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Vegetation of the Snake River Corridor in Hells Canyon—Weiser, Idaho, to the Salmon River

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Technical Report
Appendix E.3.3-1

Hells Canyon Complex
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ABSTRACT

Field work for this study was conducted from 1994 through 1999 to characterize existing vegetation conditions along 163 river miles of the Snake River and associated reservoirs, from Weiser, Idaho, at river mile (RM) 351.2, downriver to the confluence of the Snake and Salmon rivers (RM 188.2), south of Lewiston, Idaho, and for 9.6 mi along the Powder River Arm of Brownlee Reservoir. The lateral extent of the study area generally encompassed all lands within 0.5 mi of each shoreline above Hells Canyon Dam (RM 247.5) and all lands within 0.25 mi of each shoreline below Hells Canyon Dam. Vegetation sampling efforts below Hells Canyon Dam were restricted because of the area's remoteness, steep topography, and logistical constraints.

Vegetation resources of the study area were assessed at two scales. At the first scale IPC staff and contractors developed a map of general vegetation, natural feature, and land use cover types. At the second scale, staff botanists field-inventoried randomly selected sites within vegetation cover types to describe the structural, botanical, edaphic, and other site characteristics of each vegetation cover type and the different plant assemblages (communities) occurring in each cover type. Descriptions were based on actual, current vegetation rather than theoretical climax (potential natural) vegetation.

Twenty-six vegetation, natural feature, and land use cover types were classified in approximately 48,354 ha in the study area (Table 4 and Figure 3). The most abundant upland vegetation cover type in the study area was *Grassland* (17,192 ha), followed by *Shrub Savanna* (10,154 ha) and *Shrubland* (3,195 ha). Tree-dominated upland vegetation cover types were infrequent in the study area. The least abundant upland vegetation cover types were *Desertic Woodland* (< 0.1 ha) and *Forested Upland* (72 ha). The most abundant riparian vegetation cover type in the study area was *Shore & Bottomland Wetland* (882 ha), followed closely by *Scrub-Shrub Wetland* (822 ha). The most abundant natural feature cover types were *Lotic* (moving water) (7,791 ha) and *Cliff/Talus Slope* (2,722 ha). The most abundant land use cover types were *Agriculture* (2,436 ha) and *Grazing Land/Pasture* (581 ha). Total area of each cover type occurring in the legal project boundaries for the Brownlee, Oxbow, and Hells Canyon hydroelectric projects and in each of five study reaches are presented (Tables 5 and 6, respectively).

Because relatively little was known about the riparian resources in the study area, compared with upland resources, this study did more sampling on riparian habitats. More than twice the number of transects were placed in riparian vegetation than in upland vegetation.

Sampling of upland vegetation was conducted using two approaches to sample different components of the system. The first sampling effort (River Corridor Upland Sampling), using a systematic random approach, investigated upland habitat near the Snake River. Using this approach, approximately 5% of upland habitats were sampled below Hells Canyon Dam, within 0.25 mi of the shoreline, and approximately 20% of upland habitats above the dam, within 0.5 mi of the shoreline.

The second effort (General Upland Sampling) obtained data from a broader area within the canyon and supported a study on avian communities and avian-habitat relationships (Turley and

Holthuijzen 2001). This second effort focused on large (> 1 ha), relatively homogenous stands of upland habitat throughout the study area, within about 2 mi of the Snake River.

Sampling of riparian vegetation resources was also conducted using two approaches to sample different components of the system. The first sampling effort (River Corridor Riparian Sampling), a systematic random approach, investigated general riparian habitat that was directly influenced by the project, namely, those habitats occurring along the reservoir and river shorelines associated with the water level fluctuation zone. This approach was used to sample approximately 10% of the shoreline habitat throughout the study area.

The second sampling effort (General Riparian Sampling) obtained data from a broader area within the canyon and to support a study on avian communities and avian-habitat relationships (Turley and Holthuijzen 2001). This second sampling effort focused on large stands of riparian habitat (> 30 m in diameter) that occurred in the study area, often above the confluence of smaller tributary drainages, within about 2 mi of the Snake River.

IPC staff botanists sampled a total of 1,245 vegetation transects in the field: 386 upland transects and 859 riparian transects. Based on plant cover of 4 physiognomic groups (trees, shrubs, forbs, and grass), upland vegetation transects were classified into 8 upland vegetation cover types, and riparian vegetation transects were classified into 4 riparian vegetation cover types (Table 3). Ordination analyses were used to group the transects within each cover type into 122 plant assemblages (50 upland, 72 riparian), which were described and listed (Appendices 2 and 3, Table 9). Hundreds of plant species were collected, labeled, and mounted. These voucher specimens are stored in Idaho Power Company's (IPC) Environmental Department herbarium and serve as a reference collection for managers and researchers.

Most of the plant assemblages identified in this study have not been previously described, especially those occurring in riparian habitats. This is probably explained by the limited sampling efforts of previous investigations in both riparian and upland habitats of the canyon and by a previous focus on particular species of interest or mid- to late-seral, native vegetation.

Distinct distribution patterns are evident for both cover types and plant assemblages throughout the study area. The distributions of the most common upland and riparian vegetation cover types are illustrated (Figures 5 and 6). Plant assemblage distributions are presented with each assemblage description (Appendices 2 and 3). Unique site factors, including hydrologic, geomorphic, climatic, and anthropogenic (e.g., disturbance from grazing, homesteading, mining, farming), create environmental gradients that likely explain these distribution patterns across the landscape. Three general patterns occur: 1) ubiquitous, 2) regional, and 3) localized. Examples of the environmental gradients and their influence on distribution patterns are described.

Several riparian plant assemblages were found to be unique to tributary drainages of the Snake River in the study area rather than the canyon bottom. Assemblages found almost exclusively in tributaries to the Snake River include those dominated by *Betula occidentalis*, *Alnus rhombifolia*, *Philadelphus lewisii*, *Populus tricocarpa*, *Salix alba*, and *Typha latifolia*. Sites dominated by *Prunus virginiana*, *Celtis reticulata*, *Scirpus maritimus*, and *Dipsacus sylvestris* were common to both Snake River and tributary riparian zones. For each plant assemblage, the total number of transects sampled and the portion of these transects sampled in tributary drainages (as opposed to

along shorelines of the Snake River and associated reservoirs) are indicated (Table 9). Generally, all other riparian plant assemblages described are characteristic of the Snake River riparian zone in the study area (see Appendix 3).

Many plant assemblages in the canyon are dominated by introduced weeds, including many species designated as *noxious weeds* by Idaho and Oregon. In upland habitats, common dominant species include *Bromus tectorum*, *Taeniatherum caput-medusae*, and *Poa bulbosa*. In riparian habitats, *Amorpha fruticosa*, *Tamarix parviflora*, *Lepidium latifolium*, *Lythrum salicaria*, and *Conium maculatum* are common dominant or codominant members in some of the most common plant assemblages in many cover types.

Most weedy riparian assemblages occur along the headwaters of the Brownlee Reservoir Reach and in the Weiser Reach. The distribution, abundance, and life history characteristics of many riparian weedy species in the study area suggest that the large water level fluctuations from current operations on Brownlee Reservoir may help restrict downstream infestation of several weedy riparian species through riverine processes.

Results of the vegetation mapping and field sampling provide valuable information on the extent, representation, and spatial distribution of current botanical resources in the Hells Canyon area. Results can be used for planning management strategies to improve vegetation resources and can provide critical data for modeling and predicting distribution of wildlife and other environmental resources. The significance of the information is presented in the quantitative results of the cover type mapping and the quantitative descriptions of plant assemblages.

1. INTRODUCTION

Vascular plants are the most ubiquitous and taxonomically diverse macro-organisms in Hells Canyon. As primary producers they are critical components in the maintenance of a dynamic, functional ecosystem. Vascular plants and allies (fungi, lichens, and bryophytes) provide foods for animals, stabilize watershed functions, provide habitat and cover for numerous organisms, influence climatic patterns, contribute to soil development and stabilization, have specialized relationships with pollinators and seed dispersers, and provide a variety of other critical ecological functions, such as nitrogen fixation and release of oxygen.

Obtaining an accurate map of basic physiognomic plant cover types and understanding the botanical composition and structure of habitat are critical for natural resource managers to determine resource values and management actions. Vegetation acts as an integrator of many of the physical and biological attributes of an area and is the basis for most management. Cover type maps can be used to identify biologically sensitive areas and describe spatial patterns or changes in abundance and frequency of particular characteristics of the landscape (Scott et al. 1993, Caicco et al. 1995). Biologists have long used knowledge of animals' habitats and of vegetation patterns to model, predict, and map wildlife distributions and other conservation evaluations (Specht 1975, Austin 1991).

Quantitative descriptions of the extent, representation, and distribution of plant assemblages in the Hells Canyon area of northeastern Oregon and west-central Idaho are lacking. Previous investigations have been primarily concerned with characterizing potential natural vegetation and successional status of vegetation types near, or in portions of, the study area or have focused on a few plant assemblages of interest. Detailed knowledge of the nature, extent, and distribution of the riparian habitats in the canyon bottoms and the surrounding upland habitat are unavailable. This information is needed to plan management of the traditional uses of surface resources and is needed by Idaho Power Company (IPC) to assist in relicensing its three hydroelectric projects in the canyon, collectively referred to as the Hells Canyon Complex (Project 1971), with the Federal Energy Regulatory Commission (FERC). FERC requires that all license applicants describe the botanical resources of the project and its vicinity (18 CFR §4.51 [f][3]).

1.1. Objectives

To provide a basis for evaluating existing vegetation conditions, IPC staff and contractors mapped and sampled upland and riparian vegetation along a 163-mi stretch of the Snake River in the vicinity of Brownlee, Oxbow, and Hells Canyon reservoirs. This area is referred to as the Hells Canyon Study Area, or simply the study area.

The objectives of this study were to 1) identify and map the existing vegetation, natural feature, and land use cover types; 2) quantify the extent and distribution of cover types; 3) describe the botanical, edaphic, and other site characteristics of the vegetation cover types; 4) describe the plant assemblages (plant communities) affiliated with each vegetation cover type, and their extent and distribution; 5) describe general patterns of vegetation occurring in the study area; and

6) describe the possible mechanisms that determine observed patterns in the vegetation. The first general task of this investigation was to develop a map of cover types found in the study area. The second task was to select and sample sites within each vegetation cover type.

Upland vegetation was investigated using two approaches. The first was to sample upland habitat occurring along the Snake River corridor using a systematic random approach. Second, general upland vegetation data were collected during sampling efforts to describe large homogenous patches of habitat in a broader area along the corridor. This approach was to support nongame bird investigations (see Turley and Holthuijzen 2001) and to increase the number of sample sites describing upland vegetation resources. Riparian vegetation was similarly investigated using two approaches. The first used systematic random sampling of riparian vegetation directly influenced by hydroelectric operations, specifically that associated with the water level fluctuation zone. The second collected general riparian vegetation data to describe large patches of habitat in a broader area along the corridor. Again, this was to support nongame bird investigations and to increase the number of sample sites describing riparian vegetation resources. These large patches of riparian vegetation in the study area typically occurred along tributary drainages or on moist canyon slopes. The combined sampling approach provides a more complete description of the vegetation resources along the Snake River corridor through Hells Canyon.

Additional objectives of this study were to provide baseline information for many other studies required for IPC's relicensing activities in the study area. Uses of the cover type map and botanical data include 1) assessing current wildlife habitat value using Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service 1981); 2) describing and modeling wildlife distributions; 3) providing data for land use planning and management actions; 4) conducting Geographic Information System (GIS) suitability analyses for mitigation, protection, and enhancement planning; and 5) providing baseline data to assist with modeling vegetation changes under various operational (water management) scenarios. No detailed cover type map or botanical data regarding current conditions and spatial characteristics were available for the study area prior to this investigation.

1.2. Previous Studies

Several researchers have studied vegetation assemblages in Hells Canyon and surrounding areas. Upland plant assemblages have received the most attention. Cambell (1962) studied the grasslands at the northern end of Hells Canyon in northern Idaho and adjacent Washington. After limited sampling, he described two climax plant assemblages: *Agropyron spicatum/Festuca idahoensis* and *Festuca idahoensis*/*Koeleria cristata*. Daubenmire's (1970) detailed study of the steppe vegetation of Washington covers the Palouse and Columbia Basin areas but not the Snake River in Hells Canyon or its tributaries. It provides useful insights to potential vegetation characteristics in the study area as some habitats in the canyon are similar to those identified in Washington. Daubenmire described his study area as climatic climax plant associations of steppe vegetation. Franklin and Dyrness (1973) presented a generalized account of the major vegetation types in Oregon and Washington. Evans and Tisdale (1972) described some ecological characteristics of *Aristida longiseta* and *Agropyron spicatum*. Tisdale (1979) classified the grasslands of the middle Snake River Valley and its tributaries into two vegetational series (zones), the *Festuca idahoensis* and *Agropyron spicatum* series, and described different habitat

types occurring in each series. Later, Tisdale (1986) expanded on this work and classified the grasslands and associated shrublands in west-central Idaho. The work by Steele et al. (1981) and Steele and Geier-Hayes (1987, 1989, 1992, 1993, 1994) investigated central Idaho forest habitat types, which approach and sometimes occur in the study area.

Other recent studies of upland vegetation include work by Mancuso and Moseley (1995). Their study mapped and qualitatively classified and described vegetation resources on 22,838 acres surrounding the Cecil D. Andrus (formerly Brownlee) Wildlife Management Area, adjacent to Brownlee Reservoir. Mancuso (1995) conducted a similar study on the Rocking M Ranch, also adjacent to Brownlee Reservoir.

Probably the most extensive and detailed investigation of upland vegetation in the Hells Canyon vicinity was done by Johnson and Simon (1987), who studied over 1,400 sites (729 in steppe vegetation, 676 in forested vegetation) on U.S. Department of Agriculture (USDA) Forest Service (USFS)-administered lands of the Wallowa-Whitman National Forest, exclusive of the Blue Mountains. This work focused on the potential natural vegetation and successional status of vegetation types.

Riparian plant assemblages have received comparably less attention. Huschle (1975) investigated both riparian and upland habitats along a narrow strip of land immediately adjacent to the Snake River. The work by Huschle (1975), though based on limited sampling efforts, was later incorporated into a more extensive study of the Columbia River Basin by Asherin and Claar (1976). Miller (1976) and Miller and Johnson (1976) focused on the distribution and characteristics of *Alnus rhombifolia* assemblages, and Debolt (1992) studied *Celtis reticulata* assemblages along the Snake River through Hells Canyon. Mancuso and Moseley (1995) and Mancuso (1995) also described some of the tributary drainages to the Snake River on lands near Brownlee Reservoir.

The most extensive and detailed investigation of riparian vegetation in the Hells Canyon vicinity was conducted by Crowe and Clausnitzer (1997). This study inventoried and classified mid-montane wetlands of the Malheur, Umatilla, and Wallowa-Whitman National Forests, focusing on potential natural vegetation and successional status of vegetation types.

All past studies provide little information on the extent or spatial characteristics of plant assemblages in the Hells Canyon Study Area. Only a few studies provide insight on current conditions of the vegetation resources in the study area, and these studies often omit quantification of early seral plant assemblages, such as those of sites dominated by introduced weedy species.

2. STUDY AREA

2.1. Location

Hells Canyon is situated in west-central Idaho and northeastern Oregon (Figure 1) and is over 160 mi long (approximately RM 351-188). The Snake River, a major tributary to the Columbia River, is the focal point of Hells Canyon. Its generally northward flow forms the boundary between Idaho and Oregon. IPC's Hells Canyon Complex (HCC) is located on the Snake River in the southern portion of Hells Canyon and includes three hydroelectric dams and reservoirs: Brownlee, Oxbow, and Hells Canyon. In the river reach below Hells Canyon Dam, the Snake River is unimpounded, although the flows are controlled by the three-dam complex.

The study area for this investigation encompassed all lands along the Snake River and associated reservoirs along 163 river miles, from the bridge (RM 351.2) near Weiser, Idaho, downriver to the confluence of the Salmon River (RM 188.2), upriver of Lewiston, Idaho. It also includes the area along the Powder River Arm of Brownlee Reservoir (RM 296) to the Powder River Bridge, near the confluence of Eagle Creek, for a distance of 9.6 mi. The lateral extent of the study area included all lands within 0.5 mi of each shoreline above Hells Canyon Dam (RM 247.5) and all lands within 0.25 mi of each shoreline below Hells Canyon Dam. In rare instances, these distances were limited by the lateral extent of the 1:15,000-scale aerial photo coverage used in this study.

For analysis and discussion purposes, the study area was divided into five reaches (Table 1). These reach boundaries were based on distinct geomorphic features, river characteristics, and legal project boundaries.

The most upstream reach above Brownlee Reservoir, the Weiser Reach, is a 12.0-mi-long unimpounded reach, running from the bridge near Weiser (RM 351.2) to Cobb Rapids (RM 339.2). The Snake River in this reach is a low-gradient (0.2–0.4 m/km) river, having several island complexes. Influences of agricultural activities are apparent with high amounts of irrigation returns here and upriver, causing higher turbidities and increased nutrient loading. This reach is surrounded by farmland and rural development on flat to gentle topography. Stream substrates are small, with fines and sand to medium-sized cobbles prevalent throughout (Johnson et al. 1992). Flows in the Snake River are regulated by several hydroelectric facilities above RM 458 and by three major tributary rivers: the Boise River, which enters the Snake River at RM 394 and is regulated by two flood control dams; the Payette River, which enters the Snake River at RM 365.5 and is unregulated; and the Weiser River, which enters just upstream of the Weiser Reach at RM 351.8 and is also unregulated. Although the Weiser Reach is geomorphically distinct and is surrounded by unique land uses compared with other study reaches, including it in the study provides insight to some of the physical and biological factors potentially influencing downstream reaches.

The Brownlee Reservoir Reach is 55.5 mi long, extending from Cobb Rapids (RM 339.2) to Brownlee Dam (RM 283.7). Brownlee Reservoir is a steep-sided reservoir with a maximum depth approaching 300 ft near the dam. Large rock outcrops occur throughout the entire length.

Shoreline substrates are often complex and quite variable, from areas dominated by sand to areas dominated by bedrock, small- to medium-sized cobbles, and boulders of angular basalt. Shoreline slopes in the range of 20 to 30% are most common. Brownlee Reservoir has the potential for 101-ft drawdowns during late winter as regulated by the U.S. Army Corps of Engineers (COE) for flood control. In late summer/early fall, water in Brownlee Reservoir is also used to aid the recovery and protection of anadromous fish as directed by the National Marine Fisheries Service. Since the early 1990s, the reservoir has been drawn down to provide spawning flows and redd protecting flows downstream of Hells Canyon Dam. One of the most dominant habitat features of Brownlee Reservoir is the transition zone of riverine habitat to lacustrine habitat, typical of large mainstem reservoirs. The zone is especially pronounced by turbidity reduction along a longitudinal gradient in Brownlee Reservoir, which serves as a sedimentation basin, resulting in notably less turbid water leaving the Hells Canyon system. A similar gradient is noticeable on a smaller scale in the Powder River Arm of Brownlee Reservoir. The Brownlee Dam hydroelectric facilities are capable of producing 585,400 kW of electricity.

The Oxbow Reservoir Reach is 14.2 mi long and extends below Brownlee Dam (RM 283.7) to the Oxbow Dam (RM 269.5). A small reregulating reservoir surrounded by moderate to steep topography (20–75% slopes), Oxbow Reservoir fluctuates daily within 5.6 ft of the full normal pool elevation 90% of the time. The Snake River from the tailrace of Brownlee Dam to the mouth of Wildhorse Creek (1 mi downstream) is a high-velocity narrow channel. Oxbow Reservoir is relatively narrow and shallow, with maximum depths approaching 100 ft. Shorelines are primarily basalt outcrops and talus, except for alluvial fans created by small tributaries. Oxbow Dam is a 190,000-kW facility.

The Hells Canyon Reservoir Reach extends 22.0 mi below Oxbow Dam (RM 269.5) to Hells Canyon Dam (RM 247.5). This, too, is a reregulating reservoir with maximum depth approaching 200 ft. Hells Canyon Reservoir is operated within 3.8 ft of the normal full pool elevation 90% of the time. The unique design of Oxbow Powerhouse and Oxbow Dam results in a 2-mi stretch of the original river channel (from Oxbow Dam to the outflow of the powerhouse) with a minimum flow of 100 cfs, creating a backwater area that is relatively shallow and with low velocities. Indian Creek enters the Snake River in the Hells Canyon Reservoir Reach. Reservoir shorelines are generally very steep, with substrates primarily of basalt outcrops and talus slopes. The Hells Canyon powerhouse is a 391,500-kW facility.

The downstream reach runs for 59.3 mi from Hells Canyon Dam to the confluence of the Snake and Salmon rivers (RM 188.2). The Snake River in this reach is a high-gradient river (1.8 m/km) with a wide diversity of aquatic habitat, including numerous large rapids, shallow riffles, and deep pools. Substrates are highly diverse, ranging from large basalt outcrops and boulders to cobble/sand bars. This reach has experienced a steady decline in sand bars and fine sediments since before Hells Canyon Complex construction in the 1950s because upriver dams blocked about 87% of the sediment entering Brownlee Reservoir (Parkinson et al. 2001). This unimpounded reach of Hells Canyon is considered the deepest gorge in North America and is surrounded at the upstream end by nearly vertical cliff faces. At the mouth of Granite Creek, approximately 7 mi below Hells Canyon Dam, the river elevation is 1,480 ft, and the canyon depth is 7,913 ft. The canyon becomes somewhat wider near Johnson Bar (RM 230), with moderate to steep topography continuing to the Salmon River.

2.2. Political Boundaries

Population centers within a 100-mi radius of some portion of Hells Canyon include Boise, Cambridge, Council, Fruitland, Lewiston, Nampa, Payette, Riggins, and Weiser on the Idaho side, and Baker City, Enterprise, Huntington, La Grande, Ontario, and Richland on the Oregon side. Many of the people who use and benefit from the natural resources of Hells Canyon live in these cities and towns.

The Hells Canyon Complex occurs within and across the political boundaries of Idaho, Adams, and Washington counties in Idaho, and Wallowa, Baker, and Malheur counties in Oregon. State agencies with direct responsibility for wildlife population and habitat management are the Idaho Department of Fish and Game (IDFG) and the Oregon Department of Fish and Wildlife (ODFW). These agencies also administer several areas within Hells Canyon specifically for wildlife habitat, including the Cecil D. Andrus Wildlife Management Area in Idaho. Federal agencies such as the U.S. Department of Interior (USDI) Bureau of Land Management (BLM) and the USFS are responsible for managing the majority of public land in Hells Canyon. These areas fall within the jurisdictional boundaries of the Wallowa-Whitman National Forest, Oregon; Payette National Forest, Idaho; Nez Perce National Forest, Idaho; Four Rivers Field Office (FO) of the Lower Snake River District BLM, Idaho; Cottonwood FO of the Upper Columbia-Salmon Clearwater District BLM, Idaho; Baker FO and Malheur FO of the Vale District BLM, Oregon. Other government agencies with natural resource jurisdiction in the greater project area include Idaho Department of Lands, USDI National Marine Fisheries Service, USDI Bureau of Indian Affairs, and USDI Fish and Wildlife Service.

Several special management areas also occur in Hells Canyon and are directly administered by the USFS. These include the Eagle Cap Wilderness in Oregon, Hells Canyon Wilderness in Idaho and Oregon, the Hells Canyon National Recreation Area (HCNRA) in Idaho and Oregon, the Wild and Scenic Imnaha River in Oregon, the Seven Devils Scenic Area in Idaho, and the Wild and Scenic Snake River.

2.3. Land Features

Hells Canyon, the deepest and one of the most rugged river gorges in the continental United States, ranges between 2,000 to 3,000 ft deep from Weiser to Oxbow Dam. Below Oxbow Dam, the canyon enters a narrow, steep-sided chasm that is up to 5,500 ft deep. From the confluence with the Grande Ronde River, the Snake River flows onto a lava-filled basin and through a much shallower canyon to Lewiston, Idaho (U.S. Department of Energy 1985). The elevation of the Snake River near Weiser, Idaho, is about 2,090 ft msl, descending to about 910 ft msl at the confluence of the Salmon River about 59 mi below Hells Canyon Dam.

Throughout the canyon, topography is generally steep and broken with slopes often dominated by rock outcrops and talus slopes. At the deepest points of the canyon, the walls rise almost vertically. Canyon walls are deeply dissected by numerous side canyons, which often support tributaries to the Snake River. The upper reaches of the canyon walls are formed by the Seven Devils Mountains to the east and Wallowa Mountains to the west, both of which are comprised

of jagged peaks reaching to almost 10,000 ft and having subalpine and alpine conditions (U.S. Department of Agriculture 1990).

Hells Canyon consists of a series of complexly folded and faulted, metamorphosed sediments and volcanics overlain uncomformably by nearly horizontal flows of Columbia River basalt. This basalt group covered much of eastern Washington, northern Oregon, and adjacent parts of Idaho (Bush and Seward 1992). The older rocks in the series are Permian to Jurassic in age and represent at least two episodes of island arc volcanism and adjacent marine sedimentation similar to that found in the Aleutian Islands west of Alaska. These rock units represent old island arc chains that were sequentially "welded" to the west coast of North America during the late Paleozoic and early to mid-Mesozoic time by subduction of a tectonic plate beneath the North American Continental tectonic plate (Asherin and Claar 1976, U.S. Department Agriculture 1994).

In more recent geologic time, Hells Canyon was formed by the Snake River's erosion of the Blue Mountains in Oregon and Seven Devils Mountains in Idaho (U.S. Department of Energy 1985). The Snake River has existed from the Pliocene and probably cut to its present level during the Pleistocene. During the Pleistocene, glacial meltwater provided abundant runoff for down-cutting, while regional uplifting provided weak points in the 2,000- to 3,000-ft-thick basalt plateau that overlaid the Blue and Seven Devils mountains. Resulting erosion formed the currently observed drainage pattern that established the Snake River (U.S. Department Energy 1985). Northeast-trending, high-angle fault patterns characterize the extensive Snake River fault system running throughout the study area (Fitzgerald 1982).

Besides basalt, other rock types are also present within the study area. Extensive limestone outcrops are found in some tributary drainages, and local granitic outcrops also occur.

The soils throughout Hells Canyon are composed primarily of Columbian River basalt, covered in most areas with a thin mantle of residual soils from weathered native rock. Isolated areas contain deposits of windblown silt. Unconsolidated materials include ash-loess from the Mount Mazama eruption 6,900 years ago, river sands and gravel deposited during the Bonneville floods 15,000 years ago, and more recent colluvium and talus. Soil cover amounts decline northward through Hells Canyon to a point near Hells Canyon Dam (RM 247.5), where most rock faces are nearly vertical and have little soil cover (U.S. Department of Agriculture 1994).

Most soil complexes are well drained and vary from very shallow to moderately deep. Loams are the dominant textural class and vary from very stony to silty, often with a clay subsoil component (Natural Resources Conservation Service 1995).

2.4. Climate

From late fall to early spring, the climate of west-central Idaho and eastern Oregon is typically influenced by cool and moist Pacific maritime air. Periodically, this westerly flow is interrupted by outbreaks of cold, dry, continental air from the north, normally blocked by mountain ranges to the east. During summer months, a Pacific high pressure system dominates weather patterns,

resulting in minimal precipitation and more continental climatic conditions overall (Ross and Savage 1967).

Hells Canyon, located in the High Desert region, is significantly influenced by the rain shadow of the Cascade Mountain Range. The area is considered arid to semiarid with warm to hot, dry summers and relatively cold winters (Harker et al. 1993). During winter, lower elevations in Hells Canyon are generally milder (warmer temperatures and less snow accumulation) than surrounding areas. Higher-elevation areas have greater precipitation and cooler temperatures than the immediate canyon area.

Climatological information is summarized for Weiser, Richland, Brownlee Dam, and Lewiston (Figure 2). Average annual precipitation is lowest at the southern end of the study area (Weiser, 286 mm), increases northward (Richland, 298 mm), peaks around Brownlee Dam (445 mm), and declines toward Lewiston (326 mm). The average annual precipitation ranges from about 380 to 500 mm (15 to 20 in), depending on elevation. Nearly 45% of the average annual precipitation at Brownlee Dam (445 mm [17.8 in]) falls from November through January; this strongly contrasts with the 9% average recorded for July through September. Thus, most precipitation occurs in spring and winter (Tisdale et al. 1969, Tisdale 1986, Johnson and Simon 1987), and little or no precipitation falls during the hottest months of summer. Average annual evapotranspiration is estimated to be about 1,300 mm (52 in).

Mean annual temperatures are similar among the 4 weather stations. Generally, the climate tends to become drier and warmer upstream of Brownlee Dam. Climatological information from Brownlee Dam (RM 284.6) is probably characteristic of the central section of the study area and is discussed in more detail here. The canyon bottom area is dry with seasonal temperatures ranging from lows of about –5 ºC in January to highs of about 35 ºC in July (Figure 2). Temperatures below freezing are normally experienced from mid November through mid April. As a rule, winters higher in the canyons are mild, while summers on the canyon floor may be hot. Mean temperatures at elevations above 2,000 m (6,562 ft msl) range from –9 ºC in January to 13 ºC in July. In contrast, mean temperatures at elevations below 1,000 m (3,281 ft msl) range from 0 ºC in January to between 28 ºC and 33 ºC in July (Johnson and Simon 1987).

2.5. Natural Resources and Land Use

Resource uses include a diverse array of recreational, commercial, commercial-recreational, and residential activities. Traditional commercial ventures are primarily agriculture and timber related. Agricultural enterprises focus on livestock productions, although some crop production occurs around Brownlee Reservoir. Mining has a large historical presence in Hells Canyon but declined significantly in the early 1900s and is now absent, except for limited activities near Brownlee and Hells Canyon dams. Establishment of the HCNRA has restricted future mining in that area (U.S. Department of Energy 1985).

Recreational activities, mostly associated with the reservoirs and Snake River, are now a major attraction for people to Hells Canyon. The most popular activities include power boating, river rafting, and fishing (U.S. Department of Energy 1985, Krumpe et al. 1989). Recreation associated with upland areas in the canyon includes hunting, camping, backpacking, and

horseback riding. Because of the popularity of Hells Canyon's recreational resources, many commercial enterprises have capitalized on this market, generally providing outfitting and guiding services (Krumpe et al. 1989, U.S. Department of Agriculture 1994).

Vegetation resources (wildlife habitat) and the resulting wildlife resources in Hells Canyon directly and indirectly affect most of these recreational activities and therefore recreationists' experience. People engaging in activities not directly related to wildlife (e.g., river rafting, power boating) are often indirectly affected by vegetation and wildlife through viewing encounters. Although vegetation and wildlife resources do not specifically attract these people, wildlife and vegetated landscapes often contribute to the overall recreational experience. Hunting (consumptive use) and wildlife viewing (nonconsumptive use), however, do specifically draw many visitors to Hells Canyon, and these people are directly affected by the wildlife resources. The majority of recreationists (for consumptive wildlife use, nonconsumptive wildlife use, and not specifically wildlife-related use) probably consider wildlife an integral part of the overall experience of Hells Canyon. Thus, vegetation and wildlife resources add value to the public's recreational experiences and contribute to the recreation industry's economic opportunities in Hells Canyon (Krumpe et al. 1989, U.S. Department of Agriculture 1994).

2.5.1. Private Resources

Properties within Hells Canyon are owned or administered by numerous private groups and state and federal agencies. Private holdings within the project area generally involve agricultural enterprises specializing in livestock production and timber extraction. Other private holdings, although generally insignificant in total area, include rural-residential and recreational dwellings.

With approximately 800 ha of deeded property, IPC is a minor private land holder in Hells Canyon. All properties occur between Weiser, Idaho, and Hells Canyon Dam. IPC properties correspond to ownership and operations of Brownlee, Oxbow, and Hells Canyon dams, which use Snake River water resources for power production. IPC also holds numerous flooding easements along the Snake River and right-of-way easements through which power transmission lines and service roads pass.

2.5.2. Public Resources

Public lands, administered by a variety of state and federal agencies, make up the majority of land holdings within Hells Canyon. Resource uses on public lands are similar to those on private properties and include grazing, logging, and mining. The primary difference between public and private lands is that resource agencies specifically address recreation, livestock grazing, and vegetation and wildlife management. Accordingly, all agencies administering lands in Hells Canyon have completed Final Environmental Impact Statements (FEISs) regarding land use options within their jurisdictions, as well as Land and Resource Management Plans (LRMPs) outlining preferred management courses.

Within the HCNRA river corridor, the major land use is recreation. Some livestock grazing and forage production occur, but the terrain within the river corridor is generally not conducive to livestock movement or forage production. Both downstream and upstream of the HCNRA, major

land uses within the river corridor are recreation, ranching, and residential development. On the Idaho side, the Lower Snake River District BLM's Four Rivers FO lands average 5 acres per cow month (Bonneville Power Administration 1984). Cattle allotments total an estimated 19,000 animal unit months (AUMs) along Brownlee and Oxbow reservoirs. This land is considered to be of poor grazing quality because of the steep terrain and overgrazed condition of the bench areas. On the Oregon side, cattle allotments total about 9,000 AUMs, excluding privately owned grazing lands. Upstream of Oxbow Dam, approximately 1,500 acres are cultivated; most of this land is situated around Brownlee Reservoir (Bonneville Power Administration 1984).

2.5.3. Historic Land Use

Despite its isolation, Hells Canyon was occupied and exploited during historic times by explorers, fur trappers, miners, riverboat operators, townspeople, homesteaders, ranchers, the USFS, the hydroelectric industry, and recreationists. Locally intense historic use of the canyon, especially on relatively gentle slopes and benches at tributary mouths, suggests inevitable anthropogenic disturbance to the composition and structure of native plant assemblages. Before Anglo-European settlers arrived, the vegetation resources of the canyon were used primarily by wildlife, although by the late 1800s, horses acquired by the Nez Perce Tribe grazed in the canyon, and heavy use may have occurred in a few localities. Anglo-European settlement became widespread after 1870 and introduced large herds of cattle and sheep, often grazed on a yearlong basis (Evans 1967). Some examples of historic use are provided in the following narrative, largely taken from Carrey et al. (1979). Useful information on historic conditions in the canyon has also been compiled by Blair et al. (2001).

Early Anglo-European exploration of Hells Canyon began in 1806, when Lewis and Clark entered lower Hells Canyon on their return from the Pacific. Three members of the party, John Ordway, Robert Frazier, and Peter Wiser, who gave his name to the town and river of Weiser, may have visited the confluence of the Snake and Salmon rivers at this time (Carrey et al. 1979). Fur trappers with the Wilson Price Hunt party of John Jacob Astor's Pacific Fur Company entered Hells Canyon on December 3, 1811, at the confluence of Wolf Creek and the Snake River (RM 339.2), about 25 mi upriver of the present Brownlee Dam (Carrey et al. 1979), eventually camping at the Oxbow (Beal and Wells 1959).

There were many historic mines in the canyon (Carrey et al. 1979, Lindgren 1901, Livingston and Laney 1920, Parks and Swartley 1916, Swartley 1914). In 1862, Levi Allen of the Stubadore Company discovered the Peacock copper lode during an expedition up the Snake from Lewiston. Work at the Iron Dyke copper mine near Homestead, Oregon, began in 1896; at the peak of production there were about 150 men working there. The Blue Jacket Mine, located on Indian Creek, was a contemporary of the Iron Dyke Mine. Albert Kleinschmidt owned the Blue Jacket as well as the Queen and Alaska claims, also on Indian Creek. Placer mining was going on in the canyon proper during the 1880s.

Other mines in Hells Canyon included the River Queen Mine, located on the Idaho side of the Snake River below Ballard Creek, operated between ca. 1912 and ca. 1940. In the 1920s, miners built a schoolhouse in Schoolmam Gulch, below Squaw Creek, to serve approximately 10

students (Carrey et al. 1979). Mining was suspended with the outbreak of World War I but resumed thereafter.

Mining activity resulted in the construction of the Kleinschmidt Grade, built by Albert Kleinschmidt between 1889 and 1891. The road connected the Peacock Mine, in the Seven Devils area, to the Snake River so that ore could be shipped by steamboat up river to Huntington or Olds Ferry railheads.

Mining also served as the main impulse for several attempts to navigate Hells Canyon by steamboat. Navigation of the Snake River between Lewiston and Fort Boise, the confluence of the Boise and Snake rivers, became an important issue in 1862 with the discovery of gold in the Boise Basin (Carrey 1979). In 1865, competition for mining-related trade routes between Idaho and California led to attempts by the Oregon Steam and Navigation Company to establish steamboat service from Lewiston upstream to Owyhee Ferry.

There were several ferry crossings in Hells Canyon. A cable ferry crossed the river from Robinette. The Brownlee Ferry, operated after the 1860s, transported cattle from the Idaho side to Oregon so that they could winter near Halfway. There was also a ferry at Ballard Creek until 1926, when a bridge was constructed (Carrey et al. 1979).

There were many homesteads and cabins in Hells Canyon (Carrey et al. 1979). These included Oxbow Village, settled in the 1870s; Pine Creek, where there was a cabin in 1888; Wildhorse Creek, homesteaded in 1910; and the mouth of Black Canyon Creek, settled in 1911. Some sites listed by Carrey et al. (1979) include Spring Creek, farmed in 1926; Big Bar (where agricultural terraces are still visible on the Idaho side), farmed for fruit and vegetables to serve the Seven Devils, Landore, and Cuprum mining camps in the 1890s; Steamboat Creek (just above Hells Canyon Dam), site of a cabin, garden, and peach orchard in the 1890s; Stud Creek (just below the Hells Canyon Dam site), a cabin site in 1910 and 1911; Lamont Creek, site of a tent-cabin in 1905 and 1906; Chimney Bar, site of a dugout cabin with a stone fireplace and chimney in the 1890s or before; and Battle Creek, homesteaded between 1910 and 1938.

Other examples of homestead and cabin sites include Three Creeks, settled in 1899, where a 14×20-ft log house, a frame house, a barn, and irrigation ditches were constructed; Saddle Creek and its tributary Rough Creek, settled in 1895; Bernard Creek, settled in 1901, where a bunkhouse and two cabins were built; Bills Creek, homesteaded with cabins constructed between 1905 and ca. 1911 and again from ca. 1912 to 1927; Sluice Creek, where a dugout cabin was built in the early 1880s as part of a cow camp, twin cabins were built in 1909, and school was taught in a walled tent in 1922; Rush Creek, where a cabin was occupied between 1920 and 1924; Pony Bar, homesteaded in 1913; Johnson Bar, where a stone house, stone fences, and rock corral were constructed after 1914; Sheep Creek, settled in 1884 and filed on in 1913, where a stone cabin was constructed ca. 1884 and a substantial house built in 1925; Hutton Creek, where a root cellar and collapsed cabin predate the late 1930s; Caribou Creek and Little Bar, the site of a sheep operation beginning in 1921, having a shearing shed, a bunkhouse, and a cellar until the late 1940s; Myers Creek and Big Bar, having a rock cabin in the early 1900s and related to the Brownlee Shooting, an incident written about by Mark Twain. Carrey et al. (1979) lists several other homesteads in the canyon, including the Temperance Creek Ranch and the Jordan

Homestead at Kirkwood Bar, home of Idaho Governor and later U.S. Senator Len B. Jordan (Jordan 1954).

Urban development was interconnected with the growth of mining, railroads, and early hydroelectric development in Hells Canyon. In 1888, the community of Homestead was established to serve the Iron Dyke Mine, just downstream from Copperfield (Carrey et al. 1979). In 1918, a second schoolhouse was built, where two teachers taught 30 to 40 students that year. At its peak, Homestead had two stores, a post office, a gas station, and a meat market. The town declined when the railroad tracks were removed with the start of Oxbow Dam.

The development of Copperfield, one of the wildest towns in the region, began shortly before the turn of the century (Carrey et al. 1979). In 1897, the 160-acre Copperfield Ranch was established, but its land was sold in 1906 to commercial interests who had learned of railroad plans and Idaho-Oregon Light and Power Company's hydroelectric plans for the nearby Oxbow area. By 1918 the Copperfield townsite was platted. Copper mining, railroad construction, and hydroelectric development created a boom town shortly thereafter. By 1907 there were saloons, brothels, a post office, boarding houses, a jail, and other buildings. A school and railroad depot were in operation by 1909. Church and hospital services were performed in less permanent structures. A suspension bridge across the river was built in 1911 but was destroyed by a flood in the early 1920s. At the peak of the Copperfield boom, about 700 men were employed, many with permanent jobs. Another 400 people lived in the area and supported the town with farming, ranching, and other activities.

In more recent times, the USFS has had an active role in recreation activities in Hells Canyon. For example, many of the homesteads previously noted reverted to USFS ownership, trails were built through the canyon, and the Hells Canyon National Recreation Area was created on December 31, 1975 (Carrey et al. 1979).

Commercial hydroelectric development began in 1908 with the start of construction at the Idaho-Oregon Light and Power Company's plant at Oxbow Dam (Carrey et al. 1979, Stacy 1991). Construction of a diversion tunnel was completed in 1909. Financial problems reduced the power output from the originally planned 24,000 to 600 kW. The present Oxbow Dam, which incorporates the original diversion tunnel, was completed in 1961 as part of the three-dam Hells Canyon Complex. The entire complex, consisting of Hells Canyon, Oxbow, and Brownlee dams was completed in 1967.

3. METHODS

3.1. Cover Type Mapping

3.1.1. Map Development

Methods used to prepare vegetation maps are determined by the purposes for each map's use (Kuchler 1956, 1967, 1988). No single mapping strategy will work best in all locations. The map prepared for the Hells Canyon Study Area had to portray the vegetation in sufficient detail to answer questions about the aerial extent and the representation and distribution of fairly specific cover types. IPC also determined that the map detail must support wildlife studies, land use planning, and other Geographic Information System (GIS) applications for relicensing FERC Project No. 1971.

The cover type map was based on 26 vegetation, natural feature, and land use cover types (Table 2, Table 3, and Appendix 1). Riparian vegetation cover types generally followed the classification system described by Cowardin et al. (1979) and modified for Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service 1981). Four riparian cover types were used: *Shore & Bottomland Wetland*, *Emergent Herbaceous Wetland*, *Scrub-Shrub Wetland*, and *Forested Wetland*.

Riparian wetlands, in the context of this study, include both delineated wetlands and riparian areas that would not fall under the strict definition of wetlands. Riparian habitats are those lands that are transitional between wetland and upland habitat. During aerial photo-interpretation, it is not possible to accurately distinguish between all wetland and upland plant species or to interpret hydrologic indicators or soil characteristics that are used to define jurisdictional wetlands. In some cases, lands dominated by plants more common to upland habitats and growing in more mesic conditions, such as on seasonally moist soils on north- or east-facing slopes or near the bottom of drainage channels, were classified into wetland cover types. The actual extent of legally recognized wetland boundaries is not indicated on the cover type map and must be determined on the ground through formal wetland delineation techniques (see Environmental Laboratory 1987, Federal Interagency Committee for Wetland Delineation 1989). Therefore, although the term *wetland* is used in the cover type name, the term *riparian* more appropriately describes the land mapped in these cover types.

Upland vegetation cover types generally followed the classification system used for HEP as outlined in U.S. Fish and Wildlife Service (1981). Nine upland cover types were used: *Forested Upland*, *Desertic Woodland*, *Tree Savanna*, *Shrubland*, *Shrub Savanna*, *Desertic Shrubland*, *Forbland*, *Grassland*, and *Desertic Herbland* (Table 2, Table 3, and Appendix 1). Natural feature types included *Cliff*/*Talus Slope*, *Barrenland*, and open water; for the latter type impounded and unimpounded reaches of the Snake and Powder rivers were classified as *Lotic* (moving water), and disjunct ponds and stock tanks were classified as *Lentic* (standing water). Nine land use cover types were used, including *Agriculture*, *Grazing Land*/*Pasture*, *Park*/*Recreational*, *Roads*, and other urban areas. Vegetation cover types were given priority in cover type classification over land use types. For example, rangelands or forest lands may also be used as grazing land,

but the vegetation cover type (i.e., *Shrubland*, *Forested Upland*) had precedence. Land use types were mainly assigned to lands that were developed or managed for single uses.

The map was developed through standard photo-interpretation techniques using July 11, and August 22, 1993, 1:15,000-scale color infrared aerial photography. The July photography covered the study area downstream from about RM 299 on Brownlee Reservoir (just upstream of the Powder River confluence) and downstream of about RM 1.5 on the Powder River Arm of Brownlee Reservoir (Figure 3, panel 5). All HCC reservoirs are approximately at full-pool, and river flows below Hells Canyon Dam are approximately 6,000 cfs. The August photography covered the study area upriver of these points. Brownlee Reservoir elevation is approximately 2057 feet (20 feet below full-pool; 2077) and river flows in the unimpounded Weiser Reach are approximately 11,600 cfs. The photo-interpretation was an iterative process based on evidence from the aerial photos, ancillary sources (e.g., existing road and vegetation maps and contemporary [1993] true color, 1:8,400-scale aerial photos), and field observations and on knowledge of local vegetation assemblages, ecological relationships, and natural and anthropogenic perturbations.

In 1995, Michael P. Williams Consulting (Seattle, Washington) delineated polygons of the different cover types and labeled them, by code number, on transparent mylar overlays. The contractor used a desk-top stereoscope to delineate the polygon boundaries, and where possible, used only the central portions of the photography to avoid distorted areas on photo edges. All polygon boundaries, except roads, were delineated with a 0.5-mm lead pencil. Roads, including railroads, were delineated as linear features with a 0.5-mm red lead pencil; a hatched line was used to delineate the railroads. Some riparian areas and other habitats were also delineated as linear features with assigned widths. The minimum mapping units were approximately 10 m in diameter for polygons and 3 m wide for linear features. These were the smallest features that could be distinguished on the aerial photos. At times, small patches of some cover types were so abundant that it became impractical to map them separately; these areas were mapped more generally.

As the photo-interpretation progressed, two trained IPC staff field-checked all delineated polygons, where reasonably feasible, using vehicles or jet boats or hiking to access sites. Some locations were simply too difficult or dangerous to access (e.g., because of steep slopes and rock outcrops), especially below Hells Canyon Dam, without incurring extravagant expense (e.g., to charter a helicopter). Where possible, difficult access sites were scanned with binoculars from vantage points. All corrections identified during field visits were incorporated into the final mylar overlays.

In 1996, Hammon, Jensen & Wallen, Inc. (Oakland, California) was selected to perform photogrammetric data processing to obtain rectified digital coverage of cover type polygons and linear features. Most map control was obtained from corresponding U.S. Geological Survey (USGS) 1:24,000-scale quadrangle maps. In areas where quad control was unavailable, IPC collected latitude, longitude, and altitude coordinates at locations specified by the contractor, using a Trimble Navigation® Pathfinder Prolite® global positioning system receiver. These coordinates were supplied to the contractor for use in georectifying the polygons. Aerotriangulation computations were made using a combination of contractor proprietary software and the least square bundle adjustment program ALBANY®. Stereo compilation was

performed on Kern DSR-14 and Zeiss C-120 analytical stereoplotting instruments interfaced directly to a KDMS 9.0® photogrammetric mapping software system, which operated on dedicated IBM PC-compatible 486 and Pentium computers with MS-DOS. Final digital coverage of cover type polygons and linear features was provided in an ARC/INFO® format. All features were generated in a Universal Transverse Mercator projection, based on NAD27 datum, in meters.

Location boundaries of all distinct thematic features (objects) such as roads, buildings, lakes, rivers, or agricultural lands meet or exceed the National Map Accuracy Standards of 40 ft for a 1:24,000-scale map (i.e., an object's mapped location is accurate to within 40 ft). Other cover types do not have clearly defined locations or boundaries on the ground and therefore their spatial accuracy cannot be tested. At all scales the landscape displays continuous variation in species composition rather than clear delineations. Hence, polygon boundaries imply a discontinuity that is seldom as abrupt as their mapping would suggest (Williams 1996). These boundaries provide a subjective interpretation of where between-polygon variation is greater than within-polygon variation.

Final area for each cover type was calculated in hectares using ARC/INFO®.

3.1.2. Map Analysis

Analyses were performed to summarize the extent and distribution of cover types within the study area. Summaries include total area (ha) mapped and total area and relative proportion of each cover type 1) within the overall study area; 2) within the legal project boundaries for Brownlee, Oxbow, and Hells Canyon dams; and 3) within each of the 5 study reaches.

3.2. Vegetation, Soils, and Other Site Characteristics

3.2.1. General Considerations

The field sampling objective was to collect data on existing conditions in each vegetation cover type to describe the various plant assemblages that occurred and the potential driving forces behind vegetation patterns. Transect placement within cover types was done without any assumption of eventual classification or succession status, but rather for the representation of homogeneous vegetation. Obvious ecotones, microsites, exceptionally dense clumps or openings, or areas of recent severe disturbance were avoided.

Annual vegetation sampling was initiated in 1994 and completed in 1999. Upland vegetation was generally sampled from late April to late June, and riparian vegetation was generally sampled from early June to mid September. These are the periods when most vegetation reaches peak production in Hells Canyon. During each year of sampling, the crew sampled throughout the optimum growing season. Sometimes sampling times occurred outside of peak production, depending on availability of field personnel and on logistical constraints. During each year of sampling, the crew attempted to sample several 5-mi river segments throughout the study area to

mediate for variation in annual climatic conditions, except during 1994 through 1995, when the crew sampled only upriver of Hells Canyon Dam (RM 247.5).

Because relatively little is known about the study area's riparian resources, compared with upland resources, this study focused more sampling effort on riparian habitats. More than twice the number of transects were placed in riparian vegetation than in upland vegetation.

A list of noxious weed species was developed for reference during the study. For the purposes of this investigation, *noxious weeds* were defined as those species contained on either Idaho or Oregon's state noxious weed lists (Baker County, Oregon 1996; State of Idaho 1996). In addition, 4 invasive riparian species were added to the compiled list for consideration during this study, although they are not considered noxious weeds by either Idaho or Oregon: *Amorpha fruticosa* (false indigo), *Elaeagnus angustifolia* (Russian olive), *Phalaris arundinacea* (reed canarygrass), and *Tamarix* spp. (tamarisk or salt cedar). From this compiled list of 101 species, 41 were known or suspected to occur in the study area (Table 10). This study merely identified the noxious weeds found in each plant assemblage described in Appendices 2 and 3. For a more detailed investigation of noxious weeds in the canyon, see Krichbaum (2000).

In consultation with agency personnel, a list of special status species was developed for reference during the study. This list merely identified the rare plant species found in each plant assemblage listed in Appendices 2 and 3. For a more detailed investigation of rare plant species in the canyon see Krichbaum (2000).

3.2.2. Approach for Upland Vegetation Sampling

Sampling of upland vegetation was conducted using two approaches to sample different components of the system. The first sampling effort (River Corridor Upland Sampling), a systematic random approach, investigated upland habitat occurring in close proximity to the Snake River. Using this approach, approximately 5% of upland habitats were sampled below the Hells Canyon Dam within 0.25 mi of the shoreline, and approximately 20% of upland habitats above the dam within 0.5 mi of the shoreline. Upland vegetation sampling efforts below Hells Canyon Dam were restricted because of steep topography, remoteness, and logistical constraints.

The second effort (General Upland Sampling) obtained data from a broader area within the canyon. It focused on large homogenous stands of upland habitat throughout the study area within about 2 mi of the Snake River and supported a study on avian communities and avian-habitat relationships (Turley and Holthuijzen 2001).

River Corridor Upland Sampling

Because the cover type map was not available until mid 1997, it could not be used to aid in developing a sampling design based on a statistically sound representation of cover types. Therefore, a systematic sampling design was employed. Upland sampling locations were selected in the field from within 0.5×0.5-mi (0.25 mi^2) sampling blocks above Hells Canyon Dam and from within 0.25×0.25-mi (0.06 mi^2) sampling blocks below Hells Canyon Dam. A smaller sampling area was required below Hells Canyon Dam due to the rough terrain and logistical constraints of doing field work in this remote canyon reach. The study area was

initially stratified into 5-mi river segments, and by left and right river banks. Subsequently, each side of the river in each 5-mi segment was divided into ten 0.5-mi stretches in the reaches above Hells Canyon Dam, and into twenty 0.25-mi stretches below Hells Canyon Dam. Finally, 2 of the stretches were randomly selected to be sampled on each side of the river within each 5-mi river segment (4 blocks/5-mi segment). Sample blocks were mapped on USGS 7.5-minute topographic maps.

After locating a sampling block in the field, a field crew trained in cover type identification mapped/sketched all available cover type polygons and, where present, readily distinguishable plant assemblages within cover types (e.g., *Rhus trilobata*-dominated *Shrubland* polygons vs. *Purshia tridentata*-dominated *Shrubland* polygons). To view areas difficult to access by foot, binoculars were used along with boating and hiking to different vantage points. One polygon per cover type in each sample block was randomly selected for sampling. If the selected polygon was not accessible with reasonable effort (e.g., high on a steep slope or on treacherous cliff faces), another polygon was randomly selected for sampling. Nearly all sampling locations required considerable effort to reach. No more than 2 polygons per cover type were sampled in each 5-mi river segment.

Upland vegetation was measured along a single, 50-m transect line. For each transect, the slope, aspect, elevation to the nearest contour (USGS 7.5-minute topographic map), general location, UTM coordinate, and other site characterization data were recorded.

Ground cover and herbaceous plant cover were measured using a 0.2×0.5-m (0.10 m^2) quadrat (Daubenmire frame) and 6 cover classes described by Daubenmire (1959). Frames were placed at 1-m intervals along the transect, beginning at 10 m and ending at 39 m (30 frames), with the long axis of the frame parallel with the transect, the center of the frame aligned with the interval mark, and each frame placed on alternate sides of the tape (even numbered frames on the right, odd on the left). Cover was estimated for each plant species, and for moss, lichen, rock, litter, and bare ground. All plant cover, including inflorescences, was included in the cover estimates.

Shrub and tree (woody) cover were estimated using the Line Intercept method (Canfield 1941, Müller-Dombois and Ellenberg 1974) along the 50-m transect line. The cover of each woody species and the *gaps*, those areas without woody species, were recorded. Gaps in the canopy less than 20 cm were ignored unless they occurred between different species or physiognomic groups. A meter stick was used to project the intercept points of plants not in direct contact with the tape. For upland sampling, shrubs were considered to be those plants less than 5 m tall, and trees were those greater than or equal to 5 m tall. Frequency statistics were calculated on the basis of interception along each 1-m segment of the 50-m tape.

Woody species density and height were estimated by counting and measuring all individuals of each species rooted within a specified perpendicular distance from the 50-m transect (variable-sized belt transects). One of five belt sizes was selected (1×50 m, 2×50 m, 6×50 m, 10×50 m or 20×50 m) in order to obtain a count of at least 20 individuals and still remain within the cover type. A minimum of 20 individuals was determined to be needed for accurate density estimates. Usually, the smallest belt transect that captured a minimum of 20 individuals was used. Tree height was measured using a 9-m tree pole. Tree height above 9 m was estimated in 0.5-m intervals by one observer standing back and visually projecting 1-m lengths above the

top of the tree pole until the top of each tree was reached. Species status (dead or live), life form (tree or shrub), height (m, usually to the nearest 5 cm), and tree diameter (cm) at breast height (dbh) were recorded for each individual.

Soil samples were collected from 1995 through 1997. Because sampling was conducted from 1994 through 1999, soil characteristics are not available for all transects. Soil characteristics were measured by sampling 10 soil cores representing the upper 15 cm (6 in) of the mineral soil along each transect and combining all 10 cores into a composite sample for the site. Samples were collected at roughly 5-m intervals along each transect. Stukenholtz Laboratories (Twin Falls, Idaho) analyzed composite samples to determine soil texture, pH, salts (mmhos/cm), cation exchange capacity (CEC) (meq/100g), sodium of CEC (%), lime (%), organic matter (%), organic N (lb/A), nitrate-N (ppm), phosphorus (ppm), potassium (ppm), sodium (ppm), calcium (ppm), magnesium (ppm), and sulfur (ppm).

General Upland Sampling

Sites were selected following the methods described in Turley and Holthuijzen 2001. Usually 5 to 8 sites were selected in each 5-mi river segment from RM 340, at the headwaters of Brownlee Reservoir, downstream to RM 205, about 40 mi below Hells Canyon Dam. Site selection was based on cover types present in each 5-mi river segment, availability of large homogenous blocks of habitat within cover types, and topographic and logistical constraints. Because it was necessary to visit all upland and riparian bird sites (see General Riparian Sampling section below) during spring, summer, fall, and winter for several consecutive years, upland bird sites were clustered with riparian bird sites to improve sampling time and efficiency.

Vegetation at general upland sampling sites was measured using the same basic techniques as for the river corridor upland sampling. Vegetation was measured with two random 10-m transects that radiated from a center point: one from 5 to 15 m from the center point, the other from 30 to 40 m from the center point. Information was collected on species cover, woody species density, and vegetation structure. For each transect, the slope, aspect, elevation to the nearest contour (USGS 7.5-minute topographic map), general location, UTM coordinate, and other site characterization data were recorded.

Ground cover and herbaceous plant cover were measured using twenty 0.2×0.5-m (0.10 m^2) quadrats (Daubenmire frame) and the 6 cover classes described by Daubenmire (1959). Ten frames were placed on each 10-m transect at 1-m intervals, beginning at the 6 and 31 m marks. Frames were placed on the right-hand side of the tape, oriented parallel to the tape and centered on the meter mark. Cover estimates were made for the dominant 3 or 4 herbaceous plant species and for moss, lichen, rock, litter, and bare ground. The remaining nondominant species were lumped into other forb (OFORB) and other grass species (OGRAS) groups.

Shrub and tree (woody) cover were estimated using the Line Intercept method (Canfield 1941, Müller-Dombois and Ellenberg 1974), as described above for general upland sampling, along the 10 m transects. Woody species density and height were estimated by counting and measuring plants along variable-sized belt transects as described above for river corridor upland sampling.

Species status (dead or live), life form (tree or shrub), height (m, usually to the nearest 5 cm), and tree diameter (cm) at breast height (dbh) were recorded for each individual.

No soil samples were collected.

3.2.3. Approach for Riparian Vegetation Sampling

Riparian vegetation resources were sampled by two approaches to sample different components of the system. The first sampling effort (River Corridor Riparian Sampling) investigated general riparian habitat that was directly influenced by the project, specifically, those habitats occurring along the reservoir and river shorelines associated with the water level fluctuation zone. A systematic random sampling approach was used to sample approximately 10% of the shoreline habitat throughout the study area.

The second sampling effort (General Riparian Sampling) obtained data from a broader area within the canyon and supported a study on avian communities and avian-habitat relationships (Turley and Holthuijzen 2001). This second sampling effort focused on large stands of riparian habitat that occurred in the study area, often at or above the confluence of smaller tributary drainages, within about 2 mi of the Snake River.

River Corridor Riparian Sampling

To obtain specific information on the riparian vegetation resources directly influenced by the project, sampling efforts focused on areas influenced by water level fluctuations. All shoreline in the study area was stratified into 5-mi-long segments on each side of the river to insure data was collected over the total length of the study area. Each segment was divided into twenty 0.25-mi-long shoreline stretches. Two stretches were randomly selected on each side of the river within each 5-mi shoreline segment (i.e., 4 sample stretches/5-mi river segment). This provided a 10% sample of all shoreline in the study area. All shoreline sample stretches were mapped on USGS 7.5-minute topographic maps.

After a sample stretch was located in the field, shoreline vegetation was closely examined to determine the riparian species presence. Riparian species were defined as those plant species with a hydrologic indicator ranking of facultative minus (FAC–) or wetter (FAC, FAC+, FACW– FACW, FACW+, or OBL) as ranked by Reed (1988) and updated by U.S. Army Corps of Engineers (COE) (1994). Some plant species, such as *Philadelphus lewisii* and *Rubus discolor*, that do not have a hydrologic indicator ranking or have a ranking that is drier than FAC– were also selected as indicators of riparian habitat in Hells Canyon based on the investigator's knowledge of and previous work conducted in Hells Canyon environs. A list of additional indicator species was kept by project personnel. If riparian plant assemblages occurred within the sample stretch, the total length of shoreline occupied by riparian vegetation was recorded. The total area of each riparian plant community was estimated in square meters. The upriver and downriver location coordinates of each sample stretch were determined in the field using USGS 7.5-minute topographic maps.

All homogeneous patches of riparian vegetation in each riparian cover type in the sample stretch were sketched on a data form. Mapping was done by hiking and cruising the shoreline in a boat

to different vantage points and drawing the vegetation polygons in relation to visual reference features. All mapped riparian vegetation was assigned a temporary cover type/community name to distinguish between sites during sampling.

All unique plant assemblages in each cover type in each sample stretch were sampled. If more than one polygon of a specific plant community occurred in the sample stretch, then at least one-third of the polygons was randomly selected and sampled. Vegetation was measured along a single, linear 5-, 10-, 20-, or 40-m transect line, depending on the size of the plant community; the longest possible transect was used.

Vegetation and other site characteristics were estimated using the same general methods described for upland sampling, but sample sites along transects were adjusted based on transect length.

Ground cover and herbaceous plant cover were measured using twenty 0.2×0.5-m (0.10 m^2) quadrats (Daubenmire frame) and the 6 cover classes described by Daubenmire (1959). Twenty Daubenmire frames were determined to be needed for accurate plant cover estimates. Frames were placed on both sides of the tape, oriented parallel to the transect tape, at 0.5-m intervals (beginning at 0.5 m) for 5-m transects, and at 1-m intervals (beginning at 1 m) for 10-m transects. Frames were placed on just the right side and oriented parallel to the transect tape at 1-m intervals (beginning at 1 m) for 20-m transects, and at 2-m intervals (beginning at 2 m) for 40-m transects. Cover was estimated for each plant species and for moss, lichen, rock, litter, and bare ground. All plant cover, including inflorescences, was included in the cover estimates.

Shrub and tree (woody) cover were estimated as described for upland sampling, along each transect. For riparian sampling, shrubs were considered to be those plants less than 6 m tall and trees those greater than or equal to 6 m tall. Frequency statistics were calculated on the basis of interception along each 1-m segment of the total transect length.

Woody species density and height were estimated as described for upland sampling by counting and measuring all individuals of each species rooted within a specified perpendicular distance from each transect (variable-sized belt transects). Species status (dead or live), life form (tree or shrub), height (m, usually to the nearest 5 cm), and tree diameter (cm) at breast height (dbh) were recorded for each individual. No soil samples were collected along river corridor riparian sampling sites.

On islands, all unique patches of homogenous riparian vegetation were sampled. If more than one polygon of a plant community occurred, then at least one-third of the polygons were randomly selected and sampled. Several islands occurred in the upper portion of Brownlee Reservoir and upstream of Weiser, Idaho. One island occurred on Hells Canyon Reservoir. During each year of sampling, the crew sampled several 5-mi river segments and several islands throughout the study area to mediate for variation in annual climatic conditions.

General Riparian Sampling

Riparian vegetation above the high-water mark was sampled systematically throughout the study area. This sampling focused on the larger vegetation patches of homogenous riparian habitat that

generally occurred along tributary drainage bottoms or on seasonally moist canyon slopes associated with drainages.

In 1994, reconnaissance surveys were conducted to locate all large riparian cover type polygons (sites > 30 m in diameter) within the study area. The lateral extent of the reconnaissance surveys encompassed all lands within 0.5 mi of the study area shoreline. In some large tributary drainages of the Snake River, surveys were conducted up to 3 mi from the confluence. Nearly 300 riparian cover type polygons were identified. The study area was stratified into 5-mi-long river segments to insure data were collected throughout the length of the study area. Because riparian habitats have received such little prior investigation in the study area, a large percentage of sites, approximately 40% of the polygons in each riparian cover type, were randomly selected for sampling in each 5-mi river segment. Each site was mapped on USGS 7.5-minute topographic maps.

Vegetation was sampled using the same basic techniques used in the river corridor riparian sampling sites. At selected sampling points, all vegetation was measured within a 30-m diameter plot, along three 5-m transects. A compass was used to identify the 4 cardinal directions, dividing the location into 4 quadrants. One of the 4 quadrants was randomly eliminated from sampling. In each of the 3 remaining quadrants, a random azimuth bearing and transect interval (1–5, 5–10, or 10–15) were selected. The field crew checked to see that the selected transect was in the appropriate cover type (did not cross a cover type boundary) and whether it could be sampled (i.e., whether terrain was too steep or inaccessible). If transect sampling was not feasible, a new azimuth or quadrant was selected.

For each point, the slope, aspect, elevation to the nearest contour (USGS 7.5-minute topographic map), general location, UTM coordinate, and other site characterization data were recorded. Vegetation and associated site characteristics were determined using the same general methods described for upland sampling, but sample sites along transects were adjusted based on transect lengths.

Ground cover and herbaceous plant cover were measured using thirty 0.2×0.5-m (0.10 m^2) quadrats (Daubenmire frame) and the 6 cover classes described by Daubenmire (1959). Frames were placed on both sides of the tape at 1-m intervals along each of the 5-m transects. Frames were laid on the ground, with the long axis parallel to the angle of the transect line and the center aligned with the meter mark. Sample intervals were 1 to 5, 6 to 10, and 11 to 15 meters. Cover was estimated for each plant species and for moss, lichen, rock, litter, and bare ground. All plant cover, including inflorescences, was included in the cover estimates.

Shrub and tree (woody) cover were estimated along each 5-m transect using the Line Intercept method, as described for river corridor upland sampling. Frequency statistics were calculated on the basis of interception along each 1-m segment of the total transect length (15 m).

Woody species density and height were estimated as described for river corridor upland sampling by counting and measuring all individuals of each species rooted within a specified perpendicular distance from each 5-m transect (variable-sized belt transects).

Soil samples were collected from 1995 through 1997. Soil characteristics were measured by sampling 10 soil cores, representing the upper 15 cm (6 in) of the mineral soil within 20 m of the centerpoint, and combining all 10 cores into a composite sample for the site. Composite samples were analyzed as described for river corridor upland sampling.

Notes were taken to rank each site based on native/perennial species composition, seedling and young plant abundance, plant litter accumulation state, plant vigor, soil surface condition, soil erosion condition class, bare soil index, ground cover index, and domestic grazing use.

3.2.4. Field Data Analysis

SAS® v.6 software was used to summarize vegetation characteristics. Two key variables (species cover and hydrologic indicator ranking) were used initially to classify each transect to a cover type and plant assemblage. Average cover for each herbaceous species was calculated using data from the Daubenmire frames. Midpoint values of each Daubenmire cover class were used. Average cover of woody species was calculated from the line intercept data.

Hydrologic indicator ranking, as defined by Reed (1988) in *National List of Plant Species that Occur in Wetlands*, and updated by COE (1994) and U.S. Fish and Wildlife Service (1996), was used to classify hydrophytic (adapted to growing in water) vegetation. Each plant species was categorized to *riparian* or *upland* status. Riparian species were usually defined as those plant species with a hydrologic indicator ranking of facultative minus (FAC–) or wetter (FAC, FAC+, FACW–, FACW, FACW+, or OBL). Upland species were those species with a hydrologic indicator ranking of facultative upland plus (FACU+) or drier. For some species, it was necessary to classify the riparian or upland status based on local knowledge of the Hells Canyon environs because some Hells Canyon species are absent from the regional list or have a published rank of NI (insufficient information). Also, some species, such as *Philadelphus lewisii* and *Rubus discolor*, have a published ranking that is drier than FAC–, but in Hells Canyon these species occur almost exclusively in riparian habitats.

To classify each transect to a cover type (Appendix 1), it was first necessary to determine whether the vegetation on each transect was dominated by riparian or upland species. Rather than arbitrarily assigning this designation to the transect, a SAS program was written to determine riparian or upland dominance based on identifying the hydrologic status and average cover of each species occurring on the transect. Species with greater cover were given more weight in determining the outcome, as were species on the extreme ends of the hydrologic scale. For example, a transect dominated by an OBL or FACW+ species would probably result in the transect being classified as riparian, even though several incidental FAC– or UPL (upland; drier hydrologic indicator status than facultative) species also occurred on the transect with minor amounts of cover. Each species on each transect was assigned a score within an upland or riparian category. The final transect status was determined by whether the sum of all species within the transect had a higher upland score or a higher riparian score.

Once the upland or riparian classification was determined, the total cover on each transect was calculated for 4 physiognomic types: tree, shrub, forb, and grass. To classify each transect into a specific cover type, the total cover values of all riparian transects were evaluated based on the

riparian cover type criteria (Appendix 1). Likewise, all upland transects were evaluated based on the upland cover type criteria (Appendix 1). General descriptive characteristics of each cover type were generated by calculating average total cover of trees, shrubs, forbs and grasses (Section 4.2).

All transects in a cover type were then grouped into plant assemblages using Two-Way INdicator SPecies ANalysis (TWINSPAN; Cornell Labs, Ithaca, NY), a commonly used "divisive" computer program that sorts species into maximally different, but minimum in number, groups (Hill 1979, Van Groenewoud 1992). The TWINSPAN analyses were conducted using PC-ORD® Version 2.0 software (MjM Software Design, Gleneden Beach, Oregon). TWINSPAN groups species and transects by "progressive refinement of single axis ordination from reciprocal averaging" (Kent and Coker 1992). Multiple dichotomies are created until no significant dissimilarities are found within a group or a minimum sample size is reached. Generally, dichotomies beyond the third level are not considered in classification (Jongman et al. 1987, Gauch 1989, Kent and Coker 1992), but owing to the large number of transects in each cover type, dichotomies up to the sixth level were needed to separate plant assemblages. The strength of each dichotomy is measured using eigenvalues calculated during each ordination. Eigenvalues describe the amount of variation explained by a particular ordination axis (Jongman et al. 1987, Gauch 1989, Kent and Coker 1992). The larger the eigenvalue, the more variation is accounted for by the axis and the more similar are members of the group relative to other groups. Eigenvalues were used to determine which dichotomies were the strongest.

TWINSPAN cut levels were set at 0, 1, 2, 5, 10, 20, 35, and 50% cover for *Desertic Herbland*, *Desertic Shrubland*, *Shrub Savanna*, *Tree Savanna*, and *Shore & Bottomland Wetland* cover types (cover types with inherently low amounts of cover). Cut levels were 0, 2, 5, 10, 20, 35, 50, and 75% cover for all other cover types. Because of the large number of transects in each cover type, most plant assemblages were identified at the fourth or fifth classification (dichotomy) level. In some instances in the *Emergent Herbaceous Wetland*, *Shrub-Shrub Wetland*, and *Forested Wetland* cover types (with 299, 298, and 207 transects, respectively), it was necessary to split transects into different plant assemblages at the sixth level.

Infrequently occurring species with less than 1% average cover were excluded from classification analyses. Uncommon species act as outliers in classification algorithms, adding variability that obscures central tendencies (Gauch 1982, Tausch et al. 1995). Data from uncommon species are highly variable and often cannot be interpreted (Uresk 1990). The PC-ORD package allowed a maximum of 100 species to be printed in a final ordination table for each cover type. When the number of species in each cover type exceeded the maximum allowed, the first species to be eliminated were the rarest.

Plant assemblages are described using average cover, constancy (percent occurrence among transects), average frequency (percent occurrence within a transect) of the individual plant species; average cover of moss, lichen, rock, litter, and bare ground; and associated site conditions such as edaphic and topographic features (Appendices 2 and 3). Generally, species with less than about 1% cover are excluded from summary tables. Frequency of woody species is based on occurrence in each 1-m segment of the transect length. This measure of distribution is comparable to frequency by plot data (Asherin 1973).

A species list for each study area reach was developed by tallying all species found along vegetation sampling transects (Appendix 4). Because of the systematic random sampling protocols used to sample upland and riparian habitats, this appendix can also be used to indicate general abundance of each species, based on the number of transects on which it was encountered during field sampling in each river reach.

3.2.5. Nomenclature

The plant assemblage names used in this study usually consist of the one or two dominant species in the assemblage. Dominant species are usually considered those that contribute the greatest average plant cover and that occur most frequently in each assemblage. These names are not taxonomic units, have no successional status, and may not be recognized by all investigators. This nomenclature is analogous to "common names," where no bounds have been set or rules defined for using a particular common name. In some instances, generic terms such as *mixed shrub* or *annual brome* were used to identify heterogeneous plant assemblages. A slash (/) separates dominant members of differing life forms, while a hyphen (-) separates dominant members of the same life form. Scientific names are used in combination with common names to facilitate communication with users accustomed to one or the other. All scientific names follow Hitchcock and Cronquist (1991).

4. RESULTS AND DISCUSSION

4.1. Cover Type Map

4.1.1. Study Area

The cover type mapping classified about 48,354 ha within the study area, or about 99.96% of the targeted area (Table 4 and Figure 3). Approximately 19 ha of the study area were unclassified due to lack of photographic coverage.

The most abundant upland vegetation cover type in the study area was *Grassland* (17,192 ha), followed by *Shrub Savanna* (10,154 ha) and *Shrubland* (3,195 ha, Table 4). Tree-dominated upland vegetation cover types were infrequent in the study area. The rarest upland vegetation cover types were *Desertic Woodland* (0.09 ha) and *Forested Upland* (72 ha, Table 4).

The most abundant riparian vegetation cover type in the study area was *Shore & Bottomland Wetland* (882 ha). This, however, is largely an artifact of the level of Brownlee Reservoir on the dates of aerial photography. The amount of *Shore & Bottomland Wetland* in the study area is always changing. The most abundant perennial riparian vegetation cover type is *Scrub-Shrub Wetland* (822 ha, Table 4). The most abundant natural feature cover types were *Lotic* (moving water) (7,791 ha) and *Cliff/Talus Slope* (2,722 ha). The most abundant land use cover types were *Agriculture* (2,436 ha) and *Grazing Land/Pasture* (581 ha, Table 4).

4.1.2. Legal Project Boundaries

Total area was calculated for each cover type occurring in the legal project boundaries of the Brownlee, Oxbow, and Hells Canyon hydroelectric projects (Table 5). The Brownlee Project boundary is the largest (7,305 ha), followed by Hells Canyon (3,249 ha) and Oxbow (2,433 ha). This area includes all *lotic* habitat (reservoir and riverine water).

The most abundant cover types in each category (upland, riparian, natural feature, and land use) for the Brownlee Project boundary are *Shrub Savanna* (440 ha), *Shore & Bottomland Wetland* (638 ha), *Lotic* (5,264 ha), and *Agriculture* (73 ha). The Oxbow Project boundary is characterized by the dominance of *Shrub Savanna* (217 ha), *Scrub-Shrub Wetland* (20 ha), *Lotic* (500 ha), and *Industrial* (18 ha) cover types. The Hells Canyon Project boundary is characterized by *Shrub Savanna* (126 ha), *Scrub-Shrub Wetland* (30 ha), *Lotic* (910 ha), and *Park*/*Recreation* (17 ha) cover types.

4.1.3. Study Reaches

Total area was calculated for each cover type occurring in the five study reaches (Table 6). The Brownlee Reservoir Reach is the largest (23,182 ha), followed by the reach below Hells Canyon Dam (10,912 ha), Hells Canyon Reservoir (6,281), Weiser Reach (4,163 ha), and the Oxbow Reservoir Reach (3,836 ha). *Grassland* is the most abundant upland vegetation cover type in each reach. *Scrub-Shrub Wetland* is the most abundant riparian vegetation cover type in each reach except Brownlee Reservoir, where *Shore & Bottomland Wetland* is the most abundant. *Lotic* is the most abundant natural feature cover type on all reaches above Oxbow Dam, whereas *Cliff*/*Talus Slope* is the dominant natural feature cover type on Hells Canyon Reservoir and the reach below Hells Canyon Dam.

The dominant land use cover type varies considerably between study reaches. *Agriculture* is most common above and on Brownlee Reservoir, whereas Oxbow Reservoir is dominated by *Industrial*, Hells Canyon Reservoir by *Park*/*Recreation*, and below Hells Canyon Dam by *Grazing land*/*Pasture* (Table 6).

4.1.4. Distribution by River Miles

The distribution of cover types by river mile throughout the study area reveals interesting patterns. These patterns are likely explained using a gradient concept wherein unique site factors, including hydrologic, geomorphic, climatic, and anthropogenic, result in specific distribution patterns of plant species and cover types across the landscape.

Upland Cover Types

Plotting the abundance of the 4 dominant upland cover types in the study area by river mile (Figure 5) shows that most of the *Grassland* cover type is distributed in the mid to lower reaches of Brownlee Reservoir and the downstream portions of the reach below Hells Canyon Dam. Relatively less *Grassland* cover type occurs in the steep and rocky areas near each of the three hydroelectric dam sites. Most *Shrub Savanna* cover type occurs at the upstream end of Brownlee

Reservoir and then generally decreases in abundance downstream to Hells Canyon Dam, where it continues in low amounts to the Salmon River confluence. The *Shrubland* cover type is patchy in distribution, with moderate amounts occurring in the Brownlee, Oxbow, and Hells Canyon reservoir reaches and very low amounts in the rest of the study area. Forested cover types are extremely limited throughout the study area, as indicated by the distribution of the *Tree Savanna* cover type, which mostly occurs in low amounts throughout the Hells Canyon Reservoir Reach.

Riparian Cover Types

Plotting the abundance of the 4 riparian cover types (Figure 6) illustrates that most of the *Shore & Bottomland Wetland* cover type occurs in the upstream portions of Brownlee Reservoir, decreasing in abundance to Brownlee Dam and occurring in low to moderate amounts below Hells Canyon Dam. This decrease is explained by Brownlee Reservoir level fluctuations and the seasonal flood scour-zone in the unimpounded reach below Hells Canyon Dam. Most of the *Scrub-Shrub Wetland* and *Forested Wetland* cover types occur in the Weiser Reach along the relatively wide floodplains, and again in the central portions of the study area in Hells Canyon and Oxbow reservoirs and near the downstream portion of Brownlee Reservoir. In the central portion of the study area, much of the *Scrub-Shrub Wetland* and *Forested Wetland* habitats occur near the mouths of tributary drainages to the Snake River and in the bottoms of these tributaries. The *Emergent Herbaceous Wetland* cover type is rare throughout most reaches of the study area, but noticeably increases in abundance at the upper end of Brownlee Reservoir and in the Weiser Reach.

4.2. Upland Vegetation Sampling

Three hundred eighty-six upland transects were sampled in the field; these transects were classified into 8 upland cover types, using the criteria defined in Appendix 1. TWINSPAN analyses were used to group the transects within each cover type into the plant assemblages described in Appendix 2 and listed in Table 9.

4.2.1. Forested Upland

Twenty-four transects were classified into the *Forested Upland* cover type. This cover type was encountered in all reaches except the Weiser Reach, with most occurrences along Hells Canyon Reservoir (Tables 7 and 8).

Average cover characteristics, including standard deviation (SD), for each major physiognomic group and for total cover in the *Forested Upland* cover type are summarized as follows:

Group	Mean Cover (SD)	Minimum Cover	Maximum Cover
Tree	68.9 (27.8)	25.3	100.0
Shrub	47.4 (49.3)	0.0	196.0
Forb	18.9 (14.9)	0.0	49.7
Grass	20.7 (19.6)	0.0	68.9
Total Cover	156.0 (55.3)	49.6	319.3

TWINSPAN analyses identified 6 plant assemblages for the *Forested Upland* cover type (Table 9). These plant assemblages are described in Appendix 2.

Most plant assemblages in this cover type were dominated by coniferous trees. Occasional stringers of *Pseudotsuga menziesii* and *Abies grandis* extended down to the river edge in the central and lower reaches of the canyon. Stands of *Pinus ponderosa* were also found along the river in these reaches. *Symphoricarpos albus* was a common understory dominant in the coniferous assemblages. Deciduous trees that dominated other assemblages included *Robinia psuedoacacia*, *Populus tremuloides*, and *Morus alba*. Most *Forested Upland* plant assemblages were encountered scattered throughout the central reaches of the study area: the lower portion of Brownlee Reservoir Reach, the Oxbow Reservoir and Hells Canyon Reservoir reaches, and the upper portions of the reach below Hells Canyon Dam. A few transects in several of the plant assemblages were sampled in tributary drainages to the Snake River (Table 9); however, no plant assemblages are unique to tributary drainage systems.

Several introduced and noxious weeds were found in the *Forested Upland* plant assemblages. The most common listed noxious weeds included *Taeniatherum caput-medusae* and *Cynoglossum officinale*.

4.2.2. Tree Savanna

Ten transects were classified into the *Tree Savanna* cover type (Table 7). This cover type occurred in the three reaches below Brownlee Reservoir and was encountered with the highest relative frequency on Hells Canyon Reservoir (Table 8).

Average cover characteristics for each major physiognomic group and for total cover in the *Tree Savanna* cover type are summarized as follows:

Group	Mean Cover (SD)	Minimum Cover	Maximum Cover
Tree	17.6 (4.4)	11.4	24.4
Shrub	44.5 (50.2)	0.6	155.3
Forb	20.4 (11.6)	6.8	48.4
Grass	32.3 (16.4)	2.4	55.5
Total Cover	114.9 (48.2)	68.1	223.2

TWINSPAN analyses identified 4 plant assemblages for the *Tree Savanna* cover type (Table 9). These plant assemblages are described in Appendix 2.

Pinus ponderosa dominated 1 of the assemblages, while *Celtis reticulata* and *Amelanchier alnifolia* which grew tall enough (> 5 m) to be considered trees, dominated the others. Like the *Forested Upland* plant assemblages, the *Tree Savanna* plant assemblages were encountered only in the central reaches of the study area, except for the *Celtis reticulata* assemblage, which was encountered in only the reach below Hells Canyon Dam. Most of the *Amelanchier alnifolia*-dominated transects were located only in tributary drainages to the Snake River (Table 9). One noxious weed (*Cynoglossum officinale*) and one rare plant (*Carex backii*) were found in the *Tree Savanna* plant assemblages.

4.2.3. Shrubland

Eighty-six transects were classified into the *Shrubland* cover type (Table 7). This cover type was encountered in all reaches of the study area, with the highest relative frequency in the Hells Canyon Reservoir Reach (Table 8).

Average cover characteristics for each major physiognomic group and for total cover in the *Shrubland* cover type are summarized as follows:

Group	Mean Cover (SD)	Minimum Cover	Maximum Cover
Tree	0.0 (0.2)	0.0	1.6
Shrub	52.7 (33.4)	25.2	178.6
Forb	17.6 (11.9)	0.0	52.8
Grass	28.5 (15.9)	1.4	81.0
Total Cover	98.8 (36.2)	37.1	231.6

TWINSPAN analyses identified 8 plant assemblages for the *Shrubland* cover type (Table 9). These plant assemblages are described in Appendix 2.

The most commonly encountered assemblages were dominated by *Celtis reticulata*, *Artemisia tridentata*, or *Purshia tridentata*. *Celtis*-dominated sites were more abundant in the downstream study reaches, while *Artemisia*- and *Purshia*-dominated sites were encountered most often in the Oxbow Reservoir and Brownlee Reservoir reaches. A few of the transects sampled in the *Celtis reticulata*-dominated assemblage (3 of 24) were located in tributary drainages to the Snake River (Table 9), but this assemblage is not considered unique to tributary drainages in the study area. However, the majority of *Symphoricarpos albus*-dominated transects (7 of 10) were located in tributaries to the Snake River (Table 9). This assemblage is more associated with these drainages than with habitats adjacent to the Snake River.

Most *Shrubland* plant assemblages appeared fairly healthy, although the herbaceous layer was usually dominated by introduced grasses, including *Taeniatherum caput-medusae*, a listed noxious weed in Oregon. Other noxious weeds found in these assemblages included *Convolvulus*

arvensis, *Cynoglossum officinale*, and *Lepidium latifolia*. The rare plant *Carex backii* was also found in 1 assemblage.

4.2.4. Shrub Savanna

One hundred ten transects were classified into the *Shrub Savanna* cover type (Table 7). This cover type was the most frequently encountered upland vegetation cover type (Table 7). It occurred in all reaches of the study area, but was most frequently encountered in the Brownlee Reservoir Reach (Tables 7 and 8).

Average cover characteristics for each major physiognomic group and for total cover in the *Shrub Savanna* cover type are summarized as follows:

Group	Mean Cover (SD)	Minimum Cover	Maximum Cover
Tree	0.0 (0.0)	0.0	0.0
Shrub	14.0 (5.5)	5.0	25.0
Forb	18.0 (11.2)	4.5	72.5
Grass	24.3 (14.5)	2.4	70.7
Total Cover	56.3 (16.3)	27.4	99.2

TWINSPAN analyses identified 8 plant assemblages for the *Shrub Savanna* cover type (Table 9). These plant assemblages are described in Appendix 2.

The most common assemblages were dominated by *Chrysothamnus nauseosus*, *Purshia tridentata*, *Celtis reticulata*, and *Artemisia tridentata*. *Celtis*-dominated sites were more abundant in the lower study reaches, while *Chrysothamnus* and *Purshia*- and *Artemisia*-dominated sites were encountered most often in the Oxbow Reservoir and Brownlee Reservoir reaches.

