	10	5	0			1	CONIFER	2	20.00	30.00	4.60			
D-1	50	10	6	0			1	CONIFER	3	15.00	15.00	10.70			
D-1	50	10	7	0			1	CONIFER	3	21.00	36.00	7.90			
D-1	50	10	8	0			1	CONIFER	2	20.00	40.00	12.20			
D-1	50	10	9	0			1	CONIFER	1	5.00	27.00	18.30			
D-1	50	10	#	0			1	CONIFER	1	25.00	45.00	27.10			
D-1	50	10	#	0			1	CONIFER	1	10.00	51.00	36.90			
D-1	50	10	#	0			1	CONIFER	1	20.00	38.00	23.00			
2	50	10	0	1	77.00	12.20	1	PSME	3					Excavate	
2	50	10	0	2	94.00	4.30	1	THPL	4						BURNT
2	50	10	0	3	48.00	2.70	1	TSHE	4					EXCAVATE	
2	50	10	1	0			1	CONIFER	2	2.00	10.00	9.40			

Bull Run Snag and Down Wood Raw Data

2	50	10	2	0			1	CONIFER	4	16.00	30.00	19.80				
2	50	10	3	0			1	CONIFER	5	21.00	80.00	10.40				
2	50	10	4	0			1	CONIFER	5	26.00	36.00	11.60				
2	50	10	5	0			1	CONIFER	3	20.00	60.00	18.30				
T-3	10	50	0	0				UNKNOWN								SNAGS
4	50	10	1	0			1	CONIFER	4	20.00	28.00	3.50				
4	50	10	2	0			1	ALRU	4	20.00	28.00	3.50				
4	50	10	3	0			1	ALRU	1	20.00	22.00	3.30				
5	50	10	0	1	70.00	15.20	1	PSME	2					excavation		
5	50	10	0	2	50.00	15.20		PSME	2					NONE		
5	50	10	1	0			1	CONIFER	2	29.00	30.00	6.40				
5	50	10	2	0			1	TSHE	1	5.00	40.00	19.80				
SAB-1	100	10	1	0			1	ALRU	2	5.00	25.00	14.00				
SAB-1	100	10	2	0			1	ALRU	2	4.00	15.00	4.50				
SAB-1	100	10	3	0			1	ALRU	2	20.00	5.00	4.50				
SAB-1	100	10	4	0			1	ALRU	2	3.00	150.00	6.00				
SAB-1	100	10	5	0			1	ALRU	2	1.00	50.00	11.00				
SAB-1	100	10	6	0			1	ALRU	2	15.00	20.00	5.50				
SAB-1	100	10	7	0			1	ALRU	2	20.00	40.00	11.00				
SAB-2	100	10	1	0			1	UNKNOWN	3	100.00	100.00	9.00	yes			
SAB-2	100	10	2	0			1	UNKNOWN	3	10.00	20.00	12.00	no			
SAB-2	100	10	3	0			1	UNKNOWN	3	30.00	30.00	4.00	no			
D.S.-5	100	10	1	0			1	THPL	3	40.00	98.00	9.20		woodpecker		
6	100	10	1	0			1	THPL	3	40.00	50.00	11.80				
6	100	10	2	0			1	THPL	3	11.00	30.00	8.90				
6	100	10	3	0			1	ALRU	1	15.00	19.00	7.40				
6	100	10	4	0			1	THPL	3	20.00	22.00	4.50				
6	100	10	5	0			1	THPL	3	10.00	25.00	7.90				
6	100	10	6	0			1	THPL	3	35.00	47.00	7.70				
3	100	10	1	0			1	TSHE	1	1.00	40.00	22.60	yes			edge
3	100	10	2	0			1	ALRU	3	19.00	35.00	17.90				
4	100	10	1	0			2	ALRU	1	12.00	16.00	4.50				
4	100	10	2	0			2	ALRU	1	7.00	15.00	6.50				
4	100	10	3	0			2	ALRU	1	9.00	16.00	5.90				
4	100	10	4	0			2	ALRU	1	10.00	15.00	4.00				
4	100	10	5	0			1	POTR	1	14.00	15.00	5.80		Beaver		
4	100	10	6	0			1	POTR	1	12.00	26.00	9.50		Beaver		
4	100	10	7	0			1	POTR	1	10.00	17.00	4.00		Beaver		
4	100	10	8	0			1	POTR	2	2.00	18.00	8.60		Beaver		
5	100	10	1	0			1	ALRU	2	12.00	20.00	5.60				
5	100	10	2	0			2	PSME	2	31.00	30.00	14.30				
5	100	10	3	0			1	POTR	2	28.00	30.00	10.00				
5	100	10	4	0			1	POTR	2	30.00	40.00	10.00				

Bull Run Snag and Down Wood Raw Data

SAU-1	100	10	1	0			1	UNKNOWN	2	28.00	90.00	23.00		debris flowing
SAU-1	100	10	2	0			1	UNKNOWN	2	20.00	29.00	4.90		Flow debris
SAU-1	100	10	3	0			1	UNKNOWN	2	10.00	14.00	2.60		R. Alda
SAU-1	100	10	4	0			1	UNKNOWN	3	8.00	29.00	2.80		Flow Debris
SAU-1	100	10	5	0			1	UNKNOWN	2	20.00	27.00	11.70		Pine?
SAU-1	100	10	6	0			2	UNKNOWN	3	50.00	22.00	4.00		Flow Debris
USFS-1	50	10	0	1	12.00	7.60	1	ALRU	3				No	
USFS-1	50	10	1	0			1	CONIFER	2	40.00	50.00	5.00		
USFS-1	50	10	2	0			1	CONIFER	3	25.00	30.00	4.60		
USFS-2	50	10	0	1	19.00	9.10		TSHE	2				No	
USFS-2	50	10	0	2	22.00	6.10		CONIFER	3					
USFS-2	50	10	1	0				TSHE	2	10.00	16.00	5.50		
USFS-2	50	10	2	0				CONIFER	3	25.00	30.00	4.30		
USFS-3	50	10	0	1	80.00	4.90	1	CONIFER	3					
USFS-3	50	10	1	0			1	CONIFER	3	60.00	70.00	3.00		
USFS-3	50	10	2	0			1	CONIFER	3	19.00	35.00	13.70		
USFS-3	50	10	3	0			1	CONIFER	3	25.00	35.00	7.90		
USFS-3	50	10	4	0			1	UNKNOWN	3	20.00	29.00	7.90		
USFS-4	50	10	1	0			1	CONIFER	3	18.00	10.70			

BULL RUN HYDROELECTRIC PROJECT

THREATENED, ENDANGERED, SENSITIVE AND SURVEY AND MANAGE PLANT AND INVASIVE/EXOTIC PLANT SURVEYS

DRAFT REPORT

May 2001

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EDAW, Inc.

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Oregon State University

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1.0 INTRODUCTION

Portland General Electric (PGE) is currently collecting information to support an application and Applicant Prepared Environmental Assessment (APEA) to the Federal Energy Regulatory Commission (FERC) to decommission the Bull Run Hydroelectric Project. The application and APEA will address issues raised by the Terrestrial Resources Workgroup (TRW) related to the effects of decommissioning on environmental resources in the Project vicinity, including vegetation; threatened, endangered, and sensitive (TES) species (which is connected to TRW Issue T1); and Survey and Manage (S/M) plant and fungi species identified in the Northwest Forest Plan (U.S. Forest Service [USFS] and Bureau of Land Management [BLM] 1994) (which is connected to TRW Issues T1 and G2). In addition, the TWG for the Bull Run Project is concerned that decommissioning activities could result in the spread of exotic and invasive plant species (Issue T3) in the Project vicinity. This report describes procedures used for identifying and documenting TES, S/M, and exotic/invasive plant occurrences in the vicinity of the Bull Run Hydroelectric Project (FERC Project No. 477), results of the surveys, and provides management recommendations regarding these plants.

2.0 STUDY AREA

The study area for TES, S/M, and exotic/invasive plants is illustrated in Figure 2-1 and includes the following:

- Lands within the current FERC Project boundary, including the transmission line right-of-way (ROW);
- Riparian and wetland habitats along the Sandy River from approximately 2 mi. (3.2 km) upstream of Marmot Dam downstream to the confluence with the Bull Run River;
- Riparian and wetland habitats along the Little Sandy River from 0.5 mi. (0.8 km) upstream of the Little Sandy Diversion Dam downstream to the confluence with the Bull Run River;
- Riparian and wetland habitats along the Bull Run River from the confluence with the Little Sandy River downstream to the confluence with the Sandy River; and
- PGE-owned lands in the Project vicinity in the Sandy, Little Sandy, and Bull Run river drainages.

Surveys for S/M plants were conducted only on BLM and USFS lands in the study area.

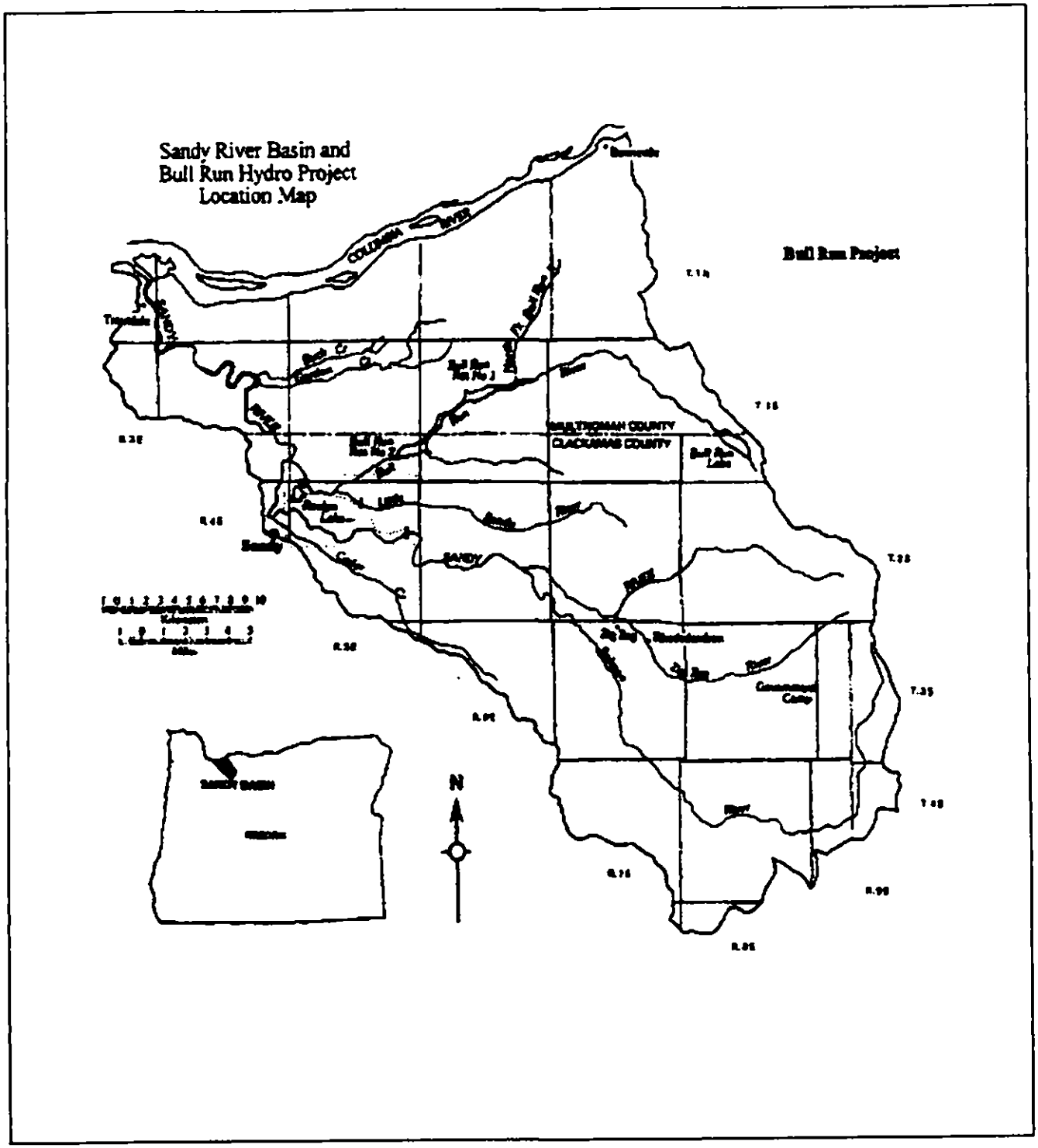

Figure 2-1. Bull Run Hydroelectric Project study area

3.0 METHODS

The surveys for TES, S/M, and exotic/invasive plants comprised the following tasks: (1) pre-field reviews; (2) field surveys; and (3) documentation and mapping of results. Each task is described below.

1. Pre-field Review

The pre-field review task consisted of developing "target" lists of TES, S/M, and exotic/invasive species to guide field surveys. For this Project, TES and S/M plants include all taxa listed at the federal or state level as threatened or endangered, all taxa that are candidates for federal or state listing, and any other species considered to be at risk of decline or in need of monitoring or protection. Specifically, TES and S/M plants include the following:

- Federally listed species, which are protected by the Endangered Species Act (ESA) of 1973 under the administration of the U.S. Fish and Wildlife Service (USFWS).
- State-listed species, which are protected by the Oregon Department of Agriculture (ODA) under the state Endangered Species Act.
- Species not granted special protection by federal or state law but considered of concern by the Oregon Natural Heritage Program (ONHP) (and included on the ONHP Lists 1, 2, 3, and 4).
- Species on the Sensitive Plant List for the USFS, Region 6 (1991).
- Species on the BLM Sensitive Species List for the Salem District.
- Species designated as Survey and Manage by the Northwest Forest Plan (USFS and BLM 1994).

Information on TES and S/M species was requested from the ONHP, which maintains a database of all taxa of concern in Oregon, including federal and state-listed species. ONHP had records of only one TES species known from any section that contained a portion of the study area (letter from Terry Campos, Conservation Information Assistant, Natural Heritage Program, 1999). Consequently, the list of rare, threatened, and endangered species of Oregon (ONHP 1998) was reviewed to identify other plant species that potentially occur in the study area (Appendix A). Botanists from Oregon State University (OSU) and the USFS were then asked to comment on this expanded list; species not likely to occur in study area habitats were removed from the list. In addition, the Mt. Hood National Forest (MHNF) botanist provided lists of USFS sensitive plants and S/M plants likely to occur in the study area. The list of target TES and S/M species includes 13 vascular plant, 1 liverwort, 5 moss, 10 lichen, and 17 fungi species (Table 3-1).

Table 3-1. Threatened, endangered, and sensitive (TES) and Survey and Manage (S/M) plant species potentially occurring in the Bull Run Project study area.

Scientific Name Common Name	USFWS Status[1]	USFS/ BLM Status[2]	ODA Status[3]	ONHP List[4]	Habitat Conditions/Flowering Time
Vascular Plants					
Botrychium minganense Moonwort	–	USFS Sensitive S/M	–	2	Meadows and moist coniferous forests; July - Sept.
Botrychium montanum Mountain grape fern	–	USFS Sensitive S/M	–	2	Shady western red cedar forests and grassy areas; July - Sept.
Botrychium pinnatum Pinnate grape fern	–	USFS Sensitive	–	2	Grassy, mossy areas on moist soil; July - Sept.
Carex livida Pale sedge	–	USFS Sensitive	–	–	Swampy woods and peat bogs; July - Aug.
Cimicifuga elata Tall bugbane	SoC	USFS Sensitive S/M	Candidate	1	Mixed coniferous/deciduous forests; June - Sept.
Corydalis aquae-gelidae Cold-water corydalis	SoC	USFS & BLM Sensitive S/M	Candidate	1	Moist soil at edges of streams; June - Sept.
Erigeron howellii Howell's daisy	SoC	USFS Sensitive	Candidate	1	Moist rocky areas; May - July.
Huperzia occidentalis Fir clubmoss	-	-	-	4	Slopes and flat areas along streams. All year.
Howellia aquatilis Howellia	T	USFS Sensitive	–	1-ex	Pond and lakes; May - July.
Montia howelii Howell's montia	SoC	USFS & BLM Sensitive	Candidate	1	Open moist or vernally moist areas; April - May.
Ophioglossum pusillum Adder's tongue	–	USFS Sensitive	–	2	Moist meadows and woods; July – Sept.
Sisyrinchium sarmentosum Pale blue-eyed grass	SoC	USFS Sensitive	Candidate	1	Moist meadows; June - July.
Sullivantia oregana Oregon sullivantia	SoC	USFS Sensitive	Candidate	1	Shady moist cliffs and ledges; May - Aug.
Liverworts					
Diplophyllum plicatum	–	S/M	–	2	Damp rock faces; all year.
Mosses					
Buxbaumia viridis	–	S/M	–	–	Rotten wood, duff, moss on rock; Aug. - Nov.
Rhizomnium nudum	–	S/M	–	–	Moist soil in woods and along streams; all year.
Schistostega pennata	–	S/M	–	2	Crevices of root wads where humidity is high all year (e.g., adjacent to ponds, lakes, streams).

Scientific Name Common Name	USFWS Status[1]	USFS/ BLM Status[2]	ODA Status[3]	ONHP List[4]	Habitat Conditions/Flowering Time
Scouleria marginata		S/M*	–	3	Rocks in streams; all year.
Tetraphis geniculata	–	S/M	–	3	Rotten logs; May - Sept.
Lichens					
Bryoria spiralifera	–	S/M*	–	2	Twigs; all year.
Dermatocarpon luridum	–	S/M*	–	–	Rocks in streams; all year.
Hydrothyria venosa	–	S/M*	–	–	Rocks in streams; all year.
Hypogymnia duplicata	–	S/M*	–	2	Moist coniferous forests, on Douglas-fir, pine twigs, mosses on rocks; all year.
Hypogymnia oceanica	–	BLM Assess S/M*	–	–	Old-growth coniferous forests; all year.
Leptogium rivale	–	S/M*	–	–	Rocks in streams; all year.
Lobaria linita	–	S/M	–	2	Moist forests; on trees, shrubs, mossy rocks; all year.
Nephroma occultum	–	BLM Assess S/M*	–	–	Coniferous forests, on bark; all year.
Pannaria rubiginosa	–	BLM Assess S/M*	–	–	Coniferous, deciduous forests, on trees; all year.
Pseudocyphellaria rainierensis	–	S/M	–	3	Moist old-growth coniferous forests; all year.
Fungi					
Alba atrellus caeuleoporus	–	S/M*	–	3	Coniferous forest, especially hemlock; fall.
Alpova alexsmithii	–	S/M*	–	3	Fall.
Bridgeoporus nobilissmus *Noble polypore*	–	BLM Sensitive S/M	–	–	All year. True fir snags, possible other conifer species.
Choiromyces alveolatus	–	S/M*	–	3	Forests; fall.
Clitocybe subditopods	–	S/M*	–	3	Fall.
Cortinarius boulderensis	–	S/M*	–	3	Coniferous forests; fall.
Cortinarius wiebeae	–	S/M*	–	3	Coniferous forests; fall.
Gymnopilus punctifolius	–	S/M*	–	3	Coniferous or deciduous forest; fall.

Scientific Name Common Name	USFWS Status[1]	USFS/ BLM Status[2]	ODA Status[3]	ONHP List[4]	Habitat Conditions/Flowering Time
Mycena quinaultensis	–	S/M*	–	3	Fall.
Octavianina macrospora	–	S/M*	–	3	Coniferous forests; fall.
Phaeocollybia oregonensis	–	S/M*	–	3	Coniferous forests; fall.
Polyozellus multiplex	–	S/M	–	–	Coniferous forest; fall.
Ramaria gelantinaurantia	–	S/M*	–	3	Coniferous forests; fall.
Ramaria stuntzii	–	S/M*	–	3	Coniferous forests; fall.
Sarcosoma mexicana	–	S/M	–	–	Late summer, fall.
Sowerbyella rhenana	–	S/M	–	3	Coniferous forests; fall.
Tricholomopsis fulvescens	–	S/M*	–	3	Decaying conifer wood above 3,280 ft (1,000 m); fall.

[1] U.S. Fish and Wildlife Service (USFWS) Status:
T: Threatened.
SoC: Species of concern; formerly Category 2 candidate for listing; species needs additional information to support a proposal to list as threatened or endangered under the Endangered Species Act (ESA), not protected under the ESA.

[2] U.S. Forest Service/Bureau of Land Management (USFS/BLM) Status:
USFS Sensitive: Listed as Sensitive in the Mt. Hood National Forest, Region 6 Forester's List (1999).
BLM Sensitive: Listed as Sensitive in the Salem District.
BLM Assess: Listed as Assessment species in the Salem District.
S/M: Listed as a Survey and Manage Species under the Northwest Forest Plan (1994);
(*; S/M Species that do not require specific surveys, but should be documented if found).

[3] Oregon Department of Agriculture (ODA) Status:
Candidates: taxa for which there is sufficient information to support a proposal to list as threatened or endangered.

[4] Oregon Natural Heritage Program (ONHP) List (ONHP 1998):
List 1: Taxa that are threatened with extinction or presumed to be extinct throughout their entire range.
List 2: Taxa that are threatened with extirpation or presumed to be extirpated from Oregon, but are more stable elsewhere
List 3: Taxa for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.
List 4: Taxa of concern that are not currently threatened or endangered and taxa that are declining but are still too common to be proposed for listing.
ex: presumed to be extirpated or extinct.

A preliminary target list of exotic/invasive plant species was prepared by consulting the ODA and the Clackamas County Soil and Water Conservation District (SWCD). The ODA maintains a state list of noxious weeds, and the SWCD maintains a list of noxious weeds for Clackamas County. The target exotic/invasive plant list was finalized after consultation with the resource agencies (Appendix B) and included 30 species.

After compiling the final target TES, S/M, and exotic/invasive species list, Project botanists reviewed the morphological characteristics of target species to develop a search image that improves detection and recognition abilities. This process included reviewing herbarium specimens and collecting information on vegetative, floral, and fruit characteristics for each target species and other taxa that are closely related or otherwise difficult to distinguish from the target species. In addition, survey protocols for S/M species were reviewed.

2. Field Surveys

Field surveys for TES, S/M, and exotic/invasive plants were conducted during August 16-20, 1999 and May 31 – June 2, 2000; surveys for S/M fungi species were conducted on USFS and BLM land on November 8-10, 1999 when conditions were more favorable for these species. The optimum survey time for target TES and S/M species was estimated using published literature, herbarium specimen records, and consultation with USFS botanists. Special consideration was given to annual weather variations (temperature and rainfall) and to elevation differences in the study area. In addition, searches for S/M species were conducted during the course of other field studies including riparian habitat sampling, amphibian surveys, and S/M amphibian and mollusk surveys.

Vegetation in the study area was mapped from aerial photographs taken in 1998 (Tressler, 2000). Based on the vegetation maps and the habitat requirements of target species, areas with a high probability of occurrence of TES and S/M species were mapped. Areas with a high probability of supporting TES and S/M species received 100 percent visual coverage. Areas with low probability of supporting TES and S/M species were surveyed incidentally (e.g., when traveling across these areas to reach high probability habitats). In some instances, close inspection of potential TES and S/M species habitat was difficult because of factors such as terrain and private property access issues. Rock outcrops, bluffs, and steep canyons were difficult to reach safely on foot. In these areas, binoculars were used to aid in plant identification. S/M species were surveyed only on USFS and BLM lands in the study area.

Searches for exotic/invasive plants were conducted throughout the study area with an emphasis on sites currently disturbed or likely to be disturbed from Project decommissioning activities. Specific plant infestation locations were mapped.

Where possible, exotic/invasive plant populations were mapped as polygons, but there also were sites identified as points or linear features because of the mapping scale. Exotic/invasive plant densities were estimated per square yard and placed in one of four categories (trace-0.5; 0.6-5; 6-20; >20/sq yd [trace-0.4; 0.5-4; 5-17; >17/sq m]).

All field surveys were conducted by a two-person team. Both the lead and assistant botanists were experienced in identifying target TES, S/M, and exotic/invasive plants and knowledgeable of the study area. The team carried maps, hand lenses, and floristic keys. For the most part, surveys were conducted using the random meander approach (Nelson 1985) in areas with a high probability of supporting target species. This approach requires that the field team use professional judgment and intuition to guide the search in a non-systematic manner.

3. Documentation/Mapping

Observations of TES, S/M, and exotic/invasive plants were recorded and mapped on Project base maps, aerial photographs, and/or topographic maps. Distance and bearing to a nearby landmark were also recorded in the field. This information was entered into the geographic information system (GIS) database for the Project. Data on habitat, slope, aspect, elevation, soils, and associated species were collected for each TES and S/M plant species occurrence using a Rare Plant Survey Form provided by ONHP (Appendix C). Factors affecting survival of TES and S/M species (e.g., deer browse, fire, etc.) were noted as applicable.

Population sizes for TES and S/M species were visually estimated (for large populations) or counted (for small populations). For large TES and S/M plant populations (and with agency permission), a voucher specimen was collected, pressed, and dried for deposition at the OSU Herbarium. Where collection posed a risk to the population, photographs were taken to allow verification by taxonomic specialists.

Because information on locations of TES and S/M is confidential, this report does not include maps or descriptions of specific locations for these species. Location data have been provided to ONHP for their records and to the USFS and BLM. Maps of exotic/invasive plant infestations are provided (see Section 4.0).

4.0 RESULTS

Results of the various survey efforts for TES, S/M, and exotic/invasive species in the vicinity of the Bull Run Project are described in the following sections.

1. TES and S/M Species

One TES vascular plant species, one lichen species, and one fungi species were found at several locations in the study area. The only vascular plant found in the study area was lesser bladderwort (*Utricularia minor*). Lesser bladderwort was initially included on the preliminary target list (Table 3-1) but was removed at the suggestion of USFS because it was thought that it was unlikely to occur in the project vicinity. Lesser bladderwort was located in a shallow cove on the south side of Rosyln Lake in about 4 in. (10.2 cm) of water in a mixed herbaceous/scrub-shrub wetland characterized by spike rush (*Juncus effusus*), Douglas spirea (*Spirea douglasii*), and skunk cabbage (*Lysichiton americanum*). Lesser bladderwort is a small aquatic herb with emergent flower stalks. This species is usually submerged in still or slowly moving water (Hitchcock and Cronquist 1973; Cooke 1997). It is an ONHP List 2 species (ONHP 1998) known in Oregon from Clackamas, Jackson, Baker, Coos, Douglas, Klamath, Washington, and Lane counties (ONHP 1998).

Pseudocyphellaria rainierensis is a thallose, foliose lichen that is pale green with a whitish or light brown lower surface (McCune and Geiser 1997). This species was observed at one location on BLM land on the south side of the Sandy River, just downstream from Marmot Dam. This lichen occurs in the western Cascades from southern British Columbia to Oregon. It is most often restricted to moist old-growth forests at mid- to lower elevations, but is rarely found in younger forests (McCune and Geiser 1997; Sillett 1997). *P. rainieresis* usually is found on bark and wood of conifers often overgrowing moss mats in the lower to mid canopy. Distribution is generally quite patchy even when suitable habitat is present, suggesting a weak dispersal capacity (McCune and Geiser 1977). It is listed as a S/M species requiring Survey Strategies 1, 2, and 3 under the Northwest Forest Plan (USFS and BLM 1994). These designations require that known sites be managed, (Strategy 1); that surveys be conducted prior to ground disturbing activities (Strategy 2); and that extensive surveys be conducted to find high priority sites for species management (Strategy 3) (USFS and BLM 1994). *P. rainierensis* known in Oregon from Clackamas, Lane, Lincoln, Linn Marion, Polk, and Tillimook counties (Castellano et al. 1999).

Otidea onotica is a fungus that is known from 23 sites in Washington and Oregon including Clackamas County (Custellano et al. 1999). This fungus was not on the preliminary target species list (Table 3-1) because it does not require surveys prior to land-disturbing activity but should be noted if observed (USFS and BLM 1994). It is a short spoon to ear-shaped fungus that is taller than broad, and pale yellow with touches of pink-apricot to rose. *O. onotica* was found at three locations in the study area near Marmot Dam. Two sites were on BLM land on the south side of the Sandy River downstream of the dam; the third site was on the north side of the Sandy River north of the cleared parking area adjacent to the dam. Under the Northwest Forest Plan, *O. onotica* is listed as a S/M species requiring Survey Strategy 3, and as a Protection Buffer species.

Recommendations for Protection Buffer species include maintaining a database of known sites and developing species or area management plans.