Some *Shrub Savanna* assemblages appeared healthy and were codominated by the native bunchgrasses *Agropyron spicatum* and *Poa secunda*. More often, the assemblages were deteriorated in health, and the herbaceous layer was dominated by introduced annual grasses such as *Bromus tectorum*, *Poa bulbosa*, and *Taeniatherum caput-medusae*. Most noxious weeds occurred in the *Celtis*-dominated assemblage. No rare plants were found in these assemblages.

4.2.5. Desertic Shrubland

Just 5 transects were classified into the *Desertic Shrubland* cover type (Table 7). This cover type was encountered in the Weiser Reach and the Brownlee Reservoir and Hells Canyon Reservoir reaches.

Average cover characteristics for each major physiognomic group and for total cover in the *Desertic Shrubland* cover type are summarized as follows:

Group	Mean Cover (SD)		Minimum Cover	Maximum Cover
Tree	0.0	(0.0)	0.0	0.0
Shrub	8.8	(5.9)	4.5	19.1
Forb	5.3	(3.6)	1.3	9.1
Grass	3.1	(2.1)	1.0	6.4
Total Cover	17.2	(6.1)	6.8	23.1

TWINSPAN analyses identified 2 plant assemblages for the *Desertic Shrubland* cover type (Table 9). These plant assemblages are described in Appendix 2.

This cover type was dominated by *Purshia tridentata* or *Artemisia tridentata*, and the plant assemblages sampled were only encountered in the Oxbow Reservoir and Brownlee Reservoir reaches. The herbaceous layer of both assemblages was dominated by annual grasses. No noxious weeds or rare plants were found.

4.2.6. Forbland

Forty-eight transects were classified into the *Forbland* cover type (Table 7). This cover type was encountered throughout the study area, but was most frequent in the Brownlee Reach (Tables 7 and 8).

Average cover characteristics for each major physiognomic group and for total cover in the *Forbland* cover type are summarized as follows:

Group	Mean Cover (SD)		Minimum Cover	Maximum Cover
Tree	0.0	(0.0)	0.0	0.0
Shrub	0.4	(0.7)	0.0	2.5
Forb	47.1	(32.7)	14.0	169.6
Grass	17.6	(13.1)	0.0	47.0
Total Cover	65.1	(33.7)	25.4	170.1

TWINSPAN analyses identified 8 plant assemblages for the *Forbland* cover type (Table 9). These plant assemblages are described in Appendix 2.

The most commonly encountered plant assemblages in this cover type were dominated by *Balsamorhiza sagittata*, *Eriogonum compositum*, and *Lomatium grayi*. These assemblages consist mostly of native species and contain few noxious weeds. Several other weedy *Forbland* plant assemblages were also encountered; these were dominated by species such as *Cardaria draba*, *Amaranthus retroflexus*, *Centaurea repens*, *Melilotus alba*, and *Tribulus terrestris*, several of which are listed noxious weeds.

A distribution gradient was evident for several assemblages in this cover type. The *Balsamorhiza sagittata*-dominated assemblage was encountered over most of the study area, whereas other

assemblages occurred only in the central reaches or in the very upper reach of the study area (see Appendix 2). No rare plants were found in these assemblages.

4.2.7. Grassland

Eighty transects were classified into the *Grassland* cover type (Table 7). This cover type was encountered throughout the study area, but most frequently in the Brownlee Reservoir Reach (Tables 7 and 8).

Average cover characteristics for each major physiognomic group and for total cover in the *Grassland* cover type are summarized as follows:

Group	Mean Cover (SD)	Minimum Cover	Maximum Cover
Tree	0.0 (0.0)	0.0	0.0
Shrub	0.8 (1.5)	0.0	4.9
Forb	18.2 (9.7)	2.0	64.8
Grass	40.9 (16.2)	14.2	86.4
Total Cover	59.9 (20.5)	25.2	144.9

TWINSPAN analyses identified 8 plant assemblages for the *Grassland* cover type (Table 9). These plant assemblages are described in Appendix 2.

The plant assemblages in this cover type included a variety dominated by native perennials and also those dominated by introduced annual grasses. The two most common assemblages are dominated by *Agropyron spicatum* and/or *Bromus tectorum*. Many of the assemblages in this cover type were distributed throughout the study area except for the Weiser Reach, where very little grassland habitat was found. The *Taeniatherum caput-medusa*-dominated assemblage was encountered only in the Oxbow Reservoir and Brownlee Reservoir reaches, and two weedy grass species-dominated assemblages were encountered only near the headwaters of Brownlee Reservoir and in the Powder River Arm of Brownlee Reservoir (see Appendix 2).

Listed noxious weeds occurring in these assemblages include (in decreasing order of abundance) *Taeniatherum caput-medusae*, *Cardaria draba*, *Onopordum acanthium*, *Dipsacus sylvestris*, and *Centaurea repens*. No rare plants were found.

4.2.8. Desertic Herbland

Twenty-three transects were classified into the *Desertic Herbland* cover type (Table 7). This cover type was most often encountered in the Brownlee Reservoir Reach (Tables 7 and 8), but it occurred occasionally in all reaches except above Brownlee Reservoir.

Average cover characteristics for each major physiognomic group and for total cover in the *Desertic Herbland* cover type are summarized as follows:

Group	Mean Cover (SD)		Minimum Cover	Maximum Cover
Tree	0.0	(0.0)	0.0	0.0
Shrub	0.9	(1.4)	0.0	4.1
Forb	7.6	(4.6)	0.0	19.1
Grass	6.6	(5.4)	0.0	17.1
Total Cover	15.2	(7.0)	0.8	23.7

TWINSPAN analyses identified 6 plant assemblages for the *Desertic Herbland* cover type (Table 9). These plant assemblages are described in Appendix 2.

Dominant forbs in these assemblages include *Lomatium grayi*, *Eriogonum compositum*, *Eriogonum strictum*, and *Alyssum desertorum*. Most assemblages are codominated by *Bromus tectorum* and were encountered primarily in the Brownlee Reservoir Reach. No noxious weeds or rare plants were found in these assemblages.

4.3. Riparian Vegetation Sampling

Based on the criteria used to define cover types (Appendix 1), 859 riparian transects were sampled in the field and their vegetation classified into 4 riparian cover types. TWINSPAN analyses were used to group the transects within each cover type into the plant assemblages described in Appendix 3 and listed in Table 9. The number of larger riparian habitats sampled in tributary riparian zones using the General Riparian Sampling protocol (Section 3.2.3) are identified in Table 9 for each plant assemblage.

4.3.1. Forested Wetland

Two hundred seven transects were classified into the *Forested Wetland* cover type (Table 7). This cover type was most frequently encountered in the Weiser Reach (Tables 7 and 8).

Average cover characteristics for each major physiognomic group and for total cover in the *Forested Wetland* cover type are summarized as follows:

Group	Mean Cover (SD)		Minimum Cover	Maximum Cover
Tree	91.5	(34.0)	30.0	175.6
Shrub	67.1	(48.8)	0.0	265.7
Forb	16.1	(16.8)	0.0	93.4
Grass	5.1	(8.7)	0.0	73.9
Total Cover	179.8	(44.2)	90.8	326.8

TWINSPAN analyses identified 18 plant assemblages for the *Forested Wetland* cover type (Table 9). These plant assemblages are described in Appendix 3.

The *Forested Wetland* cover type contains a diverse group of plant assemblages, but most sites were dominated by *Betula occidentalis*, *Alnus rhombifolia*, *Populus tricocarpa*, *Acer saccharinum*, or *Salix amygdaloides*. *Philadelphus lewisii* is by far the most common understory species and is a codominant member of several assemblages. Several less common assemblages are dominated by introduced species such as *Ulmus pumila*, *Salix alba*, *Eleagnus angustifolia*, *Acer negundo*, or *Tamarix parviflora*. Several plant assemblages showed distinct distribution gradients across the study area.

Betula occidentalis- and *Alnus rhombifolia*-dominated assemblages were encountered throughout central and lower reaches but nearly exclusively in tributary riparian areas rather than along shorelines of the Snake River (Table 9). Likewise, *Populus tricocarpa*-dominated sites were principally encountered only in the central reaches (Oxbow and lower Brownlee reservoirs) of the study area and in the riparian zones of tributary drainages (34 of 36 sites) to the Snake River (Table 9). Most of the assemblages dominated by introduced species (see Appendix 3) were found in the Weiser Reach and headwaters of the Brownlee Reservoir Reach.

All assemblages contained at least 1 listed noxious weed. Twelve noxious weed species were found. The most abundant and widespread included (in decreasing order) *Lepidium latifolium*, *Dipsacus sylvestris*, *Conium maculatum*, *Onopordum acanthium*, and *Cirsium arvense*. The rare plant *Rubus bartonianus* was found in 2 assemblages.

4.3.2. Scrub-Shrub Wetland

Two hundred ninety-eight transects were classified into the *Scrub-Shrub Wetland* cover type (Table 7). This cover type was encountered with the highest relative frequency in the Weiser Reach (Table 8).

Average cover characteristics for each major physiognomic group and for total cover in the *Scrub-Shrub Wetland* cover type are summarized as follows:

Group	Mean Cover (SD)		Minimum Cover	Maximum Cover
Tree	1.4	(5.1)	0.0	27.8
Shrub	101.9	(33.9)	29.0	221.0
Forb	20.0	(27.4)	0.0	144.0
Grass	8.4	(15.1)	0.0	123.1
Total Cover	131.6	(37.9)	30.5	232.0

TWINSPAN analyses identified 26 plant assemblages for the *Scrub-Shrub Wetland* cover type (Table 9). These plant assemblages are described in Appendix 3.

The *Scrub-Shrub Wetland* cover type contains the most diverse group of plant assemblages. The most commonly encountered assemblages were dominated by *Celtis reticulata*, *Amorpha fruticosa*, *Salix exigua*, *Prunus virginiana*, *Toxicodendron radicans*, *Salix amygdaloides*, *Philadelphus lewisii*, *Tamarix parviflora*, *Rubus discolor*, or *Rosa woodsii*.

A distinct distribution gradient is evident for many assemblages in this cover type. Generally, most native shrub-dominated assemblages were encountered throughout the study area or in just the central and lower study reaches. Introduced shrub-dominated assemblages were principally found near the headwaters of Brownlee Reservoir and in the Weiser Reach (see Appendix 3). The *Amorpha fruiticosa*-dominated assemblage is the most widespread introduced species assemblage, with sites encountered throughout the Weiser Reach and the Brownlee Reservoir and Oxbow Reservoir reaches. A few assemblages were principally found in tributaries to the Snake River. Most *Prunus virginiana*- and *Philadelphus lewisii*-dominated sites were found in the riparian zones of the tributaries (Table 9).

All but 1 assemblage contained at least 1 listed noxious weed. Thirteen noxious weed species were found. The most abundant and widespread noxious weeds included (in decreasing order) *Lepidium latifolium*, *Conium maculatum*, *Lythrum salicaria*, *Cirsium arvense*, and *Cardaria draba*. Several rare plants were found: *Rubus bartonianus* (2 assemblages), *Cyperus rivularis* (1 assemblage), and *Carex backii* (1 assemblage).

4.3.3. Emergent Herbaceous Wetland

Two hundred ninety-nine transects were classified into the *Emergent Herbaceous Wetland* cover type (Table 7). By far, this cover type was encountered with the highest relative frequency in the Weiser Reach, followed by the Brownlee Reservoir Reach (Table 8).

Average cover characteristics for each major physiognomic group and for total cover in the *Emergent Herbaceous Wetland* cover type are summarized as follows:

Group	Mean Cover (SD)		Minimum Cover	Maximum Cover
Tree	0.1	(1.2)	0.0	19.0
Shrub	2.8	(5.8)	0.0	29.3
Forb	57.8	(39.5)	0.0	156.4
Grass	25.8	(31.7)	0.0	127.6
Total Cover	86.4	(34.0)	30.8	213.4

TWINSPAN analyses identified 19 plant assemblages for the *Emergent Herbaceous Wetland* cover type (Table 9). These plant assemblages are described in Appendix 3.

This cover type contains a diverse group of plant assemblages, but most sites are dominated by *Lepidium latifolium*, *Heleochloa alopecuroides*, *Lythrum salicaria*, *Xanthium strumarium*, *Apocynum cannabinum*, *Conium maculatum*, or *Distichlis stricta*. Several of these dominant species are listed noxious weeds in Idaho and Oregon. Most of these assemblages were found in the Weiser Reach and headwaters of the Brownlee Reservoir Reach. Many of the assemblages are not unique to the riverbanks but are represented from transects within the riparian zones of tributary drainages (Table 9). However, the *Typha latifolia*-dominated assemblage was only found in tributaries to the Snake River (6 of 6 sites).

All but 3 assemblages contained at least 1 listed noxious weed species; 14 noxious weeds total were found. The most abundant and widespread weeds included (in decreasing order) *Lythrum salicaria*, *Lepidium latifolium*, *Cirsium arvense*, *Rumex crispus*, and *Dipsacus sylvestris*. One rare plant was found, *Cyperus rivularis* (1 assemblage).

4.3.4. Shore and Bottomland Wetland

Fifty-five transects were classified into the *Shore & Bottomland Wetland* cover type (Table 7). This cover type was encountered most frequently in the Brownlee Reservoir Reach and the reach below Hells Canyon Dam (Tables 7 and 8).

Average cover characteristics for each major physiognomic group and for total cover in the *Shore & Bottomland Wetland* cover type are summarized as follows:

Group	Mean Cover (SD)		Minimum Cover	Maximum Cover
Tree	0.0	(0.0)	0.0	0.0
Shrub	2.3	(6.3)	0.0	27.9
Forb	13.6	(9.0)	0.9	28.7
Grass	3.1	(5.9)	0.0	27.1
Total Cover	19.2	(8.2)	0.9	29.9

TWINSPAN analyses identified 9 plant assemblages for the *Shore & Bottomland Wetland* cover type (Table 9). These plant assemblages are described in Appendix 3.

The most abundant plant assemblage in this cover type was one dominated by *Portulaca oleracea*, an introduced weedy forb. Two assemblages were dominated by shrub species: *Celtis reticulata* and *Salix exigua*. Most of the remaining assemblages were dominated by various native forbs.

Five of the 9 assemblages contained at least 1 listed noxious weed species; a total of 5 noxious weed species was found: *Convolvulus arvensis*, *Rumex crispus*, *Lepidium latifolium*, *Lythrum salicaria*, and *Euphorbia esula*. All noxious weeds occurred infrequently in this cover type, with an average cover of less than 1%. One rare plant was found, *Cyperus rivularis*.

4.4. General Findings

The vegetation characteristics of Hells Canyon were assessed at two scales. For the first scale IPC staff used aerial photography to classify vegetation, natural feature, and land use cover types in the study area. Results of this effort provide a description of the relative amounts of vegetation cover types throughout the canyon. The second scale involved field sampling to assess the various plant assemblages occurring in each cover type and their distribution. Results of these efforts provide detailed insights regarding the floristic nature of the Hells Canyon area. The significance of the information is presented in the quantitative results of the cover type mapping

(Tables 4, 5, and 6), locations of field sampling sites (Tables 7 and 8), and the quantitative descriptions of plant assemblages (Appendices 2 and 3).

Upland vegetation cover types occupy almost 66% of the study area, compared with less than 3% for vegetated riparian cover types (*Forested Wetland, Scrub-Shrub Wetland* and *Emergent Herbaceous Wetland*) (Table 4). Although upland habitat is more abundant, the diversity of plant assemblages occurring in upland cover types is less than in riparian cover types. While 50 plant assemblages were found in the 8 upland cover types sampled (range = 2–8, mean = 5.5), 72 plant assemblages were found in the 4 riparian cover types (range = 9–27, mean = 18.3).

4.4.1. Environmental Gradients/Distribution Patterns

Plant assemblages and cover types often exhibit distinct distribution patterns in the study area. Unique site factors such as hydrologic, geomorphic, climatic, and anthropogenic influences (e.g., disturbance from grazing, homesteading, mining, farming, recreation) are believed to create environmental gradients that likely explain these distribution patterns across the landscape. Little empirical data is available to define these gradients and their influence on distribution patterns. However, field observations can be used to provide possible explanations and insight for some observed patterns. Specific environmental gradients identified and briefly discussed in the following text include soil depth; moisture availability; characteristics of lotic (moving water) environments; and presence or absence of cliff/talus slope, agriculture, and vegetation disturbance. There are certainly other environmental gradients likely influencing species distribution patterns.

Conceptually, three general distribution patterns are exhibited in the study area for plant assemblages and cover types. The first is a ubiquitous pattern where plant assemblages or cover types occur with more or less the same abundance throughout the study area. Few plant assemblages or cover types approach this pattern. The second is a regional pattern where, for example, a plant assemblage is present in the upper reaches of the study area but absent in the central or lower reaches, or vice versa. This is the most common pattern. The third is a localized pattern where a plant assemblage or cover type is found only in a specific reach or portion of a reach.

Influence of Natural Feature/Land Use Cover Types

The distribution of the three most abundant natural feature/land use cover types (*Cliff/Talus Slope*, *Agriculture*, and *Lotic*; Figure 4) and their site characteristics likely play a large role in influencing plant assemblage and cover type distribution patterns. The *Cliff/Talus Slope* cover type is not prevalent in the Weiser or Brownlee Reservoir reaches. In the vicinity of Brownlee Dam, this cover type occurs in low abundance and continues downstream to become most abundant in the vicinity of Hells Canyon Dam. It then decreases in abundance downstream for the next 15 mi or so and varies from low to moderate abundance to the confluence of the Salmon River. The presence of *Cliff/Talus Slope*, a geomorphic gradient, appears negatively correlated with abundance of several upland vegetation cover types illustrated in Figure 5. *Grassland*, *Shrub Savanna*, and *Shrubland* vegetation cover types become notably restricted in the vicinity of Hells Canyon Dam. The *Tree Savanna* cover type, however, is most abundant in this vicinity.

It coincides with the steep, rocky slopes in this vicinity where fingers of forested habitat reach down to the canyon bottom.

The other two abundant natural feature/land use cover types in the study area, *Agriculture* and *Lotic* (moving water), also create important environmental gradients that influence the abundance and distribution of plant assemblages and cover types. The *Agriculture* cover type is almost entirely restricted to the headwaters of Brownlee Reservoir and the Weiser Reach (Figure 4). A significant amount also occurs on the Powder River Arm of Brownlee Reservoir near the town of Richland, Oregon; this is not depicted in Figure 4 (see Figure 3, panel 6). Effects of agricultural practices and associated urban activities have usurped upland habitat. There is a marked decrease in upland cover types in the Weiser Reach (Figure 5) but a sharp increase in agricultural lands in this reach (Figure 4). Agricultural and urban influences have likely contributed to the introduction and spread of weedy species and could help explain the dominance of weedy species in many plant assemblages occurring in these areas.

The distribution of the *Lotic* cover type (Figure 4) is a function of the geomorphic (topographic) characteristics in the study area and the resulting water surface area on the reservoirs and unimpounded reaches. This feature and its characteristics (e.g., shallow floodplain waters vs. highly fluctuating reservoir vs. steep-gradient river) also influence plant assemblage and cover type distributions throughout the study area. Some examples are discussed in the following text.

The abundance of *Shore & Bottomland Wetland* is greatest near the headwaters of Brownlee Reservoir where a relatively broad alluvial floodplain is exposed during periods of drawdown (Figure 6). This cover type decreases in abundance downstream, directly related to the depth and topography (bathymetry) of Brownlee Reservoir and the amount of barren shore exposed on gentle slopes during reservoir drawdowns. The amount of *Shore & Bottomland Wetland* indicated in Figure 6 is an artifact of the reservoir stage during the dates of aerial photography for the cover type map: July 11, 1993, full-pool water levels below the confluence of Powder River; while on August 22, 1993, about 20 ft below full-pool upriver of the Powder River confluence. Although more exposed substrate would be expected below the confluence of the Powder River under a 20-foot drawdown, there would not be the extent as that found in shallow floodplain environments near the headwaters of Brownlee Reservoir, nor in the area of the Powder River pool, which is not depicted in Figure 6. The *Shore & Bottomland Wetland* cover type increases downstream of Hells Canyon Dam, where spring runoff seasonally scours the river channel.

Most of the available riparian habitat (*Forested Wetland*, *Scrub-Shrub Wetland*, and *Emergent Herbaceous Wetland*) immediately along the shorelines of the Snake River occurs in the upper reaches of the study area due to geomorphic characteristics that result in a relatively broad alluvial floodplain environment (Figure 6 and Figure 3, panels 1 and 2). A similar situation occurs near the mouth of the Powder River pool (Figure 3, panel 6), which is not depicted in Figure 6. Generally, all of the *Emergent Herbaceous Wetland* habitat is found in these areas. Unlike most of the study area, the Weiser Reach is a low-gradient (0.2–0.4 m/km) river, having several island complexes. Stream substrates are small, with fines and sand to medium-sized cobbles prevalent throughout (Johnson et al. 1992). In contrast, starting at about Farewell Bend on Brownlee Reservoir, the gradient of the Snake River steepens (Blair et al. 2001). A steeper gradient increases the ability of the Snake River to transport sediment as well as increases the

size distribution of the sediment (Parkinson 2001). Consequently, relatively little fine sediment was deposited by the river, which is now inundated by the reservoir complex. The gradient of the Powder River Arm of Brownlee Reservoir is also low, exposing large mudflats with small fluctuations in reservoir levels. Below Brownlee Dam, the canyon generally becomes increasingly steep and rocky, and the river is deeply incised into bedrock. These characteristics do not favor shallow areas with suitable substrate for the establishment of emergent wetland habitats.

The increase of *Forested Wetland* and *Scrub-Shrub Wetland* cover type abundance between Brownlee and Hells Canyon dams (Figure 6) largely occurs in the tributaries to the Snake River, outside of the Snake River riparian zone. However, there is also an increase here along the riparian zones of Oxbow and Hells Canyon reservoirs. These reservoirs are considered reregulating reservoirs. Oxbow Reservoir fluctuates on a daily basis within 5.6 ft of the normal full-pool elevation 90% of the time, and Hells Canyon Reservoir is operated within 3.8 ft of the normal full-pool elevation 90% of the time (Parkinson 2001). The relatively stable pool levels and daily fluctuations on these reservoirs enhance establishment of riparian and wetland vegetation compared with what would exist if the reservoirs were not held relatively stable.

Numerous studies have assessed the impacts of water level fluctuations to shoreline vegetation in reservoirs (Austin et al. 1979, Allen and Aggus 1983, Thompson 1983, Thibodeau and Nickerson 1984, Amudsen 1994). In general, level of impact depends on the timing and magnitude of fluctuation. In reservoirs with large water level fluctuations, shoreline vegetation is highly variable and often sparse (Nilsson and Keddy 1988). This is due to the severe environmental regime of flooding followed by abrupt drought imposed by drawdown. Typical species found growing under these conditions are small, fast-growing annuals that set seed quickly. Total vegetation cover tends to be low, as exhibited by the "bathtub ring" seen in reservoirs having large fluctuations, such as Brownlee. Shoreline vegetation of reservoirs with more narrow fluctuations tends to be more abundant and stable, depending on seasonal timing of the fluctuations. Several studies have found that reservoirs with narrow fluctuations and stable summer levels can attain a fairly stable shoreline vegetation within a couple of decades (Krzyzanek et al. 1986 as cited in Nilsson and Keddy 1988, Wilcox and Meeker 1991).

Below Hells Canyon Dam, the steep canyon walls and prevalence of scouring floods restrict most *Forested Wetland* habitat to tributary drainages. Much of the *Scrub-Shrub Wetland* cover type in this reach, however, occurs along the high-water mark of the river channel itself. This is where most of the *Celtis reticulata*-dominated plant assemblages occur in the study area.

Shrub Savanna Cover Type

A closer look at the distribution of a particular cover type and its plant assemblages provides examples of the distribution patterns found in the study area and identifies additional environmental gradients potentially influencing these patterns.

The abundance of the *Shrub Savanna* cover type provides an example of the regional distribution pattern (Figure 5). This is the second most abundant upland cover type (10,154 ha, 21% relative frequency) in the study area (Table 4). It occurs mostly near the headwaters of Brownlee Reservoir and then generally decreases in abundance downstream to Hells Canyon Dam, where it

continues in low amounts to the confluence of the Salmon River (Figure 5). Although little climate data is available throughout the canyon, field observations suggest that an environmental moisture gradient may partially explain this cover type's distribution: an increase in precipitation from the upper reaches to the lower reaches. Climatological information is summarized for established weather stations at Weiser, Richland, Brownlee Dam, and Lewiston in Figure 2. Average annual precipitation is lowest at the southern end of the study area (Weiser, 286 mm), increases northward (Richland, 298 mm), peaks around Brownlee Dam (445 mm), and declines toward Lewiston (326 mm). More precipitation, especially as snow, has consistently been observed on Oxbow and Hells Canyon reservoirs than on Brownlee Reservoir. Field observations suggest that the actual peak in precipitation may occur in the vicinity of Hells Canyon Dam, although there is no established weather station there for verification. This increased moisture may favor *Shrubland* over *Shrub Savanna* habitats below Brownlee Dam.

A disturbance gradient may also influence the distribution of *Shrub Savanna*. Significant disturbances occurred upstream of the Hells Canyon Dam area well before the 1950s (Blair et al. 2001). Mining, logging, and especially livestock grazing were pronounced in the upstream watershed. The relatively moderate hill slopes, from the headwaters of Brownlee Reservoir downstream to about Brownlee Dam, are more accessible to livestock grazing today, and in the past, than the steeper, rocky slopes more characteristic of Oxbow and Hells Canyon reservoirs. Increased grazing pressure above Brownlee Dam may have degraded shrubland habitats, resulting in more *Shrub Savanna*, while most *Shrubland* persists in the less accessible uplands of the Oxbow and Hells Canyon Reservoir reaches.

Several plant assemblages in the *Shrub Savanna* cover type exhibit regional distribution patterns (Appendix 2, *Shrub Savanna* plant assemblage distribution maps). *Artemisia tridentata*- and/or *Chrysothamnus nauseosus*-dominated plant assemblages were essentially found only along the Brownlee Reservoir Reach. These species are known to occupy similar habitats (Tisdale and Hironaka 1981). In Hells Canyon, as on other sites within the sagebrush-grass region, these sites tend to be on relatively deep, well-drained, and sometimes saline soils (Tisdale and Hironaka 1981). Such sites are believed to occur primarily along the Brownlee Reservoir Reach. Little published soil information is available for the canyon. The U.S. Department of Agriculture (1994) reports that the amount of soil cover declines northward through Hells Canyon to a point near Hells Canyon Dam (RM 247.5) where most rock faces are nearly vertical and have little soil cover. Field observations suggest that the deepest soils in the study area are found in the Brownlee Reservoir and Weiser reaches. *Purshia tridentata*-dominated assemblages were found primarily in Oxbow Reservoir and Hells Canyon Reservoir reaches. This species occurs in association with *Artemisia tridentata* on deep well-drained soils, but often on coarse-textured, nonsaline sites (Tisdale and Hironaka 1981). This soil preference may explain the distribution observed in the canyon: *Purshia* assemblages tend to occur downstream of *Artemisia* assemblages where the canyon becomes increasingly more steep and rocky and the soils may be coarser. *Celtis reticulata*-dominated assemblages were found essentially downstream of Brownlee Dam. This species typically occurs on lower slopes in the canyon bottom, often occupying seepage lines or areas along riparian margins. Nonriparian *Celtis*-dominated sites are among the driest sites in the canyon, and persistence of *Celtis* on these sites is due to subterranean moisture availability. *Celtis* typically grows on soils that are well-drained colluvium or alluvial sands (Johnson and Simon 1987). Most such sites occur below Brownlee Dam. *Celtis* is known to have occurred historically throughout the Brownlee Reservoir Reach

along the Snake River, becoming increasingly rare upriver of the Farewell Bend area where broad floodplains favored establishment of more mesic species (Blair et al. 2001). Most *Celtis*-dominated sites along the Brownlee Reservoir Reach were inundated with reservoir construction. The *Artemisia rigida*-dominated assemblage exhibits a localized distribution pattern. This assemblage was only encountered in the Brownlee Dam vicinity. Known to be infrequent in the canyon, it occurs on sites with shallow soils on upper canyon slopes, where presumably the climate is cooler and moister than at the canyon bottoms (Tisdale 1986).

Degraded Upland Habitat

Of particular note in upland habitats is a general increase in degraded plant assemblages upstream of Hells Canyon Dam. Upland assemblages in many cover types dominated or codominated by nonnative or invasive species such as *Chrysothamnus nauseosus*, *Bromus tectorum*, *Poa bulbosa*, *Taeniatherum caput-medusae*, and other annual *Bromus* spp. are more prevalent on the Brownlee Reservoir Reach than downstream, especially near the upper portions of Brownlee Reservoir (see Appendix 2, plant assemblage distribution maps). *Chrysothamnus nauseosus* is usually a minor component of relatively undisturbed sagebrush-grass stands (Eckert and Evans 1968, Tisdale et al. 1969, Hironaka and Fosberg 1979). Disturbance by fire or mechanical damage favors *Chrysothamnus* and results in a marked increase of the species (Daubenmire 1975, McArthur et al. 1979). *Bromus tectorum* is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). It was encountered in 447 transects and in all study reaches, with most encounters along the Brownlee Reservoir Reach (205 transects, 46% relative frequency; Appendix 4). *Poa bulbosa* is a weedy annual grass, introduced from Europe, that commonly grows in disturbed areas of most western states (Whitson et al. 1992). It was found on 177 transects, in all study reaches, with most encounters along the Brownlee Reservoir Reach (97 transects, 55% relative frequency; Appendix 4). *Taeniatherum caput-medusae* is an aggressive winter annual grass, introduced from Eurasia, and is predominant on millions of acres of semiarid rangeland in the Pacific Northwest (Whitson et al. 1992). Extremely competitive, it crowds out even such undesirable species as *Bromus tectorum*. It was encountered in 124 transects and in all study reaches, with most encounters along the Brownlee Reservoir Reach (80 transects, 65% relative frequency; Appendix 4).

Both a disturbance gradient and a moisture gradient could be influencing this pattern of degraded habitat above Hells Canyon Dam. Since construction of the Hells Canyon Complex, most anthropogenic influences have occurred above Hells Canyon Dam. This portion of the study area is more easily accessible for livestock operations, recreation, and other human activities (e.g., farming, residential pursuits), compared with the reach below Hells Canyon Dam (Blair et al. 2001). Much of the land along Oxbow and Brownlee reservoirs is considered to be of poor grazing quality because of the steep terrain and overgrazed condition of the bench areas (Bonneville Power Administration 1984). With the creation of the Hells Canyon Natural Recreation Area, most livestock grazing has dramatically decreased below Hells Canyon Dam since 1975, and only in the last decade or so has recreational use of the river in this reach significantly increased. Combined with less abundant moisture as one moves upstream from Hells Canyon Dam, the increased and relatively steady grazing pressure and other anthropogenic influences may explain the current degraded condition of many upland plant assemblages in the upstream reaches of the study area.

Forested Wetland Cover Type

A brief discussion of the distribution patterns of plant assemblages in the *Forested Wetland* cover type provides useful insight on the general distribution of riparian habitats in the study area (Appendix 3, *Forested Wetland* plant assemblage distribution maps). Several plant assemblages only occur in the upper reaches of the study area, thus expressing a localized (or restricted regional) distribution pattern. These include assemblages dominated by *Acer saccharinum*, *Salix amygdaloides*, *Salix alba*, *Salix exigua*, *Eleagnus angustifolia*, *Acer negundo*, or *Tamarix parviflora*. Life history traits of these species indicate an affinity for the relatively broad alluvial floodplain environment in this area. Many of these dominants are nonnative species that have been introduced to the Weiser Reach by residential and agricultural influences since construction of the Hells Canyon Complex. They have out-competed sparse, scattered stands of *Salix exigua* and *Celtis reticulata* that existed before construction of the Hells Canyon Complex (Blair et al. 2001).

Several *Forested Wetland* plant assemblages are almost exclusively located in tributary drainages throughout the central and lower reaches. These include assemblages dominated by *Betula occidentalis*, *Alnus rhombifolia*, and *Populus tricocarpa* (Table 9). These species favor environments where flooding and scouring events commonly occur. *Alnus rhombifolia* is well adapted to revegetating tributaries after flooding. It exhibits all the traits of a typical pioneer species by being a prolific seeder and able to sprout after disturbance (Miller 1976). *Populus tricocarpa*-dominated assemblages occur primarily in tributaries along Oxbow Reservoir and the lower portions of Brownlee Reservoir. *Populus tricocarpa* is dependent upon dynamic flow patterns and repeated flooding and scouring of unconfined floodplains. It requires moist and barren fine substrates for recruitment sites and a gradual recession of flows that does not exceed about 5 cm per day (Mahoney and Rood 1998). In the canyon, such sites are, and historically were, mostly limited to the larger tributaries to the Snake River (Blair et al. 2001).

Other *Forested Wetland* plant assemblages are generally regionally distributed throughout the study area. *Celtis reticulata*-dominated assemblages occur in all study reaches but most often in the lower reaches. Specific distribution patterns of riparian plant assemblages in all riparian cover types are given in Appendix 3.

Tributary Drainage Riparian Plant Assemblages

It is noteworthy that several riparian plant assemblages in both the *Forested Wetland* and *Emergent Herbaceous Wetland* cover types tend to be unique to the tributary drainages of the Snake River in the study area rather than occurring along shorelines in the canyon bottom (Table 9). Because of the two-approach methodology used to investigate riparian vegetation resources in the canyon (Section 3.2.3), it is possible to distinguish between those resources directly associated with the Snake River riparian zone (and associated reservoirs) and those resources more characteristic to tributary drainages. Plant assemblages found almost exclusively in tributaries to the Snake River include those dominated by *Betula occidentalis*, *Alnus rhombifolia*, *Philadelphus lewisii*, *Populus tricocarpa*, *Salix alba*, and *Typha latifolia*. Sites dominated by *Prunus virginiana*, *Celtis reticulata*, *Scirpus maritimus*, and *Dipsacus sylvestris* were common to both riparian zones (Table 9). Generally, all other plant assemblages described in Appendix 3 are considered characteristic of the Snake River riparian zone in the study area.

4.4.2. Context of Study

This study was not intended to describe every plant assemblage that currently exists in the study area. Rather, it represents a relatively large sample of the vegetation throughout the canyon, and it identifies the most likely plant assemblages one could expect to encounter within the study area. Certainly there are other plant assemblages in the canyon that were not sampled and may or may not have been described by previous investigators.

Most of the plant assemblages identified in this study have not been previously described, especially those occurring in riparian habitats. Even many frequently occurring, abundant species had not previously been identified as abundant or widespread in the canyon. Examples include *Philadelphus lewisii* and *Prunus virginiana*. *Philadelphus lewisii* is a common dominant or codominant species in the *Forested Wetland* and *Scrub-Shrub Wetland* cover types throughout the canyon. *Prunus virginiana* is one of Idaho's most ubiquitous species and is also quite common in the canyon. Many riparian plant communities in the study area were probably not previously described because of limited sampling efforts or a focus on certain species of interest (e.g., *Alnus rhombifolia*; *Celtis reticulata*; or mid- to late-seral, native vegetation).

It must be recognized that the landscape of Hells Canyon displays continuous variation in species composition at all scales and that there are many transitional areas where different plant assemblages integrate. Therefore, in addition to the plant assemblages described in this study, many areas in each cover type are occupied by transitional plant assemblages.

Generalizations regarding the floristic organization of Hells Canyon are difficult because such organization centers around the integrating environmental variables that not only account for different combinations of habitat conditions, but, through natural selection, permit a high degree of species overlap between habitats. Assemblages of plants, therefore, are rarely definitive in relation to what may appear to be distinctive habitat. In Hells Canyon, probably the most important environmental variable affecting upland and riparian habitats is the relative abundance of, or the intermittent character of, water in the habitat. For upland habitats, water abundance and intermittence character are determined by such factors as slope, aspect, soil depth, and litter accumulation, while in riparian habitats they are influenced by slope, aspect, soil depth, ground water percolation, water surface elevation changes, and flood events. These factors combine in various ways to produce a complex habitat diversity in the canyon.

4.4.3. Exotic Weeds

The disturbance of native vegetation and the settlement of the West by immigrants were accompanied by the introduction of numerous exotic, weedy species. Many plant assemblages in the canyon are dominated by introduced weeds and many species designated as *noxious weeds* by Idaho and/or Oregon.

In upland habitats, the most common dominant upland weed is *Bromus tectorum*. This species is a dominant or codominant member of the most common upland plant assemblages in the most abundant upland cover types. It is a dominant or codominant member in 20% of all identified upland assemblages (10 of 50). *Bromus tectorum* can significantly alter native rangeland vegetation composition through competitive exclusion of native species reproduction and the

facilitation of wildfires. Areas typically invaded by *Bromus tectorum* carry high amounts of continuous fine fuels and are dry enough to carry a fire (Whisenant 1990). With the shift from native rangelands dominated by perennials toward annual grasslands, fire frequency of *Bromus tectorum*-dominated rangelands in Idaho has increased to 3- to 5-year intervals (Whisenant 1990). Natural diversity has been significantly reduced as a result. And with the addition of poor grazing practices, recovery of native sagebrush-bunchgrass vegetation through natural successional pathways is altered, if not eliminated (Whisenant 1990).

Other widespread introduced upland species include *Taeniatherum caput-medusae* (Oregon listed noxious) and *Poa bulbosa*. These annual graminoids have probably been introduced and spread in the canyon by a number of vectors (e.g., livestock grazing, mining, homesteading, recreation). *Taeniatherum caput-medusae* is a serious threat to upland assemblages in the canyon. Not only can it take over sites previously dominated by weeds such as *Bromus tectorum*, but it is also capable of establishing and maintaining itself in diverse communities of native perennial plants (Miller 1996). Sites dominated by these aggressive annual species will not likely be altered to more desirable vegetation assemblages without significant human intervention with large and consistent inputs of control activities (e.g., chemical, mechanical, biological), seed and plant materials of desirable species, monitoring, and maintenance.

In riparian habitats, *Amorpha fruticosa*, *Tamarix parviflora*, *Lepidium latifolium*, *Lythrum salicaria*, *Conium maculatum*, and *Xanthium strumarium* are common dominant or codominant members in some of the most common riparian plant assemblages in many riparian cover types (Appendix 3). All of these weedy species are very competitive and can crowd out desirable vegetation, resulting in dense monocultures and a decrease in biodiversity. *Lepidium latifolia* (listed noxious in Oregon and Idaho) dominates the herbaceous layer in more riparian plant assemblages than any other species and is present in over one-half (37 of 72, 51% relative frequency) of all riparian assemblages.

Most weedy riparian assemblages occur along the headwaters of the Brownlee Reservoir and in the Weiser Reach. This is where most riparian vegetation occurs along the Snake River in the study area due to the presence of a relatively broad floodplain. Riparian zones are generally vulnerable to invasion by exotic species because rivers are dynamic and have recurrent disturbances (e.g., flooding, scour, sediment transfer and deposition), water is available all year-round, and rivers form a natural network for dispersal across the landscape (Planty-Tabacchi et al. 1995). Invasion is often even more pronounced in regulated rivers where natural communities are further disturbed (Nilsson and Berggren 2000). Prior to and since construction of the Hells Canyon Complex, many species have been introduced to the ecosystem through residential and agricultural influences both upstream and within the study area (Braatne et al. 2002). With these weed introductions and the capacity of these species to proliferate in the floodplain environment, the abundance of weeds found in these reaches is not surprising.

Although regulated water levels from hydroelectric projects contribute to invasion of riparian areas by exotic species, it appears that the large water level fluctuations resulting from current operations on Brownlee Reservoir may provide a barrier that impedes downstream infestation of many weedy species through riverine processes. Brownlee Reservoir is typically fluctuated up to 50 or more ft once or twice annually to meet flood control requirements and anadromous fishery flow release agreements. The successive drying and flooding that result in the drawdown zone of

the reservoir are not conducive to survival of established seedlings of most riparian species (Nilsson and Keddy 1988). Table 12 identifies common and abundant, exotic riparian weedy species found almost exclusively in the Weiser Reach and in the headwaters of the Brownlee Reservoir. All these species have appropriate life history traits for potentially invading downstream reaches under natural river flow conditions. More detailed information regarding the current distribution of noxious weeds is provided by Krichbaum (2000). The mechanisms for weed recruitment in the study area are currently being investigated (Braatne et al. 2002).

Tamarix species (tamarisk or salt cedar) are examples of invasive riparian species showing evidence of being impeded in downstream migration by ongoing operations on Brownlee Reservoir. *Tamarix* is aggressive and woody, producing massive quantities of small seeds and being able to propagate from buried or submerged stems or branch fragments. It often forms dense monotypic stands that out-compete other riparian species (de Gouvenain 1996), with the capacity to replace native trees and associated bird fauna (Ellis 1995, Cleverly et al. 1997). *Tamarix* species are listed in many other western states as noxious weeds, but not in Idaho or Oregon. Believed to be relatively recent invaders to the study area (10–15 yrs), *Tamarix* is quite prolific in the Weiser Reach and in the headwaters of Brownlee Reservoir but was found nowhere else in the study area (see distribution maps of *Tamarix*-dominated assemblages in the *Forested Wetland* and *Scrub-Shrub Wetland* cover types, Appendix 3; and Krichbaum 2000, Figure 16). *Tamarix* does occur downstream of the study area on the Snake and Columbia rivers. On the upper reaches of Brownlee Reservoir, young *Tamarix* seedlings (or clonal fragments) were observed to annually establish in the drawdown zone but were subsequently killed by refilling of the reservoir. *Tamarix* cannot survive flooding more than three months (Stevens 1990). The young plants that survive along the high-water mark are subsequently killed by long periods of drawdown (drought). Although not totally dependent on permanent ground water (Turner 1974), mature *Tamarix* usually occurs in areas where its roots can reach the water table (depth to ground water does not exceed 3–5 m), such as floodplains, along irrigation ditches, and on lakeshores. Given the invasive capacity of *Tamarix*, it could spread rapidly downstream to quickly dominate shoreline riparian habitats if water levels were held relatively stable on Brownlee Reservoir.

That few riparian weed occurrences are found below Hells Canyon Dam may be explained by the absence of suitable microconditions for these species to germinate and persist. Current simulation studies with weeds of different life history traits may provide a better understanding about the potential future expansions under various operation scenarios (Braatne et al. 2002).

Although current operations on Brownlee Reservoir may be effective in controlling downstream infestation of several weedy riparian species, many of these species may have been introduced to the Oxbow and Hells Canyon reservoir reaches by other vectors (e.g., recreation activities, vehicles, livestock, homesteading) coincident with, and prior to, construction and operation of the Hells Canyon Complex. These reaches historically, and today, have been accessible by vehicle traffic.

In the early 1970s, Asherin and Claar (1976) documented the dominance of some plant assemblages by weedy species in both upland and riparian habitats. Such species included *Taeniatherum caput-medusae*, *Bromus tectorum*, *Sisymbrium altissimum*, *Bromus japonicus*, *Lepidium latifolium*, *Elaeagnus angustifolia*, *Robinia pseudoacacia*, *Cirsium arvense*, and *Acer*

negundo. The magnitude of historical weedy species abundance is unknown. Except for the limited sampling (41 upland and riparian transects in the Hells Canyon study area) by Asherin and Claar (1976), most previous investigators focused on mid- or late-seral vegetation and omitted quantification of weedy or pioneering species. With certainty, it can be concluded that introduced weed species in the canyon have continued to spread and occupy more of the landscape.

Early European settlers, even deep in the canyon, altered the landscape considerably, especially near homestead sites. Evidence of this is found in many woody ornamental or fruit-bearing shrubs and trees that were encountered during field sampling. These plants have escaped and naturalized into surrounding upland and riparian habitats. The ornamental escapees found during sampling are summarized in Table 13. The distribution of these species by reach is given in Appendix 4.

4.5. Management Implications

Vegetation maps are commonly used by many natural resource managers. They provide valuable information on the extent, representation, and spatial distribution of botanical resources. They are used for planning management strategies to improve vegetation resources and are an important tool for modeling and predicting distribution of wildlife and other environmental resources. However, two important caveats should be mentioned about this vegetation map (Figure 3) with its GIS database, and about vegetation maps in general, so that users are aware of the limitations.

First, vegetation maps do not show habitats smaller than the minimum mapping unit. Thus, microhabitat elements, which may be locally or regionally significant, are not delineated. In this study, the minimum mapping units for riparian habitats were approximately 10 m in diameter for polygons and 3 m wide for linear features. The linear cover types are not illustrated in Figure 3, but are available in the GIS database. Upland habitats were mapped at a more general detail. Therefore, smaller features than these, which could include tributary streams, small open water pools or stock ponds, small patches of shrubs, or thin bands of riparian vegetation, were not identified. Because the *Emergent Herbaceous Wetlands* cover type often occurred as thin, patchy bands of vegetation, which were difficult to distinguish on aerial photographs and impractical to delineate and map separately, their coverage may be slightly underestimated.

Second, classifications of natural systems are imprecise; there will always be zones of transition and variants, and vegetation boundaries may not be discrete (Jennings 1993). The point at which one cover type ends and another begins is often subjective and based on the interpreter's perspective and scale of reference. Some amount of intelligent generalization is required in any mapping exercise (Stoms 1992).

Vegetation data is useful to resource managers as a guide to understanding the current condition of vegetation resources and to guide management plans for areas that have been impacted by heavy grazing, fire, timber harvesting, recreation, or other disturbance activities. Considerable details have been included in the site information (Appendices 2 and 3) to describe each plant assemblage and permit a clearer perception of its current distribution and site conditions.

Although this study was focused along the Snake River in the Hells Canyon area, many of the plant assemblages, species, and site conditions described here are typically found in other canyon environments throughout west-central Idaho, northeastern Oregon, and southeastern Washington. This investigation indicates a general floristic agreement between the plant assemblages described for the study area and similar plant assemblages described in the vicinity, with the exception of the many previously undescribed plant assemblages. Vegetation counterparts are noted in the sections describing each plant assemblage. The user needs to exercise caution in making extrapolations or interpretations beyond the stated or obvious. The plant assemblages described herein are those that exist under the influence of such disturbance factors as homesteading, grazing, timber harvesting, recreation use, repeated fires, flooding (especially in tributaries), and hydroelectric operations.

Unarguably, the structure and composition of many native plant assemblages in the study area have been affected by past anthropogenic disturbances. The high degree of historic human-caused disturbance in the study area has been locally intense and often of long duration. Most, if not all, of the easily accessible lands in the study area have been exploited by many users. However, the rate, extent, and degree of change to native plant assemblages from any single type of disturbance cannot be quantified with certainty. Because disturbance is a main conduit for weed establishment and spread, controlling disturbance and implementing effective weed control measures will be primary management challenges in the study area.

Because changes may be considered and implemented in the future for hydroelectric operations in the canyon, special attention should be given to the potential effects of such changes on the spread of introduced riparian weeds. Given that current operations on Brownlee Reservoir may inhibit downstream migration of many riparian weed species, changes to these operations may eliminate this impediment. Operation scenarios in which Brownlee Reservoir would be kept relatively stable with minimal water level fluctuations would likely result in a rapid increase in riparian vegetation along the reach in suitable habitat. This new riparian vegetation would likely become perpetually dominated by the weedy species now prevalent in the Weiser Reach. Such changes may also negatively influence existing downstream riparian plant assemblages by creating increased competition with introduced species.

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Table 1. River reaches and codes for the Hells Canyon Study Area.

Code	Reach	River Mile	Miles
BA	Above Brownlee (Weiser)	351.2–339.2	12.0
BR	Brownlee Reservoir	339.2–283.7	55.5
OX	Oxbow Reservoir	283.7–269.5	14.2
HC	Hells Canyon Reservoir	269.5–247.5	22.0
HB	Below Hells Canyon Dam	247.5–188.2	59.3

Table 2. Vegetation, land use and land cover types for the Hells Canyon Study Area.

No.[1]	Cover Type	No.[1]	Cover Type
	Riparian Vegetation [2]		***Natural Feature***
1	Emergent Herbaceous Wetland	6	Lentic (Standing Water)
3	Shore & Bottomland Wetland	7	Lotic (Moving Water)
4	Scrub-Shrub Wetland	17	Barrenland (i.e., Sand Dunes)
5	Forested Wetland	18	Cliff/Talus Slope
	Upland Vegetation [3]		***Land Use***
8	Forested Upland	19	Disturbed
9	Shrubland	20	Agriculture (Cultivated)
10	Tree Savanna	21	Grazing Land/Pasture
11	Shrub Savanna	22	Urban
12	Desertic Woodland	23	Residential
13	Desertic Shrubland	24	Industrial
14	Desertic Herbland	25	Parks/Recreation
15	Grassland	26	Roads
16	Forbland	27	Forested/Orchard

[1] Numbers refer to codes used in classifying mapping polygons and correspond with the definitions found in Appendix 1.

[2] Riparian vegetation cover types generally follow the classification system described by Cowardin et al. (1979) and modified for Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service 1981).

[3] Upland vegetation cover types generally follow the classification system used for HEP cover types as outlined in U.S. Fish and Wildlife Service (1981).

Table 3. Summary criteria used to delineate vegetation cover types for the Hells Canyon Study Area.

No.	Cover Type	Woody Cover (%)	Tree Cover (%)	Shrub Cover (%)	Herb Cover (%)	Total Veg. Cover (%)	Comment
1	Emergent Herbaceous Wetland	< 30				> 30	Riparian Assemblage-dominated by perennial plants
3	Shore & Bottomland Wetland					< 30	Riparian Assemblage (if vegetation present)
4	Scrub-Shrub Wetland	≥ 30	< 30			> 30	Riparian Assemblage, woody vegetation < 6 m tall
5	Forested Wetland	≥ 30	≥ 30			> 30	Riparian Assemblage, woody vegetation ≥ 6 m tall
8	Forested Upland		≥ 25			≥ 25	Upland Assemblage, trees > 5 m tall
9	Shrubland			≥ 25		> 25	Upland Assemblage, may include trees < 5 m tall
10	Tree Savanna		5< x< 25			≥ 25	Upland Assemblage, trees > 5 m tall
11	Shrub Savanna		< 5	5< x< 25		≥ 25	Upland Assemblage, may include trees < 5 m tall
12	Desertic Woodland		≥ 5			≤ 25	Upland Assemblage, trees > 5 m tall
13	Desertic Shrubland		< 5	≥ 5		≤ 25	Upland Assemblage, may have trees < 5 m tall
14	Desertic Herbland		< 5	< 5		≤ 25	Upland Assemblage
15	Grassland		< 5	< 5	Grass > Forb	≥ 25	Upland Assemblage
16	Forbland		< 5	< 5	Forb > Grass	≥ 25	Upland Assemblage
17	Barrenland					≤ 5	Upland Assemblage, undisturbed
18	Cliff/Talus					≤ 5	Upland Assemblage
19	Disturbed					< 15	Upland Assemblage, > 50% disturbed by human activities

Table 4. Aerial extent of cover types identified in the Hells Canyon Study Area based on 1993 aerial photography.

Cover Type	ha[1]	% of Total
Upland Vegetation		
Forested Upland	72.26	0.15
Tree Savanna	231.03	0.48
Desertic Woodland	0.09	0.00
Shrubland	3,195.07	6.60
Shrub Savanna	10,154.26	20.99
Desertic Shrubland	550.92	1.14
Forbland	152.14	0.31
Grassland	17,192.46	35.54
Desertic Herbland	352.00	0.73
Riparian Vegetation		
Forested Wetland	389.88	0.80
Scrub-Shrub Wetland	822.37	1.70
Emergent Herbaceous Wetland	216.03	0.45
Shore & Bottomland Wetland	882.22	1.82
Natural Features		
Barrenland	52.86	0.11
Cliff/Talus Slope	2,722.28	5.63
Lentic	9.75	0.02
Lotic	7,791.08	16.11
Land Use		
Disturbed	44.25	0.09
Agriculture	2,436.00	5.04
Grazing Land/Pasture	580.60	1.20
Urban	2.14	0.00
Residential	211.86	0.44
Industrial	189.08	0.39
Park/Recreation	94.53	0.20
Roads	1.95	0.00
Forested/Orchard	7.40	0.02
Total area classified	48,354.51	99.96
Unclassified region in study area	18.93	0.04
Total area	48,373.44	100.00

[1] Shaded values indicate the most abundant cover type in each cover type category.

Table 5. Aerial extent of each cover type within the legal project boundaries of the three hydroelectric projects in the Hells Canyon Study Area based on 1993 aerial photography.

	Brownlee			Oxbow			Hells Canyon		
	Project Boundary		Study Area	Project Boundary		Study Area	Project Boundary		Study Area
Cover Type	**ha**[1]	**%**	**%**	**ha**[1]	**%**	**%**	**ha**[1]	**%**	**%**
Upland Vegetation									
Forested Upland	0.72	0.01	0.00	2.22	0.23	0.00	2.66	0.20	0.01
Desertic Woodland	-	-	-	0.09	0.01	0.00	-	-	-
Tree Savanna	0.06	0.00	0.00	3.20	0.33	0.01	7.19	0.55	0.01
Shrubland	149.41	2.05	0.31	60.61	6.16	0.13	51.43	3.91	0.11
Shrub Savanna	439.87	6.02	0.91	217.47	22.09	0.45	125.77	9.57	0.26
Desertic Shrubland	7.77	0.11	0.02	-	-	-	20.03	1.52	0.04
Forbland	25.07	0.34	0.05	1.51	0.15	0.00	-	-	-
Grassland	356.51	4.88	0.74	89.10	9.05	0.18	36.81	2.80	0.08
Desertic Herbland	15.37	0.18	0.03	-	-	-	0.47	0.04	0.00
Riparian Vegetation									
Forested Wetland	15.60	0.21	0.03	7.18	0.73	0.01	14.25	1.08	0.03
Scrub-Shrub Wetland	77.77	1.06	0.16	19.85	2.02	0.04	30.36	2.31	0.06
Emergent Herbaceous Wetland	121.83	1.67	0.25	0.24	0.02	0.00	-	-	-
Shore & Bottomland Wetland	638.11	8.73	1.32	16.49	1.67	0.03	0.86	0.07	0.00
Natural Features									
Barrenland	9.45	0.13	0.02	-	-	-	-	-	-
Cliff/Talus Slope	13.67	0.19	0.03	17.91	1.82	0.04	91.37	6.95	0.19
Lentic	0.24	0.00	0.00	-	-	-	0.10	0.01	0.00
Lotic	5,263.51	72.05	10.88	500.18	50.80	1.03	909.98	69.21	1.88
Land Use									
Disturbed	8.67	0.12	0.02	2.30	0.23	0.00	0.77	0.06	0.00
Agriculture	72.86	1.00	0.15	-	-	-	-	-	-
Grazing Land/Pasture	26.87	0.37	0.06	5.94	0.60	0.01	-	-	-
Urban	-	-	-	2.14	0.22	0.00	-	-	-
Residential	10.25	0.14	0.02	11.83	1.20	0.02	0.99	0.08	0.00
Industrial	22.90	0.31	0.05	18.14	1.84	0.04	4.73	0.36	0.01
Park/Recreation	29.15	0.40	0.06	7.76	0.79	0.02	16.83	1.28	0.03
Roads	0.86	0.01	0.00	-	-	-	-	-	-
Forested/Orchard	0.17	0.00	0.00	0.49	0.05	0.00	0.19	0.01	0.00
Total area classified	7,305.49	100.00	15.10	984.65	100.00	2.04	1,314.79	100.00	2.72
Unclassified region in legal project boundary	1.31	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total area	7,306.80	100.02	15.10	984.65	100.00	2.04	1,314.79	100.00	2.72

[1] Shaded values indicate the most abundant cover type in each main category of cover types for each project boundary.

Table 6. Aerial extent of each cover type within each study reach of the Hells Canyon Study Area based on 1993 aerial photography.

	Above Brownlee (Weiser)			Brownlee Reservoir			Oxbow Reservoir		
	Reach		Study Area	Reach		Study Area	Reach		Study Area
Cover Type	**ha**[1]	**%**	**%**	**ha**[1]	**%**	**%**	**ha**[1]	**%**	**%**
Upland Vegetation									
Forested Upland	0.72	0.02	0.00	0.11	0.00	0.00	8.28	0.22	0.02
Tree Savanna	-	-	-	1.00	0.00	0.00	9.61	0.25	0.02
Desertic Woodland	-	-	-	-	-	-	0.09	0.00	0.00
Shrubland	31.21	0.75	0.06	1,646.45	7.10	3.40	517.19	13.48	1.07
Shrub Savanna	313.47	7.53	0.65	5,733.28	24.73	11.85	1,090.69	28.43	2.25
Desertic Shrubland	4.03	0.10	0.01	263.49	1.14	0.54	0.27	0.01	0.00
Forbland	33.32	0.80	0.07	113.56	0.49	0.23	2.39	0.06	0.00
Grassland	755.87	18.16	1.56	7,789.91	33.60	16.10	1,321.25	34.44	2.73
Desertic Herbland	25.28	0.61	0.05	157.98	0.68	0.33	-	-	-
Riparian Vegetation									
Forested Wetland	36.86	0.88	0.08	69.35	0.30	0.14	57.62	1.50	0.12
Scrub-Shrub Wetland	84.73	2.03	0.18	285.79	1.23	0.59	127.45	3.32	0.26
Emergent Herbaceous Wetland	66.40	1.59	0.14	148.52	0.64	0.31	0.34	0.01	0.00
Shore & Bottomland Wetland	11.48	0.28	0.02	646.93	2.79	1.34	16.49	0.43	0.03
Natural Features									
Barrenland	0.76	0.02	0.00	39.79	0.17	0.08	-	-	-
Cliff/Talus Slope	8.76	0.21	0.02	102.16	0.44	0.21	109.81	2.86	0.23
Lentic	7.81	0.19	0.02	1.58	0.01	0.00	-	-	-
Lotic	526.12	12.64	1.09	5,068.67	21.86	10.48	514.17	13.40	1.06
Land Use									
Disturbed	17.46	0.42	0.04	18.57	0.08	0.04	4.03	0.11	0.01
Agriculture	1,895.40	45.53	3.92	507.27	2.19	1.05	-	-	-
Grazing Land/Pasture	100.73	2.42	0.21	434.50	1.87	0.90	2.14	0.06	0.00
Urban	-	-	-	-	-	-	-	-	-
Residential	162.09	3.89	0.34	23.56	0.10	0.05	10.14	0.26	0.02
Industrial	73.60	1.77	0.15	49.73	0.21	0.10	41.14	1.07	0.09
Park/Recreation	3.14	0.07	0.01	58.88	0.25	0.12	3.32	0.09	0.01
Roads	0.25	0.01	0.00	1.71	0.01	0.00	-	-	-
Forested/Orchard	3.29	0.08	0.01	2.51	0.01	0.01	-	-	-
Total area classified	4,162.78	100.00	8.63	23,165.30	99.90	47.87	3,836.42	100.00	7.92
Unclassified region in study reach	0.02	> 0.00	0.00	16.57	> 0.07	.03	0.00	0.00	0.00
Total area	4,162.80	100.00	8.63	23,181.87	100.00	47.90	3,836.42	100.00	7.92

[1] Shaded values indicate the most abundant cover type in each main category of cover types for each reach.

Table 6. (Cont.).

	Hells Canyon Reservoir			Below Hells Canyon Dam		
	Reach		Study Area	Reach		Study Area
Cover Type	**ha[1]**	**%**	**%**	**ha[1]**	**%**	**%**
Upland Vegetation						
Forested Upland	45.01	0.72	0.09	18.15	0.17	0.04
Tree Savanna	103.55	1.65	0.21	116.88	1.07	0.24
Desertic Woodland	-	-	-	-	-	
Shrubland	688.56	10.96	1.42	311.66	2.86	0.64
Shrub Savanna	1,421.41	22.63	2.94	1,595.41	14.62	3.30
Desertic Shrubland	67.52	1.08	0.14	215.61	1.98	0.45
Forbland	1.55	0.02	0.00	1.33	0.01	0.00
Grassland	1,822.48	29.02	3.77	5,502.94	50.43	11.38
Desertic Herbland	13.22	0.21	0.03	155.52	1.43	0.32
Riparian Vegetation						
Forested Wetland	93.83	1.49	0.19	132.21	1.21	0.27
Scrub-Shrub Wetland	96.11	1.53	0.20	228.29	2.09	0.47
Emergent Herbaceous Wetland	-	-	-	0.77	0.01	0.00
Shore & Bottomland Wetland	1.96	0.03	0.00	205.36	1.88	0.42
Natural Features						
Barrenland	-	-	-	12.31	0.11	0.03
Cliff/Talus Slope	942.83	15.01	1.95	1,558.73	14.28	3.22
Lentic	0.36	0.01	0.00	-	-	-
Lotic	918.32	14.62	1.90	763.81	7.00	1.58
Land Use						
Disturbed	1.97	0.03	0.00	2.22	0.02	0.00
Agriculture	-	-	-	33.33	0.31	0.07
Grazing Land/Pasture	0.20	0.00	0.00	43.03	0.39	0.09
Urban	2.14	0.03	0.00	-	-	-
Residential	14.64	0.23	0.03	1.43	0.01	0.00
Industrial	19.04	0.30	0.04	5.58	0.05	0.01
Park/Recreation	22.54	0.36	0.05	6.66	0.06	0.01
Roads	-	-	-	-	-	-
Forested/Orchard	1.60	0.03	0.00	-	-	-
Total area classified	6,278.84	99.96	12.96	10,911.23	99.99	22.54
Unclassified region in study reach	1.66	> 0.03	0.00	0.69	< 0.01	0.00
Total area	6,280.50	100.00	12.96	10,911.92	100.00	22.54

Table 7. Number of vegetation transects in each cover type in each reach of the Hells Canyon Study Area.

Cover Type	Reach[1] BA[2]	BR[2]	OX[2]	HC[2]	HB[2]	Total
Upland						
Forested Upland	-	3	5	14	2	24
Tree Savanna	-	-	2	3	5	10
Shrubland	2	37	6	26	15	86
Shrub Savanna	2	62	9	24	13	110
Desertic Shrubland	1	3	-	1	-	5
Forbland	3	22	5	8	10	48
Grassland	5	38	2	14	21	80
Desertic Herbland	-	17	1	3	2	23
Subtotal	**13**	**182**	**30**	**93**	**68**	**386**
Riparian						
Forested Wetland	51	50	23	46	37	207
Scrub-Shrub Wetland	56	124	19	49	50	298
Emergent Herbaceous Wetland	113	125	16	14	31	299
Shore & Bottomland Wetland	3	26	0	3	23	55
Subtotal	**223**	**325**	**58**	**112**	**141**	**859**
Total	**236**	**507**	**88**	**205**	**209**	**1,245**

[1] Shaded values indicate the reach in which each cover type was most frequently encountered.

[2] BA = Brownlee Above (or Weiser), BR = Brownlee Reservoir, OX = Oxbow Reservoir, HC = Hells Canyon Reservoir, HB = Below Hells Canyon Dam.

Table 8. Number of vegetation transects in each cover type standardized per river mile in each reach of the Hells Canyon Study Area.

	Reach[1]				
Cover Type	**BA[2]**	**BR[2]**	**OX[2]**	**HC[2]**	**HB[2]**
Upland					
Forested Upland	-	0.05	0.35	0.64	0.03
Tree Savanna	-	-	0.14	0.17	0.08
Shrubland	0.17	0.67	0.42	1.18	0.25
Shrub Savanna	0.17	1.12	0.63	1.09	0.22
Desertic Shrubland	0.08	0.05	-	0.05	-
Forbland	0.25	0.39	0.35	0.36	0.17
Grassland	0.42	0.68	0.14	0.64	0.34
Desertic Herbland	-	0.31	0.07	0.17	0.03
Riparian					
Forested Wetland	4.25	0.90	1.62	2.09	0.62
Scrub-Shrub Wetland	4.67	2.23	1.33	2.23	0.84
Emergent Herbaceous Wetland	9.42	2.25	1.13	0.64	0.52
Shore & Bottomland Wetland	0.25	0.47	0.00	0.17	0.39

[1] Shaded values indicate the reach in which each cover type was most frequently encountered.

[2] BA = Brownlee Above (or Weiser), BR = Brownlee Reservoir, OX = Oxbow Reservoir, HC = Hells Canyon Reservoir, HB = Below Hells Canyon Dam.

Table 9. List of plant assemblages occurring in each cover type in the Hells Canyon Study Area based on TWINSPAN classification of cover data.

Assemblage Name[1]	Assemblage Code	No.
Forested Upland		
Douglas-fir/common snowberry (*Pseudotsuga menziesii/Symphoricarpos albus*)	PSME/SYAL	8(1)
ponderosa pine/common snowberry (*Pinus ponderosa/Symphoricarpos albus*)	PIPO/SYAL	8(2)
black locust (*Robinia pseudoacacia*)	ROPS	4(2)
quaking aspen/poison ivy (*Populus tremuloides/Toxicodendron radicans*)	POTR/TORA	2(2)
grand fir/globe huckleberry-rocky mountain maple (*Abies grandis/Vaccinium globulare-Acer glabrum*)	ABGR/VAGL-ACGL	1
white mulberry (*Morus alba*)	MOAL	1
Tree Savanna		
ponderosa pine (*Pinus ponderosa*)	PIPO	3
netleaf hackberry (*Celtis reticulata*)	CERE	3
serviceberry-bitter cherry (*Amelanchier alnifolia-Prunus emarginata*)	AMAL-PREM	3(2)
serviceberry-cherry plum (*Amelanchier alnifolia-Prunus cerasifera*)	AMAL-PRCE	1(1)
Shrubland		
netleaf hackberry (*Celtis reticulata*)	CERE	24(3)
Big sagebrush (*Artemisia tridentata*)	ARTR	20
Big sagebrush-gray rabbitbrush (*Artemisia tridentata-Chrysothamnus nauseosus*)	ARTR-CHNA	13
bitterbrush (*Purshia tridentata*)	PUTR	16
common snowberry-mixed shrub (*Symphoricarpos albus*-mixed shrub)	SYAL-MIXED SHRUB	10(7)
curl leaf mountain mahogany (*Cercocarpus ledifolius*)	CELE	1
greasewood (*Sarcobatus vermiculatus*)	SAVE	1
matrimony vine (*Lycium halimifolium*)	LYHA	1

[1] Included for each plant assemblage are the common name, Latin binomial, species codes, and sample size (No.). Numbers in parentheses are a subset of the total, indicating numbers of transects sampled in tributary drainage riparian zones rather than along the Snake River riparian zone. A slash (/) separates dominant members of differing life forms (trees, shrubs, forbs, grasses), while a hyphen (-) separates dominant members of the same life form.

Table 9. (Cont.)

Assemblage Name[1]	Assemblage Code	No.
Shrub Savanna		
gray rabbitbrush/cheatgrass (*Chrysothamnus nauseosus/Bromus tectorum*)	CHNA/BRTE	31
bitterbrush/cheatgrass (*Purshia tridentata/Bromus tectorum*)	PUTR/BRTE	20
bitterbrush/bluebunch wheatgrass (*Purshia tridentata/Agropyron spicatum*)	PUTR/AGSP	9
bitterbrush/arrowleaf balsamroot/bluebunch wheatgrass (*Purshia tridentata/Balsamorhiza sagittata/Agropyron spicatum*)	PUTR/BASA/AGSP	4
netleaf hackberry/bluebunch wheatgrass-annual brome species (*Celtis reticulata/Agropyron spicatum-annual brome species*)	CERE/AGSP-ANNUAL BROME	21
Big sagebrush/annual brome species (*Artemisia tridentata/annual brome species*)	ARTR/ANNUAL BROME	16
Big sagebrush/bulbous bluegrass-bluebunch wheatgrass (*Artemisia tridentata/Poa bulbosa-Agropyron spicatum*)	ARTR/POBU-AGSP	7
stiff sagebrush/Sandberg's bluegrass (*Artemisia rigida/Poa secunda*)	ARRI/POSE	2
Desertic Shrubland		
bitterbrush (*Purshia tridentata*)	PUTR	4
Big sagebrush/bulbous bluegrass (*Artemisia tridentata/Poa bulbosa*)	ARTR/POBU	1
Forbland		
arrowleaf balsamroot/bluebunch wheatgrass-cheatgrass (*Balsamorhiza sagittata/Agropyron spicatum-Bromus tectorum*)	BASA/AGSP-BRTE	24
heart-leaved buckwheat-Gray's lomatium/cheatgrass (*Eriogonum compositum-Lomatium grayi/Bromus tectorum*)	ERCO5-LOGR/BRTE	9
whitetop/bulbous bluegrass (*Cardaria draba/Poa bulbosa*)	CADR/POBU	4
green pigweed (*Amaranthus retroflexus*)	AMRE2	4
green pigweed-purslane (*Amaranthus retroflexus-Portulaca oleracea*)	AMRE2-POOL	2
Russian knapweed-goose-grass (*Centaurea repens-Galium aparine*)	CERE2-GAAP	2
white sweetclover-Japanese brome (*Melilotus alba-Bromus japonicus*)	MEAL/BRJA	2
puncturevine (*Tribulus terrestris*)	TRTE	1

[1] Included for each plant assemblage are the common name, Latin binomial, species codes, and sample size (No.). Numbers in parentheses are a subset of the total, indicating numbers of transects sampled in tributary drainage riparian zones rather than along the Snake River riparian zone. A slash (/) separates dominant members of differing life forms (trees, shrubs, forbs, grasses), while a hyphen (-) separates dominant members of the same life form.

Table 9. (Cont.)

Assemblage Name[1]	Assemblage Code	No.
Grassland		
bluebunch wheatgrass (*Agropyron spicatum*)	AGSP	22
Cheatgrass (*Bromus tectorum*)	BRTE	13
cheatgrass-bluebunch wheatgrass (*Bromus tectorum-Agropyron spicatum*)	BRTE-AGSP	18
Idaho fescue-bluebunch wheatgrass (*Festuca idahoensis-Agropyron spicatum*)	FEID-AGSP	9
medusahead wildrye (*Taeniatherum caput-medusae*)	TACA	8
bulbous bluegrass-Sandberg's bluegrass (*Poa bulbosa-Poa secunda*)	POBU-POSE	7
Quackgrass (*Agropyron repens*)	AGRE	2
meadow fescue-quackgrass (*Festuca pratensis-Agropyron repens*)	FEPR-AGRE	1(1)
Desertic Herbland		
Gray's lomatium/cheatgrass (*Lomatium grayi/Bromus tectorum*)	LOGR/BRTE	6
mixed herbaceous (mixed herbaceous)	MIXED HERB	2(1)
mixed herbaceous/bluebunch wheatgrass (mixed herbaceous*/Agropyron spicatum*)	MIXED HERB/AGSP	5
heart-leaved buckwheat/cheatgrass (*Eriogonum compositum/Bromus tectorum*)	ERCO5/BRTE	4
blue mountain eriogonum/cheatgrass (*Eriogonum strictum/Bromus tectorum*)	ERST2/BRTE	3
desert alyssum/cheatgrass (*Alyssum desertorum/Bromus tectorum*)	ALDE/BRTE	3
Forested Wetland		
water birch-white alder/syringa (*Betula occidentalis-Alnus rhombifolia/Philadelphus lewisii*)	BEOC-ALRH/PHLE	47(45)
white alder/syringa (*Alnus rhombifolia/Philadelphus lewisii*)	ALRH/PHLE	24(22)
white alder/poison ivy (*Alnus rhombifolia/Toxicodendron radicans*)	ALRH/TORA	7(4)
black cottonwood (*Populus trichocarpa*)	POTR2	10(9)

[1] Included for each plant assemblage are the common name, Latin binomial, species codes, and sample size (No.). Numbers in parentheses are a subset of the total, indicating numbers of transects sampled in tributary drainage riparian zones rather than along the Snake River riparian zone. A slash (/) separates dominant members of differing life forms (trees, shrubs, forbs, grasses), while a hyphen (-) separates dominant members of the same life form.

Table 9. (Cont.)

Assemblage Name[1]	Assemblage Code	No.
***Forested Wetland* (*cont.*)**		
black cottonwood/syringa (*Populus trichocarpa/Philadelphus lewisii*)	POTR2/PHLE	26(25)
silver maple (*Acer saccharinum*)	ACSA	19
peachleaf willow (*Salix amygdaloides*)	SAAM	16
netleaf hackberry (*Celtis reticulata*)	CERE	14(5)
netleaf hackberry-Himalayan blackberry (*Celtis reticulata-Rubus discolor*)	CERE-RUDI	3(1)
Siberian elm (*Ulmus pumila*)	ULPU	9
white willow (*Salix alba*)	SAAL	3(3)
white willow/Wood's rose (*Salix alba/Rosa woodsii*)	SAAL/ROWO	6
coyote willow-Wood's rose (*Salix exigua-Rosa woodsii*)	SAEX-ROWO	6
Russian olive (*Elaeagnus angustifolia*)	ELAN	6
box elder maple (*Acer negundo*)	ACNE	5
Great Plains cottonwood (*Populus deltoides*)	PODE	3
Tamarisk, salt cedar (*Tamarix parviflora*)	TAPA	2
black locust/false indigo (*Robinia pseudoacacia/Amorpha fruticosa*)	ROPS/AMFR	1
Scrub-Shrub Wetland		
netleaf hackberry (*Celtis reticulata*)	CERE	6
netleaf hackberry-poison ivy (*Celtis reticulata-Toxicodendron radicans*)	CERE-TORA	40(1)
false indigo (*Amorpha fruticosa*)	AMFR	35
false indigo-coyote willow (*Amorpha fruticosa-Salix exigua*)	AMFR-SAEX	10
false indigo/hemp dogbane (*Amorpha fruticosa/Apocynum cannabinum*)	AMFR/APCA	4

[1] Included for each plant assemblage are the common name, Latin binomial, species codes, and sample size (No.). Numbers in parentheses are a subset of the total, indicating numbers of transects sampled in tributary drainage riparian zones rather than along the Snake River riparian zone. A slash (/) separates dominant members of differing life forms (trees, shrubs, forbs, grasses), while a hyphen (-) separates dominant members of the same life form.

Table 9. (Cont.)

Assemblage Name[1]	Assemblage Code	No.
***Scrub-Shrub Wetland* (*cont.*)**		
coyote willow (*Salix exigua*)	SAEX	22
coyote willow-Wood's rose (*Salix exigua-Rosa woodsii*)	SAEX-ROWO	5
coyote willow/hemp dogbane (*Salix exigua/Apocynum cannabinum*)	SAEX/APCA	9
common chokecherry (*Prunus virginiana*)	PRVI	21(14)
poison ivy (*Toxicodendron radicans*)	TORA	21(1)
peachleaf willow/coyote willow (*Salix amygdaloides/Salix exigua*)	SAAM/SAEX	17(1)
peachleaf willow/coyote willow/common cocklebur (*Salix amygdaloides/Salix exigua/Xanthium strumarium*)	SAAM/SAEX/XAST	20
peachleaf willow/Wood's rose (*Salix amygdaloides/Rosa woodsii*)	SAAM/ROWO	4
syringa (*Philadelphus lewisii*)	PHLE	17(10)
Himalayan blackberry (*Rubus discolor*)	RUDI	14(1)
tamarisk, salt cedar (*Tamarix parviflora*)	TAPA	10
tamarisk, salt cedar/western goldenrod (*Tamarix parviflora/Solidago occidentalis*)	TAPA/SOOC	12
tamarisk, salt cedar/common cocklebur (*Tamarix parviflora/Xanthium strumarium*)	TAPA/XAST	3
tamarisk, salt cedar/marsh grass (*Tamarix parviflora/Heleochloa alopecuroides*)	TAPA/HEAL	3
Wood's rose (*Rosa woodsii*)	ROWO	2
Wood's rose-golden currant (*Rosa woodsii-Ribes aureum*)	ROWO-RIAU	11
Russian olive (*Elaeagnus angustifolia*)	ELAN	3
virgin's bower (*Clematis ligusticifolia*)	CLLI	3
dog rose (*Rosa canina*)	ROCA	2
Siberian elm (*Ulmus pumila*)	ULPU	2

[1] Included for each plant assemblage are the common name, Latin binomial, species codes, and sample size (No.). Numbers in parentheses are a subset of the total, indicating numbers of transects sampled in tributary drainage riparian zones rather than along the Snake River riparian zone. A slash (/) separates dominant members of differing life forms (trees, shrubs, forbs, grasses), while a hyphen (-) separates dominant members of the same life form.

Table 9. (Cont.)

Assemblage Name[1]	Assemblage Code	No.
Emergent Herbaceous Wetland		
coyote willow (*Salix exigua*)	SAEX	22
broad-leaved pepperweed (*Lepidium latifolium*)	LELA	50(2)
broad-leaved pepperweed-poison hemlock (*Lepidium latifolium-Conium maculatum*)	LELA-COMA4	17
marsh grass (*Heleochloa alopecuroides*)	HEAL	37
purple loosestrife-mixed herbaceous (*Lythrum salicaria*-mixed herbaceous)	LYSA-MIXED HERB	35(1)
common cocklebur (*Xanthium strumarium*)	XAST	38(2)
hemp dogbane (*Apocynum cannabinum*)	APCA	24
alkali saltgrass (*Distichlis stricta*)	DIST	19
purslane (*Portulaca oleracea*)	POOL	11(1)
reed canarygrass (*Phalaris arundinacea*)	PHAR	10
American licorice (*Glycyrrhiza lepidota*)	GLLE	9(1)
water smartweed (*Polygonum coccineum*)	POCO3	8(1)
smooth scouring rush (*Equisetum laevigatum*)	EQLA	7(1)
common cattail (*Typha latifolia*)	TYLA	6(6)
seacoast bullrush (*Scirpus maritimus*)	SCMA	6(4)
teasel (*Dipsacus sylvestris*)	DISY	6(2)
yellow flag (*Iris pseudacorus*)	IRPS	4(1)
mixed herbaceous (mixed herbaceous)	MIXED HERB	3(1)
prairie cordgrass (*Spartina pectinata*)	SPPE	3
water smartweed (*Polygonum amphibium*)	POAM	1

[1] Included for each plant assemblage are the common name, Latin binomial, species codes, and sample size (No.). Numbers in parentheses are a subset of the total, indicating numbers of transects sampled in tributary drainage riparian zones rather than along the Snake River riparian zone. A slash (/) separates dominant members of differing life forms (trees, shrubs, forbs, grasses), while a hyphen (-) separates dominant members of the same life form.

Table 9. (Cont.)

Assemblage Name[1]	Assemblage Code	No.
Shore & Bottomland Wetland		
purslane (*Portulaca oleracea*)	POOL	18
netleaf hackberry (*Celtis reticulata*)	CERE	13
Eaton's aster (*Aster eatonii*)	ASEA	7
common cocklebur (*Xanthium strumarium*)	XAST	6
coyote willow (*Salix exigua*)	SAEX	4
awned flatsedge (*Cyperus aristatus*)	CYAR	3
mixed herbaceous (mixed herbaceous)	MIXED HERB	2
hemp dogbane (*Apocynum cannabinum*)	APCA	1
showy milkweed (*Asclepias speciosa*)	ASSP	1

[1] Included for each plant assemblage are the common name, Latin binomial, species codes, and sample size (No.). Numbers in parentheses are a subset of the total, indicating numbers of transects sampled in tributary drainage riparian zones rather than along the Snake River riparian zone. A slash (/) separates dominant members of differing life forms (trees, shrubs, forbs, grasses), while a hyphen (-) separates dominant members of the same life form.

Table 10. Noxious weeds and other invasive species considered during the study.

	IPCC[1]	Latin Binomial	Common Name
Idaho Noxious Weeds[2]	AECY	*Aegilops cylindrica*	jointed goatgrass
	AMTO	*Ambrosia tomentosa*	skeletonleaf bursage
	CADR	*Cardaria draba*	hoary cress
	CANU2	*Carduus nutans*	musk thistle
	CEDI	*Centaurea diffusa*	diffuse knapweed
	CEMA2	*Centaurea maculosa*	spotted knapweed
	CEPR	*Centaurea pratensis*	meadow knapweed
	CERE2	*Centaurea repens*	Russian knapweed
	CESO	*Centaurea solstitalis*	yellow starthistle
	CHJU	*Chondrilla juncea*	rush skeletonweed
	CIAR	*Cirsium arvense*	Canada thistle
	COMA4	*Conium maculatum*	poison hemlock
	COAR	*Convolvulus arvensis*	field bindweed
	CRVU	*Crupina vulgaris*	common crupina
	CYSC2	*Cytisus scoparius*	Scotch broom
	EUDE	*Euphorbia dentata*	toothed spurge
	EUES	*Euphorbia esula*	leafy spurge
	HIAU	*Hieracium aurantiacum*	orange hawkweed
	HIPR	*Hieracium pratense*	meadow hawkweed
	HYNI	*Hyoscyamus niger*	black henbane
	ISTI	*Isatis tinctoria*	dyer's woad
	LELA	*Lepidium latifolium*	perennial pepperweed
	LIDA	*Linaria dalmatica*	Dalmation toadflax
	LIVU	*Linaria vulgaris*	yellow toadflax
	LYSA	*Lythrum salicaria*	purple loosestrife
	MIVE	*Milium vernale*	milium
	NAST	*Nardus stricta*	matgrass
	ONAC	*Onopordum acanthium*	Scotch thistle
	SEJA	*Senecio jacobaea*	tansy ragwort
	SOEL	*Solanum eleagnifolium*	silverleaf nightshade
	SORO	*Solanum rostratum*	buffalobur
	SOAR	*Sonchus arvensis*	perennial sowthistle
	SOHA	*Sorghum halepense*	Johnsongrass
	TRTE	*Tribulus terrestris*	puncturevine
	ZYFA	*Zygophyllum fabago*	Syrian beancaper
Oregon Noxious Weeds[3]	BIDEN	*Bidens* spp.	beggar's lice
	CADR	*Cardaria draba*	white top
	CANU2	*Carduus nutans*	musk thistle
	CEDI	*Centaurea diffusa*	diffuse knapweed
	CEMA2	*Centaurea maculosa*	spotted knapweed
	CERE2	*Centaurea repens*	Russian knapweed
	CESO	*Centaurea solstitalis*	yellow starthistle
	CHJU	*Chrondrilla juncea*	rush skeletonweed

[1] IPCC = the species code used by Idaho Power Company.

[2] The Idaho listed species are from the 2000 Idaho Department of Agriculture Noxious Weed List.

[3] The Oregon listed species are from the 1999 Baker and Wallowa County Noxious Weed lists (priority A-C species).

Table 10. (Cont.)

	IPCC[1]	Latin Binomial	Common Name
Oregon Noxious Weeds[3] (cont.)	CIAR	*Cirsium arvense*	Canada thistle
	COMA4	*Conium maculatum*	poison hemlock
	COAR	*Convovulus arvensis*	field bindweed
	CUSCU	*Cuscuta* spp.	dodder
	CYOF	*Cynoglossum officionale*	hound's tongue
	DISY	*Dipsacus sylvestris*	teasel
	EUES	*Euphorbia esula*	leafy spurge
	HYPE	*Hypericum perforatum*	St. John's wort
	ISTI	*Isatis tinctoria*	dyer's woad
	LELA	*Lepidium latifolium*	perennial pepperweed
	LIDA	*Linaria dalmatica*	Dalmation toadflax
	LYSA	*Lythrum salicaria*	purple loosestrife
	ONAC	*Onopordum acanthium*	Scotch thistle
	RUCR	*Rumex crispus*	curly dock
	SAAE	*Salvia aethiopis*	Mediterranean sage
	SEJA	*Senecio jacobaea*	tansy ragwort
	TACA	*Taeniatherum caput-medusae*	medusahead
	TRTE	*Tribulus terrestris*	punctureveine
Other Invasive Species	AMFR	*Amorpha fruticosa*	false indigo
	ELAN	*Elaeagnus angustifolia*	Russian olive
	PHAR	Phalaris arundinacea	reed canarygrass
	TAMAR	Tamarix spp.	tamarisk, salt cedar

[1] IPCC = the species code used by Idaho Power Company.

[2] The Idaho listed species are from the 2000 Idaho Department of Agriculture Noxious Weed List.

[3] The Oregon listed species are from the 1999 Baker and Wallowa County Noxious Weed lists (priority A-C species).

Table 11. Rare plant species considered during the study.

Latin Binomial	Common Name	IPPC[1]	Priority[2]
Oregon Rare Vascular Plants			
Achnatherum wallowaensis	Wallowa ricegrass	ACWA	I
Allium brandegii	Brandegee's onion	ALBR	I
Allium geyeri var. *geyeri*	Geyer's onion	ALGEG	S
Allium lemmonii	Lemmon's onion	ALLE	I
Arabis davidsonii	Davidson's rockcress	ARDA	I
Arabis hastatula	Hells Canyon rockcress	ARHA	S
Astragalus atratus var. *owyheensis*	Owyhee milkvetch	ASATO	I
Astragalus mulfordiae	Mulford's milkvetch	ASMU	S
Astragalus purshii var. *ophiogenes*	Snake River milkvetch	ASPUO	I
Balsamorhiza hookeri var. *idahoensis*	Hooker's balsamroot	BAHOI	I
Bolandra oregana	Oregon bolandra	BOOR	I
Botrychium spp.	grapefern	BOTRY	I
Bupleurum americanum	bupleurum	BUAM	I
Calochortus macrocarpus var. *maculosus*	sagebrush mariposa	CAMAM	S
Calochortus nitidus	broad-fruit mariposa	CANI	S
Camissonia palmeri	Palmer's evening primrose	CAPA3	I
Carex backii	Back's sedge	CABA	I
Carex hystericina	porcupine sedge	CAHY	I
Carex praticola	meadow sedge	CAPR	I
Castilleja flava var. *rustica*	rural paintbrush	CAFLR	I
Chaenactis cusickii	Cusick's false yarrow	CHCU	S
Chaenactis stevioides	desert pincussion	CHST	I
Clematis columbiana var. *columbiana*	rock clematis	CLCOC	I
Cryptantha propria	Malheur Cryptantha	CRPR	I
Cryptantha simulans	pine woods Cryptantha	CRSI	I
Cymopterus acaulis var. *greeleyorum*	Greeley's wavewing	CYACG	S
Cyperus rivularis (*C. bipartitus*)	shining flatsedge	CYRI	I
Cyperus schweinitzii	Schweintz flatsedge	CYSC	S
Cypripedium fasciculatum	clustered lady's slipper	CYFA	S
Dryopteris filix-mas	male fern	DRFI	I
Elatine brachysperma	short-seeded waterwort	ELBR	S
Erigeron disparipilus	white cussion erigeron	ERDI4	I
Erigeron engelmannii var. *davisii*	Engelmann's daisy	EREND	I
Eriogonum ochrocephalum var.*calcareum*	ochre-flowered buckwheat	EROCC	I
Eriogonum salicornioides	annual salt buckwheat	ERSA	I
Gilia capillaris (*G. sinistra* ssp. *sinistra*)	smooth-leaved gilia (sinister g.)	GICA	I
Hackelia cronquistii	Cronquist's stickseed	HACR	S
Hackelia patens var. *patens*	spreading stickseed	HAPAP	I
Haplopappus radiatus	Snake River goldenweed	HARA	S
Heliotropium curassavicum	salt heliotrope	HECU	I
Lepidium davisii	Davis' peppergrass	LEDA	S

[1] IPCC = the species code used by Idaho Power Company.

[2] Those species with a priority = S were specifically searched for during vegetation sampling. When encountered, a Natural Heritage Database Form (Idaho or Oregon, as applicable) was completed for each population. Species with a priority = I were not specifically searched for, but a Heritage Form was completed on populations encountered incidentally during vegetation sampling. Specific results of rare plant inventories along the Snake River in Hells Canyon are presented by Krichbaum (2000).

Table 11. (Cont.).

Latin Binomial	Common Name	IPPC[1]	Priority[2]
***Oregon Rare Vascular Plants* (*cont.*)**			
Leptodactylon pungens ssp. *hazeliae*	Hazel's prickly phlox	LEPUH	S
Lomatium salmoniflorum	Salmon River lomatium	LOSA	I
Lupinus cusickii	Cusick's lupine	LUCU	S
Mimulus clivicola	bank monkeyflower	MICL	I
Mimulus hymenophyllus	membrane-leaved monkeyflower	MIHY	S
Mimulus patulus	stalked-leaved monkeyflower	MIPAP	S
Mirabilis macfarlanei	Macfarlane's four-o'clock	MIMA	S
Myriophyllum sibiricum	Siberian water milfoil	MYSI	I
Penstemon janishiae	Janish's penstemon	PEJA	I
Phacelia minutissima	least phacelia	PHMI	S
Pleuropogon oregonus	Oregon semaphorgrass	PLOR	S
Polystichum kruckebergii	Kruckberg's sword fern	POKR	I
Potamogeton filiformis	slender-leaved pondweed	POFI	I
Primula cusickiana	Wallowa primrose	PRCU	I
Ribes cereum var. *colubrinum*	wax current	RICEC	I
Rubus bartonianus	bartonberry	RUBA	S
Salix brachycarpa var. *brachycarpa*	short-fruited willow	SABRB	I
Silene spauldingii	Spaulding's silene	SISP2	S
Stanleya confertiflora	Oregon princes plume	STCO	S
Thelypodium howellii ssp. *spectabilis*	Howell's spectacular thelypody	THHOS	S
Trifolium douglasii	Douglas' clover	TRDO	S
Idaho Rare Vascular Plants			
Allium aaseae	Aase's onion	ASAA	S
Allium anceps	two-headed onion	ALAN	I
Allium madidum	swamp onion	ALMA2	I
Arabis hastatula	Hells Canyon rockcress	ARHA	S
Astragalus atratus var. *inseptus*	mourning milkvetch	ASATI	I
Astragalus mulfordiae	Mulford's milkvetch	ASMU	S
Astragalus oniciformis	Picabo milkvetch	ASON	I
Astragalus purshii var. *ophiogenes*	Snake River milkvetch	ASPUO	I
Astragalus vallaris	Snake Canyon milkvetch	ASVA	I
Bacopa rotundifolia	round leaf water-hyssop	BARO	I
Blepharidachne kingii	King's desertgrass	BLKI	I
Botrychium spp.	grapefern	BOTRY	I
Calochortus macrocarpus var. *maculosus*	sagebrush mariposa	CAMAM	S
Camissonia palmeri	Palmer's evening primrose	CAPA3	I
Chaenactis cusickii	Cusick's false yarrow	CHCU	S
Chaenactis stevioides	desert pincushion	CHST	I
Chrysothamnus nauseosus ssp. *nanus*	dwarf gray rabbitbrush	CHNAN	I
Cleomella plocasperma	alkali cleomella	CLPL	I

[1] IPCC = the species code used by Idaho Power Company.

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Table 11. (Cont.).

Latin Binomial	Common Name	IPPC[1]	Priority[2]
***Idaho Rare Vascular Plants* (*cont.*)**			
Crepis bakeri ssp. *idahoensis*	Idaho hawksbeard	CRBAI	S
Cryptantha propria	Malheur cryptantha	CRPR	I
Cryptantha simulans	pine woods cryptantha	CRSI	I
Cuscuta denticulata	tooth-sepal dodder	CUDE	S
Cymopterus acaulis var. *greeleyorum*	Greeley's wavewing	CYACG	S
Cyperus rivularis (*C. bipartitus*)	shining flatsedge	CYRI	I
Cypripedium fasciculatum	clustered lady's slipper	CYFA	S
Dimeresia howellii	dimeresia	DIHO	I
Downingia bacigalupii	Bacigalupi's downingia	DOBA	I
Eatonella nivea	white eatonella	EANI	I
Epipactis gigantea	chatterbox orchid	EPGI	I
Eriogonum ochrocephalum var. *calcareum*	ochre-flowered buckwheat	EROCC	I
Eriogonum salicornioides	annual salt buckwheat	ERSA	I
Eriogonum shockleyi var. *packardae*	Packard's buckwheat	ERSHP	S
Eriogonum shockleyi var. *shockleyi*	matted cowpie buckwheat	ERSHS	I
Hackelia cronquistii	Cronquist's stickseed	HACR	S
Halimolobos perplexa var. *perplexa*	puzzling halimolobos	HAPEP	I
Haplopappus hirtus var. *sonchifolius*	sticky goldenweed	HAHIS	I
Haplopappus radiatus	Snake River goldenweed	HARA	S
Ipomopsis polyclaydon	spreading gilia	IPPO	I
Lepidium davisii	Davis' peppergrass	LEDA	S
Lepidium papilliferum	slickspot peppergrass	LEPA	S
Leptodactylon pungens ssp. *hazeliae*	Hazel's prickly phlox	LEPUH	S
Lomatium dissectum var. *dissectum*	fern-leaved desert parsley	LODID	I
Lomatium salmoniflorum	Salmon River lomatium	LOSA	I
Mimulus clivicola	bank monkeyflower	MICL	I
Mimulus hymenophyllus	membrane-leaved monkeyflower	MIHY	S
Mimulus patulus	stalked-leaved monkeyflower	MIPAP	S
Mimulus ringens	Allegheny monkeyflower	MIRI	I
Mimulus washingtonensis ssp. *ampliatus*	spacious monkeyflower	MIWAA	S
Mirabilis macfarlanei	Macfarlane's four-o'clock	MIMA	S
Penstemon janishiae	Janish's penstemon	PEJA	I
Pentagramma triangularis ssp. *triangularis*	gold-back fern	PETRT	I
Peraphyllum ramosissimum	squaw apple	PERA3	I
Peteria thompsoniae	spine-nodded milkvetch	PETH	I
Phacelia inconspicua	obscure phacelia	PHIN	S
Phacelia minutissima	least phacelia	PHMI	S
Polystichum kruckebergii	Kruckberg's sword-fern	POKR	I
Primula cusickiana	Cusick's primrose	PRCU	I
Psathyrotes annua	annual brittlebrush	PSAN	I
Rubus bartonianus	bartonberry	RUBA	S

[1] IPCC = the species code used by Idaho Power Company.

[2] Those species with a priority = S were specifically searched for during vegetation sampling. When encountered, a Natural Heritage Database Form (Idaho or Oregon, as applicable) was completed for each population. Species with a priority = I were not specifically searched for, but a Heritage Form was completed on populations encountered incidentally during vegetation sampling. Specific results of rare plant inventories along the Snake River in Hells Canyon are presented by Krichbaum (2000).

Table 11. (Cont.).

Latin Binomial	Common Name	IPPC[1]	Priority[2]
***Idaho Rare Vascular Plants* (*cont.*)**			
Sedum borschii	Borsch's stonecrop	SEBO	I
Stanleya confertiflora	Oregon princes plume	STCO	S
Stylocline filaginea	stylocline	STFI	I
Teucrium canadense var. *occidentale*	American wood sage	TECAO	S
Thelypodium laciniatum var. *streptanthoides*	thick-leaved thelypody	THLAS	I
Trifolium plumosum var. *amplifolium*	plumed clover	TRPLA	I

[1] IPCC = the species code used by Idaho Power Company.

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Table 12. Common and abundant weedy species found almost exclusively along transects in the Weiser Reach and the headwaters of Brownlee Reservoir.

Origin[1]	Latin Binomial	Common Name	Life Form	Noxious
I	*Acer negundo*	box elder	Tree	
I	*Acer saccharinum*	silver maple	Tree	
I	*Elmus americana*	American Elm	Tree	
I	*Elaeagnus angustifolia*	Russian olive	Tree	
I	*Fraxinus pennsylvanica*	green ash	Tree	
I	*Salix alba*	white willow	Tree	
I	*Amorpha fruticosa*	false indigo	Shrub	
I	*Tamarix* sp.	tamarisk, salt cedar	Shrub	
N	*Apocynum cannabinum*	hemp dogbane	Forb	
I	*Cirsium arvense*	Canada thistle	Forb	Yes
I	*Conium maculatum*	poison hemlock	Forb	Yes
I	*Lepidium latifolium*	pepperweed	Forb	Yes
I	*Lythrum salicaria*	purple loosestrife	Forb	Yes
I	*Portulaca oleracea*	purslane	Forb	
I	*Heleochloa alopecuroides*	marsh grass	Grass	
N	*Phalaris arundinacea*	reed canary grass	Grass	

[1] I = Introduced, N = Native

Table 13. Ornamental plants encountered in the study area.

Use	Latin Binomial	Common Name	No. Transects
Ornamental/Shade	*Acer negundo*	box elder maple	55
Ornamental/Shade	*Acer saccharinum*	silver maple	74
Ornamental	*Amorpha fruticosa*	false indigo	114
Ornamental/Shade	*Elaeagnus angustifolia*	Russian olive	36
Ornamental/Shade	*Fraxinus pennsylvanica*	green ash	25
Ornamental/Shade/Fruit	*Juglans nigra*	black walnut	5
Ornamental/Shade/Fruit	*Juglans regia*	English walnut	25
Ornamental	*Lycium halimifolium*	matrimony vine	2
Ornamental/Fruit	*Malus pumila*	apple	1
Ornamental/Fruit	*Morus alba*	white mulberry	15
Ornamental	*Parthenocissis quinquefolia*	Virginia creeper	1
Ornamental/Fruit	*Prunus armeniaca*	apricot	10
Ornamental/Fruit	*Prunus avium*	bird cherry	7
Ornamental/Fruit	*Prunus cerasifera*	cherry plum	18
Ornamental/Fruit	*Prunus domestica*	cultivated plum	1
Ornamental/Fruit	*Pyrus communis*	pear	1
Ornamental	*Robinia pseudoacacia*	black locust	11
Ornamental/Fruit	*Rubus discolor*	Himalayan blackberry	43
Ornamental/Fruit	*Rubus laciniatus*	evergreen blackberry	7
Ornamental/Shade	*Salix alba*	white willow	45
Ornamental	*Syringa vulgaris*	lilac	1
Ornamental	*Tamarix parviflora*	tamarisk, salt cedar	98
Ornamental/Shade	*Ulmus americana*	American elm	50
Ornamental/Shade	*Ulmus pumila*	Siberian elm	36

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Salmon

Imnaha

95

Salmo

Riggins

Enterprise

Joseph

Idaho County
Adams County

Hells Canyon Dam

River

River

Wallowa County

Imnaha

Union County

Baker County

Oxbow Dam

Halfway

Brownlee Dam

Powder

River

Richland

Washington County
Adams County

Counc

Snake

urkee

Cambridge

Midvale

95

84

r County
eur County

Farewell Bend

Weiser

Crane Creek Reservoir

Legend

- Primary Route
- Secondary Route
- Transmission Lines
- Idaho Power Facility
- City or Town

N

IDAHO POWER
Geographic Information Services

Vicinity Map

5 2.5 0 5 10 MILES

Tech. Report E.3.3-1 Figure 1

HELLS CANYON

Location of the Hells Canyon Study Area

IDAHO POWER COMPANY
BOISE, IDAHO

SCALE: As Shown DATE: Aug. 2000

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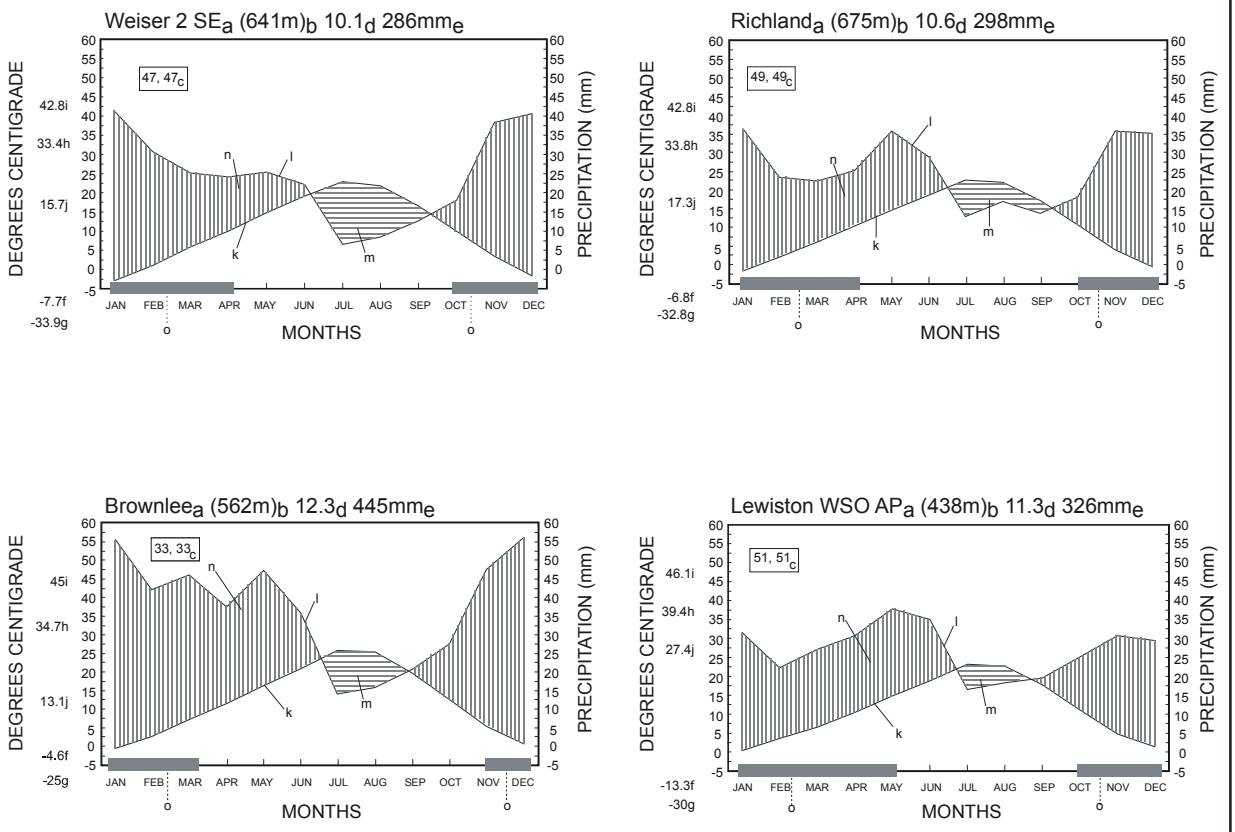

a: Station
b: Elevation
c: Number of years of observation (temperature, precipitation)
d: Mean annual temperature in °C
e: Mean annual precipitation in millimeters
f: Mean daily minimum of the coldest month
g: Lowest recorded temperature
h: Mean daily maximum of the hottest month
i: Highest recorded temperature
j: Mean daily temperature range
k: Monthly means of temperature in °C
l: Monthly means of precipitation in millimeters
m: Arid period (horizontal hatched)
n: Humid period (vertical hatched)
o: Months with an absolute minimum below 0 °C

Figure 2. Köppen climate diagrams for the Weiser, Richland, Brownlee Dam, and Lewiston weather stations, Hells Canyon Study Area, Idaho–Oregon border.

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Porter Island

Snake River R.V. Park

Oasis

arrows Island

Westlake Island

McRea Island

Weiser

342 341 343 340 339 344 345 346 347 348 349 350 351 0 352 353

30

Study Area

Boise

Snake River

Panel 1 of 16

Vicinity Map

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
- Ditch or Canal
- IPC Project Bdy.
- Political Bdy.
- Water Body
- River Mile
- IPC Project Facility
- Pump Station
- Spring
- Well

Thematic Features Legend

- Desertic Woodland
- Tree Savanna
- Forested Upland
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- Shrubland
- Shrub Savanna
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- Forbland
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- Barren Land
- Disturbed
- Cliff/Talus Slope
- Lentic
- Lotic
- Parks/Rec.
- Residential
- Industrial
- Urban
- Roads

GN MN
0°08' 2 MILS
17°30' 311 MILS

UTM GRID AND 1987
MAGNETIC NORTH DECLINATION
AT CENTER OF OXBOW QUADRANGLE

1 .5 0 MILES

Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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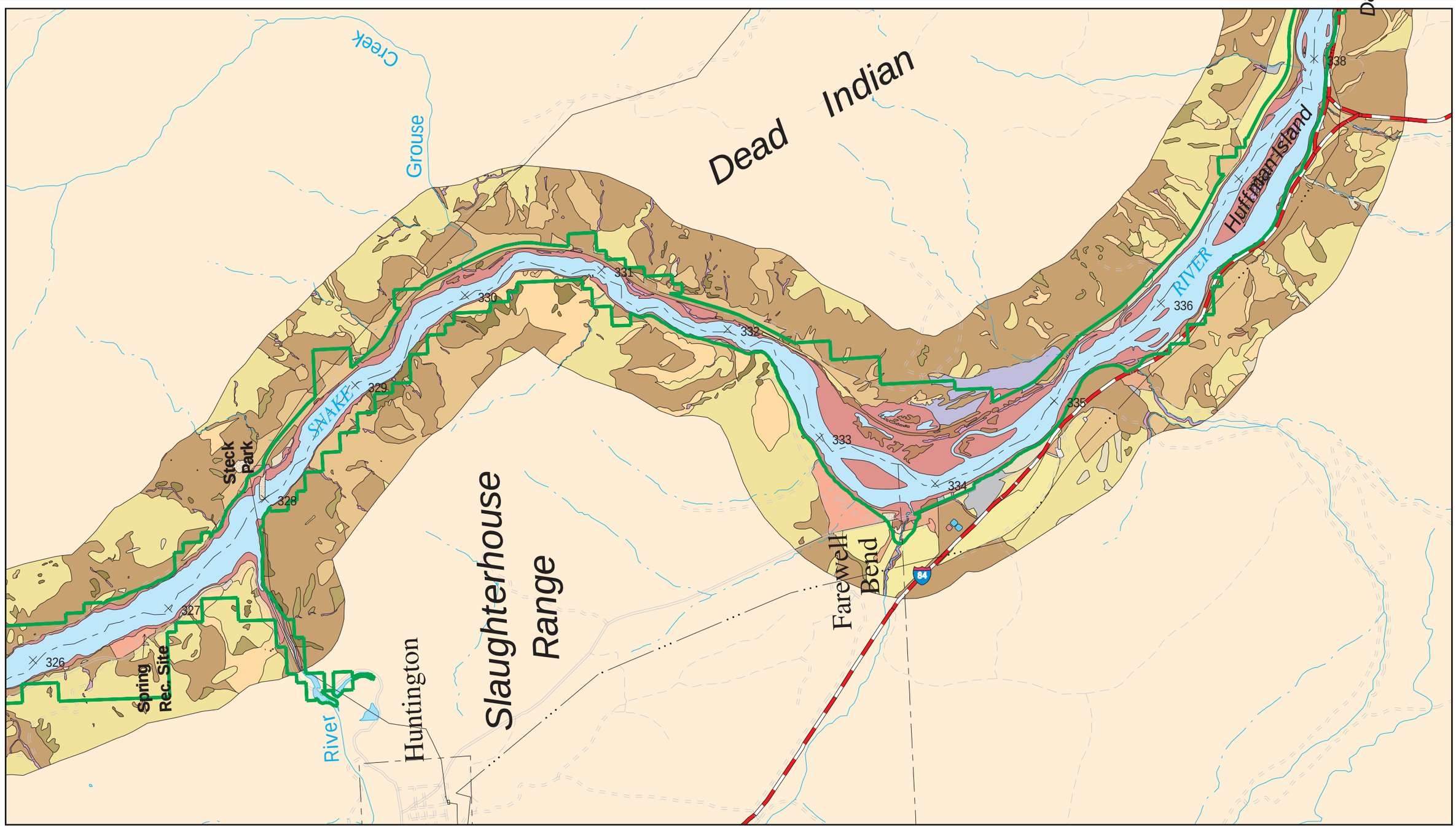

Study Area

Boise

Snake River

Vicinity Map

Panel 2 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
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- Residential
- Industrial
- Urban
- Roads

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Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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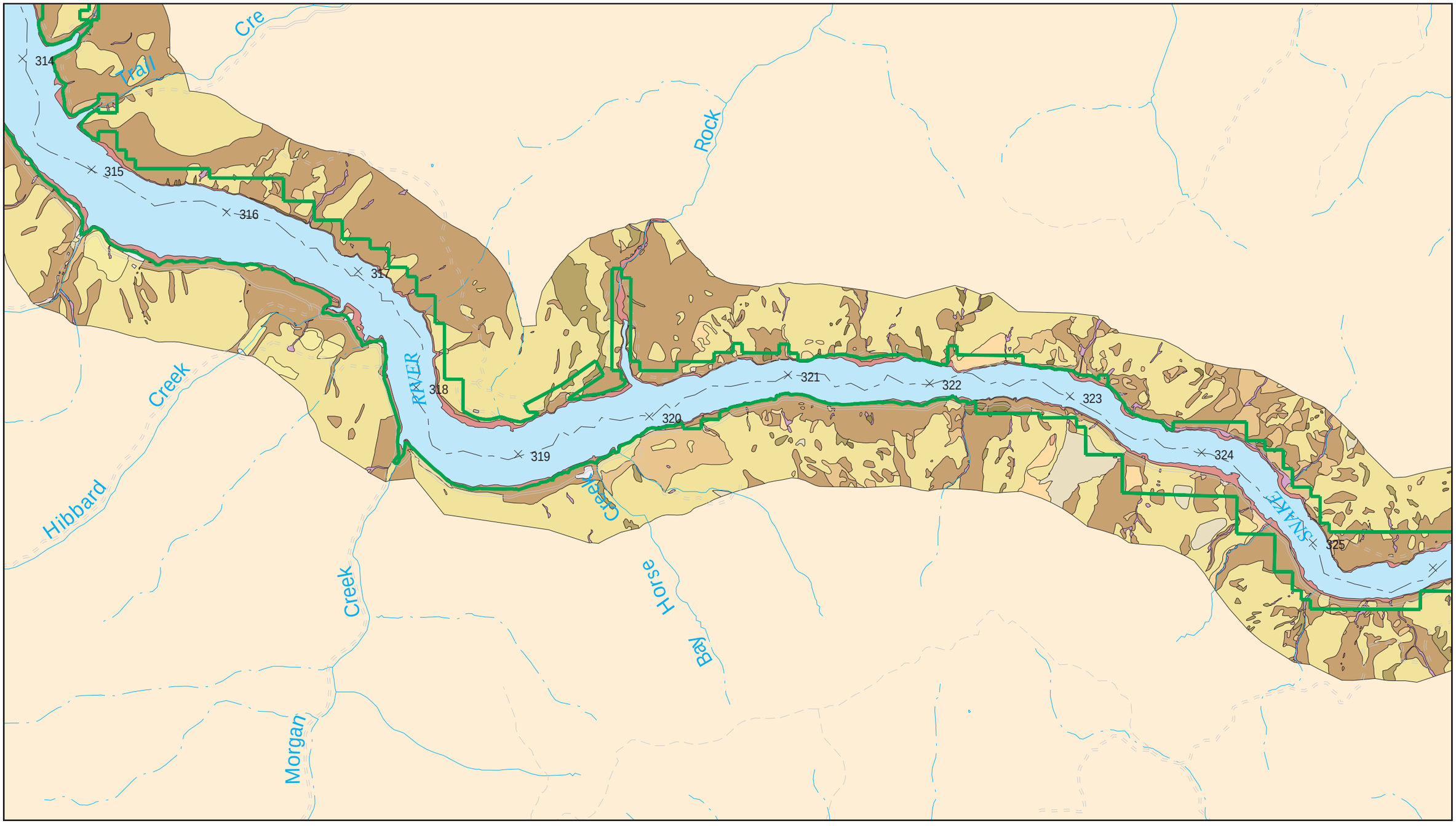

Study Area

Vicinity Map

Panel 3 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
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Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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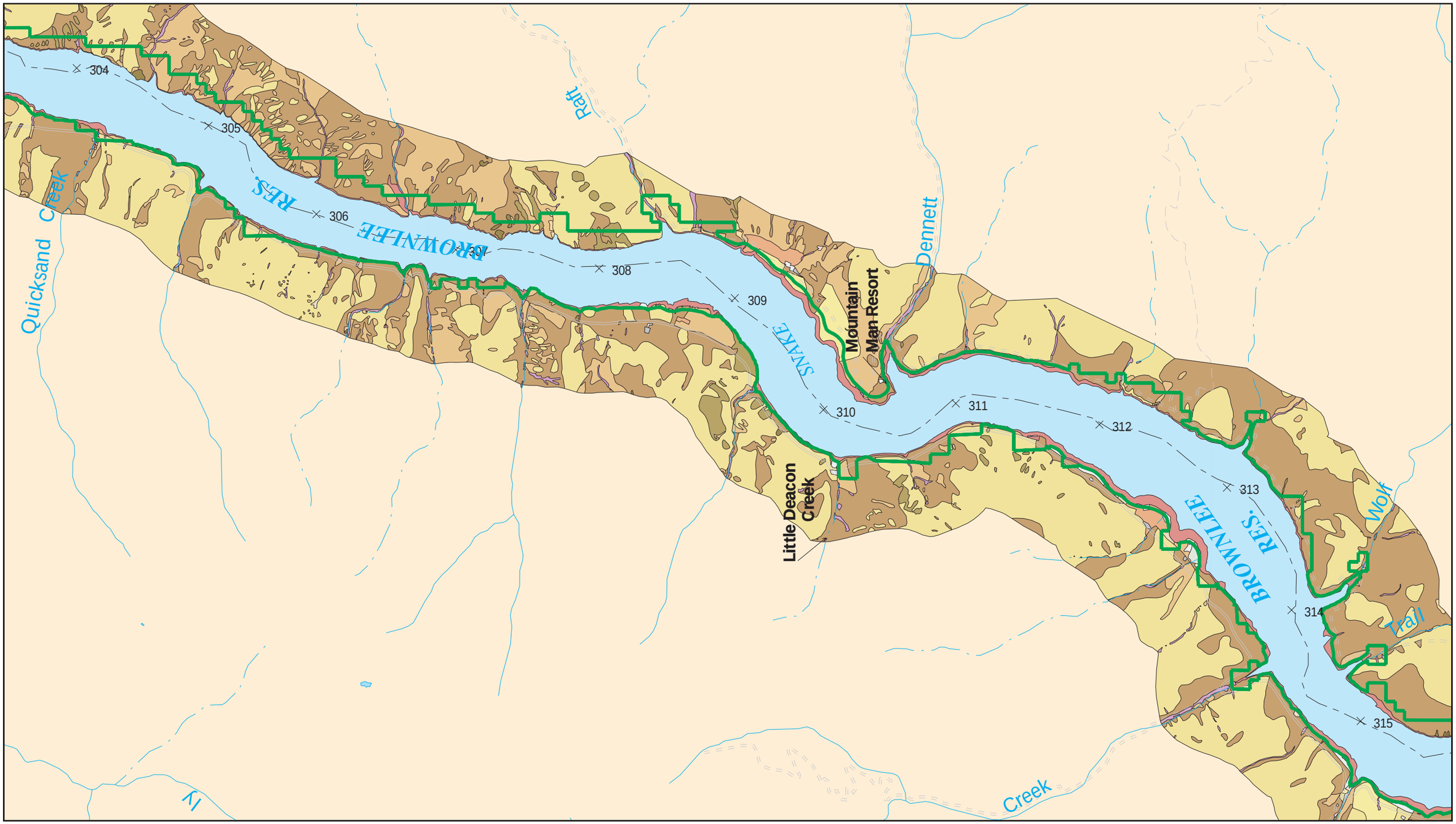
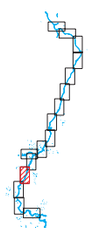


Vicinity Map

Panel 4 of 16



IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
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- Urban
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Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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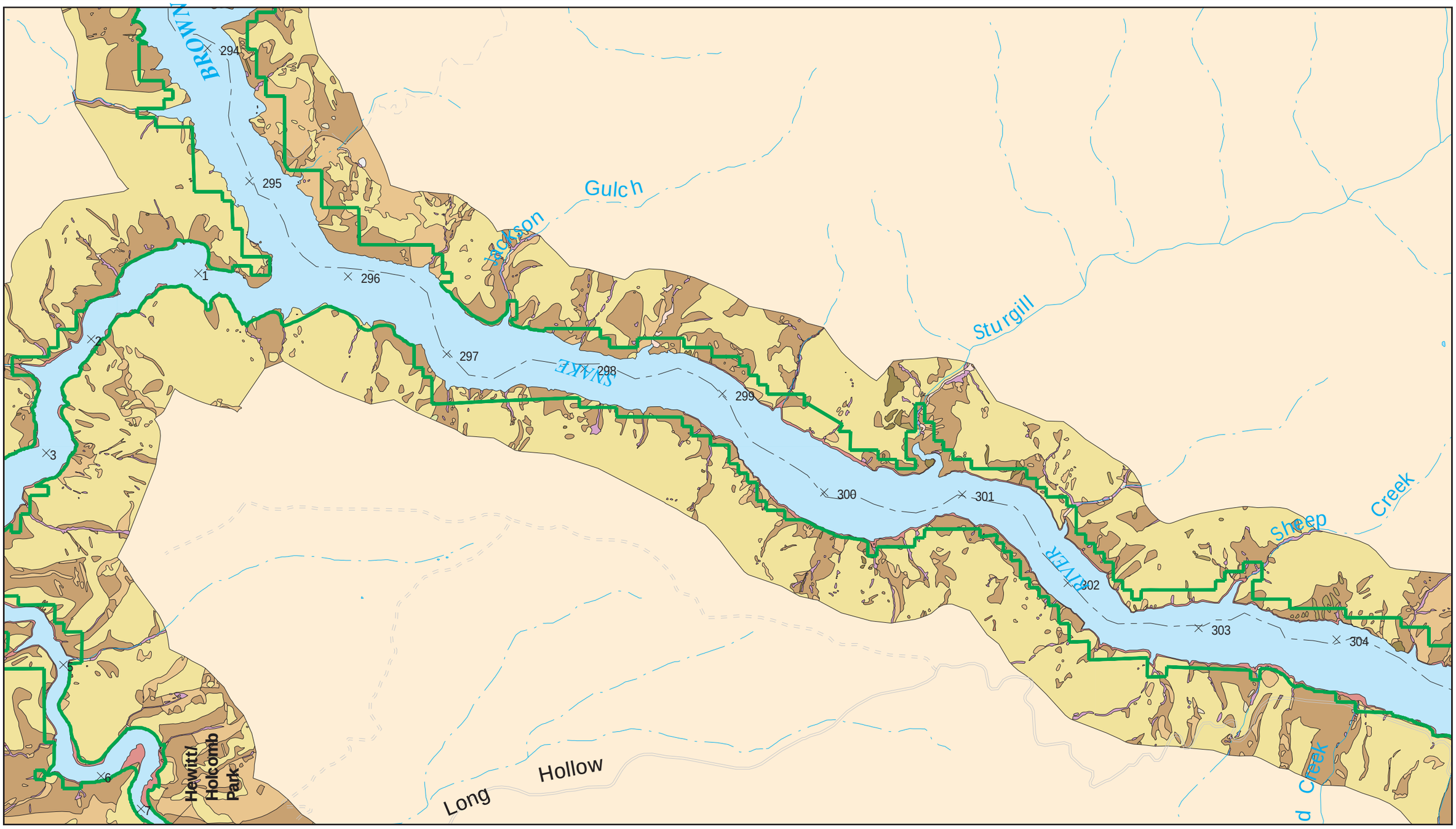

Study Area

Boise
Snake River

Vicinity Map

Panel 5 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
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- Urban
- Roads

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Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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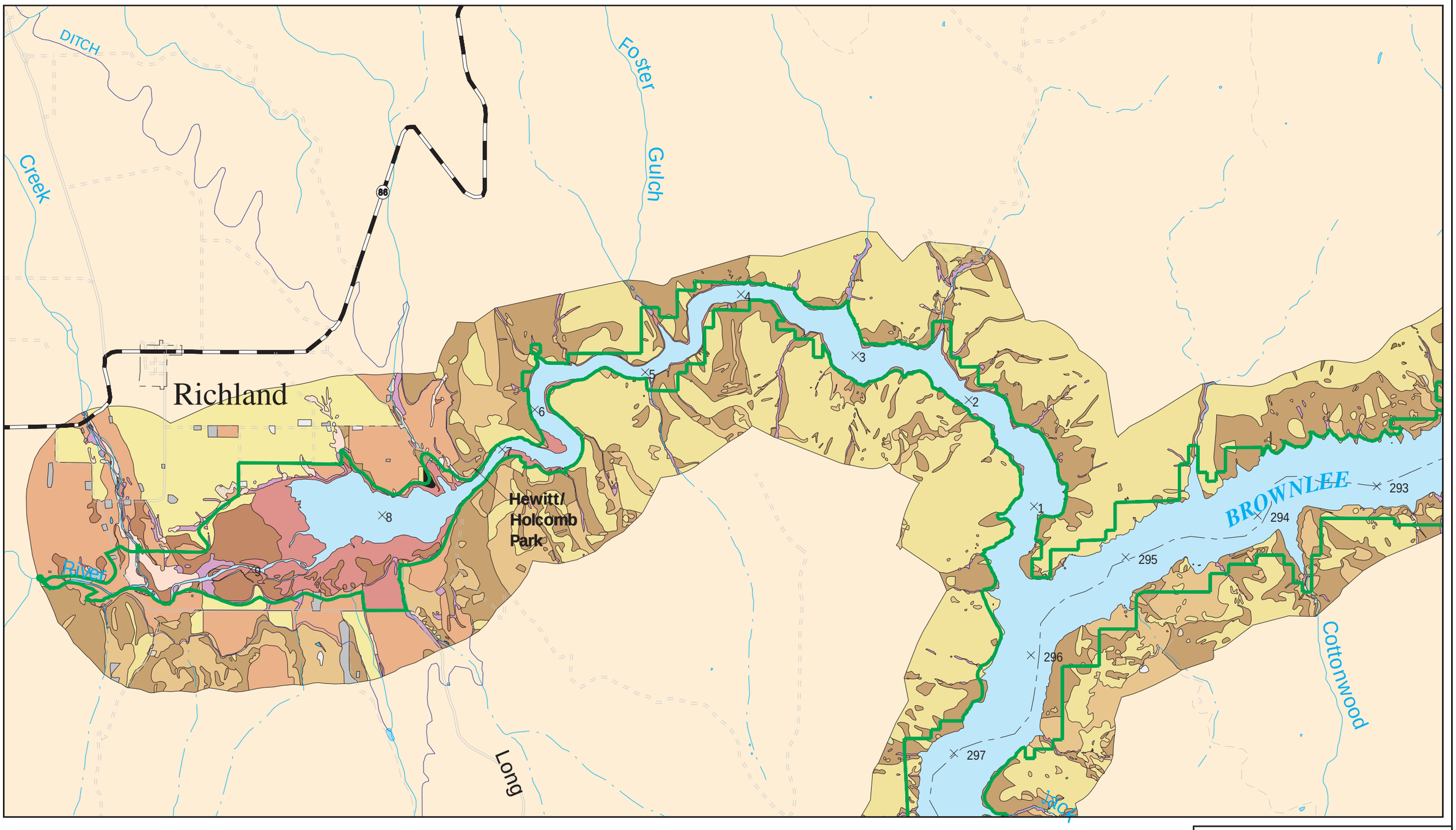

Vicinity Map

Panel 6 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
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- IPC Project Bdy.
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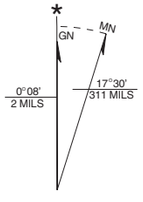

UTM GRID AND 1987
MAGNETIC NORTH DECLINATION
AT CENTER OF OXBOW QUADRANGLE

Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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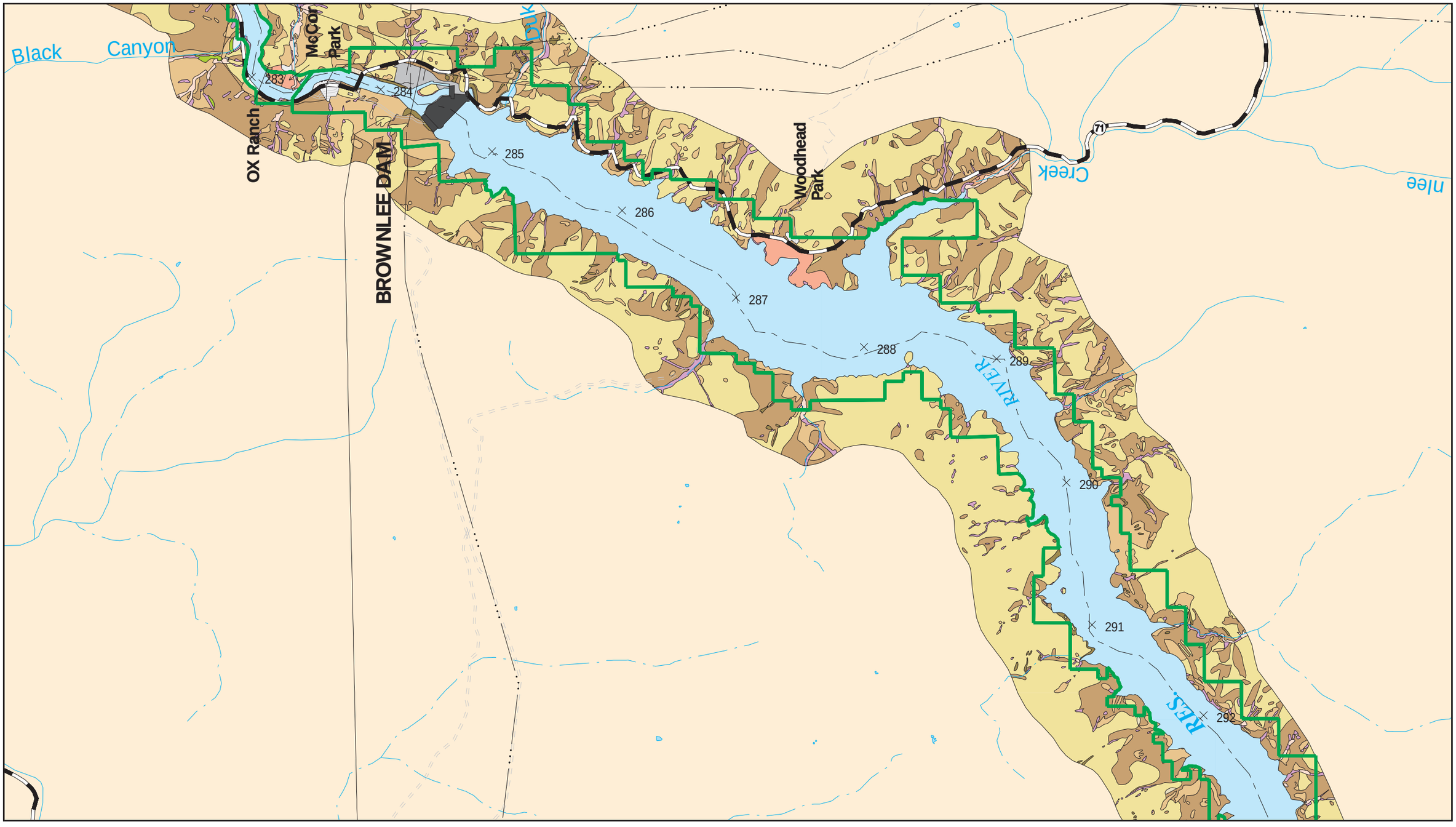

Study Area

Boise
Snake River

Vicinity Map

Panel 7 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
- Ditch or Canal
- IPC Project Bdy.
- Political Bdy.
- Water Body
- River Mile
- IPC Project Facility
- Pump Station
- Spring
- Well

Thematic Features Legend

- Desertic Woodland
- Tree Savanna
- Forested Upland
- Desertic Shrubland
- Shrubland
- Shrub Savanna
- Grassland
- Forbland
- Desertic Herbland
- Forested/Orchard
- Agriculture (Cultivated)
- Grazing Land/Pasture
- Forested Wetland
- Shore & Bottomland Wetland
- Scrub-Shrub Wetland
- Emergent Herbaceous Wetland
- Barren Land
- Disturbed
- Cliff/Talus Slope
- Lentic
- Lotic
- Parks/Rec.
- Residential
- Industrial
- Urban
- Roads

N

Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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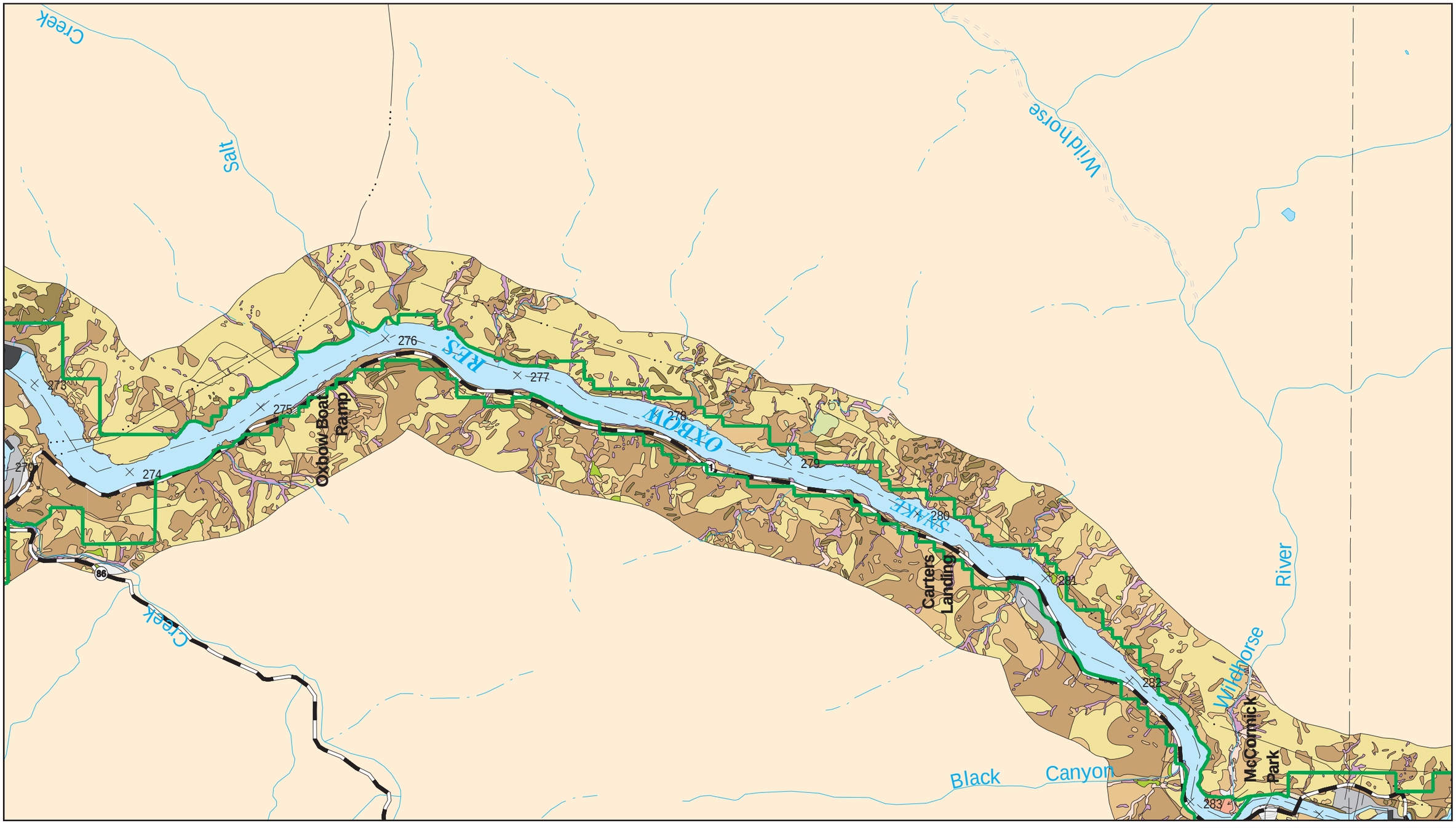

Study Area

Boise

Snake River

Vicinity Map

Panel 8 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
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- Political Bdy.
- Water Body
- River Mile
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- Well

Thematic Features Legend

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- Residential
- Industrial
- Urban
- Roads

N

Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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Study Area

Boise
Snake River

Vicinity Map

Panel 9 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
- Ditch or Canal
- IPC Project Bdy.
- Political Bdy.
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Thematic Features Legend

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- Industrial
- Urban
- Roads

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Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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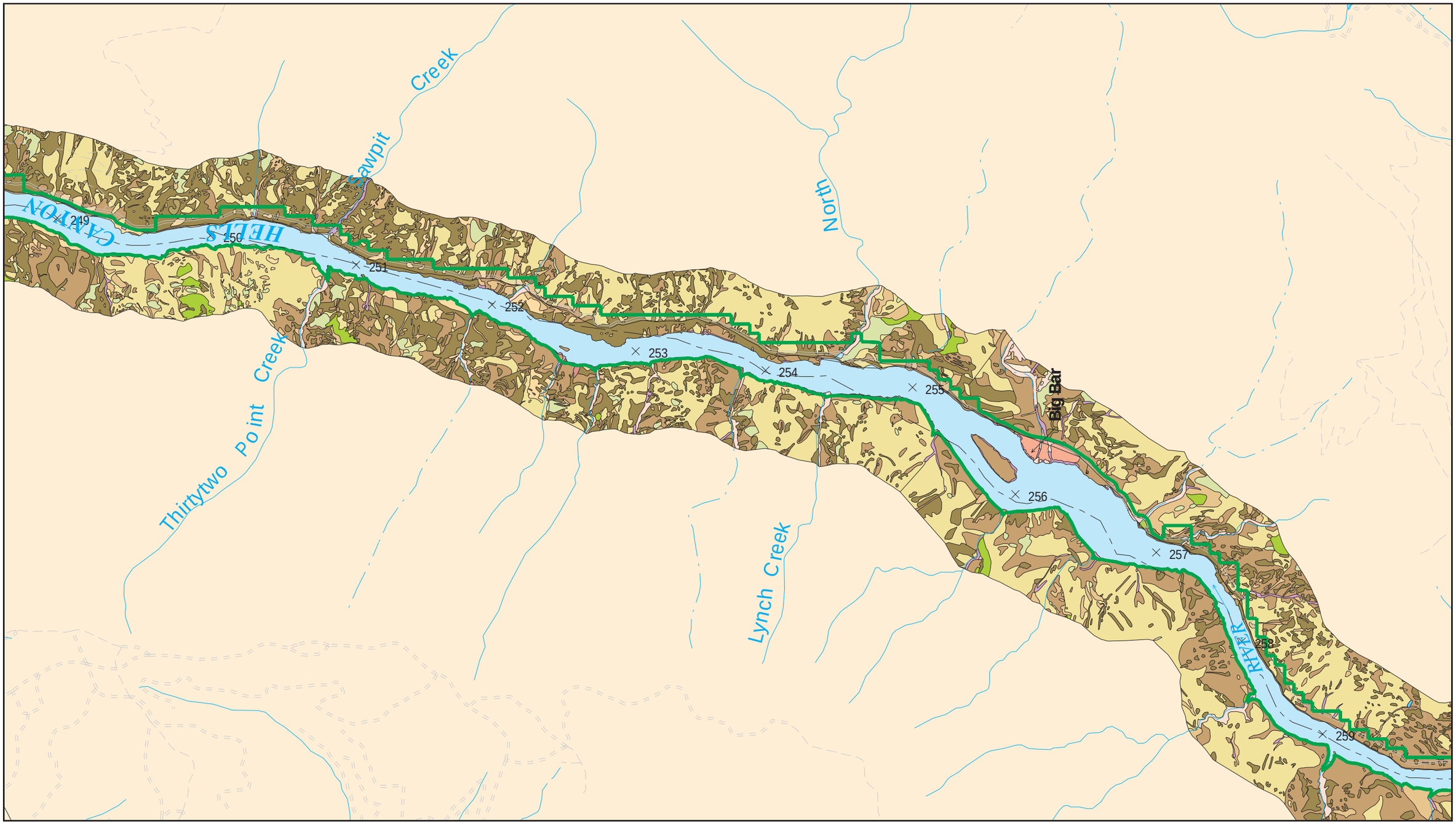

Study Area

Boise

Snake River

Vicinity Map

Panel 10 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
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- Political Bdy.
- Water Body
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- Pump Station
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- Residential
- Industrial
- Urban
- Roads

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Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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Three

Granite

Deep

Creek

Battle

Barton Heights

Creek

Stud

Hells Canyon Dam

Deep Cr. Trail

Hells Canyon Cr. Rec. Site

HWY 71

HWY 71

HWY 71

233

239

240

241

242

243

244

245

246

247

248

Vicinity Map

Panel 11 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
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- Political Bdy.
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- Parks/Rec.
- Residential
- Industrial
- Urban
- Roads

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Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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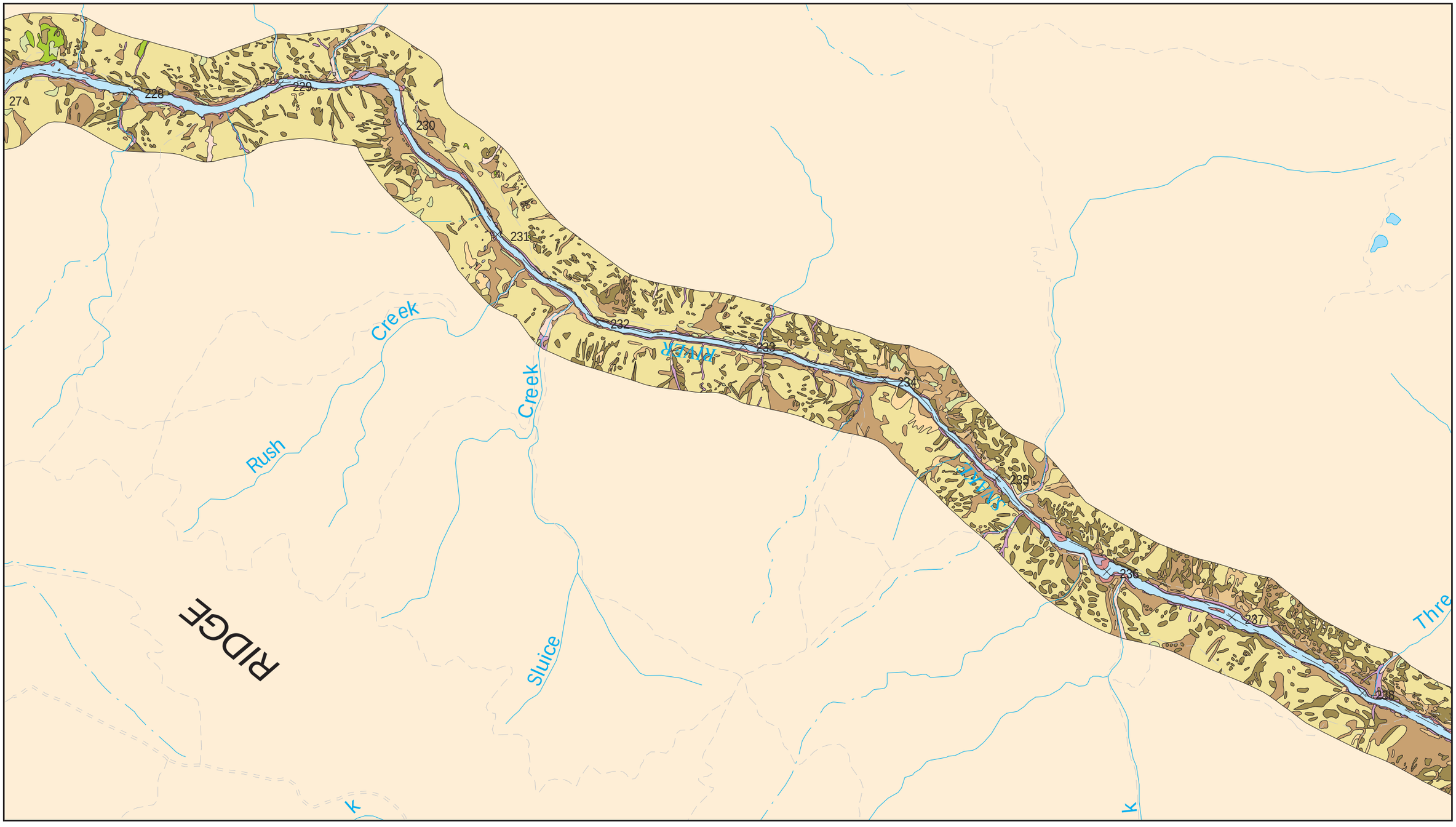

Vicinity Map

Panel 12 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
- Ditch or Canal
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- Political Bdy.
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- River Mile
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- Well

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- Industrial
- Urban
- Roads

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1 .5 0 MILES

Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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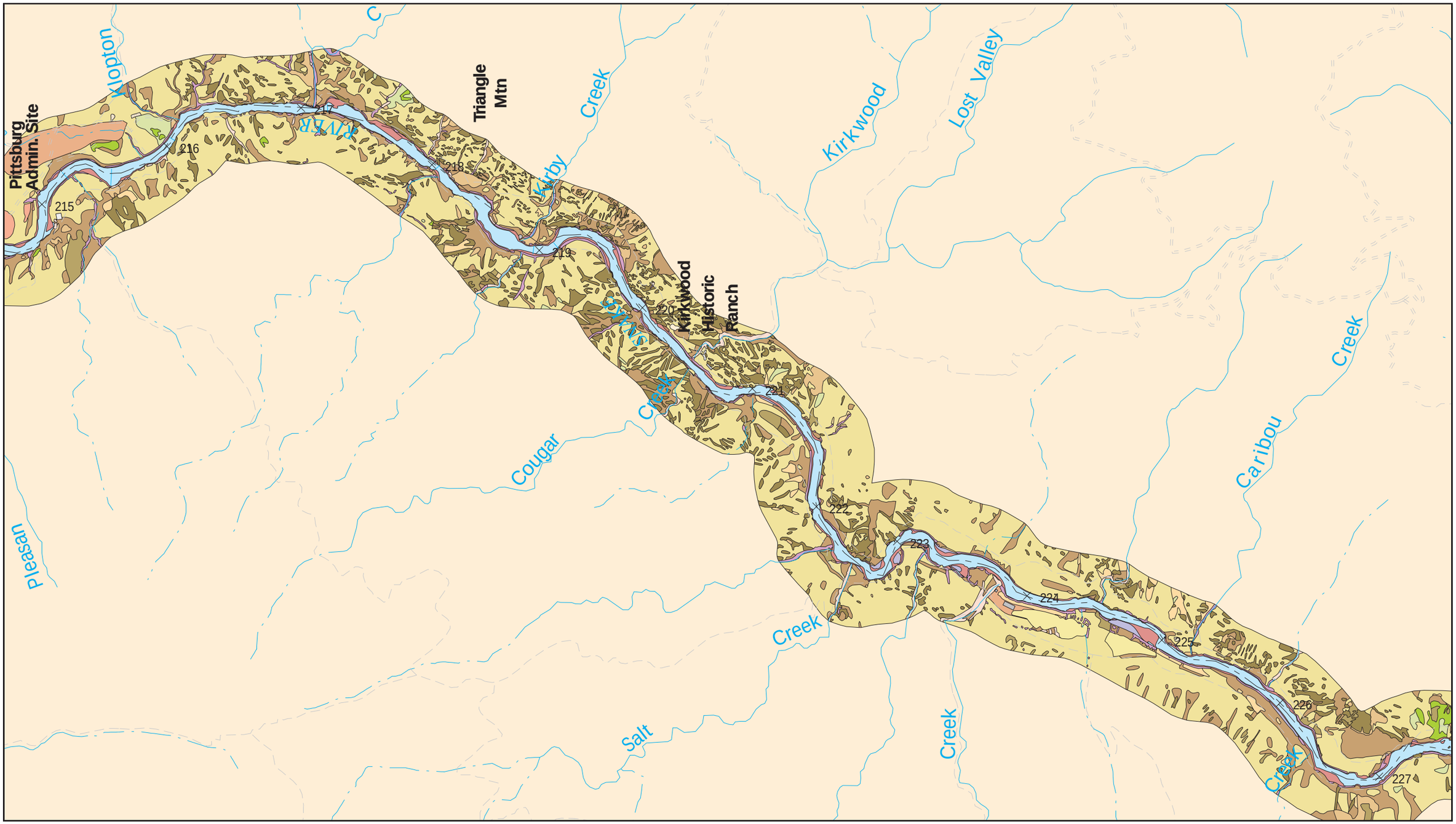
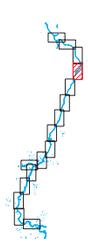


Vicinity Map

Panel 13 of 16



IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
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- Parks/Rec.
- Residential
- Industrial
- Urban
- Roads

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Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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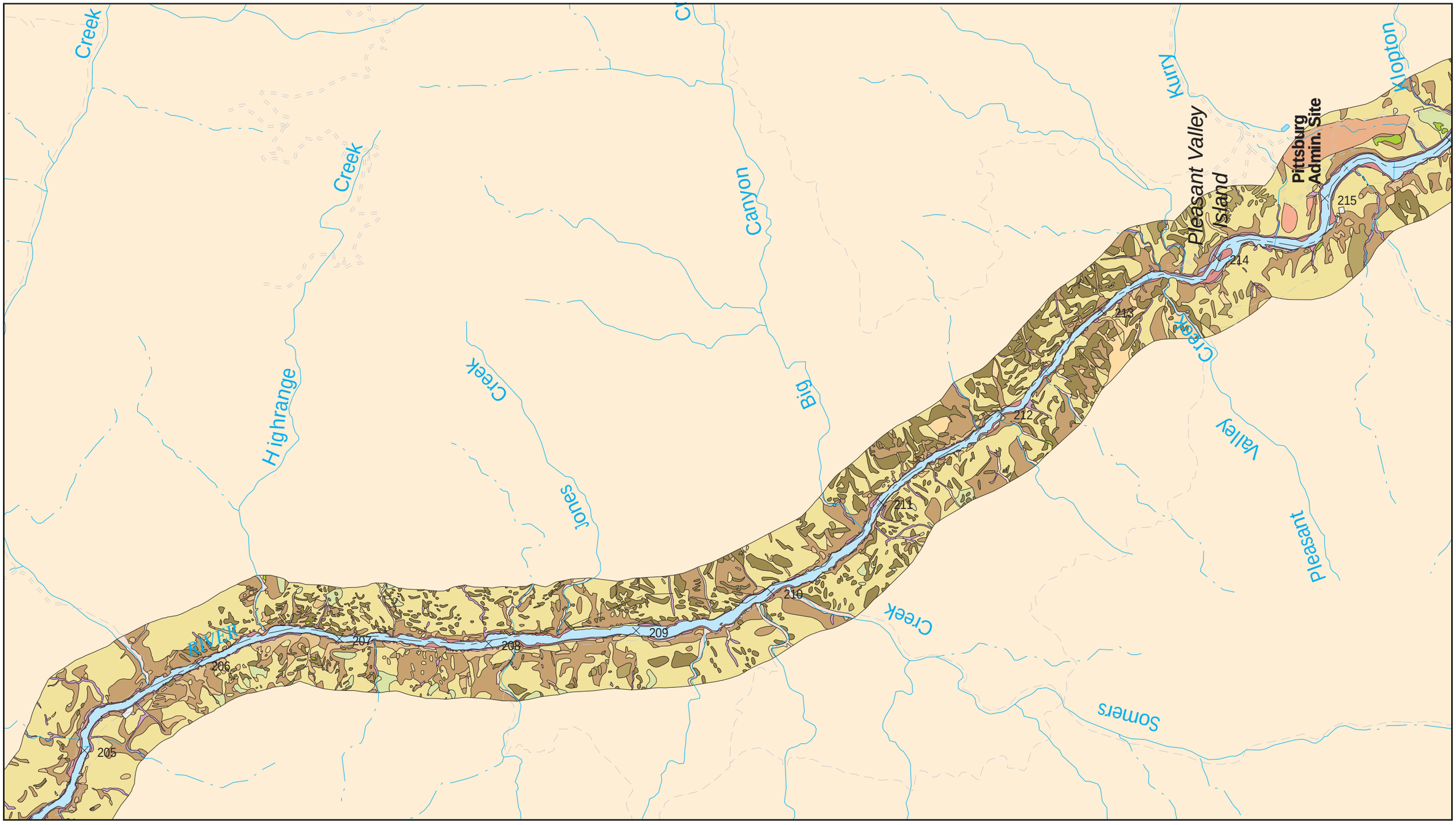

Study Area

Boise
Snake River

Vicinity Map

Panel 14 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
- Ditch or Canal
- IPC Project Bdy.
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- Lotic
- Parks/Rec.
- Residential
- Industrial
- Urban
- Roads

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Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

1 .5 0 MILES

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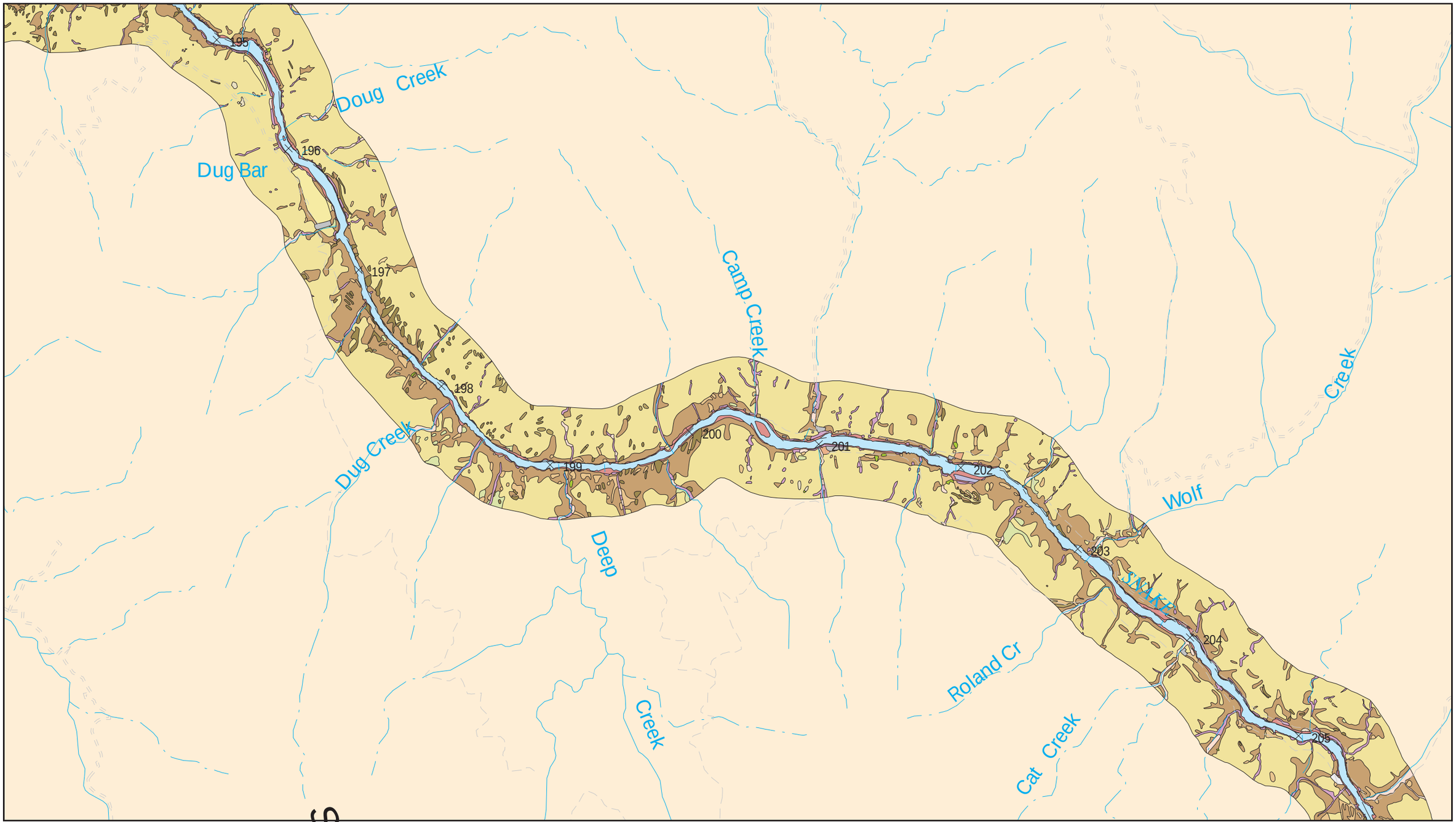

SUMMIT

Study Area

Panel 15 of 16

Vicinity Map

Boise
Snake River

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
- Transmission Line
- Perennial River or Stream
- Intermittent River or Stream
- Ditch or Canal
- IPC Project Bdy.
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- Spring
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Thematic Features Legend

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- Scrub-Shrub Wetland
- Emergent Herbaceous Wetland
- Barren Land
- Disturbed
- Cliff/Talus Slope
- Lentic
- Lotic
- Parks/Rec.
- Residential
- Industrial
- Urban
- Roads

GN MN
0°08' 2 MILS
17°30' 311 MILS

UTM GRID AND 1987
MAGNETIC NORTH DECLINATION
AT CENTER OF OXBOW QUADRANGLE

1 .5 0 MILES

Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

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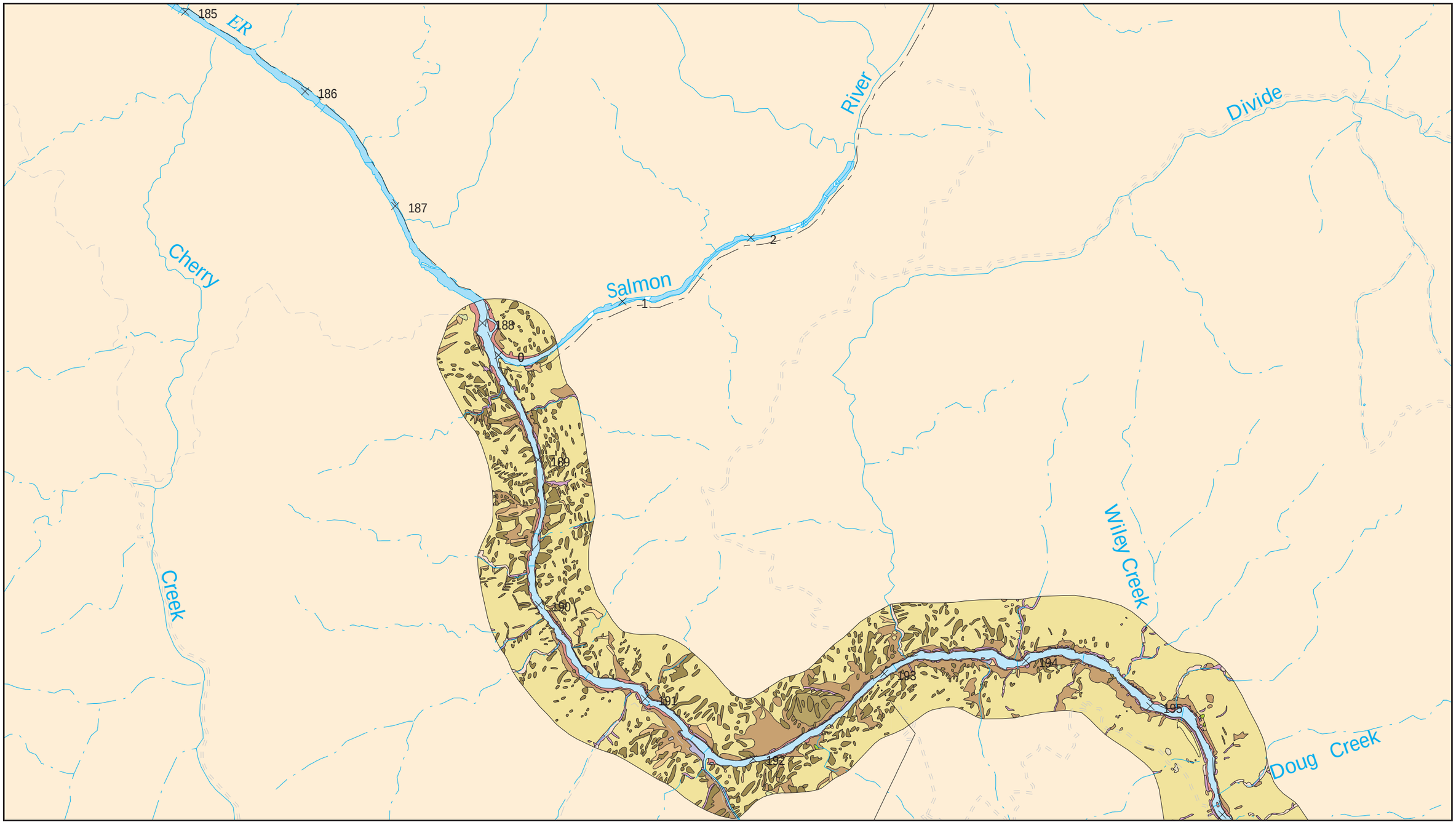

Study Area

Boise
Snake River

Vicinity Map

Panel 16 of 16

IDAHO POWER
Geographic Information Services

Base Features Legend

- Primary Route
- Secondary Route
- Light Duty Road
- Unimproved Road
- Trail
- Railroad
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- Roads

GN
MN
0°08'
2 MILS
17°30'
311 MILS

UTM GRID AND 1987
MAGNETIC NORTH DECLINATION
AT CENTER OF OXBOW QUADRANGLE

Tech. Report E.3.3-1 Figure 3

Cover Types of the Hells Canyon Study Area

1 .5 0 MILES

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Arrows indicate relative positions of reach divisions, where HC = Hells Canyon Dam, OX = Oxbow Dam, BR = Brownlee Dam, and BA = Cobb Rapids

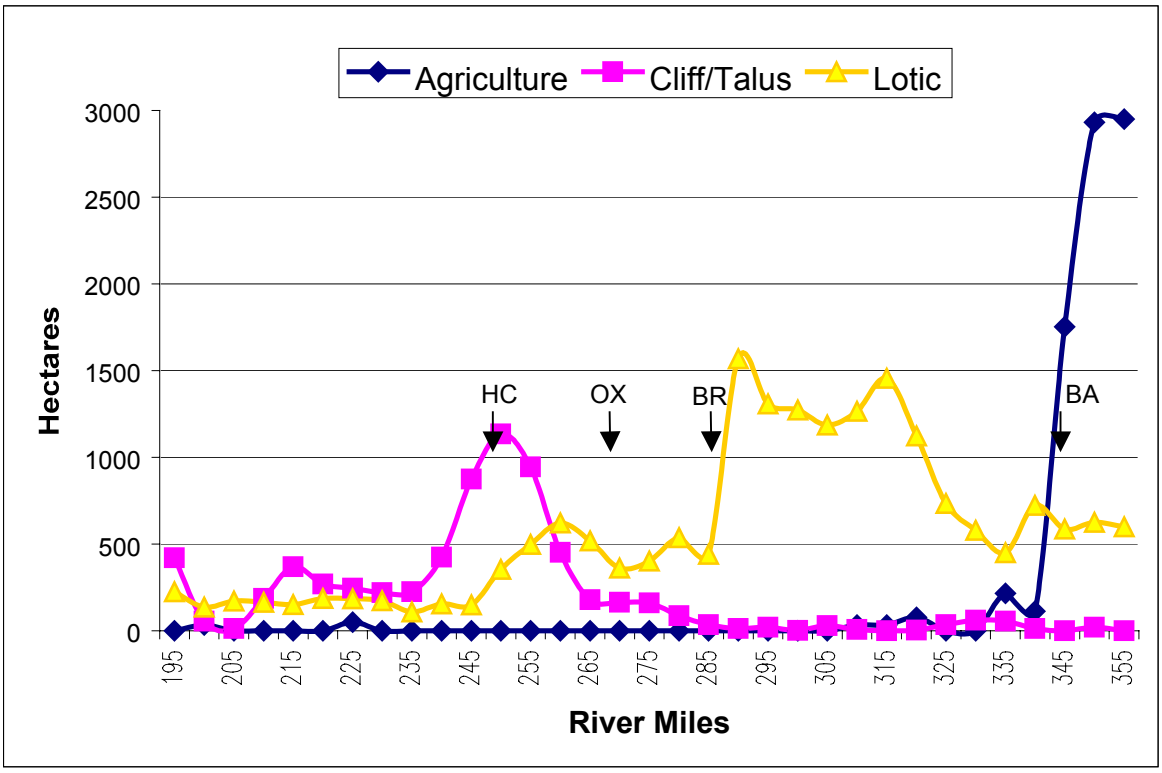

Figure 4. Natural feature/land use cover type abundance by river mile in the Hells Canyon study area.

Arrows indicate relative positions of reach divisions, where HC = Hells Canyon Dam, OX = Oxbow Dam, BR = Brownlee Dam, and BA = Cobb Rapids.

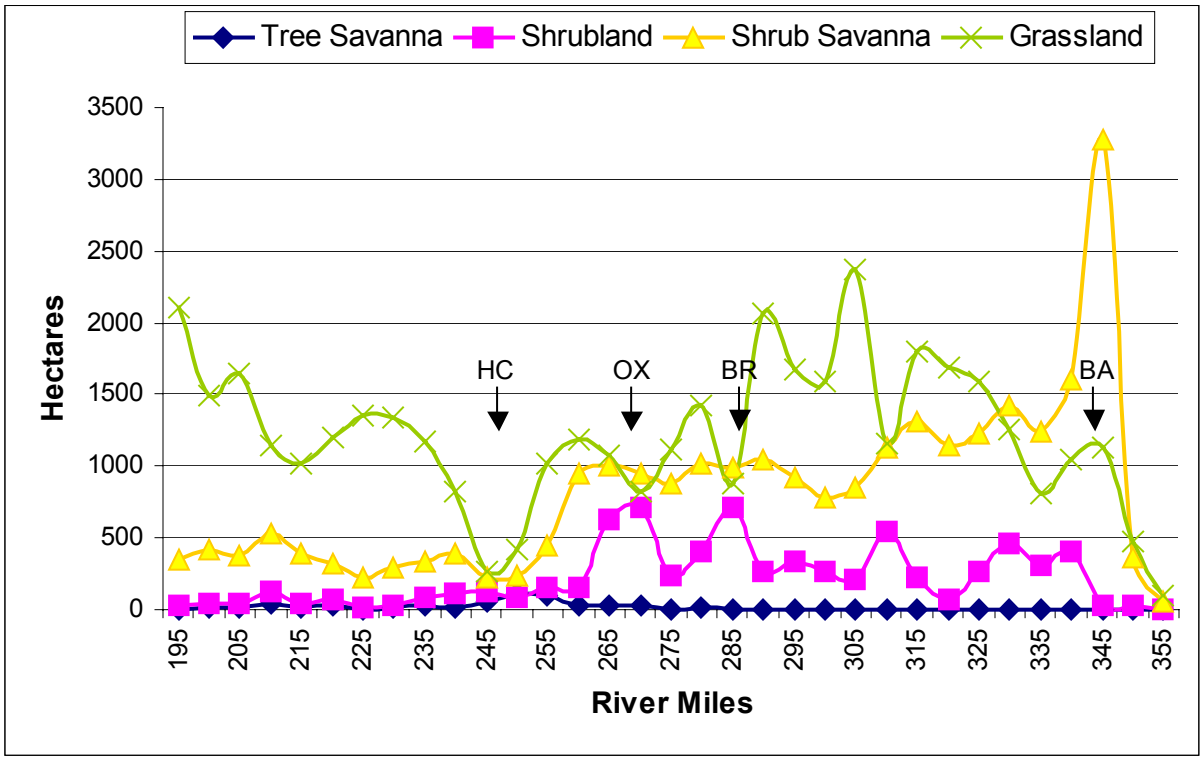

Figure 5. Upland cover type abundance by river mile in the Hells Canyon study area.

Arrows indicate relative positions of reach divisions, where HC = Hells Canyon Dam, OX = Oxbow Dam, BR = Brownlee Dam, and BA = Cobb Rapids.

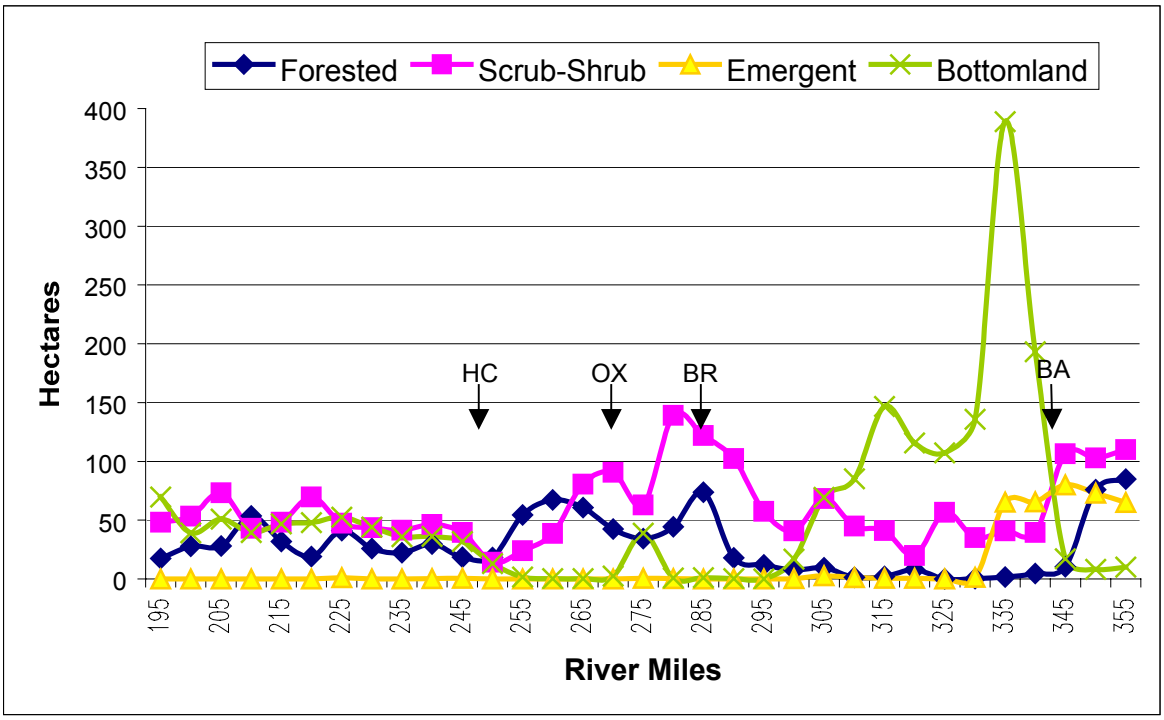

Figure 6. Riparian cover type abundance by river mile in the Hells Canyon study area.

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Appendix 1. Cover type definitions, codes, and identification numbers used to define vegetation, natural feature, and land use cover types for the Hells Canyon Study Area.

References cited in the Appendices can be found in the Literature Cited section of the main report.

No.	Code	Definitions[1]
1	EHW	*Emergent Herbaceous Wetland*—is usually dominated by emergent, erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. Found only in the riparian zone, this cover type has vegetation present for most of the growing season (in most years) and is usually dominated by perennial plants. It has less than 30% cover of woody vegetation and a total vegetation cover of at least 30%. The lands in this cover type are usually saturated with or covered by water for at least part of the growing season. However, because of the difficulties in distinguishing between species and interpreting hydrologic indicators during remote sensing activities, some lands in this cover type may be dominated by upland species (FAC, FAC−, and UPL hydrologic indicator status; see Reed [1988]) and in located areas without the necessary hydrologic regime to be considered "jurisdictional wetlands" by the U.S. Army Corps of Engineers (COE). Actual extent of "wetland" boundaries is not indicated on cover type maps and must be determined on the ground through formal wetland delineation techniques.
3	SBW	*Shore & Bottomland Wetland*—-may consist of bare sand, gravel, or rocky areas along the riparian zone. If vegetation is present, its cover is less than 30%. Examples of this cover type include Rock Bottom, Unconsolidated Bottom, Streambed, Rocky Shore, and Unconsolidated Shore, as defined by Cowardin (1979). Actual extent of jurisdictional "wetland" boundaries is not indicated on cover type maps and must be determined on the ground through formal wetland delineation techniques.
4	SSW	*Scrub-Shrub Wetland*—is dominated by woody wetland vegetation less than 6 m (20 ft) tall in the riparian zone. It has a total vegetation cover of at least 30% and at least 30% cover of woody vegetation. Because of the difficulties in distinguishing between species and interpreting hydrologic indicators during remote sensing activities, some lands in this cover type are dominated by upland species (FAC, FAC−, and UPL hydrologic indicator status; see Reed [1988]) and in located areas without the necessary hydrologic regime to be considered "jurisdictional wetlands" by the COE. Actual extent of "wetland" boundaries is not indicated on cover type maps and must be determined on the ground through formal wetland delineation techniques.

[1] Wetland cover types follow the classification system described by Cowardin et al. (1979) and modified for Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service 1981). Upland cover types generally follow the classification system used for HEP cover types as outlined in U.S. Fish and Wildlife Service (1981).

Appendix 1. (Cont.).

No.	Code	Definitions[1]
5	FW	*Forested Wetland*—is dominated by woody wetland vegetation that is 6 m (20 ft) tall or taller in the riparian zone. It has a total vegetation cover of at least 30% and at least 30% cover of woody vegetation. Because of the difficulties in distinguishing between species and interpreting hydrologic indicators during remote sensing activities, some lands in this cover type are dominated by upland species (FAC, FAC−, and UPL hydrologic indicator status; see Reed [1988]) and in located areas without the necessary hydrologic regime to be considered "jurisdictional wetlands" by the COE. Actual extent of "wetland" boundaries is not indicated on cover type maps and must be determined on the ground through formal wetland delineation techniques.
6	LS	*Lentic* (Standing Water)—is nonmoving, open-water habitat such as ponds and lakes.
7	LM	*Lotic* (Moving Water)—is moving, open-water habitat such as rivers and streams.
8	FU	*Forested Upland*—is dominated by trees (taller than 5 m) and has a tree canopy cover of at least 25%.
9	S	*Shrubland*—an upland vegetation community, dominated by shrubs (including small trees shorter than 5 m). Shrub canopy cover is at least 25%. Total vegetation cover is greater than 25%.
10	TS	*Tree Savanna*—an upland community, with a canopy cover of trees (taller than 5 m) between 5% and 25%. Total vegetation cover is at least 25%. The area between trees is typically dominated by grasses or other herbaceous vegetation.
11	SS	*Shrub Savanna*—an upland community, with a canopy cover of shrubs (including small trees shorter than 5 m) between 5% and 25%. This cover type has a total vegetation cover of at least 25%. The area between shrubs is typically dominated by grasses or other herbaceous vegetation.
12	DW	*Desertic Woodland*—an upland community, with 1 to 25% total vegetation cover and trees (taller than 5 m) forming the dominant vegetation stratum. It includes sparsely vegetated types in nondesert areas.
13	DS	*Desertic Shrubland*—an upland community, with 1 to 25% total vegetation cover and shrubs (and small trees shorter than 5 m) forming the dominant vegetation stratum. This cover type includes sparsely vegetated habitats in nondesert areas.
14	DH	*Desertic Herbland*—an upland community with 1 to 25% total vegetation cover and nonwoody plants (including lichens and mosses) forming the dominant vegetation stratum. It includes sparsely vegetated types in nondesert areas.
15	G	*Grassland*—an upland community with a total vegetation cover of at least 25%, dominated by nonwoody plants (including lichens and mosses), of which grasses (native or introduced) are dominant. This cover type may include prairies, rangeland, and upland subalpine meadows.