2. Invasive and Exotic Plants

Fifteen species of noxious weeds and non-native plants were found in the Bull Run study area (Table 4-1 and Figure 4-1). Infestations were primarily associated with disturbed areas around Project facilities, roads, or recreation sites. Several of these plants were not on the target list of invasive/exotic species but are introduced species known to colonize disturbed sites. The following narrative describes the observed infestations by species and provides some background information on the ecology of these plants.

a. Bouncingbet

Bouncingbet (*Saponaria officinalis*) is a perennial in the pink family (*Caryophyllacae*) that was introduced from Europe as a garden plant and is now escaped and established as a weed. The plant spreads rapidly and can replace native plant species (Whitson et al. 1996). In the Bull Run study area, bouncingbet occurs in areas that are disturbed by human use or on islands that are scoured by high flows. It was not on the target list of invasive/exotic species. Bouncingbet occurs in small patches (<12 sq yd [10 sq m]) and in low densities (Figure 3-1) on sandy islands and on the shoreline in the Sandy River bypass reach. It has a scattered distribution in the study area and does not occur in large patches.

b. Bull Thistle

Bull thistle (*Cirsium vulgare*) is a spiny biennial herb that grows up to 5 ft (1.5 m) tall, with many spreading branches. Bull thistle is a native of Eurasia and is widely established in North America, often introduced as a seed contaminant. It is a highly competitive weed found in pastures, roadsides, and disturbed sites (Whitson et al 1996). In the study area it occurs on the south side of the canal that carries water from the Marmot Dam flume to the tunnel that leads to the Little Sandy diversion. Bull thistle occurs at low densities but is widely scattered along the south side of the canal. This is a highly disturbed area that also hosts Canada thistle (*C. arvense*) and Himalayan blackberry (*Rubus discolor*).

c. Canada Thistle

Canada thistle is a colony-forming perennial that forms deep and extensive horizontal roots. Stems are from 1 to 4 ft (0.3-1.2m) tall. Canada thistle is

Table 4-1: General location of exotic/invasive plants in the Bull Run Hydroelectric Project study area.

Species	Marmot Dam Area				Little Sandy Area				Bull Run Area		
	Marmot Dam & Reservoir	Marmot Dam Access Rd	Sandy R. Bypass Reach	Marmot Flume & Canal	Little Sandy Diversion	Little Sandy Diversion Access Rd	Little Sandy R. Bypass Reach	Little Sandy Flume	Bull Run R. Bypass Reach	Rosyln Lake	Powerhouse Vicinity & T-Line ROW
Bouncing bet *Saponaria officinalis*			X								
Bull thistle[B] *Cirsium vulgare*				X							
Canada thistle[B] *Cirsium arvense*	X			X	X	X					
Common tansy *Tanacetum vulgare*		X									
English ivy *Hedera helix*			X							X	
Evergreen blackberry *Rubus laciniatus*										X	
Giant knotweed[B] *Polygonum sachalinese*			X								X
Himalayan knotweed[B] *Polygonum polystachyum*											X
Himalayan blackberry *Rubus discolor*	X		X	X	X		X	X		X	X
Policeman's helmet *Impatiens glandulifera*	X		X								
Robert's geranium *Geranium robertianum*	X		X				X				
St. John's-wort[B] *Hypericum perforatum*	X		X		X		X	X			X
Scot's broom[B] *Cytisus scoparius*	X		X		X		X	X			X
Tansy ragwort[B] *Senecio jacobea*	X									X	
Trailing blackberry *Rubus ursinus*	X							X	X		

[B] 'B' designated weed – weeds of economic importance which are regionally abundant, but which may have limited distribution.

[T] Target weed – a priority noxious weed designated by the State Weed Board as a target weed species on which the ODA will implement at statewide management plan.

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a native of southeastern Eurasia that was introduced to Canada as a contaminant of crop seed as early as the 18th century. It is an aggressive weed that is difficult to control; breaking up the roots by plowing only serves to increase the number of plants (Nuzzo 1997). Canada thistle occurs in several areas of the study area including the Marmot dam reservoir, along the Sandy flume and canal, and near the Little Sandy diversion and its access road. The largest infestations are along the Sandy Canal and a small patch (<12 sq yd [10 sq m]) on the Little Sandy diversion access road.

d. Evergreen Blackberry

Evergreen blackberry (*Rubus laciniantus*) is an escaped and naturalized Eurasian species found from British Columbia to California, primarily on the west side of the Cascades. It is a pioneering species of disturbed upland sites that prefers bright sun and is intolerant of deep shade (Cooke 1997). Evergreen blackberry infestations were observed at two locations in the study area adjacent to Rosyln Lake. One site was located at the edge of the lake near the day use parking lot, and the second is near the outfall of the Little Sandy flume.

e. Himalayan Blackberry

Himalayan blackberry is a non-native species commonly found in the Pacific Northwest. It is a native to Asia and was introduced to the United States from England (Pojar and MacKinnon 1994). The species tends to form dense, impenetrable walls that shade native ground cover and can tolerate a wide range of moisture regimes. Himalayan blackberry occurs throughout the study area with prominent infestations at Marmot Dam, along the Sandy Canal, at Rosyln Lake, near the Bull Run powerhouse, and along the transmission line corridor.

f. Trailing Blackberry

Trailing blackberry (*Rubus ursinus*) is a native species that often forms dense mats of vines on the ground. It occurs throughout the study area at low densities but forms dense infestations at only a few locations. It was found near Marmot Dam, along the Little Sandy Canal, and in the Bull Run bypass reach. It does not appear to pose a significant weed problem.

g. Scot's Broom

Scot's broom (*Cytisus scoparius*) is native to central and southern Europe and the British Isles, and is well established in the Pacific Northwest on well-drained sites over a wide range of precipitation regimes (Hitchock and Cronquist 1973). The success of Scot's Broom is due to its tolerance of a wide range of soil conditions, its ability to fix nitrogen and grow for

most of the year given adequate precipitation and mild climate, and its abundant production of long-lasting viable seeds (Hoshovsky 1998). It is a woody perennial in the pea family that grows to 10 ft (3 m) and often pioneers disturbed sites. Scot's broom can be controlled through hand, mechanical, or chemical methods. It occurs at several locations in the study area, but there is one particularly dense infestation on a broad bench along the diverted reach of the Little Sandy River. Other locations in the study area are small (<12 sq yd [10 sq m]) and widely scattered.

h. Robert's Geranium

Robert's geranium (*Geranium robertianum*) is a native of Eurasia and is a common forest weed found throughout western Washington and Oregon. It is a native of Eurasia (Hitchcock and Cronquist 1973). Robert's geranium is widely distributed in the study area but most often occurs as scattered individual plants. It was commonly observed in all forested habitat but was mapped as infestations in only three general areas of the Project: near Marmot Dam, along the Sandy River bypass reach, and along the Little Sandy River bypass reach. It is an upland species and was found above the ordinary high water mark and not within the riparian zone.

i. English Ivy

English ivy (*Hedera helix*) is a European vine that is widely used as an ornamental species throughout North America (Hitchcock and Cronquist, 1973). It often naturalizes and can form dense mats that prohibit the growth of native herbaceous species. English ivy infestations occur at two locations in the study area. The first is at Dodge Park along the bypass reach of the Sandy River, and the second is in a forest on the south side of Rosyln Lake. While it is dense (>20 plants/sq yd [17/sq m]) at these locations it is not widespread in the study area.

j. St. John's-wort

St. John's-wort (*Hypericum perforatum*) is a common weed native to Europe that is often found on sandy or gravelly soils in the Pacific Northwest. It is a perennial that reproduces by seeds or by short runners with stems that are 1 to 3 ft (0.3 to 0.9 m) tall (Whitson et al. 1996). It is generally found at low densities (<0.5 plants/sq yd [0.4/sq m]) throughout the study area, but dense patches occur on disturbed sites near Marmot Dam and along the Sandy River downstream of the dam, near the Little Sandy Diversion Dam, and along the Little Sandy wooden-box flume and bypass reach.

k. Policeman's Helmet

Policeman's helmet (*Impatiens glandulifera*) is an Asiatic ornamental that has been found in British Columbia, western Washington, and western Oregon (Hitchcock and Cronquist 1973). Although this species is not on the Oregon Noxious Weed List and was not on the target weed list for the study area, it is considered extremely invasive, particularly in moist lowland areas (Washington State Noxious Weed Control Board 2000). It is listed as a 'Class B designate' noxious weed in Washington, meaning it is designated for control by state law. It is considered to be controllable in Washington because its distribution is still somewhat limited (Washington State Noxious Weed Control Board 2000).

Policemen's helmet was observed at two locations in the Bull Run study area—on a sandbar on the north side of the Sandy River just upstream from Marmot Dam, and adjacent to the Sandy River about 300 yd (274 m) downstream of the dam. The downstream location is along a small drainage adjacent to the fish holding pond. Both locations support dense stands of policeman's helmet, with greater than 20 plants/sq yd (17/sq m).

l. Giant Knotweed

Giant knotweed (*Polygonum sachalinese*) is an Asiatic native that is used as an ornamental and has become an aggressive weed west of the Cascades (Hitchcock and Cronquist 1973). Knotweed was first noticed along the Sandy River as recently as 1996. It can grow up to 12 ft (3.6m) tall and generally spreads when roots are moved by floods or in contaminated soil (The Nature Conservancy of Oregon. No date).

In the study area, giant knotweed occurs in the following locations: (1) about 0.25 mile (0.4 km) downstream of Marmot Dam; (2) on the north side of the Bull Run River adjacent to the downstream side of the bridge that crosses the river immediately upstream of the powerhouse; (3) adjacent to a spoils deposit site on the southeast corner of the Bull Run Road and Waterworks Road; and (4) at Dodge Park. The patch of giant knotweed at Dodge Park is small, less than 1 sq yd (0.9 sq m); the infestations at the other locations vary from about 3.5 to 11 sq yds (3 to 9 sq m). PGE has initiated control efforts at the spoils deposit site and the site adjacent to the bridge over the Bull Run River.

m. Himalayan Knotweed

Himalayan knotweed (*Polygonum polystachyum*) is an introduced species from Asia that has become established in several areas of the Pacific Northwest. It is smaller that giant knotweed but is an aggressive weed that can become an invasive problem (Pojar and MacKinnon 1994). Himalayan knotweed was found at one location on the north side of

Waterworks Road, about 50 yards (46 m) east of the intersection with Bull Run Road.

n. Tansy Ragwort

Tansy ragwort (*Senecio jacobea*) is a biennial or short-lived perennial from a taproot that can reach a length of 6 ft (1.8 m) (Whitson et al. 1996). Tansy ragwort is native to Europe and is widespread in Washington, Oregon, and California. It occurs in the study area on disturbed soils near Marmot Dam and Rosyln Lake. Densities of tansy ragwort at these locations are relatively low, between 0.6 and 5 plants/sq yd (0.5 – 4.1/sq m).

o. Common Tansy

Common tansy (*Tanacetum vulgare*) is an aromatic perennial that can grow to 6 ft (Whitson et al. 1996). It is a native of Europe and is established in the United States where it was introduced as an ornamental and for medicinal purposes. It is a common weed of disturbed sites, roadsides, and pastures. Common tansy occurs in the study area along the Marmot Dam access road. This road shoulder is regularly mowed, which may limit the spread of common tansy.

5.0 MANAGEMENT RECOMMENDATIONS

Most exotic/invasive species in the study area are scattered, and infestations generally occur at low densities and do not pose a significant risk of spreading to adjacent land. There are, however, several species that because of their aggressive growth habit, pose a significant risk of invading other areas. The giant knotweed and Himalayan knotweed infestations near the Bull Run powerhouse and near Marmot Dam should be vigorously controlled. A combination of cutting and application of herbicide has proved successful in knotweed control (Seiger 1991). Policeman's helmet infestations that occur immediately upstream of Marmot Dam and near the fish holding pond downstream of the dam are localized and would be easy to control before they spread to other sites. The Scot's broom infestation on a bench along the Little Sandy River is the largest in the study area and should be removed to prevent its spread, particularly during deconstruction of the wooden flume. The last infestation that should be controlled is the common tansy that occurs along the Marmot Dam access road. Because traffic will increase along the road during facility removal, there is a risk that this species could spread. A program of cutting and herbicide application should be prepared and implemented.

6.0 LITERATURE CITED

Castellano, Michael A; J.E. Smith, T. O'Dell, E. Cazares, and S. Nugent 1999. Handbook to strategy 1 fungal taxa from the Northwest Forest Plan. Gen. Tech. Rep. PNW-GTR-476. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 195 p.

Cooke, S.S. 1997. A field guide to the common wetland plants of western Washington and northwestern Oregon. Seattle Audubon Society and Washington Native Plant Society, Seattle, WA.

Hitchcock, C.L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle, WA.

Hoshovsky, M. 1998. Element stewardship abstract for *Cytisus scoparius* and *Genista monspessulanus*. The Nature Conservancy, Arlington, Va.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR.

Nelson, J.R. 1985. Rare plant survey techniques for impact assessment. Pages 159-166 *In* Thomas S. Elias (ed.). Conservation and management of rare and endangered plants. Proceedings of a conference of the California Native Plant Society. Sacramento, California.

Nuzzo, V. 1997. Element stewardship abstract for *Cirsium arvense*. The Nature Conservancy, Arlington, VA.

ONHP (Oregon Natural Heritage Program). 1998. Rare, threatened, and endangered plants and animals of Oregon. Oregon Natural Heritage Program. Portland, Oregon.

Pojar, J. and A. MacKinnon. 1994. Plants of the Pacific Northwest coast. Lone Pine Publishing, Redmond, WA.

Seiger, L. 1991. Element stewardship abstract for *Polygonum cuspitdatum*. The Nature Conservancy, Arlington VA.

Sillett, S.C. 1997. Pp 254-260 *In*: Conservation and management of native plants and fungi. T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke, and M.V. Wilson (ed.). Native Plant Society of Oregon, Corvallis, Oregon. 1997.

Tressler, R. 2000. Plant Associations of the Bull Run Project Area, EDAW, Inc.

The Nature Conservancy of Oregon. No date. Japanese knotweed.

USFS (U.S. Forest Service) and BLM (Bureau of Land Management). 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the Northern Spotted Owl; Standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. U.S. Department of Agriculture, Forest Service, and U.S. Department of the Interior, Bureau of Land Management. April 1994. Portland, Oregon.

USFWS (U.S. Fish and Wildlife Service). 1991. Sensitive plant species list for Region 6.

Washington State Noxious Weed Control Board. 2000 Information about policeman's helmet. www/wa.gov/agr/weedboard/weed_info/policehelmit.html.

Whitson, T.D., L.C. Burrill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R.D. Lee, and Robert Parker. 1996. Weeds of the West. The Western Society of Weed Science in cooperation with the Western United States Land Grant Universities Cooperative Extension Services.