[1] Wetland cover types follow the classification system described by Cowardin et al. (1979) and modified for Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service 1981). Upland cover types generally follow the classification system used for HEP cover types as outlined in U.S. Fish and Wildlife Service (1981).

Appendix 1. (Cont.).

No.	Code	Definitions[1]
16	F	*Forbland*—an upland community with a total vegetation cover of at least 25%, dominated by nonwoody plants (including lichens and mosses), of which forbs (native or introduced) are dominant. This cover type includes many weedy fields, old fields, and other types in early successional stages.
17	B	*Barrenland* (e.g., Sand Dunes)—is an undisturbed (by direct human influence) upland area that has a total vegetation cover of 5% or less.
18	CTS	*Cliff*/*Talus Slope*—consists of nearly vertical rock or bare soil faces or slopes of unconsolidated rock material with a total vegetation cover of 5% or less.
19	D	*Disturbed*—is land with more than 50% of the area disturbed by human activities and having a total vegetation cover of less than 15%. This cover type may include off-road vehicle areas, rural trash dumps, and soil borrow pits.
20	A	*Agriculture* (Cultivated)—land that is principally used for the production of agricultural crops or products.
21	GP	*Grazing Land*/*Pasture*—land that is principally used for pasture or grazing of domestic livestock.
22	U	*Urban*—land that is principally located in a city and pertaining to city life (i.e., small business buildings and facilities).
23	R	*Residential*—land that is principally associated with human housing. This cover type may include homes, garages, yards, gardens, sidewalks, driveways, and small livestock pens and pastures (1–2 acres).
24	I	*Industrial*—land that is principally used for larger businesses and corporations, such as office complexes, manufacturing plants, and warehouses.
25	PR	*Parks*/*Recreation*—cultivated landscape that is principally used for human recreation, such as city and county parks, roadside rest areas, and picnic areas.
26	R	*Roads*—consists of roadways for vehicle travel, including major freeways and highways, local paved roads, and improved gravel and dirt roads. This cover type may be mapped as a linear feature rather than a polygon.
27	FO	*Forested*/*Orchard*—is an area of artificially planted and cultivated trees for fruit, nut, or timber production.

[1] Wetland cover types follow the classification system described by Cowardin et al. (1979) and modified for Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service 1981). Upland cover types generally follow the classification system used for HEP cover types as outlined in U.S. Fish and Wildlife Service (1981).

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Appendix 2 (cont.).

Forested Upland

Pseudotsuga menziesii*/*Symphoricarpos albus (PSME/SYAL)
(Douglas-fir/common snowberry) 8 stands

The *Pseudotsuga menziesii*/*Symphoricarpos albus* plant assemblage was one of the most common assemblages encountered in the *Forested Upland* cover type. It was encountered along the Hells Canyon Reservoir (6 sites) and the Oxbow Reservoir (2 sites) reaches. Sites occurred between 2,280 and 3,800 ft on 22- to 41-degree slopes with a northerly aspect. Soils were slightly neutral (pH = 6.6), as typically found on upland soils in the study area.

Thirtytwo Point Creek Plot: HC98TPC21U

In Idaho and eastern Oregon, *Pseudotsuga menziesii* occupies millions of acres. As a disturbance species, it grows primarily in the *Abies grandis-Juniperus-Tsuga* forests (Johnson 1995). In Hells Canyon, these stands are apparently in late-seral stage, indicated by the low amount of *Pinus ponderosa. Pinus ponderosa* will dominate over *Pseudotsuga menziesii* in early and mid-seral stands by at least a 2 to 1 ratio (Johnson and Simon 1987). *Pinus ponderosa* is less shade tolerant than *Pseudotsuga menziesii*, and the pine seedlings will not survive beneath the denser canopy of *Pseudotsuga menziesii*. Other sun-loving plants, such as *Arnica cordifolia*, are also more extensive under the open canopy of early seral stands. *Pseudotsuga menziesii* relies heavily on overstory shade for seedling establishment. The seedlings generally occur beneath tree canopies, but in openings they will also establish beneath canopies of certain shrubs. *Pseudotsuga menziesii* was encountered in 13 transects, in 3 different cover types, and in all reaches but the Weiser.

This assemblage is characterized by an overstory of *Pseudotsuga menziesii* with *Symphoricarpos albus* and a few other shrubs in the understory. Average height of *Pseudotsuga menziesii* is about 20 m, with a mean canopy cover of about 59%. The plant occurs in most plots along transects (frequency = 63%). *Symphoricarpos albus* is a relatively common woody species in the study area. It was encountered in 64 transects, in 6 cover types, and in all reaches but the Weiser. In this assemblage, *Symphoricarpos albus* is the most abundant shrub species under late-seral or climax conditions (Johnson and Simon 1987). In these stands, *Symphoricarpos albus* is the most frequently occurring shrub species in plots along transects (frequency = 26%), and it occurs with the greatest density in both the mature shrub and seedling shrub age classes. Average height is 0.6 m for mature plants and about 0.3 m for seedling plants.

Other codominant shrub species in the understory include *Physocarpus malvaceus* and *Amelanchier alnifolia*. This assemblage is species rich in trees, shrubs, forbs, and graminoids. The herbaceous layer is dominated by *Agropyron spicatum*. Most species in this plant assemblage are native, and only 1 listed

Appendix 2 (cont.).

noxious weed was found, *Cynoglossum officinale*, listed as noxious in Oregon. It occurs in trace amounts (< 1% cover) and infrequently. Litter and mosses combined cover more than 60% of the ground surface.

Other Studies

This plant assemblage is similar to the *Pseudotsuga menziesii-Symphoricarpos albus* and the *Pseudotsuga menziesii-Physocarpus malvaceus* habitat types described by Daubenmire and Daubenmire (1968) in eastern Washington and northern Idaho, the *Pseudotsuga menziesii*/*Symphoricarpos albus* plant association described by Johnson and Simon (1987) in the Wallowa-Snake Province, the *Pseudotsuga menziesii*/*Symphoricarpos albus*-floodplain plant association described by Crowe and Clausnitzer (1997) in eastern Oregon, and the *Pseudotsuga menziesii*/*Symphoricarpos albus*–habitat type described by Steele and Geier-Hayes (1995) in central Idaho.

Appendix 2 (cont.).

PSME/SYAL Site Conditions

Elevation (ft): 2,635 (range 2,280–3,800)

Slope (°): 32 (range 22–41)

Aspect: N(3), NE(3), NW(2)

[A] Soil Texture: clay loam(1), sandy loam(2), silty loam(2)

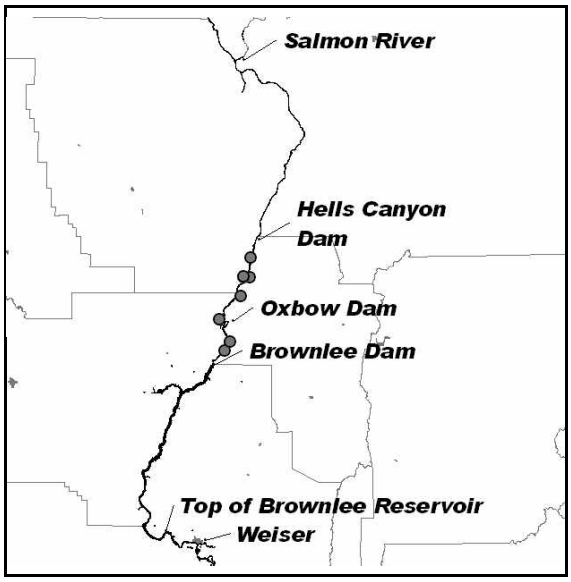
[A] Organic Matter %: 9.8 (6.3–15.3)

[A] pH: 6.6 (6.1–7.0)

[A] ON ppm: 46.2 (18.0–65.0)

[A] CEC meq/100g: 19.4 (15.9–24.0)

[A] Soil characteristic data available for 5 stands.



PSME/SYAL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (7) [b]							
N	*Pseudotsuga menziesii*	58.7	62.5	100.0	387	19.93		
N	*Amelanchier alnifolia*	10.2	10.8	25.0	350	7.18		
N	*Pinus ponderosa*	3.2	4.0	37.5	7	22.33		
	Shrubs (20) [b]							
N	*Physocarpus malvaceus*	12.9	18.5	62.5	3,500	1.03	8,880	0.30
N	*Symphoricarpos albus*	11.4	25.7	100.0	7,064	0.60	29,776	0.30
N	*Amelanchier alnifolia*	4.5	9.0	87.5	229	3.05	646	0.16
N	*Philadelphus lewisii*	2.9	7.3	50.0	5,797	1.00	2,022	0.33
N	*Ribes niveum*	2.5	4.2	25.0	4	0.50	254	0.27
N	*Toxicodendron radicans*	2.5	5.6	25.0	258	0.67	118	0.28
N	*Spiraea betulifolia*	2.4	8.6	75.0			3,800	0.30
N	*Acer glabrum*	2.0	3.0	25.0	833	0.71	375	0.04
N	*Holodiscus discolor*	2.0	3.0	25.0	50	2.30		
	Grasses (9) [b]							
N	*Agropyron spicatum*	5.3	41.7	75.0				
	Forbs (30) [b]							
I	*Stellaria media*	3.1	29.2	50.0				
N	*Arnica cordifolia*	2.5	17.1	62.5				
N	*Tonella floribunda*	2.4	32.1	87.5				
N	*Galium aparine*	2.1	27.5	75.0				
N	*Montia perfoliata*	2.0	21.7	62.5				
	Litter	41.4	84.2	100.0				
	Moss	23.3	65.0	100.0				
	Rock	9.7	32.5	100.0				
	Bare Soil	5.8	30.0	100.0				
	Lichen	5.7	39.2	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 2 (cont.).

Forested Upland

Pinus ponderosa*/*Symphoricarpos albus (PIPO/SYAL)
(ponderosa pine/common snowberry) 8 stands

The *Pinus ponderosa*/*Symphoricarpos albus* plant assemblage was one of the most common assemblages encountered in the *Forested Upland* cover type. Sites with this assemblage were found in all reaches of the study area except above Brownlee Reservoir. Sites occurred between 1,400 and 4,200 ft on 3- to 35-degree slopes, usually with a northerly aspect. Soils were moderately acidic (pH = 5.6), probably due to the long occupancy of *Pinus ponderosa* on the sites, as evergreens tend to increase acidity of surface soils over time.

Warm Springs Plot: OX96WRM03U

Pinus ponderosa is a post-fire species in the *Pseudotsuga menziesii* zone and even in forests where *Abies grandis* is climax (Johnson 1995). Sites with this assemblage consist of older stands of *Pinus ponderosa* with a scarcity of saplings. Unsuitable seedbeds and poor dispersion of the heavy seed limit pine regeneration (Steele and Geier-Hayes 1989). Distance to seed source and infrequent cone crops are often responsible for seed scarcity. Logging and burning stimulate several shrub and herb layer species, which can quickly dominate potential seedbeds. *Pinus ponderosa* was encountered in 23 transects, 6 cover types, and all reaches but the Weiser.

The average height of the *Pinus ponderosa* canopy in this assemblage is 15.2 m with a canopy cover of about 40%. *Symphoricarpos albus* is a relatively common woody species in the study area. It was encountered in 64 transects, 6 cover types, and all reaches but the Weiser. In this assemblage, *Symphoricarpos albus* is the most frequently occurring shrub species in plots along transects (frequency = 20%) and has the greatest cover (12%). It occurs with the greatest density in both the mature shrub and seedling shrub age classes. Average height of mature plants is 0.5 m and about 0.3 m for seedling plants.

Several other shrub species contribute minor coverage in the understory. This assemblage is species rich in trees, shrubs, forbs, and graminoids. Most species in this plant assemblage are native to the area except for several introduced graminoids. Two weeds listed noxious in Oregon were encountered: *Taeniatherum caput-medusae* and *Cynoglossum officinale*. Both occur in trace amounts (< 1% cover) and infrequently. Litter covers nearly one-half of the ground surface.

Other Studies

This plant assemblage is somewhat similar to the *Pinus ponderosa-Symphoricarpos albus* habitat type described by Daubenmire and Daubenmire (1968) in eastern Washington and northern Idaho, the *Pinus*

Appendix 2 (cont.).

ponderosa/*Symphoricarpos albus* plant association described by Johnson and Simon (1987) in the Wallowa-Snake Province, and the *Pinus ponderosa* phase of the *Pseudotsuga menziesii*/*Physocarpus malvaceus* habitat type described by Steele et al. (1981) and Steele and Geier-Hayes (1989) in central Idaho. Asherin and Claar (1976) describe a *Pinus ponderosa*/*Agropyron spicatum* vegetation type that occurs in the area, but did not collect any vegetation measurements for this type. Daubenmire and Daubenmire (1968) also describe a *Pinus ponderosa-Festuca idahoensis* habitat type that extends down to the Snake River on north-facing slopes in the Hells Canyon Reservoir area and below Hells Canyon Dam.

Appendix 2 (cont.).

PIPO/SYAL Site Conditions

Elevation (ft): 2,667.5 (range 1,400–4,200)

Slope (°): 24.6 (range 3.0–35.0)

Aspect: N(3), NE(1), NW(3), S(1)

[a] Soil Texture: loamy sand (1), sandy loam(3), silty loam(1)

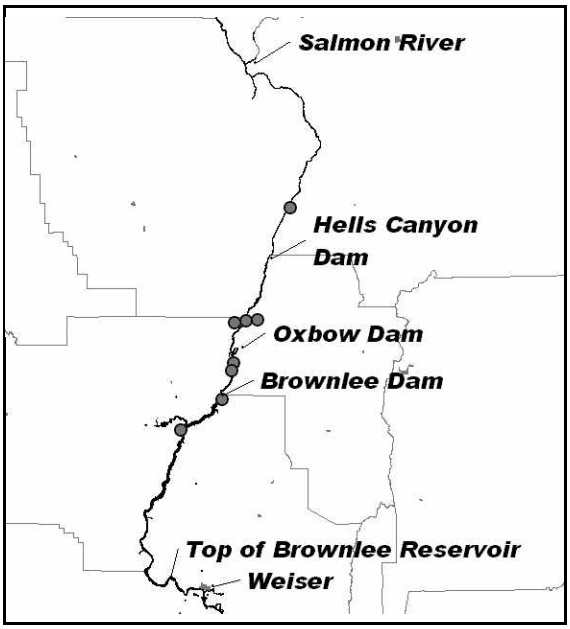
[a] Organic Matter %: 7 (2.9–11.0)

[a] pH: 5.6 (5.2–6.8)

[a] ON ppm: 43.2 (18.0–65.0)

[a] CEC meq/100g: 15.2 (8.0–20.0)

[a] Soil characteristic data available for 5 stands.



PIPO/SYAL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (5) [b]							
N	*Pinus ponderosa*	40.2	42.5	75.0	218	15.20		
N	*Prunus emarginata*	3.8	4.2	12.5	63	8.14		
N	*Amelanchier alnifolia*	3.4	4.2	37.5	590	7.05		
	Shrubs (16) [b]							
N	*Symphoricarpos albus*	11.7	20.4	62.5	5,015	0.55	15,492	0.28
N	*Prunus emarginata*	8.5	14.8	37.5	1,049	2.20	204	0.24
N	*Spiraea betulifolia*	5.2	7.3	12.5	1,500	0.62	2,875	0.30
N	*Amelanchier alnifolia*	4.5	8.0	87.5	566	1.69	275	0.13
N	*Symphoricarpos oreophilus*	3.4	6.0	12.5	1,750	0.63	1,250	0.38
N	*Toxicodendron radicans*	3.3	3.8	25.0	2,000	0.64	2,113	0.30
N	*Rosa woodsii*	3.3	7.9	50.0	1,067	0.85	104	0.31
N	*Sambucus cerulea*	2.3	2.5	12.5				
	Grasses (15) [b]							
I	*Poa pratensis*	4.0	22.5	50.0				
N	*Festuca idahoensis*	3.1	12.1	25.0				
I	*Bromus tectorum*	3.0	27.9	62.5				
N	*Agropyron spicatum*	2.9	26.2	62.5				
	Forbs (26) [b]							
	Litter	46.3	87.1	100.0				
	Moss	9.6	37.5	100.0				
	Rock	8.3	34.2	100.0				
	Bare Soil	7.3	54.2	100.0				
	Lichen	2.6	33.3	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 2 (cont.).

Forested Upland

Robinia pseudoacacia (ROPS)
(black locust) 4 stands

The *Robinia pseudoacacia* plant assemblage is uncommon in the *Forested Upland* cover type. It was encountered in the Brownlee and Hells Canyon Reservoir reaches and in the reach below Hells Canyon Dam. Sites with this assemblage occurred between 1,320 and 2,077 ft on 3- to 8-degree slopes in close proximity to the Snake River. Given the presence of many weedy species that colonize disturbed areas, these sites are probably related to past or current homesteading activities. The occurrence of an introduced ornamental species, *Syringa vulgaris* (purple lilac), at 1 site is strong evidence of former human occupation. At the 1 site where a soil sample was taken, soil pH was neutral (pH = 6.6).

Temperance Creek Plot: HB96TEMO23R

Robinia pseudoacacia is native to the eastern United States and probably brought west to Idaho and Oregon for use as a windbreak tree and as a drought-resistant ornamental. The wood is very resistant to decay when in the ground, and groves of black locust were planted near many early farms in Idaho as a source of fence posts (Johnson 1995). From extensive plantings, *Robinia pseudoacacia* has escaped in Idaho and Oregon to the extent that it now prospers in the wild at mid and lower elevations. It generally appears in groves, sprouting from widespread roots (Johnson 1995). *Robinia pseudoacacia* was encountered in 11 transects, 3 cover types, and all but the Oxbow Reservoir Reach.

In this assemblage, the average tree height of *Robinia pseudoacacia* is 9.6 m, and the mean canopy cover is over 90%. It occurs in nearly all plots along transects (frequency = 92%). In the shrub size class, *Robinia pseudoacacia* is a healthy understory component, averaging about 3.5 m in height. Nearly all plants occurring in this plant assemblage are introduced. The herbaceous stratum is species rich in weedy forbs and graminoids. *Poa bulbosa*, *Bromus sterilis*, and *Taeniatherum caput-medusae* are common graminoids, each averaging more than 10% cover. This assemblage includes 6 noxious weeds that are listed in either Idaho or Oregon or both: *Taeniatherum caput-medusae*, *Cynoglossum officinale*, *Onopordum acanthium*, *Lepidium latifolium*, *Rumex crispus*, and *Convolvulus arvensis*. Except for the first 2 species, the average cover and relative frequency of most of these species are low. Litter covers more than 70% of the ground surface.

Other Studies

The *Robinia pseudoacacia* plant assemblage has not been previously described for the Hells Canyon area. Asherin and Claar (1976) sampled 1 site dominated by *Robinia pseudoacacia* and *Anthriscus scandicina* along the Little Goose and Lower Monumental Reservoirs on the Columbia River.

Appendix 2 (cont.).

ROPS Site Conditions

Elevation (ft): 1,715 (range 1,320–2,077)

Slope (°): 4.8 (range 3.0–8.0)

Aspect: E(1), SE(3)

[a] Soil Texture: loamy sand (1)

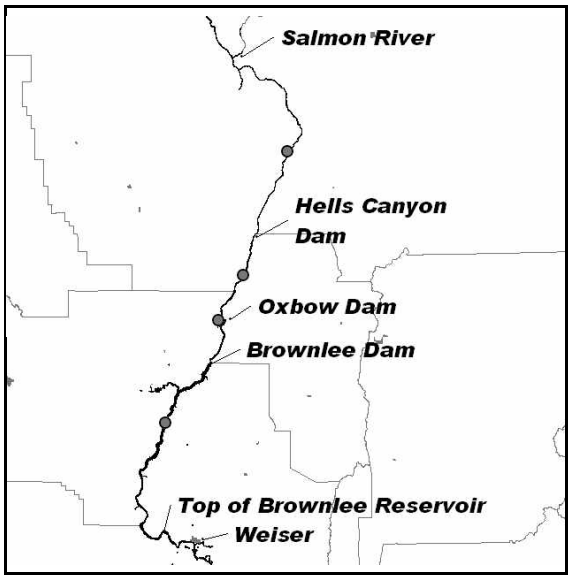
[a] Organic Matter %: 5.2

[a] pH: 6.6

[a] ON ppm: 65.0

[a] CEC meq/100g: 14.9

[a] Soil characteristic data available for 1 stand.



ROPS Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
I	*Robinia pseudoacacia*	90.4	91.7	100.0	1,572	9.65		
	Shrubs (8) [b]							
I	*Robinia pseudoacacia*	19.3	27.9	75.0	424	3.49		
I	*Syringa vulgaris*	5.8	8.3	25.0	2,292	2.08	1,000	0.03
I	*Prunus cerasifera*	2.5	8.3	25.0	2,500	1.45	2,500	0.25
	Grasses (9) [b]							
I	*Poa bulbosa*	12.8	25.0	25.0				
I	*Bromus sterilis*	12.3	32.5	50.0				
I	*Taeniatherum caput-medusae*	10.9	21.3	25.0				
I	*Bromus tectorum*	5.4	27.5	75.0				
I	*Secale cereale*	1.7	7.5	25.0				
	Forbs (14) [b]							
I	*Lactuca serriola*	3.0	20.8	50.0				
I	*Cynoglossum officinale*	2.9	20.4	50.0				
I	*Onopordum acanthium*	1.9	9.2	25.0				
	Litter	70.2	100.0	100.0				
	Rock	6.7	26.7	100.0				
	Bare Soil	3.0	43.3	100.0				
	Lichen	1.9	22.1	100.0				
	Moss	0.1	3.3	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1.5% cover not listed in table.

Appendix 2 (cont.).

Forested Upland

Populus tremuloides/*Toxicodendron radicans* (POTR/TORA)
(quaking aspen/poison ivy) 2 stands

The *Populus tremuloides*/*Toxicodendron radicans* plant assemblage is rare in the *Forested Upland* cover type. One site with this assemblage was encountered on the Oxbow Reservoir Reach and 1 site on the Hells Canyon Reservoir Reach. Sites occurred at 1,720 and 2,200 ft elevation on a 10- and a 16-degree slope; slope aspects were east and northwest. Soils were neutral (pH = 6.7), typical of upland soils in the canyon.

Cow Creek Plot: OX95COW01R

Populus tremuloides is an early-seral, sun-loving species that is displaced by invading conifer species. As conifers trees grow taller, they shade aspens, causing eventual death unless fire or logging removes the conifers (Johnson 1995). *Populus tremuloides* was encountered on 12 transects; in 2 cover types; and in the Brownlee Reservoir, Oxbow Reservoir, and Hells Canyon Reservoir reaches.

In this assemblage, the average height of *Populus tremuloides* is 10.1 m with a mean canopy cover of 38%. It occurs in about one-half of all plots along transects (frequency = 43%). *Toxicodendron radicans* is one of the most commonly encountered shrub species in the study area. It occurred in 196 transects, in 10 cover types, and in all study reaches. In this assemblage, *Toxicodendron radicans* provides about 7% cover and has abundant plants in the seedling shrub height-class that average about 0.2 m tall. *Philadelphus lewisii* is an important understory species in this plant assemblage, providing almost 19% cover with plants averaging about 1.5 m tall.

This assemblage is species rich (n = 43), and most species are native. However, the herbaceous layer is dominated by 2 introduced species: *Bromus tectorum* and *Onopordum acanthium*. Three species listed as noxious weeds in either Idaho or Oregon are present: *Taeniatherum caput-medusae*, *Onopordum acanthium*, and *Cynoglossum officinale*. Litter covers 59% of the ground surface; rocks covers about 22%.

Other Studies

This plant assemblage has not been previously described in the Hells Canyon area. Johnson and Simon (1987) document the presence of an occasional *Populous tremuloides* plant community type in the Wallow-Snake Province, and Crowe and Clausnitzer (1997) describe several *Populous tremuloides*-dominated plant communities in mid-montane wetland areas in eastern Oregon.

Appendix 2 (cont.).

POTR/TORA Site Conditions

Elevation (ft): 1,970 (range 1,720–2,220)

Slope (°): 13.0 (range 10.0–16.0)

Aspect: E(1), SW(1)

[a] Soil Texture: loamy sand (1), sandy loam(1)

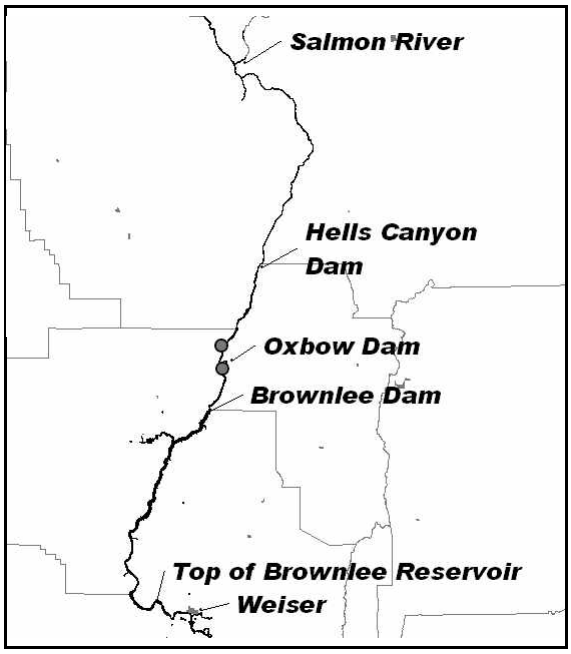
[a] Organic Matter %: 4.5 (2.0–6.9)

[a] pH: 6.7 (6.6–6.7)

[a] ON ppm: 52.5 (40.0–65.0)

[a] CEC meq/100g: 14.5 (11.0–17.9)

[a] Soil characteristic data available for 2 stands.



POTR/TORA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (3) [b]							
N	*Populous tremuloides*	38.0	43.4	50.0	1,350	10.13		
I	*Prunus armeniaca*	11.1	16.7	50.0	900	6.37		
N	*Celtis reticulata*	2.1	3.4	50.0				
	Shrubs (10) [b]							
N	*Philadelphus lewisii*	18.8	26.7	50.0	16,000	1.54	5,000	0.20
N	*Toxicodendron radicans*	6.6	20.0	100.0			68,000	0.19
N	*Prunus virginiana*	2.7	10.0	50.0	2,000	1.03	500	0.28
N	*Populus tremuloides*	1.8	13.4	50.0			38,500	0.17
N	*Crataegus douglasii*	1.6	3.4	50.0	1,000	1.22	1,000	0.26
	Grasses (10) [b]							
I	*Bromus tectorum*	16.9	73.3	100.0				
I	*Poa bulbosa*	5.1	43.4	50.0				
I	*Bromus japonicus*	3.1	61.7	100.0				
N	*Elymus glaucus*	2.8	31.7	100.0				
	Forbs (22) [b]							
I	*Onopordum acanthium*	10.7	41.7	50.0				
I	*Lactuca serriola*	3.4	35.0	100.0				
N	*Helianthus annuus*	2.5	16.7	50.0				
N	*Geranium pusillum*	2.3	31.7	50.0				
N	*Polygonum douglasii*	1.7	16.7	100.0				
N	*Sisymbrium altissimum*	1.5	18.4	50.0				
	Litter	59.0	100.0	100.0				
	Rock	22.5	46.7	100.0				
	Lichen	12.8	46.7	100.0				
	Moss	10.2	50.0	100.0				
	Bare soil	4.1	46.7	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1.5% cover not listed in table.

Appendix 2 (cont.).

Forested Upland

Abies grandis*/*Vaccinium globulare-Acer glabrum (ABGR/VAGL-ACGL)
(grand fir/globe huckleberry-Rocky Mountain maple) 1 stand

The *Abies grandis*/*Vaccinium globulare-Acer glabrum* plant assemblage is rare in the *Forested Upland* cover type. It was encountered at just 1 site in the Hells Canyon Reservoir Reach at the upper margins of the study area at an elevation of 5,320 ft. This site occurred on a 22-degree slope with a northeasterly aspect. The soil was moderately acidic (pH = 5.7), probably due to the long occupancy of *Abies grandis*, as evergreens tend to increase acidity of surface soils over time.

Ballard Creek Plot: HC94018B

Abies grandis is rare along the Snake River corridor of Hells Canyon and was only encountered at higher elevations. This is a very shade-tolerant species and thus acts as a climax species in forested areas. Overstory canopy coverage of *Abies grandis* was 97%, with an average height of about 9.9 m. In this stand, the understory is codominated by *Vaccinium globulare* and *Acer glabrum*. *Vaccinium globulare* is also rare in the study area, only encountered at higher elevations. *Acer glabrum* is a somewhat common woody species in the study area. It was encountered in 56 transects, 4 cover types, and all study reaches.

The herbaceous stratum is species rich in forbs (n = 10), but species poor in graminoids (n = 1). All species in this plant assemblage are native to the area, and no listed noxious weeds were found. Litter covers about 19% of the ground surface.

Other Studies

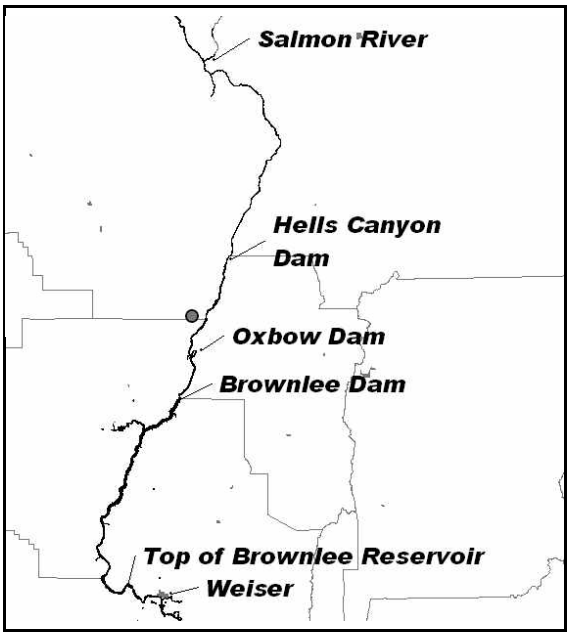
This plant assemblage is similar to the *Abies grandis*/*Acer glabrum* and *Abies grandis*/*Vaccinium membranaceum* plant associations described by Johnson and Simon (1987) in the Wallowa-Snake Province and the *Abies grandis*/*Acer glabrum* habitat type described by Steele and Geier-Hayes (1992) in west-central Idaho.

Appendix 2 (cont.).

ABGR/VAGL-ACGL Site Conditions

Elevation (ft): 5,320
Slope (°): 22.0
Aspect: NE(1)
[a] Soil Texture: loamy sand (1)
[a] Organic Matter %: 8.8
[a] pH: 5.7
[a] ON ppm: 18.0
[a] CEC meq/100g: 14.0

[a] Soil characteristic data available for 1 stand.



ABGR/VAGL-ACGL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
N	*Abies grandis*	97.0	100.0	100.0	360	9.94		
	Shrubs (9) [b]							
N	*Vaccinium globulare*	73.0	100.0	100.0	16,000	0.58	100,000	0.28
N	*Acer glabrum*	61.0	70.0	100.0	4,000	1.70	2,000	0.40
N	*Lonicera utahensis*	18.0	30.0	100.0	8,000	0.80	8,000	0.38
N	*Chimaphila umbellata*	17.0	60.0	100.0			28,000	0.15
N	*Spiraea betulifolia*	15.0	50.0	100.0	2,000	0.90	72,000	0.22
N	*Amelanchier alnifolia*	5.0	10.0	100.0				
N	*Ribes viscosissimum*	4.0	10.0	100.0	2,000	1.22		
N	*Sorbus scopulina*	3.0	10.0	100.0			6,000	0.34
	Grasses (1) [b]							
	Forbs (10) [b]							
N	*Aquilegia* sp.	13.7	63.3	100.0				
N	*Fragaria vesca*	5.0	50.0	100.0				
	Unknown forb	2.4	13.3	100.0				
N	*Smilacina racemosa*	1.2	13.3	100.0				
	Litter	19.3	56.7	100.0				
	Rock	5.0	50.0	100.0				
	Moss	0.8	13.3	100.0				
	Bare Soil	0.2	6.7	100.0				
	Lichen	0.2	6.7	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Forested Upland

Morus alba (MOAL)
(white mulberry) 1 stand

The *Morus alba* plant assemblage is rare in the *Forested Upland* cover type. It was encountered at just 1 site near the high-water mark on the Hells Canyon Reservoir Reach. This site occurred at an elevation of 1,683 ft on a 36-degree slope with a southeast aspect. No soil samples were collected at this site.

Hells Canyon Reservoir Plot: HC970920G2

Morus alba is native to eastern Asia and is considered to be naturalized in Idaho. It was probably brought to Idaho for its fruit, although the tree is also considered an attractive ornamental (Johnson 1995). *Morus alba* is relatively rare along the Snake River corridor in Hells Canyon. It was encountered in 14 transects, 5 cover types, and each study reach. In the canyon, it occasionally grows on gravel bars, in rocks near the high-water mark, or in tributary drainages. Overstory canopy coverage of *Morus alba* at this site is 100%, average height is about 8.1 m, and the species occurs in every plot along transects (frequency = 100%). The understory is codominated by introduced forbs, principally *Marrubium vulgare* and *Cynoglossum officinale*.

This assemblage has a moderate amount of species (n = 21), and most are introduced. Two listed noxious weeds were found: *Cynoglossum officinale* and *Lepidium latifolium*. Litter covers about 55% of the ground surface, and rock covers 33%.

Other Studies

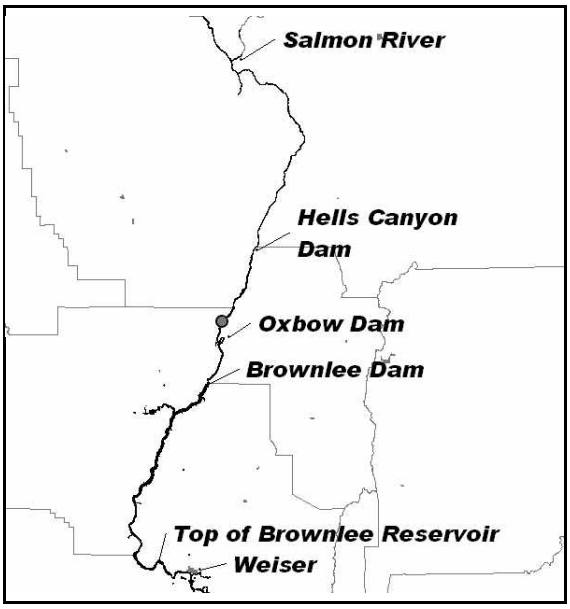
This plant assemblage has not been previously described in the study area.

Appendix 2 (cont.).

MOAL Site Conditions

Elevation (ft): 1,683
Slope (°): 36.0
Aspect: SE(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



MOAL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
I	*Morus alba*	100.0	100.0	100.0	500	8.10	167	0.13
	Shrubs (4) [b]							
	Grasses (5) [b]							
N	*Elymus glaucus*	3.3	35.0	100.0				
I	*Bromus sterilis*	2.4	70.0	100.0				
I	*Bromus japonicus*	0.9	10.0	100.0				
	Forbs (11) [b]							
I	*Marrubium vulgare*	29.1	65.0	100.0				
I	*Cynoglossum officinale*	12.5	45.0	100.0				
I	*Asperugo procumbens*	3.6	40.0	100.0				
I	*Lactuca serriola*	1.0	15.0	100.0				
N	*Lomatium grayi*	0.9	10.0	100.0				
N	*Galium aparine*	0.8	30.0	100.0				
I	*Lepidium latifolium*	0.6	25.0	100.0				
	Litter	55.4	100.0	100.0				
	Rock	33.0	90.0	100.0				
	Bare Soil	3.2	50.0	100.0				
	Lichen	1.0	40.0	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 2 (cont.).

Tree Savanna

Pinus ponderosa (PIPO)
(ponderosa pine) 3 stands

The *Pinus ponderosa* plant assemblage is the most xeric of all conifer-forested plant assemblages in the study area. This assemblage occurs infrequently and was encountered at just 2 sites in the reach below Hells Canyon Dam and at 1 site on the Hells Canyon Reservoir Reach. Sites occurred between 1,520 and 2,400 ft on 5- to 38-degree slopes on west- and northeast-facing slopes. No soil samples were collected on these sites.

New Big Barr Plot: HC98BAR03U

Pinus ponderosa is very common as a post-fire species in the *Pseudotsuga menziesii* zone and even in forests where *Abies grandis* is climax (Johnson 1995). The sites with this assemblage are apparently in a late-seral stage, indicated by the absence of other conifer species. *Pinus ponderosa* was encountered in 23 transects, 6 cover types, and all reaches but the Weiser Reach. In this assemblage, *Pinus ponderosa* has an average height of about 17 m, and it contributes all 19% of the overstory canopy coverage. It also occurs in the shrub height-class, indicating that reproduction is occurring in this assemblage. *Celtis reticulata* is also an important shrub species, contributing about 6% cover in the understory.

The herbaceous stratum is relatively species rich in forbs (n = 36) and graminoids (n = 8). Many species in this plant assemblage are native to the area. Introduced annual brome species dominate the herbaceous layer, but 2 native graminoids also contribute a significant amount of cover: *Agropyron spicatum* and *Festuca idahoensis*. One listed noxious weed was found: *Cynoglossum officinale*. It has a mean cover of less than 2%. Litter covers nearly one-half of the ground surface, and mosses cover about 33% of the ground.

Other Studies

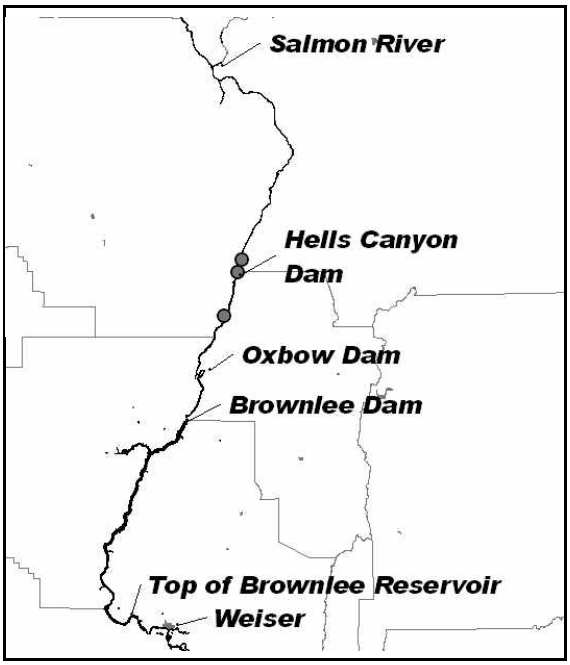
This plant assemblage probably represents a more xeric variation of the *Pinus ponderosa*/*Agropyron spicatum* and *Pinus ponderosa*/*Festuca idahoensis* plant associations described by Johnson and Simon (1987) in the Wallowa-Snake Province, due to its lower-elevation occurrence and greater dominance of annual graminoids. Asherin and Claar (1976) mention a similar *Pinus ponderosa*/*Agropyron spicatum* vegetation type that occurs in the area, but did not collect any vegetation measurements for this type. Daubenmire and Daubenmire (1968) describe a *Pinus ponderosa-Festuca idahoensis* habitat type that extends down to the Snake River on north-facing slopes in Hells Canyon Reservoir area and below Hells Canyon Dam.

Appendix 2 (cont.).

PIPO Site Conditions

Elevation (ft): 1,813.3 (range 1,520–2,400)
Slope (°): 16.3 (range 5.0–38.0)
Aspect: NE(1), W(2)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



PIPO Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
N	*Pinus ponderosa*	19.0	20.7	100.0	40	16.97		
	Shrubs (7) [b]							
N	*Celtis reticulata*	5.8	15.3	66.7	867	1.09		
N	*Pinus Ponderosa*	1.8	3.3	33.3			133	0.11
	Grasses (8) [b]							
I	*Bromus* sp.	19.1	73.3	100.0				
N	*Agropyron spicatum*	9.9	55.5	100.0				
N	*Festuca idahoensis*	8.2	33.3	33.3				
N	*Poa secunda*	1.4	14.4	33.3				
	Forbs (36) [b]							
I	*Cynoglossum officinale*	1.8	31.1	33.3				
I	*Lactuca serriola*	1.3	50.0	100.0				
N	*Montia perfoliata*	1.2	36.7	100.0				
N	*Hieracium* sp.	1.0	12.2	33.3				
N	*Lithophragma* sp.	1.0	40.0	100.0				
N	*Galium aparine*	1.0	38.9	100.0				
	Litter	48.4	98.9	100.0				
	Moss	32.9	100.0	100.0				
	Rock	7.9	37.8	100.0				
	Lichen	4.1	45.6	100.0				
	Bare Soil	1.6	18.9	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Tree Savanna

Celtis reticulata (CERE)
(netleaf hackberry) 3 stands

The *Celtis reticulata* plant assemblage occurs infrequently in the *Tree Savanna* cover type. It was encountered at 3 sites in the reach below Hells Canyon Dam. This plant assemblage is the most xeric of all upland forested plant assemblages in the study area. Sites occurred between 1,200 and 1,480 ft on 6- to 15-degree slopes on a variety of aspects. Soil pH was neutral (pH = 7.1).

Granite Creek Plot: HB97GRA02U

Celtis reticulata is probably the most common woody species seen from the river in Hells Canyon, especially below Hells Canyon Dam. It occupies a wide variety of habitats in Idaho's western canyons. On rocky outcrops it may be a gnarled, twisted shrub, but in stream bottoms it has reasonably straight stems and may be 20 to 30 inches in diameter (Johnson 1995). *Celtis reticulata* was encountered in 343 transects, 11 cover types, and all study reaches. It is a dominant species in 9 plant assemblages in 6 different cover types. In this plant assemblage, *Celtis reticulata* grew tall enough to be classified into a tree-dominated cover type. Average height of *Celtis reticulata* is about 5.6 m. It contributes about 10% of the canopy coverage and occurs in about 11% of plots along transects. *Pinus ponderosa* also occurs in the tree height-class with average cover of about 8% and an average height of about 11.6 m. *Celtis reticulata* dominates the shrub height-class, contributing an additional 18% cover and having an average height of 1.6 m.

The herbaceous stratum is species rich in forbs (n = 19) and graminoids (n = 11). Many species in this plant assemblage are native to the area; however, the herbaceous layer is dominated by introduced graminoids, including *Bromus tectorum*, *Festuca megalura*, and *Bromus sterilis*. No listed noxious weed species were found. Litter covers nearly 65% of the ground surface, and mosses cover about 19% of the ground.

Other Studies

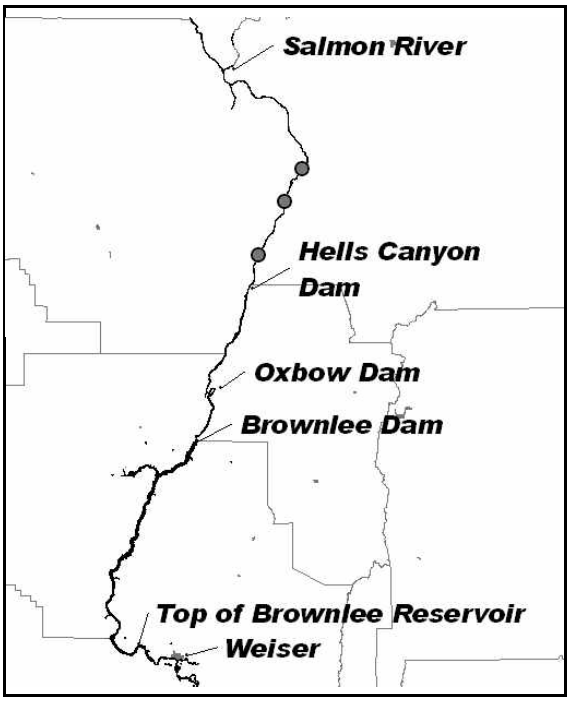
This plant assemblage probably represents a more disturbed variation of the *Celtis reticulata*/*Agropyron spicatum* plant association described by Johnson and Simon (1987) in the Wallowa-Snake Province, due to the dominance of introduced annual graminoids. Because of the dominance of introduced species in the herbaceous understory, this plant assemblage is also similar to some of the *Celtis douglasii* (synonymous with *Celtis reticulata*) communities described by Asherin and Claar (1976) along the Snake and Columbia rivers and the *Celtis douglasii-Bromus tectorum* habitat type described by Daubenmire (1970).

Appendix 2 (cont.).

CERE Site Conditions

Elevation (ft): 1,343.3 (range 1,200–1,480)
Slope (°): 9.0 (range 6.0–15.0)
Aspect: N(1), SW(1), W(1)
[a] Soil Texture: sandy loam (1)
[a] Organic Matter %: 4.3
[a] pH: 7.1
[a] ON ppm: 60.0
[a] CEC meq/100g: 12.0

[a] Soil characteristic data available for 1 stand.



CERE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
N	*Celtis reticulata*	10.4	11.3	66.7	60	5.66		
N	*Pinus ponderosa*	8.1	10.0	33.3	107	11.64		
	Shrubs (4) [b]							
N	*Celtis reticulata*	18.4	24.7	100.0	498	1.60	324	0.24
	Grasses (11) [b]							
I	*Bromus tectorum*	13.5	73.3	100.0				
I	*Festuca megalura*	10.3	27.8	33.3				
I	*Bromus sterilis*	9.4	53.3	100.0				
N	*Sporobolus cryptandrus*	3.3	34.4	100.0				
I	*Poa bulbosa*	2.6	22.2	33.3				
I	*Bromus rigidus*	1.6	8.9	33.3				
	Forbs (19) [b]							
N	*Geranium pusillum*	1.3	33.3	66.7				
N	*Opuntia polycantha*	1.2	6.7	33.3				
I	*Arenaria serpyllifolia*	1.1	35.6	100.0				
I	*Veronica arvensis*	1.0	35.5	100.0				
	Litter	64.7	100.0	100.0				
	Moss	19.0	71.1	100.0				
	Rock	7.4	41.1	100.0				
	Lichen	3.1	45.6	100.0				
	Bare Soil	2.7	33.3	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Tree Savanna

Amelanchier alnifolia-Prunus emarginata (AMAL-PREM)
(serviceberry-bitter cherry) 3 stands

The *Amelanchier alnifolia-Prunus emarginata* plant assemblage is uncommon in the *Tree Savanna* cover type. It was encountered at 2 sites in the Oxbow Reservoir Reach and at 1 site in the Hells Canyon Reservoir Reach. Sites occurred between 2,060 and 2,560 ft on 11- to 18-degree slopes on northern to western aspects. Soils were slightly acidic (pH = 6.5).

Limestone Gulch Plot: OX95LST61R

Amelanchier alnifolia is a tall shrub, but becomes a small, many-stemmed tree in a number of habitats. This species probably grows in more habitats than any other woody plant in Idaho. Scattered plants may be found on rocky outcrops or along streams in the bunchgrass zone or in the sagebrush zone. *Amelanchier alnifolia* occurs in all forested areas up to the lower spruce-fir zone (Johnson 1995). In Hells Canyon, it was encountered in 141 transects, 8 cover types, and all study reaches except the Weiser Reach. In the canyon it often grows tall enough (> 5 m) to be classified as a tree. In this assemblage, the average height of *Amelanchier alnifolia* in the tree height-class is about 7.1 m. In the shrub height-class, its average height is 0.8 m. *Prunus emarginata* is a somewhat less common woody species. It was encountered in 39 transects, 9 cover types, and all study reaches except the Weiser Reach. *Prunus emarginata* can also be a small tree or medium-sized shrub. In Hells Canyon, it often grows tall enough to be classified into a tree height-class-dominated cover type. In this assemblage, its average height in the tree height-class is about 7.9 m and in the shrub height-class is about 1.2 m. Including both height-classes, *Amelanchier alnifolia* provides about 26% cover, and *Prunus emarginata* provides about 17% cover.

This plant assemblage is relatively species rich in shrubs (n = 11), forbs (n = 24), and graminoids (n = 9). Two shrub species are particularly important in this plant assemblage: *Crataegus douglasii* and *Symphoricarpos albus*. Many species in this plant assemblage are native to the area; however, the herbaceous layer is dominated by introduced graminoids, including *Poa pratensis*, *Bromus tectorum*, and *Agropyron repens*. This assemblage contains 1 rare plant species, *Carex backii*, and 2 noxious weed species, *Dipsacus sylvestris* and *Cynoglossum officinale*. All occur in trace amounts (< 1% cover) and infrequently. Litter covers over 82% of the ground surface.

Other Studies

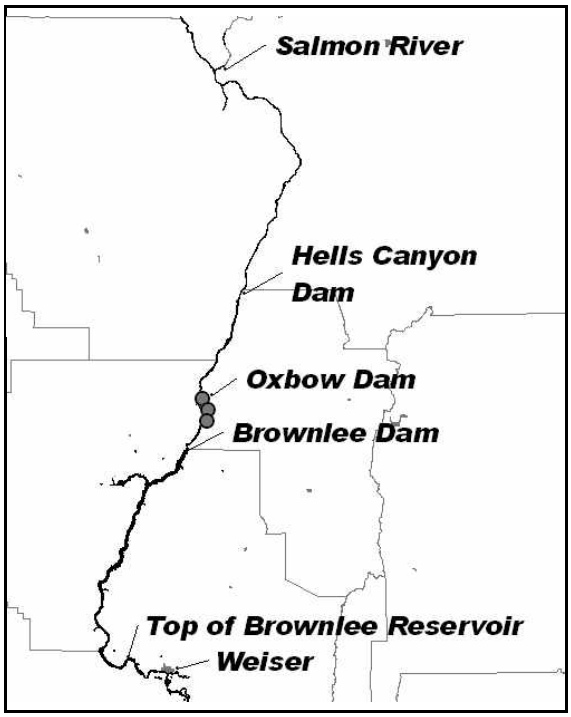
This plant assemblage has not been previously described. An *Amelanchier alnifolia* plant community type was described by Crowe and Clausnitzer (1997) in mid-montane wetlands of eastern Oregon. Asherin and Claar (1976) briefly describe an *Amelanchier alnifolia* vegetation type and a *Prunus emarginata* vegetation type along the Snake and Columbia rivers, but they did not collect any vegetation measurements for this type.

Appendix 2 (cont.).

AMAL-PREM Site Conditions

Elevation (ft): 2,286.7 (range 2,060–2,560)
Slope (°): 13.3 (range 11.0–18.0)
Aspect: N(1), NW(1), W(1)
[a] Soil Texture: sandy loam (3)
[a] Organic Matter %: 7.9 (range 6.0–10.2)
[a] pH: 6.5 (range 6.2–6.7)
[a] ON ppm: 65.0
[a] CEC meq/100g: 16.5 (range 16.0–17.2)

[a] Soil characteristic data available for 3 stands.



AMAL-PREM Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (4) [b]							
N	*Prunus emarginata*	11.3	13.3	66.7	400	7.87		
N	*Amelanchier alnifolia*	4.4	5.3	66.7	77	7.08		
	Shrubs (11) [b]							
N	*Crataegus douglasii*	33.5	35.6	66.7	2,000	3.46	6,667	0.06
N	*Symphoricarpos albus*	26.1	40.2	100.0	64,133	0.68	117,933	0.27
N	*Amelanchier alnifolia*	21.8	25.1	100.0	3,733	0.82	7,600	0.17
N	*Toxicodendron radicans*	7.7	11.1	33.3	11,667	0.59	45,000	0.32
N	*Crataegus columbiana*	6.7	8.9	33.3	3,333	0.96	5,000	0.31
N	*Prunus emarginata*	5.6	13.3	66.7	4,000	1.19	7,000	0.26
N	*Celtis reticulata*	5.2	6.7	66.7			667	0.06
N	*Prunus virginiana*	2.1	4.7	66.7	267	1.55	3,600	0.31
	Grasses (9) [b]							
I	*Poa pratensis*	5.2	33.3	66.7				
I	*Bromus tectorum*	5.1	25.6	33.3				
I	*Agropyron repens*	2.8	23.3	33.3				
	Forbs (24) [b]							
N	*Galium aparine*	5.1	61.1	100.0				
N	*Montia perfoliata*	3.5	33.3	66.7				
I	*Verbascum thapsus*	2.9	8.9	66.7				
I	*Anthriscus scandicina*	2.8	33.3	66.7				
N	*Tonella floribunda*	2.6	23.3	33.3				
N	*Woodsia oregana*	2.5	13.3	33.3				
	Litter	82.1	100.0	100.0				
	Moss	3.3	43.3	100.0				
	Bare Soil	1.4	28.9	100.0				
	Rock	1.0	13.3	100.0				
	Lichen	0.6	17.8	100.0				

[a] N = Native, I = Introduced

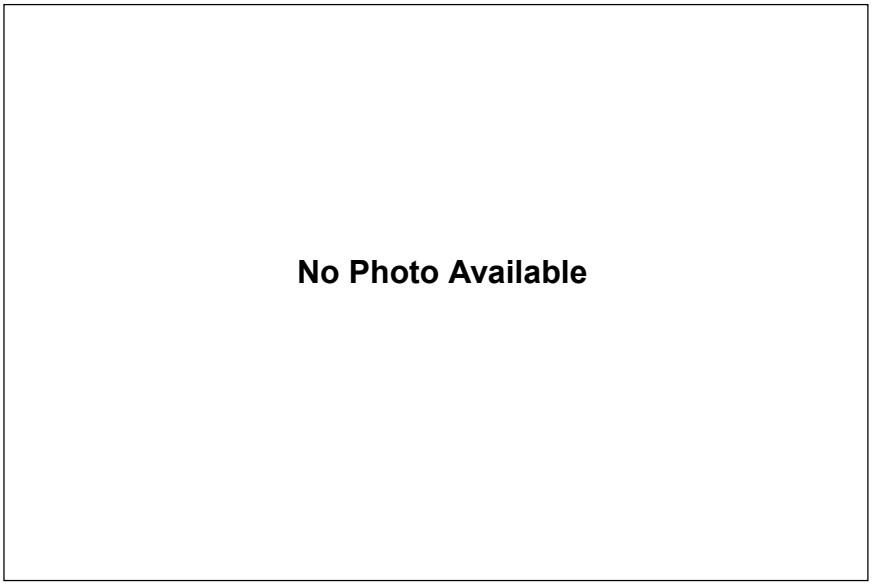
[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 2 (cont.).

Tree Savanna

Amelanchier alnifolia-Prunus cerasifera (AMAL-PRCE)
(serviceberry-cherry plum) 1 stand

The *Amelanchier alnifolia-Prunus cerasifera* plant assemblage was encountered at just 1 site in the Hells Canyon Reservoir Reach. This site occurred at 1,963 ft on a 14-degree slope with a northwest aspect. No soil samples were collected at this site.



Amelanchier alnifolia is a tall shrub, but becomes a small, many-stemmed tree in a number of habitats. This species probably grows in more habitats than any other woody plant in Idaho. Scattered plants may be found on rocky outcrops or along streams in the bunchgrass zone or in the sagebrush zone. *Amelanchier alnifolia* occurs in all forested areas up to the lower spruce-fir zone (Johnson 1995). In Hells Canyon, it was encountered in 141 transects, 8 cover types, and all study reaches except the Weiser Reach. It often grows tall enough (> 5 m) to be classified as a tree. At this site the average height of *Amelanchier alnifolia* plants is about 4.6 m, and they provide 24% cover. *Prunus cerasifera* is a somewhat uncommon woody species. It was encountered on 18 transects, 5 cover types, and 3 study reaches: Oxbow Reservoir, Hells Canyon Reservoir, and Below Hells Canyon Dam. *Prunus cerasifera* was most likely introduced to the area as an ornamental and a source of edible fruit. Several varieties of this species are used in horticulture. Except in this plant assemblage, *Prunus cerasifera* was never found at levels considered dominant in an assemblage. Most often, *Prunus cerasifera* was encountered in association with *Alnus rhombifolia* assemblages. In the AMAL-PRCE assemblage, *Prunus cerasifera* provides about 17% cover. *Rhus glabra* is also common in the understory, contributing about 9% cover.

This plant assemblage is relatively species rich in forbs (n = 26) and graminoids (n = 8). Many species in this plant assemblage are native to the area; however, the herbaceous layer is mostly dominated by introduced graminoids. No noxious weed species were found. Litter covers about 54% of the ground surface. Mosses, rocks, and lichens each cover about 20–35% of the surface, and very little bare soil is exposed.

Other Studies

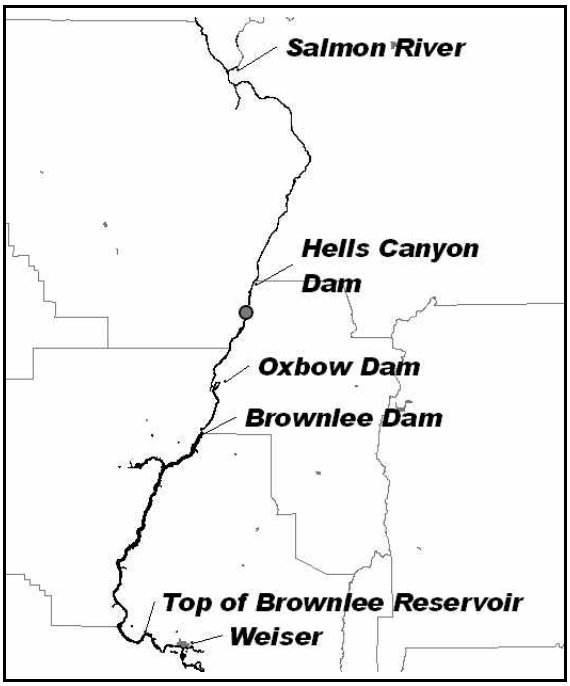
This plant assemblage has not been previously described. A somewhat related *Amelanchier alnifolia* plant community type was described by Crowe and Clausnitzer (1997) in mid-montane wetlands of eastern Oregon. Asherin and Claar (1976) briefly describe an *Amelanchier alnifolia* vegetation type along the Snake and Columbia rivers, but they did not collect any transect measurements for this type.

Appendix 2 (cont.).

AMAL-PRCE Site Conditions

Elevation (ft): 1,963.0 (range 1,963.0–1,963.0)
Slope (°): 14.0 (range 14.0–14.0)
Aspect: NW(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



AMAL-PRCE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
I	*Prunus cerasifera*	16.7	20.0	100.0				
	Shrubs (4) [b]							
N	*Amelanchier alnifolia*	24.0	33.3	100.0	2,667	4.56		
N	*Rhus glabra*	8.7	26.7	100.0	6,000	0.74	3,333	0.35
	Grasses (8) [b]							
I	*Poa pratensis*	6.4	30.0	100.0				
N	*Agropyron spicatum*	4.1	30.0	100.0				
I	*Bromus sterilis*	3.4	83.3	100.0				
I	*Bromus brizaeformis*	2.0	43.3	100.0				
I	*Bromus tectorum*	1.8	70.0	100.0				
I	*Bromus japonicus*	1.4	40.0	100.0				
	Forbs (26) [b]							
N	*Lupinus arbustus*	3.6	43.3	100.0				
N	*Galium aparine*	2.9	63.3	100.0				
N	*Lithospermum ruderale*	2.6	6.7	100.0				
I	*Myosotis micrantha*	1.5	60.0	100.0				
I	*Veronica arvensis*	1.5	43.3	100.0				
I	*Arenaria serpyllifolia*	1.0	40.0	100.0				
	Litter	53.8	100.0	100.0				
	Moss	34.6	83.3	100.0				
	Rock	33.6	83.3	100.0				
	Lichen	20.0	76.7	100.0				
	Bare Soil	1.2	13.3	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Shrubland

Celtis reticulata (CERE)
(netleaf hackberry) 24 stands

Celtis reticulata is probably the most common woody species seen from the river in Hells Canyon, especially below Hells Canyon Dam. The *Celtis reticulata* plant assemblage was the most commonly encountered assemblage in the *Shrubland* cover type. It becomes increasingly less abundant upstream of Hells Canyon Dam. This assemblage was encountered at 13 sites below Hells Canyon Dam, 8 sites on the Hells Canyon Reservoir Reach, and 3 sites in the Brownlee Reservoir Reach. Sites occurred between 1,017 and 2,080 ft on 6- to 90-degree slopes on a variety of aspects. Soil pH was neutral (pH = 7.2).

Cache Creek Plot: HB97CCH01U

Celtis reticulata occupies a wide variety of habitats in Idaho's western canyons. On rocky outcrops it may be a gnarled, twisted shrub, but in stream bottoms it has reasonably straight stems and may be 20 to 30 inches in diameter (Johnson 1995). *Celtis reticulata* was encountered in 343 transects, 11 cover types, and all study reaches. It is a dominant species in 9 plant assemblages in 6 different cover types. In this plant assemblage, average height of *Celtis reticulata* is about 2.1 m, and it contributes about 28% canopy cover. It occurs in more than one-third of all plots along transects (frequency = 38%). Other important shrub species include *Rhus glabra*, *Toxicodendron radicans*, and *Sambucus cerulea*, each contributing 6 to 8% cover. *Toxicodendron radicans* has the highest shrub densities in both the mature and seedling height-classes.

This assemblage is species rich in shrubs (n = 20), forbs (n = 36), and graminoids (n = 15). Many species in this plant assemblage are native to the area; however, the herbaceous layer is mostly dominated by introduced graminoids, including *Bromus sterilis* and *Bromus tectorum*. *Agropyron spicatum* is also a fairly abundant graminoid species. One noxious weed was encountered in this assemblage: *Convolvulus arvensis*. Its average cover is less than 1%, and it occurs infrequently. Litter covers over 43% of the ground surface, and rock covers about 26% of the ground.

Other Studies

This plant assemblage is somewhat similar to a *Celtis reticulata*/*Agropyron spicatum* plant association described by Johnson and Simon (1987) in the Wallowa-Snake Province and the *Celtis reticulata* series described by Tisdale (1986) in west-central Idaho. Because of the dominance of introduced species in the herbaceous understory, the plant assemblage is more similar to the *Celtis douglasii* (synonymous with *Celtis reticulata*) communities described by Asherin and Claar (1976) and the *Celtis douglasii-Bromus tectorum* habitat type described by Daubenmire (1970),

Appendix 2 (cont.).

CERE Site Conditions

Elevation (ft): 1,671.7 (range 1,017–2,080)

Slope (°): 22.8 (range 6.0–90.0)

Aspect: E(7), N(1), NE(1), NW(3), S(1), SE(6), SW(1), W(4)

[a] Soil Texture: clay loam (1), loamy sand (1), sandy loam (6), silty loam (1)

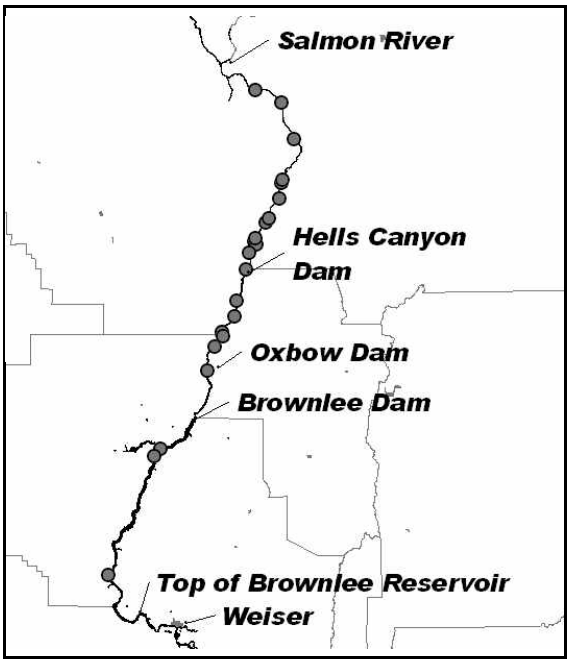
[a] Organic Matter %: 6.8 (range 4.2–9.6)

[a] pH: 7.2 (range 6.5–7.8)

[a] ON ppm: 59.2 (range 18.0–65.0)

[a] CEC meq/100g: 16.8 (range 13.0–24.0)

[a] Soil characteristic data available for 9 stands.



CERE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
	Shrubs (20) [b]							
N	*Celtis reticulata*	28.4	38.4	87.5	1,108	2.08	479	0.23
N	*Rhus glabra*	7.7	15.5	37.5	2,185	1.10	340	0.35
N	*Toxicodendron radicans*	6.4	10.7	29.2	10,219	0.62	35,342	0.28
N	*Sambucus cerulea*	5.6	6.8	12.5	134	2.93	14	0.40
N	*Prunus emarginata*	1.9	3.9	12.5	125	0.92	14	0.31
N	*Philadelphus lewisii*	1.7	2.9	20.8	581	1.16	58	0.33
N	*Glossopetalon nevadense*	1.6	3.7	8.3	138	0.66	317	0.38
	Grasses (15) [b]							
I	*Bromus sterilis*	6.0	29.1	41.7				
I	*Bromus tectorum*	5.4	49.8	83.3				
N	*Agropyron spicatum*	5.2	33.5	66.7				
I	*Bromus japonicus*	1.9	27.8	66.7				
	Bromus sp.	1.6	12.4	20.8				
	Forbs (36) [b]							
N	*Balsamorhiza* sagittata	1.6	4.3	20.8				
	Litter	43.4	98.3	100.0				
	Rock	25.9	76.2	100.0				
	Moss	13.1	68.8	100.0				
	Lichen	8.3	56.7	100.0				
	Bare Soil	5.3	47.4	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1.5% cover not listed in table.

Appendix 2 (cont.).

Shrubland

Artemisia tridentata (ARTR)
(big sagebrush) 20 stands

The *Artemisia tridentata* plant assemblage is common in the *Shrubland* cover type. It was encountered in all reaches except the Weiser Reach, but nearly all *Artemisia tridentata* plant assemblage sites were located in the Brownlee Reservoir Reach (16 sites), probably in association with deeper soils that occur there. Sites occurred between 1,850 and 3,260 ft on 8- to 42-degree slopes on a variety of aspects. Average soil pH was slightly acidic (pH = 6.5).

Ten-Mile Creek Plot: BR96TEN02U

Artemisia tridentata is distributed throughout the semiarid regions of North America. It has broad ecological tolerance and can survive under a great range of environmental conditions. Two subspecies of *Artemisia tridentata* most likely occur in the study area: *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) and *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush). No attempt was made to distinguish between subspecies in this study.

Artemisia tridentata is a commonly occurring shrub in portions of the study area. It was encountered on 112 transects and in 9 cover types, but rarely in any reach except along Brownlee Reservoir. In this assemblage, *Artemisia tridentata* has an average height of 1.2 m and contributes about 25% canopy cover. *Rhus glabra* is the most common secondary shrub in this assemblage.

This assemblage is species rich in shrubs (n = 10), forbs (n = 33), and graminoids (n = 15). Many native herbaceous species are present in trace amounts of cover (< 2%), but the herbaceous layer is dominated by introduced graminoids, mostly *Bromus tectorum*, *Taeniatherum caput-medusae*, and *Bromus japonicus*. *Taeniatherum caput-medusae* is the only listed noxious weed encountered in this assemblage; it is listed noxious in Oregon but not Idaho. Litter covers about 63% of the ground surface.

Other Studies

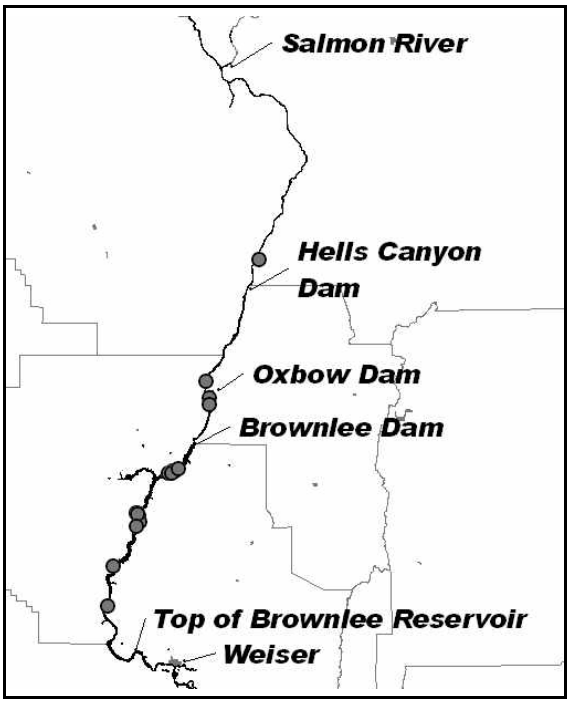
Johnson and Simon (1987) describe several *Artemisia tridentata* ssp. *vaseyana* plant associations, but they are probably representative of more mesic, higher-elevation sites than those in the study area. Given the dominance of introduced graminoids and the sparse amount of *Agropyron spicatum* in the study area assemblage, it probably represents a more disturbed (by grazing and fire) assemblage than the *Artemisia tridentata-Agropyron spicatum* habitat type described by Daubenmire (1970) in the steppe vegetation of Washington. The study area assemblage is similar to the *Artemisia tridentata-Bromus tectorum* plant community described by Asherin and Claar (1976), based on their sampling of 1 site on Brownlee Reservoir.

Appendix 2 (cont.).

ARTR Site Conditions

Elevation (ft): 2,324.9 (range 1,850–3,260)
Slope (°): 21.0 (range 8.0–42.0)
Aspect: N(3), NE(6), NW(6), SE(1), SW(1), W(3)
[a] Soil Texture: loamy sand (2), sandy loam (4)
[a] Organic Matter %: 3.3 (range 2.4–3.7)
[a] pH: 6.5 (range 6.2–7.1)
[a] ON ppm: 52.5 (range 45.0–55.0)
[a] CEC meq/100g: 14.2 (range 11.5–17.0)

[a] Soil characteristic data available for 6 stands.



ARTR Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (10) [b]							
N	*Artemisia tridentata*	24.5	45.4	75.0	1,835	1.20	944	0.27
N	*Rhus glabra*	5.8	13.6	15.0	1,840	1.04	280	0.38
N	*Toxicodendron radicans*	5.0	5.0	5.0	5,000	0.65	14,000	0.36
N	*Rosa woodsii*	1.6	2.0	5.0	833	0.84	667	0.30
N	*Purshia tridentata*	1.5	2.5	5.0	58	1.31		
	Grasses (15) [b]							
I	*Bromus tectorum*	11.3	67.0	95.0				
I	*Taeniatherum caput-medusae*	8.5	30.0	50.0				
I	*Bromus japonicus*	7.7	58.2	70.0				
N	*Poa secunda*	1.9	31.4	95.0				
N	*Agropyron spicatum*	1.5	9.7	55.0				
	Forbs (33) [b]							
N	*Epilobium paniculatum*	1.5	35.3	95.0				
	Litter	63.2	99.5	100.0				
	Moss	10.1	63.3	100.0				
	Rock	5.9	41.7	100.0				
	Bare Soil	5.6	56.0	100.0				
	Lichen	4.0	38.8	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1.5% cover not listed in table.

Appendix 2 (cont.).

Shrubland

Artemisia tridentata-Chrysothamnus nauseosus (ARTR-CHNA)
(big sagebrush-gray rabbitbrush) 13 stands

The *Artemisia tridentata-Chrysothamnus nauseosus* plant assemblage is common in the *Shrubland* cover type. It was primarily encountered in the Brownlee Reservoir Reach (11 sites), along with an occasional stand in the Weiser Reach (2 sites). Sites occurred between 2,080 and 3,012 ft on 0- to 19-degree slopes on a variety of aspects. Soil pH was neutral (pH = 7.2).

Quicksand Creek Plot: BR96QKS32U

Artemisia tridentata is distributed throughout the semiarid regions of North America. It has broad ecological tolerance and can survive under a great range of environmental conditions. Two subspecies of *Artemisia tridentata* most likely occur in the study area: *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) and *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush). No attempt was made to distinguish between subspecies in this study. *Artemisia tridentata* was encountered on 112 transects, in 9 cover types, and rarely in any reach except along Brownlee Reservoir. Average height of *Artemisia tridentata* in this assemblage is about 1 m, and the plant contributes about 23% of the canopy cover.

Chrysothamnus nauseosus is a common steppe shrub and frequently shares habitats with *Artemisia tridentata*. It has a more restricted ecological range and requires somewhat moister conditions and sandier soils (Taylor 1992). It is usually a minor component of relatively undisturbed sagebrush-grass stands (Eckert and Evans 1968, Tisdale et al. 1969, Hironaka and Fosberg 1979). Disturbance by fire or mechanical damage favors *Chrysothamnus* and results in a marked increase of the species (Daubenmire 1975, McArthur et al. 1979). This reaction is primarily due to the species' capacity to sprout and to its high rate of reproduction from seed when competition from other species has been reduced. *Chrysothamnus nauseosus* was encountered on 104 transects, in 8 cover types, and in all study reaches except along Hells Canyon Reservoir. It, too, is mostly found along Brownlee Reservoir, with just an occasional occurrence in other study reaches. In this plant assemblage, the average height of *Chrysothamnus nauseosus* is about 0.8 m. It contributes about 12% of the canopy cover.

This assemblage is species rich in forbs (n = 19) and graminoids (n = 16). Many native herbaceous species are present in trace amounts of cover (< 2%), but the herbaceous layer is dominated by introduced graminoids, mostly *Bromus tectorum* and *Poa bulbosa*. Two listed noxious weeds were found: *Taeniatherum caput-medusae* and *Lepidium latifolium*. Litter covers about 60% of the ground surface.

Appendix 2 (cont.).

Other Studies

This plant assemblage has not been previously described for the study area. A somewhat related *Chrysothamnus nauseosus-Artemisia tridentata-Bromus tectorum* community was described by Asherin and Claar (1976), which they based on sampling of 2 sites, 1 along Brownlee Reservoir and 1 along McNary Reservoir on the Columbia River.

ARTR-CHNA Site Conditions

Elevation (ft): 2,236.3 (range 2,080–3,012)

Slope (°): 9.8 (range 0–19.0)

Aspect: F(2), N(1), NE(2), NW(3), SE(1), SW(2), W(2)

[a] Soil Texture: clay loam (1), loamy sand (2), sandy loam (2)

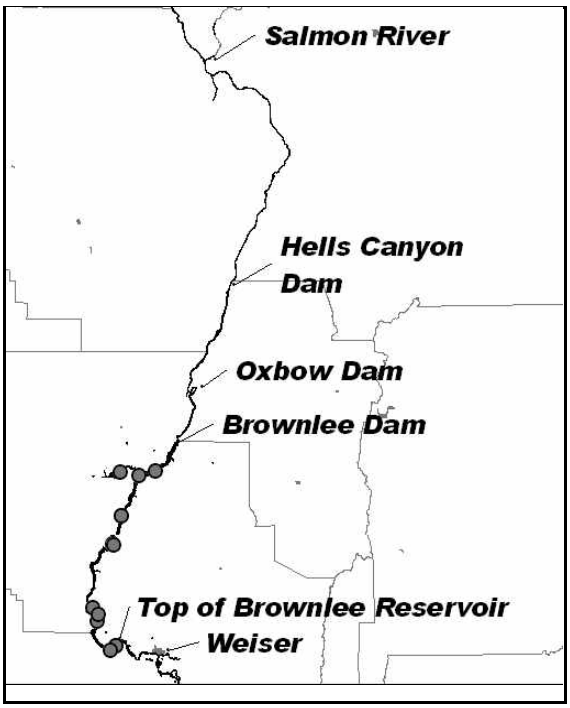
[a] Organic Matter %: 4.0 (range 2.1–6.1)

[a] pH: 7.2 (range 6.8–7.7)

[a] ON ppm: 55.5 (range 40.0–65.0)

[a] CEC meq/100g: 17.3 (range 9.6–26.0)

[a] Soil characteristic data available for 5 stands.



ARTR-CHNA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (4) [b]							
N	*Artemisia tridentata*	22.8	48.2	92.3	4,037	0.99	10,469	0.29
N	*Chrysothamnus nauseosus*	11.5	30.8	100.0	2,004	0.78	3,831	0.35
	Grasses (16) [b]							
I	*Bromus tectorum*	12.9	48.2	53.8				
I	*Poa Bulbosa*	7.2	27.6	61.5				
	Bromus sp.	3.8	29.9	53.8				
I	*Taeniatherum caput-medusae*	3.1	13.8	38.5				
N	*Poa secunda*	2.6	34.2	61.5				
	Poa sp.	1.6	13.1	15.4				
	Forbs (19) [b]							
I	*Anthriscus scandicina*	5.3	13.5	15.4				
N	*Montia perfoliata*	2.1	11.5	38.5				
	Litter	59.3	100.0	100.0				
	Moss	8.3	62.2	100.0				
	Bare Soil	5.4	57.6	100.0				
	Lichen	2.0	32.3	100.0				
	Rock	1.6	32.2	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1.5% cover not listed in table.

Appendix 2 (cont.).

Shrubland

Purshia tridentata (PUTR)
(bitterbrush) 16 stands

The *Purshia tridentata* plant assemblage is commonly encountered in the *Shrubland* cover type. This assemblage was most often found along the Hells Canyon Reservoir Reach (10 sites) and occasionally along the Oxbow Reservoir (3 sites) and Brownlee Reservoir (3 sites) reaches. Sites occurred between 1,800 and 2,720 ft on 14- to 39-degree slopes on a variety of aspects. Soil pH was neutral (pH = 6.7), which is common for upland soils in Hells Canyon.

Bob Creek Plot: HC96BOB42U

Purshia tridentata occurs over a large area in North America, including the Rocky Mountain and Pacific coastal states. Its leaves and twigs constitute one of the best browse plants in the West for deer, elk, and antelope. *Purshia tridentata* is an important winter food source for deer and elk, especially on windswept, relatively snow-free slopes, where plants often become stunted from excessive browsing. *Purshia tridentata* is generally found on deep, well-drained, often coarse-textured, non-saline soils, including sandy or rocky habitats somewhat more moist than is typical for the sagebrush-steppe (Taylor 1992). *Purshia tridentata* is a commonly occurring shrub in portions of the study area. It was encountered on 88 transects, in 10 cover types, and in all study reaches except below Hells Canyon Dam. It is typically associated with habitats along Oxbow and Hells Canyon Reservoirs. The average height of *Purshia tridentata* in this assemblage is about 1.2 m, and it contributes about 24% canopy coverage. Several other shrubs are found occasionally in this assemblage; *Philadelphus lewisii* is the most frequent and provides the most cover (about 5%).

This assemblage is species rich in forbs (n = 44) and graminoids (n = 13). Many of the herbaceous species are native to Hells Canyon; however, the herbaceous layer is dominated by introduced graminoids, mostly *Bromus tectorum* and *Poa bulbosa*. One listed noxious weed is present in the assemblage: *Taeniatherum caput-medusae*. This species occurs in trace amounts (< 1% cover) and infrequently. Litter covers over 30% of the ground surface, and bare soil is present on about 18% of the ground surface.

Other Studies

This plant assemblage is more xeric and degraded (probably from past fires and grazing effects) than the *Purshia tridentata*/*Festuca idahoensis-Agropyron spicatum* and the *Purshia tridentata*/*Agropyron spicatum* plant associations described by Johnson and Simon (1987) in the Wallowa-Snake Province. It is dominated by introduced annual grasses in the herbaceous layer, and *Festuca idahoensis* and *Agropyron spicatum* only occur in trace amounts. Somewhat related assemblages are also described by Daubenmire (1970) for steppe vegetation in Washington, including the *Purshia tridentata-Festuca idahoensis* and

Appendix 2 (cont.).

Purshia tridentata-Agropyron spicatum habitat types. The *Purshia tridentata* plant assemblage described by IPC staff is more similar to the *Purshia tridentata-Bromus tectorum* community described by Asherin and Claar (1976), based on their sampling of 2 sites along Oxbow and Hells Canyon reservoirs.

PUTR Site Conditions

Elevation (ft): 2,151.1 (range 1,800–2,720)

Slope (°): 28.2 (range 14.0–39.0)

Aspect: E(3), N(2), NE(3), NW(2), S(3), SE(1), SW(1), W(1)

[a] Soil Texture: loamy sand (1), sandy loam (3), silty loam (2)

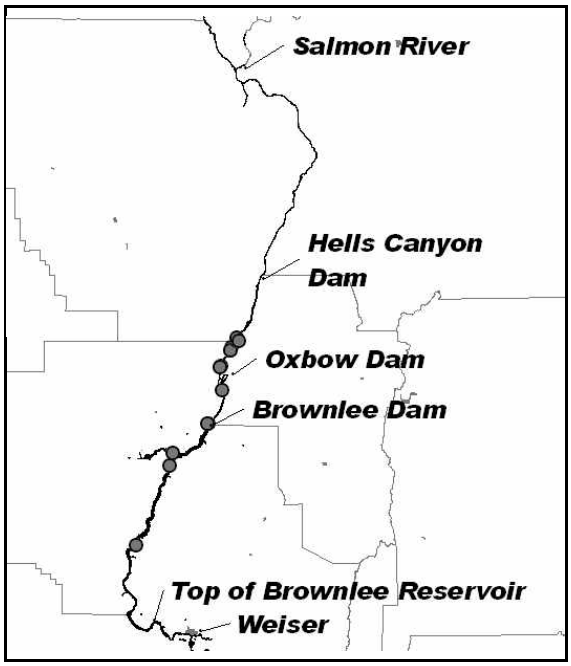
[a] Organic Matter %: 2.6 (range 2.0–4.1)

[a] pH: 6.7 (range 5.7–7.7)

[a] ON ppm: 54.2 (range 40.0–85.0)

[a] CEC meq/100g: 17.1 (range 11.0–21.0)

[a] Soil characteristic data available for 6 stands.



PUTR Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (9) [b]							
N	*Purshia tridentata*	24.5	40.0	81.3	881	1.21	153	0.37
N	*Philadelphus lewisii*	5.3	7.5	12.5	1,106	1.01	713	0.29
N	*Rhus glabra*	2.5	5.0	12.5	700	1.17	180	0.29
N	*Prunus emarginata*	1.9	4.6	12.5	639	0.99	33	0.38
	Grasses (13) [b]							
I	*Bromus tectorum*	9.3	61.3	68.8				
I	*Poa bulbosa*	3.6	18.1	43.8				
	Bromus sp.	3.3	27.4	50.0				
N	*Agropyron spicatum*	1.5	11.6	37.5				
N	*Poa secunda*	1.2	25.0	81.3				
	Forbs (44) [b]							
	Unknown forb	1.2	21.9	25.0				
N	*Draba verna*	1.0	38.5	87.5				
	Litter	30.8	97.3	100.0				
	Bare Soil	18.5	77.6	100.0				
	Rock	14.8	73.1	100.0				
	Moss	9.6	66.6	100.0				
	Lichen	3.6	55.5	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Shrubland

***Symphoricarpos albus*-mixed shrub** (SYAL-MIXED SHRUB)
(common snowberry-mixed shrub) 10 stands

The *Symphoricarpos albus*-mixed shrub plant assemblage was encountered in all reaches except above Brownlee Reservoir (Weiser Reach). Seven of the 10 sites with this assemblage were located in tributary drainages to the Snake River (Table 9), suggesting it is more characteristic of moist tributary slopes in the study area than of slopes associated with the Snake River corridor. Sites occurred between 1,920 and 3,329 ft on 4- to 55-degree slopes, mostly on north and westerly aspects. This assemblage occurs on more mesic upland sites. Soil pH was neutral (pH = 6.6), which is common for upland soils in Hells Canyon.

Granite Creek Plot: HB96GRN09R

Symphoricarpos albus is palatable to cattle and big game. It is resistant to fire and sprouts vigorously after burning. A relatively common woody species in the study area, *Symphoricarpos albus* was encountered in 64 transects, 6 cover types, and all but the Weiser Reach. Average height of *Symphoricarpos albus* in this assemblage is about 0.7 m, and the plant contributes about 34% of the canopy coverage.