APPENDIX A

PRELIMINARY LIST OF SPECIAL STATUS PLANT SPECIES KNOWN OR SUSPECTED TO OCCUR IN THE BULL RUN STUDY AREA

Appendix A - Species listed by ONHP as occurring in Clackamas County, Oregon

	ONHP List[1]	ODA Status[2]	USFWS Status[3]
Vascular Plants			
Agoseris elata	2	-	-
Agrostis humilis	3	-	-
Arabis furcata	4	-	-
Aster curtus	1	LT	SoC
Aster gormanii	1	-	SoC
Botrychium lanceolatum	2	-	-
Botrychium minganense	2	-	-
Botrychium montanum	2	-	-
Botrychium pinnatum	2	-	-
Calamagrostis breweri	2	-	-
Carex livida	2	-	-
Castilleja rupicola	2	-	-
Cimicifuga elata	1	C	SoC
Collomia larsenii	4	-	-
Delphinium leucophaeum	1	LE	SoC
Delphinium pavonaceum	1	LE	SoC
Delphinium nuttallii	2	-	-
Douglasia laevigata	3	-	-
Epilobium luteum	3	-	-
Erigeron cascadensis	4	-	-
Erigeron howellii	1	C	SoC
Eriophorum polystachion	4	-	-
Euonymus occidentalis	4	-	-
Fritillaria camschatcensis	2	-	-
Howellia aquatilis	1-ex	-	LT
Huperzia occidentalis	4	-	-
Lycopodium complanatum	2	-	-
Lycopodiella inundata	2	-	-
Montia diffusa	2	-	-
Montia howellii	1	C	SoC
Rhynchospora alba	3	-	-
Scheuchzeria palustris	2	-	-
Sisyrinchium sarmentosum	1	C	SoC
Streptopus streptopoides	2	-	-
Sullivantia oregana	1	C	SoC
Tauschia stricklandii	2	-	-
Utricularia minor	2	-	-
Verbana hastata	3	-	-
Bryophytes			
Anthelia julacea	3	-	-
Calypogeia sphagnicola	2	-	-
Mosses			
Brachydontium olympicum	2	-	-
Bruchia bolanderi	2	-	-
Polytrichum sexangulare	3	-	-
Scouleria marginata	2	-	-
Tayloria serrata	2	-	-
Tetraphis geniculata	2	-	-

Appendix A - Species listed by ONHP as occurring in Clackamas County, Oregon

	ONHP List[1]	ODA Status[2]	USFWS Status[3]
Lichens			
Bryoria spiralifera	2	-	-
Pseudocyphellaria rainierensis	3	-	-
Tholurna dissimilis	3	-	-
Fungi			
Albatrellus caeruleoporus	3	-	-
Alpova alexsmithii	3	-	-
Amanita novinupta	3	-	-
Armillaria viscidipes	3	-	-
Brauniellula albipes	3	-	-
Bridgeoporus nobilissimus	1	-	-
Choiromyces alveolatus	3	-	-
Clitocybe subditopoda	3	-	-
Cortinarius boulderensis	3	-	-
Cortinarius wiebeae	3	-	-
Gymnopilus punctifolius	3	-	-
Hebeloma occidentale	3	-	-
Hygrophorus albicarneus	3	-	-
Hygrophorus albiflavus	3	-	-
Lyophyllum acutipes	3	-	-
Lyophyllum furfurellum	3	-	-
Lyophyllum lubricum	3	-	-
Lyophyllum soldipes	3	-	-
Mycena quinaultensis	3	-	-
Octavianina macrospora	3	-	-
Omphalina isabellina	3	-	-
Phaeocollybia oregonensis	3	-	-
Ramaria gelatinaurantia	3	-	-
Ramaria stuntzii	3	-	-
Rhizopogon clavitisporus	3	-	-
Rhizopogon masonae	3	-	-
Rhizopogon rogersii	3	-	-
Sowerbyella rhenana	3	-	-
Squamanita paradoxa	3	-	-
Stephensia bynumii	3	-	-
Tricholomopsis fulvescens	3	-	-

[1] Oregon Natural Heritage Program (ONHP) List:

List 1: Taxa that are threatened with extinction or presumed to be extinct throughout their entire range.

List 2: Taxa that are threatened with extirpation or presumed to be extirpated from Oregon, but are more stable elsewhere.

List 3: Taxa for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.

List 4: Taxa of concern that are not currently threatened or endangered and taxa that are declining but are still too common to be proposed for listing.

ex = presumed extirpated or extinct.

[2] Oregon Department of Agriculture (ODA) Status:

C- Candidates-taxa for which there is sufficient information to support a proposal to list as threatened or endangered; LE - Listed Endangered; LT - Listed Threatened.

[3] U.S. Fish and Wildlife Service (USFWS) Status:

SoC: Species of concern; formerly Category 2 candidate for listing; species needs additional information to support a proposal to list as threatened or endangered under the Endangered Species Act (ESA); not protected under the ESA.

APPENDIX B

PRELIMINARY LIST OF EXOTIC/INVASIVE PLANT SPECIES IN THE BULL RUN STUDY AREA

Appendix B - Potential exotic/invasive plant species in the Bull Run study area.

Common Name	Scientific Name	Oregon State Noxious Weed Designation[1]
Ragweed	*Ambrosia artemisiifolia*	B
Purple starthistle	*Centaurea calcitrapa*	A
Diffuse knapweed	*Centaurea diffusa*	B
Spotted knapweed	*Centaurea maculosa*	B
Meadow knapweed	*Centaurea pratensis*	B
Russian knapweed	*Centaurea repens*	B
Yellow starthistle	*Centaurea solstitalis*	B
Canada thistle	*Cirsium arvense*	B
Bull thistle	*Cirsium vulgare*	B
Poison hemlock	*Conium maculatum*	B
Field bindweed	*Convolvulus arvensis*	B
Houndstongue	*Cynoglossum officinale*	B
Scot's broom	*Cytisus scoparius*	B
South American waterweed	*Elodea densa*	B
Quackgrass	*Elytrigia repens* =*Agropyron repens*	B
Robert's geranium	*Geranium robertianum*	*
English ivy	*Hedera helix*	*
St. John's-wort	*Hypericum perforatum*	B
Dalmation toadflax	*Linaria dalmatica*	B
Yellow toadflax	*Linaria vulgare*	B
Purple loosestrife	*Lythrum salicaria*	B
Japanese knotweed	*Polygonum cuspidatum*	B
Giant knotweed	*Polygonum sachalinense*	B
Himalayan blackberry	*Rubus discolor*	*
Evergreen blackberry	*Rubus laciniatus*	*
Trailing blackberry	*Rubus ursinus*	*
Tansy ragwort	*Senecio jacobaea*	B, T
Johnsongrass	*Sorghum halepense*	B
Gorse	*Ulex aruopaeus*	B, T
Spiny cocklebur	*Xanthium spinosum*	B

[1] State weed designation from the State of Oregon Noxious Weed List (1/1/96) from www.oda.state.or.us/Plant/noxiousweeds.html:

'A' designated weed – A weed of known economic importance which occurs in Oregon in small enough infestations to make eradication/containment possible; or is not known to occur, but its presence in neighboring states makes future occurrence in Oregon seem imminent.

'B' designated weed – A weed of economic importance which is regionally abundant, but which may have limited distribution in some counties.

T = Target weed – A priority noxious weed designated by the State Weed Board as a target weed species on which the ODA will implement a statewide management plan.

* - Species not classified as a noxious weed but judged to be a threat to biodiversity (pers. comm., M. Stein, Botanist, Mount Hood National Forest, July 15. 1999).

APPENDIX C

ONHP RARE PLANT SURVEY FORM

Oregon Natural Heritage Program / 821 SE 14th Avenue / Portland, Oregon 97214 / 503-731-3070 / fax 503-230-9639

Rare Plant Field Survey Form

Please complete all entries in the top section above the heavy line. Please complete as much as possible the more detailed section below the heavy line. You may use the back for comments or additional space. If possible, please attach a map of the location, preferably something of the same quality as a USGS 7.5' map.

Scientific Name: _____

Date of Field Work: _____ (mo. day year) County: _____ Collection: ____Yes (_____ coll #, herbarium), ____No

Directions: _____

_____

_____

Reporter: _____ Phone: _____

Address: _____

---

1. **LOCATION** - Attach separate map or sketch a map indicating exact site, scale and proximity to prominent features.
   - A. Is this a new location record? _____Yes _____No _____Unknown. Is this a subsequent visit? _____Yes _____No
   - B. Plant found? _____Yes _____No If no, reason: _____
   - C. Location: T_____ R_____ Sec_____ _____1/4 of _____1/4 (use back for more TRS)
   - D. Owner/Manager: _____
2. **SPECIES BIOLOGY**
   - A. Phenology: _____% in flower, _____% in fruit, _____% in leaf
   - B. Population size: Number of plants: _____ Area occupied: _____
   - C. Age Class: _____% seedlings, _____% immature, _____% 1st year, _____% mature, _____% senescent
3. **HABITAT**
   - A. Plant communities/Habitat Description: _____
   - B. Aspect: _____ (enter compass direction(s) or degrees)
   - C. Slope: _____slight (0°-20°), _____moderate (20°-45°), _____extreme (45°+), _____vertical
   - D. Topographic position: _____crest, _____upper slope, _____mid-slope, _____lower slope, _____bottom
   - E. Light: _____open, _____filtered, _____shade
   - F. Moisture: _____inundated, _____saturated, _____moist, _____dry
   - G. Elevation range: _____ to _____ (choose unit: feet or meters)
   - H. Substrate/soil: _____
   - I. Associated species: _____
   - J. Visible threats/potential disturbance: _____
4. **DETERMINATION** - How was plant identified? (choose one or more, please fill in the source for each choice)
   _____keyed in flora, _____compared with specimen, _____compared with photo/drawing,
   _____identified by someone else, _____other.
   Source (name of flora/which specimen/which drawing/name of identifier): _____
5. **PHOTOGRAPHS/SLIDES**
   Did you take a print or slide: _____Yes (specify which), _____No. May we obtain duplicates at our cost? _____Yes ____No

BULL RUN HYDROELECTRIC PROJECT

THREATENED, ENDANGERED, AND SENSITIVE (TES) AND SURVEY AND MANAGE (S/M) WILDLIFE

DRAFT REPORT

March 2001

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1.0 INTRODUCTION

Portland General Electric (PGE) is currently collecting information to support a surrender application and Applicant Prepared Environmental Assessment (APEA) to decommission the Bull Run Hydroelectric Project (FERC No. 477). The surrender application and APEA will address the effects of decommissioning on environmental resources in the Project vicinity. Consequently, PGE decided to conduct a number of field surveys in the Project vicinity to identify the occurrence of and habitat for threatened, endangered, and sensitive (TES) wildlife species and species designated as Survey and Manage (S/M) by the Northwest Forest Plan (U.S. Forest Service [USFS] and Bureau of Land Management [BLM] 1994). The results of this study will be used in the APEA to: (1) describe the existing TES and S/M wildlife associated with the Project; (2) estimate the direct and indirect effects of Project decommissioning on TES and S/M wildlife (Issue W1, as identified in meetings of the Terrestrial Resources Sub-Committee); (3) assess the potential effects of reestablishment of natural flows and hydrology on wetland- and riparian-dependent TES and S/M species that occur in the bypass reaches (Issue T2); and (4) identify potential protection, mitigation, and restoration measures where necessary.

2.0 STUDY AREA

The Bull Run Hydroelectric Project is located northeast of the city of Sandy, Oregon, on the Sandy, Little Sandy, and Bull Run rivers (Figure 2-1). Elevations within the FERC Project boundary range from approximately 400 to 750 ft (122 to 229 m) above sea level. The area is within the western Cascades physiographic province and the western hemlock (*Tsuga heterophylla*) vegetation zone (Franklin and Dyrness 1988). This zone is characterized by a wet, mild, maritime climate. Rainfall in the Project vicinity ranges between 70 and 80 in. (178 and 203 cm) per year (Halverson et al. 1986). Land ownership in the study area is a combination of USFS, BLM, and private.

The Bull Run Hydroelectric Project includes two diversion dams—Marmot Dam and the Little Sandy Diversion Dam, on the Sandy and Little Sandy rivers, respectively (Figure 2-2). Water is diverted from these two rivers through a complex system of canals, tunnels, and flumes, and routed to Roslyn Lake, the Project forebay. From the forebay, flow is delivered to the Bull Run powerhouse through the penstocks. The diverted water is returned to the Bull Run River after passing through the powerhouse.

The study area for TES wildlife species surveys included the following:

- Lands within the current FERC Project boundary, including the transmission line right-of-way (ROW);
- Riparian and wetland habitat along the Sandy River from approximately 3 mi (4.8 km) upstream of the Marmot Dam downstream to the confluence with the Bull Run River;
- Riparian and wetland habitat along the Little Sandy River from 1 mi (1.6 km) upstream of the Little Sandy Diversion Dam downstream to the confluence with the Bull Run River;
- Riparian and wetland habitat along the Bull Run River from the confluence with the Little Sandy River downstream to the confluence with the Sandy River; and
- All PGE-owned lands in the Project vicinity in the Sandy, Little Sandy, and Bull Run river drainages.

Surveys for S/M species and northern spotted owl (*Strix occidentalis caurina*), which is federally listed as threatened, were restricted to USFS and BLM lands in the Project vicinity.

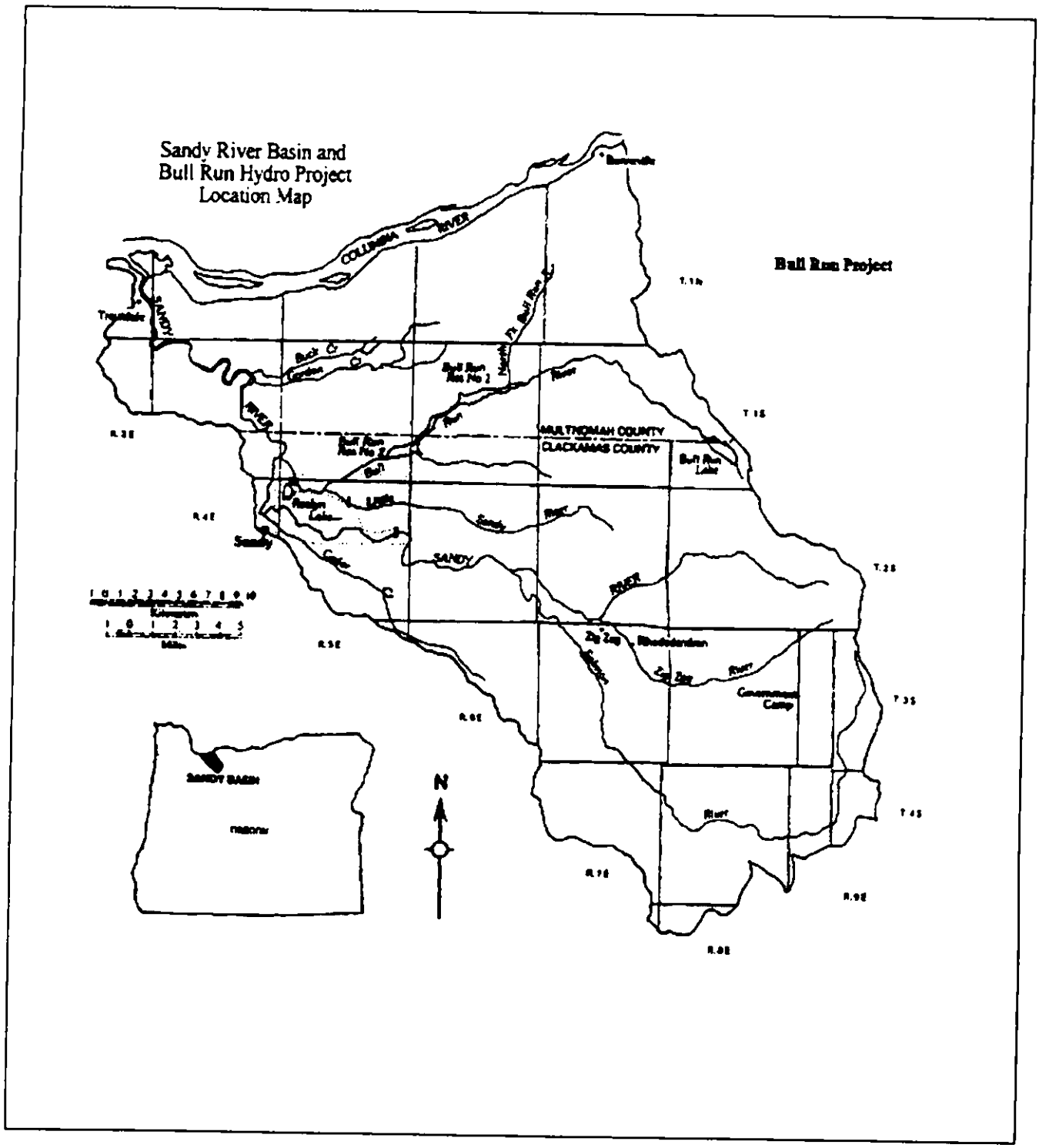

Figure 2-1. Bull Run Hydroelectric Project study area.

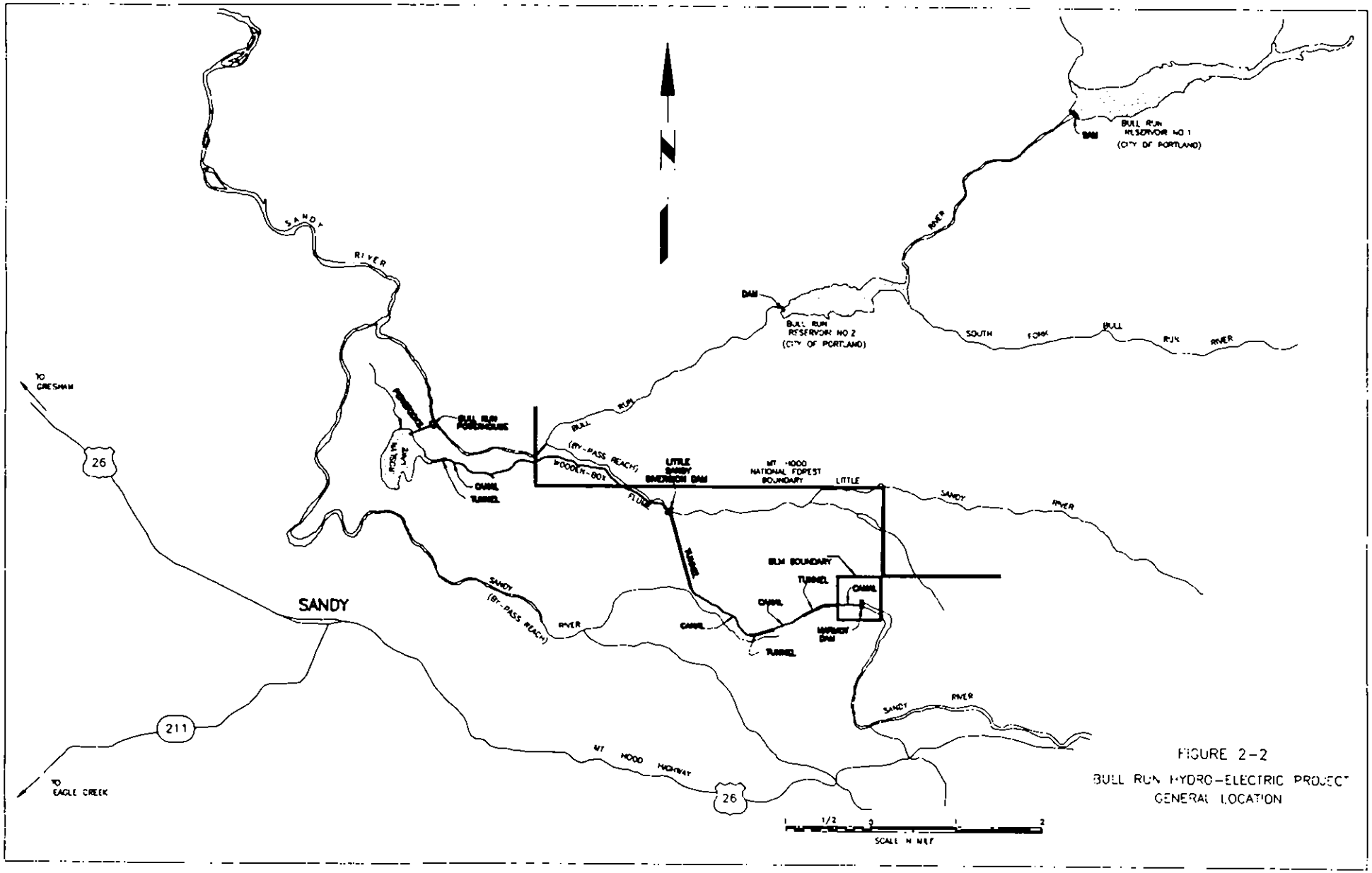

FIGURE 2-2
BULL RUN HYDRO-ELECTRIC PROJECT
GENERAL LOCATION

3.0 METHODS

The TES and S/M wildlife study involved the following tasks: (1) compile and review a target list of TES and S/M wildlife species; (2) acquire existing data on TES and S/M species that potentially occur in the study area; (3) conduct field surveys; and (4) document and map results. Each of these tasks is described below.

3.1 Compile Target TES and S/M Wildlife Species List

For this project, TES and S/M wildlife included all taxa listed at the federal or state level as threatened or endangered, all taxa that are candidates for federal or state listing, and any other species considered to be at risk of decline or in need of monitoring or protection. Specifically, TES and S/M wildlife include the following:

- Federally listed or proposed threatened and endangered species, which are protected by the Endangered Species Act of 1973 under the administration of the U.S. Fish and Wildlife Service (USFWS)
- State-listed species, which are protected by the Oregon Department of Fish and Wildlife (ODFW) under the state Endangered Species Act
- Species not granted special protection by federal or state law but considered of concern by the USFWS or by the Oregon Natural Heritage Program (ONHP)
- Species designated as S/M under the Northwest Forest Plan (USFS and BLM 1994)
- Species listed as sensitive by the USFS for Region 6 (2000)
- Species listed as special status/special attention by the BLM (1999) for the Cascade Regional Area (pers. comm., J. Irving, BLM, Salem, Oregon, August 19, 1999)

Agency consultation and literature review indicated that 58 TES vertebrate wildlife species occur or potentially occur in the vicinity of the Bull Run Project (Table 3-1). Of the species listed in Table 3-1, the ONHP has records of the following: (1) harlequin ducks (*Histronicus histronicus*) on the Sandy River between Marmot Dam and Revenue Bridge in the study area; (2) Oregon slender salamanders (*Batrachoseps wrighti*) at Bull Run Reservoir No. 2; (3) spotted owls northeast of the Little Sandy River Diversion; and (4) fringed myotis (*Myotis volans*) east of Marmot Dam (letter from T. Campos, Conservation Information Assistant, ONHP, Portland, June 15, 1999). Eleven S/M terrestrial mollusk species potentially occur in the study area (Table 3-2); surveys for 8 of these species are required on the Mount Hood National Forest (MHNF). Two S/M aquatic mollusks also potentially occur (Table 3-2).

3.2 Acquire Existing Data

The USFS and BLM were contacted to obtain maps of suitable spotted owl habitat. The only other data available were the ONHP data discussed in Section 3.1.

Table 3-1. Threatened, endangered, and sensitive and Survey and Manage vertebrate species potentially occurring in the Bull Run Hydroelectric Project Study Area.

Common Name *Scientific Name*	*USFWS Status*[1]	*BLM Status*[2]	*USFS Status*[3]	*ODFW Status*[4]	*ONHP List*[5]	*Habitat Requirements*[6]
Amphibians (8)						
Cope's Giant Salamander *Dicamptodon copei*	–	BA	Sens.	SU	2	Mountain streams
Cascade Torrent Salamander *Rhyacotriton cascadae*	–	BT	Sens.	SV	3	High gradient streams, seeps below 3,500 ft
Clouded Salamander *Aneides ferreus*	–	BT	–	SU	3	Douglas-fir forests up to 5,400 ft
Oregon Slender Salamander* *Batrachoseps wrighti*	–	BT	Sens.	SU	3	Second- and old-growth forests, under bark, or within termite channels of large logs and stumps
Larch Mountain Salamander *Plethodon larseli*	SoC	BS S/M	Sens. S/M	SV	2	Talus slopes, old-growth forests
Western Toad *Bufo boreas*	–	BT	–	SV	3	Ponds, lakes, wetlands
Tailed Frog *Ascaphus truei*	SoC	BS	–	SV	3	Clear, cold, rocky streams in humid forests of Douglas-fir, pine, spruce, maple, and alder
Northern Red-legged Frog *Rana aurora aurora*	SoC	BS	–	SU	3	Marshes, streams, lakes, reservoirs, and ponds (with cattails) up to 3,000 ft in elevation
Reptiles (3)						
Sharptail Snake *Contia tenuis*	–	–	–	SV	4	Riparian zones, meadows, Douglas-fir/vine maple forests
Northwestern Pond Turtle *Clemmys marmorata marmorata*	SoC	BS	Sens.	SC	2	Ponds, marshes, and rivers with rocky or muddy bottom with cattails or other shoreline vegetation
Painted Turtle *Chrysemys picta*	–	BS	Sens.	SC	2	Ponds, marshes, and rivers

Table 3-1. Threatened, endangered, and sensitive and Survey and Manage vertebrate species potentially occurring in the Bull Run Hydroelectric Project Study Area.

Common Name *Scientific Name*	*USFWS Status*[1]	*BLM Status*[2]	*USFS Status*[3]	*ODFW Status*[4]	*ONHP List*[5]	*Habitat Requirements*[6]
Birds (34)						
Common Loon *Gavia immer*	–	–	–	–	2-ex	Large lakes
Horned Grebe *Podiceps auritus*	–	–	Sens.	SP	4	Lakes, ponds
Red-necked Grebe *Podiceps grisegena*	–	–	Sens.	SC	2	Shallow lakes
Eared Grebe *Podiceps nigricollis*	–	–	–	–	–	Lakes
Greater Yellowlegs *Tringa melanoleuca*	–	–	–	-	4	Nests in tundra; winters on coastal marshes and inland lakes
Solitary Sandpiper *Tringa solitaria*	–	–	–	–	4	Along streams, lakes, wetlands
Trumpeter Swan *Cygnus buccinator*	SoC	–	–	–	–	Lakes, large rivers
Harlequin Duck* *Histronicus histronicus*	SoC	BS	Sens.	SU	2	Swift streams
Barrow's Goldeneye *Bucephala islandica*	–	–	–	SU	4	Open lakes and small ponds with adjacent forests or woodlands with large trees to provide nest cavities
Bufflehead *Bucephala albeola*	–	–	Sens.	SP	2	Open lakes and small ponds with adjacent forests or woodlands with large trees to provide nest cavities
Bald Eagle[7] *Haliaeetus leucocephalus*	T	–	F	T	1	Nests in mostly conifer forest with some old growth within 1 mile of water; winters near concentrated food source
Peregrine Falcon *Falco peregrinus anatum*	–	–	Sens.	E	1	Nests on ledges located on sheer cliffs >150-ft tall close to water

Table 3-1. Threatened, endangered, and sensitive and Survey and Manage vertebrate species potentially occurring in the Bull Run Hydroelectric Project Study Area.

Common Name *Scientific Name*	*USFWS Status*[1]	*BLM Status*[2]	*USFS Status*[3]	*ODFW Status*[4]	*ONHP List*[5]	*Habitat Requirements*[6]
Northern Goshawk *Accipiter gentilis*	SoC	BS	–	SC	3	Dense conifer-dominated mixed woodlands
Merlin *Falco columbarius*	–	–	–	–	2-ex	Winters in a variety of habitats
Boreal Owl *Aegolius funerous*	–		–	SU	3	Dense conifer forests
Spotted Owl* *Strix occidentalis caurina*	T	–	Sens.	T	1	Primarily in mature and old-growth forests below 4,000 ft
Northern Pygmy Owl *Glaucidium gnoma*	–	–	–	SC	4	Dense woodlands in foothills and mountains
Common Nighthawk *Chordeiles minor*	–	BS	–	SC	4	Open woodlands, suburbs, towns
Mountain Quail *Oreortyx pictus*	-	–	–	SU	4	Brushy ravines, mountain slopes
Lewis' Woodpecker *Melanerpes lewis*	–	BS	–	SC	3	Open woodlands of interior foothills and valleys
Williamson's Sapsucker *Sphyrapicus thyroideus*	–	–	-	SU	3	Dry pine forests
Black-backed Woodpecker *Picoides arcticus*	-	BS	–	SC	4	Conifer forests, often in burned-over areas
Three-toed Woodpecker *Picoides tridactylus*	–	–	–	SC	4	Conifer forests, often in burned-over areas
Pileated Woodpecker *Dryocopus pileatus*	–	BT	–	SV	4	Mature forests; becoming common in second-growth forests

Table 3-1. Threatened, endangered, and sensitive and Survey and Manage vertebrate species potentially occurring in the Bull Run Hydroelectric Project Study Area.

Common Name *Scientific Name*	*USFWS Status*[1]	*BLM Status*[2]	*USFS Status*[3]	*ODFW Status*[4]	*ONHP List*[5]	*Habitat Requirements*[6]
Olive-sided Flycatcher *Contopus cooperi*	SoC	BS	–	SV	3	Conifer forests
Little Willow Flycatcher *Epidonax traillii brewsterii*	SoC	BS	–	SV	3	Mountain meadows, riparian zones; brushy pastures, hawthorn
Purple Martin *Progne subis*	–	BS	–	SC	3	Nests in woodland cavities
Horned Lark *Eremophila alpestris strigata*	–	BS	–	SC	3	Dirt fields, gravel ridges
Yellow-breasted Chat *Icteria virens*	–	–	–	SC	4	Dense thickets
Western Meadowlark *Sturnella neglecta*	–	BS	–	SC	4	Fields and meadows
Oregon Vesper Sparrow *Pooecetes gramineus affinis*	–	BS	Sens.	SC	3	Open grassland, farmland, forest clearings
Western Bluebird *Sialia mexicana*	–	BT	–	SV	4	Open woodlands, orchards, farmlands
Pine Grosbeak *Pinicola emucleator*	–	–	–	–	3	Open conifer forests; winters in deciduous woods, orchards
Tri-colored Blackbird *Agelaius tricolor*	SoC	–	Sens.	SP	2	Wet meadows, rangelands
Mammals (13)						
Baird's Shrew *Sorex bairdii permiliensis.*	–	–	Sens.	–	–	Conifer and deciduous forests
Long-eared Myotis *Myotis evotis*	SoC	BS/B	–	SU	4	Thinly forested areas, near buildings or trees; caves

Table 3-1. Threatened, endangered, and sensitive and Survey and Manage vertebrate species potentially occurring in the Bull Run Hydroelectric Project Study Area.