This assemblage is species rich in shrubs (n = 15), forbs (n = 44), and graminoids (n = 15). Several other shrub species constitute important elements in this assemblage, each contributing 10 to 19% cover; these include *Amelanchier alnifolia*, *Physocarpus malvaceus*, *Rosa woodsii*, and *Prunus virginiana*. Nearly all species in this assemblage are native. One rare plant, *Carex backii*, and 1 listed noxious weed, *Cynoglossum officinale*, are present. Litter covers about 52% of the ground surface, and very little bare soil is exposed.

Other Studies

This plant assemblage has not been previously described. A somewhat related *Symphoricarpos albus*-*Rosa* spp. plant association was described by Johnson and Simon (1987) in the Wallowa-Snake Province.

Appendix 2 (cont.).

SYAL-MIXED SHRUB Site Conditions

Elevation (ft): 2,333.5 (range 1,920–3,329)

Slope (°): 30.7 (range 4.0–55.0)

Aspect: N(8), NE(1), NW(1), W(1)

[a] Soil Texture: clay loamy (2), loamy sand (2), sandy loam (1)

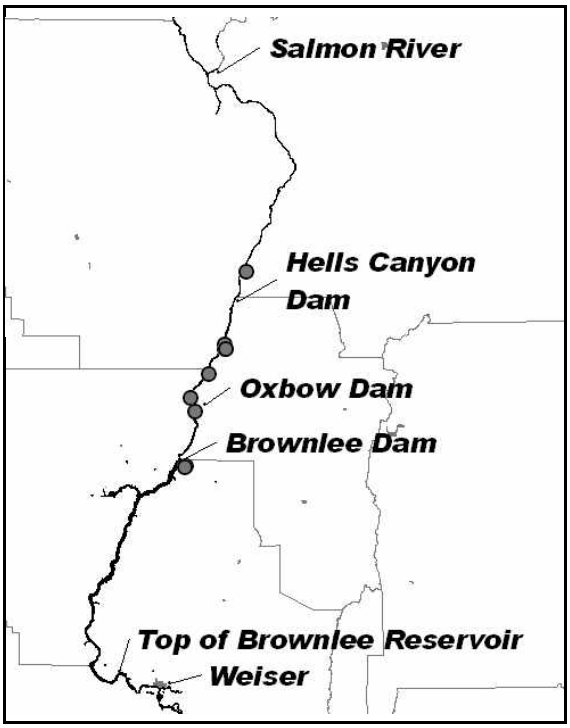
[a] Organic Matter %: 9.3 (range 6.4–16.1)

[a] pH: 6.6 (range 6.0–7.2)

[a] ON ppm: 46.2 (range 18.0–65.0)

[a] CEC meq/100g: 18.5 (range 13.7–27.0)

[a] Soil characteristic data available for 5 stands.



SYAL-MIXED SHRUB Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (15) [b]							
N	*Symphoricarpos albus*	34.5	51.4	80.0	27,205	0.67	93,843	0.31
N	*Amelanchier alnifolia*	19.2	27.0	80.0	2,468	2.39	1,956	0.19
N	*Physocarpus malvaceus*	18.5	28.4	80.0	6,952	1.03	3,711	0.29
N	*Rosa woodsii*	12.6	24.9	60.0	13,493	0.83	12,091	0.36
N	*Prunus virginiana*	10.7	18.2	70.0	2,484	1.60	3,103	0.29
N	*Crataegus douglasii*	6.9	8.0	10.0	467	1.94	67	0.38
N	*Ceanothus sanguineus*	2.2	3.2	20.0				
	Grasses (15) [b]							
N	*Calamagrostis rubescens*	6.8	12.3	20.0				
I	*Poa pratensis*	5.7	29.7	80.0				
N	*Agropyron spicatum*	4.2	40.0	80.0				
N	*Festuca idahoensis*	2.7	15.0	40.0				
	Forbs (44) [b]							
N	*Woodsia oregana*	2.6	11.0	20.0				
I	*Anthriscus scandicina*	2.1	11.3	50.0				
	Litter	51.7	98.7	100.0				
	Moss	18.9	81.3	100.0				
	Rock	12.7	30.7	100.0				
	Bare Soil	3.0	22.7	100.0				
	Lichen	1.3	21.7	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 2 (cont.).

Shrubland

Cercocarpus ledifolius (CELE)
(curl leaf mountain mahogany) 1 stand

The *Cercocarpus ledifolius* plant assemblage was encountered at just 1 site in the Hells Canyon Reservoir Reach. It occurred at an elevation of 1,840 ft, on a 32-degree slope on a west aspect. In Hells Canyon, *Cercocarpus ledifolius* is often observed in association with rocky limestone outcrops. Soil at the 1 stand tested was mildly alkaline (pH = 7.4) due to the association with limestone.

Allison Creek Plot: HC94041B

Cercocarpus ledifolius grows in Idaho chiefly from the Salmon River southward (Johnson 1995). It is a valuable browse plant for deer and elk. Relatively rare in the study area, *Cercocarpus ledifolius* was encountered on just 4 transects, in 2 cover types, and in the Hells Canyon Reach (3 transects) and the reach below Hells Canyon Dam (1 transect). It was often observed in association with limestone outcrops, but it also occurs on basalt parent material. Average height of *Cercocarpus ledifolius* plants in this assemblage is about 2.5 m, and they contribute about 42% of the canopy coverage.

This assemblage is relatively species poor in graminoids (n = 4) and species rich in forbs (n = 10). The herbaceous layer is dominated by *Agropyron spicatum*, which provides over 17% cover. Nearly all species in this assemblage are native. No listed noxious weeds were found. Litter covers about 21% of the ground surface, and bare rock covers 20% of the surface.

Other Studies

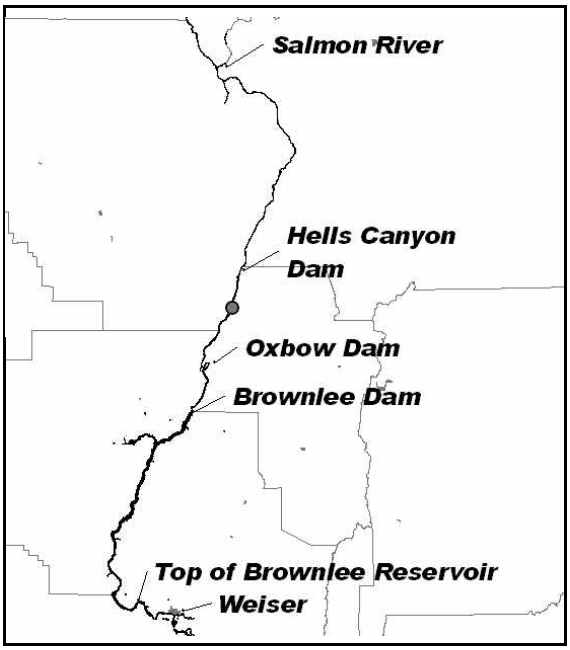
This plant assemblage is similar to the *Cercocarpus ledifolius* plant community type described by Johnson and Simon (1987) in the Wallowa-Snake Province and somewhat similar to the *Cercocarpus ledifolius-Bromus tectorum* community described by Asherin and Claar (1976) from 1 site below the confluence of the Salmon River.

Appendix 2 (cont.).

CELE Site Conditions

Elevation (ft): 1,840.0
Slope (°): 32.0
Aspect: W(1)
[a] Soil Texture: clay loamy (1)
[a] Organic Matter %: 7.2
[a] pH: 7.4
[a] ON ppm: 18.0
[a] CEC meq/100g: 26.0

[a] Soil characteristic data available for 1 stand.



CELE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
	Shrubs (3) [b]							
N	*Cercocarpus ledifolius*	42.5	52.0	100.0	240	2.53		
N	*Amelanchier alnifolia*	5.3	8.0	100.0	100	2.87		
N	*Celtis reticulata*	1.8	4.0	100.0	20	3.34		
	Grasses (4) [b]							
N	*Agropyron spicatum*	17.3	93.3	100.0				
	Forbs (10) [b]							
N	*Astragalus cusickii*	2.7	13.3	100.0				
N	*Balsamorhiza sagittata*	1.3	6.7	100.0				
	Litter	20.7	90.0	100.0				
	Rock	20.0	80.0	100.0				
	Bare Soil	2.4	13.3	100.0				
	Lichen	0.4	16.7	100.0				
	Moss	0.3	10.0	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Shrubland

Sarcobatus vermiculatus (SAVE)
(greasewood) 1 stand

The *Sarcobatus vermiculatus* plant assemblage is rare in the *Shrubland* cover type. It was encountered at just 1 site in the Brownlee Reservoir Reach. It occurred at an elevation of 2,077 ft on the level slope of the shoreline fringe. No soil samples were collected at this site.

Darrows Island Plot: BR99DARASY

Sarcobatus vermiculatus is a salt-tolerant plant that typically grows on saline or alkaline flats and playas. Such sites are only found in the upper reaches of the study area. In southern Idaho and eastern Oregon, *Sarcobatus vermiculatus* grows on such sites throughout sagebrush-steppe. It often forms extensive populations in salt flats, excluding almost all other vegetation. Usually it inhabits areas where abundant groundwater is available to its deeply penetrating root system (Taylor 1992). Average height of *Sarcobatus vermiculatus* plants in this assemblage is about 1.5 m, and they contribute over 59% of the canopy cover.

This assemblage is relatively species poor (n = 13). The little herbaceous vegetation present is dominated by *Bromus tectorum*. About one-half the species in this assemblage are native. One listed noxious weed was encountered: *Lepidium latifolium*. Litter and mosses cover 61% and about 39%, respectively, of the ground surface. About 20% of bare soil is exposed.

Other Studies

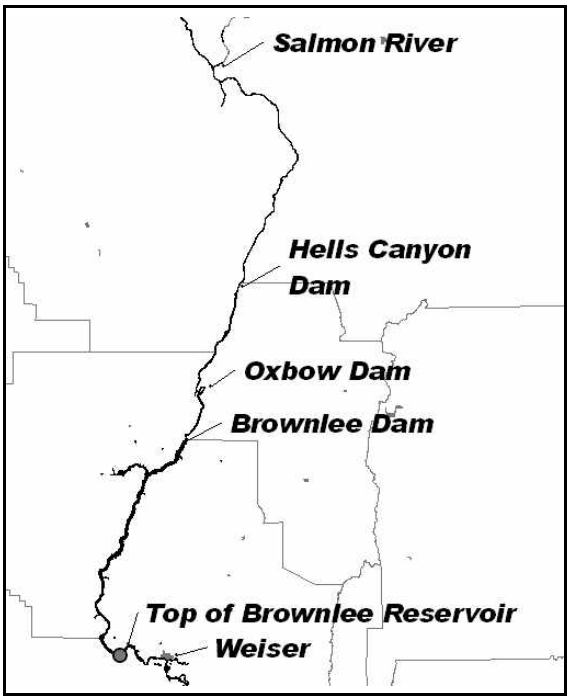
This plant assemblage is probably similar to the *Sarcobatus vermiculatus-Distichlis stricta* habitat type described by Daubenmire (1970) in the steppe vegetation of Washington, where, under heavy grazing pressure, *Bromus tectorum* replaced the *Distichlis stricta*.

Appendix 2 (cont.).

SAVE Site Conditions

Elevation (ft): 2,077
Slope (°): 0.0
Aspect: F(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAVE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
N	*Sarcobatus vermiculatus*	59.1	72.5	100.0	3,000	1.51		
N	*Artemisia tridentata*	1.7	5.0	100.0	500	0.93		
N	*Ribes aureum*	1.5	2.5	100.0			250	0.40
	Grasses (6) [b]							
I	*Bromus tectorum*	3.3	60.0	100.0				
	Poa sp.	3.2	75.0	100.0				
	Forbs (4) [b]							
I	*Kochia scoparia*	1.9	75.0	100.0				
I	*Lepidium latifolium*	0.6	25.0	100.0				
N	*Descurainia pinnata*	0.5	20.0	100.0				
	Litter	61.0	100.0	100.0				
	Moss	38.9	85.0	100.0				
	Bare Soil	20.3	70.0	100.0				
	Lichen	1.9	50.0	100.0				
	Rock	0.1	5.0	100.0				

[a] N = Native, I = Introduced

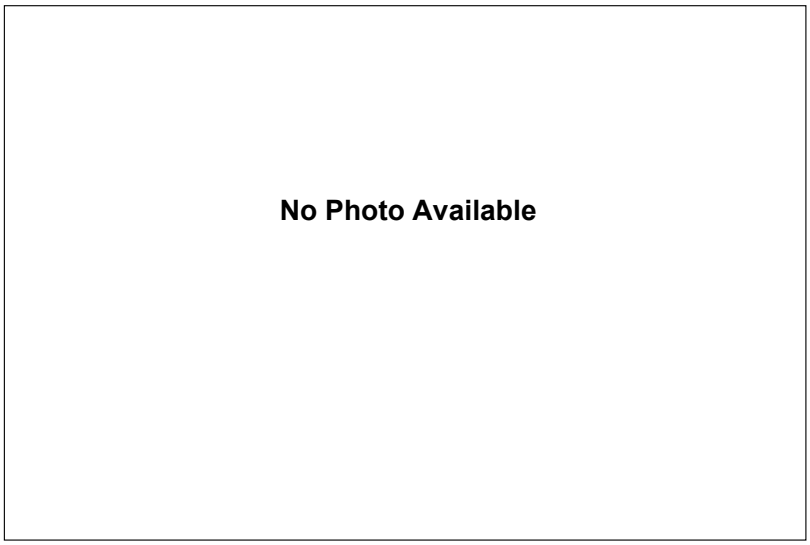
[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 2 (cont.).

Shrubland

Lycium halimifolium (LYHA)
(matrimony vine) 1 stand

The *Lycium halimifolium* plant assemblage is rare in the *Shrubland* cover type. It was encountered at just 1 site in the Brownlee Reservoir Reach. It occurred at an elevation of 2,077 ft on the level slope of the shoreline fringe. No soil samples were collected at this site.



In the study area, *Lycium halimifolium* is a Eurasian species that has escaped from cultivation as an ornamental plant. When present in Hells Canyon, it is often associated with old homestead sites. *Lycium halimifolium* rarely occurs in the study area. It was encountered on just 2 transects, in 2 cover types, and in the Brownlee Reservoir and Hells Canyon Reservoir reaches. Average height of *Lycium halimifolium* plants in this assemblage is about 1.3 m. *Lycium halimifolium* is the only shrub species in the assemblage, and it contributes over 90% of the canopy coverage.

This assemblage is species poor (n = 7). The little herbaceous vegetation present is dominated by *Cuscuta indecora*; most are weedy species typically found on disturbed sites. One listed noxious weed was found: *Lepidium latifolium*. Litter covers over 86% of the ground surface.

Other Studies

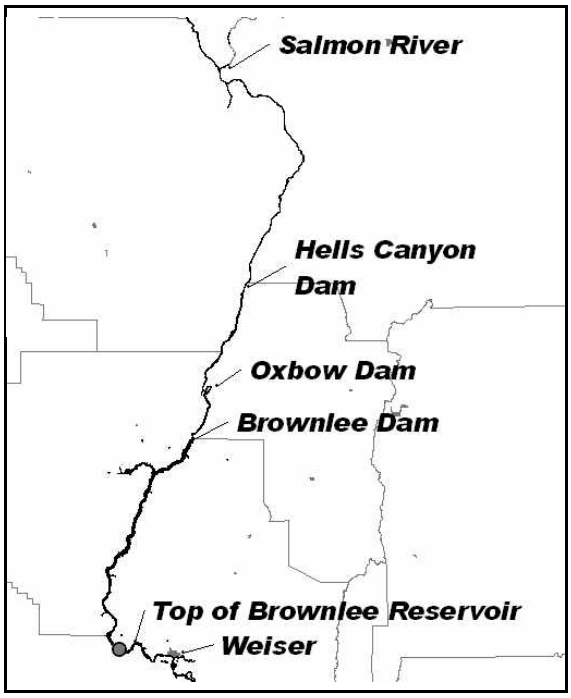
This plant assemblage has not previously been described for the study area.

Appendix 2 (cont.).

LYHA Site Conditions

Elevation (ft): 2,077
Slope (°): 0.0
Aspect: F(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



LYHA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (1) [b]							
I	*Lycium halimifolium*	90.5	100.0	100.0	43,333	1.29	3,333	0.40
	Grasses (1) [b]							
N	*Elymus triticoides*	1.4	30.0	100.0				
	Forbs (5) [b]							
N	*Cuscuta indecora*	4.6	35.0	100.0				
I	*Lepidium latifolium*	2.7	55.0	100.0				
N	*Verbena bracteata*	2.7	10.0	100.0				
N	*Asclepias speciosa*	0.8	5.0	100.0				
	Polygonum sp.	0.1	5.0	100.0				
	Litter	86.2	100.0	100.0				
	Bare Soil	6.5	25.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				
	Rock	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 2 (cont.).

Shrub Savanna

Chrysothamnus nauseosus/*Bromus tectorum* (CHNA/BRTE)
(gray rabbitbrush/cheatgrass) 31 stands

The *Chrysothamnus nauseosus*/*Bromus tectorum* plant assemblage is the most common assemblage in the *Shrub Savanna* cover type. It was primarily encountered in the Brownlee Reservoir Reach (29 sites); there was an occasional stand in the Weiser Reach (2 sites). Sites occurred between 2,077 and 2,604 ft on 0- to 37-degree slopes on a variety of aspects. Soils were mildly alkaline (pH = 7.7).

Near Hewitt Park Plot: BR97HEW01U

Chrysothamnus nauseosus is a common steppe shrub and frequently shares habitats with *Artemisia tridentata*. It has a more restricted ecological range and requires somewhat moister conditions and sandier soils (Taylor 1992). *Chrysothamnus nauseosus* is usually a minor component of relatively undisturbed sagebrush-grass stands (Eckert and Evans 1968, Tisdale et al. 1969, Hironaka and Fosberg 1979). Disturbance by fire or mechanical damage favors *Chrysothamnus nauseosus* and results in a marked increase of the species (Daubenmire 1975, McArthur et al. 1979). This reaction is primarily due to the species' capacity to sprout and to the high rate of reproduction from seed when competition from other species has been reduced. *Chrysothamnus nauseosus* is a relatively common species in the upper reaches of the study area. It was encountered on 104 transects, in 8 cover types, and in all study reaches except along Hells Canyon Reservoir. It is mostly found along Brownlee Reservoir, with just an occasional occurrence in other study reaches. In this plant assemblage, *Chrysothamnus nauseosus* has an average height of about 0.6 m and contributes about 12% canopy coverage.

Bromus tectorum is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). *Bromus tectorum* is the most commonly occurring graminoid in the study area. It was encountered in 447 transects, in all cover types (12), and in all study reaches, most encounters being along the Brownlee Reservoir Reach (205 transects).

This assemblage is species rich in forbs (n = 19) and graminoids (n = 14). Many herbaceous species that provide trace amounts of cover (< 1%) are native, but the herbaceous layer is dominated by introduced graminoids, mostly *Bromus tectorum* and *Poa bulbosa*. A few listed noxious weeds were found: specifically, *Taeniatherum caput-medusae*, *Dipsacus sylvestris*, and *Cynoglossum officinale*. Litter covers about 42% of the ground surface, and bare soil cover is about 17%.

Appendix 2 (cont.).

Other Studies

This plant assemblage has not been previously described for the study area. Asherin and Claar (1976) describe 3 somewhat related plant communities from 1 or 2 sites sampled in each community along the Snake River below the confluence of the Salmon River: *Chrysothamnus nauseosus-Bromus tectorum-Helianthus annuus*, *Chrysothamnus nauseosus-Bromus tectorum-Opuntia polycantha*, and *Chrysothamnus nauseosus-Bromus tectorum-Veronica arvensis*.

Appendix 2 (cont.).

CHNA/BRTE Site Conditions

Elevation (ft): 2,203.3 (range 2,077–2,604)

Slope (°): 14.9 (range 0.0–37.0)

Aspect: E(4), F(2), NE(1), NW(1), S(4), SE(6), SW(5), W(8)

[a] Soil Texture: clay loamy (1), loamy sand (1), sandy loam (4), silty loam (1)

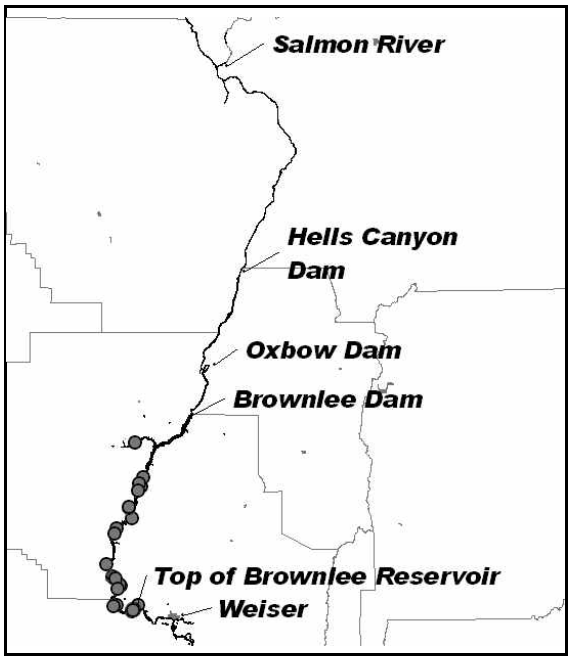
[a] Organic Matter %: 2.5 (range 1.2–4.3)

[a] pH: 7.7 (range 7.1–8.0)

[a] ON ppm: 44.3 (range 30.0–60.0)

[a] CEC meq/100g: 17.9 (range 12.0–31.0)

[a] Soil characteristic data available for 7 stands.



CHNA/BRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (10) [b]							
N	*Chrysothamnus nauseosus*	11.7	36.1	96.8	1,789	0.64	6,020	0.31
N	*Artemisia tridentata*	1.5	4.8	51.6	393	0.82	696	0.25
N	*Purshia tridentata*	0.7	1.2	12.9	83	0.82	55	0.36
N	*Brickellia microphylla*	0.5	0.8	3.2	24	0.71	2	0.15
	Grasses (14) [b]							
I	*Bromus tectorum*	11.6	57.2	77.4				
I	*Poa bulbosa*	9.1	34.9	67.7				
	Bromus sp.	4.1	26.9	45.2				
N	*Poa secunda*	3.4	29.8	67.7				
N	*Sitanion hystrix*	0.9	7.5	45.2				
	Festuca sp.	0.7	9.6	35.5				
	Unknown grass	0.5	20.3	45.2				
	Forbs (19) [b]							
I	*Erodium cicutarium*	3.0	45.6	74.2				
I	*Alyssum desertorum*	1.3	28.5	58.1				
	Unknown forb	1.1	42.9	54.8				
N	*Eriogonum strictum*	0.7	8.1	38.7				
I	*Dipsacus sylvestris*	0.7	2.6	3.2				
N	*Amsinckia retrorsa*	0.6	11.7	25.8				
N	*Draba verna*	0.6	22.7	58.1				
	Litter	41.8	100.0	100.0				
	Bare Soil	16.8	84.5	100.0				
	Rock	6.8	67.5	100.0				
	Moss	2.8	43.9	100.0				
	Lichen	1.9	33.2	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 2 (cont.).

Shrub Savanna

Purshia tridentata*/*Bromus tectorum (PUTR/BRTE)
(bitterbrush/cheatgrass) 20 stands

The *Purshia tridentata*/*Bromus tectorum* plant assemblage was commonly encountered in the *Shrub Savanna* cover type. It was most often found along the Hells Canyon Reservoir Reach (10 sites), but also the Oxbow (7 sites) and Brownlee Reservoir (3 sites) reaches. Sites occurred between 1,870 and 3,080 ft on 11- to 43-degree slopes on a variety of aspects. Soil pH was neutral (pH = 6.7), common for upland soils in Hells Canyon.

North of Steck Park Plot: BR97BLM024

Purshia tridentata occurs over a large area in North America, including the Rocky Mountain and Pacific coastal states. Its leaves and twigs constitute one of the best browse plants in the West for deer, elk, and antelope. *Purshia tridentata* is an important winter food source for deer and elk, especially on windswept, relatively snow-free slopes, where the plants often become stunted from excessive browsing. *Purshia tridentata* is generally found on deep, well-drained, often coarse-textured, non-saline soils, including sandy or rocky habitats somewhat more moist than is typical for the sagebrush-steppe (Taylor 1992). *Purshia tridentata* is a commonly occurring shrub in portions of the study area. It was encountered on 88 transects, in 10 cover types, and in all study reaches except below Hells Canyon Dam. It is typically associated with habitats along Oxbow and Hells Canyon reservoirs. The average height of *Purshia tridentata* in this assemblage is about 1.1 m, and the plant contributes about 12% canopy coverage.

Bromus tectorum is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). *Bromus tectorum* is the most commonly occurring graminoid in the study area. It was encountered in 447 transects, in all cover types (n = 12), and in all study reaches, with most encounters along the Brownlee Reservoir Reach (205 transects). In this assemblage, *Bromus tectorum* and other annual bromes that could not be identified to species (probably *Bromus tectorum* also) dominate the herbaceous layer with 8% cover. Other native graminoids, such as *Poa secunda*, *Agropyron spicatum,* and *Sitanion hystrix*, are present but only in trace amounts (< 1% cover).

This assemblage is relatively species rich in forbs (n = 35) and graminoids (n = 8). Most species are native, and no listed noxious weeds were found. Bare ground is exposed on over 27% of the ground surface.

Appendix 2 (cont.).

Other Studies

This plant assemblage is more xeric and degraded than the *Purshia tridentata*/*Festuca idahoensis-Agropyron spicatum* and the *Purshia tridentata*/*Agropyron spicatum* plant associations described by Johnson and Simon (1987) in the Wallowa-Snake Province. This *Purshia tridentata*/*Bromus tectorum* plant assemblage is dominated by introduced annual grasses in the herbaceous layer, *Festuca idahoensis* is absent, and *Agropyron spicatum* only occurs in trace amounts (< 2% cover). It probably represents degraded conditions of the *Purshia tridentata-Festuca idahoensis* or *Purshia tridentata-Agropyron spicatum* habitat types described by Daubenmire (1970) for steppe vegetation in Washington and is similar to the *Purshia tridentata-Bromus tectorum* community described by Asherin and Claar (1976), based on their sampling of 2 sites along Oxbow and Hells Canyon reservoirs.

Appendix 2 (cont.).

PUTR/BRTE Site Conditions

Elevation (ft): 2,209.5 (range 1,870–3,080)

Slope (°): 25.5 (range 11.0–43.0)

Aspect: E(2), NE(1), NW(2), S(3), SE(4), SW(6), W(2)

[a] Soil Texture: loamy sand (5)

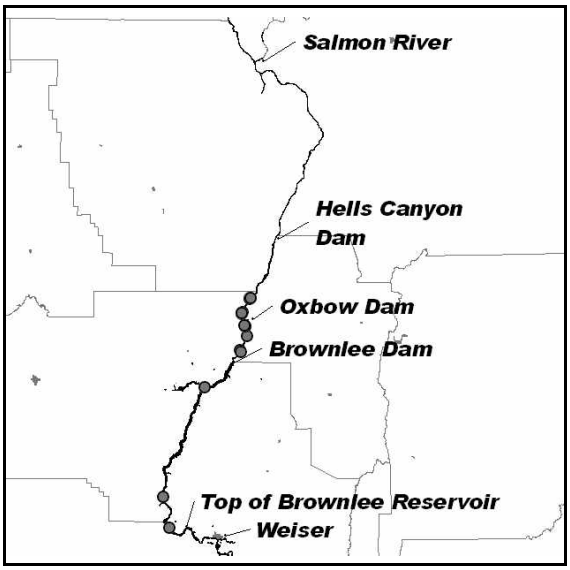
[a] Organic Matter %: 2.4 (range 2.0–2.8)

[a] pH: 6.7 (range 6.0–7.3)

[a] ON ppm: 45.0 (range 40.0–50.0)

[a] CEC meq/100g: 12.2 (range 9.1–14.3)

[a] Soil characteristic data available for 5 stands.



PUTR/BRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (8) [b]							
N	*Purshia tridentata*	11.9	22.2	95.0	543	1.08	111	0.34
N	*Artemisia tridentata*	1.2	3.0	5.0	240	0.68	310	0.37
N	*Rhus glabra*	1.1	4.3	10.0	408	0.86	475	0.31
N	*Chrysothamnus nauseosus*	0.8	1.6	10.0	55	0.64	125	0.24
	Grasses (8) [b]							
	Bromus sp.	5.8	69.7	75.0				
I	*Bromus tectorum*	2.2	23.9	25.0				
N	*Poa secunda*	1.8	25.1	75.0				
	Forbs (35) [b]							
N	*Draba verna*	1.7	57.7	90.0				
N	*Lomatium grayii*	1.7	15.4	60.0				
	Unknown forb	1.1	19.0	20.0				
N	*Microsteris gracilis*	0.9	33.3	80.0				
I	*Holosteum umbellatum*	0.8	26.2	60.0				
N	*Eriogonum compositum*	0.7	4.8	20.0				
N	*Brodiaea douglasii*	0.7	23.8	65.0				
N	*Eriogonum strictum*	0.6	7.6	25.0				
N	*Epilobium paniculatum*	0.6	24.8	75.0				
I	*Erodium cicutarium*	0.6	10.9	55.0				
	Bare Soil	27.3	88.7	100.0				
	Litter	23.6	99.5	100.0				
	Rock	20.4	80.8	100.0				
	Moss	6.8	59.8	100.0				
	Lichen	4.2	57.8	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.6% cover not listed in table.

Appendix 2 (cont.).

Shrub Savanna

Purshia tridentata*/*Agropyron spicatum (PUTR/AGSP)
(bitterbrush/bluebunch wheatgrass) 9 stands

The *Purshia tridentata*/*Agropyron spicatum* plant assemblage is occasionally encountered in the *Shrub Savanna* cover type. This assemblage was most often found along the Hells Canyon Reservoir Reach (6 sites) and was less common in the Brownlee Reservoir Reach (2 sites) and the reach below Hells Canyon Dam (1 site). Sites occurred between 1,560 and 2,860 ft on 25- to 35-degree slopes on easterly and westerly aspects. Soils for the 2 stands tested were slightly acidic (pH = 6.3).

Powder River Plot: BR95POW04U

Purshia tridentata occurs over a large area in North America, including the Rocky Mountain and Pacific coastal states. Its leaves and twigs constitute one of the best browse plants in the West for deer, elk, and antelope. *Purshia tridentata* is an important winter food source for deer and elk, especially on windswept, relatively snow-free slopes, where plants often become stunted from excessive browsing. It is generally found on deep, well-drained, often coarse-textured, non-saline soils, including sandy or rocky habitats somewhat more moist than is typical for the sagebrush-steppe (Taylor 1992). *Purshia tridentata* is a commonly occurring shrub in portions of the study area. It was encountered on 88 transects, in 10 cover types, and in all study reaches except below Hells Canyon Dam. It is typically associated with habitats along Oxbow and Hells Canyon reservoirs. The average height of *Purshia tridentata* in this assemblage is about 0.9 m, and the species contributes about 8.5% canopy coverage.

Agropyron spicatum is one of the most important forage grasses of the sagebrush-steppe. It is a common and often conspicuous dominant in the more moist regions, particularly in areas of deep soil accumulation (Taylor 1992). It has a wide geographic and ecological range and occurs throughout western North America east of the Cascades and Pacific coastal mountains. *Agropyron spicatum* is an important constituent of the Pacific Northwest bunchgrass, sagebrush, mountain shrub, pinyon/juniper, and ponderosa pine regions (Tisdale and Hironaka 1981). In the study area, where it is a commonly occurring graminoid, *Agropyron spicatum* was observed from the canyon bottoms up to middle elevations (about 6,000 ft). It was encountered in 239 transects, 11 cover types, and in all study reaches, but was rare in the Weiser Reach (1 transect). In this assemblage, *Agropyron spicatum* dominates the herbaceous layer with 4.4% cover. Other native graminoids, such as *Festuca idahoensis* and *Poa secunda*, are present but only in trace amounts (< 1% cover).

Appendix 2 (cont.).

This assemblage is relatively species rich in forbs (n = 37) and graminoids (n = 9). Most species are native, and no listed noxious weeds were found. Rock covers about 28% of the ground surface, and bare ground is exposed over about 34% of the surface.

Other Studies

This plant assemblage is somewhat similar to the *Purshia tridentata*/*Agropyron spicatum* plant association described by Johnson and Simon (1987) in the Wallowa-Snake Province, but it occurs on drier habitats and is composed of more drought-tolerant species in the herbaceous layer. It is somewhat related to the *Purshia tridentata-Agropyron spicatum* and *Purshia tridentata-Festuca idahoensis* habitat types described by Daubenmire (1970) for steppe vegetation in Washington, and because of the presence of *Festuca idahoensis*, more closely resembles the latter habitat type.

Appendix 2 (cont.).

PUTR/AGSP Site Conditions

Elevation (ft): 2,090.0 (range 1,560–2,860)

Slope (°): 31.1 (range 25.0–35.0)

Aspect: E(2), NE(1), SE(2), SW(2), W(2)

[a] Soil Texture: loamy sand (5), sandy loam (1), silty loam (2)

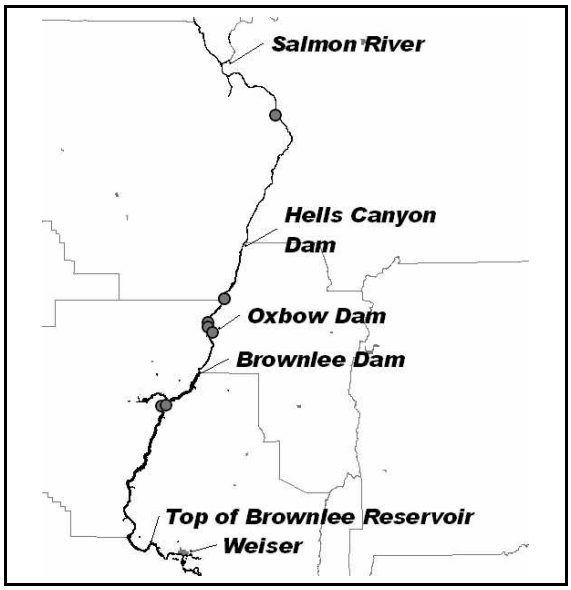
[a] Organic Matter %: 2.2 (range 1.6–3.0)

[a] pH: 6.3 (range 5.9–7.2)

[a] ON ppm: 50.0 (range 35.0–70.0)

[a] CEC meq/100g: 13.8 (range 8.9–21.0)

[a] Soil characteristic data available for 8 stands.



PUTR/AGSP Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (7) [b]							
N	*Purshia tridentata*	8.5	14.9	77.8	508	0.89	30	0.38
N	*Rhus glabra*	4.0	10.0	44.4	724	0.75	509	0.39
N	*Amelanchier alnifolia*	1.5	2.0	33.3	29	1.76	7	0.25
	Grasses (9) [b]							
N	*Agropyron spicatum*	4.4	25.7	77.8				
I	*Bromus tectorum*	3.4	61.5	88.9				
N	*Festuca idahoensis*	1.6	9.3	11.1				
I	*Bromus japonicus*	0.6	22.2	66.7				
	Forbs (37) [b]							
N	*Galium aparine*	1.9	31.3	55.6				
N	*Cryptantha intermedia*	1.8	26.7	44.4				
N	*Epilobium paniculatum*	1.5	34.6	77.8				
N	*Eriogonum vimineum*	1.4	31.1	55.6				
N	*Astragalus cusickii*	1.2	4.1	11.1				
N	*Tonella floribunda*	0.8	18.9	33.3				
N	*Scutellaria angustifolia*	0.7	13.1	44.4				
N	*Phacelia hastata*	0.7	10.0	44.4				
N	*Chaenactis douglasii*	0.7	14.4	55.6				
N	*Cryptantha flaccida*	0.6	10.7	22.2				
	Bare Soil	33.7	91.7	100.0				
	Rock	27.9	95.6	100.0				
	Litter	16.4	98.9	100.0				
	Lichen	3.2	52.0	100.0				
	Moss	2.9	40.4	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.6% cover not listed in table.

Appendix 2 (cont.).

Shrub Savanna

Purshia tridentata*/*Balsamorhiza sagittata*/*Agropyron spicatum (PUTR/BASA/AGSP) (bitterbrush/arrowleaf balsamroot/bluebunch wheatgrass) 4 stands

The *Purshia tridentata*/*Balsamorhiza sagittata*/*Agropyron spicatum* plant assemblage was occasionally encountered in the *Shrub Savanna* cover type. This assemblage was found along the Brownlee Reservoir (2 sites) and Hells Canyon Reservoir (2 sites) reaches. Sites occurred between 1,950 and 2,720 ft on 22- to 45-degree slopes on a variety of aspects. Soil pH was slightly acidic (pH = 6.5).

Ten-Mile Creek Plot: BR96TEN01U

Purshia tridentata occurs over a large area in North America, including the Rocky Mountain and Pacific coastal states. Its leaves and twigs constitute one of the best browse plants in the West for deer, elk, and antelope. *Purshia tridentata* is an important winter food source for deer and elk, especially on windswept, relatively snow-free slopes, where the plants often become stunted from excessive browsing. It is generally found on deep, well-drained, often coarse-textured, non-saline soils, including sandy or rocky habitats somewhat more moist than is typical for the sagebrush-steppe (Taylor 1992). *Purshia tridentata* is a commonly occurring shrub in portions of the study area. It was encountered on 88 transects, in 10 cover types, and in all study reaches except below Hells Canyon Dam. It is typically associated with habitats along Oxbow and Hells Canyon reservoirs. The average height of mature *Purshia tridentata* plants in this assemblage is about 1.4 m, and the height of seedling plants is about 0.3 m. *Purshia tridentata* contributes 3% canopy coverage.

When abundantly present, *Balsamorhiza sagittata*, a native herb with large yellow flower heads, creates one of the most colorful assemblages in upland habitats. It typically grows in deep soil and has a thick carrot-like root. A somewhat common upland species in the study area, *Balsamorhiza sagittata* was encountered on 64 transects, in 6 cover types, and in all study reaches. It is most common along the Brownlee Reservoir Reach. In this assemblage, *Balsamorhiza sagittata* codominates the herbaceous layer with *Agropyron spicatum* and provides about 9% cover.

Agropyron spicatum is one of the most important forage grasses of the sagebrush-steppe. It is a common and often conspicuous dominant in the more moist regions, particularly in areas of deep soil accumulation (Taylor 1992). It has a wide geographic and ecological range and occurs throughout western North America east of the Cascades and Pacific coastal mountains. *Agropyron spicatum* is an important constituent of the Pacific Northwest bunchgrass, sagebrush, mountain shrub, pinyon/juniper, and ponderosa pine regions (Tisdale and Hironaka 1981). In the study area, where it is a commonly occurring graminoid, *Agropyron spicatum* was observed from the canyon bottoms up to middle elevations (about 6,000 ft). It was encountered in 239 transects, in 11 cover types, and in all study reaches, but was rare in

Appendix 2 (cont.).

the Weiser Reach (1 transect). In this assemblage, *Agropyron spicatum* dominates the herbaceous layer with over 18% cover.

This assemblage is relatively species rich in forbs (n = 32) and graminoids (n = 8). Most species are native, and no listed noxious weeds were found. Rock covers about 14% of the ground surface, and bare ground is exposed over about 23% of the surface.

Other Studies

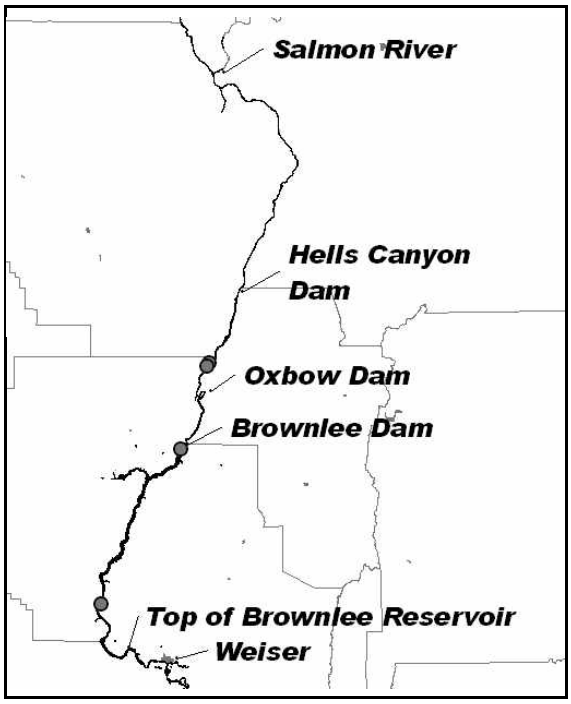
This plant assemblage is similar to the *Purshia tridentata*/*Agropyron spicatum* plant association described by Johnson and Simon (1987) in the Wallowa-Snake Province and the *Purshia tridentata-Agropyron spicatum* habitat type described by Daubenmire (1970) for steppe vegetation in Washington.

Appendix 2 (cont.).

PUTR/BASA/AGSP Site Conditions

Elevation (ft): 2,297.5 (range 1,950–2,720)
Slope (°): 31.3 (range 22.0–45.0)
Aspect: E(2), NW(1), SE(1)
[a] Soil Texture: sandy loam (2)
[a] Organic Matter %: 2.5 (range 2.1–2.9)
[a] pH: 6.5 (range 6.0–6.9)
[a] ON ppm: 65.0 (range 40.0–90.0)
[a] CEC meq/100g: 15.7 (range 15.0–16.3)

[a] Soil characteristic data available for 2 stands.



PUTR/BASA/AGSP Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (6) [b]							
N	*Purshia tridentata*	3.0	9.3	75.0	150	1.37	100	0.29
N	*Clematis ligusticifolia*	2.3	4.5	25.0	15	0.68	75	0.28
N	*Glossopetalon nevadense*	0.9	2.5	25.0	8	0.50	33	0.29
N	*Artemisia tridentata*	0.5	1.5	25.0	50	0.86	42	0.15
	Grasses (8) [b]							
N	*Agropyron spicatum*	18.1	66.7	100.0				
I	*Bromus tectorum*	3.2	59.2	75.0				
N	*Poa secunda*	1.0	31.7	75.0				
I	*Bromus japonicus*	0.6	15.9	50.0				
	Bromus sp.	0.6	11.3	25.0				
	Forbs (32) [b]							
N	*Balsamorhiza sagittata*	8.7	35.0	100.0				
N	*Lomatium dissectum*	2.7	13.3	25.0				
N	*Crepis occidentalis pumila*	1.5	12.5	25.0				
N	*Draba verna*	1.1	42.1	75.0				
N	*Plectritis macrocera*	1.1	32.9	75.0				
N	*Collinsia parviflora*	0.7	19.2	25.0				
I	*Verbascum thapsus*	0.7	2.5	25.0				
N	*Phylox longifolia*	0.5	7.5	25.0				
N	*Microsteris gracilis*	0.5	20.0	25.0				
N	*Tonella floribunda*	0.5	15.8	25.0				
	Litter	28.0	95.0	100.0				
	Bare Soil	22.6	75.0	100.0				
	Rock	13.8	84.2	100.0				
	Moss	11.7	60.9	100.0				
	Lichen	4.3	42.1	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 2 (cont.).

Shrub Savanna

***Celtis reticulata*/*Agropyron spicatum*-annual brome species** (CERE/AGSP-ANNUAL BROME) (netleaf hackberry/bluebunch wheatgrass-annual brome species) 21 stands

Celtis reticulata is probably the most common woody species seen from the river in Hells Canyon, especially below Hells Canyon Dam. The *Celtis reticulata*/*Agropyron spicatum*-annual brome plant assemblage is a common assemblage in the *Shrub Savanna* cover type. It was encountered in all study reaches except the Weiser Reach, with most occurrences below Hells Canyon Dam. Sites occurred between 1,020 and 2,077 ft on 2- to 38-degree slopes on a variety of aspects. Soils were slightly acidic (pH = 6.8), common for upland soils in Hells Canyon.

Hutton Gulch Plot: HB96HUT01U

Celtis reticulata occupies a wide variety of habitats in Idaho's western canyons. On rocky outcrops it may be a gnarled, twisted shrub, but in stream bottoms it has reasonably straight stems and may be 20 to 30 inches in diameter (Johnson 1995). *Celtis reticulata* was encountered in 343 transects, 11 cover types, and in all study reaches. It is a dominant species in 9 plant assemblages in 6 different cover types. In this plant assemblage, average height of mature *Celtis reticulata* is about 1.5 m, and the plant contributes 6.5% canopy coverage. *Celtis reticulata* is also present in the seedling height-class. Several other shrub species provide trace amounts of cover (< 1% each).

Agropyron spicatum is one of the most important forage grasses of the sagebrush-steppe. It is a common and often conspicuous dominant in the more moist regions of its range, particularly in areas of deep soil accumulation (Taylor 1992). It has a wide geographic and ecological range and occurs throughout western North America east of the Cascades and Pacific coastal mountains. It is an important constituent of the Pacific Northwest bunchgrass, sagebrush, mountain shrub, pinyon/juniper, and ponderosa pine regions (Tisdale and Hironaka 1981). In the study area, where it is a commonly occurring graminoid, *Agropyron spicatum* was observed from the canyon bottoms up to middle elevations (about 6,000 ft). It was encountered in 239 transects, 11 cover types, and all study reaches, but was rare in the Weiser Reach (1 transect). In this assemblage, *Agropyron spicatum* dominates the herbaceous layer with an average of 7.5% cover, and it occurs in nearly one-half of all plots along transects (frequency = 44%). Other native graminoids, such as *Aristida longiseta* and *Sporobolus cryptandrus*, are present but only in trace amounts (1.4% and 1% cover, respectively; < 1% for others). The herbaceous layer is codominated by annual bromes, including *Bromus tectorum*, *Bromus japonicus*, and *Bromus sterilis*, which combined account for about 9% cover.

Appendix 2 (cont.).

This assemblage is relatively species rich in shrubs (n = 17), forbs (n = 50), and graminoids (n = 17). Most species are native; however, several listed noxious weeds were found: specifically, *Taeniatherum caput-medusae*, *Lepidium latifolium*, *Conium maculatum*, *Dipsacus sylvestris*, *Hypericum perforatum*, and *Cynoglossum officinale*. Litter covers about 39% and rock covers 30% of the ground surface.

Other Studies

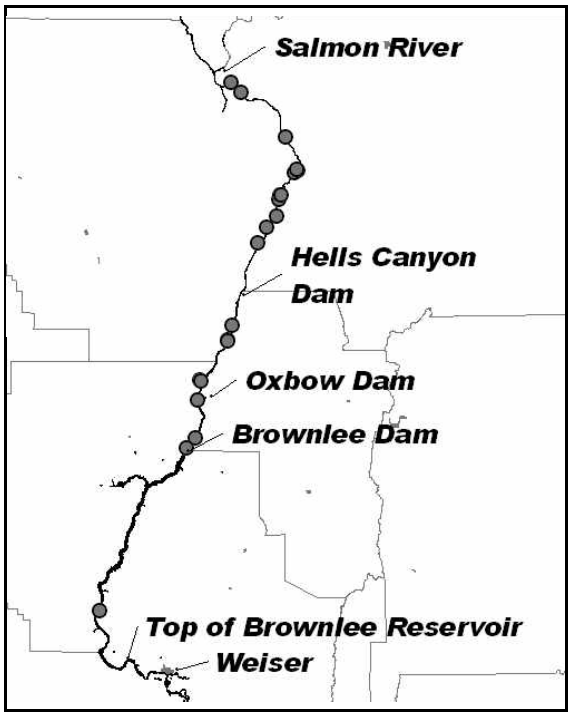
This plant assemblage is similar to a *Celtis reticulata*/*Agropyron spicatum* plant association described by Johnson and Simon (1987) in the Wallowa-Snake Province, the *Celtis reticulata* series described by Tisdale (1986) in west-central Idaho, and the *Celtis douglasii* (synonymous with *Celtis reticulata*)-*Agropyron spicatum* community described in the study area by Asherin and Claar (1976). Because of the prevalence of introduced species in the herbaceous understory, this plant assemblage is also similar to the *Celtis douglasii-Bromus tectorum* habitat type described by Daubenmire (1970).

Appendix 2 (cont.).

CERE/AGSP-ANNUAL BROME Site Conditions

Elevation (ft): 1,578.3 (range 1,020–2,077)
Slope (°): 19.2 (range 2.0–38.0)
Aspect: E(2), N(1), NE(1), NW(4), S(2), SE(4), SW(3), W(3)
[a] Soil Texture: loamy sand (5), sandy loam (4)
[a] Organic Matter %: 3.7 (range 1.1–6.9)
[a] pH: 6.8 (range 6.3–7.7)
[a] ON ppm: 54.4 (range 30.0–65.0)
[a] CEC meq/100g: 12.0 (range 6.6–17.0)

[a] Soil characteristic data available for 9 stands.



CERE/AGSP-ANNUAL BROME Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
	Shrubs (17) [b]							
N	*Celtis reticulata*	6.5	12.0	76.2	437	1.47	879	0.25
N	*Rhus glabra*	1.2	3.0	19.0	633	0.69	33	0.39
	Grasses (17) [b]							
N	*Agropyron spicatum*	7.5	44.4	76.2				
I	*Bromus tectorum*	5.1	57.5	81.0				
I	*Bromus japonicus*	2.0	37.2	57.1				
I	*Bromus sterilis*	1.5	7.8	38.1				
N	*Aristida longiseta*	1.4	7.9	23.8				
N	*Sporobolus cryptandrus*	1.0	8.6	52.4				
	Forbs (50) [b]							
I	*Lepidium latifolium*	1.8	7.4	9.5				
I	*Dianthus armeria*	1.1	6.5	9.5				
I	*Conium maculatum*	1.1	4.8	4.8				
I	*Dipsacus sylvestris*	1.1	5.9	14.3				
N	*Galium aparine*	1.1	20.5	66.7				
I	*Arenaria serpyllifolia*	1.0	33.4	76.2				
I	*Veronica arvensis*	1.0	35.4	66.7				
I	*Lactuca serriola*	1.0	23.7	81.0				
I	*Myosotis micrantha*	1.0	31.7	57.1				
I	*Medicago sativa*	1.0	2.8	9.5				
	Litter	39.2	99.0	100.0				
	Rock	29.6	77.9	100.0				
	Moss	20.7	77.4	100.0				
	Lichen	8.3	62.9	100.0				
	Bare Soil	4.2	52.0	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Shrub Savanna

Artemisia tridentata/annual brome (ARTR/ANNUAL BROME)
(big sagebrush/annual brome) 16 stands

The *Artemisia tridentata*/annual brome plant assemblage is common in the *Shrub Savanna* cover type, but was only encountered in the Brownlee Reservoir Reach. Sites occurred between 2,077 and 2,970 ft on 0- to 47-degree slopes on a variety of aspects. Average soil pH for the 2 stands tested was neutral (pH = 6.7), which is common for upland soils in Hells Canyon.

Ben Creek Plot: BR97BEN02U

Artemisia tridentata is distributed throughout the semiarid regions of North America. It has a broad ecological tolerance and can survive under a great range of environmental conditions. Two subspecies of *Artemisia tridentata* most likely occur in the study area: *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) and *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush). No attempt was made to distinguish between subspecies in this study. A commonly occurring shrub in portions of the study area, *Artemisia tridentata* was encountered on 112 transects and in 9 cover types, but rarely in any reach except along Brownlee Reservoir. Average height of *Artemisia tridentata* plants in this assemblage is about 1 m, and they contribute about 12% canopy coverage.

This assemblage is species rich in forbs (n = 24) and graminoids (n = 14). Most herbaceous species are native, but the herbaceous layer is primarily dominated by introduced graminoids, mostly *Taeniatherum caput-medusae* and *Bromus japonicus*. *Taeniatherum caput-medusae* is the only listed noxious weed found in this assemblage. Litter covers 54% of the ground surface.

Other Studies

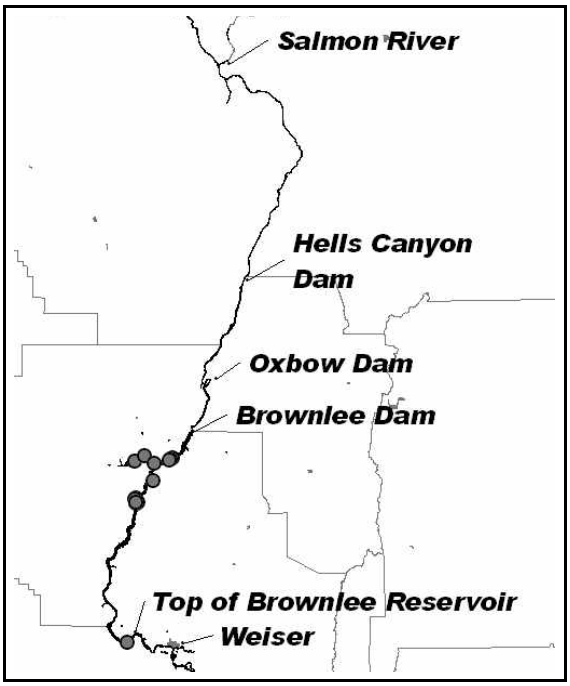
Johnson and Simon (1987) describe several *Artemisia tridentate vaseyana* plant associations that are probably representative of more mesic, higher-elevation sites than those in the study area. This study area assemblage is more similar to the *Artemisia tridentata-Bromus tectorum* plant community described by Asherin and Claar (1976), based on their 1 sample site on Brownlee Reservoir. It is also similar to the *Artemisia tridentata-Agropyron spicatum* habitat type described by Daubenmire (1970) for steppe vegetation in Washington, but the study area assemblage is in a degraded condition due to the dominance of introduced species in the herbaceous understory.

Appendix 2 (cont.).

ARTR/ANNUAL BROME Site Conditions

Elevation (ft): 2,316.8 (range 2,077–2,970)
Slope (°): 20.6 (range 0.0–47.0)
Aspect: E(3), F(1), N(2), NE(7), NW(1), W(2)
[a] Soil Texture: loamy sand (1), sandy loam (1)
[a] Organic Matter %: 4.5 (range 3.9–5.1)
[a] pH: 6.7 (range 6.6–6.8)
[a] ON ppm: 62.5 (range 60.0–65.0)
[a] CEC meq/100g: 12.5 (range 11.0–14.0)

[a] Soil characteristic data available for 2 stands.



ARTR/ANNUAL BROME Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (4) [b]							
N	*Artemisia tridentata*	11.8	31.6	100.0	1,979	1.03	1,539	0.24
N	*Chrysothamnus nauseosus*	0.5	1.8	50.0	92	0.71	197	0.27
N	*Amelanchier alnifolia*	0.5	0.6	6.3				
	Grasses (14) [b]							
I	*Taeniatherum caput-medusae*	9.6	40.4	62.5				
I	*Bromus japonicus*	3.5	44.5	68.8				
N	*Poa secunda*	2.9	36.3	93.8				
I	*Bromus tectorum*	2.2	32.5	56.3				
	Unknown grass	1.8	50.9	75.0				
I	*Poa pratensis*	1.3	6.6	18.8				
	Bromus sp.	1.3	11.3	25.0				
I	*Poa bulbosa*	0.7	7.9	50.0				
N	*Agropyron spicatum*	0.7	3.8	25.0				
I	*Agropyron repens*	0.5	3.8	12.5				
	Festuca sp.	0.5	7.1	25.0				
	Forbs (24) [b]							
N	*Epilobium paniculatum*	3.2	35.5	93.8				
	Unknown forb	2.3	60.0	75.0				
N	*Artemisia ludoviciana*	1.9	9.4	12.5				
I	*Verbascum blattaria*	0.8	9.0	50.0				
I	*Lactuca serriola*	0.8	15.4	50.0				
N	*Lithophragma bulbiferum*	0.7	7.2	18.8				
I	*Anthriscus scandicina*	0.7	5.3	18.8				
N	*Montia perfoliata*	0.6	5.9	25.0				
N	*Lithophragma* sp.	0.5	7.1	37.5				
N	*Lupinus* sp.	0.5	3.1	31.3				
	Litter	54.0	99.4	100.0				
	Bare Soil	13.4	78.1	100.0				
	Moss	6.6	55.7	100.0				
	Rock	5.8	49.5	100.0				
	Lichen	2.2	26.5	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 2 (cont.).

Shrub Savanna

Artemisia tridentata*/*Poa bulbosa-Agropyron spicatum (ARTR/POBU-AGSP)
(big sagebrush/bulbous bluegrass-bluebunch wheatgrass) 7 stands

The *Artemisia tridentata*/*Poa bulbosa-Agropyron spicatum* plant assemblage is occasionally encountered in the *Shrub Savanna* cover type. It was encountered in only the Brownlee Reservoir Reach on sites between 2,290 and 2,902 ft on 15- to 30-degree slopes on westerly aspects. Soil at the 1 stand tested was slightly acidic (pH = 6.5).

Trail Creek Plot: BR96TCA02U

Artemisia tridentata is distributed throughout the semiarid regions of North America. It has a broad ecological tolerance and can survive under a great range of environmental conditions. Two subspecies of *Artemisia tridentata* most likely occur in the study area: *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) and *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush). No attempt was made to distinguish between subspecies in this study. A commonly occurring shrub in portions of the study area, *Artemisia tridentata* was encountered on 112 transects and in 9 cover types, but rarely in any reach except along Brownlee Reservoir. Average height of *Artemisia tridentata* plants in this assemblage is 1 m, and they contribute 12.5% canopy coverage. *Chrysothamnus nauseosus* is the only other shrub species in this assemblage.

Introduced from Europe, *Poa bulbosa* is now weedy in pastures, grain fields, and roadsides in scattered areas of most states in the West (Whitson et al. 1992). A commonly encountered species in the study area, it was found on 177 transects, in 10 cover types, and in all study reaches. In this assemblage, it dominates the herbaceous layer, providing over 22% cover and occurring in nearly every plot along transects (93% frequency). *Agropyron spicatum*, a valuable native perennial grass (Tisdale and Hironaka 1981), codominates the stands with almost 12% cover. It occurs in nearly one-half of all plots along transects (46% frequency). This assemblage is relatively species rich in forbs (n = 17) and graminoids (n = 9). Many of the herbaceous species are native. Litter covers about 32% of the ground surface.

Other Studies

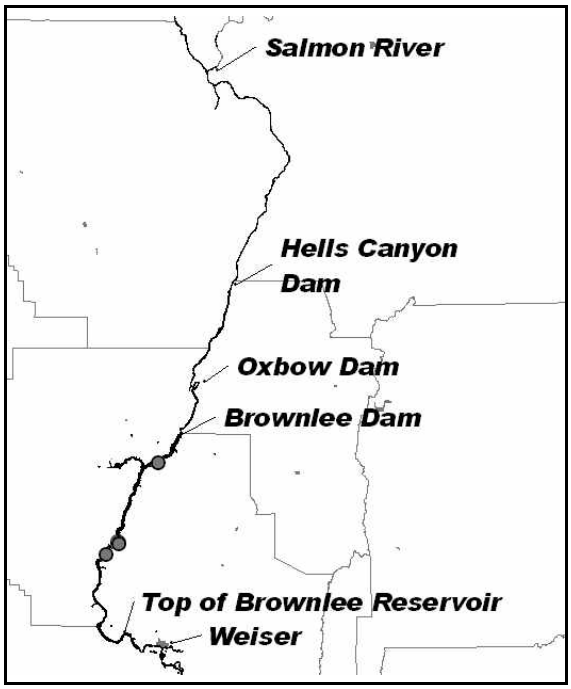
This assemblage has not been previously described in the study area. Johnson and Simon (1987) describe several *Artemisia tridentata vaseyana* plant associations; they are probably representative of more mesic, higher-elevation sites than those in the study area, and none is dominated in the herbaceous layer by *Poa bulbosa*. The study area plant assemblage is similar to the *Artemisia tridentata-Agropyron spicatum* habitat type described by Daubenmire (1970) for steppe vegetation of Washington, but is in a degraded condition due to the dominance of *Poa bulbosa* in the herbaceous understory.

Appendix 2 (cont.).

ARTR/POBU-AGSP Site Conditions

Elevation (ft): 2,608.4 (range 2,290–2,902)
Slope (°): 22.6 (range 15.0–30.0)
Aspect: NW(6), W(1)
[a] Soil Texture: sandy loam (1)
[a] Organic Matter %: 2.9
[a] pH: 6.5
[a] ON ppm: 50.0
[a] CEC meq/100g: 16.5

[a] Soil characteristic data available for 1 stand.



ARTR/POBU-AGSP Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (2) [b]							
N	*Artemisia tridentata*	12.5	28.6	100.0	1,574	1.00	2,595	0.22
N	*Chrysothamnus nauseosus*	3.7	9.1	100.0	401	0.72	451	0.29
	Grasses (9) [b]							
I	*Poa bulbosa*	22.1	92.6	100.0				
N	*Agropyron spicatum*	11.7	45.7	100.0				
N	*Festuca idahoensis*	3.6	7.1	14.3				
N	*Sitanion hystrix*	1.3	15.7	57.1				
	Other grass	0.9	30.7	71.4				
I	*Bromus commutatus*	0.7	13.8	14.3				
	Forbs (17) [b]							
N	*Lupinus* sp.	3.7	26.4	71.4				
N	*Lithophragma bulbiferum*	2.4	34.3	85.7				
N	*Lupinus caudatus*	2.0	10.5	14.3				
	Other forb	1.5	51.4	71.4				
N	*Draba verna*	1.2	41.4	100.0				
N	*Phlox longifolia*	0.9	18.3	85.7				
N	*Balsamorhiza sagittata*	0.9	8.1	71.4				
	Litter	32.2	100.0	100.0				
	Moss	12.2	94.5	100.0				
	Bare Soil	7.5	71.7	100.0				
	Rock	2.8	45.5	100.0				
	Lichen	2.1	43.8	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.7% cover not listed in table.

Appendix 2 (cont.).

Shrub Savanna

Artemisia rigida/*Poa secunda* (ARRI/POSE)
(stiff sagebrush/Sandberg's bluegrass) 2 stands

The *Artemisia rigida*/*Poa secunda* plant assemblage is rare in the *Shrub Savanna* cover type. It was encountered in only the Brownlee Reservoir Reach (2 sites), at elevations of 2,120 and 2,400 ft on a 15- and a 30-degree slope on westerly aspects. Soil pH was neutral (pH = 6.8), which is common for upland soils in Hells Canyon.

Board Creek Plot: BR97BRU22U

Artemisia rigida is a low-growing, deciduous species that occurs on soils that are extremely shallow to bedrock, usually basalt (Hall 1967, Daubenmire 1970). This species is confined to the northwestern portion of the sagebrush-steppe, mainly Washington and eastern Oregon. In Idaho its occurrence is limited to small areas close to the state's western border. *Artemisia rigida* grows in a fairly wide range of climatic conditions. The sparse, herbaceous understory and open nature of the stands make them virtually immune to fire (Tisdale and Hironaka 1981). Rarely occurring in the study area, *Artemisia rigida* was found on just 4 transects, in 3 cover types, and only in the Brownlee Reservoir Reach. Average height of *Artemisia rigida* plants in this assemblage is 0.7 m, and they contribute about 13% canopy coverage. *Eriogonum sphaerocephalum* is the only other shrub species in this assemblage.

Poa secunda (synonymous with *Poa sandbergii*) is a native bunchgrass, smaller in stature and inhabiting thinner, drier soils than *Agropyron spicatum* (Taylor 1992). A commonly encountered upland species in the study area, *Poa secunda* was found on 242 transects, in 11 cover types, and in all study reaches. In this assemblage, it dominates the herbaceous layer, with almost 10% cover, and it occurs in nearly every plot along transects (frequency = 93%). Introduced annual bromes are subdominant and occur with less cover and frequency.

This assemblage is relatively species poor in graminoids (n = 5) but species rich in forbs (n = 16). Nearly all of the herbaceous species are native. No listed noxious weeds were found. Bare rock covers over 29% of the ground surface, bare soil is exposed on about 16% of the surface, and mosses cover about 16%.

Other Studies

This assemblage is similar to the *Artemisia rigida-Poa secunda* habitat type described by Daubenmire (1970) for the steppe region of Washington and somewhat similar to the *Artemisia rigida/Poa sandbergii* plant association described by Johnson and Simon (1987) for the Wallow-Snake Province. However,

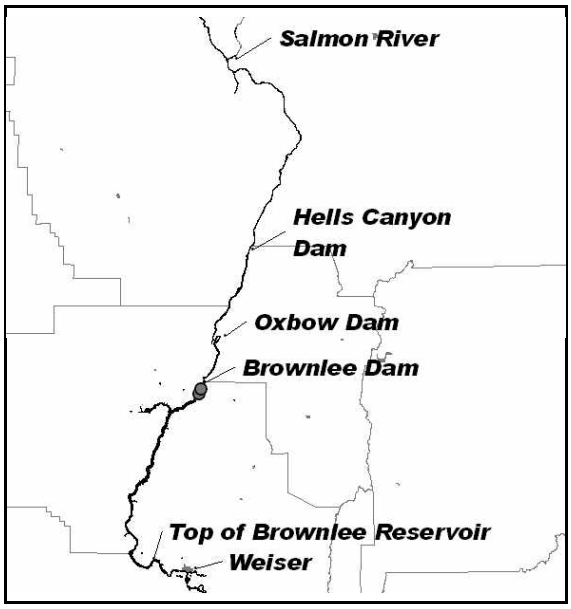
Appendix 2 (cont.).

compared with the latter plant association, the study area assemblage has a larger component of introduced and xeric species.

ARRI/POSE Site Conditions

Elevation (ft): 2,260 (range 2,120–2,400)
Slope (°): 19.5 (range 17.0–22.0)
Aspect: NW(1), W(1)
[a] Soil Texture: loamy sand (1), sandy loam (1)
[a] Organic Matter %: 2.5 (range 2.0–2.9)
[a] pH: 6.8 (range 6.6–7.0)
[a] ON ppm: 45.0 (range 40.0–50.0)
[a] CEC meq/100g: 15.1 (range 14.2–16.0)

[a] Soil characteristic data available for 2 stands.



ARRI/POSE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (2) [b]							
N	*Artemisia rigida*	12.6	43.0	100.0	900	0.68	6,700	0.25
N	*Eriogonum sphaerocephalum*	2.0	6.0	50.0	200	0.51	2,800	0.27
	Grasses (5) [b]							
N	*Poa secunda*	9.7	93.4	100.0				
I	*Bromus tectorum*	5.3	85.0	100.0				
I	*Bromus japonicus*	1.5	41.7	50.0				
N	*Festuca microstachys*	1.4	45.0	100.0				
	Forbs (16) [b]							
N	*Lomatium macrocarpum*	2.3	40.0	100.0				
N	*Draba verna*	2.0	70.0	100.0				
I	*Holosteum umbellatum*	1.5	51.7	100.0				
N	*Lomatium triternatum*	1.1	25.0	50.0				
N	*Epilobium paniculatum*	0.9	35.0	100.0				
N	*Microsteris gracilis*	0.9	35.0	100.0				
N	*Allium acuminatum*	0.8	23.3	100.0				
N	*Anthriscus scandicina*	0.7	5.0	50.0				
N	*Penstemon deustus*	0.5	3.4	50.0				
	Rock	29.2	90.0	100.0				
	Moss	16.2	81.7	100.0				
	Bare Soil	15.6	91.7	100.0				
	Litter	13.9	100.0	100.0				
	Lichen	4.6	71.7	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 2 (cont.).

Desertic Shrubland

Purshia tridentata (PUTR)
(bitterbrush) 4 stands

The *Purshia tridentata* plant assemblage was the most commonly encountered assemblage in the *Desertic Shrubland* cover type. It was found along the Brownlee Reservoir (3 sites) and the Hells Canyon Reservoir (1 site) reaches. Sites occurred between 2,090 and 2,400 ft on 30- to 34-degree slopes on a variety of aspects. Soil at the 1 stand tested was moderately alkaline (pH = 8.0).

Near Darrows Island Plot: BR98DAR02U

Purshia tridentata occurs over a large area in North America, including the Rocky Mountain and Pacific coastal states. Its leaves and twigs constitute one of the best browse plants in the West for deer, elk, and antelope. It is an important winter food source for deer and elk, especially on windswept, relatively snow-free slopes, where the plants often become stunted from excessive browsing. *Purshia tridentata* is generally found on deep, well-drained, often coarse-textured, non-saline soils, including sandy or rocky habitats somewhat more moist than is typical for the sagebrush-steppe (Taylor 1992). A commonly occurring shrub in portions of the study area, *Purshia tridentata* was encountered on 88 transects, in 10 cover types, and in all study reaches except below Hells Canyon Dam. It is typically associated with habitats along Oxbow and Hells Canyon reservoirs. The average height of *Purshia tridentata* in this assemblage is 0.75 m, and it contributes about 9% canopy coverage.

This assemblage has a sparse herbaceous layer with no clear dominant species. It has a moderate number of species (n = 26), and most are native. No listed noxious weeds were found. Bare ground is exposed on over 40% of the ground surface, and bare rock covers 40% of the surface. By definition, the *Desertic Shrubland* cover type contains the most xeric of shrub-dominated plant assemblages. This *Purshia tridentata* assemblage is similar to the *Purshia tridentata*/*Bromus tectorum* plant assemblage found in the *Shrub Savanna* cover type, but it occurs on more xeric sites.

Other Studies

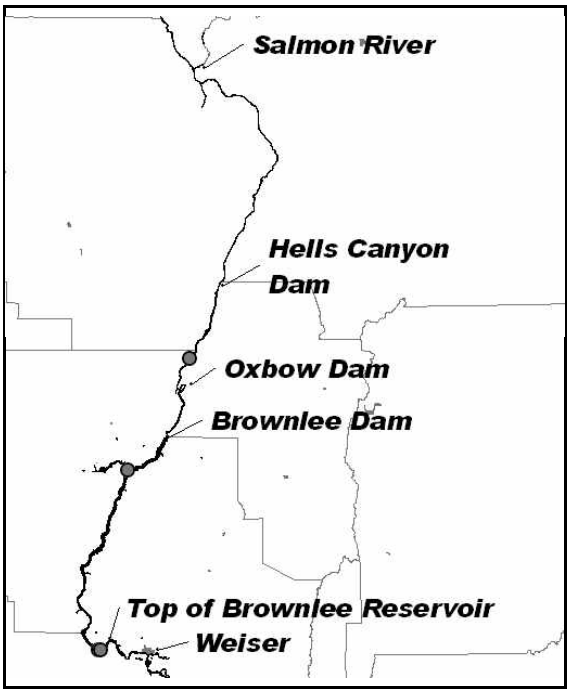
This plant assemblage is somewhat similar to the *Purshia tridentata-Bromus tectorum* community described by Asherin and Claar (1976), based on their sampling of 2 sites along Oxbow and Hells Canyon reservoirs, but the *Purshia tridentata* plant assemblage occurs on more xeric sites. It is somewhat similar to the *Purshia tridentata-Agropyron spicatum* habitat type described by Daubenmire (1970) for steppe vegetation in Washington, but in more degraded and xeric conditions.

Appendix 2 (cont.).

PUTR Site Conditions

Elevation (ft): 2,252.5 (range 2,090–2,400)
Slope (°): 31.8 (range 30.0–34.0)
Aspect: E(1), S(1), SE(1), W(1)
[a] Soil Texture: clay loam (1)
[a] Organic Matter %: 2.1
[a] pH: 8.0
[a] ON ppm: 40.0
[a] CEC meq/100g: 31.0

[a] Soil characteristic data available for 1 stand.



PUTR Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (4) [b]							
N	*Purshia tridentata*	8.6	16.8	100.0	433	0.75	449	0.23
N	*Chrysothamnus nauseosus*	0.6	3.0	50.0	85	0.60	355	0.28
N	*Artemisia tridentata*	0.2	0.5	50.0			30	0.42
	Grasses (7) [b]							
	Bromus sp.	0.8	26.7	50.0				
I	*Bromus tectorum*	0.6	25.0	50.0				
N	*Melica bulbosa*	0.3	5.0	25.0				
	Forbs (15) [b]							
N	*Lomatium grayii*	1.4	6.7	25.0				
	Unknown forb	0.8	23.8	25.0				
N	*Plagiobothrys tenellus*	0.3	6.3	25.0				
I	*Erodium cicutarium*	0.3	5.8	25.0				
N	*Phacelia heterophylla*	0.3	2.9	50.0				
N	*Physaria oregona*	0.3	10.0	25.0				
	Bare Soil	40.4	94.2	100.0				
	Rock	40.0	98.8	100.0				
	Litter	5.1	77.5	100.0				
	Lichen	3.7	76.3	100.0				
	Moss	1.1	29.2	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.3% cover not listed in table.

Appendix 2 (cont.).

Desertic Shrubland

Artemisia tridentata/*Poa bulbosa* (ARTR/POBU)
(big sagebrush/bulbous bluegrass) 1 stand

The *Artemisia tridentata*/*Poa bulbosa* plant assemblage is rare in the *Desertic Shrubland* cover type. It was encountered at just 1 site in the Weiser Reach, at an elevation of 2,160 ft on a 22-degree slope on a west aspect. The soil at this site was moderately alkaline (pH = 8.0).

Near Porters Island Plot: BA97POI03U

Artemisia tridentata is distributed throughout the semiarid regions of North America. It has a broad ecological tolerance and can survive under a great range of environmental conditions. Two subspecies of *Artemisia tridentata* most likely occur in the study area: *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) and *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush). No attempt was made in this study to distinguish between subspecies. A commonly occurring shrub in portions of the study area, *Artemisia tridentata* was encountered on 112 transects and in 9 cover types, but rarely in any reach except along Brownlee Reservoir. Average height of *Artemisia tridentata* plants in this assemblage is 0.7 m, and they contribute 5.3% canopy coverage.

Introduced from Europe, *Poa bulbosa* is now weedy in pastures, grain fields, and roadsides in scattered areas of most states in the West (Whitson et al. 1992). A commonly encountered species in the study area, *Poa bulbosa* was found on 177 transects, in 10 cover types, and in all study reaches. In this assemblage, it dominates the herbaceous layer, with 5.3% cover, and it occurs in most plots along the transect (frequency = 73%).

This assemblage is relatively species rich in forbs (n = 12), and most species are native. No listed noxious weeds were found. Bare ground is exposed on 59% of the ground surface, and bare rock contributes 10% of the ground cover. By definition, the *Desertic Shrubland* cover type contains the most xeric of shrub-dominated plant assemblages. This *Artemisia tridentata*/*Poa bulbosa* assemblage is similar to the *Artemisia tridentata*/*Poa bulbosa-Agropyron spicatum* plant assemblage found in the *Shrub Savanna* cover type, but it occurs on more xeric sites. *Agropyron spicatum* is also absent from the herbaceous layer.

Other Studies

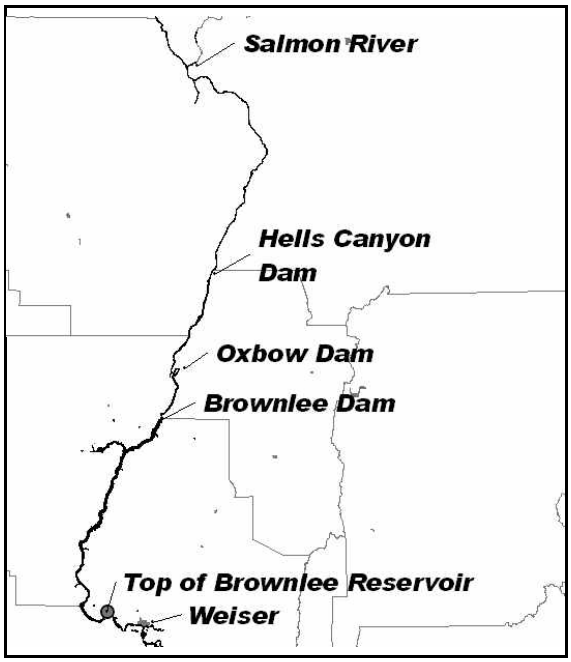
This assemblage has not been previously described in the study area. Johnson and Simon (1987) describe several *Artemisia tridentata vaseyana* plant associations, but these associations are probably representative of more mesic, higher-elevation sites than those in the study area, and none is dominated in the herbaceous layer by *Poa bulbosa*.

Appendix 2 (cont.).

ARTR/POBU Site Conditions

Elevation (ft): 2,160
Slope (°): 22.0
Aspect: W(1)
[a] Soil Texture: clay (1)
[a] Organic Matter %: 3.9
[a] pH: 8.0
[a] ON ppm: 60.0
[a] CEC meq/100g: 36.0

[a] Soil characteristic data available for 1 stand.



ARTR/POBU Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (2) [b]							
N	*Artemisia tridentata*	5.3	14.0	100.0	400	0.70	1,200	0.28
N	*Purshia tridentate*	0.8	6.0	100.0			600	0.38
	Grasses (4) [b]							
I	*Poa bulbosa*	5.3	73.3	100.0				
I	*Bromus tectorum*	0.8	30.0	100.0				
	Forbs (12) [b]							
I	*Alyssum desertorum*	2.2	70.0	100.0				
I	*Ranunculus testiculatus*	1.3	53.3	100.0				
N	*Phlox longifolia*	0.9	16.7	100.0				
N	*Epilobium paniculatum*	0.7	26.7	100.0				
N	*Eriogonum strictum*	0.5	3.3	100.0				
N	*Sisymbrium altissimum*	0.5	20.0	100.0				
	Bare Soil	59.0	100.0	100.0				
	Rock	10.0	96.7	100.0				
	Litter	8.6	100.0	100.0				
	Lichen	0.5	20.0	100.0				
	Moss	0.1	20.0	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 2 (cont.).

Forbland

Balsamorhiza sagittata*/*Agropyron spicatum-Bromus tectorum (BASA/AGSP-BRTE) (arrowleaf balsamroot/bluebunch wheatgrass-cheatgrass) 24 stands

The *Balsamorhiza sagittata*/*Agropyron spicatum-Bromus tectorum* plant assemblage was the most commonly encountered assemblage in the *Forbland* cover type. This assemblage was found in each study reach. Sites occurred between 1,080 and 2,450 ft on 0- to 46-degree slopes on a variety of aspects. Soil pH was neutral (pH = 6.6), common for upland soils in Hells Canyon.

Farewell Bend Plot: BR97FWB01U

When present in abundance, *Balsamorhiza sagittata*, a native herb with large yellow flower heads, creates one of the most colorful assemblages in upland habitats. It typically grows in deep soil and has a thick, carrot-like root. *Balsamorhiza sagittata* is a somewhat common upland species in the study area. It was encountered on 64 transects, in 6 cover types, and in all study reaches. It is most common along the Brownlee Reservoir Reach. In this assemblage, *Balsamorhiza sagittata* dominates the herbaceous layer and provides over 5% cover. It is present in nearly one-quarter of all plots along transects (frequency = 18%).

Agropyron spicatum is one of the most important forage grasses of the sagebrush-steppe. It is a common and often conspicuous dominant in the more moist regions, particularly in areas of deep soil accumulation (Taylor 1992). It has a wide geographic and ecological range and occurs throughout western North America east of the Cascades and Pacific coastal mountains. It is an important constituent of the Pacific Northwest bunchgrass, sagebrush, mountain shrub, pinyon/juniper, and ponderosa pine regions (Tisdale and Hironaka 1981). A commonly occurring graminoid in the study area, *Agropyron spicatum* was observed from the canyon bottoms up to middle elevations (about 6,000 ft). It was encountered in 239 transects, in 11 cover types, and in all study reaches but was rare in the Weiser Reach (1 transect). In this assemblage, *Agropyron spicatum* codominates the herbaceous layer with *Bromus tectorum* and provides over 7% cover. *Bromus tectorum* is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). *Bromus tectorum* is the most commonly occurring graminoid in the study area. It was encountered in 447 transects, in all cover types (n = 12), and in all study reaches, with most encounters being along the Brownlee Reservoir Reach (205 transects). In this assemblage, *Bromus tectorum* provides almost 4% cover and is present in over one-half of all plots along transects (frequency = 56%).

Appendix 2 (cont.).

This assemblage is species rich in forbs (n = 60) and graminoids (n = 23). Most are native species; however, several listed noxious weeds were found: specifically, *Taeniatherum caput-medusae*, *Convolvulus arvensis*, *Dipsacus sylvestris*, and *Cardaria draba*. Litter covers over 31% of the ground surface, and bare rock is exposed on over 22% of the ground surface.

Other Studies

This plant assemblage has not been previously described. It shows some similarities with the early seral stage of the *Festuca idahoensis-Agropyron spicatum*/*Balsamorhiza sagittata* plant community described by Johnson and Simon (1987) for the Wallowa-Snake Province. However, this *Balsamorhiza sagittata*/*Agropyron spicatum-Bromus tectorum* plant assemblage is quite different in many aspects, particularly in the absence of many principle indicator species and the scarcity of *Festuca idahoensis*.

Appendix 2 (cont.).

BASA/AGSP-BRTE Site Conditions

Elevation (ft): 1,815.3 (range 1,080–2,450)

Slope (°): 20.2 (range 0.0–46.0)

Aspect: E(7), F(2), N(2), NE(2), NW(1), SE(4), SW(1), W(5)

[a] Soil Texture: loamy sand (5), sandy loam (6), silty loam (1)

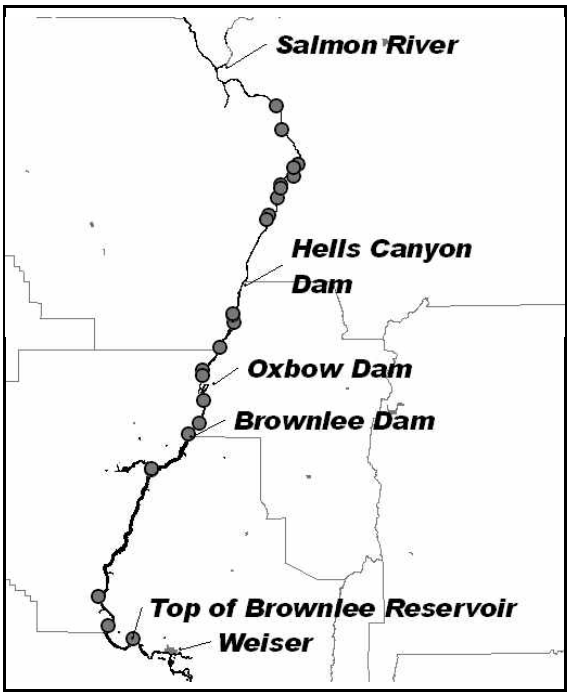
[a] Organic Matter %: 4.2 (range 1.8–7.7)

[a] pH: 6.6 (range 5.7–7.3)

[a] ON ppm: 52.9 (15.0–65.0)

[a] CEC meq/100g: 14.1 (9.5–21.0)

[a] Soil characteristic data available for 24 stands.



BASA/AGSP-BRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (14) [b]							
	Grasses (23) [b]							
N	*Agropyron spicatum*	7.4	37.2	75.0				
I	*Bromus tectorum*	3.8	56.4	75.0				
I	*Poa bulbosa*	3.0	21.5	45.8				
	Bromus sp.	2.1	22.0	29.2				
N	*Poa secunda*	1.4	27.8	75.0				
N	*Sporobolus cryptandrus*	1.3	8.4	25.0				
	Forbs (60) [b]							
N	*Balsamorhiza sagittata*	5.4	18.4	37.5				
I	*Erodium cicutarium*	3.4	25.3	54.2				
I	*Melilotus officinalis*	1.8	4.4	8.3				
I	*Veronica arvensis*	1.3	27.1	50.0				
I	*Cichorium intybus*	1.2	6.6	12.5				
	Geranium sp.	1.2	3.9	4.2				
I	*Medicago sativa*	1.1	3.5	8.3				
N	*Artemisia ludovicinana*	1.1	3.5	8.3				
	Litter	31.4	99.5	100.0				
	Rock	22.3	79.0	100.0				
	Moss	10.4	56.2	100.0				
	Bare Soil	10.0	69.0	100.0				
	Lichen	5.0	58.8	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Forbland

Eriogonum compositum-Lomatium grayi*/*Bromus tectorum (ERCO5-LOGR/BRTE)
(heart-leaved buckwheat-Gray's lomatium/cheatgrass) 9 stands

The *Eriogonum compositum-Lomatium grayi*/*Bromus tectorum* plant assemblage was the second most common assemblage found in the *Forbland* cover type. It was primarily encountered in the Brownlee Reservoir Reach (6 sites) with an occasional stand in the Oxbow Reservoir (2 sites) and Hells Canyon Reservoir (1 site) reaches. Sites occurred between 1,910 and 2,900 ft on 13- to 30-degree slopes on a variety of aspects. Soil pH was neutral (pH = 7.0).

Limepoint Plot: HC97LIM01U

Eriogonum compositum is a native species and perhaps the most spectacular of the many *Eriogonum* species. It produces many clusters, or small umbels, of unusually bright yellow flowers in a flat-topped inflorescence. The plants are very distinctive with relatively large leaves that are triangular or heart-shaped, finely woolly, and all basal. *Eriogonum compositum* occupies rocky habitats, and it flowers in early summer (Taylor 1992). *Eriogonum compositum* is an occasional species along the reservoir reaches. It was encountered in 27 transects, in 6 cover types, and principally along the Brownlee Reservoir Reach. In this assemblage, it codominates the herbaceous layer with *Lomatium grayi* and provides over 5% cover. It is present on about one-fourth of all plots along transects (frequency = 24%).