Common Name *Scientific Name*	*USFWS Status*[1]	*BLM Status*[2]	*USFS Status*[3]	*ODFW Status*[4]	*ONHP List*[5]	*Habitat Requirements*[6]
Fringed Myotis* *Myotis thysanodes*	SoC	BS/B	Sens.	SV	3	Open conifer forest, riparian areas
Long-legged Myotis *Myotis volans*	SoC	BS/B	–	SU	4	Buildings; crevices in rock ledges, conifer forest
Yuma Myotis *Myotis yumanensis*	SoC	BS	–	–	4	Douglas-fir forest, riparian areas, tunnels, or buildings
Silver-haired Bat *Lasionyctris noctivagans*	–	BT/B	–	SU	3	Conifer forest, caves, mine tunnels, buildings for roosts
Pacific Western Big-eared Bat *Corynorhinus townsendii townsendii*	SoC	BS/B	–	SC	3	Caves, mine tunnels, buildings for roosts
White-footed Vole *Arborimus = Phenacomys albipes*	SoC	BS	–	SU	3	Dense forests, near small streams
Red Tree Vole *Phenacomys longicaudus* ssp.	–	S/M	S/M	–	–	Riparian and conifer forest
Western Gray Squirrel *Sciurus griseus*	–	–	–	SU	3	Oak and open conifer forests
American Marten *Martes americana*	–	BT	–	SV	3	Conifer forest, riparian areas
Pacific Fisher *Martes pennanti*	SoC	-	Sens.	SC	2	Mature, closed-canopy forests often near riparian areas
California Wolverine *Gulo gulo*	SoC	–	Sens.	T	2	Open forests typically at higher elevations

[1] **USFWS Status**: **E** - (Listed Endangered) taxa which are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range; **T** - (Listed Threatened) taxa likely to become endangered within the foreseeable future; **SoC**-Species of Concern.

[2] **BLM Status** (pers. comm., J. Irving, BLM, Salem, Oregon, August 19, 1999): **BS** = Sensitive; **BT** = Tracking; **B** = Record of Decision (ROD) buffer or extra protection species; **S/M** - Survey and Manage species (USFS and BLM 1994).

[3] **USFS Status**: **Sens.** - Updated USFS Region 6 Forester's Sensitive Animal List (USFS 2000). **S/M** - Survey and Manage species (USFS and BLM 1994).

[4] **ODFW Status** (ONHP 1998): **T** (Threatened) – species likely to become endangered within the foreseeable future; **SC** - (Sensitive Critical) species for which listing as threatened or endangered is pending; or those for which listing as threatened or endangered may be appropriate if immediate conservation actions are not taken; **SV** - (Sensitive Vulnerable) species for which listing as threatened or endangered is not believed to be imminent and can be avoided through continued or expanded use of adequate protective measures and monitoring; **SP** - (Sensitive Peripheral or Naturally Rare) peripheral species refer to those whose Oregon populations are on the edge of their range; naturally rare species are those which had low population numbers historically in Oregon because of naturally limiting factors; maintaining the status quo for the habitats and populations of these species is a minimum requirement; **SU** - (Sensitive Undetermined Status) species for which status is unclear.

[5] **ONHP List** (ONHP 1998): **List 1**-contains taxa that are threatened with extinction or presumed to be extinct throughout their entire range; it is largely consistent with the Listed, Category 1 and 2 species from the USFWS. **List 2**-contains taxa that are threatened with extirpation or presumed to be extirpated from the State of Oregon. **List 3**-contains species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range. **List 4**-contains taxa which are of concern, but are not currently threatened or endangered. **ex** - presumed extirpated.

[6] **Sources**: letter from T. Campos, Conservation Data Assistant, ONHP, Portland, Oregon, June 15, 1999; pers. comm., J. Irving, BLM, Salem, Oregon, August 19, 1999.

[7] Currently proposed for removal from the list of threatened and endangered species (64 FR 36453-36464).

• Confirmed record in or near study area (letter from T. Campos, Conservation Data Assistant, ONHP, Portland, Oregon, June 15, 1999).

Table 3-2. Terrestrial and aquatic mollusks on the USFS/BLM Survey and Manage List that potentially occur in the vicinity of the Bull Run Hydroelectric Project.

Common Name (*Scientific Name*)	*Status in 2000*[1]	*Current Status*[2]
Terrestrial Species		
Puget Oregonian *(Cryptomastix devia)*	2	1A
Columbia oregonian (*C. hendersoni*)	1	1A
Oregon megomphix (*Megomphix hemphilli*)*	2	1A
Dalles sideband (*Monadenia fidelis minor*)	1	1A
Crater Lake tightcoil (*Pristiloma arcticum crateris*)	2	1B
Evening fieldslug (*Deroceras hesperium*)	2	1B
Warty jumping-slug (*Hemphillia glandulosa*)	2	1C
Malone jumping-slug (*H. malonei*)*	3	1C
Panther jumping-slug (*H. Pantherina*)	1	1C
Blue-grey tail-dropper (*Prophysaon coeruleum*)	2	Removed
Papillose tail-dropper (*P. dubium*)	2	Removed
Aquatic Species		
Columbia duskysnail (*Lyogyrus* n. Sp. 1)	2	1A
Basalt juga (*Juga [Oreobasis]* n. Sp. 2)	2	1A

[1] **Source**: Terrestrial Mollusk Survey Protocol, October 29, 1997 (Furnish et al. 1997a and 1997b).
1 = May occur, but not expected. Know these species in case they are encountered.
2 = Suspected to occur. Surveys required.
3 = Known to occur in vicinity. Surveys required.

[2] **Source**: (USFS and BLM 2000)
1A = Manage all known sites, conduct pre-disturbance and strategic surveys.
1B = Manage all known sites, pre-disturbance surveys not practical. Conduct strategic surveys.
1C = Manage high-priority sites, conduct pre-disturbance and strategic surveys.

* BLM known occurrence within 3 miles upstream (pers. comm., J. Irving, BLM, Salem, Oregon, August 19, 1999).

3.3 Field Surveys

Five types of field surveys for TES and S/M wildlife were conducted in the Bull Run study area: (1) fall 1999 and spring 2000 amphibian surveys in potential habitat, (2) early spring 2000 amphibian egg mass surveys, (3) terrestrial and aquatic S/M mollusk surveys, (4) spotted owl surveys, and (5) incidental bird and mammal observations during the July-August vegetation mapping and riparian zone characterization field work and other field activities. Data recorded for each TES and S/M species observed during surveys included: date, weather conditions, species, location, life stage (egg mass, larvae, juvenile, adult), general habitat, specific habitat, and comments (see field form in Appendix A). Locations of TES and S/M species were plotted on aerial photographs and topographic maps. Identification relied on Storm and Leonard (1995), Leonard et al. (1993), Corkran and Thoms (1996), and Nussbaum et al. (1983). The following sections describe the various survey tasks.

3.3.1 TES and S/M Amphibian Surveys

Surveys for TES and S/M amphibian species were conducted during the fall of 1999 and spring of 2000 in habitats with a high probability of supporting these species and likely to be affected by Project decommissioning. Areas likely to provide suitable habitat for TES and S/M amphibians included the following:

- The Project diversion impoundments and associated wetland and riparian habitats;
- Roslyn Lake and associated riparian and wetland habitats;
- The bypass reaches of the Bull Run, Little Sandy, and Sandy rivers and associated riparian and wetland habitats;
- Seeps and talus along the wooden-box flumes and canals; and
- The steep, forested areas on BLM and USFS land surrounding Marmot Dam and along the wooden-box flume downstream of the Little Sandy Diversion Dam.

Teams of two biologists conducted all amphibian surveys during November 9-12, 1999 and April 4-6 and 24-25, 2000 when substrate and air moisture levels and temperatures were sufficiently high to observe amphibians, and to meet the survey protocol requirements for the Larch Mountain salamander (*Plethodon larseli*) (Subgroup 1996). The following sections describe the methods used to survey for amphibians in aquatic and terrestrial habitats.

- Aquatic Habitats–In aquatic systems (streams and ponds), area- and time-constrained surveys were used to search shoreline and riparian habitats. Surveys involved: (1) searching the edges and shallow water zones for amphibians; and (2) when appropriate, turning rocks, litter, and debris in and near streams to find adult and larval amphibians (Corkran and Thoms 1996; Bury and Corn 1991). Shoreline plots were 33 x 16 ft (10 x 5 m) in size and extended from the water's edge upslope for approximately 16 ft (5 m). Each waterfall, rock/talus slope, and seep encountered near the streams during the surveys was searched completely. These habitat features have a relatively high probability of supporting Cascade torrent salamanders (*Rhyacotriton cascadae*) and tailed frogs (*Ascaphus truei*) and warrant special emphasis (Subgroup 1996; pers. comm., C. Crisafulli, Research Biologist, USFS, Amboy, Washington, 20 February 1997). Habitat features that were too large to survey completely were examined for approximately 0.5 person-hours, with the area covered documented on field forms. Only sites that could be safely accessed were surveyed.

- Terrestrial Habitats–Surveys for terrestrial TES and S/M amphibians involved searching under rocks, bark, leaf litter, and logs (Corn and Bury 1990). Surveys in talus and forested habitat on the USFS and BLM lands were conducted in 164 x 33 ft (50 x 10 m) belt transects using the protocol for Larch Mountain salamanders (Crisafulli 1999). This protocol requires a minimum of three survey visits at a site to conclude species absence.

3.3.2 Amphibian Egg Mass Surveys

An efficient method for determining presence of pond-breeding amphibians, such as red-legged frogs (*Rana aurora aurora*) and western toads (*Bufo boreas*), is a visual search for egg masses (Thoms et al. 1997). Frogs and toads typically congregate and deposit egg masses in ponds or still water in late winter to mid-spring (Corkran and Thoms 1996; Leonard et al. 1993; Nussbaum et al. 1983; Olson and Leonard 1997). Searches for egg masses were conducted in wetlands and ponds in the study area on April 4-6 and 24-25, 2000. Egg masses and larvae were identified following Corkran and Thoms (1996). Sites were revisited if initial observations indicated no evidence of breeding activity.

3.3.3 Survey and Manage Mollusk Surveys

Surveys for S/M terrestrial mollusk species (Table 3-2) were conducted on USFS and BLM land within the FERC Project boundary on January 31-February 1, 2000 and February 23-25, 2000. The surveys were conducted by contractors highly experienced in identifying mollusks using the protocol established by the USFS and BLM (Furnish et al. 1997a). Additional observations of mollusks were recorded incidentally during amphibian surveys.

Surveys for aquatic S/M mollusks were conducted August 29 – 30, 2000. These surveys consisted of using the USFS/BLM protocol (Furnish et al. 1997b) to search 1 m^2 plots along transects up- and downstream of Marmot Dam along the Sandy River and in small seeps on BLM ownership, and along the bypass reach of the Little Sandy River on USFS lands.

3.3.4 Spotted Owl Surveys

Spotted owl surveys were conducted to determine presence/absence on USFS and BLM land near Marmot Dam and along the wooden-box flume downstream of Little Sandy Diversion Dam. These surveys followed the protocol established by the USFS (USFS 1988). Four call stations were used during this study: one located on the ridge near the southern border of the BLM property south of Marmot Dam, two along the PGE project road on the north side of the river just downstream and just upstream of Marmot Dam, and one along the wooden-box flume on near the middle of suitable habitat on the USFS land (Figure 3-1). Surveys were conducted six times between April and July: April 4 and 24, May 18, June 1-2 and 27, and July 26.

3.3.5 Other Observations

All TES and S/M wildlife species and their sign detected incidental to vegetation cover type mapping and riparian zone characterization field work in July and August 1999 were noted on aerial photos and maps. Incidental to all other surveys, biologists looked for TES and S/M mammal species and their sign. A special effort was made to document any cave entrances, cliffs, and snag-rich forest stands, as these habitats represent potential habitat for several amphibian, bird, and bat species on the TES and S/M lists. Biologists examined sections of the elevated wooden-box flume and other Project-related structures for evidence of bat roosting during the spring and fall 1999 field work.

Pond/lake shoreline habitats were qualitatively assessed for turtle habitat (e.g., presence of cover and basking logs). Northwestern pond turtle (*Clemmys marmorata marmorata*) surveys were conducted at the Marmot Dam and Little Sandy Diversion Dam impoundments, and at Roslyn Lake incidental to the July and August field visits. During these surveys, biologists used binoculars to search shorelines and basking logs in the lakes for turtles. To increase the probability of observing TES reptiles during these field trips, biologists also looked under cover objects.

LARGE-FORMAT IMAGES

One or more large-format images (over 8 ½" X 11") go here.
These images are available in FERRIS at:

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File Date: 5-21-03 Docket No.: P-477

Parent Accession No.: 030523-0118

Set No.: 1 of 1

Number of page(s) in set: 1

3.4 Analysis and Reporting

Survey effort and observation data were entered into a database using Excel software. Data were summarized and locations plotted using Arc/View geographic information system (GIS) software.

4.0 RESULTS AND DISCUSSION

The following sections summarize the result of the various TES and S/M wildlife surveys conducted in the Bull Run Hydroelectric Project study area.

4.1 TES and S/M Amphibian Surveys

The November 1999 and April 2000 amphibian and reptile surveys included the following:

- Two surveys of aquatic habitat in the bypass reach of the Little Sandy and Sandy rivers
- Two surveys of seeps along the canal and wooden-box flume and wetlands near Project structures
- Three surveys to meet the Larch Mountain salamander survey protocol on BLM and USFS land near Marmot Dam and downslope of the wooden-box flume

Three TES amphibian species were documented in the Bull Run study area—the Cascade torrent salamander, Oregon slender salamander, and red-legged frog (Table 4-1).

- **Cascade torrent salamander**—Cascade torrent salamanders were found in the following locations: (1) a seep in the splash zone immediately downstream of the Marmot Dam on BLM land, (2) a forested wetland/seep on the hillside southwest of Marmot Dam on BLM land, (3) several wetlands near the wooden-box flume, and (4) along the lower Bull Run River. All of these locations included only small patches of suitable habitat but supported both adult and larval individuals.