Lomatium grayi grows throughout most of the sagebrush-steppe, usually preferring coarse, rocky habitats, such as talus slopes. It has bright yellow flowers borne in tight umbels on leafless stems. The leaves divide into numerous small segments, and the plants give off a very strong, rather unpleasant, parsley-like odor (Taylor 1992). A common species in the study area, *Lomatium grayi* was encountered in 54 transects, in 9 cover types, and in nearly all study reaches. There were no occurrences in the Weiser Reach and only a rare occurrence below Hells Canyon Dam. In this assemblage, *Lomatium grayi* is a codominant species, providing over 5% cover and occurring on about one-fourth of all plots along transects (frequency 24%).

Bromus tectorum is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). The most commonly occurring graminoid in the study area, *Bromus tectorum* was encountered in 447 transects, in all cover types (n = 12), and in all study reaches, with most occurrences along the Brownlee Reservoir Reach (205 transects). In this assemblage, *Bromus tectorum* provides over 5% cover and is present in over 82% of all plots along transects.

Appendix 2 (cont.).

This assemblage is species rich in forbs (n = 37) and graminoids (n = 9). Many species are native, and no listed noxious weed species are present. Bare soil is exposed on 27% of the ground surface, and bare rock covers over 26% of the ground.

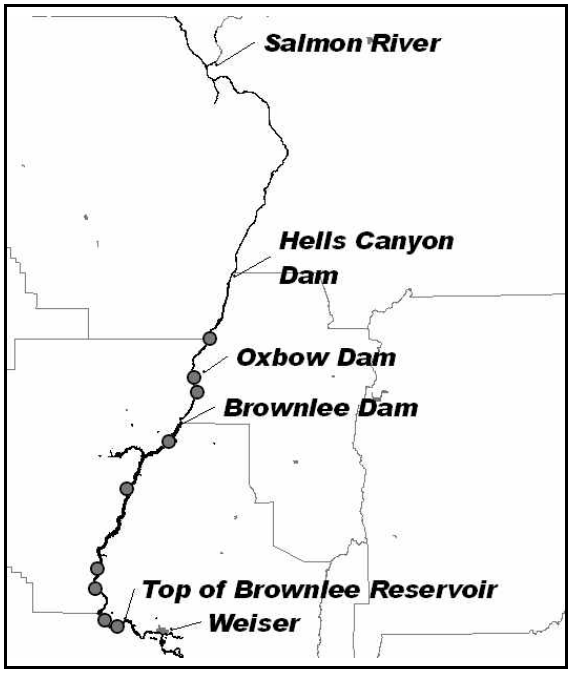
Other Studies

This plant assemblage has not been described for the study area. It may be similar to the *Eriogonum compositum-Poa secunda* habitat type identified, but not described, by Daubenmire (1970).

ERCO5-LOGR/BRTE Site Conditions

Elevation (ft): 2,250 (range 1,910–2,900)
Slope (°): 22.4 (range 13.0–30.0)
Aspect: NE(1), S(3), SE(2), SW(1), W(2)
[a] Soil Texture: loamy sand (4), sandy loam (4)
[a] Organic Matter %: 2.1 (range 1.0–3.0)
[a] pH: 7.0 (range 6.5–7.3)
[a] ON ppm: 41.9 (30.0–50.0)
[a] CEC meq/100g: 15.0 (10.5–19.0)

[a] Soil characteristic data available for 8 stands.



ERCO5-LOGR/BRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (8) [b]							
	Grasses (9) [b]							
I	*Bromus tectorum*	5.2	82.6	100.0				
N	*Festuca idahoensis*	1.9	10.7	11.1				
N	*Poa secunda*	1.2	29.6	66.7				
	Forbs (37) [b]							
N	*Eriogonum compositum*	6.2	24.1	33.3				
N	*Lomatium grayi*	5.1	24.5	44.4				
N	*Crepis occidentalis*	2.8	11.1	11.1				
N	*Eriogonum strictum*	2.8	21.8	44.4				
I	*Alyssum desertorum*	1.6	51.5	66.7				
N	*Draba verna*	1.1	45.9	77.8				
	Bare Soil	27.0	95.2	100.0				
	Rock	26.2	100.0	100.0				
	Litter	11.8	99.6	100.0				
	Lichen	5.0	77.8	100.0				
	Moss	2.5	44.5	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Forbland

Cardaria draba*/*Poa bulbosa (CADR/POBU)
(whitetop/bulbous bluegrass) 4 stands

The *Cardaria draba*/*Poa secunda* plant assemblage was encountered occasionally in the *Forbland* cover type. It was encountered at 3 sites in the Brownlee Reservoir Reach and at 1 site in Hells Canyon Reservoir Reach. Sites occurred between 2,080 and 5,460 ft on 5- to 13-degree slopes on a variety of aspects. Soil pH was moderately acidic (pH = 6.0).

Bend Creek Plot: BR97BEN04U

Cardaria draba is a listed noxious weed in Idaho and Oregon. This perennial is common in disturbed soils and is highly competitive with other species once it becomes established. *Cardaria draba* contains glucosinolates which can be toxic to cattle (Selleck 1964). Plants emerge in early spring and bloom and set seed by midsummer (Whitson et al. 1992). *Cardaria draba* is a fairly common weed species in the Weiser and the upper portions of the Brownlee Reservoir reaches. It was encountered on an occasional transect in the Oxbow Reservoir and Hells Canyon Reservoir reaches. In total, *Cardaria draba* was encountered on 36 transects and in 7 cover types. In this plant assemblage, it provides 13% cover and is present on 44% of all plots along transects. Several other weedy species are also abundant in this assemblage, including *Asperugo procumbens* and *Onopordum acanthium*.

Introduced from Europe, *Poa bulbosa* is now weedy in pastures, grain fields, and roadsides in scattered areas of most states in the West (Whitson et al. 1992). A commonly encountered species in the study area, it was found on 177 transects, in 10 cover types, and in all study reaches. In this assemblage, *Poa bulbosa* is the dominant graminoid, with 12% cover, and it occurs in more than one-half of the plots along transects (56% frequency).

This assemblage is species poor in graminoids (n = 5) but species rich in forbs (n = 26). Few native species occur and only in trace amounts. Several listed noxious weeds occur: specifically, *Cardaria draba*, *Onopordum acanthium*, *Lepidium latifolium*, and *Convolvulus arvensis*. Litter covers nearly 43% of the ground surface.

Other Studies

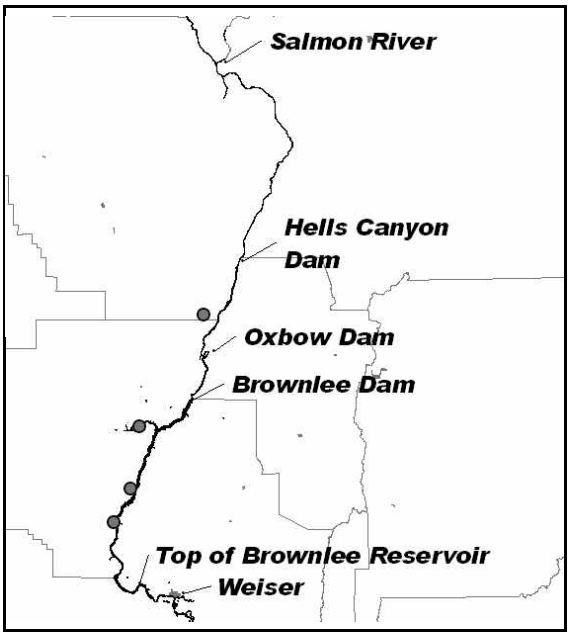
This assemblage has not been previously described in the study area.

Appendix 2 (cont.).

CADR/POBU Site Conditions

Elevation (ft): 2,992.5 (range 2,080–5,460)
Slope (°): 7.3 (range 5.0–13.0)
Aspect: E(1), N(1), NE(1), SE(1)
[a] Soil Texture: loamy sand (1), sandy loam (1)
[a] Organic Matter %: 5.7 (range 3.5–7.8)
[a] pH: 6.0 (range 5.0–6.9)
[a] ON ppm: 35.5 (16.0–55.0)
[a] CEC meq/100g: 11.5 (10.0–13.0)

[a] Soil characteristic data available for 2 stands.



CADR/POBU Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (2) [b]							
	Grasses (5) [b]							
I	*Poa bulbosa*	12.0	55.9	75.0				
I	*Bromus tectorum*	7.9	46.7	50.0				
	Forbs (26) [b]							
I	*Cardaria draba*	13.0	44.2	50.0				
I	*Asperugo procumbens*	11.5	30.9	50.0				
I	*Onopordum acanthium*	10.7	22.5	25.0				
I	*Chorispora tenella*	3.3	32.5	50.0				
I	*Ranunculus testiculatus*	2.4	37.5	75.0				
N	*Eriogonum heracleoides*	2.4	10.8	25.0				
N	*Arenaria aculeata*	2.2	17.5	25.0				
	Litter	42.9	99.2	100.0				
	Rock	14.1	36.7	100.0				
	Bare Soil	11.8	75.8	100.0				
	Moss	0.2	6.7	100.0				
	Lichen	0.2	5.8	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 2 (cont.).

Forbland

Amaranthus retroflexus (AMRE2)
(green pigweed) 4 stands

The *Amaranthus retroflexus* plant assemblage was an occasionally encountered assemblage in the *Forbland* cover type. It was encountered only in the Brownlee Reservoir Reach, at full-pool elevation (2,077 ft) on 0- to 9-degree slopes, usually on a flat aspect. No soil characteristic data were taken at these sites.

Farewell Bend Island Plot: BR98AFBBS3

Amaranthus retroflexus is a weedy annual, widely distributed throughout the western states and commonly found in cultivated lands, gardens, and disturbed areas. Germination occurs anytime during the growing season when soil moisture is sufficient (Whitson et al. 1992). *Amaranthus retroflexus* is a common weed species in the Weiser and the upper portions of the Brownlee Reservoir reaches. It was rarely encountered on transects in the Oxbow Reservoir and Hells Canyon Reservoir reaches and was not encountered below Hells Canyon Dam. In total, *Amaranthus retroflexus* was encountered on 130 transects and in 6 cover types (mostly in *Emergent Herbaceous Wetland*). In this plant assemblage, it significantly dominates with over 58% cover, and it is present in nearly all plots along transects (frequency = 98%). Several other weedy species occur, including *Chenopodium foliosum*.

This assemblage is species poor in graminoids (n = 4) and has a moderate number of forbs (n = 12). Few native species occur and only in trace amounts. No listed noxious weeds were found. Bare soil is exposed over 34% of the ground surface, and litter covers nearly 15% of the surface.

Other Studies

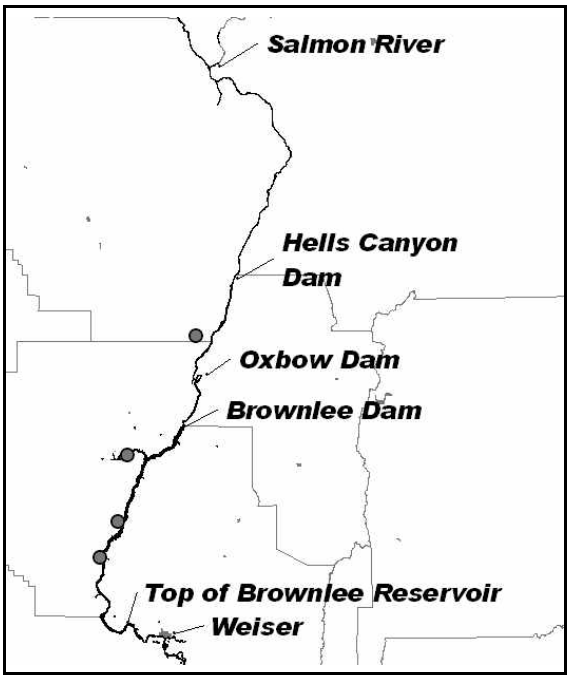
This assemblage has not been previously described in the study area.

Appendix 2 (cont.).

AMRE2 Site Conditions

Elevation (ft): 2,077
Slope (°): 2.3 (range 0.0–9.0)
Aspect: F(3), NW(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



AMRE2 Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (1) [b]							
	Grasses (4) [b]							
I	*Heleochloa alopecuroides*	1.2	26.3	50.0				
	Forbs (12) [b]							
I	*Amaranthus retroflexus*	58.4	97.5	100.0				
I	*Chenopodium foliosum*	2.8	57.5	75.0				
I	*Amaranthus albus*	1.9	23.8	50.0				
N	*Xanthium strumarium*	1.8	12.5	50.0				
I	*Chenopodium album*	1.5	32.5	75.0				
I	*Portulaca oleracea*	1.2	16.3	50.0				
	Bare Soil	34.1	93.8	100.0				
	Litter	14.7	93.8	100.0				
	Rock	0.2	2.5	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Forbland

Amaranthus retroflexus-Portulaca oleracea (AMRE2-POOL)
(green pigweed-purslane) 2 stands

The *Amaranthus retroflexus-Portulaca oleracea* plant assemblage is rare in the *Forbland* cover type. It was encountered at 2 sites in the Brownlee Reservoir Reach, both at full-pool elevation (2,077 ft) and on 5-degree slopes. No soil characteristic data were collected.

Farewell Bend Plot: BR981422G5

Amaranthus retroflexus is a weedy annual, widely distributed throughout the western states and commonly found in cultivated lands, gardens, and disturbed areas. Germination occurs anytime during the growing season when soil moisture is sufficient. (Whitson et al. 1992). *Amaranthus retroflexus* is a common weed species in the Weiser and the upper portions of the Brownlee Reservoir reaches. It was rarely encountered on transects in the Oxbow Reservoir and Hells Canyon Reservoir reaches and was not encountered below Hells Canyon Dam. In total, *Amaranthus retroflexus* was encountered on 130 transects and in 6 cover types (mostly in *Emergent Herbaceous Wetland*). In this plant assemblage, it dominates with nearly 26% cover and is present in all plots along transects (frequency = 100%). This assemblage was classified separately from the *Amaranthus retroflexus* assemblage because of the lesser amount of *Amaranthus retroflexus* cover and a unique combination of associated species. *Chenopodium foliosum* is absent, and *Portulaca oleracea* is subdominant.

Portulaca oleracea was introduced from Europe and has become a troublesome weed in cultivated fields and gardens. It is especially persistent in soils that remain moist much of the time. It produces seed throughout the growing season and has the ability to root again after cultivation (Whitson et al. 1992). *Portulaca oleracea* is a common weed species in the upper portions of the Brownlee Reservoir Reach and in the Weiser Reach. It was rarely encountered on transects in the Hells Canyon Reservoir Reach and the reach below Hells Canyon Dam. It was not encountered on the Oxbow Reservoir Reach. In total, *Portulaca oleracea* was encountered on 149 transects and in 5 cover types (mostly in *Emergent Herbaceous Wetland*). In this plant assemblage, it provides 4% cover and is present on more than one-half of all plots along transects (frequency = 60%).

This assemblage is species poor in graminoids (n = 2) and forbs (n = 5). Few native species occur and only in trace amounts. No listed noxious weeds were found. Bare rock comprises over 65% of the ground cover, and bare soil is exposed on over 22% of the surface.

Appendix 2 (cont.).

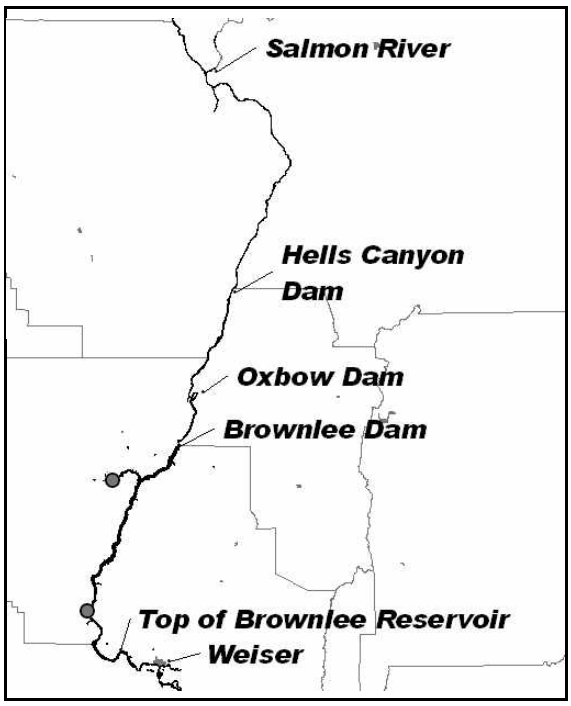
Other Studies

This assemblage has not been previously described in the study area.

AMRE2-POOL Site Conditions

Elevation (ft): 2,077
Slope (°): 5.0
Aspect: E(1), NW(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



AMRE2-POOL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (0) [b]							
	Grasses (2) [b]							
N	*Phalaris arundinacea*	3.4	35.0	50.0				
I	*Heleochloa alopecuroides*	0.4	15.0	50.0				
	Forbs (5) [b]							
I	*Amaranthus retroflexus*	25.8	100.0	100.0				
I	*Portulaca oleracea*	4.1	60.0	100.0				
N	*Xanthium strumarium*	0.5	20.0	50.0				
I	*Amaranthus albus*	0.2	7.5	50.0				
N	*Euphorbia glyptosperma*	0.2	5.0	50.0				
	Rock	65.1	100.0	100.0				
	Bare soil	22.6	87.5	100.0				
	Litter	1.4	55.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 2 (cont.).

Forbland

Centaurea repens-Galium aparine (CERE2-GAAP)
(Russian knapweed-goose-grass) 2 stands

The *Centaurea repens-Galium aparine* plant assemblage is rare in the *Forbland* cover type. It was encountered at 2 sites in the Weiser Reach at an elevation of 2,090 ft. Both sites were on 0- to 1-degree slopes. No soil characteristic data were taken at these sites.

Weiser Island Plot: BA98WSRAS0

Centaurea repens is a listed noxious weed in Idaho and Oregon. It is an allelopathic, very competitive perennial, forming dense colonies by adventitious shoots from widely spreading roots. A native of Eurasia, it is now distributed throughout the western states, commonly found in cultivated lands, pastures, roadsides, and disturbed areas (Whitson et al. 1992). A single plant may produce 1,200 seeds, which remain viable two to three years. *Centaurea repens* is a rare weed species in the Weiser Reach and was not encountered in any other study reach. *Centaurea repens* was encountered on 4 transects and in 3 cover types. In this plant assemblage, it provides over 35% cover and is present in all plots along transects (frequency = 100%).

Galium aparine is a native annual common in the western states. In recent years it has become a serious weed in cultivated fields, particularly in hay or grain fields where it clings to and tangles with the crop, making harvest difficult (Whitson et al. 1992). *Galium aparine* is one of the most common weed species in the study area. It was encountered on 377 transects, in 11 cover types, and in all study reaches. In this plant assemblage, *Galium aparine* provides over 35% cover and is present in nearly every plot along transects (frequency = 95%).

This assemblage has few graminoid (n = 2) and forb (n = 9) species, and about one-half are listed noxious weeds: specifically, *Centaurea repens*, *Cirsium arvense*, *Conium maculatum*, *Cardaria draba*, and *Lepidium latifolium*. Litter covers over 97% of the ground surface.

Other Studies

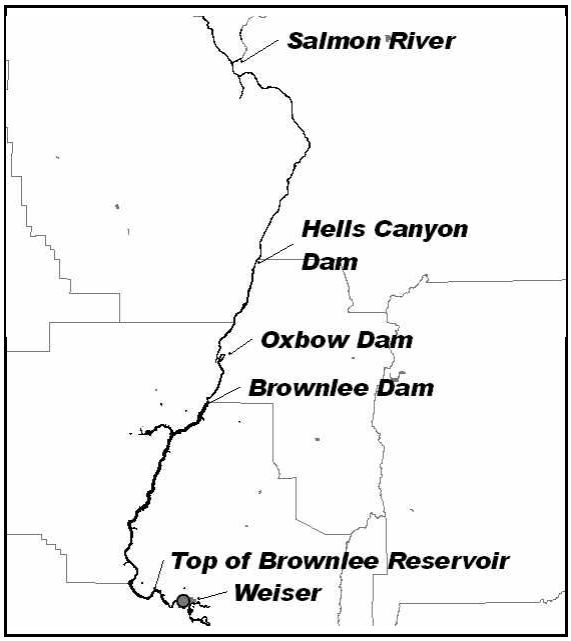
This assemblage has not been previously described in the study area.

Appendix 2 (cont.).

CERE2-GAAP Site Conditions

Elevation (ft): 2,090
Slope (°): 0.5 (range 0.0–1.0)
Aspect: F(1), W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



CERE2-GAAP Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (0) [b]							
	Grasses (2) [b]							
I	*Agropyron repens*	0.7	25.0	100.0				
I	*Bromus tectorum*	0.2	7.5	50.0				
	Forbs (9) [b]							
N	*Glycyrrhiza lepidota*	37.9	50.0	50.0				
N	*Galium aparine*	35.4	95.0	100.0				
I	*Centaurea repens*	35.3	100.0	100.0				
I	*Cirsium arvense*	17.5	40.0	50.0				
I	*Conium maculatum*	15.9	45.0	50.0				
I	*Cardaria draba*	14.9	45.0	50.0				
I	*Lepidium latifolium*	2.6	17.5	50.0				
N	*Asclepias speciosa*	2.2	12.5	50.0				
N	*Urtica dioica*	1.0	2.5	50.0				
	Litter	97.5	100.0	100.0				
	Bare soil	0.0	0.0	0.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				
	Rock	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 2 (cont.).

Forbland

Melilotus alba-Bromus japonicus (MEAL-BRJA)
(white sweetclover-Japanese brome) 2 stands

The *Melilotus alba-Bromus japonicus* plant assemblage is rare in the *Forbland* cover type. It was encountered in only the Brownlee Reservoir Reach, at or below the full-reservoir pool level at elevations of 2,072 and 2,077 ft. Sites occurred on 5- and 31-degree slopes. No soil characteristic data were taken at these sites.

Powder River Plot: BR981517G1

Melilotus alba is an introduced weedy legume that can be an annual or biennial. It is common along roadsides and disturbed areas. *Melilotus alba* is often one of the first plants to appear on disturbed sites and is sometimes promoted for soil stabilization or soil improvement (Whitson et al. 1992). It is a common weed species in all study reaches except below Hells Canyon Dam. *Melilotus alba* was encountered on 85 transects and in 7 cover types. In this plant assemblage, it is the dominant herbaceous species, providing almost 32% cover and occurring in most plots along transects (frequency = 67.5%). Several other weedy forbs are also abundant in this assemblage, including *Medicago lupulina*, *Dipsacus sylvestris*, and *Xanthium strumarium*.

The codominant graminoid in this assemblage is *Bromus japonicus*. A weedy annual or winter annual introduced from Europe, it occurs throughout the West and has become a nuisance in depleted ranges, cultivated areas, and dry soils in disturbed areas (Whitson et al. 1992). *Bromus japonicus* is one of the most common weedy grass species in all study reaches, encountered on 281 transects and in 11 cover types. In this plant assemblage, *Bromus japonicus* provides over 13% cover and is present in nearly every plot along transects (frequency = 97.5%).

This assemblage is species poor in graminoids (n = 5) but relatively species rich in forbs (n = 16). Most species are introduced and weedy in nature. This assemblage includes several listed noxious weeds: specifically, *Taeniatherum caput-medusae*, *Convolvulus arvensis*, and *Cynoglossum officinale*. Litter covers over 54% of the ground surface, and bare soil is exposed on about 14% of the surface.

Other Studies

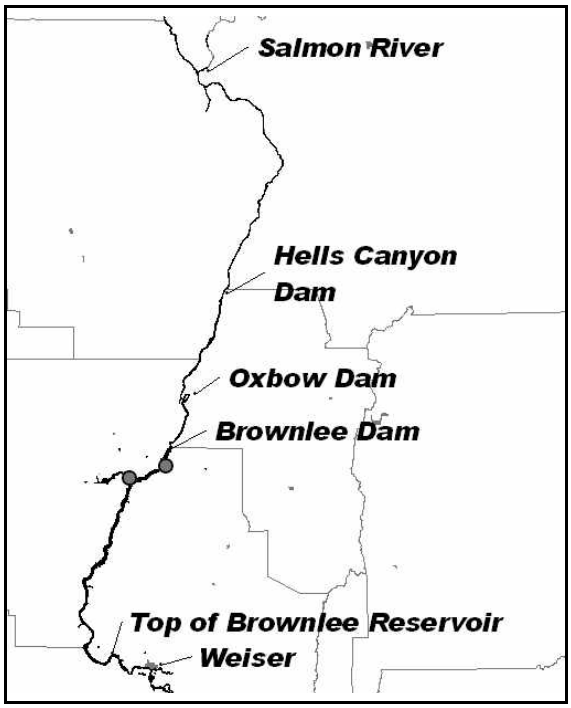
This assemblage has not been previously described in the study area.

Appendix 2 (cont.).

MEAL-BRJA Site Conditions

Elevation (ft): 2,074.5 (range 2072.0–2,077.0)
Slope (°): 18.0 (range 5.0–31.0)
Aspect: E(1), W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



MEAL-BRJA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (0) [b]							
	Grasses (5) [b]							
I	*Bromus japonicus*	13.7	97.5	100.0				
I	*Bromus sterilis*	3.8	50.0	50.0				
I	*Taeniatherum caput-medusae*	2.5	45.0	50.0				
	Forbs (16) [b]							
I	*Melilotus alba*	31.9	67.5	100.0				
I	*Medicago lupulina*	17.9	42.5	50.0				
I	*Dipsacus sylvestris*	12.6	47.5	50.0				
N	*Xanthium strumarium*	11.9	42.5	50.0				
I	*Melilotus* sp.	3.1	15.0	50.0				
I	*Convolvulus arvensis*	2.5	25.0	50.0				
	Litter	54.1	100.0	100.0				
	Bare soil	13.6	52.5	100.0				
	Rock	8.1	42.5	100.0				
	Lichen	0.5	20.0	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 2 (cont.).

Forbland

Tribulus terrestris (TRTE)
(puncturevine) 1 stand

The *Tribulus terrestris* plant assemblage is rare in the *Forbland* cover type. It was encountered at just 1 site in the Brownlee Reservoir Reach. It occurred at the full-reservoir pool elevation of 2,077 ft on a 17-degree slope. No soil samples were taken at this site.

Farewell Bend Plot: BR981802I6

Tribulus terrestris is a listed noxious weed in Idaho and Oregon. It is an annual, mat-forming plant introduced from southern Europe. *Tribulus terrestris* is now widely scattered over much of the United States, growing along roadways and in cultivated lands and disturbed areas. The hard, spiny burs are injurious to livestock and frequently puncture the tires of bicycles. Because of its sharp burs, *Tribulus terrestris* has been spread over a wide area by animals and vehicles (Whitson et al. 1992). An uncommon weed species in the study area, *Tribulus terrestris* was encountered on 15 transects, in 3 cover types, and in only the Brownlee Reservoir Reach and the reach below Hells Canyon Dam. In this plant assemblage, *Tribulus terrestris* is the only species providing more than trace amounts of cover. It provides over 40% cover and is present in every plot along transects (frequency = 100%).

This assemblage has no graminoids and few forbs (n = 5), most of which are also introduced weedy species. *Tribulus terrestris* is the only listed noxious weed in the assemblage. Bare soil is exposed on over 53% of the surface.

Other Studies

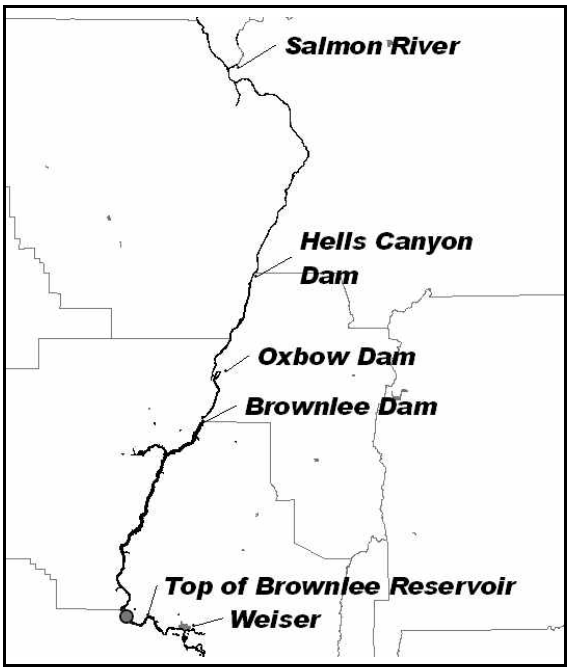
This assemblage has not been previously described in the study area.

Appendix 2 (cont.).

TRTE Site Conditions

Elevation (ft): 2,077.0
Slope (°): 17.0
Aspect: SW(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



TRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (0) [b]							
	Grasses (0) [b]							
	Forbs (5) [b]							
I	*Tribulus terrestris*	40.2	100.0	100.0				
I	*Amaranthus retroflexus*	0.8	30.0	100.0				
I	*Amaranthus albus*	0.3	10.0	100.0				
I	*Portulaca oleracea*	0.3	10.0	100.0				
N	*Xanthium strumarium*	0.3	10.0	100.0				
	Bare Soil	53.1	100.0	100.0				
	Rock	17.2	100.0	100.0				
	Litter	0.3	10.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 2 (cont.).

Grassland

Agropyron spicatum (AGSP)
(bluebunch wheatgrass) 22 stands

The *Agropyron spicatum* plant assemblage is the most common assemblage in the *Grassland* cover type. This assemblage is found in all study reaches except the Weiser Reach. Sites occurred between 1,361 and 2,714 ft, on 20- to 37-degree slopes on a variety of aspects. Soil pH was slightly acidic (pH = 6.5).

Across from Little Timber Canyon Plot: BR97XLT02U

Agropyron spicatum is one of the most important forage grasses of the sagebrush-steppe. It is a common and often conspicuous dominant in the more moist regions, particularly in areas of deep soil accumulation (Taylor 1992). *Agropyron spicatum* has a wide geographic and ecological range and occurs throughout western North America east of the Cascades and the Pacific coastal mountains. It is an important constituent of the Pacific Northwest bunchgrass, sagebrush, mountain shrub, pinyon/juniper, and ponderosa pine regions (Tisdale and Hironaka 1981). A common grass species in the study area, *Agropyron spicatum* was observed from the canyon bottoms up to middle elevations (about 6,000 ft). It was encountered in 239 transects, in 11 cover types, and in all study reaches, but it is rare in the Weiser Reach (1 transect). In this assemblage, *Agropyron spicatum* dominates the herbaceous layer with almost 24% cover, and it occurs in nearly all plots along transects (frequency = 84%). Other grasses providing more than trace amounts of cover include *Bromus tectorum*, *Poa bulbosa*, and *Poa secunda*. *Balsamorhiza sagittata* was the most abundant forb.

This assemblage is relatively species rich in forbs (n = 47) and graminoids (n = 18). Most are native species, and no listed noxious weeds are present. Litter covers nearly 31% of the ground surface.

Other Studies

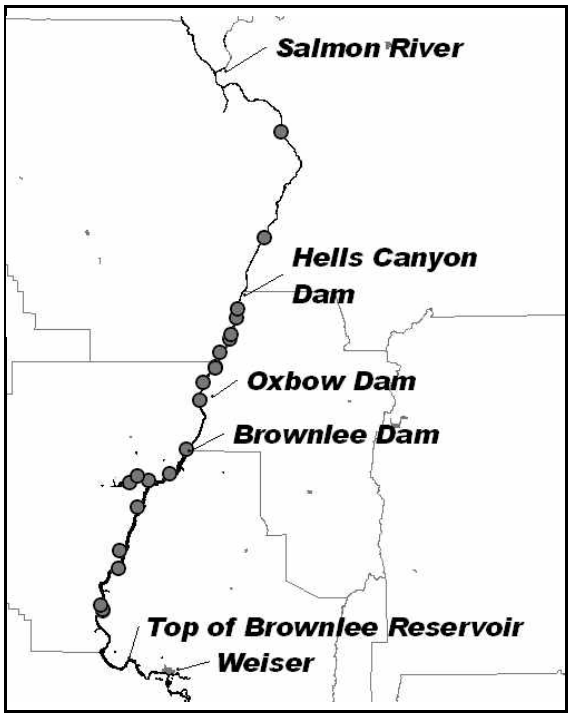
This plant assemblage is most similar to the *Agropyron spicatum-Bromus tectorum-Bromus japonicus* plant community described by Asherin and Claar (1976), based on their sample of 1 site in the reach between Brownlee and Hells Canyon dams. Johnson and Simon (1987) describe several *Agropyron spicatum*-dominated plant associations in the Wallowa-Snake Province. This plant assemblage may represent an early seral stage of such associations but is dissimilar to those described. It is probably related to a successional stage of the general *Agropyron spicatum-Festuca idahoensis* habitat type described by Daubenmire (1970) for the steppe vegetation of Washington.

Appendix 2 (cont.).

AGSP Site Conditions

Elevation (ft): 2,131 (range 1,361–2,714.0)
Slope (°): 31.9 (range 20.0–37.0)
Aspect: E(5), N(2), NE(1), NW(4), S(1), SE(4), W(5)
[a] Soil Texture: loamy sand(7) sandy loam(6)
[a] Organic Matter %: 3.3 (range 1.5–5.9)
[a] pH: 6.5 (range 5.3–7.2)
[a] ON ppm: 54.6 (range 15.0–90.0)
[a] CEC meq/100g: 14.2 (range 10.1–20.5)

[a] Soil characteristic data available for 13 stands.



AGSP Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (14) [b]							
	Grasses (18) [b]							
N	*Agropyron spicatum*	23.9	83.9	100.0				
I	*Bromus tectorum*	4.2	67.8	90.9				
I	*Poa bulbosa*	2.8	21.6	45.5				
N	*Poa secunda*	2.8	36.9	86.4				
N	*Festuca idahoensis*	1.8	10.5	18.2				
I	*Bromus japonicus*	0.9	23.6	50.0				
	Forbs (47) [b]							
N	*Balsamorhiza sagittata*	3.4	13.6	50.0				
N	*Draba verna*	0.9	36.2	68.2				
N	*Lithophragma* sp.	0.8	8.3	22.7				
N	*Galium aparine*	0.8	16.8	45.5				
N	*Lupinus* sp.	0.8	5.1	9.1				
	Litter	30.8	97.1	100.0				
	Rock	24.6	87.7	100.0				
	Bare Soil	11.4	68.2	100.0				
	Moss	9.8	58.0	100.0				
	Lichen	4.5	53.9	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.8% cover not listed in table.

Appendix 2 (cont.).

Grassland

Bromus tectorum (BRTE)
(cheatgrass) 13 stands

The *Bromus tectorum* plant assemblage is common in the *Grassland* cover type. It was encountered in all study reaches except the Oxbow Reservoir Reach. Sites occurred between 1,140 and 2,390 ft on 0- to 28-degree slopes on a variety of aspects. Soil pH was neutral (pH = 7.0), common for upland soils in Hells Canyon.

Granite Creek Plot: HB97GRA01U

Bromus tectorum is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). *Bromus tectorum* is the most commonly occurring graminoid in the study area. It was encountered in 447 transects, in all cover types (12), and in all study reaches, with most encounters along the Brownlee Reservoir Reach (205 transects). In this assemblage, *Bromus tectorum* dominates the herbaceous layer with 20% cover, and it occurs in nearly all plots along transects (frequency = 89%). *Sporobolus cryptandrus* is the next most dominant species based on cover, frequency, and constancy.

This assemblage is species rich in forbs (n = 35) and graminoids (n = 18); about one-half these species are native. Three listed noxious weeds are found in this assemblage: specifically, *Taeniatherum caput-medusae*, *Onopordum acanthium*, and *Cardaria draba*. Litter covers over 62% of the ground surface.

Other Studies

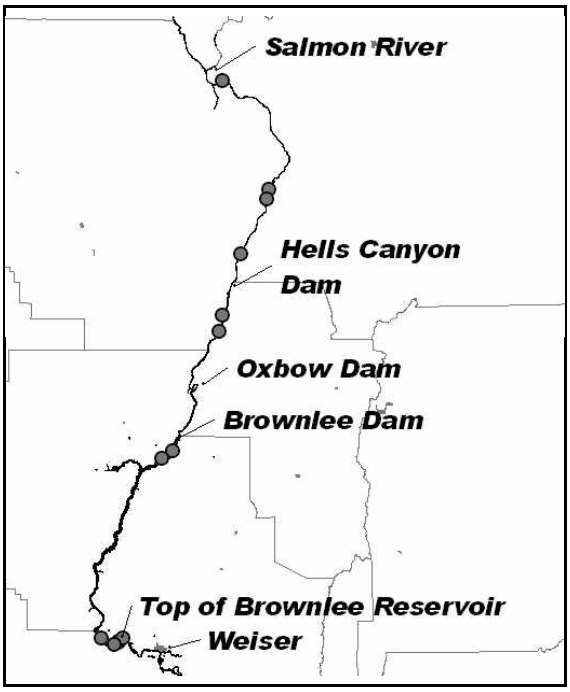
This assemblage has not been previously described for the study area. Asherin and Claar (1976) describe a somewhat related *Sporobolus cryptandrus-Bromus tectorum* plant community based on their sampling of 2 sites along the Snake River below the confluence with the Salmon River. However, this study area plant assemblage is unique because of the overwhelming dominance by *Bromus tectorum.* It is probably related to a successional stage of the general *Agropyron spicatum-Festuca idahoensis* habitat type described by Daubenmire (1970) for the steppe vegetation of Washington. Due to the dominance of the aggressive, introduced species *Bromus tectorum*, sites in this assemblage may never return to previous potential climax conditions and instead represent an altered successional pathway dominated by *Bromus tectorum*.

Appendix 2 (cont.).

BRTE Site Conditions

Elevation (ft): 1,861.5 (range 1,140.0–2,390.0)
Slope (°): 8.9 (range 0.0–28.0)
Aspect: E(1), F(4), NW(2), S(3), SE(2), W(1)
[a] Soil Texture: loamy sand(3) sandy loam(4) silty loam(1)
[a] Organic Matter %: 2.4 (range 2.4–2.4)
[a] pH: 7.0 (range 7.0–7.0)
[a] ON ppm: 45.0 (range 45.0–45.0)
[a] CEC meq/100g: 16.0 (range 16.0–16.0)

[a] Soil characteristic data available for 8 stands.



BRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (5) [b]							
	Grasses (18) [b]							
I	*Bromus tectorum*	20.0	89.0	100.0				
I	*Bromus sterilis*	4.1	7.7	7.7				
N	*Sporobolus cryptandrus*	4.0	29.2	46.2				
N	*Distichlis stricta*	3.1	15.4	23.1				
N	*Aristida longiseta*	3.0	15.1	23.1				
I	*Taeniatherum caput-medusae*	2.5	30.3	53.8				
I	*Poa pratensis*	2.1	6.4	15.4				
N	*Poa secunda*	2.0	11.8	38.5				
I	*Bromus japonicus*	1.6	26.4	30.8				
	Forbs (35) [b]							
I	*Medicago stativa*	2.8	9.0	15.4				
I	*Erodium cicutarium*	1.8	31.2	61.5				
N	*Grindelia squarrosa*	1.7	6.5	7.7				
	Litter	62.3	99.1	100.0				
	Moss	4.7	34.5	100.0				
	Bare Soil	3.1	47.2	100.0				
	Rock	3.0	24.7	100.0				
	Lichen	1.5	16.8	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1.5% cover not listed in table.

Appendix 2 (cont.).

Grassland

Bromus tectorum-Agropyron spicatum (BRTE-AGSP)
(cheatgrass-bluebunch wheatgrass) 18 stands

The *Bromus tectorum-Agropyron spicatum* plant assemblage is the second most common assemblage in the *Grassland* cover type. It was found in the Brownlee Reservoir and Hells Canyon Reservoir reaches and the reach below Hells Canyon Dam. Sites occurred between 1,170 and 2,320 ft on 0- to 37-degree slopes on a variety of aspects. Soils were slightly alkaline (pH = 7.5), according to soil characteristic data from 2 sites.

Burnt River Plot: BR97BRN04U

Bromus tectorum is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). *Bromus tectorum* is the most commonly occurring graminoid in the study area. It was encountered in 447 transects, in all cover types (12), and in all study reaches, with most encounters along the Brownlee Reservoir Reach (205 transects). In this assemblage, *Bromus tectorum* dominates the herbaceous layer with about 18% cover, and it occurs in nearly all plots along transects (frequency = 82%). *Agropyron spicatum* is the next most dominant species based on cover, frequency, and constancy values. A common grass species in the study area, it was encountered in 239 transects, in 11 cover types, and in all study reaches; it is rare in the Weiser Reach (1 transect).

This assemblage is species rich in shrubs (n = 13), forbs (n = 28), and graminoids (n = 11), and most species are native. All shrub species occur infrequently and provide trace amounts of cover (< 1%). Two listed noxious weeds occur in this assemblage: *Taeniatherum caput-medusae* and *Dipsacus sylvestris*. Litter covers over 35% of the ground surface.

Other Studies

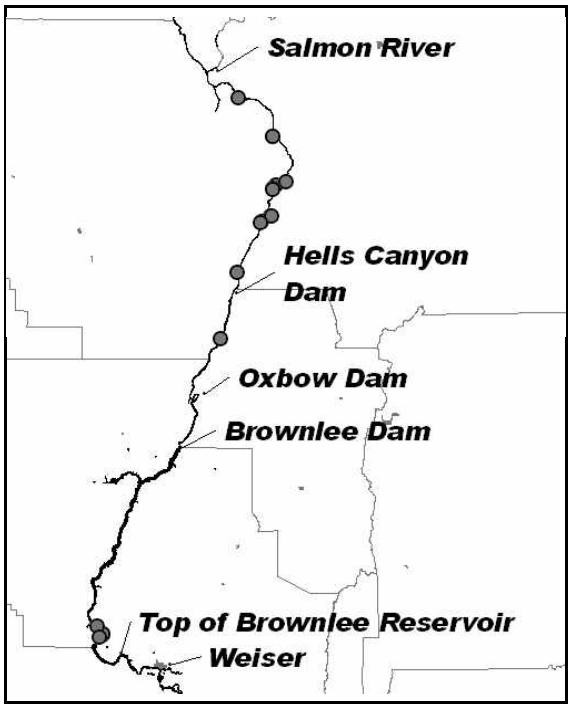
This plant assemblage has not been previously described for the study area. Johnson and Simon (1987) describe several *Agropyron spicatum*-dominated plant associations in the Wallowa-Snake Province. This plant assemblage may represent an early seral-stage of such associations but is dissimilar to those described. It is probably related to a successional stage of the general *Agropyron spicatum-Festuca idahoensis* habitat type described by Daubenmire (1970) for the steppe vegetation of Washington. Due to the dominance of the aggressive, introduced species *Bromus tectorum*, sites in this assemblage may never return to previous potential climax conditions and instead represent an altered successional pathway ultimately dominated by *Bromus tectorum*.

Appendix 2 (cont.).

BRTE-AGSP Site Conditions

Elevation (ft): 1,727.3 (range 1,170.0–2,320.0)
Slope (°): 17.4 (range 0.0–37.0)
Aspect: E(7), F(1), NE(1), NW(1), S(1), SW(2), W(5)
[a] Soil Texture: loamy sand(1) silty loam(1)
[a] Organic Matter %: 2.3 (range 2.0–2.5)
[a] pH: 7.5 (range 7.1–7.9)
[a] ON ppm: 42.5 (range 40.0–45.0)
[a] CEC meq/100g: 18.0 (range 12.0–24.0)

[a] Soil characteristic data available for 2 stands.



BRTE-AGSP Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
	Shrubs (13) [b]							
	Grasses (11) [b]							
I	*Bromus tectorum*	17.7	81.9	94.4				
N	*Agropyron spicatum*	3.7	22.1	61.1				
I	*Poa bulbosa*	3.7	10.0	11.1				
N	*Sporobolus cryptandrus*	2.9	23.1	44.4				
	Bromus sp.	1.6	14.8	22.2				
N	*Festuca microstachys*	1.0	4.2	16.7				
N	*Aristida longiseta*	1.0	7.5	22.2				
	Forbs (28) [b]							
I	*Erodium cicutarium*	2.4	33.3	77.8				
	Unknown forb	2.3	67.5	77.8				
N	*Lithophragma parviflorum*	1.3	13.3	38.9				
I	*Dipsacus sylvestris*	1.0	10.0	11.1				
	Litter	35.8	99.2	100.0				
	Rock	16.0	72.3	100.0				
	Bare Soil	12.1	70.6	100.0				
	Moss	8.0	52.4	100.0				
	Lichen	5.0	44.4	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Grassland

Festuca idahoensis-Agropyron spicatum (FEID-AGSP)
(Idaho fescue-bluebunch wheatgrass) 9 stands

The *Festuca idahoensis-Agropyron spicatum* plant assemblage is a common assemblage in the *Grassland* cover type. It was found in the Brownlee Reservoir (5 sites) and Hells Canyon Reservoir (1 site) reaches and the reach below Hells Canyon Dam (3 sites). Sites occurred between 1,340 and 2,930 ft on 17- to 38-degree slopes on a variety of aspects. Soils were slightly acidic (pH = 6.5), according to soil characteristic data from 2 sites.

Big Canyon Creek Plot: HB97BCC01U

Festuca idahoensis is one of the most important forage grasses of the sagebrush-steppe. It grows as a common and often conspicuous dominant in the more moist regions, particularly in areas of deep soil accumulation (Taylor 1992). *Festuca idahoensis* is somewhat uncommon in the study area. It was encountered in 37 transects, in 7 cover types, and in all study reaches except the Weiser Reach. In this assemblage, *Festuca idahoensis* dominates the herbaceous layer with 20% cover, and it occurs in most plots along transects (frequency = 75%). *Agropyron spicatum* is codominant with almost 11% cover and 64% frequency of occurrence in plots. It is one of the most important forage grasses of the sagebrush-steppe. *Agropyron spicatum* tends to be more common in the more moist regions, particularly in areas of deep soil accumulation (Taylor 1992). It has a wide geographic and ecological range and occurs throughout western North America east of the Cascades and the Pacific coastal mountains. A common graminoid in the study area, *Agropyron spicatum* was encountered in 239 transects, in 11 cover types, and in all study reaches; it is rare in the Weiser Reach (1 transect).

This assemblage is species rich in shrubs (n = 8), forbs (n = 33), and graminoids (n = 10), and most species are native. All shrubs occur infrequently and provide only trace amounts of cover (< 1%). One listed noxious weed is found in this assemblage: *Hypericum perforatum*. Litter covers over 54% of the ground surface, and mosses cover about 27% of the surface.

Other Studies

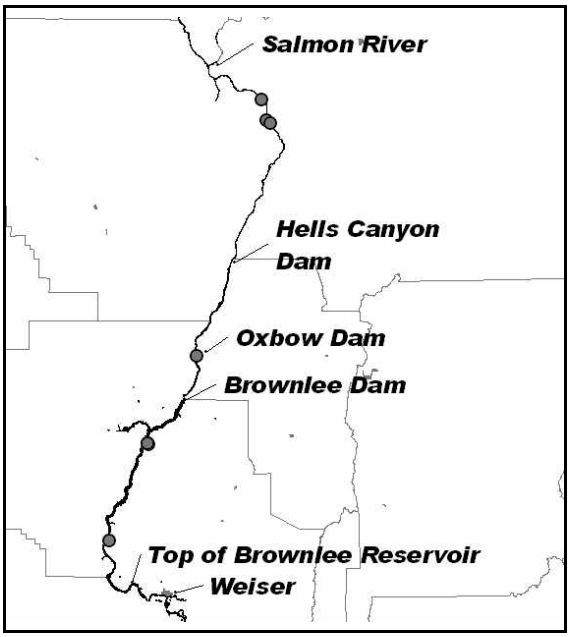
This plant assemblage is similar to the *Festuca idahoensis-Agropyron spicatum*/*Balsamorhiza sagittata* plant community described by Johnson and Simon (1987) in the Wallowa-Snake Province. However, this assemblage is believed to be more representative of canyon-bottom environs than the higher-elevation sites (3,800-6,000 ft) previously described. It is probably related to a successional stage of the *Agropyron spicatum-Festuca idahoensis* habitat type described by Daubenmire (1970) for the steppe vegetation of Washington.

Appendix 2 (cont.).

FEID-AGSP Site Conditions

Elevation (ft): 2,309.2 (range 1,340.0–2,930.0)
Slope (°): 31.4 (range 17.0–38.0)
Aspect: N(6), NE(1), NW(1), W(1)
[a] Soil Texture: loamy sand(2)
[a] Organic Matter %: 4.4 (range 4.3–4.4)
[a] pH: 6.5 (range 6.3–6.7)
[a] ON ppm: 62.5 (range 60.0–65.0)
[a] CEC meq/100g: 12.9 (range 11.0–14.7)

[a] Soil characteristic data available for 2 stands.



FEID-AGSP Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (8) [b]							
	Grasses (10) [b]							
N	*Festuca idahoensis*	20.0	75.0	100.0				
N	*Agropyron spicatum*	10.8	63.9	100.0				
I	*Bromus japonicus*	2.3	21.3	66.7				
	Unknown grass	1.9	43.9	55.6				
	Forbs (33) [b]							
	Unknown forb	1.5	43.3	55.6				
N	*Cerastium arvense*	1.5	12.2	22.2				
N	*Lupinus* sp.	1.3	11.7	44.4				
I	*Myosotis micrantha*	1.0	37.6	77.8				
	Litter	54.8	100.0	100.0				
	Moss	27.0	92.4	100.0				
	Lichen	5.3	62.0	100.0				
	Bare Soil	4.5	59.1	100.0				
	Rock	2.6	33.3	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Grassland

Taeniatherum caput-medusae (TACA)
(medusahead wildrye) 8 stands

The *Taeniatherum caput-medusae* plant assemblage is common in the *Grassland* cover type. It was encountered in the Brownlee Reservoir (6 sites), Oxbow Reservoir (1 site), and Hells Canyon Reservoir (1 site) reaches. Sites occurred between 2,077 and 2,530 ft on 6- to 26-degree slopes on a variety of aspects. Soils tested were slightly acidic (pH = 6.5).

Wayle Creek Plot: BR95WAY01U

Taeniatherum caput-medusae is an aggressive winter annual grass, introduced from Eurasia, and is predominant on millions of acres of semiarid rangeland in the Pacific Northwest (Whitson et al. 1992). It is extremely competitive, even crowding out such undesirable species as *Bromus tectorum.* It is a low-value forage species for both livestock and wildlife. *Taeniatherum caput-medusae* is common in the study area; it was encountered in 124 transects, in 11 cover types, and in all study reaches. Most encounters were along the Brownlee Reservoir Reach (80 transects); below Hells Canyon Dam, it was encountered on only 1 transect. In this assemblage, *Taeniatherum caput-medusae* dominates the herbaceous layer with over 41% cover, and it occurs in every plot along transects. *Bromus tectorum* is the next most dominant species.

This assemblage is relatively species rich in forbs (n = 33) and graminoids (n = 11); about one-half the species are native. Two listed noxious weeds occur in this assemblage: *Taeniatherum caput-medusae* and *Dipsacus sylvestris*. Litter covers over 74% of the ground surface.

Other Studies

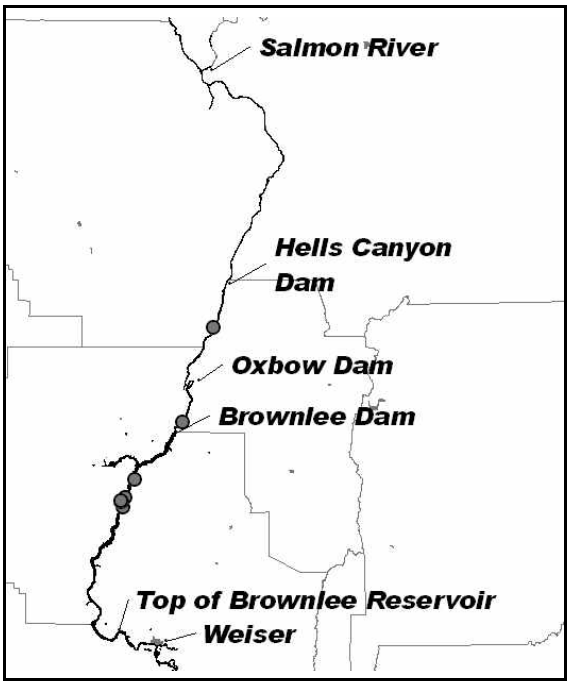
This assemblage is similar to the *Taeniatherum caput-medusae-Bromus tectorum* plant community described by Asherin and Claar (1976), based on their sampling of 1 transect along the Brownlee Reservoir Reach. It is probably related to a successional stage of the general *Agropyron spicatum-Festuca idahoensis* habitat type described by Daubenmire (1970) for the steppe vegetation of Washington. Due to the dominance of the aggressive introduced species in this assemblage, these sites may never return to previous potential climax conditions and instead represent an altered successional pathway dominated by *Taeniatherum caput-medusae* and/or *Bromus tectorum*.

Appendix 2 (cont.).

TACA Site Conditions

Elevation (ft): 2,292.8 (range 2,077.0–2,530.0)
Slope (°): 14.4 (range 6.0–26.0)
Aspect: E(2), NW(1), SE(1), SW(1), W(3)
[a] Soil Texture: loamy sand(3)
[a] Organic Matter %: 2.5 (range 2.3–2.7)
[a] pH: 6.5 (range 6.0–6.9)
[a] ON ppm: 48.3 (range 45.0–50.0)
[a] CEC meq/100g: 10.3 (range 8.8–11.6)

[a] Soil characteristic data available for 3 stands.



TACA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (7) [b]							
	Grasses (11) [b]							
I	*Taeniatherum caput-medusae*	41.4	100.0	100.0				
I	*Bromus tectorum*	6.2	36.5	50.0				
N	*Poa secunda*	2.1	26.9	62.5				
	Festuca sp.	1.2	14.4	25.0				
	Forbs (33) [b]							
I	*Erodium cicutarium*	3.6	41.7	62.5				
I	*Verbascum blattaria*	2.7	40.0	100.0				
N	*Helianthus annuus*	2.0	36.5	62.5				
N	*Epilobium paniculatum*	1.7	32.7	75.0				
I	*Veronica arvensis*	1.4	22.5	25.0				
	Unknown forb	1.1	40.0	50.0				
	Litter	74.2	100.0	100.0				
	Moss	4.7	68.3	100.0				
	Bare Soil	3.4	62.9	100.0				
	Rock	2.6	40.0	100.0				
	Lichen	1.3	21.9	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 2 (cont.).

Grassland

Poa bulbosa-Poa secunda (POBU-POSE)
(bulbous bluegrass-Sandberg's bluegrass) 7 stands

The *Poa bulbosa-Poa secunda* plant assemblage is uncommon in the *Grassland* cover type. This assemblage was encountered in the Brownlee Reservoir (6 sites) and Weiser (1 site) reaches. Sites occurred between 2,120 and 2,680 ft on 2- to 28-degree slopes on a variety of aspects. Soil pH was neutral (pH = 7.0), based on soil characteristic data from 1 site.

Porters Island Plot: BA97POI01U

Introduced from Europe, *Poa bulbosa* is a weedy, annual grass that commonly grows in pastures, grain fields, and roadsides in scattered areas of most states in the West (Whitson et al. 1992). A common species in the study area, *Poa bulbosa* was found on 177 transects, in 10 cover types, and in all study reaches. In this assemblage, *Poa bulbosa* dominates the herbaceous layer with over 12% cover, and it occurs in more than one-half of the plots along transects (frequency = 59%).

Poa secunda (synonymous with *Poa sandbergii*) is a native bunchgrass that inhabits thinner, drier soils than *Agropyron spicatum* and often grows on lithosols (Taylor 1992). It is a widespread species in the western United States and occurs in the Yukon and British Columbia provinces of Canada. *Poa secunda* is common in the canyon. It was encountered in 242 transects, in 11 cover types, and in all study reaches; most encounters were along the Brownlee Reservoir Reach (121 transects). In this assemblage, *Poa secunda* is codominant, providing almost 10% cover and occurring in more than one-half of the plots along transects (frequency = 55%). Other native graminoids, such as *Sitanion hystrix* and *Agropyron spicatum*, are present with low amounts of cover.

This assemblage is relatively species rich in forbs (n = 22) and graminoids (n = 9) and has mostly native species. One listed noxious weed occurs in this assemblage: *Taeniatherum caput-medusae*. Litter covers almost 34% of the ground surface, and bare soil is exposed on about 17% of the surface.

Other Studies

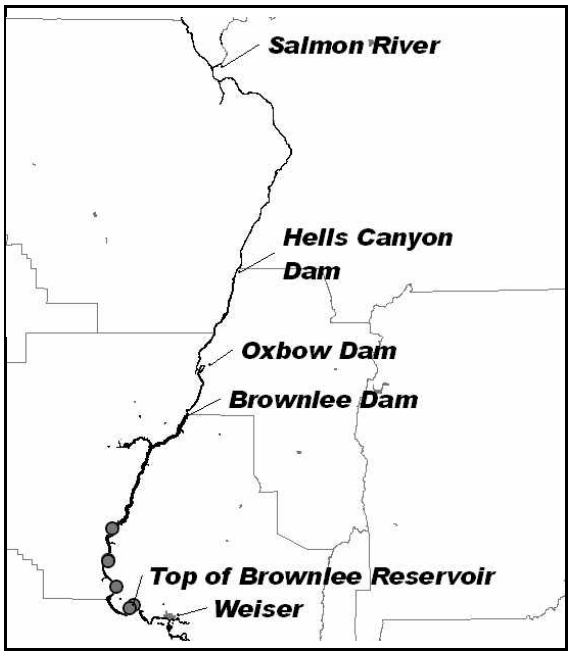
This plant assemblage has not been previously described.

Appendix 2 (cont.).

POBU-POSE Site Conditions

Elevation (ft): 2,353.1 (range 2,120.0–2,680.0)
Slope (°): 12.0 (range 2.0–28.0)
Aspect: E(1), NE(1), NW(1), S(1), SW(1), W(2)
[a] Soil Texture: sandy loam(1)
[a] Organic Matter %: 2.4
[a] pH: 7.0
[a] ON ppm: 45.0
[a] CEC meq/100g: 16.0

[a] Soil characteristic data available for 1 stand.



POBU-POSE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
	Grasses (9) [b]							
I	*Poa bulbosa*	12.7	58.8	71.4				
N	*Poa secunda*	9.9	54.5	85.7				
	Bromus sp.	2.8	45.5	57.1				
N	*Sitanion hystrix*	2.5	23.3	42.9				
N	*Agropyron spicatum*	2.1	8.8	42.9				
I	*Taeniatherum caput-medusae*	1.6	13.3	42.9				
I	*Bromus tectorum*	1.5	26.0	42.9				
	Forbs (22) [b]							
I	*Erodium cicutarium*	2.5	26.2	57.1				
	Unknown forb	1.9	62.1	71.4				
N	*Epilobium paniculatum*	1.5	26.9	42.9				
	Litter	33.8	100.0	100.0				
	Bare Soil	16.8	90.2	100.0				
	Rock	3.6	59.3	100.0				
	Moss	1.7	45.5	100.0				
	Lichen	1.0	29.3	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1.5% cover not listed in table.

Appendix 2 (cont.).

Grassland

Agropyron repens (AGRE)
(quackgrass) 2 stands

The *Agropyron repens* plant assemblage is rare in the *Grassland* cover type. It was encountered in the Brownlee Reservoir (1 site) and the Weiser (1 site) reaches. Sites occurred near the shoreline at 2,077 and 2,090 ft on a 0- and a 9-degree slope. Soil characteristic data were not collected at these sites.

Weiser Island Plot: BA98WSRAS7

Agropyron repens is an aggressive, perennial, weedy grass that reproduces by seed or spreads by shallow rhizomes. These rhizomes are able to penetrate hard soils or even tubers and roots of other plants (Taylor 1992). *Agropyron repens* was introduced from the Mediterranean area and has spread over much of North America, but it is uncommon in the canyon. It was encountered on 31 transects, in 8 cover types, and mostly in the Weiser and Brownlee Reservoir reaches; it was encountered on 1 transect in the Hells Canyon Reservoir Reach. In this assemblage, *Agropyron repens* dominates the herbaceous layer with over 62% cover, and it occurs in nearly all plots along transects (frequency = 95%). *Centaurea repens*, a listed noxious weed in Idaho and Oregon, is the most dominant forb in this assemblage with almost 20% cover. *Cardaria draba*, another listed noxious weed in Idaho and Oregon, is also fairly common in the assemblage.

This assemblage has few forbs (n = 8) and graminoids (n = 6), and most are introduced species. In total, 3 listed noxious weeds occur in this assemblage: *Centaurea repens*, *Cardaria draba*, and *Onopordum acanthium*. Litter covers 76% of the ground surface.

Other Studies

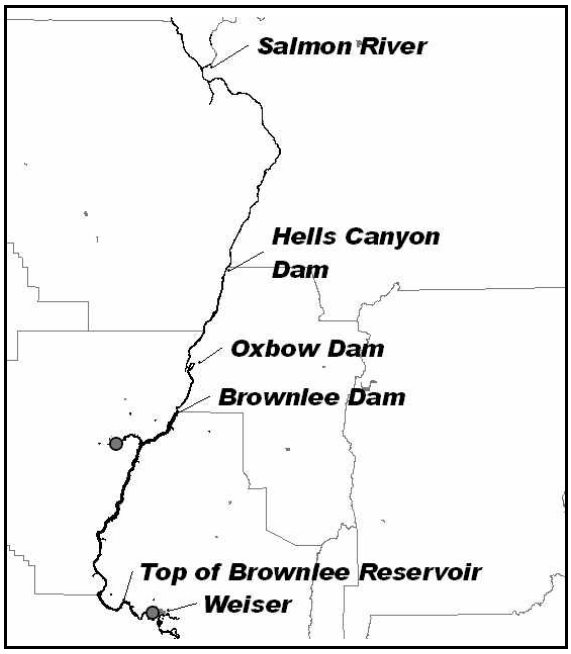
This assemblage has not been previously described.

Appendix 2 (cont.).

AGRE Site Conditions

Elevation (ft): 2,083.5 (range 2,077.0–2,090.0)
Slope (°): 4.5 (range 0.0–9.0)
Aspect: F(1), NW(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



AGRE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (0) [b]							
	Grasses (6) [b]							
I	*Agropyron repens*	62.3	95.0	100.0				
I	*Bromus sterilis*	2.7	30.0	50.0				
I	*Poa pratensis*	1.5	12.5	50.0				
I	*Bromus tectorum*	0.6	25.0	100.0				
	Forbs (8) [b]							
I	*Centaurea repens*	19.9	50.0	50.0				
N	*Galium aparine*	15.3	90.0	100.0				
I	*Cardaria draba*	6.5	50.0	50.0				
I	*Lactuca serriola*	0.6	25.0	100.0				
	Litter	76.0	100.0	100.0				
	Rock	10.6	42.5	100.0				
	Moss	3.6	42.5	100.0				
	Bare Soil	3.3	35.0	100.0				
	Lichen	0.2	5.0	100.0				

[a] N = Native, I = Introduced

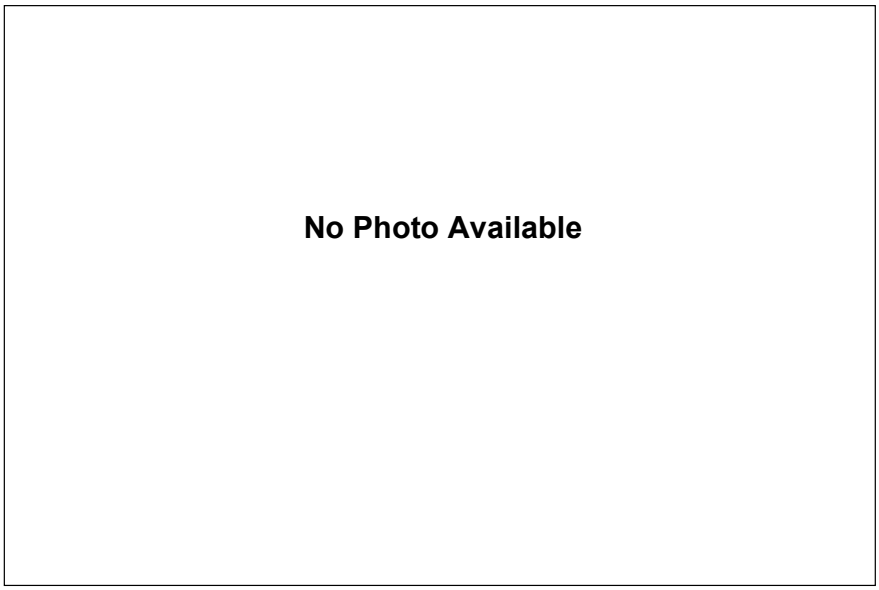
[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 2 (cont.).

Grassland

Festuca pratensis-Agropyron repens (FEPR-AGRE)
(meadow fescue-quackgrass) 1 stand

The *Festuca pratensis-Agropyron repens* plant assemblage is rare in the *Grassland* cover type. It was encountered at 1 site in the Brownlee Reservoir Reach. The site occurred at 2,130 ft on a level slope. No soil characteristic data were collected at this site.



Festuca pratensis is a valuable forage grass introduced from Europe. It is widely established in the Pacific Northwest (Hitchcock and Cronquist 1991) but is rare in the canyon. It was encountered on just 5 transects, in 3 cover types, and in the Brownlee Reservoir (4 transects) and Hells Canyon Reservoir reaches (1 transect). In this assemblage, *Festuca pratensis* dominates the herbaceous layer with almost 60% cover and occurs in nearly all plots along transects (frequency = 90%).

Agropyron repens is codominant in this assemblage. It is an aggressive, perennial, weedy grass that reproduces by seed or spreads by shallow rhizomes. These rhizomes are able to penetrate hard soils or even tubers and roots of other plants (Taylor 1992). *Agropyron repens* was introduced from the Mediterranean area and has spread over much of North America. It is more common in the canyon than *Festuca pratensis*. *Agropyron repens* was encountered on 31 transects, in 8 cover types, and mostly in the Weiser and Brownlee Reservoir reaches. In this assemblage, it provides almost 16% cover and occurs in most plots along transects (frequency = 75%).

This assemblage is species poor in forbs (n = 5) and graminoids (n = 5), and more than one-half the species are introduced. No listed noxious weed species were found. Litter covers 23% of the ground surface.

Other Studies

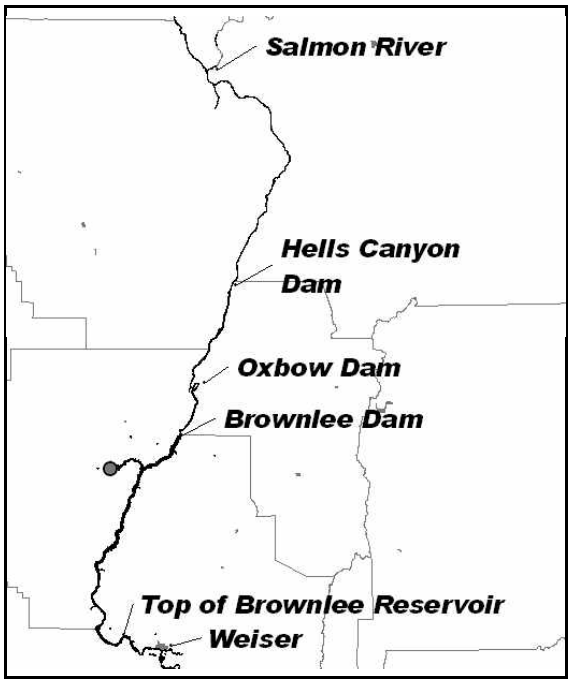
This assemblage has not been previously described.

Appendix 2 (cont.).

FEPR-AGRE Site Conditions

Elevation (ft): 2,130.0
Slope (°): 0.0
Aspect: F(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



FEPR-AGRE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (0) [b]							
	Grasses (5) [b]							
I	*Festuca pratensis*	59.9	90.0	100.0				
I	*Agropyron repens*	15.7	75.0	100.0				
I	*Agrostis alba*	3.9	25.0	100.0				
N	*Juncus balticus*	3.8	75.0	100.0				
N	*Carex* sp.	3.2	30.0	100.0				
	Forbs (5) [b]							
I	*Trifolium pratense*	1.3	25.0	100.0				
I	*Taraxacum officinale*	0.4	15.0	100.0				
N	*Equisetum laevigatum*	0.1	5.0	100.0				
N	*Ranunculus cymbalaria*	0.1	5.0	100.0				
	Unknown forb	0.1	5.0	100.0				
	Litter	23.2	100.0	100.0				
	Bare Soil	0.4	15.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				
	Rock	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 2 (cont.).

Desertic Herbland

Lomatium grayi/*Bromus tectorum* (LOGR/BRTE)
(Gray's lomatium/cheatgrass) 6 stands

The *Lomatium grayi*/*Bromus tectorum* plant assemblage is the most common assemblage in the *Desertic Herbland* cover type. It was primarily encountered in the Brownlee Reservoir Reach (5 sites), with 1 site in the Oxbow Reservoir Reach. Sites occurred between 1,880 and 2,400 ft on 17- to 29-degree slopes on southwesterly aspects. Soil pH was mildly alkaline (pH = 7.5).

Near Cottonwood Creek Plot: BR98COT21U

Lomatium grayi grows throughout most of the sagebrush-steppe, usually preferring coarse, rocky habitats, such as talus slopes. It has bright yellow flowers borne in tight umbels on leafless stems. The leaves of this plant divide into numerous small segments, and the plants give off a very strong, rather unpleasant, parsley-like odor (Taylor 1992). *Lomatium grayi* is a common species in the study area. It was encountered in 54 transects, in 9 cover types, and in all study reaches except the Weiser Reach; with only a rare occurrence below Hells Canyon Dam. In this assemblage, *Lomatium grayi* is the dominant herbaceous species, providing almost 5% cover and occurring in nearly one-half of all plots along transects (frequency = 44%). Two other native forbs, *Eriogonum compositum* and *Draba verna*, are also common in this assemblage.

Bromus tectorum is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). *Bromus tectorum* is the most commonly occurring graminoid in the study area. It was encountered in 447 transects, in all cover types (12), and in all study reaches, with most encounters along the Brownlee Reservoir Reach (205 transects). In this assemblage, it and another unidentified *Bromus* sp., probably also *Bromus tectorum*, were the dominant grasses. *Bromus tectorum* provides 3% cover and is present in over one-half of all plots along transects (frequency = 56%).

This assemblage has a moderate number of forbs (n = 13) and graminoids (n = 7), and most are native. No listed noxious weeds were found. Rock covers almost 41% of the ground surface, and bare soil is exposed on about 31% of the surface.

Other Studies

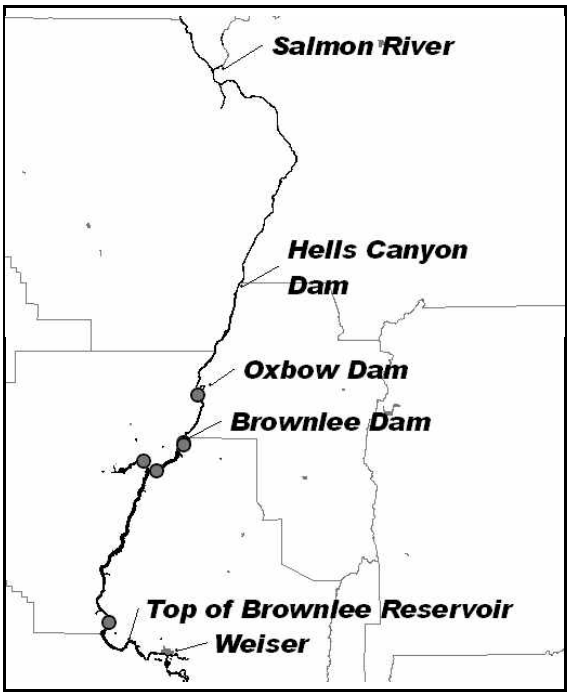
This plant assemblage has not been previously described for the canyon.

Appendix 2 (cont.).

LOGR/BRTE Site Conditions

Elevation (ft): 2,165.0 (range 1,880.0–2,400.0)
Slope (°): 21.5 (range 17.0–29.0)
Aspect: S(1), SW(3), W(2)
[a] Soil Texture: LOSA(1), SALO(2), SILO(1)
[a] Organic Matter %: 1.6 (range 1.5–1.6)
[a] pH: 7.5 (range 7.4–7.8)
[a] ON ppm: 35.0
[a] CEC meq/100g: 16.0 (range 13.0–21.0)

[a] Soil characteristic data available for 4 stands.



LOGR/BRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (5) [b]							
	Grasses (7) [b]							
I	*Bromus tectorum*	3.0	56.1	66.7				
	Bromus sp.	1.3	33.3	33.3				
N	*Poa secunda*	0.8	22.8	66.7				
I	*Bromus japonicus*	0.7	27.8	66.7				
	Forbs (13) [b]							
N	*Lomatium grayi*	4.9	44.4	83.3				
N	*Eriogonum compositum*	2.0	17.8	83.3				
N	*Draba verna*	1.0	41.1	66.7				
I	*Erodium cicutarium*	0.7	16.7	50.0				
I	*Holosteum umbellatum*	0.6	23.9	83.3				
	Rock	40.9	100.0	100.0				
	Bare Soil	31.3	97.2	100.0				
	Litter	6.3	99.5	100.0				
	Lichen	3.8	76.7	100.0				
	Moss	3.1	48.9	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.6% cover not listed in table.

Appendix 2 (cont.).

Desertic Herbland

Mixed herbaceous (MIXED HERB)
(mixed herbaceous) 2 stands

The mixed herbaceous plant assemblage is rare in the *Desertic Herbland* cover type. It was encountered at 1 site along the Brownlee Reservoir Reach and 1 site along the Hells Canyon Reservoir Reach. The sites occurred at 1,690 and 2,320 ft on a 0- and a 40-degree slope. No soil characteristic data were collected from these sites.

Magpie Gulch Plot: BR96MAG21U

No single dominant species is present in this assemblage, and all species occur in trace amounts (< 2% cover) and infrequently. This assemblage occurs on very barren and xeric habitats in the canyon. No listed noxious weed species occur. Rock covers 54% of the ground surface, and bare soil is exposed on almost 36% of the surface.

Other Studies

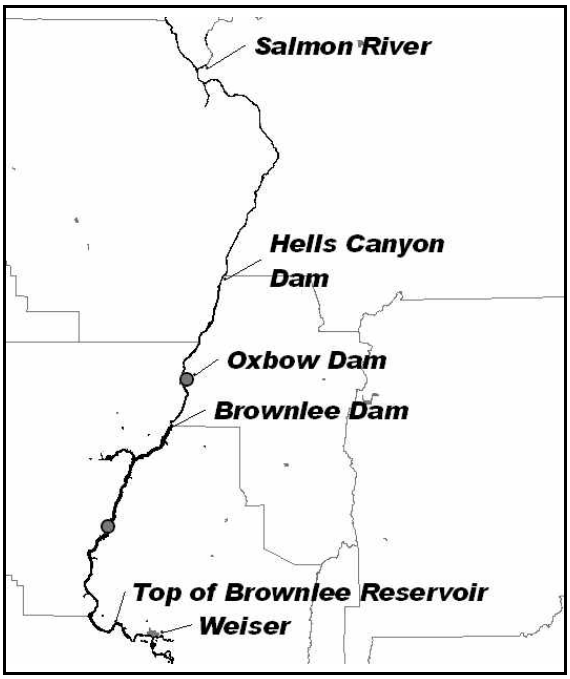
This plant assemblage has not been previously described for the canyon.

Appendix 2 (cont.).

MIXED HERB Site Conditions

Elevation (ft): 2,005.0 (range 1,690–2,320.0)
Slope (°): 20.0 (range 0.0–40.0)
Aspect: E(1), F(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



MIXED HERB Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
N	*Grayia spinosa*	0.2	1.0	50.0			62	0.31
	Grasses (1) [b]							
I	*Bromus tectorum*	0.3	10.0	50.0				
	Forbs (6) [b]							
N	*Erigeron compositum*	1.3	8.4	50.0				
N	*Eriogonum* sp.	1.1	15.0	50.0				
I	*Verbascum thapsus*	1.1	1.7	50.0				
N	*Stanleya viridiflora*	0.6	15.0	50.0				
N	*Cryptantha celosioides*	0.3	1.7	50.0				
I	*Lactuca serriola*	0.2	5.0	50.0				
	Rock	54.0	100.0	100.0				
	Bare Soil	35.8	50.0	100.0				
	Litter	3.0	51.7	100.0				
	Moss	0.7	26.7	100.0				
	Lichen	0.2	5.0	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.1% cover not listed in table.

Appendix 2 (cont.).

Desertic Herbland

Mixed herbaceous/*Agropyron spicatum* (MIXED HERB/AGSP)
(mixed herbaceous/bluebunch wheatgrass) 5 stands

The mixed herbaceous/*Agropyron spicatum* plant assemblage is the second most common assemblage in the *Desertic Herbland* cover type. This assemblage was found in all study reaches except the Weiser and Oxbow Reservoir reaches. Sites occurred between 1,240 and 2,140 ft on 5- to 36-degree slopes on easterly and westerly aspects. Soils were mildly alkaline (pH = 7.5).

Little Timber Canyon Plot: BR97LTC01U

No forb species is clearly dominant in this assemblage. All forbs are native, occur with less than 1% average cover, and are infrequently encountered along transects. The dominant grass is *Agropyron spicatum*, one of the most important forage grasses of the sagebrush-steppe. It is a common and often conspicuous dominant in the more moist regions, particularly in areas of deep soil accumulation (Taylor 1992). *Agropyron spicatum* has a wide geographic and ecological range and occurs throughout western North America east of the Cascades and the Pacific coastal mountains. It is an important constituent of the Pacific Northwest bunchgrass, sagebrush, mountain shrub, pinyon/juniper, and ponderosa pine regions (Tisdale and Hironaka 1981). A common grass species in the study area, *Agropyron spicatum* was observed from the canyon bottoms up to middle elevations (about 6,000 ft). It was encountered in 239 transects, in 11 cover types, and in all study reaches; it is rare in the Weiser Reach (1 transect). In this assemblage, *Agropyron spicatum* dominates the herbaceous layer with almost 5% cover, and it occurs in many plots along transects (frequency = 35%). *Cenchrus longispinus* is also fairly abundant in this assemblage. This grass was introduced from Europe and has become a nuisance throughout most of the United States. It has stiff, sharp spines and grows in cultivated fields and disturbed areas but favors sandy, or well-drained, gravelly soils (Taylor 1992).

This assemblage is species rich in forbs (n = 17) and has a moderate number of graminoids (n = 7). No listed noxious weeds were encountered. Bare rock is present on over 36% of the surface, and bare soil is exposed on over 30% of the surface.

Other Studies

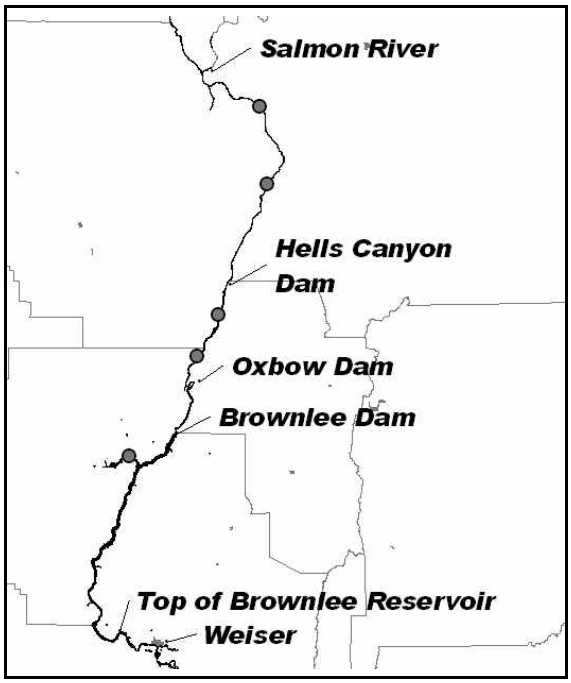
This plant assemblage may be related to previously described assemblages dominated by *Agropyron spicatum* (see Asherin and Claar 1976, Johnson and Simon 1987) but is thought to be representative of barren, xeric sites at the lower elevations of the canyon.

Appendix 2 (cont.).

MIXED HERB/AGSP Site Conditions

Elevation (ft): 1,742.0 (range 1,240–2,140.0)
Slope (°): 27.2 (range 5.0–36.0)
Aspect: E(1), SE(1), SW(2), W(1)
[a] Soil Texture: silty loam(2)
[a] Organic Matter %: 2.8 (range 2.2–3.4)
[a] pH: 7.5 (range 7.3–7.7)
[a] ON ppm: 50.0 (range 45.0–55.0)
[a] CEC meq/100g: 20.5 (range 20.0–21.0)

[a] Soil characteristic data available for 2 stands.



MIXED HERB/AGSP Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (7) [b]							
N	*Purshia tridentata*	0.4	0.8	40.0	76	0.92	21	0.29
	Grasses (7) [b]							
N	*Agropyron spicatum*	4.9	34.7	60.0				
I	*Cenchrus longispinus*	3.0	17.0	20.0				
	Bromus sp.	2.9	20.0	20.0				
I	*Bromus tectorum*	1.2	43.7	80.0				
	Forbs (17) [b]							
	Unknown forb	0.6	25.0	40.0				
N	*Polygonum douglasii*	0.5	16.0	40.0				
N	*Cryptantha intermedia*	0.5	19.0	60.0				
N	*Epilobium paniculatum*	0.4	17.7	60.0				
N	*Tonella floribunda*	0.4	16.0	60.0				
	Rock	36.1	80.0	100.0				
	Bare Soil	30.5	82.3	100.0				
	Litter	8.9	100.0	100.0				
	Moss	6.0	36.0	100.0				
	Lichen	4.7	50.3	100.0				

[a] N = Native, I = Introduced

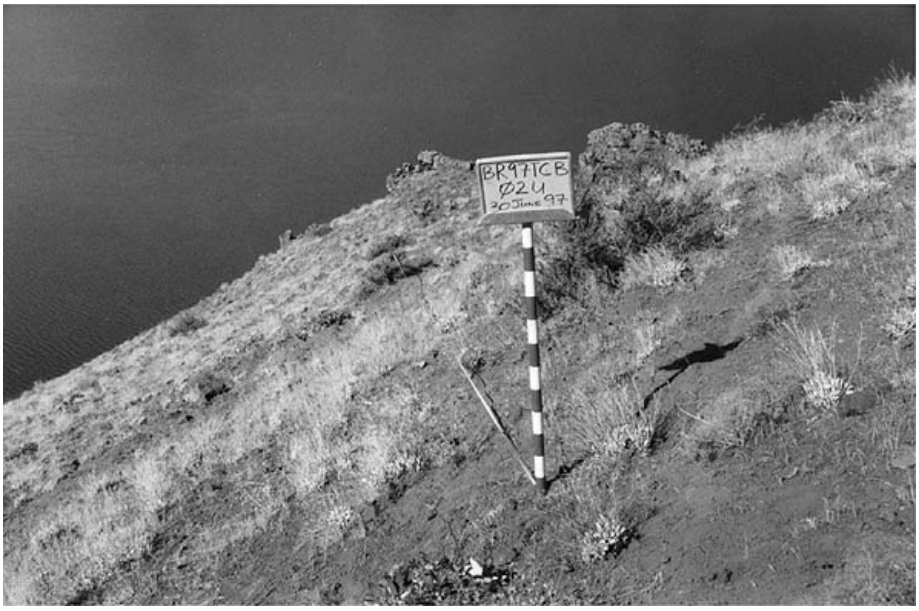
[b] Total number of species in a life form. Species with less than 0.4% cover not listed in table.

Appendix 2 (cont.).

Desertic Herbland

Eriogonum compositum*/*Bromus tectorum (ERCO5/BRTE)
(heart-leaved buckwheat/cheatgrass) 4 stands

The *Eriogonum compositum*/*Bromus tectorum* plant assemblage is relatively common in the *Desertic Herbland* cover type. It was only encountered in the Brownlee Reservoir Reach. Sites occurred between 2,180 and 2,260 ft on 14- to 33-degree slopes on south and westerly aspects. Soils were mildly alkaline (pH = 7.7).



Near Timber Canyon Plot: BR97TCB02U

Eriogonum compositum is a native species and perhaps the most spectacular of the many species of *Eriogonum*. It produces many clusters, or small umbels, of unusually bright yellow flowers in a flat-topped inflorescence. The plants are very distinctive with relatively large leaves that are triangular or heart-shaped, finely woolly, and all basal. *Eriogonum compositum* occupies rocky habitats and flowers in early summer (Taylor 1992). It is an occasional species along the reservoir study reaches. It was encountered in 27 transects, in 6 cover types, and principally along the Brownlee Reservoir Reach. In this assemblage, *Eriogonum compositum* is the dominant forb, providing almost 3% cover and occurring in about one-fourth of all plots along transects (frequency = 21%). Several other native forbs provide trace amounts of cover in this assemblage.

Bromus tectorum is the dominant grass species. It is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). *Bromus tectorum* is the most commonly occurring graminoid in the study area. It was encountered in 447 transects, in all cover types (12), and in all study reaches, with most encounters along the Brownlee Reservoir Reach (205 transects). In this assemblage, *Bromus tectorum* provides over 4% cover and is present in more than one-half of all plots along transects (frequency = 64%).

This assemblage is relatively species rich in forbs (n = 17) but has a limited number of graminoids (n = 4). Most species are native, and no listed noxious weeds occur. Rock covers over 44% of the ground surface, and bare soil is exposed on almost 32% of the surface.

Other Studies

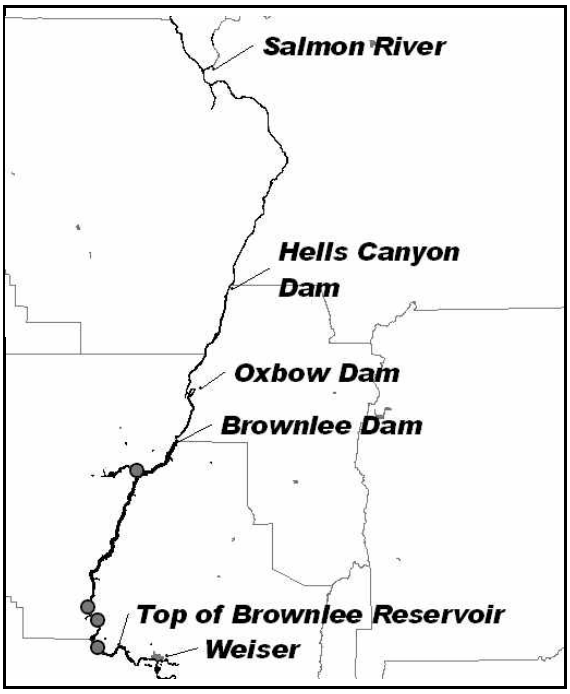
This plant assemblage has not been previously described for the canyon. It may be similar to the *Eriogonum compositum-Poa secunda* habitat type identified, but not described, by Daubenmire (1970).

Appendix 2 (cont.).

ERCO5/BRTE Site Conditions

Elevation (ft): 2,215.0 (range 2,180.0–2,260.0)
Slope (°): 27.3 (range 14.0–33.0)
Aspect: S(1), SW(1), W(2)
[a] Soil Texture: clay loam(1), sandy loam(1), silty loam(2)
[a] Organic Matter %: 3.0 (range 2.4–3.5)
[a] pH: 7.7 (range 7.6–7.8)
[a] ON ppm: 50.0 (range 45.0–55.0)
[a] CEC meq/100g: 23.0 (range 13.0–34.0)

[a] Soil characteristic data available for 4 stands.



ERCO5/BRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (6) [b]							
N	*Purshia tridentata*	2.4	6.0	75.0	113	0.68	258	0.28
N	*Eriogonum microthecum*	0.5	3.0	50.0			800	0.31
	Grasses (4) [b]							
I	*Bromus tectorum*	4.4	64.2	100.0				
N	*Oryzopsis hymenoides*	0.6	3.3	25.0				
	Forbs (15) [b]							
N	*Eriogonum compositum*	2.7	20.9	100.0				
N	*Eriogonum strictum*	0.8	6.7	100.0				
N	*Delphinium nuttallianum*	0.4	4.2	25.0				
N	*Galium aparine*	0.3	7.5	25.0				
N	*Scutellaria angustifolia*	0.3	5.8	25.0				
	Rock	44.5	98.3	100.0				
	Bare Soil	31.8	78.4	100.0				
	Litter	8.7	80.8	100.0				
	Lichen	1.2	34.2	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.3% cover not listed in table.

Appendix 2 (cont.).

Desertic Herbland

Eriogonum strictum*/*Bromus tectorum (ERST2/BRTE)
(blue mountain eriogonum/cheatgrass) 3 stands

The *Eriogonum strictum*/*Bromus tectorum* plant assemblage is uncommon in the *Desertic Herbland* cover type. It was encountered in only the Brownlee Reservoir Reach. Sites occurred between 2,140 and 2,515 ft on 29-degree slopes of southerly aspects. Soils were mildly alkaline (pH = 7.4).

Near Burnt River Plot: BR97BRX05U

A native species, *Eriogonum strictum* occurs in the western half of the sagebrush-steppe, from sagebrush shrublands to *Pinus* ponderosa forests, but mostly in sandy plains (Taylor 1992). It is extensively branched, with each branch bearing a small cluster of whitish to pale yellow or pink flowers. *Eriogonum strictum* is a common species in the canyon, especially along the Brownlee Reservoir Reach. It was encountered in 61 transects, 9 cover types, and all study reaches, with 46 transects along the Brownlee Reservoir Reach. In this assemblage, *Eriogonum strictum* is the dominant forb, providing 1.5% cover and occurring in over one-fourth of all plots along transects (frequency = 29%). Several other native forbs provide trace amounts of cover in this assemblage.

Bromus tectorum is the dominant grass species. It is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). The most commonly occurring graminoid in the study area, *Bromus tectorum* was encountered in 447 transects, in all cover types (12), and in all study reaches, with most encounters along the Brownlee Reservoir Reach (205 transects). In this assemblage, *Bromus tectorum* provides almost 4% cover and is present in most plots along transects (frequency = 84%).

This assemblage is relatively species rich in forbs (n = 15) but has a limited number of graminoids (n = 3). Most species are native, and no listed noxious weeds occur. Rock covers over 27% of the ground surface, and bare soil is exposed on almost 40% of the surface.

Other Studies

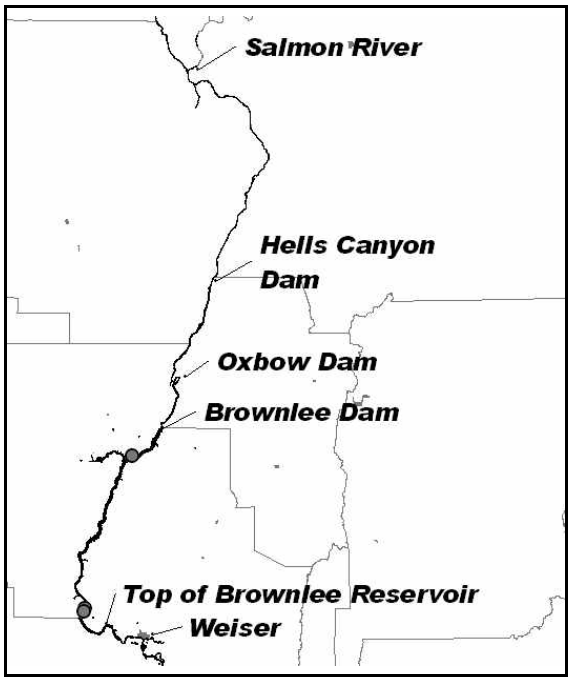
This plant assemblage has not been previously described for the canyon.

Appendix 2 (cont.).

ERST2/BRTE Site Conditions

Elevation (ft): 2,291.7 (range 2,140–2,515.0)
Slope (°): 29.0
Aspect: S(2), SE(1)
[a] Soil Texture: loamy sand(1), sandy loam(1)
[a] Organic Matter %: 1.2 (range 1.0–1.4)
[a] pH: 7.4 (range 7.2–7.6)
[a] ON ppm: 32.5 (range 30.0–35.0)
[a] CEC meq/100g: 15.4 (range 14.7–16.0)

[a] Soil characteristic data available for 2 stands.



ERST2/BRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (7) [b]							
N	*Purshia tridentata*	0.8	2.7	66.7	44	0.66	189	0.36
	Grasses (3) [b]							
I	*Bromus tectorum*	3.8	84.4	100.0				
N	*Stipa comata*	3.8	18.9	33.3				
	Forbs (15) [b]							
N	*Lomatium grayi*	1.9	6.7	33.3				
N	*Eriogonum strictum*	1.5	28.9	100.0				
I	*Erodium cicutarium*	0.9	30.0	66.7				
N	*Phacelia heterophylla*	0.8	24.4	66.7				
N	*Eriogonum compositum*	0.7	6.7	66.7				
N	*Chaenactis douglasii*	0.6	12.2	66.7				
	Bare Soil	40.0	98.9	100.0				
	Rock	27.1	98.9	100.0				
	Litter	7.9	88.9	100.0				
	Lichen	1.5	21.1	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 2 (cont.).

Desertic Herbland

Alyssum desertorum/*Bromus tectorum* (ALDE/BRTE)
(desert alyssum/cheatgrass) 3 stands

The *Alyssum desertorum*/*Bromus tectorum* plant assemblage is uncommon in the *Desertic Herbland* cover type; it was encountered in only the Brownlee Reservoir Reach. Sites occurred between 2,080 and 2,320 ft on 4- to 38-degree slopes. Soils were moderately alkaline (pH = 8.0). This assemblage occurs in some of the harshest, most xeric upland habitats in the canyon.

Farewell Bend Plot: BR97FWB02U

Alyssum desertorum is an Old World weed, occasionally occurring in the Pacific Northwest (Hitchcock and Cronquist 1991). It occurs in dry and barren habitats and is a common species in the canyon, especially along the Brownlee Reservoir Reach. *Alyssum desertorum* was encountered in 70 transects, in 8 cover types, and all study reaches, including 49 transects along the Brownlee Reservoir Reach. In this assemblage, *Alyssum desertorum* is the dominant forb, providing 1.7% cover and occurring in one-half of all plots along transects (frequency = 50%). Several other native forbs provide trace amounts of cover in this assemblage.

Bromus tectorum is the dominant grass species. It is an introduced annual grass that has become distributed throughout the sagebrush-steppe. It competes successfully with native species, especially in overgrazed or otherwise disturbed areas (Taylor 1992). The most commonly occurring graminoid in the study area, *Bromus tectorum* was encountered in 447 transects, in all cover types (12), and in all study reaches, with most encounters along the Brownlee Reservoir Reach (205 transects). In this assemblage, *Bromus tectorum* provides 1.4% cover and is present in over one-half of all plots along transects (frequency = 51%).

This assemblage is species poor in forbs (n = 5) and graminoids (n = 2). Most are native species, and no listed noxious weeds occur. Rock covers over 37% of the ground surface, and bare soil is exposed on over 44% of the surface.

Other Studies

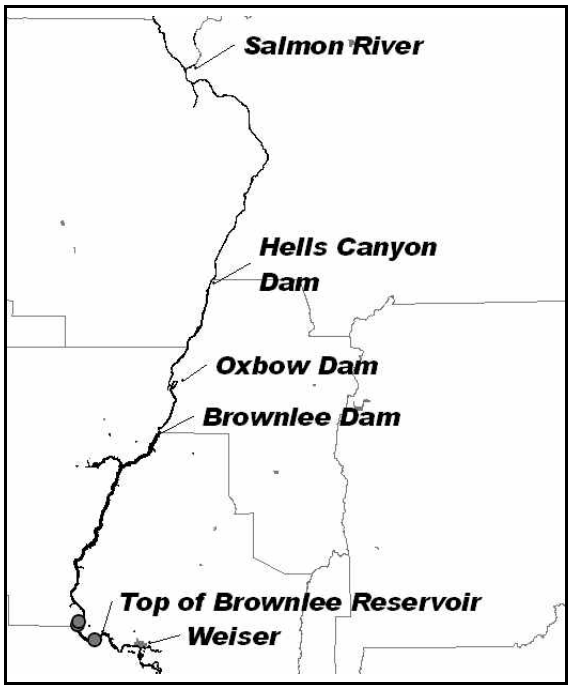
This plant assemblage has not been previously described for the canyon.

Appendix 2 (cont.).

ALDE/BRTE Site Conditions

Elevation (ft): 2,200 (range 2,080–2,320.0)
Slope (°): 22.0 (range 4.0–38.0)
Aspect: E(1), S(2)
[a] Soil Texture: CLLO(1), SALO(1), SAND(1)
[a] Organic Matter %: 1.7 (range 0.2–2.5)
[a] pH: 8.0 (range 7.9–8.0)
[a] ON ppm: 35.0 (range 15.0–45.0)
[a] CEC meq/100g: 19.1 (range 4.3–33.0)

[a] Soil characteristic data available for 3 stands.



ALDE/BRTE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (5) [b]							
	Grasses (2) [b]							
I	*Bromus tectorum*	1.4	51.1	66.7				
	Unknown graminoid	0.3	10.0	33.3				
	Forbs (5) [b]							
I	*Alyssum desertorum*	1.7	50.0	66.7				
N	*Astragalus cusickii*	1.3	12.2	66.7				
N	*Eriogonum compositum*	0.9	13.3	66.7				
N	*Eriogonum strictum*	0.4	5.5	66.7				
N	*Microsteris gracilis*	0.2	7.8	33.3				
	Bare Soil	44.4	95.6	100.0				
	Rock	37.3	67.8	100.0				
	Litter	5.3	82.2	100.0				
	Lichen	0.7	27.8	100.0				
	Moss	0.1	5.5	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.1% cover not listed in table.

Appendix 3. Riparian plant assemblages.

References cited in the Appendices can be found in the Literature Cited section of the main report.

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Populus deltoides (PODE)
(Great Plains cottonwood) 3 stands 278

Tamarix parviflora (TAPA)
(tamarisk or salt cedar) 2 stands 280

Robinia pseudoacacia*/*Amorpha fruticosa (ROPS/AMFR)
(black locust/false indigo) 1 stand 282

Scrub-Shrub Wetland 284

Celtis reticulata (CERE)
(netleaf hackberry) 6 stands 284

Celtis reticulata-Toxicodendron radicans (CERE-TORA)
(netleaf hackberry-poison ivy) 40 stands 286

Amorpha fruticosa (AMFR)
(false indigo) 35 stands 288

Amorpha fruticosa-Salix exigua (AMFR-SAEX)
(false indigo-coyote willow) 10 stands 290

Amorpha fruticosa*/*Apocynum cannabinum (AMFR/APCA)
(false indigo/hemp dogbane) 4 stands 292

Salix exigua (SAEX)
(coyote willow) 22 stands 294

Salix exigua-Rosa woodsii (SAEX-ROWO)
(coyote willow-Wood's rose) 5 stands 296

Salix exigua-Apocynum cannabinum (SAEX-APCA)
(coyote willow-hemp dogbane) 9 stands 299

Prunus virginiana (PRVI)
(common chokecherry) 21 stands 301

Toxicodendron radicans (TORA)
(poison ivy) 21 stands 303

Salix amygdaloides*/*Salix exigua (SAAM/SAEX)
(peachleaf willow/coyote willow) 17 stands 305

Salix amygdaloides/Salix exigua/Xanthium strumarium (SAAM/SAEX/XAST)
(peachleaf willow/coyote willow/common cocklebur) 20 stands 307

Salix amygdaloides*/*Rosa woodsii (SAAM/ROWO)
(peachleaf willow/Wood's rose) 4 stands 310

Philadelphus lewisii (PHLE)
(syringa) 17 stands 312

Rubus discolor (RUDI)
(Himalayan blackberry) 14 stands 314

Tamarix parviflora (TAPA)
(tamarisk or salt cedar) 10 stands 316

Tamarix parviflora*/*Solidago occidentalis (TAPA/SOOC)
(tamarisk or salt cedar/western goldenrod) 12 stands 318

Tamarix parviflora*/*Xanthium strumarium (TAPA/XAST)
(tamarisk or salt cedar/common cocklebur) 3 stands 320

Tamarix parviflora/Heleochloa alopecuroides (TAPA/HEAL)
(tamarisk or salt cedar/marsh grass) 3 stands 322

Rosa woodsii (ROWO)
(Wood's rose) 2 stands 324

Rosa woodsii-Ribes aureum (ROWO-RIAU)
(Wood's rose-golden currant) 11 stands 326

Elaeagnus angustifolia (ELAN)
(Russian olive) 3 stands 328

Clematis ligusticifolia (CLLI)
(virgin's bower) 3 stands 330

Rosa canina (ROCA)
(dog rose) 2 stands 332

Ulmus pumila (ULPU)
(Siberian elm) 2 stands 334

Populus trichocarpa (POTR2)
(black cottonwood) 1 stand 336

Emergent Herbaceous Wetland 338

Lepidium latifolium (LELA)
(broad-leaved pepperweed) 50 stands 338

Lepidium latifolium-Conium maculatum (LELA-COMA4)
(broad-leaved pepperweed-poison hemlock) 17 stands 340

Heleochloa alopecuroides (HEAL)
(marsh grass) 37 stands 342

Lythrum salicaria-mixed herbaceous (LYSA-MIXED HERB)
(purple loosestrife-mixed herbaceous) 35 stands 344

Xanthium strumarium (XAST)
(common cocklebur) 38 stands 346

Apocynum cannabinum (APCA)
(hemp dogbane) 24 stands 348

Distichlis stricta (DIST)
(alkali saltgrass) 19 stands 350

Portulaca oleracea (POOL)
(purslane) 11 stands 352

Phalaris arundinacea (PHAR)
(reed canarygrass) 10 stands 354

Glycyrrhiza lepidota (GLLE)
(American licorice) 9 stands 356

Polygonum coccineum (POCO3)
(water smartweed) 8 stands 358

Equisetum laevigatum (EQLA)
(smooth scouring rush) 7 stands 360

Typha latifolia (TYLA)
(common cattail) 6 stands 362

Scirpus maritimus (SCMA)
(seacoast bulrush) 6 stands 364

Dipsacus sylvestris (DISY)
(teasel) 6 stands 366

Iris pseudacorus (IRPS)
(yellow flag) 4 stands 368

Mixed herbaceous (MIXED HERB)
(mixed herbaceous) 3 stands 370

Spartina pectinata (SPPE)
(prairie cordgrass) 3 stands 372

Polygonum amphibium (POAM)
(water smartweed) 1 stand..... 374

Shore & Bottomland Wetland..... 376

Portulaca oleracea (POOL)
(purslane) 18 stands..... 376

Celtis reticulata (CERE)
(netleaf hackberry) 13 stands 378

Aster eatonii (ASEA)
(Eaton's aster) 7 stands 380

Xanthium strumarium (XAST)
(common cocklebur) 6 stands 382

Salix exigua (SAEX)
(coyote willow) 4 stands 384

Cyperus aristatus (CYAR)
(awned flatsedge) 3 stands 386

Mixed herbaceous (MIXED HERB)
(mixed herbaceous) 2 stands 388

Apocynum cannabinum (APCA)
(hemp dogbane) 1 stand 390

Asclepias speciosa (ASSP)
(showy milkweed) 1 stand..... 392

Appendix 3 (cont.).

Forested Wetland

Betula occidentalis-Alnus rhombifolia/Philadelphus lewisii (BEOC-ALRH/PHLE)
(water birch-white alder/syringa) 47 stands

The *Betula occidentalis-Alnus rhombifolia/Philadelphus lewisii* plant assemblage is the most common assemblage in the *Forested Wetland* cover type. It was encountered in all reaches except the Weiser Reach, with most sites found along Hells Canyon Reservoir (14 sites) and the reach below Hells Canyon Dam (25 sites). Nearly all sites (45 of 47) were found in tributary drainages to the Snake River (Table 9), suggesting this assemblage is more characteristic of tributaries in the study area than in the Snake River riparian zone. Sites occurred between 1,200 and 2,760 ft on 2- to 40-degree slopes on a variety of aspects. Soil pH was mildly alkaline (pH = 7.4).

Three Creeks Plot: HB96THR09R

Betula occidentalis is a small- to medium-sized tree, usually having several stems from the same base. It prospers along perennial streams; and along the main streams leading into the lower Salmon and middle Snake rivers, *Betula occidentalis* stems can reach a diameter of over 20 inches (Johnson 1995). A fairly common native tree species in the canyon, *Betula occidentalis* was encountered on 66 transects, in 3 cover types, and in all reaches except the Weiser Reach. In this assemblage, it codominates the tree layer, providing over 25% cover and occurring in over one-fourth of all plots along transects (frequency = 27%). Average height of *Betula occidentalis* is almost 11 m.

Alnus rhombifolia is codominant in this assemblage. A native species, *Alnus rhombifolia* is best adapted to pioneer sites created by mud-rock debris flow in stream bottoms (Miller 1976). It needs heat and lots of water. The main distribution range for *Alnus rhombifolia* is California. Farther north, it grows in deep valleys of western Idaho and in the lower Salmon and Clearwater and middle Snake river canyons, where it has become isolated in warm canyons (Johnson 1995). *Alnus rhombifolia* is a common riparian tree in the canyon. It was encountered on 92 transects, in 2 cover types, and in all reaches except the Weiser Reach. In this assemblage, *Alnus rhombifolia* provides over 24% cover and is present in about one-fourth of plots along transects (frequency = 26%). Its average height is nearly 16 m.

Philadelphus lewisii is a native species that ranges from British Columbia north through Oregon and Washington and east to Montana. It is widely distributed in northern Idaho and is the state flower (Taylor 1992). This attractive shrub bears numerous, rather large, fragrant white flowers. It is a very common shrub in the canyon and is a codominant species in several plant assemblages. It was encountered on 173 transects, in 9 cover types, and in all reaches except the Weiser Reach. In this plant assemblage, *Philadelphus lewisii* clearly dominates the understory, providing 28% cover and occurring in more than

Appendix 3 (cont.).

one-third of all plots along transects (frequency = 39%). Average height of *Philadelphus lewisii* plants in the mature height-class is about 1.7 m and in the seedling height-class is about 0.3 m.

This assemblage is species rich in trees (n = 22), shrubs (n = 41), forbs (n = 21), and graminoids (n = 8). Most species are native. The rare endemic *Rubus bartonianus* was found in 1 site in this assemblage. Two species of noxious weeds occur in trace amounts (< 1% cover): *Dipsacus sylvestris* and *Cynoglossum officinale*. Litter covers about 57% of the ground surface and rock is exposed on about 25% of the surface.

Other Studies

This assemblage has not been previously described in the canyon. It is somewhat related to the *Alnus rhombifolia/Betula occidentalis* community type described by Miller (1976) and occurring along the Snake River in the study area. Crowe and Clausnitzer (1997) also describe two plant community types dominated by *Betula occidentalis*: *Betula occidentalis*/mesic forb and *Betula occidentalis*/*Carex* spp. However, these are dissimilar to this assemblage in Hells Canyon.

Appendix 3 (cont.).

BEOC-ALRH/PHLE Site Conditions

Elevation (ft): 1,763.2 (range 1,200.0–2,760.0)

Slope (°): 11.6 (range 2.0–40.0)

Aspect: E(10), N(5), NE(1), NW(7), S(5), SE(7), W(12)

[a] Soil Texture: clay loam(2), loamy sand(5), sandy loam(19), silty loam(11)

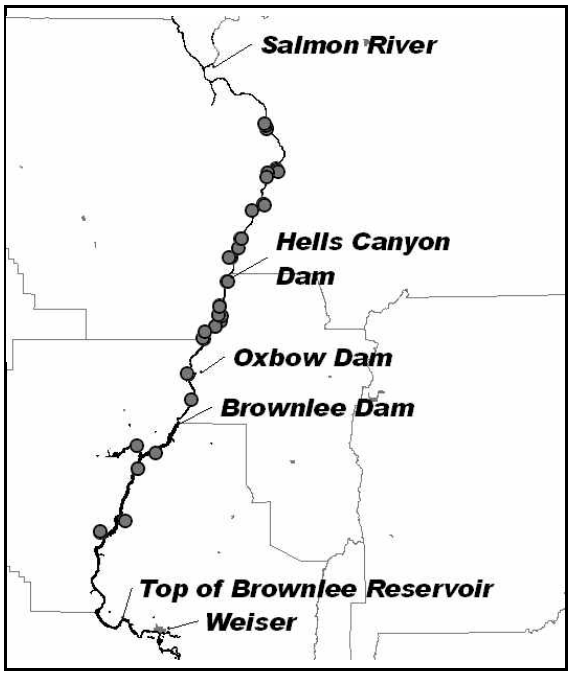
[A] Organic Matter %: 10.0 (range 2.1–33.0)

[A] pH: 7.4 (range 6.5–8.1)

[A] ON ppm: 62.5 (range 18.0–65.0)

[A] CEC meq/100g: 18.0 (range 8.8–28.0)

[A] Soil characteristic data available for 37 stands.



BEOC-ALRH/PHLE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (22) [b]							
N	*Betula occidentalis*	25.3	26.9	57.4	1,557	10.87		
N	*Alnus rhombifolia*	24.3	26.0	59.6	172	15.90		
N	*Celtis reticulata*	13.6	15.6	53.2	94	7.83		
I	*Juglans regia*	5.3	5.4	10.6	23	17.50		
N	*Crataegus douglasii*	4.3	5.1	14.9	161	7.36		
N	*Sambucus cerulea*	3.7	4.3	34.0	112	7.18		
N	*Prunus virginiana*	3.1	3.5	19.1	79	7.40		
N	*Acer glabrum*	2.6	3.0	14.9	157	8.96		
	Shrubs (41) [b]							
N	*Philadelphus lewisii*	28.0	39.0	95.7	13,537	1.74	5,680	0.31
N	*Celtis reticulata*	12.2	17.7	74.5	1,043	2.15	4,741	0.11
N	*Toxicodendron radicans*	11.5	20.6	68.1	4,567	0.67	18,851	0.26
N	*Prunus virginiana*	6.4	10.4	51.1	3,791	1.40	3,451	1.40
N	*Sambucus cerulea*	5.9	8.7	40.4	467	4.43		
N	*Cornus stolonifera*	3.4	5.1	19.1	108	2.64	7	0.46
N	*Holodiscus discolor*	2.5	3.1	12.8	1,291	1.73	369	0.28
	Grasses (8) [b]							
I	*Bromus sterilis*	2.9	21.3	74.5				
	Forbs (21) [b]							
I	*Anthriscus scandicina*	5.0	36.0	83.0				
N	*Galium aparine*	2.9	34.6	91.5				
	Litter	56.6	93.4	100.0				
	Rock	25.1	65.8	100.0				
	Moss	6.8	47.7	100.0				
	Bare Soil	6.6	45.1	100.0				
	Lichen	1.4	26.1	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2.5% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Alnus rhombifolia/Philadelphus lewisii (ALRH/PHLE)
(white alder/syringa) 24 stands

The *Alnus rhombifolia/Philadelphus lewisii* plant assemblage is one of the most common assemblages in the *Forested Wetland* cover type. It was encountered downstream of Brownlee Dam and most commonly in the Hells Canyon Reservoir Reach (15 stands). Nearly all sites (22 of 24) were found in tributary drainages to the Snake River (Table 9), suggesting this assemblage is more characteristic of tributaries in the study area than in the Snake River riparian zone. Sites occurred between 1,240 and 2,220 ft on 2- to 24-degree slopes on a variety of aspects. Soil pH was neutral (pH = 7.0).

Granite Creek Plot: HB96GRN07R

Alnus rhombifolia is a native species, best adapted to pioneer sites created by mud-rock debris flow in stream bottoms (Miller 1976). *Alnus rhombifolia* needs heat and lots of water. Its main distribution range is California. Farther north, *Alnus rhombifolia* grows in deep valleys of western Idaho and in the lower Salmon and Clearwater and middle Snake river canyons, where it has become isolated in warm canyons (Johnson 1995). *Alnus rhombifolia* is a common riparian tree in the canyon. It was encountered on 92 transects, in 2 cover types, and in all reaches except the Weiser Reach. In this assemblage, *Alnus rhombifolia* provides over 75% cover and is present in most plots along transects (frequency = 78%). Its average height is nearly 15 m.

Philadelphus lewisii ranges from British Columbia north through Oregon and Washington and east to Montana. It is widely distributed in northern Idaho and is the state flower (Taylor 1992). This attractive shrub bears numerous, rather large, very fragrant white flowers. *Philadelphus lewisii* is a very common shrub in the canyon and is a codominant species in several plant assemblages. It was encountered on 173 transects, in 9 cover types, and in all reaches except the Weiser Reach. In this assemblage, *Philadelphus lewisii* clearly dominates the understory, providing almost 25% cover and occurring in more than one-third of all plots along transects (frequency = 35%). Average height of *Philadelphus lewisii* plants in the mature height-class is about 2 m and in the seedling height-class is about 0.3 m.

This assemblage is species rich in trees (n = 20), shrubs (n = 32), and forbs (n = 17). Only 4 species of graminoids occur. Most species are native. The rare endemic *Rubus bartonianus* was found in 1 site in this assemblage. Five species of noxious weeds were found in trace amounts: *Lepidium latifolium*, *Cynoglossum officinale*, *Conium maculatum*, *Dipsacus sylvestris*, and *Convolvulus arvensis*. Litter covers about 57% of the ground surface, and rock is exposed on about 27% of the surface.

Appendix 3 (cont.).

Other Studies

This assemblage is somewhat similar to the *Alnus rhombifolia/Philadelphus lewisii* community type described by Miller (1976) and occurring along the Snake River in the study area. Asherin and Claar (1976) also describe two related assemblages occurring in the study area: the *Alnus rhombifolia-Philadelphus lewisii-Poa trivialis* and the *Alnus rhombifolia-Philadelphus lewisii-Arenaria serpyllifolia* plant communities.

Appendix 3 (cont.).

ALRH/PHLE Site Conditions

Elevation (ft): 1,803.8 (range 1,240.0–2,220.0)

Slope (°): 8.3 (range 2.0–24.0)

Aspect: E(6), N(4), NE(2), NW(4), SE(2), W(6)

[a] Soil Texture: clay loam(1), loamy sand(7), sandy loam(9)

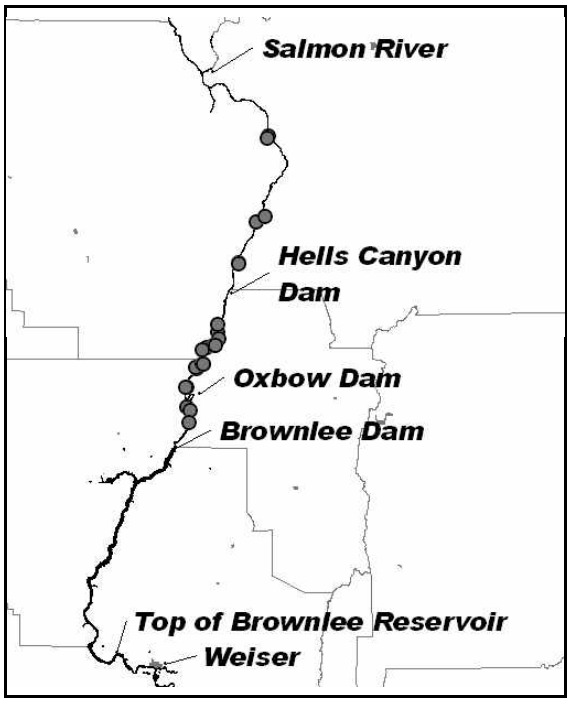
[a] Organic Matter %: 6.4 (range 2.0–20.2)

[a] pH: 7.0 (range 6.0–7.7)

[a] ON ppm: 60.8 (range 18.0–70.0)

[a] CEC meq/100g: 15.9 (range 12.0–29.0)

[a] Soil characteristic data available for 17 stands.



ALRH/PHLE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (20) [b]							
N	*Alnus rhombifolia*	75.5	78.1	95.8	1,153	14.85		
I	*Juglans regia*	7.7	8.9	20.8	14	14.19		
I	*Morus alba*	4.6	5.6	16.7	35	11.98		
I	*Acer negundo*	3.5	3.9	8.3	225	8.22		
N	*Celtis reticulata*	2.3	2.8	16.7	22	7.30		
	Shrubs (32) [b]							
N	*Philadelphus lewisii*	24.6	35.3	91.7	9,564	1.95	1,668	0.31
N	*Cornus stolonifera*	7.1	9.0	33.3	1,945	1.98	167	0.23
N	*Celtis reticulata*	6.0	8.9	37.5	1,128	1.87	544	0.13
I	*Rubus discolor*	5.6	8.9	29.2	3,435	0.95	1,679	0.31
N	*Acer glabrum*	4.4	6.9	37.5	869	2.16	833	0.18
N	*Crataegus douglasii*	3.2	4.4	41.7	340	4.09	125	0.17
N	*Prunus virginiana*	2.8	6.1	41.7	2,620	1.38	1,222	0.30
N	*Rubus parviflorus*	2.2	3.3	16.7	897	0.95	238	0.32
N	*Crataegus columbiana*	2.1	2.5	8.3			83	0.42
	Grasses (4) [b]							
	Forbs (17) [b]							
I	*Anthriscus scandicina*	2.3	21.4	62.5				
N	*Urtica dioica*	2.2	6.0	29.2				
	Litter	56.6	91.7	100.0				
	Rock	26.7	67.4	100.0				
	Bare Soil	7.1	41.9	100.0				
	Moss	3.3	38.9	100.0				
	Lichen	0.7	19.4	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Alnus rhombifolia/Toxicodendron radicans (ALRH/TORA)
(white alder/poison ivy) 7 stands

The *Alnus rhombifolia/Toxicodendron radicans* plant assemblage is uncommon in the *Forested Wetland* cover type. It was encountered in 7 transects in the reservoir reaches of the study area. More than one-half of the sites (4 of 7) were found in tributary drainages to the Snake River (Table 9). Sites occurred between 1,683 and 2,390 ft on 5- to 26-degree slopes on a variety of aspects. Soil pH was neutral (pH = 7.3).

Dennett Creek Plot: BR95DEN02R

Alnus rhombifolia is a native species, best adapted to pioneer sites created by mud-rock debris flow in stream bottoms (Miller 1976). This species needs heat and lots of water. Its main range is in California. Farther north, *Alnus rhombifolia* grows in deep valleys of western Idaho and in the lower Salmon and Clearwater and middle Snake river canyons, where it has become isolated in warm canyons (Johnson 1995). *Alnus rhombifolia* is a common riparian tree species in the canyon. It was encountered on 92 transects, in 2 cover types, and in all reaches except the Weiser Reach. In this assemblage, *Alnus rhombifolia* clearly dominates the overstory, providing 83% cover and occurring in most plots along transects (frequency = 89%). Its average height is 12.3 m.

Toxicodendron radicans is a perennial, varying from a sub-shrub, often less than 1 m tall, to a distinct shrub, up to 3 m tall. It occupies many habitats, including floodplains, river terraces, right-of-ways, and other disturbed sites (Whitson et al. 1992). A common nuisance plant in the canyon, *Toxicodendron radicans* was encountered on 196 transects, in 10 cover types, and in all study reaches. It becomes increasingly more abundant downstream of Brownlee Dam, with most sites occurring in the reach below Hells Canyon Dam (75 sites). In this plant assemblage, *Toxicodendron radicans* clearly dominates the understory, providing almost 20% cover and occurring in almost one-third of all plots along transects (frequency = 29%). Average height of *Toxicodendron radicans* plants in the mature height-class is about 0.7 m and in the seedling height-class is about 0.3 m.

This assemblage is relatively species rich in trees (n = 6), shrubs (n = 8), forbs (n = 23), and graminoids (n = 7). Most species are native. Four species of noxious weeds were found in low amounts: *Cynoglossum officinale*, *Rumex crispus*, *Conium maculatum*, and *Dipsacus sylvestris*. Litter covers about 46% of the ground surface, and rock is exposed on about 21% of the surface.

OTHER STUDIES

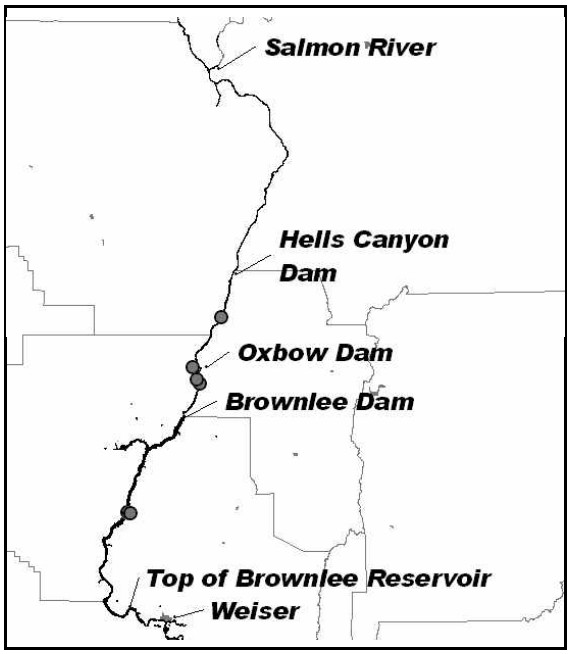
This assemblage has not been previously described in the canyon.

Appendix 3 (cont.).

ALRH/TORA Site Conditions

Elevation (ft): 1,998.1 (range 1,683.0–2,390.0)
Slope (°): 11.0 (range 5.0–26.0)
Aspect: E(1), N(1), SE(1), SW(1), W(3)
[a] Soil Texture: sandy loam(4)
[a] Organic Matter %: 5.3 (range 3.2–7.6)
[a] pH: 7.3 (range 6.7–7.6)
[a] ON ppm: 61.3 (range 55.0–65.0)
[a] CEC meq/100g: 16.0 (range 15.0–17.0)

[a] Soil characteristic data available for 4 stands.



ALRH/TORA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (6) [b]							
N	*Alnus rhombifolia*	83.0	88.6	100.0	2,202	12.27		
I	*Ulmus pumila*	8.2	8.6	14.3	24	7.30		
N	*Populus trichocarpa*	6.4	8.6	14.3	14	15.25		
I	*Morus alba*	4.1	4.8	14.3				
N	*Sambucus cerulea*	2.3	2.9	14.3				
	Shrubs (8) [b]							
N	*Toxicodendron radicans*	19.9	28.6	71.4	3,772	0.74	18,266	0.25
N	*Spiraea betulifolia*	7.2	8.6	14.3			2,000	0.12
N	*Philadelphus lewisii*	4.8	5.7	57.1	233	2.04	479	0.27
N	*Amelanchier alnifolia*	3.9	4.3	14.3				
N	*Clematis ligusticifolia*	2.1	4.3	28.6	214	2.30	47	0.13
	Grasses (7) [b]							
	Forbs (23) [b]							
I	*Stellaria media*	2.3	17.6	42.9				
	Litter	46.2	97.6	100.0				
	Rock	21.3	70.5	100.0				
	Bare Soil	16.0	74.3	100.0				
	Lichen	0.5	8.1	100.0				
	Moss	0.2	6.7	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Populus trichocarpa (POTR2)
(black cottonwood) 10 stands

The *Populus trichocarpa* plant assemblage occurs occasionally in the *Forested Wetland* cover type. It was encountered at 9 sites in the Brownlee Reservoir Reach and 1 site in the Oxbow Reservoir Reach. Nearly all sites (9 of 10) were found in tributary drainages to the Snake River (Table 9), suggesting this assemblage is more characteristic of tributaries in the study area than in the Snake River riparian zone. Sites occurred between 1,800 and 2,760 ft on 3- to 32-degree slopes on all but easterly aspects. Soil pH was mildly alkaline (pH = 7.5).

Board Creek Plot: BR95BOR02R

Populus trichocarpa is Hells Canyon's largest native broadleaf tree. It is one of the most widespread trees in Idaho and Oregon; few rivers lack stretches dominated by this tree. In Hells Canyon, *Populus trichocarpa* is an occasional tree species found along tributary drainages. It was encountered on 57 transects, in 3 cover types, and in all reaches, but was most common in tributaries along the lower portions of the Brownlee Reservoir Reach (34 transects) and along Oxbow Reservoir (12 transects). This species is adapted to, and dependent upon, dynamic flow patterns and repeated flooding and scouring of unconfined floodplains. *Populus trichocarpa* requires moist and barren fine substrates for recruitment sites and a gradual recession of flows that does not exceed about 5 cm per day (Mahoney and Rood 1998). In the canyon, such sites are limited to the larger tributaries to the Snake River. In this assemblage, *Populus trichocarpa* clearly dominates the overstory, providing over 69% cover and occurring in most plots along transects (frequency = 74%). It has an average height of 15.1 m. Some major woody constituents of this assemblage include *Crataegus douglasii*, *Philadelphus lewisii*, and *Cornus stolonifera*.

This assemblage is relatively species rich in trees (n = 9), shrubs (n = 19), forbs (n = 20), and graminoids (n = 6), while total cover of herbaceous species is relatively low. Most species are native. Five species of noxious weeds were found in trace amounts: *Conium maculatum*, *Onopordum acanthium*, *Dipsacus sylvestris*, *Rumex crispus*, and *Cirsium arvense*. Litter covers over 65% of the ground surface, and rock is exposed on over 15% of the surface.

Other Studies

This assemblage has not been previously described in the canyon. Asherin and Claar (1976) mention a cottonwood vegetation type (*Populus deltoides* and *Populus trichocarpa*) that occurred in a few small sites in the study area, but they give no description. Crowe and Clausnitzer (1997) describe several assemblages in a *Populus trichocarpa* series on adjacent mid-montane National Forest lands in Oregon.

Appendix 3 (cont.).

POTR2 Site Conditions

Elevation (ft): 2,369.0 (range 1,800.0–2,760.0)

Slope (°): 13.0 (range 3.0–32.0)

Aspect: N(2), NW(4), S(2), W(2)

[a] Soil Texture: clay loam(1), loamy sand(1), sandy loam(3), silty loam(2)

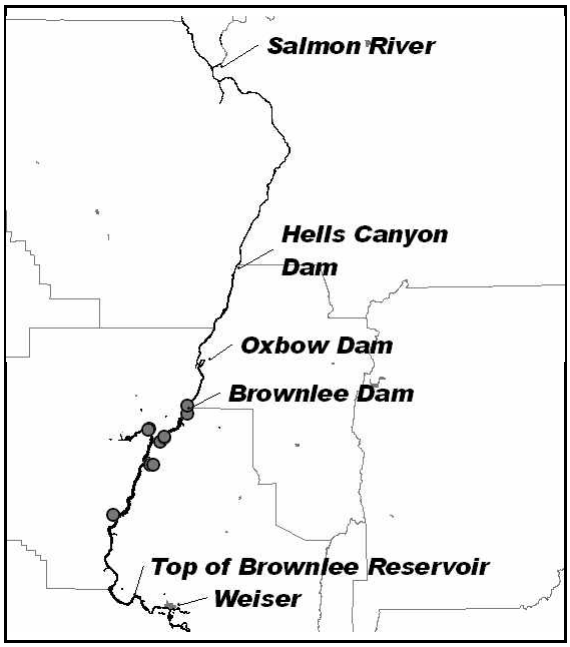
[a] Organic Matter %: 8.6 (range 5.1–12.0)

[a] pH: 7.5 (range 7.0–7.8)

[a] ON ppm: 65.0

[a] CEC meq/100g: 20.0 (range 13.8–28.0)

[a] Soil characteristic data available for 7 stands.



POTR2 Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (9) [b]							
N	*Populus trichocarpa*	69.3	73.5	90.0	559	15.08		
N	*Crataegus douglasii*	16.4	18.7	40.0	1,001	6.78		
N	*Betula occidentalis*	4.9	5.3	50.0	527	10.16		
N	*Amelanchier alnifolia*	4.7	4.7	30.0	660	9.12		
N	*Cornus stolonifera*	3.3	3.3	10.0	33	6.15		
	Shrubs (19) [b]							
N	*Philadelphus lewisii*	21.4	28.0	80.0	6,160	2.01	3,520	0.28
N	*Cornus stolonifera*	14.7	17.3	40.0	2,318	1.27	1,100	0.22
N	*Populus trichocarpa*	6.9	18.8	80.0	4,626	1.56	5,889	0.31
N	*Toxicodendron radicans*	5.3	11.3	60.0	4,692	0.61	13,908	0.29
N	*Crataegus douglasii*	5.1	6.7	50.0	725	2.96	1,365	0.20
N	*Amelanchier alnifolia*	4.7	8.0	40.0	200	4.05	50	0.04
N	*Rubus parviflorus*	3.0	5.3	10.0	818	0.72	818	0.35
N	*Ribes aureum*	2.8	7.3	40.0	1,791	1.43	182	0.13
	Grasses (6) [b]							
	Forbs (20) [b]							
I	*Arctium minus*	6.5	11.3	30.0				
N	*Smilacina racemosa*	2.9	9.7	10.0				
	Litter	65.2	100.0	100.0				
	Rock	15.4	43.0	100.0				
	Bare Soil	11.4	47.5	100.0				
	Moss	1.9	22.0	100.0				
	Lichen	0.8	14.5	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Populus trichocarpa/Philadelphus lewisii (POTR2/PHLE)
(black cottonwood/syringa) 26 stands

The *Populus trichocarpa/Philadelphus lewisii* plant assemblage is common in the *Forested Wetland* cover type. It was encountered in 26 transects in the reservoir reaches of the study area. Nearly all sites (25 of 26) were found in tributary drainages to the Snake River (Table 9), suggesting this assemblage is more characteristic of tributaries in the study area than in the Snake River riparian zone. Sites occurred between 1,920 and 4,000 ft on 3- to 26-degree slopes, on all but southerly aspects. Soil pH was neutral (pH = 6.9).

Dukes Creek Plot: BR95DUK08R

Populus trichocarpa is Hells Canyon's largest native broadleaf tree. It is one of the most widespread trees in Idaho and Oregon; few rivers lack stretches dominated by this tree. In Hells Canyon, *Populus trichocarpa* is an occasional tree species along tributary drainages. It was encountered on 57 transects, in 3 cover types, and in all reaches. It was most common in tributaries to the Snake River along the lower portions of the Brownlee Reservoir Reach (34 transects) and along Oxbow Reservoir (12 transects). This species is adapted to, and dependent upon, dynamic flow patterns and repeated flooding and scouring of unconfined floodplains. *Populus trichocarpa* requires moist and barren fine substrates for recruitment sites and a gradual recession of flows that does not exceed about 5 cm per day (Mahoney and Rood 1998). In the canyon, such sites are limited to the larger tributaries to the Snake River. In this assemblage, *Populus trichocarpa* dominates the overstory, providing 20% cover and occurring in about one-quarter of the plots along transects (frequency = 21%). It has an average height of about 15 m. Another major tree species constituent of this assemblage is *Betula occidentalis*.

Philadelphus lewisii is a native species that ranges from British Columbia north through Oregon and Washington and east to Montana. It is widely distributed in northern Idaho and is the state flower (Taylor 1992). This attractive shrub bears numerous, rather large, very fragrant white flowers. *Philadelphus lewisii* is a very common shrub in the canyon and is a codominant species in several plant assemblages. It was encountered on 173 transects, in 9 cover types, and in all reaches except the Weiser Reach. In this plant assemblage, *Philadelphus lewisii* dominates the understory, providing over 18% cover and occurring in one-quarter of all plots along transects (frequency = 25%). Average height of *Philadelphus lewisii* plants in the mature height-class is about 1.4 m and in the seedling height-class is about 0.3 m. Two other major woody constituents of this assemblage include *Symphoricarpos albus* and *Crataegus douglasii*.

Appendix 3 (cont.).

This assemblage is relatively species rich in trees (n = 15), shrubs (n = 33), forbs (n = 28), and graminoids (n = 9), while total cover of herbaceous species is relatively low. Most species are native. Five species of noxious weeds were found: *Cynoglossum officinale*, *Onopordum acanthium*, *Convolvulus arvensis*, *Cirsium arvense*, and *Dipsacus sylvestris*. Litter covers over 75% of the ground surface, and rock is exposed on over 9% of the surface.

Other Studies

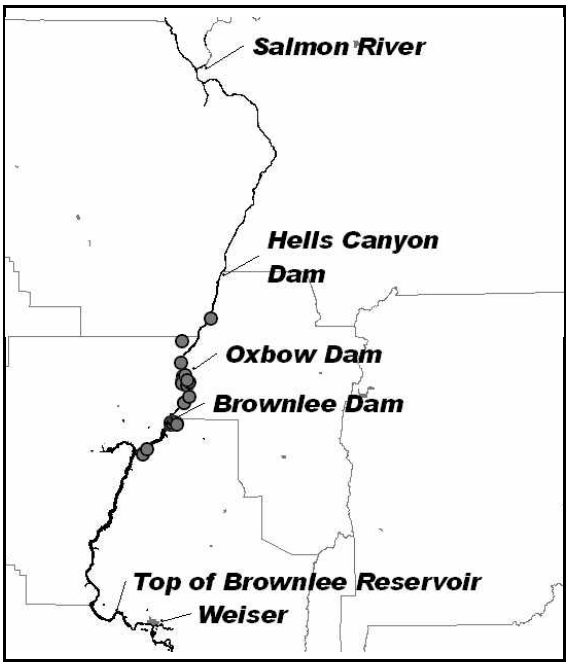
This assemblage has not been previously described in the canyon. Asherin and Claar (1976) mention a cottonwood vegetation type (*Populus deltoides* and *Populus trichocarpa*) that occurred in a few small sites in the study area, but they give no description. Crowe and Clausnitzer (1997) describe several assemblages in a *Populus trichocarpa* series on adjacent National Forest lands in Oregon.

Appendix 3 (cont.).

POTR2/PHLE Site Conditions

Elevation (ft): 2,418.8 (range 1,920.0–4,000.0)
Slope (°): 10.2 (range 3.0–26.0)
Aspect: E(3), N(6), NE(6), SW(2), W(9)
[a] Soil Texture: loamy sand(1), sandy loam(19), silty loam(2)
[a] Organic Matter %: 7.5 (range 4.0–12.0)
[a] pH: 6.9 (range 5.8–7.8)
[a] ON ppm: 62.3 (range 16.0–65.0)
[a] CEC meq/100g: 17.5 (range 14.6–20.0)

[a] Soil characteristic data available for 22 stands.



POTR2/PHLE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (15) [b]							
N	*Populus trichocarpa*	20.0	21.0	42.3	158	14.95		
N	*Betula occidentalis*	12.9	14.4	30.8	745	9.87		
N	*Alnus rhombifolia*	8.8	9.2	23.1	153	13.98		
N	*Crataegus douglasii*	7.9	8.5	38.5	681	7.19		
N	*Prunus virginiana*	4.8	5.4	38.5	165	7.82		
N	*Populus tremuloides*	4.6	5.9	15.4	51	13.48		
N	*Amelanchier alnifolia*	4.1	4.9	34.6	490	7.55		
N	*Acer glabrum*	3.2	3.3	23.1	331	9.11		
	Shrubs (33) [b]							
N	*Philadelphus lewisii*	18.2	25.4	73.1	7,739	1.41	5,352	0.30
N	*Symphoricarpos albus*	13.9	27.6	80.8	28,679	0.70	50,769	0.29
N	*Crataegus douglasii*	13.8	19.1	46.2	1,442	2.37	2,289	0.20
N	*Prunus virginiana*	9.7	16.8	69.2	7,344	1.35	3,270	0.28
N	*Toxicodendron radicans*	9.0	14.1	61.5	6,869	0.64	41,555	0.29
N	*Amelanchier alnifolia*	5.7	10.0	53.8	2,385	2.10	5,145	0.16
N	*Physocarpus malvaceus*	3.7	5.6	26.9	1,467	1.01	417	0.37
N	*Populus trichocarpa*	3.4	5.6	42.3	2,846	1.07	2,146	0.29
N	*Cornus stolonifera*	3.2	6.4	34.6	1,923	1.91	269	0.39
	Grasses (9) [b]							
	Forbs (28) [b]							
	Litter	75.1	96.8	100.0				
	Rock	8.4	34.0	100.0				
	Bare Soil	6.6	41.2	100.0				
	Moss	3.8	38.6	100.0				
	Lichen	1.9	34.0	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 3% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Acer saccharinum (ACSA)
(silver maple) 19 stands

The *Acer saccharinum* plant assemblage is fairly common in the *Forested Wetland* cover type. It was encountered in 19 transects, but only in the Weiser Reach. Sites occurred between 2,080 and 2,095 ft and most often on gentle or almost flat slopes. No soil data were collected.

West Weiser Flat Island Plot: BA97WWFDS1

Acer saccharinum was brought to Idaho and Oregon as an ornamental tree. It is one of the fastest growing broadleaf trees in the area. After escaping from urban and rural landscapes, *Acer saccharinum* is now well established along many Idaho and Oregon rivers. Its seeds mature in April and May, while those of most other maples mature in fall. The seeds do not travel far by wind, but they do float well. When floodwaters swell the rivers, *Acer saccharinum* seeds drift downstream. They become best established on muddy shorelines, but also establish in rocks along rivers, usually near the high-water mark (Johnson 1995). In Hells Canyon, *Acer saccharinum* is a fairly common tree species, but only in the upper reaches. It was encountered on 74 transects, in 3 cover types, in the Weiser Reach (71 transects), and the headwaters of Brownlee Reservoir (3 transects). Apparently, this species has not yet invaded the lower reaches of the canyon.

In this assemblage, *Acer saccharinum* dominates the overstory, providing over 70% cover and occurring in about three-quarters of the plots along transects (frequency = 73%). It has an average height of about 13.2 m. Several other introduced tree species are fairly abundant in this assemblage, including *Acer negundo*, *Salix alba*, and *Ulmus americana*.

This assemblage is relatively species rich in trees (n = 9), shrubs (n = 17), and forbs (n = 12), but few graminoids occur (n = 3). Total cover of herbaceous species is relatively low. About one-half the species are native. Two species of noxious weeds were found: *Lepidium latifolium* and *Conium maculatum*. Bare soil is exposed on nearly 45% of the ground surface, and litter covers almost 37% of the ground.

Other Studies

This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

ACSA Site Conditions

Elevation (ft): 2,087.6 (range 2,080.0–2,095.0)

Slope (°): 3.2 (range 0.0–34.0)

Aspect: E(2), F(12), N(2), NE(1), NW(1), SW(1)

[a] Soil Texture: 0

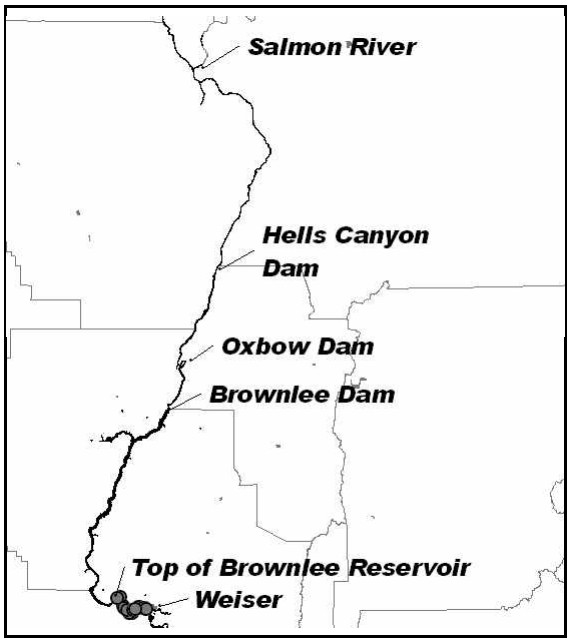
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ACSA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (9) [b]							
I	*Acer saccharinum*	70.3	73.3	100.0	822	13.15		
I	*Acer negundo*	17.5	21.4	73.7	302	9.13		
I	*Salix alba*	17.3	19.6	57.9	254	12.83		
I	*Ulmus americana*	14.3	17.8	57.9	187	11.68		
N	*Salix amygdaloides*	3.4	6.4	15.8	80	11.58		
	Shrubs (17) [b]							
I	*Salix alba*	4.0	6.1	42.1	204	3.55	72	0.27
I	*Acer negundo*	3.3	4.2	47.4	32	2.36	21	0.21
N	*Ribes aureum*	3.3	5.3	31.6	935	0.91	76	0.28
N	*Rosa woodsii*	2.3	5.8	36.8	794	1.23	292	0.25
	Grasses (3) [b]							
	Forbs (12) [b]							
I	*Lepidium latifolium*	2.5	17.6	52.6				
	Bare Soil	44.6	85.8	100.0				
	Litter	36.7	99.5	100.0				
	Rock	0.9	3.2	100.0				
	Lichen	0.2	3.2	100.0				
	Moss	0.1	0.8	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Salix amygdaloides (SAAM)
(peachleaf willow) 16 stands

The *Salix amygdaloides* plant assemblage is somewhat common in the *Forested Wetland* cover type. It was encountered at 16 sites, but only in the Weiser Reach and in the headwaters of Brownlee Reservoir. Sites occurred between 2,077 and 2,090 ft and most often on gentle or almost flat slopes. No soil data were collected.

McRea Island Plot: BA97MCRBS0

Salix amygdaloides, a native of Idaho and Oregon, is usually a shrub, but on the Snake River Plain, and particularly in southwestern Idaho, it grows tall enough to be considered a tree (Johnson 1995). In Hells Canyon, *Salix amygdaloides* is a common tree species, but principally just in and below the Weiser Reach. It was encountered in 4 cover types on 129 transects in 3 locations: the Weiser Reach (70 transects), the headwaters of Brownlee Reservoir (55 transects), and the Hells Canyon Reservoir Reach (1 transect). In this assemblage, *Salix amygdaloides* dominates the overstory, providing 61% cover and occurring in most of the plots along transects (frequency = 64%). Its average height is about 9.3 m. Two introduced tree species are fairly common in this assemblage: *Acer negundo* and *Ulmus americana*.

This assemblage is relatively species rich in trees (n = 9), shrubs (n = 15), and forbs (n = 28), but few graminoids occur (n = 4). Total herbaceous species cover is low and is dominated by *Lepidium latifolium*, listed a noxious weed species in both Idaho and Oregon. Five other noxious weed species were found in trace amounts (< 1% cover): *Lythrum salicaria*, *Onopordum acanthium*, *Cirsium arvense*, *Conium maculatum*, and *Cuscuta* sp. Most of the species in this assemblage are introduced. Litter covers over 61% of the ground surface, and bare soil is exposed on nearly 25% of the ground.

Other Studies

This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

SAAM Site Conditions

Elevation (ft): 2,080.6 (range 2,077.0–2,090.0)

Slope (°): 5.4 (range 0.0–15.0)

Aspect: E(1), F(6), N(2), NE(2), NW(1), SE(1), SW(1), W(2)

[a] Soil Texture: 0

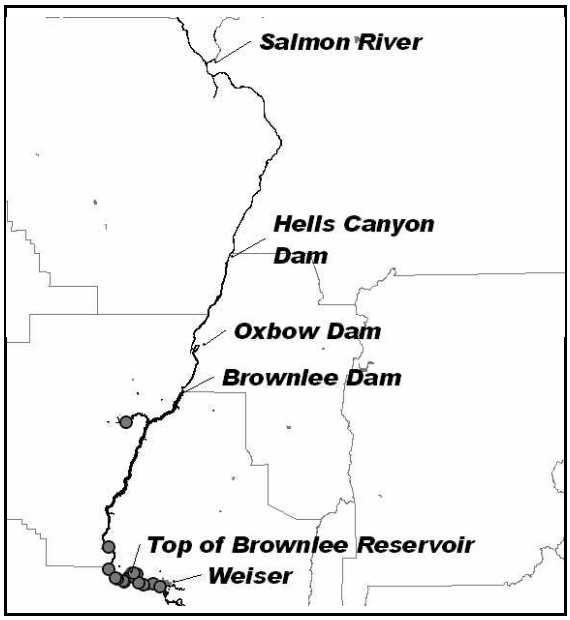
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAAM Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (9) [b]							
N	*Salix amygdaloides*	61.0	64.4	87.5	6,046	9.32		
I	*Acer negundo*	11.5	12.3	25.0	268	8.97		
I	*Ulmus americana*	8.7	9.7	25.0	46	11.08		
I	*Ulmus pumila*	4.1	4.4	6.3	31	8.83		
I	*Elaeagnus angustifolia*	2.5	2.8	12.5	16	13.00		
I	*Fraxinus pennsylvanica*	2.1	2.5	12.5	16	7.20		
I	*Acer saccharinum*	2.0	2.2	18.8	28	11.67		
	Shrubs (15) [b]							
N	*Salix amygdaloides*	13.6	15.9	62.5	693	3.76	1	0.41
N	*Ribes aureum*	9.8	11.3	31.3	359	2.48	477	0.17
N	*Rosa woodsii*	3.5	5.0	18.8	2,086	1.45	365	0.28
N	*Salix exigua*	2.5	3.9	25.0	551	2.04	23	0.35
	Grasses (4) [b]							
	Forbs (28) [b]							
I	*Lepidium latifolium*	6.6	25.9	50.0				
N	*Apocynum cannabinum*	2.6	5.6	12.5				
I	*Chenopodium album*	2.6	9.1	18.8				
N	*Solidago gigantea*	2.4	7.5	25.0				
N	*Atriplex patula*	2.2	11.3	43.8				
	Litter	61.4	100.0	100.0				
	Bare Soil	24.8	64.1	100.0				
	Rock	0.2	1.3	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Celtis reticulata (CERE)
(netleaf hackberry) 14 stands

Celtis reticulata is probably the most common woody species seen from the river in Hells Canyon, especially below Hells Canyon Dam. *Celtis reticulata* is a very common plant assemblage in *Shrubland* and *Scrub-Shrub Wetland* cover types and can often grow tall enough to even be somewhat common in the *Forested Wetland* cover type. This species becomes increasingly less abundant upstream of Hells Canyon Dam. The *Celtis reticulata* assemblage in this cover type occurred between 1,100 and 2,560 ft on 5- to 35-degree slopes on a variety of aspects. Some sites (5 of 14) were found in tributary drainages to the Snake River (Table 9), suggesting this assemblage is also characteristic of tributaries in the study area and not just the Snake River riparian zone. Soil pH was moderately alkaline (pH = 7.9).

Farewell Bend Plot: BR981952G2

Celtis reticulata occupies a wide variety of habitats in Idaho's western canyons. On rocky outcrops it may be a gnarled, twisted shrub, but in stream bottoms it has reasonably straight stems and may be 20 to 30 inches in diameter (Johnson 1995). *Celtis reticulata* was encountered in 343 transects, 11 cover types, and in all study reaches. It is a dominant species in 9 plant assemblages in 6 different cover types. In this plant assemblage, average height of *Celtis reticulata* is over 7.3 m, and it contributes nearly 58% canopy coverage. It is dominant in both the tree and shrub life forms. A codominant shrub species in this assemblage is *Toxicodendron radicans*, which has the highest shrub densities in both the mature and seedling height-classes.

This assemblage is species rich in shrubs (n = 20), forbs (n = 18), and graminoids (n = 7). Most species in this plant assemblage are native to the area; however, the herbaceous layer is mostly dominated by introduced graminoids, including *Bromus sterilis* and *Bromus tectorum*. Four noxious weed species were found in trace amounts (< 1% cover): *Dipsacus sylvestris*, *Cynoglossum officinale*, *Lepidium latifolium*, and *Hypericum perforatum.* Litter covers 46% of the ground surface, and rock covers almost 35% of the ground.

Other Studies

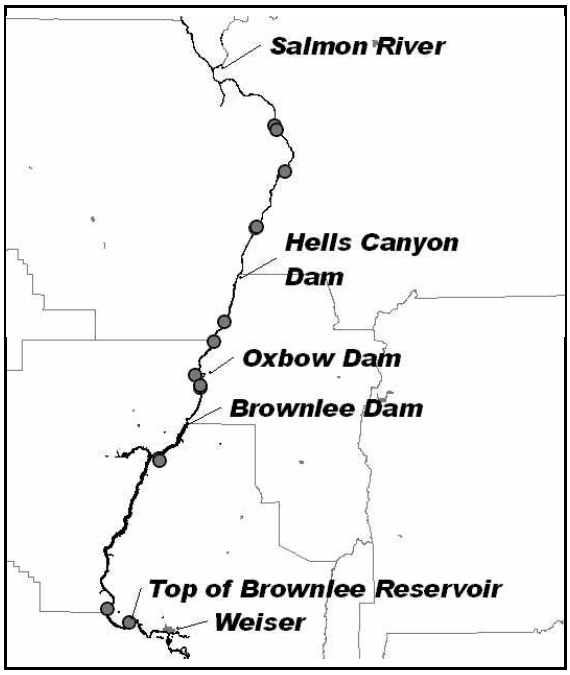
This plant assemblage is somewhat related to a *Celtis reticulata/Agropyron spicatum* plant association described by Johnson and Simon (1987) in the Wallowa-Snake Province and the *Celtis reticulata* series described by Tisdale (1986) in west-central Idaho. It is also similar to the *Celtis douglasii* (synonymous with *Celtis reticulata*) communities described by Asherin and Claar (1976).

Appendix 3 (cont.).

CERE Site Conditions

Elevation (ft): 1,716.0 (range 1,100.0–2,560.0)
Slope (°): 19.9 (range 5.0–35.0)
Aspect: E(1), NE(3), SE(5), SW(1), W(4)
[a] Soil Texture: sandy loam(2), silty loam(1)
[a] Organic Matter %: 6.7 (range 5.1–9.4)
[a] pH: 7.9 (range 7.8–8.0)
[a] ON ppm: 65.0
[a] CEC meq/100g: 18.0 (range 15.0–22.0)

[a] Soil characteristic data available for 3 stands.



CERE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (8) [b]							
N	*Celtis reticulata*	57.9	61.7	92.9	1,031	7.34		
N	*Rhamnus purshiana*	3.2	4.2	21.4	14	7.36		
N	*Amelanchier alnifolia*	2.8	2.9	7.1	33	7.37		
N	*Crataegus douglasii*	2.6	3.3	14.3	100	8.02		
N	*Sambucus cerulea*	2.4	2.4	7.1	43	6.98		
I	*Acer negundo*	2.2	2.5	7.1	24	8.80		
N	*Alnus rhombifolia*	2.1	2.1	7.1	12	9.30		
	Shrubs (20) [b]							
N	*Celtis reticulata*	21.2	31.3	100.0	1,252	1.97	6,399	0.17
N	*Toxicodendron radicans*	17.0	25.1	71.4	16,396	0.66	18,687	0.26
N	*Rhamnus purshiana*	8.5	11.4	28.6	680	2.54	381	0.09
N	*Amelanchier alnifolia*	6.3	7.5	14.3				
N	*Crataegus douglasii*	3.4	6.9	28.6	111	2.53	107	0.04
N	*Crataegus columbiana*	2.4	2.9	7.1	476	1.85		
N	*Cornus stolonifera*	2.4	2.4	7.1	25	4.00		
	Grasses (7) [b]							
N	*Bromus sterilis*	7.0	35.5	64.3				
	Forbs (18) [b]							
I	*Anthriscus scandicina*	4.7	22.9	35.7				
N	*Galium aparine*	2.4	26.0	57.1				
	Litter	46.0	98.3	100.0				
	Rock	34.8	73.2	100.0				
	Bare Soil	7.3	49.0	100.0				
	Moss	2.7	22.4	100.0				
	Lichen	2.2	35.7	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Celtis reticulata-Rubus discolor (CERE-RUDI)
(netleaf hackberry-Himalayan blackberry) 3 stands

Celtis reticulata is probably the most common woody species seen from the river in Hells Canyon, especially below Hells Canyon Dam. *Celtis reticulata* is a very common plant assemblage in *Shrubland* and *Scrub-Shrub Wetland* cover types and often grows tall enough to even be somewhat common in the *Forested Wetland* cover type. This species becomes increasingly less abundant upstream of Hells Canyon Dam. The *Celtis reticulata-Rubus discolor* assemblage is rare in the *Forested Wetland* cover type. It occurred between 1,380 and 1,683 ft on easterly aspects of 8- to 12-degree slopes. No soil data were collected.

Big Bar Island Plot: HC98BBARS5

Celtis reticulata occupies a wide variety of habitats in Idaho's western canyons. On rocky outcrops it may be a gnarled, twisted shrub, but in stream bottoms it has reasonably straight stems and may be 20 to 30 inches in diameter (Johnson 1995). *Celtis reticulata* was encountered in 343 transects, 11 cover types, and in all study reaches. It is a dominant species in 9 plant assemblages in 6 different cover types. In this plant assemblage, average height of *Celtis reticulata* is over 7.2 m, and it contributes over 44% canopy coverage.

Rubus discolor is introduced from the Old World and has become a serious pest in many areas, especially in Oregon west of the Cascades (Hitchcock and Cronquist 1991). It can form impenetrable thickets and choke out most other vegetation. In the canyon, it is a somewhat common riparian species. It is both loved and hated by recreationists: loved for berry picking opportunities but cursed for preventing shoreline access for camping and fishing. It was encountered in 43 transects, in all wetland cover types, and in all study reaches except the Weiser Reach. It was most often encountered along Hells Canyon Reservoir (34 transects) and below Hells Canyon Dam (7 transects). In this assemblage, *Rubus discolor* provides almost 92% of the understory canopy cover, occurs in nearly every plot along transects (frequency = 89%), and has the highest shrub density of any species.

This assemblage is relatively species poor in trees (n = 4), shrubs (n = 7), forbs (n = 3), and graminoids (n = 5). Most herbaceous species are introduced. Two noxious weed species were found: *Taeniatherum caput-medusae* and *Dipsacus sylvestris*. Litter covers over 80% of the ground surface, and rock covers about 14% of the ground.

Other Studies

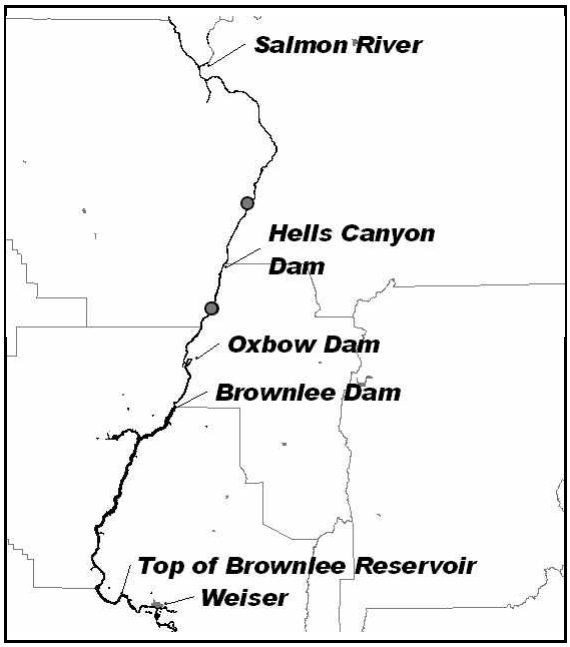
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

CERE-RUDI Site Conditions

Elevation (ft): 1,582.0 (range 1,380.0–1,683.0)
Slope (°): 9.7 (range 8.0–12.0)
Aspect: E(2), NE(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



CERE-RUDI Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (4) [b]							
N	*Celtis reticulata*	44.4	48.1	100.0	63	7.22		
N	*Alnus rhombifolia*	26.9	28.9	33.3	333	17.29		
	Shrubs (7) [b]							
I	*Rubus discolor*	91.9	89.4	100.0	116,133	1.31	1,200	0.40
N	*Philadelphus lewisii*	4.1	6.7	33.3	133	1.80		
N	*Crataegus douglasii*	1.6	3.3	33.3				
N	*Toxicodendron radicans*	1.6	3.3	33.3	3,333	0.61	3,333	0.44
I	*Prunus cerasifera*	1.5	2.5	33.3				
N	*Rhamnus purshiana*	1.3	6.7	33.3	133	2.20		
	Grasses (5) [b]							
I	*Taeniatherum caput-medusae*	2.0	6.7	33.3				
I	*Poa pratensis*	1.6	6.7	66.7				
	Forbs (3) [b]							
N	*Equisetum hyemale*	1.3	7.8	33.3				
N	*Solidago Canadensis*	1.1	5.0	33.3				
	Litter	80.4	100.0	100.0				
	Rock	13.8	40.6	100.0				
	Bare Soil	1.6	13.3	100.0				
	Lichen	1.2	20.6	100.0				
	Moss	0.3	12.2	100.0				

[a] N = Native, I = Introduced

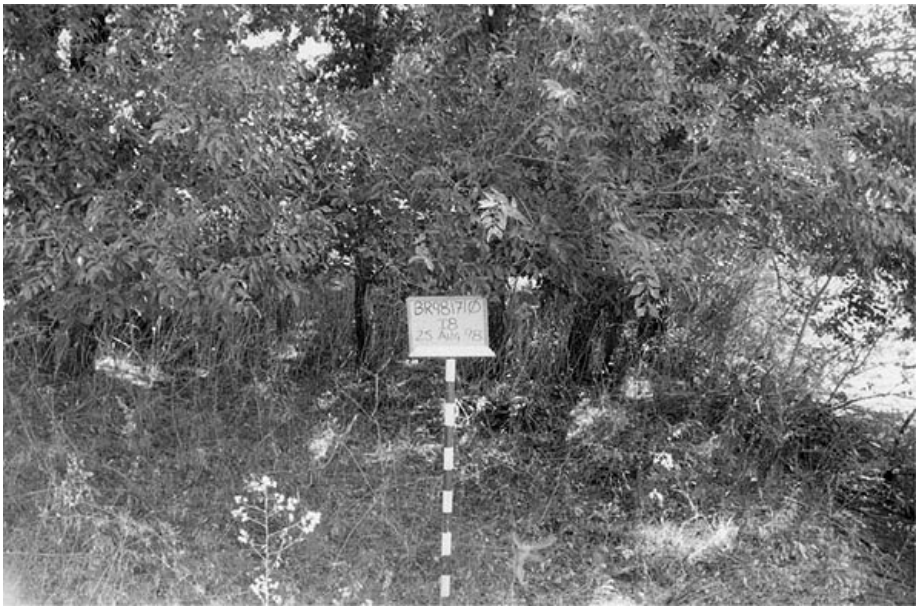
[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Ulmus pumila (ULPU)
(Siberian elm) 9 stands

The *Ulmus pumila* plant assemblage occurs occasionally in the *Forested Wetland* cover type. It was encountered in all the reservoir reaches of the study area, but most commonly along the Hells Canyon Reservoir Reach (7 stands). It occurred between 1,683 and 2,077 ft on 3- to 44-degree slopes on a variety of aspects. No soil data were collected from these sites.



Near Burnt River Plot: BR981710I8

Ulmus pumila is the most common elm planted in the interior of the western United States. From eastern Siberia and northern China, it was brought for use as a windbreak, especially around farms and ranches, and as an ornamental (Johnson 1995). In Hells Canyon, *Ulmus pumila* has probably escaped from old homestead sites and now occasionally occurs in the mouths of tributaries or along shorelines. It was encountered in 36 transects, 3 cover types, and in all study reaches except below Hells Canyon Dam. *Ulmus pumila* was fairly common in the Hells Canyon Reservoir Reach (15 transects), in the headwaters of Brownlee Reservoir (6 transects), and in the Weiser Reach (12 transects). In this plant assemblage, *Ulmus pumila* has an average height of about 9.7 m, and it contributes nearly 90% canopy coverage. Two other introduced species are somewhat abundant in the understory: *Rubus discolor* and *Amorpha fruticosa*.

Ulmus pumila is the only species in the tree layer; however, this assemblage is species rich in shrubs (n = 18), forbs (n = 16), and graminoids (n = 6). Most of the dominant species in each life form are introduced. Two noxious weed species were found in trace amounts (< 1% cover): *Lepidium latifolium* and *Dipsacus sylvestris*. Rock covers over 41% of the ground surface, and litter covers about 41% of the ground.

Other Studies

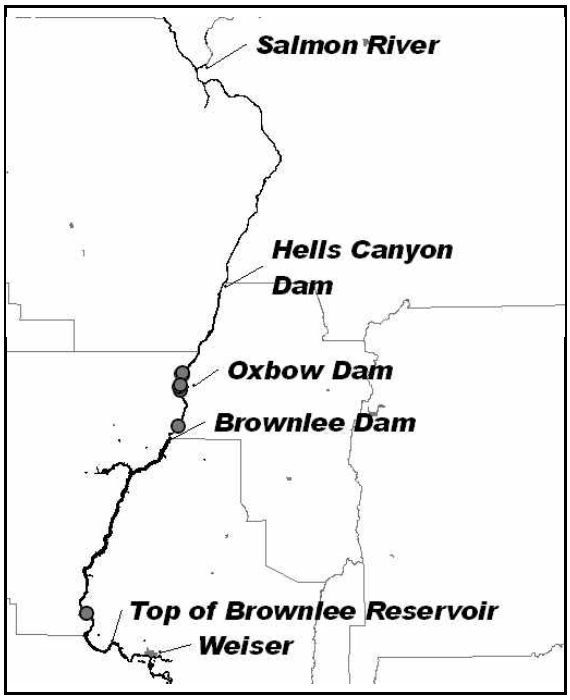
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

ULPU Site Conditions

Elevation (ft): 1,742 (range 1,683.0–2,077.0)
Slope (°): 20.6 (range 3.0–44.0)
Aspect: E(3), NE(1), NW(2), SE(1), W(2)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ULPU Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
I	*Ulmus pumila*	89.5	91.4	100.0	1,098	9.69		
	Shrubs (18) [b]							
I	*Rubus discolor*	22.2	22.2	33.3	8,611	1.21	28	0.15
I	*Ulmus pumila*	13.1	17.5	55.6	778	2.98	1,287	0.12
I	*Amorpha fruticosa*	10.0	16.7	44.4	1,282	2.06	2,944	0.11
I	*Parthenocissis quinquefolia*	4.6	6.7	11.1	222	0.61	333	0.33
N	*Celtis reticulata*	3.4	6.7	22.2	167	1.09	1,333	0.20
N	*Clematis ligusticifolia*	3.1	12.2	33.3	278	1.85	111	0.10
	Grasses (6) [b]							
	Forbs (16) [b]							
N	*Montia perfoliata*	1.5	6.7	11.1				
N	*Lycopus asper*	1.4	7.8	11.1				
	Rock	41.5	80.6	100.0				
	Litter	40.8	98.9	100.0				
	Bare Soil	9.7	52.8	100.0				
	Lichen	0.8	12.8	100.0				
	Moss	0.6	13.3	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Salix alba (SAAL)
(white willow) 3 stands

The *Salix alba* plant assemblage is rare in the *Forested Wetland* cover type. It was encountered at 3 sites on the Powder River Arm of the Brownlee Reservoir Reach. All sites were found in tributary drainages to the Powder River Arm of Brownlee Reservoir (Table 9), suggesting this assemblage is more characteristic of tributaries in the study area than of the riparian zone influenced by the Hells Canyon Complex. Sites occurred at 2,100 ft on flat slopes. Soil pH was mildly alkaline (pH = 7.5).

Powder River Plot: BR95POW01R

Salix alba, a native of cold interior Europe and Asia, has been planted in the western United States for many years (Johnson 1995), primarily as a windbreak and to control stream bank erosion, but also as an ornamental in rural areas. *Salix alba* has escaped along streams and rivers and on lake edges, but never far from farms or towns (Johnson 1995). It is thought to spread only vegetatively from branches that break off trees and are carried downstream, eventually becoming buried in mud, where they form roots and new plants). Escaped plants have been found only downstream from established trees or along lakeshores. In Hells Canyon, *Salix alba* was encountered on 44 transects in 3 riparian cover types, in both the Weiser Reach (41 transects) and the Powder River Arm of the Brownlee Reservoir Reach (3 transects). In this assemblage, *Salix alba* dominates the overstory, providing nearly 62% cover and occurring in most of the plots along transects (frequency = 65%). It has an average height of about 17 m. Several other native trees and shrubs are fairly abundant in this assemblage, including *Crataegus douglasii*, *Populus trichocarpa*, *Alnus rhombifolia*, *Betula occidentalis*, and *Cornus stolonifera*. The herbaceous layer is principally dominated by introduced grasses and forbs.

This assemblage has a moderate number of species (n = 31), and most are native. One noxious weed species was found: *Cynoglossum officinale;* it provides over 5% cover and occurs in about one-quarter of plots along transects (frequency = 24%). Litter covers almost 56% of the ground surface, and bare soil is exposed on nearly 29% of the ground.

Other Studies

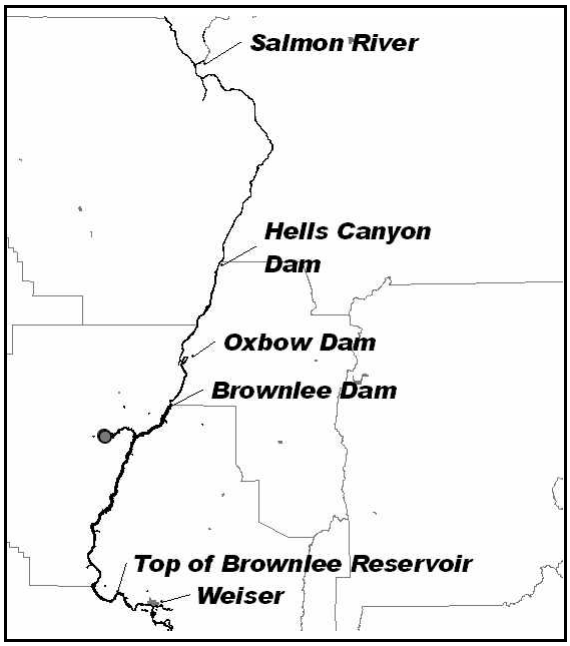
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

SAAL Site Conditions

Elevation (ft): 2,100.0
Slope (°): 0.0
Aspect: F(3)
[a] Soil Texture: LOSA(2), SALO(1)
[a] Organic Matter %: 3.8 (range 2.4–4.9)
[a] pH: 7.5 (range 7.0–7.8)
[a] ON ppm: 56.7 (range 45.0–65.0)
[a] CEC meq/100g: 12.7 (range 8.9–15.2

[a] Soil characteristic data available for 3 stands.



SAAL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (6) [b]							
I	*Salix alba*	61.8	64.5	100.00	3,789	17.04	3,789	17.04
N	*Crataegus douglasii*	25.5	28.9	66.7	2,233	7.75		
N	*Populus trichocarpa*	22.2	24.4	66.7	289	18.50		
N	*Alnus rhombifolia*	19.0	24.4	100.0	233	8.49		
N	*Betula occidentalis*	16.9	20.0	66.7	833	11.29		
	Shrubs (8) [b]							
N	*Cornus stolonifera*	14.5	20.0	100.0	1,811	1.96		
N	*Crataegus douglasii*	6.7	11.1	100.0	1,500	1.50	1,322	0.16
	Grasses (9) [b]							
I	*Poa pratensis*	9.3	47.8	100.0				
N	*Carex lanuginosa*	3.8	41.1	100.0				
I	*Agropyron repens*	3.7	45.5	66.7				
I	*Agrostis alba*	2.1	22.2	100.0				
	Forbs (12) [b]							
I	*Solanum dulcamara*	6.8	28.9	66.7				
I	*Cynoglossum officinale*	5.5	24.4	100.0				
N	*Solidago gigantea*	4.2	16.7	66.7				
I	*Cirsium vulgare*	2.2	17.8	33.3				
	Litter	55.6	100.0	100.0				
	Bare Soil	28.9	92.2	100.0				
	Moss	1.9	28.9	100.0				
	Lichen	1.0	21.1	100.0				
	Rock	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Salix alba*/*Rosa woodsii (SAAL/ROWO)
(white willow/Wood's rose) 6 stands

The *Salix alba*/*Rosa woodsii* plant assemblage is rare in the *Forested Wetland* cover type. It was encountered at 6 sites in the Weiser Reach. Sites occurred between 2,080 and 2,090 ft on 0- to 24-degree slopes. No soil data were collected.

Westlake Island Plot: BA97WSTAS4

Salix alba, a native of cold interior Europe and Asia, has been planted in the western United States for many years (Johnson 1995), primarily as a windbreak and to control stream bank erosion, but also as an ornamental in rural areas. It has escaped along streams and rivers and on lake edges, but never far from farms or towns (Johnson 1995). *Salix alba* is thought to spread only vegetatively from branches that break off trees and are carried downstream, eventually becoming buried in mud, where they form roots and a new plant. Escaped plants have been found only downstream from established trees or along lakeshores. In Hells Canyon, *Salix alba* was encountered on 44 transects and in 3 riparian cover types, in both the Weiser Reach (41 transects) and the Powder River Arm of the Brownlee Reservoir Reach (3 transects). In this assemblage, *Salix alba* dominates the overstory, providing nearly 56% cover and occurring in most of the plots along transects (frequency = 58%). It has an average height of about 8.9 m. All other species in the tree layer are also introduced.

Rosa woodsii dominates the shrub layer and is considered a codominant species in this assemblage. It is the most common Rocky Mountain *Rosa* species. The hips, or fruit, of any wild roses may be eaten and are often used to make jams and jellies. In Hells Canyon, *Rosa woodsii* was a commonly encountered riparian species and also occurred in many upland transects. It was encountered on 175 transects, in 10 cover types, and in all study reaches; it was more common in the Weiser Reach (58 transects) and headwaters of Brownlee Reservoir (54 transects). In this assemblage, it dominates the shrub layer, providing nearly 26% cover and occurring in about one-third of all plots along transects (frequency = 33%). Its average height is about 1.5 m.