- **Oregon slender salamander**—Oregon slender salamanders were found in uplands on USFS property downslope of the wooden-box flume and on BLM land south of Marmot Dam. Along the wooden-box flume, one Oregon slender salamander was noted under loose bark near downed logs on a steep north-facing slope. The forest in this area was composed of large diameter Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), and western redcedar (*Thuja plicata*). Thirteen Oregon slender salamanders were found during the late April survey of the uplands to the south of Marmot Dam. These individuals were associated with large Douglas-fir logs on the north-facing slope. One other Oregon slender salamander was found immediately south of the dam during the February S/M terrestrial mollusk surveys.

- **Northern red-legged frog**—Adult red-legged frogs were seen along the shoreline of Roslyn Lake, in seeps associated with the wooden-box flume, and in a forested wetland to the east of Roslyn Lake. The forests along Roslyn Lake and elsewhere in the study area provide abundant habitat for adult red-legged frogs, while the small wetlands and ponds provide habitat for egg deposition and larvae development (see Section 4.2 for additional information on breeding evidence).

Table 4-1. Summary of amphibian and reptile observations in the Bull Run Hydroelectric Project study area.

Date	Location	Plots[1]	Survey Time (hr:min)	Species	No. Individuals	Life Stage	Habitat[2]
November 8-12, 1999	Bull Run River-Upstream of Powerhouse	5	2:12	None	--	--	--
	Bull Run River-Downstream of Powerhouse	3	1:20	Dunn's salamander	3	adult	RUS/RD
				Cascade torrent salamander	1	adult	RUS
				Rough-skinned newt	1	adult	RUS
	Sandy River-Upstream of Marmot Dam	3	1:00	None			
	Sandy River-Downstream of Marmot Dam	5	2:58	Dunn's salamander	1	adult	RUS/RD
				Cascade torrent salamander	2	adult	RUS/RD
				Rough-skinned newt	1	adult	RUS/RD
	Little Sandy River Downstream of Diversion Dam	7	1:35	Dunn's salamander	1	adult	RUS/RD
				Western redbacked salamander	2	adult	RUS/RD
				Rough-skinned newt	1	adult	RUS/RD
	Marmot Dam-Adjacent Uplands	7	3:59	Cascade torrent salamander	3	adult	Seep
				Cascade torrent salamander	1	juvenile	Seep
				Dunn's salamander	1	adult	Seep
				Rough-skinned newt	1	adult	MS
	Wooden-box Flume and Adjacent Uplands	44	11:00	Cascade torrent salamander	1	unk.	Seep
				Cascade torrent salamander	8	adult	Seep
				Western redbacked salamander	3	juvenile	RD
				Western redbacked salamander	3	adult	RD
				Northwestern salamander	1	adult	
				Dunn's salamander	5	adult	M/seep
				Red-legged frog	1	adult	Seep
				Chorus frog	1	adult	Seep
				Rough-skinned	1	adult	Seep

Table 4-1. Summary of amphibian and reptile observations in the Bull Run Hydroelectric Project study area.

Date	Location	Plots[1]	Survey Time (hr:min)	Species	No. Individuals	Life Stage	Habitat[2]
				newt			
	Roslyn Lake Shoreline and Adjacent Habitats	4	1:16	Red-legged frog	1	juvenile	RD
				Chorus frog	1	adult	RD
April 4-5, 2000	Marmot Dam-Uplands	6	3:11	Northwestern garter snake	1	adult	DST
				Cascade torrent salamander	2	juvenile	Seep
				Cascade torrent salamander	14	adult	Seep
				Rough-skinned newt	1	adult	MS
	Marmot Dam-Pool	1	0:19	Northwestern salamander	7	egg masses	RUS
				Rough-skinned newt	24	adult	RUS
	Roslyn Lake-Shoreline	2 (3,000 ft)	0:50	Red-legged frog	1	adult	LUB
				Northwestern salamander	2	egg masses	LUB
				Unidentified frog	1	adult	LUB
	Wetland east of Roslyn Lake	1	0:45	Red-legged frog	5	adult	PFO
				Red-legged frog	2	tadpoles	PFO
				Red-legged frog	23	egg masses	PFO
				Chorus frog	1	adult	PFO
				Northwestern salamander	7	egg masses	PFO
	Roslyn Lake Forested Wetland	1	0:20	Northwestern salamander	44	egg masses	PFO
				Northwestern salamander	1	adult	PFO
	Wooden-box Flume and Adjacent Habitats	4	2:00	Oregon slender salamander	1	adult	MS
April 24-25, 2000	Wooden-box Flume and Adjacent Habitats	4	1:30	Rough-skinned newt	2	adult	UM

Table 4-1. Summary of amphibian and reptile observations in the Bull Run Hydroelectric Project study area.

Date	Location	Plots[1]	Survey Time (hr:min)	Species	No. Individuals	Life Stage	Habitat[2]
				Dunn's salamander	1	adult	MS
				Ensatina	1	adult	MS
				Red-legged frog	2	adult	UM
	Marmot Dam-Uplands	6	2:40	Oregon slender salamander	13	adult	M

[1] plot size was 33 x 16 ft (10 x 5 m).

[2] RUS=riverine shoreline, RD=riparian deciduous, LUB=lacustrine unconsolidated bottom, PFO=palustrine forested wetland, M=mature conifer forest, MS=mid-successional conifer forest, UM=upland mixed forest, DST=disturbed, Seep=small wetland/seep.

4.2 Amphibian Egg Mass Surveys

The only location in the study area where red-legged frog egg masses or tadpoles were found was the forested wetland east of Roslyn Lake (Table 4-1). This wetland is not dependent on the Project for water, but its outlet does flow into Roslyn Lake. In April, 23 red-legged frog egg masses were recorded along with several northwestern salamander (*Ambystoma gracile*) egg masses, indicating extensive amphibian breeding. No TES amphibian egg masses were found in project impoundments, seeps under the leaking flume, or the bypass reach of the Little Sandy River.

Both the southern portion of Roslyn Lake and a small side channel associated with the Marmot Dam diversion had concentrations of rough-skinned newts (*Taricha granulosa*) and evidence (egg masses) of breeding by northwestern salamanders. In general, the water velocity in the pools behind Sandy and Little Sandy diversion dams is too high to provide suitable habitat for stillwater-breeding amphibians. It is unlikely that red-legged frogs use Roslyn Lake for substantial egg laying, as there are few sites in the lake that are protected from wave action and recreational boating. Northwestern salamander egg masses were also noted in the forested wetland and drainage ditch just west of Roslyn Lake.

The bypass reach of the Little Sandy River was surveyed for amphibian breeding activity. Although portions of the reach have very low flow, there does not appear to be adequate backwater area for pond breeding. No larval pond- or stream-dwelling amphibians were found in the Little Sandy River.

4.3 Survey and Manage Mollusk Surveys

Surveys for terrestrial mollusks documented three S/M species in the study area—the Oregon megomphix (*Megomphix hemphilli*), Malone's jumping-slug (*Hemphillia malonei*), and papillose tail-dropper (*Prophysaon dubium*) (Table 4-2, Appendix B). The first two species were found on both USFS and BLM lands; the papillose tail-dropper—a species that has since been eliminated from the S/M list (USFS and BLM 2000)—was found only on BLM land. In all, five and ten species of slugs and snails, respectively, were found during field surveys.

Table 4-2. Relative abundance of terrestrial mollusk species observed at the Bull Run Hydroelectric Project.

Species	Relative Abundance[b]			
	BLM land near Marmot Dam		USFS land along flume	
	Visit No. 1[c] (14 plots)	Visit No. 2[c] (15 plots)	Visit No. 1[c] (4 plots)	Visit No. 2[c] (4 plots)
Slugs				
Reticulate tail-dropper (*Prophysaon andersoni*)	low	moderate	--	moderate
Scarlet-back tail-dropper (*Prophysaon vanattae*)	--	low	--	--
Papillose tail-dropper (*Prophysaon dubium*)	--	low	--	--
Ariolimax columbianus	low	moderate	--	moderate
Malone's jumping-slug (Hemphillia malonei)[a]	low	--	--[d]	--[d]
Snails				
Forestsnail (*Allogona* sp.)	--	--	--[e]	--[e]
Beaded lancetooth (*Ancotrema sportella*)	high	high	high	high
Oregon lancetooth (*Ancotrema hybridum*)	low	moderate	low	moderate
Robust lancetooth (*Haplotrema vancouverense*)	high	high	high	high
Cryptomastix germana	moderate	moderate	moderate	moderate
Columbia Gorge Oregonian (*Cryptomastix hendersonii*)	--	--	--	moderate
Denticulate tightcoil (*Pristoloma lansingii*)	low	low	low	--
Striate tightcoil (*Pristoloma stearnsi*)	low	--	low	--
Pacific sideband (*Monadenia fidelis fidelis*)	--	high	--	high
Oregon Megomphix (*Megomphix hemphilli*)	--	high	--	high

[a] Bold type = Survey and Manage species (USFS and BLM 2000).

[b] abundance: low = 1-5 detections, moderate = 6-20, high >20.

[c] Visit No. 1--January 31-February 1, 2000; Visit No. 2--February 23-25, 2000.

[d] *Hemphillia malonei* observed on USFS land along Little Sandy River during amphibian surveys.

[e] *Allogona* sp. Noted on USFS land along flume during amphibian surveys.

Oregon megomphix were found at approximately two-thirds of the plots surveyed in the study area, both on BLM and USFS land. They were particularly common in leaf litter and in the soil near bigleaf maple (*Acer macrophyllum*) and swordfern (*Polystichum munitum*). This is the common habitat association for Oregon megomphix (BLM 1999). The Oregon megomphix has been found to be extremely common throughout the western Cascade Mountains in Oregon (pers. comm., O. Schumacher, Ecologist, Environmental Consultants Oregon, Corvallis, January 31, 2000).

During the terrestrial mollusk surveys, the Malone's jumping-slug was only found in one plot on BLM land. This plot was located in a forested wetland on the north-facing slope southwest of Marmot Dam. In addition, a single Malone's jumping-slug was found on the floodplain of the Little Sandy River on USFS land, incidental to amphibian surveys. Malone's jumping-slugs occur in moist to wet forests from the southern Puget Sound of Washington to west central Oregon (BLM 1999). Two papillose tail-droppers were found near Marmot Dam—one upstream of the dam and one downstream. Both were found on moss on a downed log. This is a widespread species that is strongly associated with hardwood logs and leaf litter (BLM 1999). The downstream site is in the floodplain and could be affected by dam removal.

No aquatic S/M mollusk species were found in the Bull Run study area. Species not on the USFS/BLM S/M list were noted in a number of locations with the exception of the Sandy River. No aquatic mollusks of any species were found in the Sandy River, either up- or downstream of Marmot Dam. It appears that the substrate immediately upstream of the dam is composed almost entirely of sand and silt and is not conducive for mollusks. A number of *Juga (juga) silicula* or *J. (juga) hemphilli* snails were found in a small seep and stream just northeast of the dam. Many *J. (juga) hemphilli* or *J. (juga) silicula* snails were found throughout the Little Sandy River. There were also a few individuals of *J. (juga) plicifera*. Voucher specimens of shells that we could not positively identify as species not on the USFS/BLM S/M list were examined by Tom Burke and Terry Frest, aquatic mollusk experts. Their examination confirmed that the shells were not S/M species and were most likely worn specimens of *J. (juga) hemphilli* (pers. comm. T. Burke, Ecologist, Wenatchee National Forest Research Lab, Wenatchee, Washington, February 3, 2001)

4.4 Spotted Owl Surveys

Spotted owl surveys were conducted following the USFS survey protocol on the BLM and USFS land in the study area. No spotted owls were detected during any of the six visits (Table 4-3).

Table 4-3. Bull Run spotted owl survey results from 2000 (start time/observations).

Date	Station (start time/observations)			
	South of Marmot Dam	Northeast of Marmot Dam	Northwest of Marmot Dam	USFS land along Flume
April 4	20:55/none	21:58/none	22:23/none	23:30/none
April 24	22:40/none	21:15/none	21:38/none	20:15/none
May 18	23:15/none	21:42/none	22:04/none	20:43/none
June 1 and 2	01:22/none	23:16/none	23:55/none	22:05/none
June 27	23:03/none	21:40/none	22:05/none	20:40/none
July 26	23:05/none	21:40/none	22:02/none	20:42/none

4.5 Other Observations

The bald eagle (*Haliaeetus leucocephalus*) and bufflehead (*Bucephala albeola*) were the only TES bird or mammal species detected in the study area during the 1999-2000 surveys; in addition, the pileated woodpecker (*Dryocopus pileatus*) has been observed in the study area incidentally by PGE biologists. Bald eagles were observed on several occasions during 1999 and 2000. Eagles were observed soaring over the area or perching at Roslyn Lake. It is possible that eagles forage for salmonids along the Sandy River, both up and downstream of Marmot Dam. Also, eagles likely forage occasionally for waterfowl and fish at Roslyn Lake. The Little Sandy River does not have accessible foraging habitat for bald eagles. Buffleheads were observed on Roslyn Lake on one occasion outside of the breeding season. There was no evidence of bufflehead breeding in the study area. Virtually all of the conifer, upland mixed, and riparian forests surrounding the project provide suitable habitat for pileated woodpeckers.

Project structures were examined for evidence of use by roosting bats. The underside of the wooden-box flume has wood beams with potentially suitable crevices for bat roosting. However, the moisture level is too high for bats to make use of the structures. No bats were observed

roosting under Revenue Bridge downstream of Marmot Dam or the pedestrian bridge that provides access to the south abutment of Marmot Dam.

Red tree vole (*Arborimus longicaudus*) surveys were not conducted because no suitable habitat would be affected by project decommissioning.

A list of bird and mammal species noted incidentally during field surveys covered in this report is provided in Appendix C.

Surveys of project impoundments conducted during the summer of 1999 failed to detect northwestern pond turtles or painted turtles (*Chrysemys picta*). The flow velocities through Marmot and Little Sandy Diversion dams is probably too high for these species, which both prefer ponds and slow-moving water. Roslyn Lake is unlikely habitat for turtles because of a combination of disturbance from recreationists during the spring and summer, and a lack of well-developed wetland habitat and basking sites. Much of the lake shoreline is composed of steep levees that support only a very narrow band of rushes (*Juncus* spp.) along the water's edge; only small sections along the southern shore have somewhat protected "bays" with good shoreline vegetation.

5.0 LITERATURE CITED

BLM (Bureau of Land Management). 1999. Field guide to survey and manage terrestrial mollusk species from the Northwest Forest Plan. Bureau of Land Management, Oregon State Office.

Bury, R.B. and P.S. Corn. 1991. Sampling methods for amphibians in streams in the Pacific Northwest. U.S.D.A. Forest Service, Gen. Tech. Rept. PNW-GTR-275.

Corkran, C.C. and C. Thoms. 1996. Amphibians of Oregon, Washington, and British Columbia: a field identification guide. Lone Pine Press. Edmonton, Alberta, Canada. 175pp.

Corn, P.S. and B. Bury. 1990. Sampling methods for terrestrial amphibians and reptiles. U.S. Forest Service General Tech. Rept. PNW-GTR-256.

Crisafulli, C.M. 1999. Survey Protocol for Larch Mountain Salamander *(Plethodon larselli)*. Chapter 7 In: Survey Protocols for amphibians under the Survey & Manage Provision of the Northwest Forest Plan. USFS and BLM. Version 3.0. October 1999.

Franklin, J.F. and C.T. Dyrness. 1988. Natural vegetation of Oregon and Washington. Oregon State Univ. Press, Corvallis. 452pp.

Furnish, J., T. Burke, T. Weasma, J. Applegarth, N. Duncan, R. Monthey, and D. Gowan. 1997a. Survey protocol for terrestrial mollusk species from the Northwest Forest Plan, Draft Version 2.0 (October 29, 1997). USFS and BLM.

Furnish, J., R. Monthey, and J. Applegarth. 1997b. Survey protocol for aquatic mollusk species from the Northwest Forest Plan, Draft Version 2.0 (October 29, 1997). USFS and BLM.

Halverson, N.M., C. Topik, and R. Van Vickle. 1986. Plant association and management guide for the western hemlock zone Mt. Hood National Forest. USDA Forest Service, Pacific Northwest Region. R6-ECOL-232A-1986.

Leonard, W.P., H.A. Brown, L.L .C. Jones, K.R. McAllister, and R.M. Storm. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle, Washington. 168pp.

Nussbaum, R.A., E.D. Brodie, Jr., and R.M. Storm. 1983. Amphibians and reptiles of the Pacific Northwest. Univ. of Idaho Press, Moscow. 332pp.

Olson, D.H. and W.P. Leonard. 1997. Amphibian inventory and monitoring: a standardized approach for the PNW. pp 1-22 In: D.H. Olson, W.P. Leonard, and R.B. Bury, editors, Sampling amphibians in lentic habitats. Northwest Fauna No. 4. Soc. Northwestern Vertebrate Biol. 134pp.

ONHP (Oregon Natural Heritage Program). 1998. Rare, threatened, and endangered species of Oregon. Portland, Oregon.

Storm, R.M. and W.P. Leonard (eds.). 1995. Reptiles of Washington and Oregon. Seattle Audubon Society, Seattle, Washington. 176pp.

Subgroup (Survey and Manage Amphibian Subgroup). 1996. Draft survey protocols for component/strategy 2 amphibians species. USDA Forest Service, Pacific Northwest Research Station.

Thoms, C., C.C. Corkran, and D.H. Olson. 1997. Basic amphibian survey for inventory and monitoring in lentic habitats. pp 47-54. In: D. H. Olson, W.P. Leonard, and R.B. Bury, eds. Sampling amphibians in lentic habitats: methods and approaches for the Pacific Northwest. Northwest Fauna No. 4. Society for Northwestern Vertebrate Biology. Olympia Washington. 134 pp.

USFS (U.S. Forest Service). 1988. Spotted owl inventory and monitoring handbook.

USFS. 2000. Updated Regional Forester's Sensitive Animal List. Region 6. Portland, Oregon. November 28, 2000.

USFS and BLM. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl.

USFS and BLM. 2000. Final Supplemental Environmental Impact Statement for Amendment to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines.

Appendix A

Wildlife Observation Data Form

PGE Westside Hydroelectric Project Wildlife Observation Form

Survey Type:

☐ Amphibian

☐ Mollusk

☐ Incidental Obs.

☐ Other _____

Date: _____

Start Time: _____

Stop Time: _____

General Survey Location: _____

Sampling Station: _____

Observer(s): _____

Cloud Cover: _____

Air Temp (°C): _____

Precipitation: _____

Sampling Station/ Location	Species Observed	Age/ Sex	Observation Type (I/S/T/A/E)	No. of Individuals/ Egg Masses	General Habitat Type	Specific Habitat Characteristics (Microsite Features)	Substrate	Water/ Substrate Temp. (°C)	Plot/Feature Description (Size, shape, etc.)

Comments:

WILDLIFE SURVEY FORM INSTRUCTIONS:

Start/ Stop Time:	Record in military time the survey time for stream as a whole (not survey points).
Sampling Station/ Location:	Record the location of the amphibian/reptile observation (e.g., river/creek name; distance from confluence or major landmark; Township, Range, Section).
Species Observed:	Record common name of species observed.
Age/Sex:	Age and Sex (if possible)
Observation Type:	I = individual, T = track, S = scat, E = egg, C = carcass, A = auditory
General Habitat Type:	Record the dominant habitat type of the species observation using habitat codes identified in the Cover Type Mapping Study. If the observation occurs at the edge of 2 or more habitat types, record both types (e.g., J/DST, J/PP, OW/RF).
Specific Habitat Characteristics:	Record a more detailed description of species habitat (e.g., found under log, in litter, under rocks, etc.).
Substrate/ Water Temperature:	Record, in Celcius, the water temperature at all amphibian sampling locations.
Substrate:	Record substrate of amphibian/mollusk observation: (1) bedrock; (2) boulders (>12"); (3) cobble (1-12"); (4) gravel (0.1-1"); (5) sand (>0.001"); and (6) fines (<0.001"). Log, Tree Trunk, etc.
Plot/Feature Description (Size, shape, ect)	Record descriptive information that make habitat or natura/man-made feature unique.
Comments:	Record any other pertinent information of the species observation.

Appendix B

Terrestrial Mollusk Survey Data

Overview; Bull Run Terrestrial Mollusk Survey's, Visit #1

Environmental Consultants Oregon, January 31, 2000 to February 01, 2000.

Summary;

Terrestrial mollusk surveys were conducted on January 31, 2000 and February 01, 2000 for the Bull Run and Marmot Dam project areas. Surveys were on both Salem, BLM and Mt. Hood National Forest lands, with surveys in accordance with survey and manage protocol version 2.0. A total of 18 S&M mollusk sites were located during the first survey visit. Thirteen of the known mollusk sites were *Megomphix hemphilli* sites with one site OCS-006 having both *Megomphix hemphilli* and *Hemphillia malonei* present. Other non-target species were detected during the first visit surveys, two slug species *Prophysaon andersoni* and *Ariolimax columbianus*, and numerous snail species including *Ancotrema sportella, Ancotream hybridum, Haplotrema vancouverense, Cryptomastix germana, Vespericola columbiana, Monadenia fidelis, Pristiloma lansingi* and *Pristiloma stearnsi*. These surveys were conducted relatively late in the season, yet the overall high number of detections and relatively warm temperatures dictated that many species of terrestrial mollusk were still very active and readily detectable. The second survey effort will take place during the spring season adhering with the current protocol objectives in order to develop a complete understanding of the terrestrial mollusk diversity within the defined project area. All sites have been mapped on 7.5min U.S.G.S topographic maps, with appropriate UTM coordinates and reference site numbers. All Known sites were flagged and marked with surveyor initials/plot numbers, date, project name and mollusk species detected. Overall detection rates for S&M species were high in the project area, reflecting what seemed to be very suitable habitat within the Bull Run project area

Bull Run Mollusk Surveys (PGE)

Species	present	absent	Density	Visit #
Snails				
Ancotrema sportella	x		high	1
Ancotrema hybridum	x		low	1
Haplotrema vancouverense	x		high	1
Vespericola columbiana	x		high	1
Cryptomastix germana	x		moderate	1
Monadenia fidelis	x		high	1
Megomphix hemphilli	x		moderate	1
Pristiloma lansingi	x		low	1
Pristiloma stearnsi	x		low	1
Cryptomastix devia		x		1
Slugs				
Ariolimax columbianus	x		low	1
Prophysaon andersoni	x		low	1
Prophysaon coeruleum		x		1
Prophysaon dubium		x		1
Prophysaon foliolatum		x		1
Prophysaon vanattae		x		1
Prophysaon obscurum		x		1
Hemphillia malonei	x		low	1
Bold type = Survey and Manage Species				
Absence recordings are only based on survey effort				
Density: Low (1-5) Mod. (5-20) High (20+)				
Environmental Consultants Oregon February 05, 2000				

S&M Fungi & Lichen Bull Run

Fungi Species	Detection #	UTM north	UTM east	Site #
Otidea onotica	1	5027436	567859	OCS-003
Otidea onotica	2	5027389	567596	OCS-006
Otidea onotica	3	5027677	567825	OCS-013
Lichen Species				
Psuedocyphilaria rainierensis	1	5027466	567518	OCS-012
All lichen and fungi species listed are survey and manage species				
Environmental Consultants Oregon February 05, 2000				

Mollusk Contract Data Base

Site Number	UTM-E	UTM-N	Month	Day	Year	PRCO	PRDU	MEHE	PRAR	HEMA	Plot/Point	Collector	Distrct	Proj Name	Visit #
OCS001	567960	5027404	1	31	2000			1			OCS001	O Schumacher	Salem BLM	Bull Run Marmot Dam	1
OCS003	567859	5027436	1	31	2000			1			OCS003	O Schumacher	Salem BLM	Bull Run Marmot Dam	1
OCS004	567792	5027422	1	31	2000			1			OCS004	O Schumacher	Salem BLM	Bull Run Marmot Dam	1
OCS006	567596	5027389	1	31	2000			1		1	OCS006	O Schumacher	Salem BLM	Bull Run Marmot Dam	1
OCS007	568007	5027447	2	1	2000			1			OCS007	O Schumacher	Mt Hood, USFS	Bull Run Flume	1
OCS008	563875	5029524	2	1	2000			1			OCS008	O Schumacher	Mt Hood, USFS	Bull Run Flume	1
OCS009	563714	5029595	1	31	2000			1			OCS009	O Schumacher	Salem BLM	Bull Run Marmot Dam	1
OCS010	567705	5027469	1	31	2000			1			OCS010	O Schumacher	Salem BLM	Bull Run Marmot Dam	1
OCS011	567671	5027464	1	31	2000			1			OCS011	O Schumacher	Salem BLM	Bull Run Marmot Dam	1
OCS012	567625	5027460	1	31	2000			1			OCS012	O Schumacher	Salem BLM	Bull Run Marmot Dam	1
OCS013	567837	5027646	1	31	2000			1			OCS013	O Schumacher	Salem BLM	Bull Run Marmot Dam	1
JEE303	568404	5027263	1	31	2000			1			JEE303	J Earp	Salem BLM	Bull Run Marmot Dam	1
JEE304	568227	5027397	1	31	2000			1			JEE304	J Earp	Salem BLM	Bull Run Marmot Dam	1
JEE305	568054	5027572	1	31	2000			1			JEE305	J Earp	Salem BLM	Bull Run Marmot Dam	1
JEE307	568343	5027458	1	31	2000			1			JEE307	J Earp	Salem BLM	Bull Run Marmot Dam	1
JEE510	562792	5030059	2	1	2000			1			JEE510	J Earp	Mt Hood, USFS	Bull Run Flume	1
JEE511	563298	5029867	2	1	2000			1			JEE511	J Earp	Mt Hood, USFS	Bull Run Flume	1
JEE512	568130	5027610	1	31	2000			1			JEE512	J Earp	Salem BLM	Bull Run Marmot Dam	1

Terrestrial Mollusk Species	Presence	High	Mod	Low	Visit #	Flume	Marmot dam
Slugs							
Prophysaon andersoni	x		x		2	x	x
Prophysaon coeruleum					2		
Prophysaon Vanattae	x			x	2		x
Prophysaon dubium	x			x	2		x
Prophysaon obscurum					2		
Ariolimax Columbianus	x		x		2	x	x
Hemphillia malonei							
Snails							
Ancotrema sportella	x	x			2	x	x
Ancotrema hybridum	x		x		2	x	x
Haplotrema vancouverense	x	x			2	x	x
Cryptomastix devia					2		
Cryptomastix germana	x		x		2	x	x
Cryptomastix hendersoni	x		x		2	x	
Pristiloma lansingii	x			x	2		x
Pristiloma arcticum crateris					2		
Monadenia fidelis	x	x			2	x	x
Megomphix hemphilli	x	x			2	x	x
Helminthoglypta hertleini					2		

Species List For Visit #2 on the Bull Run Project
PGE and Edaw Terrestrial Mollusk Surveys, February 23, 24, 25, 2000

Bold Type = Survey and Manage Species

Markers

Name: Ocs-021 Megomphix hemphilli
Short Name: cs021M
Coordinates: 10 568144 E, 5027430 N

Name: Ocs-022 Megomphix hemphillii
Short Name: cs022M
Coordinates: 10 568221 E, 5027373 N

Name: ocs-020 Megomphix Hemphilli
Short Name: cs020M
Coordinates: 10 568041 E, 5027433 N

Name: Ocs-024 Megomphix hemphilli
Short Name: cs024M
Coordinates: 10 568195 E, 5027300 N

Name: Ocs-025 No target species
Short Name: cs025N
Coordinates: 10 567897 E, 5027412 N

Name: Ocs-026 Megomphix hemphilli
Short Name: cs026M
Coordinates: 10 567740 E, 5027418 N

Name: Ocs-023 Prophysaon dubium
Short Name: cs023P
Coordinates: 10 568313 E, 5027336 N

Name: Ocs-028 No target species
Short Name: cs028N
Coordinates: 10 567424 E, 5027388 N

Name: Ocs-029 Megomphix hemphilli
Short Name: cs029M
Coordinates: 10 567291 E, 5027306 N

Name: Ocs-030 Megomphix hemphilli
Short Name: cs030M
Coordinates: 10 568227 E, 5027538 N

Name: Ocs-031 Megomphix hemphilli
Short Name: cs031M
Coordinates: 10 568073 E, 5027628 N

Name: Ocs-032 Megomphix hemphilli
Short Name: cs032M
Coordinates: 10 567741 E, 5027693 N

Name: Ocs-034 Prophysaon dubium
Short Name: cs034P
Coordinates: 10 567362 E, 5027502 N

Name: Ocs-027 Megomphix hemphilli
Short Name: cs027M

Coordinates: 10 567603 E, 5027363 N

Name: Ocs-033 No target species

Short Name: cs033N

Coordinates: 10 567492 E, 5027469 N

Appendix C

Reptile, Bird, and Mammal Species Noted Incidentally in Bull Run Study Area

REPTILES
Northwestern garter snake

BIRDS
American dipper
Belted kingfisher
Bewick's wren
Black-capped chickadee
Bufflehead
California gull
Canada goose
Chestnut-backed chickadee
Common flicker
Common merganser
Downy woodpecker
Golden-crowned kinglet
Great blue heron
Mallard
Northwestern crow
Pacific slope flycatcher
Red-tailed hawk
Ruffed grouse
Song sparrow
Spotted sandpiper
Spotted towhee
Steller's jay
Varied thrush
Vaux's swift
Winter wren

MAMMALS
Beaver
Black-tailed deer
Douglas squirrel
Ground squirrel