This assemblage is relatively species rich (n = 44). The herbaceous layer is principally dominated by introduced forbs, namely *Lepidium latifolium*, a listed noxious weed in both Idaho and Oregon. *Lepidium latifolium* is abundant in many riparian plant assemblages along the headwaters of Brownlee Reservoir and in the Weiser Reach. Five other noxious weed species were found in trace amounts (< 1% cover): *Cirsium arvense*, *Conium maculatum*, *Lythrum salicaria*, *Cuscuta* sp., and *Onopordum acanthium*. Litter covers over 71% of the ground surface, and bare soil is exposed on about 11% of the ground.

Appendix 3 (cont.).

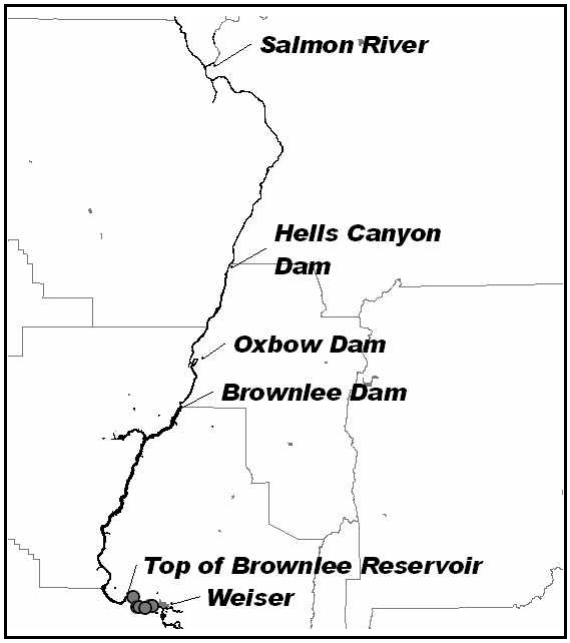
Other Studies

This assemblage has not been previously described in the study area.

SAAL/ROWO Site Conditions

Elevation (ft): 2,087.5 (range 2,080.0–2,090.0)
Slope (°): 7.3 (range 0.0–24.0)
Aspect: F(4), S(1), W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAAL/ROWO Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (4) [b]							
I	*Salix alba*	55.8	57.9	100.0	479	8.82		
I	*Acer saccharinum*	10.5	10.4	33.3	111	12.46		
I	*Acer negundo*	5.8	6.7	33.3	70	9.71		
I	*Ulmus americana*	3.3	4.6	33.3	7	15.00		
	Shrubs (7) [b]							
N	*Rosa woodsii*	25.7	32.5	83.3	5,333	1.46	1,250	0.36
I	*Salix alba*	10.6	15.8	83.3	153	3.35		
N	*Salix exigua*	7.6	8.8	16.7	229	4.38		
N	*Ribes aureum*	1.1	2.5	50.0	313	1.17	63	0.33
	Grasses (6) [b]							
N	*Panicum capillare*	2.7	11.7	16.7				
	Forbs (30) [b]							
I	*Lepidium latifolium*	33.4	71.7	100.0				
N	*Smilacina stellata*	3.1	16.7	50.0				
N	*Atriplex patula*	1.5	10.8	16.7				
	Rumex sp.	1.0	9.2	16.7				
	Litter	71.2	100.0	100.0				
	Bare Soil	11.3	61.7	100.0				
	Moss	0.3	1.7	100.0				
	Lichen	0.2	1.7	100.0				
	Rock	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Salix exigua-Rosa woodsii (SAEX-ROWO)
(coyote willow-Wood's rose) 6 stands

The *Salix exigua-Rosa woodsii* plant assemblage is rare in the *Forested Wetland* cover type. It was encountered at 6 sites, mostly in the Weiser Reach (5 sites). Sites occurred between 2,077 and 2,090 ft on flat to 35-degree slopes on a variety of aspects. No soil data were collected. This assemblage is similar to the *Salix exigua-Rosa woodsii* plant assemblage identified in the *Scrub-Shrub Wetland* cover type.

West Lake Island Plot: BA982092G7

Salix exigua is native to Idaho and Oregon and is common on sandbars, gravel bars, and among rocks along rivers and larger streams, particularly at low to mid elevations. It forms dense, shrubby patches after flood disturbance and is an indicator of poor stream channel stability (Miller 1976). At times *Salix exigua* can grow to become a small tree, most often along calm stretches of a river or on smaller streams (Johnson 1995). In Hells Canyon, *Salix exigua* plants were encountered on 184 transects, in all 4 riparian cover types, and mostly in the Weiser Reach (86 transects) and the headwaters of Brownlee Reservoir (76 transects). In this assemblage, *Salix exigua* dominates the overstory, providing nearly 32% cover and occurring in about one-third of the plots along transects (frequency = 35%). In the tree layer, it has an average height of about 7 m. *Salix exigua* is also abundant in the shrub layer, providing nearly 29% cover, and again in about one-third of all plots along transects (frequency = 37%).

Rosa woodsii is considered codominant in this assemblage. It is the most common Rocky Mountain *Rosa* species. The hips, or fruit, of any wild roses may be eaten and are often used to make jams and jellies. In Hells Canyon, *Rosa woodsii* was a commonly encountered riparian species and also occurred in several upland transects. It was encountered on 175 transects, in 10 cover types, and in all study reaches. It was more common in the Weiser Reach (58 transects) and headwaters of Brownlee Reservoir (54 transects). In this assemblage, it dominates the shrub layer, providing 51% cover and occurring in more than one-half of all plots along transects (frequency = 53%). Its average height is about 1.6 m. *Ribes aureum* is also fairly abundant in the shrub layer.

This assemblage has a relatively low number of species (n = 17). The herbaceous layer has only 1 graminoid species and is principally dominated by the weedy forb *Lepidium latifolium*, a listed noxious weed species in both Idaho and Oregon. This species is abundant in many riparian plant assemblages along the headwaters of Brownlee Reservoir and in the Weiser Reach. In this assemblage, litter covers over 48% of the ground surface, and bare soil is exposed on over 35% of the ground. No mosses or lichens were observed.

Appendix 3 (cont.).

Other Studies

Asherin and Claar (1976) identify several *Salix exigua*-dominated plant communities based on one or two site investigations in the study area. Miller (1976) documents a *Salix exigua* community type, distinctive in its depauperate appearance, at the mouths of streams on both the Salmon and Snake rivers. Herbaceous flora associated with the community type include disturbance species, such as annual *Bromus* spp., *Artemisia ludoviciana*, and *Toxicodendron radicans*. Crowe and Clausnitzer (1997) identify a *Salix exigua*-dominated plant association that occurs at elevations of 3,000 to 4,340 ft throughout the Blue and Wallowa mountains.

Appendix 3 (cont.).

SAEX-ROWO Site Conditions

Elevation (ft): 2,087.8 (range 2,077.0–2,090.0)

Slope (°): 16.7 (range 0.0–35.0)

Aspect: F(1), N(2), NE(1), S(1), SW(1)

[a] Soil Texture: 0

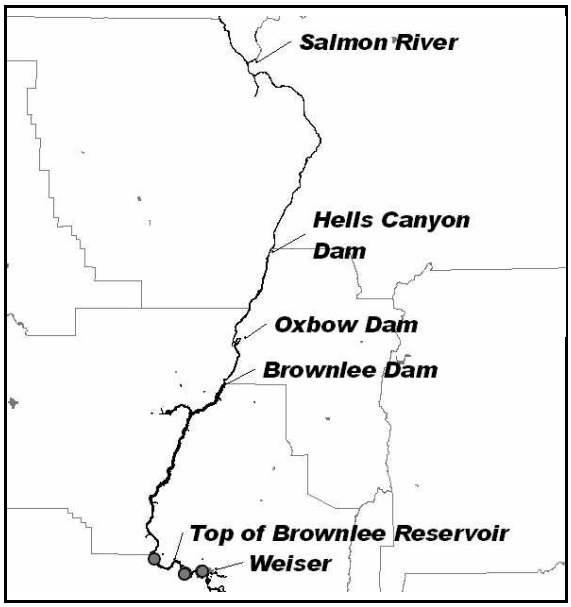
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAEX-ROWO Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (4) [b]							
N	*Salix exigua*	32.0	35.0	50.0	3,782	6.99		
I	*Elaeagnus angustifolia*	11.7	12.5	16.7	42	6.53		
N	*Salix amygdaloides*	7.6	8.8	33.3	21	7.15		
I	*Acer negundo*	5.3	6.7	16.7				
	Shrubs (7) [b]							
N	*Rosa woodsii*	51.0	53.3	66.7	21,417	1.57	417	0.28
N	*Salix exigua*	28.6	36.7	83.3	4,583	2.41	458	0.31
N	*Ribes aureum*	17.3	20.8	66.7	1,333	2.45	556	0.28
N	*Salix amygdaloides*	6.3	8.3	33.3	167	5.30		
I	*Amorpha fruticosa*	3.3	3.8	16.7				
I	*Elaeagnus angustifolia*	2.9	3.3	16.7				
	Grasses (1) [b]							
	Forbs (8) [b]							
I	*Lepidium latifolium*	6.0	37.5	83.3				
N	*Apocynum cannabinum*	3.9	14.2	33.3				
	Litter	48.4	99.2	100.0				
	Bare Soil	35.2	81.7	100.0				
	Rock	0.7	2.5	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Elaeagnus angustifolia (ELAN)
(Russian olive) 6 stands

The *Elaeagnus angustifolia* plant assemblage is rare in the *Forested Wetland* cover type. It was encountered at 6 sites in the Weiser Reach. Sites occurred between 2,080 and 2,090 ft on 0- to 32-degree slopes on a variety of aspects. No soil data were collected.

Island above Cobb Rapids Plot: BA98ADRBSK

Elaeagnus angustifolia, from the steppes of central Asia, was initially brought to the interior of the western United States for use as a drought-resistant windbreak (Johnson 1995). Once promoted as a desirable ornamental shade tree and source of food and protection for wildlife, it was later recognized as a nuisance (Whitson et al. 1992). Commonly cultivated in Oregon and Idaho, *Elaeagnus angustifolia* has escaped and naturalized, particularly where soil is wet in the spring, such as along small streams, irrigation ditches, and on river terraces and bottomlands (Johnson 1995). Often it is now so prevalent in low-lying pastures, meadows, and waterways that it has become a serious weed problem.

In Hells Canyon, *Elaeagnus angustifolia* plants were encountered on 36 transects in 3 riparian cover types, in both the Weiser Reach (32 transects) and headwaters of Brownlee Reservoir (4 transects). In this assemblage, it dominates the overstory, providing over 55% cover and occurring in about two-thirds of the plots along transects (frequency = 61%). In the tree layer, it has an average height of 7.8 m. *Elaeagnus angustifolia* is also abundant in the shrub layer, providing over 10% cover and occurring in 15% of all plots along transects. *Amorpha fruticosa* is the most common species in the shrub layer (cover = 21%, frequency = 25%).

This assemblage is species rich (n = 39). The herbaceous layer consists of many weedy species and is principally dominated by *Lepidium latifolium*, an introduced forb that is a listed noxious weed in both Idaho and Oregon. This species is common in many riparian plant assemblages along the headwaters of Brownlee Reservoir and in the Weiser Reach. Four other noxious weed species occur in this assemblage: *Conium maculatum*, *Dipsacus sylvestris*, *Onopordum acanthium*, and *Cirsium arvense*. Litter covers over 56% of the ground surface, and bare soil is exposed on over 27% of the ground.

Other Studies

This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

ELAN Site Conditions

Elevation (ft): 2,082.5 (range 2,080.0–2,090.0)

Slope (°): 11.3 (range 0.0–32.0)

Aspect: F(2), NE(1), NW(1), SW(2)

[a] Soil Texture: 0

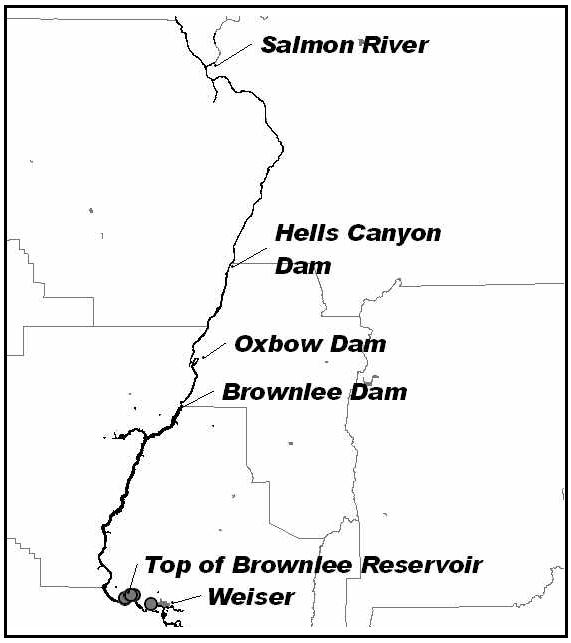
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ELAN Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
I	*Elaeagnus angustifolia*	55.4	60.8	100.0	553	7.80		
N	*Salix amygdaloides*	12.5	13.3	16.7	367	8.10		
	Shrubs (11) [b]							
I	*Amorpha fruticosa*	20.5	25.4	66.7	2,344	2.10	837	0.21
I	*Elaeagnus angustifolia*	10.6	15.0	83.3	750	2.85	650	0.30
I	*Ulmus americana*	3.4	5.8	33.3	333	1.25		
I	*Fraxinus pennsylvanica*	2.1	5.0	16.7	1,191	1.25		
	Grasses (6) [b]							
	Festuca sp.	10.4	13.3	16.7				
	Forbs (22) [b]							
I	*Lepidium latifolium*	10.6	39.2	100.0				
N	*Apocynum cannabinum*	4.8	30.8	33.3				
I	*Conium maculatum*	4.8	32.5	66.7				
I	*Nepeta cataria*	2.8	19.2	66.7				
I	*Anthriscus scandicina*	2.6	5.0	16.7				
	Litter	56.1	91.7	100.0				
	Bare Soil	27.4	62.5	100.0				
	Lichen	0.3	0.8	100.0				
	Moss	0.0	0.0	0.0				
	Rock	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Acer negundo (ACNE)
(box elder maple) 5 stands

The *Acer negundo* plant assemblage is rare in the *Forested Wetland* cover type. It was encountered at 5 sites in the Weiser Reach. Sites occurred between 2,080 and 2,090 ft and on flat slopes. No soil data were collected.

Weiser Island Plot: BA98WSRASM

Acer negundo var. *interius*, interior box elder, is native to southeastern Idaho but not to Oregon. *Acer negundo* var. *violaceum*, violet box elder, is native to the Great Plains eastward and was brought west by pioneers to provide quick shade. This latter variety is the one found in the Hells Canyon study area and is now common in southern Idaho, western Idaho, and eastern Oregon. It has naturalized along most lower-elevation rivers, irrigation ditches, and pastures. It prospers so well that most people think it is a true native (Johnson 1995). It is likely that both varieties occur in the Weiser Reach.

Acer negundo is a common tree in the Weiser Reach. It was encountered on 55 transects, in 3 riparian cover types, and in all study reaches, but was clearly more abundant in the Weiser Reach (47 transects). It occurred in 5 transects in the Hells Canyon Reservoir Reach and in just 1 transect in each of the other study reaches. In this assemblage, *Acer negundo* dominates both the tree layer (cover = 77%, frequency = 83%) and the shrub layer (cover = 9%, frequency = 11%). It has an average height of about 10.6 m in the tree layer and about 3 m in the shrub layer.

This assemblage has a moderate number of species (n = 24) and most are introduced. The herbaceous layer is dominated by *Conium maculatum* and *Lepidium latifolium*. Both these species are listed as noxious weeds in Idaho and Oregon. Two other noxious weed species occur in trace amounts (< 1% cover): *Lythrum salicaria* and *Rumex crispus*. Litter covers almost 44% of the ground surface, and bare soil is exposed on almost 40% of the ground.

Other Studies

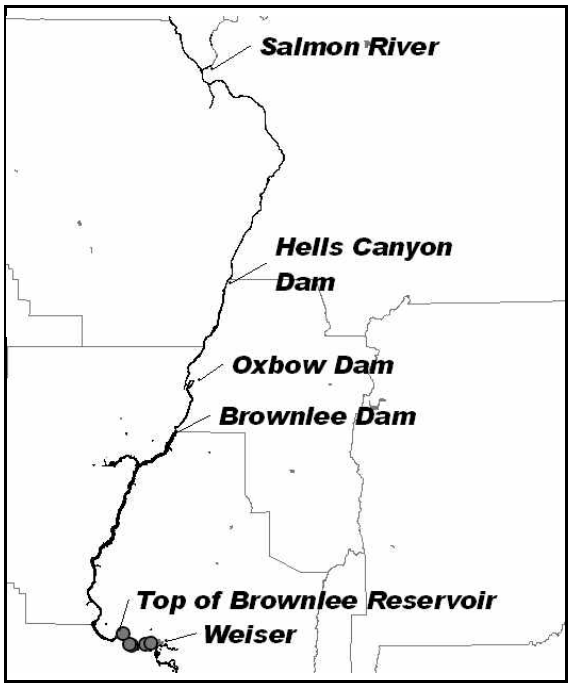
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

ACNE Site Conditions

Elevation (ft): 2,084.0 (range 2,080.0–2,090.0)
Slope (°): 0.00 (range 0.0–0.0)
Aspect: F(5)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ACNE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (5) [b]							
I	*Acer negundo*	77.2	82.5	100.0	771	10.55		
I	*Salix alba*	8.1	9.5	40.0	92	13.44		
N	*Salix amygdaloides*	5.0	6.0	6.0	133	11.56		
I	*Acer saccharinum*	2.5	3.0	40.0	155	11.95		
I	*Ulmus americana*	1.0	1.0	20.0	3	16.00		
	Shrubs (10) [b]							
I	*Acer negundo*	8.8	10.5	100.0	107	3.05	17	0.13
N	*Ribes aureum*	1.8	3.0	60.0	403	2.19	210	0.14
	Grasses (2) [b]							
N	*Phalaris arundinacea*	1.0	11.0	40.0				
	Forbs (22) [b]							
I	*Conium maculatum*	3.5	22.0	80.0				
I	*Lepidium latifolium*	3.1	16.0	20.0				
N	*Smilacina stellata*	1.1	4.0	20.0				
I	*Amaranthus retroflexus*	0.7	4.0	40.0				
I	*Nepeta cataria*	0.5	11.0	20.0				
I	*Lythrum salicaria*	0.5	4.0	40.0				
	Litter	43.6	100.0	100.0				
	Bare Soil	39.9	84.0	100.0				
	Lichen	0.4	12.0	100.0				
	Moss	0.0	0.0	0.0				
	Rock	0.0	0.0	0.0				

[a] N = Native, I = Introduced

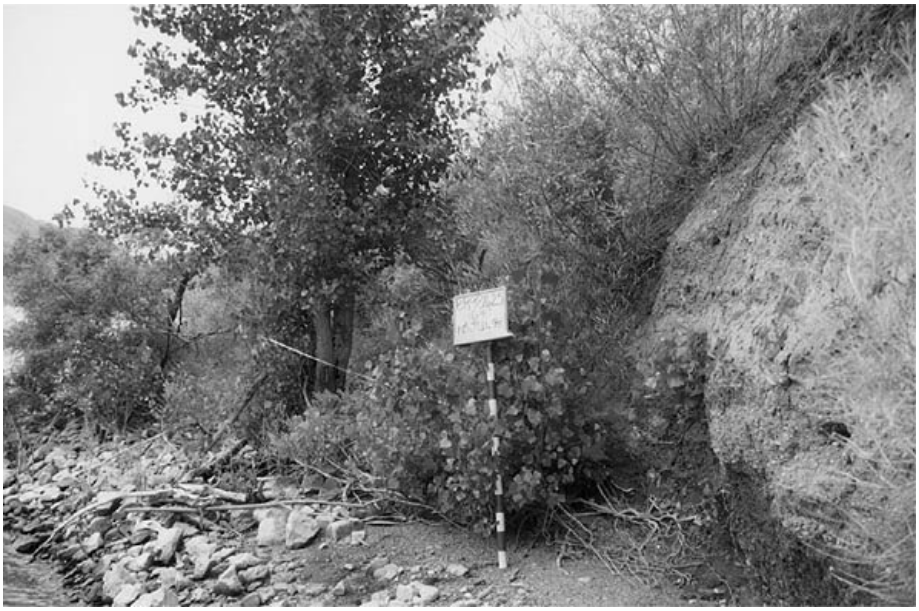
[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Forested Wetland

Populus deltoides (PODE)
(Great Plains cottonwood) 3 stands

The *Populus deltoides* plant assemblage is rare in the *Forested Wetland* cover type. It was encountered at 3 sites in the Brownlee Reservoir Reach. Sites occurred at the reservoir high-water mark (2,077 ft) on 5- to 18-degree slopes on eastern and southern aspects. No soil information was collected.



Quicksand Creek Plot: BR981625G4

Populus deltoides was probably introduced to Idaho and Oregon by early settlers, who favored this species' fast growth and shade. It has been in Idaho long enough to produce the largest-known tree of its species in the United States—138 inches in diameter and 85 ft tall, found near Burley, Idaho, (Johnson 1995). Across the Snake River Plain, *Populus deltoides* has naturalized along the Snake River and its tributaries. Many hybridized forms are found in the area. In Hells Canyon, *Populus deltoides* is an uncommon tree; it was encountered on 12 transects in 3 cover riparian types, in the Brownlee Reservoir (9 transects), Weiser (2 transects), and Hells Canyon Reservoir (1 transect) reaches. In this assemblage, *Populus deltoides* clearly dominates the overstory, providing 91% cover and occurring in nearly all plots along transects (frequency = 93%). Its average height is about 11.5 m.

This assemblage is relatively species poor (n = 13), with little understory vegetation. The most abundant constituent of the herbaceous layer is *Lepidium latifolium*, listed a noxious weed in both Idaho and Oregon. This species is abundant in many riparian plant assemblages along the headwaters of Brownlee Reservoir and in the Weiser Reach. One other noxious weed species occurs in trace amounts (< 1% cover): *Taeniatherum caput-medusae*. Nearly all species in this assemblage are introduced. Litter covers 49% of the ground surface, and rock is exposed on over 12% of the surface.

Other Studies

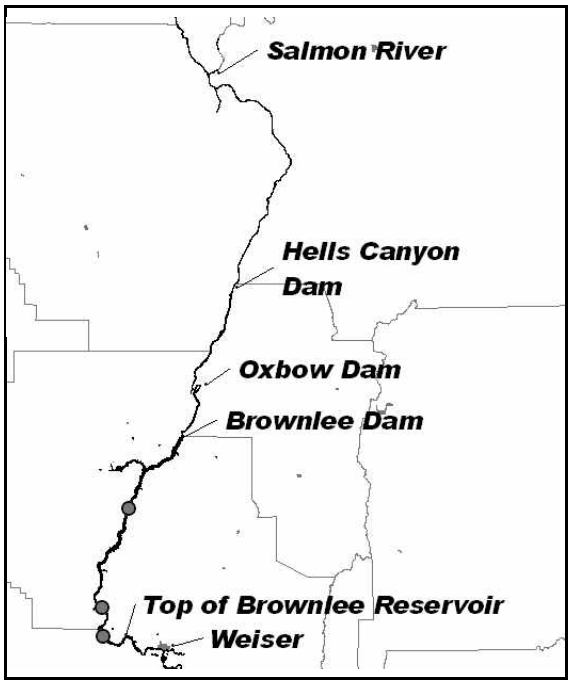
This assemblage has not been previously described in the canyon. Asherin and Claar (1976) mention a cottonwood vegetation type (*Populus deltoides* and *Populus trichocarpa*) that occurred in a few small areas in the study area along riverbanks and on tributaries, but they give no description.

Appendix 3 (cont.).

PODE Site Conditions

Elevation (ft): 2,077.0
Slope (°): 9.3 (range 5.0–18.0)
Aspect: E(2), S(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



PODE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
I	*Populus deltoides*	91.0	93.3	100.0	947	11.47		
	Shrubs (5) [b]							
I	*Populus deltoides*	15.8	26.7	33.3	3,333	0.85	2,333	0.24
I	*Amorpha fruticosa*			33.3	17	2.15		
N	*Artemisia tridentata*			33.3			333	0.15
N	*Celtis reticulata*			33.3			1,000	0.3
I	*Morus alba*			33.3	50	2.62		
	Grasses (4) [b]							
I	*Bromus tectorum*	0.7	28.3	66.7				
	Unknown graminoid	0.6	1.7	33.3				
I	*Bromus japonicus*	0.3	10.0	33.3				
I	*Taeniatherum caput-medusae*	0.1	5.0	33.3				
	Forbs (4) [b]							
I	*Lepidium latifolium*	4.1	58.3	66.7				
I	*Melilotus alba*	1.5	16.7	33.3				
I	*Lactuca serriola*	0.3	10.0	66.7				
N	*Asclepias speciosa*	0.1	5.0	66.7				
	Litter	49.0	100.0	100.0				
	Rock	12.2	63.3	100.0				
	Bare Soil	9.5	56.7	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Forested Wetland

Tamarix parviflora (TAPA)
(tamarisk or salt cedar) 2 stands

The *Tamarix parviflora* plant assemblage is rare in the *Forested Wetland* cover type. It was encountered at 2 sites in the Brownlee Reach. Sites occurred at the high-water mark (2,077 ft) and most often on gentle slopes. No soil data were collected.

Birch Creek Plot: BR981985G8

Tamarix parviflora is native to Eurasia and was probably brought to Idaho and Oregon to serve as an ornamental tree. *Tamarix parviflora* has become naturalized in southwestern Idaho, mainly along the Snake River bottomlands or near the salt desert shrub type of vegetation. An aggressive invader, it sprouts from the roots and also spreads by seed. In Hells Canyon at the upstream end of the study area, *Tamarix parviflora* appears to be rapidly increasing. It was encountered on 98 transects in 5 cover types, in just the Weiser Reach (33 transects) and the Brownlee Reservoir Reach (65 transects). Apparently, this species has not yet invaded the lower reaches of the canyon. In this assemblage, *Tamarix parviflora* dominates the overstory, providing over 84% cover and occurring in most plots along transects (frequency = 85%). It has grown tall enough at these sites to be classified as a tree (> 6 m), with an average height of about 6.7 m.

This assemblage is species poor in all life forms (n = 5), and all but 1 species are introduced. Total cover of herbaceous species is low, the only species being *Lepidium latifolium*, a listed noxious weed in both Idaho and Oregon. Litter covers over 70% of the ground surface, and rock is exposed on 17% of the ground. This assemblage is very similar to the more common *Tamarix parviflora*-dominated assemblage in the *Scrub-Shrub Wetland* cover type, which is dominated by plants about 2.9 m tall.

Other Studies

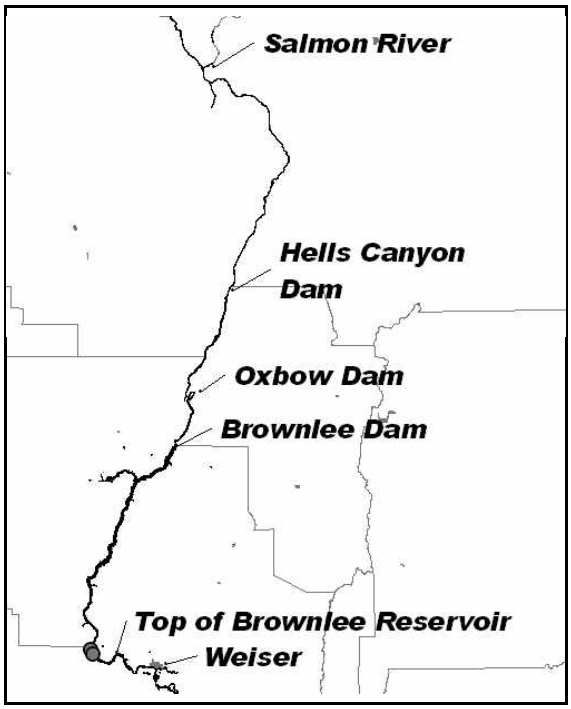
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

TAPA Site Conditions

Elevation (ft): 2,077.0
Slope (°): 5.0 (range 0.0–10.0)
Aspect: F(1), NE(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



TAPA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
I	*Tamarix parviflora*	84.1	85.0	100.0	8,175	6.71		
I	*Populus deltoides*	32.4	37.5	50.0	100	14.25		
	Shrubs (3) [b]							
I	*Tamarix parviflora*	60.3	67.5	100.0	2,750	4.52		
I	*Amorpha fruticosa*	5.8	10.0	50.0	250	2.10		
N	*Rosa woodsii*			50.0	1,000	1.89	250	0.40
	Grasses (0) [b]							
	Forbs (1) [b]							
I	*Lepidium latifolium*	3.3	45.0	100.0				
	Litter	70.4	100.0	100.0				
	Rock	17.0	42.5	100.0				
	Bare Soil	0.0	0.0	0.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Forested Wetland

Robinia pseudoacacia*/*Amorpha fruticosa (ROPS/AMFR)
(black locust/false indigo) 1 stand

The *Robinia pseudoacacia*/*Amorpha fruticosa* plant assemblage is rare in the *Forested Wetland* cover type. It was encountered at 1 site on the Brownlee Reservoir Reach. This site occurred at the high-water mark (2,077 ft) on an 11-degree slope with an east aspect. No soil data were collected at the site.

Quicksand Creek Plot: BR981625G9

Native to the eastern United States, *Robinia pseudoacacia* was probably brought west to Idaho and Oregon for use as a windbreak and a drought-resistant ornamental. Its wood is very resistant to decay when in the ground, and near many of the early farms in Idaho, groves of black locust were planted as a source of fence posts (Johnson 1995). From extensive plantings, *Robinia pseudoacacia* has escaped in Idaho and Oregon to the extent that it now prospers in the wild at mid and lower elevations. In Hells Canyon, it was encountered in 11 transects, in 3 cover types, and in all but the Oxbow Reservoir Reach. Generally, it occurred in upland habitats, but here it was classified as a riparian assemblage due to its association with *Amorpha fruticosa*. *Robinia pseudoacacia* is the only species in the tree layer, and it provides 100% cover and occurs in every plot along the transect (frequency = 100%). Its average height is about 8.3 m. It is also abundant in the shrub layer, providing 16% cover and occurring in one-fifth of the plots (frequency = 20%), with an average height of 1.7 m.

Amorpha fruticosa is the most common species in the shrub layer. It is native to the midwestern United States but has become widely distributed/naturalized throughout temperate North America. It is known to dominate riparian areas and commonly reproduces asexually following flood disturbance (Lapin and Nothnagle 1995). *Amorpha fruticosa* numbers are increasing in the Hells Canyon area. The species' growth habit and preferred habitats are similar to *Salix exigua*, and it could be considered an ecological equivalent to *Salix exigua*. *Amorpha fruticosa* grows in dense stands almost anywhere there is moisture, including stream banks, irrigation ditches, moist pastures, and gullies at mid to lower elevations (Elmore 1976, Hickman 1993). In Hells Canyon, it is often found just above the high-water line. *Amorpha fruticosa* was encountered in 114 transects, in all study reaches, but primarily in the Brownlee Reservoir (56 transects) and Weiser (39 transects) reaches. It occurred in all 4 riparian cover types. In this assemblage, it is the dominant shrub, providing 33% cover and occurring in one-half of the plots along the transect (frequency = 50%).

This assemblage is species poor (n = 8). The herbaceous layer is dominated by introduced weedy species. One noxious weed species occurs in low amounts: *Taeniatherum caput-medusae*. It provides just over 1%

Appendix 3 (cont.).

cover and occurs in 20% of all plots along the transect. Rock covers about 36% of the ground surface, and litter covers 36% of the surface.

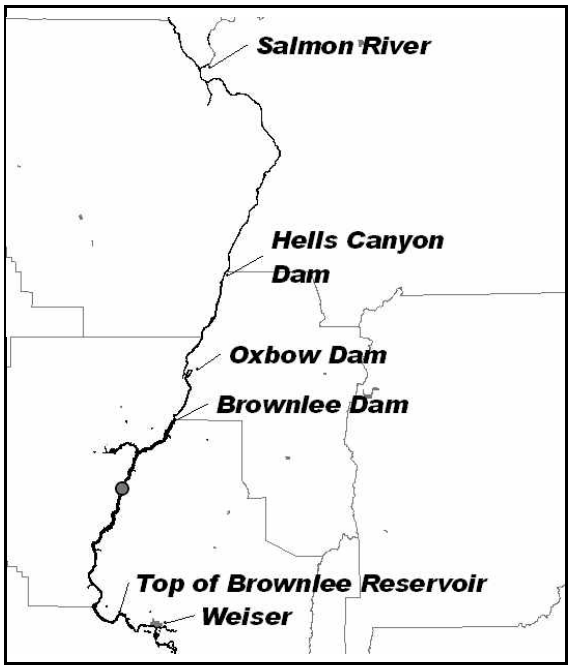
Other Studies

This assemblage has not been previously described for the Hells Canyon area.

ROPS/AMFR Site Conditions

Elevation (ft): 2,077.0
Slope (°): 11.0
Aspect: E(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ROPS/AMFR Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
I	*Robinia pseudoacacia*	100.0	100.0	100.0	6,500	8.28		
	Shrubs (2) [b]							
I	*Amorpha fruticosa*	33.0	50.0	100.0	1,500	1.60	1,000	0.20
I	*Robinia pseudoacacia*	16.0	20.0	100.0	500	1.70		
	Grasses (4) [b]							
I	*Bromus japonicus*	10.5	55.0	100.0				
I	*Bromus tectorum*	7.3	90.0	100.0				
I	*Taeniatherum caput-medusae*	1.2	20.0	100.0				
N	*Hordeum jubatum*	0.3	10.0	100.0				
	Forbs (2) [b]							
I	*Lactuca serriola*	2.6	50.0	100.0				
I	*Ranunculus testiculatus*	0.1	5.0	100.0				
	Rock	36.3	90.0	100.0				
	Litter	36.0	100.0	100.0				
	Bare Soil	6.3	35.0	100.0				
	Lichen	0.1	5.0	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Celtis reticulata (CERE)
(netleaf hackberry) 6 stands

Celtis reticulata is probably the most common woody species seen from the river in Hells Canyon, especially below Hells Canyon Dam. An assemblage completely dominated by *Celtis reticulata*, however, is somewhat rare in the *Scrub-Shrub Wetland* cover type. A *Celtis reticulata*-dominated assemblage is usually codominated by *Toxicodendron radicans*. The *Celtis reticulata* assemblage was encountered on 6 transects in the Brownlee Reservoir Reach. All sites occurred at the high-water mark (2,077 ft) on 20- to 52-degree slopes on a variety of aspects. No soil information was collected.

Johnson Bar Plot: HB970550G1

Celtis reticulata occupies a wide variety of habitats in Idaho's western canyons. On rocky outcrops it may be a gnarled, twisted shrub, but in stream bottoms it has reasonably straight stems and may be 20 to 30 inches in diameter (Johnson 1995). *Celtis reticulata* was encountered in 343 transects, 11 cover types, and all study reaches. It is a dominant species in 9 plant assemblages in 6 different cover types. In this assemblage, the average height of *Celtis reticulata* is about 1.9 m. It contributes about 91% canopy coverage and occurs in nearly every plot along transects (frequency = 99%). No other species is dominant in this assemblage.

The assemblage is relatively species poor (n = 12), and about one-half the species are native. One species of noxious weed occurs in trace amounts: *Lepidium latifolium*. Rock covers over 56% of the ground surface, and litter covers over 15% of the ground.

Other Studies

This plant assemblage is somewhat similar to a *Celtis reticulata/Agropyron spicatum* plant association described by Johnson and Simon (1987) in the Wallowa-Snake Province and the *Celtis reticulata* series described by Tisdale (1986) in west-central Idaho. It is more similar to the *Celtis douglasii* (synonymous with *Celtis reticulata*) communities described by Asherin and Claar (1976) due to presence of introduced herbaceous species, and it is similar to the *Celtis reticulata* community type described by Miller (1976).

Appendix 3 (cont.).

CERE Site Conditions

Elevation (ft): 2,077.0

Slope (°): 31.3 (range 20.0–52.0)

Aspect: E(2), NW(1), SE(1), SW(1), W(1)

[a] Soil Texture: 0

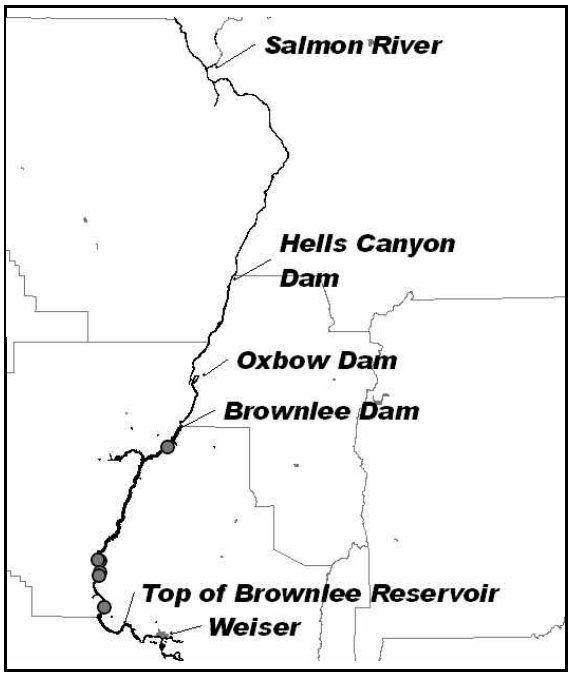
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



CERE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (4) [b]							
N	*Celtis reticulata*	90.5	99.2	100.0	3,792	1.86	2,417	0.21
N	*Prunus virginiana*	2.3	6.7	16.7	833	0.69	1,000	0.37
I	*Amorpha fruticosa*	0.6	1.7	16.7				
N	*Clematis ligusticifolia*	0.4	3.3	16.7			167	0.35
	Grasses (3) [b]							
I	*Bromus japonicus*	1.1	15.8	33.3				
I	*Bromus tectorum*	0.8	27.5	83.3				
	Unknown graminoid	0.1	5.0	16.7				
	Forbs (5) [b]							
N	*Lomatium grayi*	0.6	3.3	16.7				
N	*Phacelia ramosissima*	0.5	12.5	16.7				
I	*Lepidium latifolium*	0.4	7.5	16.7				
N	*Artemisia dracunculus*	0.2	5.0	16.7				
N	*Xanthium strumarium*	0.2	5.8	16.7				
	Rock	56.4	96.7	100.0				
	Litter	15.4	98.3	100.0				
	Bare Soil	14.2	61.7	100.0				
	Lichen	0.2	7.5	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Celtis reticulata-Toxicodendron radicans (CERE-TORA)
(netleaf hackberry-poison ivy) 40 stands

The *Celtis reticulata-Toxicodendron radicans* plant assemblage is the most common assemblage in the *Scrub-Shrub Wetland* cover type. It was principally encountered along the reach below Hells Canyon Dam (31 sites), but also in the Brownlee Reservoir (1 site) and Hells Canyon Reservoir (8 sites) reaches. Sites occurred from 990 to 2,072 ft on 5- to 35-degree slopes on a variety of aspects. Soil pH was neutral (pH = 7.1) according to information from 2 sites.

Five Pine Rapids Plot: HB980255G1

Celtis reticulata is probably the most common woody species seen from the river in Hells Canyon, especially below Hells Canyon Dam. It occupies a wide variety of habitats in Idaho's western canyons. On rocky outcrops it may be a gnarled, twisted shrub, but in stream bottoms it has reasonably straight stems and may be 20 to 30 inches in diameter (Johnson 1995). *Celtis reticulata* was encountered in 343 transects, 11 cover types, and all study reaches. It is a dominant species in 9 plant assemblages in 6 different cover types. In this plant assemblage, its average height is about 6.7 m in the tree height-class and 2.1 m in the shrub height-class. It contributes over 50% canopy coverage and occurs in most plots along transects (frequency = 62%).

Toxicodendron radicans is the codominant shrub in this assemblage. This species is native to Oregon and Idaho and occupies many habitats along floodplains and river terraces. In Hells Canyon, it is a commonly occurring understory species and is often a nuisance to recreationists, causing severe skin rashes. It varies from a sub-shrub, often less than 1 m tall, to a distinct shrub, up to 3 m tall (Whitson et al. 1992). In some locations in the canyon it can form a nearly impenetrable canopy. It was encountered on 196 transects, in 10 cover types, and in all study reaches, but principally below Hells Canyon Dam (75 transects). In this assemblage, *Toxicodendron radicans* contributes over 27% cover and occurs in about one-third of all plots along transects (frequency = 37%).

This assemblage is relatively species rich in shrubs (n = 25), graminoids (n = 9), and forbs (n = 14), and most species are native. One rare plant was found in trace amounts: *Rubus bartonianus*; 3 species of noxious weeds were also found in trace amounts: *Taeniatherum caput-medusae*, *Cardaria draba*, and *Lepidium latifolium*. Rock covers over 68% of the ground surface, and litter covers almost 20% of the ground.

Other Studies

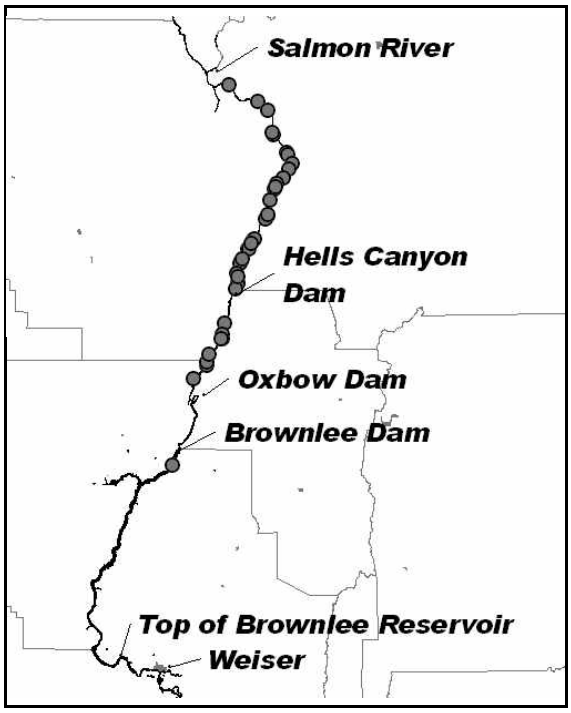
This plant assemblage has not been described for the Hells Canyon area.

Appendix 3 (cont.).

CERE-TORA Site Conditions

Elevation (ft): 1,376.6 (range 990.0–2,072.0)
Slope (°): 19.7 (range 5.0–35.0)
Aspect: E(7), N(5), NE(3), NW(10), S(4), SE(4), SW(3), W(4)
[a] Soil Texture: sandy loam(2)
[a] Organic Matter %: 6.8 (range 3.9–9.6)
[a] pH: 7.1 (range 6.4–7.7)
[a] ON ppm: 39.0 (range 18.0–60.0)
[a] CEC meq/100g: 15.5 (range 14.0–17.0)

[a] Soil characteristic data available for 2 stands.



CERE-TORA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
N	*Celtis reticulata*	0.7	0.8	10.0	3	6.73		
	Prunus sp.	0.2	0.3	2.5	1	6.10		
	Shrubs (25) [b]							
N	*Celtis reticulata*	50.2	62.0	95.0	3,447	2.13	6,044	0.26
N	*Toxicodendron radicans*	27.5	36.9	72.5	17,306	0.72	23,298	0.29
N	*Philadelphus lewisii*	5.1	7.0	30.0	298	2.18	6	0.24
N	*Salix exigua*	2.1	2.5	5.0	438	1.34		
N	*Rosa woodsii*	2.0	3.1	15.0	926	1.53		
I	*Rubus discolor*	1.2	1.8	7.5	500	0.65	13	0.28
	Grasses (9) [b]							
I	*Bromus sterilis*	2.8	16.5	30.0				
N	*Paspalum distichum*	1.0	2.3	2.5				
I	*Bromus tectorum*	1.0	6.0	25.0				
	Forbs (14) [b]							
N	*Glycyrrhiza lepidota*	1.6	3.2	15.0				
	Rock	68.3	92.3	100.0				
	Litter	19.8	89.8	100.0				
	Lichen	4.5	48.6	100.0				
	Bare Soil	3.6	29.2	100.0				
	Moss	3.3	32.2	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Amorpha fruticosa (AMFR)
(false indigo) 35 stands

The *Amorpha fruticosa* plant assemblage was the second most common assemblage encountered in the *Scrub-Shrub Wetland* cover type. It was principally encountered along the Brownlee Reservoir Reach (29 sites), but also in the Hells Canyon Reservoir (5 sites) and Weiser (1 site) reaches. Sites occurred between 1,683 and 2,080 ft on 5- to 45-degree slopes on a variety of aspects. No soil information was collected.

Burnt River Plot: BR981710I9

Amorpha fruticosa is native to the midwestern United States, but has become widely distributed/naturalized throughout temperate North America. It is known to dominate riparian areas and commonly reproduces asexually following flood disturbance (Lapin and Nothnagle 1995). *Amorpha fruticosa* numbers are increasing in the Hells Canyon area. The species' growth habit and preferred habitats are similar to *Salix exigua*, and *Amorpha fruticosa* could be considered an ecological equivalent to *Salix exigua*. *Amorpha fruticosa* grows in dense stands almost anywhere there is moisture, including stream banks, irrigation ditches, moist pastures, and gullies at mid to lower elevations (Elmore 1976, Hickman 1993). In Hells Canyon, it is often found just above the high water line. *Amorpha fruticosa* was encountered in 114 transects and in all study reaches, but primarily in the Brownlee Reservoir (56 transects) and Weiser (39 transects) reaches. It occurred in all 4 riparian cover types. In this assemblage, *Amorpha fruticosa* is clearly the dominant shrub, providing almost 92% cover and occurring in almost every plot along transects (frequency = 96%).

The herbaceous layer is dominated by introduced weedy species, including *Lepidium latifolium*, a listed noxious weed in both Idaho and Oregon. Another noxious weed also occurs in trace amounts: *Taeniatherum caput-medusae*. This assemblage is relatively species rich (n = 33). Rock covers almost one-half of the ground (cover = 49%), and litter covers over 35% of the ground surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

AMFR Site Conditions

Elevation (ft): 2,021.0 (range 1,683.0–2,080.0)

Slope (°): 20.1 (range 5.0–45.0)

Aspect: E(5), N(4), NE(2), NW(6), S(4), SE(5), SW(2), W(7)

[a] Soil Texture: 0

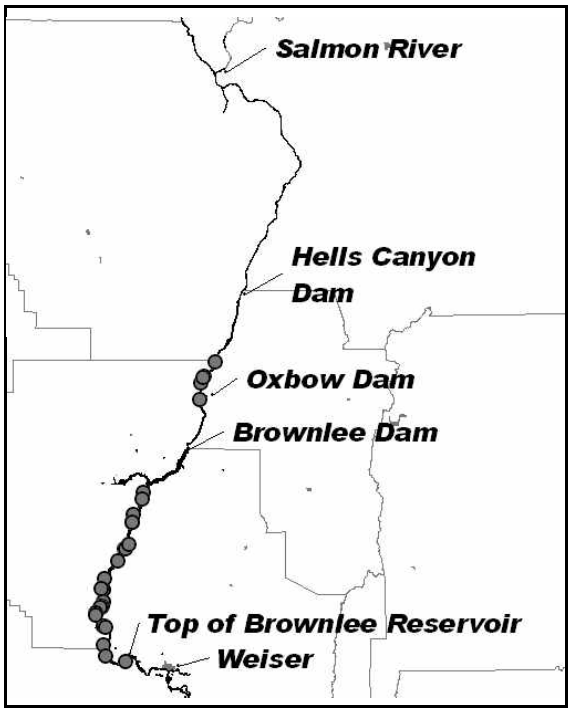
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



AMFR Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (12) [b]							
I	*Amorpha fruticosa*	91.9	95.8	97.1	5,611	2.17	1,457	0.06
I	*Rubus discolor*	1.6	2.3	2.9	71	1.76		
N	*Prunus virginiana*	1.6	3.9	8.6	471	0.81	471	0.24
I	*Rosa canina*	1.1	1.7	8.6	24	2.02	29	0.13
N	*Clematis ligusticifolia*	0.8	2.1	8.6	57	1.53	67	0.25
N	*Rhus glabra*	0.7	2.0	5.7	438	1.26	57	0.13
	Grasses (6) [b]							
I	*Bromus tectorum*	4.0	35.6	71.4				
I	*Bromus japonicus*	1.4	16.3	31.4				
	Forbs (15) [b]							
I	*Lepidium latifolium*	7.2	25.6	48.6				
N	*Solidago occidentalis*	1.6	5.9	8.6				
	Brassicaceae sp.	0.5	1.4	2.9				
	Rock	48.9	82.3	100.0				
	Litter	35.1	98.3	100.0				
	Bare Soil	3.0	39.7	100.0				
	Lichen	0.4	4.4	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Amorpha fruticosa-Salix exigua (AMFR-SAEX)
(false indigo-coyote willow) 10 stands

The *Amorpha fruticosa-Salix exigua* plant assemblage is uncommon in the *Scrub-Shrub Wetland* cover type. It was encountered along the Brownlee Reservoir Reach (8 sites) and at 1 site in both the Hells Canyon Reservoir and the Weiser reaches. Sites occurred at 1,683 to 2,080 ft on 8- to 52-degree slopes on a variety of aspects. No soil information was collected.

Across from Big Deacon Creek Plot: BR971462I3

Amorpha fruticosa is native to the midwestern United States, but has become widely distributed/naturalized throughout temperate North America. It is known to dominate riparian areas and commonly reproduces asexually following flood disturbance (Lapin and Nothnagle 1995). *Amorpha fruticosa* numbers are increasing in the Hells Canyon area. Its growth habit and preferred habitats are similar to *Salix exigua*, and *Amorpha fruticosa* could be considered an ecological equivalent to *Salix exigua*. *Amorpha fruticosa* grows in dense stands almost anywhere there is moisture, including stream banks, irrigation ditches, moist pastures, and gullies at mid to lower elevations (Elmore 1976, Hickman 1993). In Hells Canyon, it is often found just above the high water line. *Amorpha fruticosa* was encountered in 114 transects and in all study reaches, but primarily in the Brownlee Reservoir (56 transects) and the Weiser (39 transects) reaches. It occurred in all 4 riparian cover types. In this assemblage, *Amorpha fruticosa* is the dominant shrub, providing almost 53% cover and occurring in most plots along transects (frequency = 58%). Its average height is about 2.2 m.

Salix exigua is native to Idaho and Oregon and is common on sandbars, gravel bars, and among rocks along rivers and larger streams, particularly at low to mid elevations. It forms dense, shrubby patches after flood disturbance and is an indicator of poor stream channel stability (Miller 1976). At times it can grow to become a small tree, most often along calm river stretches or on smaller streams (Johnson 1995). In Hells Canyon, *Salix exigua* plants were encountered on 184 transects, in all 4 riparian cover types, and mostly in the Weiser Reach (86 transects) and in the headwaters of Brownlee Reservoir (76 transects). In this assemblage, *Salix exigua* is codominant, providing over 32% cover and occurring in one-third of the plots along transects (frequency = 33%). It has an average height of about 1.7 m.

The herbaceous layer is dominated by introduced weedy species. This assemblage is species rich (n = 35), and about one-half the species are native. Three noxious weeds occur in trace amounts: *Lepidium latifolium*, *Conium maculatum*, and *Cynoglossum officinale*. Litter covers most of the ground surface (cover = 66%), and rock covers over 20% of the surface.

Other Studies

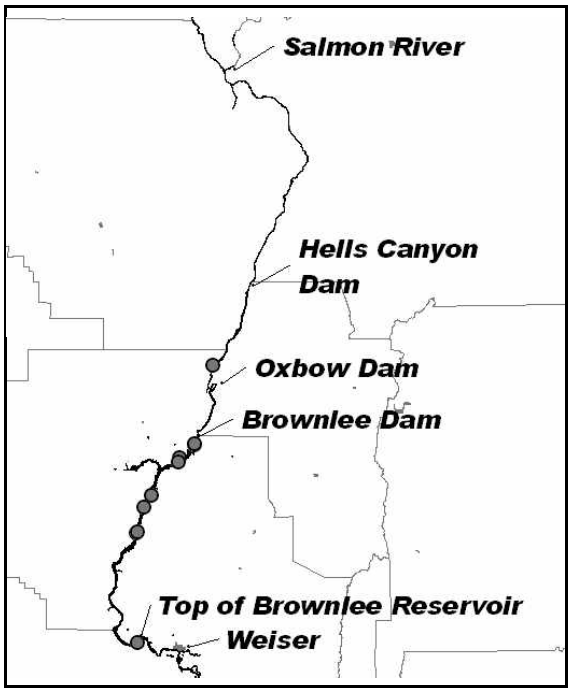
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

AMFR-SAEX Site Conditions

Elevation (ft): 2,037.1 (range 1,683.0–2,080.0)
Slope (°): 21.5 (range 8.0–52.0)
Aspect: N(1), NW(3), SE(2), W(4)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



AMFR-SAEX Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (9) [b]							
I	*Amorpha fruticosa*	52.7	57.5	90.0	3,183	2.15	150	0.32
N	*Salix exigua*	32.2	33.0	40.0	5,400	1.69	400	0.36
I	*Elaeagnus angustifolia*	10.0	10.0	10.0	33	5.75		
N	*Philadelphus lewisii*	3.3	4.0	10.0	200	1.73		
N	*Celtis reticulata*	1.4	4.0	20.0	300	1.13	200	0.25
N	*Artemisia tridentata*	0.9	3.0	20.0	300	0.83	200	0.17
N	*Ribes aureum*	0.9	2.0	10.0				
	Grasses (7) [b]							
I	*Bromus japonicus*	7.8	47.5	80.0				
I	*Bromus tectorum*	5.6	43.0	80.0				
I	*Bromus sterilis*	1.4	18.0	40.0				
	Forbs (19) [b]							
I	*Anthriscus scandicina*	11.9	45.0	50.0				
N	*Solidago gigantea*	6.1	10.0	10.0				
N	*Galium aparine*	2.8	29.5	60.0				
I	*Arctium minus*	1.4	4.0	10.0				
I	*Lepidium latifolium*	1.0	7.0	30.0				
I	*Lappula redowskii*	0.9	2.0	10.0				
N	*Lycopus asper*	0.5	4.0	10.0				
N	*Artemisia ludoviciana*	0.5	2.0	10.0				
	Litter	65.9	100.0	100.0				
	Rock	20.2	58.0	100.0				
	Bare Soil	3.6	37.5	100.0				
	Lichen	0.6	21.5	100.0				
	Moss	0.1	4.5	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Amorpha fruticosa*/*Apocynum cannabinum (AMFR/APCA)
(false indigo/hemp dogbane) 4 stands

The *Amorpha fruticosa*/*Apocynum cannabinum* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It was encountered at 4 sites along the Weiser Reach. Sites occurred between 2,085 and 2,090 ft on 2- to 19-degree slopes, mostly on northeasterly aspects. No soil information was collected.

McRea Island Plot: BA97MCRES4

Amorpha fruticosa is native to the midwestern United States, but has become widely distributed/naturalized throughout temperate North America. It is known to dominate riparian areas and commonly reproduces asexually following flood disturbance (Lapin and Nothnagle 1995). *Amorpha fruticosa* numbers are increasing in the Hells Canyon area. Its growth habit and preferred habitats are similar to *Salix exigua*, and *Amorpha fruticosa* could be considered an ecological equivalent to *Salix exigua*. *Amorpha fruticosa* grows in dense stands almost anywhere there is moisture, including stream banks, irrigation ditches, moist pastures, and gullies at mid to lower elevations (Elmore 1976, Hickman 1993). In Hells Canyon, it is often found just above the high water line. *Amorpha fruticosa* was encountered in 114 transects and in all study reaches, but primarily in the Brownlee Reservoir (56 transects) and the Weiser (39 transects) reaches. It occurred in all 4 riparian cover types. In this assemblage, it is the dominant shrub, providing over 41% cover and occurring in most plots along transects (frequency = 61%). It has an average height of about 1.4 m.

Apocynum cannabinum is a widespread native, perennial herb that can become weedy along roadsides and in other disturbed areas. It has been called Indian hemp because of its use by prehistoric tribes for high-quality fiber (Whitson et al. 1992). It is poisonous to livestock. In Hells Canyon, *Apocynum cannabinum* was encountered on 93 transects and in 7 cover types, but principally in the Weiser Reach (55 transects). In this assemblage, it provides the most cover of any species (cover = 70%) and is present in almost all plots along transects (frequency = 98%).

This assemblage is species rich in graminoids (n = 10) and forbs (n = 22), but about one-half are introduced, and most occur in trace amounts (< 1% cover). Three noxious weed species occur: *Cardaria draba*, *Cirsium arvense*, and *Lepidium latifolium*. Rock covers over 23% of the ground surface, and bare soil is exposed on over 21% of the surface.

Other Studies

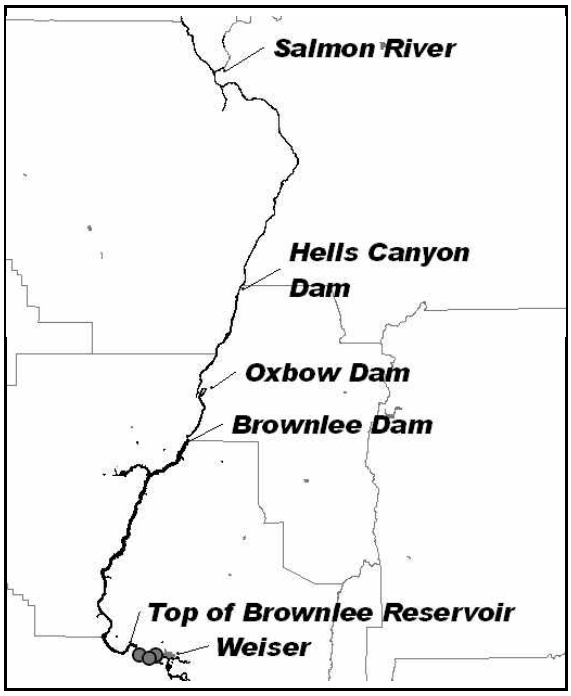
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

AMFR/APCA Site Conditions

Elevation (ft): 2,088.8 (range 2,085.0–2,090.0)
Slope (°): 8.8 (range 2.0–19.0)
Aspect: NE(3), S(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



AMFR/APCA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (7) [b]							
I	*Amorpha fruticosa*	41.2	61.3	100.0	6,500	1.42	2,500	0.30
N	*Salix exigua*	6.5	12.5	50.0	3,750	1.00	1,750	0.28
I	*Fraxinus pennsylvanica*	6.3	8.8	50.0	375	1.48		
I	*Salix alba*	3.7	8.8	50.0	750	1.61		
	Grasses (10) [b]							
N	*Cyperus erythrorhizos*	1.3	23.8	100.0				
N	*Phalaris arundinacea*	1.2	18.8	50.0				
	Forbs (22) [b]							
N	*Apocynum cannabinum*	69.9	97.5	100.0				
N	*Glycyrrhiza lepidota*	5.4	12.5	75.0				
N	*Equisetum hyemale*	2.8	21.3	25.0				
I	*Lythrum salicaria*	2.4	31.3	75.0				
I	*Convolvulus sepium*	1.9	11.3	75.0				
N	*Polygonum coccineum*	1.5	5.0	50.0				
I	*Polygonum persicaria*	1.2	17.5	100.0				
N	*Lindernia dubia*	1.0	40.0	50.0				
N	*Solidago occidentals*	1.0	11.3	50.0				
	Rock	23.3	28.8	100.0				
	Bare Soil	21.1	73.8	100.0				
	Litter	20.4	88.8	100.0				
	Moss	0.5	20.0	100.0				
	Lichen	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Salix exigua (SAEX)
(coyote willow) 22 stands

The *Salix exigua* plant assemblage is common in the *Scrub-Shrub Wetland* cover type. It was encountered in all study reaches except along Hells Canyon Reservoir. It was most common along the headwaters of Brownlee Reservoir (13 sites). Sites occurred from 1,140 to 2,080 ft on 0- to 44-degree slopes on a variety of aspects. No soil information was collected.

Daly Creek Plot: BR981422G3

Salix exigua is native to Idaho and Oregon and is common on sandbars, gravel bars, and among rocks along rivers and larger streams, particularly at low to mid elevations. It forms dense, shrubby patches after flood disturbance and is an indicator of poor stream channel stability (Miller 1976). At times *Salix exigua* can grow to become a small tree, most often along calm river stretches or on smaller streams (Johnson 1995). In Hells Canyon, *Salix exigua* occurs as a dominant or codominant species in several plant assemblages. This species was encountered on 184 transects, in all 4 riparian cover types, and mostly in the Weiser Reach (86 transects) and the headwaters of Brownlee Reservoir (76 transects). In this assemblage, it is the only dominant species, providing over 80% cover and occurring in nearly all plots along transects (frequency = 96%). It has an average height of about 1.6 m.

This assemblage is relatively species rich in shrubs (n = 8), graminoids (n = 9), and forbs (n = 22); however, most forbs occur infrequently and in low amounts. Most species in this assemblage are native. Three species of noxious weeds occur: *Cardaria draba*, *Cirsium arvense*, and *Lepidium latifolium*. Rock covers about one-third of the ground surface (cover = 33%), and bare soil is exposed on almost 27% of the surface.

Other Studies

Asherin and Claar (1976) identify several *Salix exigua*-dominated plant communities based on one or two site investigations in the study area. Miller (1976) documents a *Salix exigua* community type, distinctive in its depauperate appearance, at the mouths of streams on both the Salmon and Snake rivers. Herbaceous flora associated with the community type include disturbance species, such as annual *Bromus* spp., *Artemisia ludoviciana*, and *Toxicodendron radicans*. Crowe and Clausnitzer (1997) identify a *Salix exigua*-dominated plant association that occurs at elevations of 3,000 to 4,340 ft throughout the Blue and Wallowa mountains.

Appendix 3 (cont.).

SAEX Site Conditions

Elevation (ft): 1,813.7 (range 1,140.0–2,080.0)

Slope (°): 11.8 (range 0.0–44.0)

Aspect: E(2), F(5), N(4), NE(2), NW(3), S(4), SE(1), W(1)

[a] Soil Texture: 0

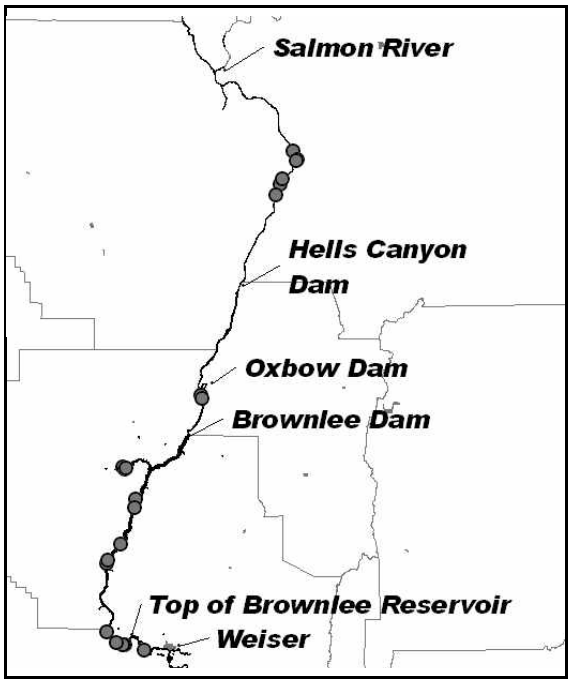
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAEX Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (8) [b]							
N	*Salix exigua*	80.3	96.3	100.0	18,523	1.60	8,719	0.29
I	*Rosa canina*	1.7	2.7	4.5	682	1.12	455	0.18
N	*Clematis ligusticifolia*	1.0	1.4	4.5	45	0.70		
N	*Clematis reticulata*	0.9	2.7	13.6	23	0.90	182	0.23
	Grasses (9) [b]							
N	*Phalaris arundinacea*	9.0	13.9	18.2				
N	*Spartina pectinata*	1.7	4.5	4.5				
N	*Panicum capillare*	0.6	6.8	18.2				
	Forbs (22) [b]							
I	*Iris pseudacorus*	2.1	5.0	13.6				
N	*Polygonum lapathifolium*	0.8	4.5	4.5				
N	*Solidago occidentalis*	0.7	5.2	18.2				
N	*Lycopus asper*	0.6	3.0	4.5				
I	*Cardaria draba*	0.6	1.8	4.5				
N	*Galium aparine*	0.5	1.4	4.5				
N	*Euphorbia glyptosperma*	0.5	2.7	4.5				
	Rock	32.6	58.4	100.0				
	Bare Soil	26.9	61.8	100.0				
	Litter	24.2	87.0	100.0				
	Moss	1.6	7.5	100.0				
	Lichen	0.3	1.8	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Salix exigua-Rosa woodsii (SAEX-ROWO)
(coyote willow-Wood's rose) 5 stands

The *Salix exigua-Rosa woodsii* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It was encountered at 4 sites along the Weiser Reach and at 1 site in the Brownlee Reservoir Reach. Sites occurred from 2,077 to 2,090 ft on 4- to 31-degree slopes on a variety of aspects. No soil information was collected. This assemblage is similar to the *Salix exigua-Rosa woodsii* plant assemblage identified in the *Forested Wetland* cover type.

Islands above Cobb Rapids Plot: BA98ADRBSL

Salix exigua is native to Idaho and Oregon and is common on sandbars, gravel bars, and among rocks along rivers and larger streams, particularly at low to mid elevations. It forms dense, shrubby patches after flood disturbance and is an indicator of poor stream channel stability (Miller 1976). At times it can grow to become a small tree, most often along calm river stretches or on smaller streams (Johnson 1995). In Hells Canyon, *Salix exigua* occurs as a dominant or codominant species in several plant assemblages. This species was encountered on 184 transects, in all 4 riparian cover types, and mostly in the Weiser Reach (86 transects) and the headwaters of Brownlee Reservoir (76 transects). In this assemblage, it is the dominant species, providing nearly 73% cover and occurring in nearly all plots along transects (frequency = 88%). It has an average height of about 2.4 m.

Rosa woodsii is considered codominant in this assemblage. It is the most common Rocky Mountain *Rosa* species. The hips, or fruit, of any wild roses may be eaten and are often used to make jams and jellies. In Hells Canyon, *Rosa woodsii* was a commonly encountered riparian species, and it also occurred in several upland transects. It was encountered on 175 transects, in 10 cover types, and in all study reaches. *Rosa woodsii* was more common in the Weiser Reach (58 transects) and headwaters of Brownlee Reservoir (54 transects). In this assemblage, it dominates the shrub understory, providing over 36% cover and occurring in 43% of all plots along transects. It has an average height of about 1.5 m.

The herbaceous layer has no graminoid species but has 10 forb species. This layer is dominated by the weedy forb *Lepidium latifolium*, listed a noxious weed in both Idaho and Oregon. This species is abundant in many riparian plant assemblages along the headwaters of Brownlee Reservoir and in the Weiser Reach. Two other noxious weed species were encountered in this assemblage: *Cirsium arvense* and *Conium maculatum*. Litter covers almost 78% of the ground surface, and bare soil is exposed on 9% of the ground. No mosses or lichens were observed.

Appendix 3 (cont.).

Other Studies

Asherin and Claar (1976) identify several *Salix exigua*-dominated plant communities based on one or two site investigations in the study area. Miller (1976) documents a *Salix exigua* community type, distinctive in its depauperate appearance, at the mouths of streams on both the Salmon and Snake rivers. Herbaceous flora associated with the community type include disturbance species, such as annual *Bromus* spp., *Artemisia ludoviciana*, and *Toxicodendron radicans*. Crowe and Clausnitzer (1997) identify a *Salix exigua*-dominated plant association that occurs at elevations of 3,000 to 4,340 ft throughout the Blue and Wallowa mountains.

Appendix 3 (cont.).

SAEX-ROWO Site Conditions

Elevation (ft): 2,083.4 (range 2,077.0–2,090.0)

Slope (°): 14.2 (range 4.0–31.0)

Aspect: N(1), NE(2), NW(1), SE(1)

[a] Soil Texture: 0

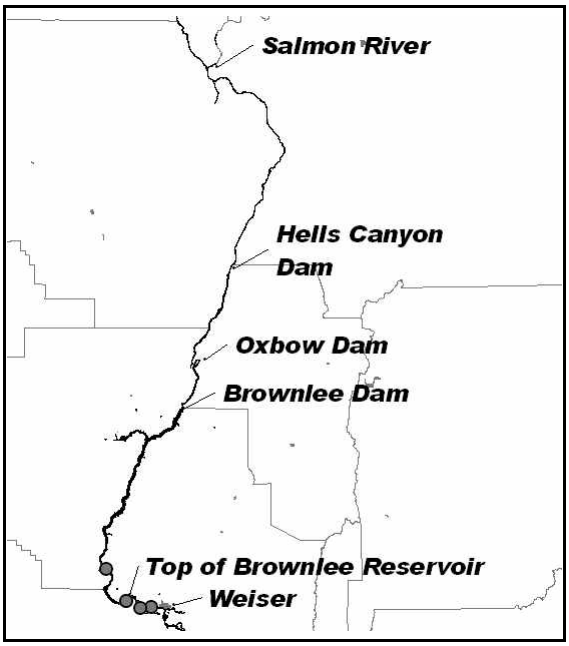
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAEX-ROWO Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
I	*Fraxinus pennsylvanica*	3.9	5.0	20.0	83	9.20		
I	*Elaeagnus angustifolia*	1.6	2.0	20.0	17	6.40		
	Shrubs (7) [b]							
N	*Salix exigua*	72.7	87.5	100.0	31,700	2.37	7,100	0.36
N	*Rosa woodsii*	36.3	43.0	100.0	10,200	1.49	2,000	0.33
N	*Salix amygdaloides*	13.2	15.5	20.0	1,000	0.55		
I	*Amorpha fruticosa*	3.7	5.0	40.0	1,000	0.95	5,000	0.10
I	*Tamarix parviflora*	3.2	4.5	20.0				
I	*Elaeagnus angustifolia*	2.8	3.5	20.0				
	Grasses (0) [b]							
	Forbs (10) [b]							
I	*Lepidium latifolium*	24.0	74.0	80.0				
N	*Asclepias speciosa*	12.2	22.0	40.0				
I	*Cirsium arvense*	3.6	19.0	20.0				
N	*Smilacina stellata*	1.9	8.0	20.0				
	Litter	77.5	100.0	100.0				
	Bare Soil	9.0	42.0	100.0				
	Rock	2.0	17.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Salix exigua-Apocynum cannabinum (SAEX-APCA)
(coyote willow-hemp dogbane) 9 stands

The *Salix exigua-Apocynum cannabinum* plant assemblage is uncommon in the *Scrub-Shrub Wetland* cover type. It was encountered at 7 sites along the Weiser Reach, at 1 site in the Hells Canyon Reservoir Reach, and in the reach below Hells Canyon dam. Sites occurred from 1,110 to 2,090 ft on 0- to 38-degree slopes on a variety of aspects. No soil information was collected.

McRae Island Plot: BA97MCRBS1

Salix exigua is native to Idaho and Oregon and is common on sandbars, gravel bars, and among rocks along rivers and larger streams, particularly at low to mid elevations. It forms dense, shrubby patches after flood disturbance and is an indicator of poor stream channel stability (Miller 1976). At times it can grow to become a small tree, most often along calm river stretches on smaller streams (Johnson 1995). In Hells Canyon, *Salix exigua* occurs as a dominant or codominant species in several plant assemblages. This species was encountered on 184 transects, in all 4 riparian cover types, and mostly in the Weiser Reach (86 transects) and the headwaters of Brownlee Reservoir (76 transects). In this assemblage, it is the dominant species, providing nearly 80% cover and occurring in nearly all plots along transects (frequency = 96%). It has an average height of about 1.5 m.

Apocynum cannabinum is a widespread native, perennial herb that can become weedy along roadsides and in other disturbed areas. It has been called Indian hemp because of its use by prehistoric tribes for high-quality fiber (Whitson et al. 1992). It is poisonous to livestock. In Hells Canyon, it was encountered on 93 transects and in 7 cover types, but principally in the Weiser Reach (55 transects). In this assemblage, *Apocynum cannabinum* is codominant, providing almost 25% cover and occurring in most plots along transects (frequency = 73%).

This assemblage is species rich in graminoids (n = 17) and forbs (n = 42). Most are native and occur in trace amounts (< 1% cover). One rare plant species—*Cyperus rivularis*—and 5 noxious weeds—*Lythrum salicaria*, *Lepidium latifolium*, *Conium maculatum*, *Euphorbia esula*, and *Cirsium arvense*—were found. Litter covers over 35% of the ground surface, and bare soil is exposed on about 21% of the ground.

Other Studies

Asherin and Claar (1976) identify several *Salix exigua*-dominated plant communities based on one or two site investigations in the study area. Miller (1976) documents a *Salix exigua* community type, distinctive in its depauperate appearance, at the mouths of streams on both the Salmon and Snake rivers. Herbaceous

Appendix 3 (cont.).

flora associated with the community type include disturbance species, such as annual *Bromus* spp., *Artemisia ludoviciana*, and *Toxicodendron radicans*. Crowe and Clausnitzer (1997) identify a *Salix exigua*-dominated plant association that occurs at elevations of 3,000 to 4,340 ft throughout the Blue and Wallowa mountains.

SAEX-APCA Site Conditions

Elevation (ft): 1,935.6 (range 1,110.0–2,090.0)

Slope (°): 11.2 (range 0.0–38.0)

Aspect: E(2), F(2), N(2), NE(1), S(1), W(1)

[A] Soil Texture: 0

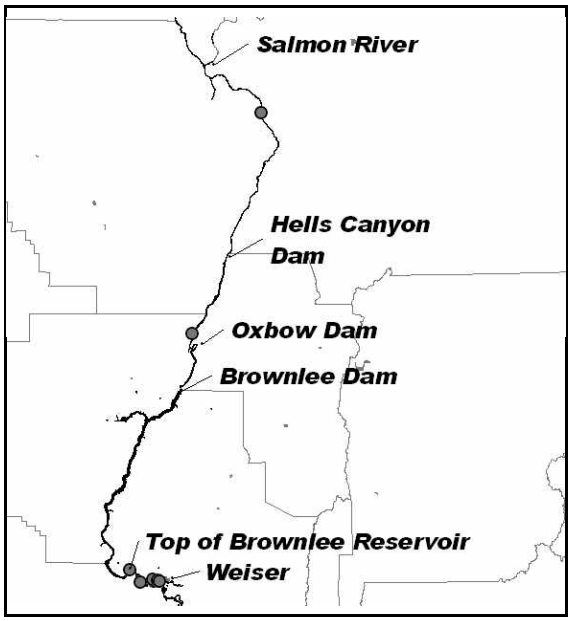
[A] Organic Matter %: 0

[A] pH: 0

[A] ON ppm: 0

[A] CEC meq/100g: 0

[A] Soil characteristic data unavailable.



SAEX-APCA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
I	*Acer negundo*	2.4	2.8	11.1	5	7.00		
	Shrubs (5) [b]							
N	*Salix exigua*	79.7	95.6	100.0	36,769	1.48	12,810	0.0
	Grasses (17) [b]							
N	*Phalaris arundinacea*	4.4	26.7	55.6				
I	*Agropyron repens*	3.1	6.7	11.1				
N	*Juncus balticus*	1.2	8.9	11.1				
I	*Echinochloa crus-galli*	1.1	20.6	55.6				
	Forbs (42) [b]							
N	*Apocynum cannabinum*	24.9	72.8	100.0				
I	*Lythrum salicaria*	4.8	31.7	66.7				
N	*Glycyrrhiza lepidota*	1.9	6.1	22.2				
N	*Solidago missouriensis* var. *fasciculata*	1.9	7.2	11.1				
N	*Equisetum arvense*	1.4	9.4	11.1				
I	*Lepidium latifolium*	1.4	13.3	44.4				
I	*Polygonum persicaria*	1.1	22.8	55.6				
N	*Polygonum coccineum*	1.0	4.4	11.1				
	Litter	35.3	94.4	100.0				
	Bare Soil	20.7	88.9	100.0				
	Rock	11.3	23.9	100.0				
	Moss	4.2	37.8	100.0				
	Lichen	1.6	21.7	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Prunus virginiana (PRVI)
(common chokecherry) 21 stands

The *Prunus virginiana* plant assemblage is common in the *Scrub-Shrub Wetland* cover type. It was encountered in all study reaches except the Weiser Reach. It is most abundant in the Oxbow and Hells Canyon Reservoir areas. Many sites (14 of 21) were found in tributary drainages to the Snake River (Table 9), suggesting this assemblage is also characteristic of tributaries in the study area and not just the Snake River riparian zone. Sites occurred from 1,300 to 2,610 ft on 4- to 35-degree slopes on a variety of aspects. Average soil pH was neutral (pH = 7.1).

Hunter Creek Plot: HC980962G4

Prunus virginiana is a small tree or tall shrub and is one of the most widespread woody plants in North America. It occupies habitats from stream bottoms to rocky outcrops, from Canada to Utah, from the lowest elevations to the subalpine zone (Johnson 1995). In the Hells Canyon area, *Prunus virginiana* is more commonly a medium to tall shrub that occupies moist slopes and riparian areas. It was encountered in 158 transects, in all study reaches except the Weiser Reach, and in 9 cover types. In this assemblage, it provides over 20% cover and occurs in about one-third of all plots along transects (frequency = 29%). Several other shrub species are abundant in this assemblage: namely, *Celtis reticulata*, *Crataegus douglasii*, *Toxicodendron radicans*, and *Rosa woodsii*.

This assemblage is extremely species rich (n = 90), and most species are native. Most herbaceous species occur in trace amounts (< 1% cover). Litter covers most of the ground surface (cover = 57%), and rock covers almost 16% of the surface.

Other Studies

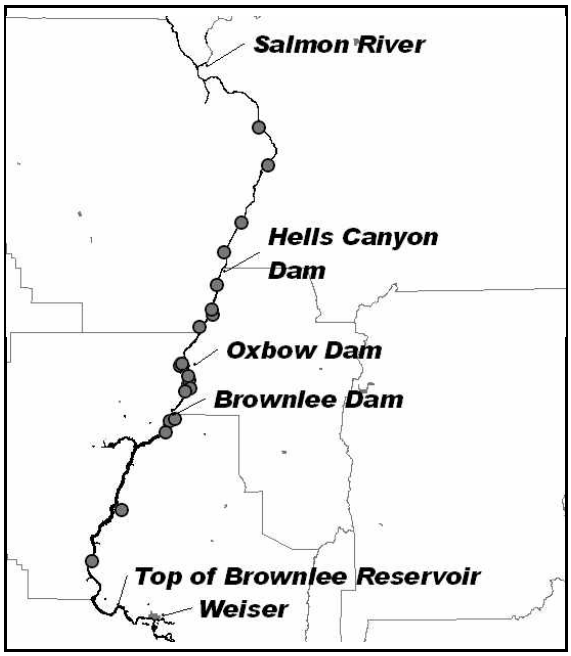
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

PRVI Site Conditions

Elevation (ft): 1,954.4 (range 1,300.0–2,610.0)
Slope (°): 17.8 (range 4.0–35.0)
Aspect: E(5), N(6), NW(2), S(2), W(6)
[A] Soil Texture: sandy loam(13), silty loam(1)
[A] Organic Matter %: 7.8 (range 3.4–15.0)
[A] pH: 7.1 (range 6.3–7.9)
[A] ON ppm: 63.9 (range 55.0–65.0)
[A] CEC meq/100g: 16.8 (range 13.0–20.0)

[A] Soil characteristic data available for 14 stands.



PRVI Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (12) [b]							
	Shrubs (32) [b]							
N	*Prunus virginiana*	20.1	28.5	81.0	8,468	1.66	3,840	0.27
N	*Celtis reticulata*	17.6	22.6	57.1	385	2.67	1,407	0.12
N	*Crataegus douglasii*	13.7	14.8	39.1	3,047	3.28	2,286	0.04
N	*Toxicodendron radicans*	13.5	21.9	52.4	5,714	0.69	50,093	0.29
N	*Rosa woodsii*	10.2	19.6	42.9	15,611	1.33	2,443	0.31
N	*Philadelphus lewisii*	9.6	13.3	47.6	10,524	1.73	2,383	0.34
N	*Crataegus columbiana*	5.7	9.3	28.6	4,611	1.49	3,254	0.26
N	*Symphoricarpos albus*	5.7	10.3	33.3	14,616	0.84	9,096	0.35
N	*Ribes niveum*	5.2	5.7	9.5	302	1.32	63	0.23
N	*Sambucus cerulea*	4.5	6.2	28.6	548	2.12		
N	*Acer glabrum*	2.7	2.9	14.3	24	5.90	381	0.11
	Grasses (13) [b]							
I	*Bromus sterilis*	4.0	23.9	52.4				
	Forbs (33) [b]							
I	*Anthriscus scandicina*	7.6	40.9	71.4				
N	*Galium aparine*	2.4	36.4	90.5				
	Litter	57.0	98.3	100.0				
	Rock	15.9	53.4	100.0				
	Bare Soil	7.2	51.3	100.0				
	Moss	4.7	45.2	100.0				
	Lichen	1.8	28.6	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Toxicodendron radicans (TORA)
(poison ivy) 21 stands

The *Toxicodendron radicans* plant assemblage is common in the *Scrub-Shrub Wetland* cover type. It was encountered in all study reaches except the Weiser Reach. Sites occurred from 1,390 to 2,120 ft on 0- to 41-degree slopes on a variety of aspects. No soil information was collected.

Dry Creek Plot: BR981735G1

Toxicodendron radicans is native to Oregon and Idaho and occupies many habitats along floodplains and river terraces. In Hells Canyon, it is a commonly occurring understory species and is often a nuisance to recreationists, causing severe skin rashes. It varies from a sub-shrub, often less than 1 m tall, to a distinct shrub, up to 3 m tall (Whitson et al. 1992). In some locations in the canyon, *Toxicodendron radicans* can form nearly impenetrable stands. It was encountered on 196 transects in 10 cover types and in all study reaches, but principally below Hells Canyon Dam (75 transects). In this assemblage, it is clearly the dominant species, contributing over 77% cover and occurring in most plots along transects (frequency = 86%). Average height of mature plants (> 0.5 m tall) is about 0.7 m.

This assemblage is relatively species rich in shrubs (n = 9), graminoids (n = 7), and forbs (n = 35), while all but *Toxicodendron radicans* occur in low amounts and infrequently. Most species are introduced. This assemblage contains 7 species of noxious weeds: *Taeniatherum caput-medusae*, *Lepidium latifolium*, *Dipsacus sylvestris*, *Conium maculatum*, *Cynoglossum officinale*, *Cardaria draba*, and *Onopordum acanthium*. Litter covers almost 47% of the ground surface, and rock covers about 39% of the ground.

Other Studies

This plant assemblage has not been described for the Hells Canyon area. Asherin and Claar (1976) identify a few vegetation types in which *Toxicodendron radicans* occurs as a codominant species in the understory.

Appendix 3 (cont.).

TORA Site Conditions

Elevation (ft): 1,827.0 (range 1,390.0–2,120.0)

Slope (°): 23.6 (range 0.0–41.0)

Aspect: E(2), F(1), NE (2), NW(3), S(3), SE(5), SW(3), W(2)

[A] Soil Texture: 0

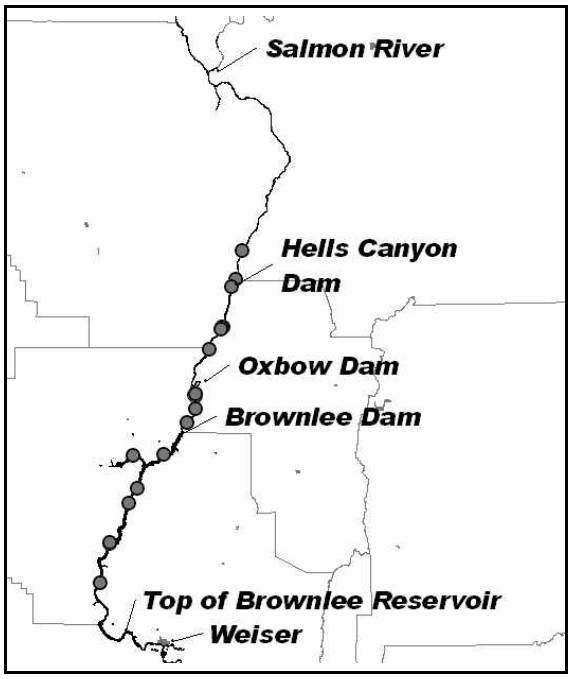
[A] Organic Matter %: 0

[A] pH: 0

[A] ON ppm: 0

[A] CEC meq/100g: 0

[A] Soil characteristic data unavailable.



TORA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
	Shrubs (9) [b]							
N	*Toxicodendron radicans*	77.1	86.2	90.5	60,317	0.71	116,238	0.32
N	*Celtis reticulata*	3.9	5.2	19.0	476	1.65	159	0.40
I	*Rubus laciniatus*	2.8	3.8	9.5	762	0.68	286	0.38
I	*Rubus discolor*	2.7	4.8	9.5	95	0.90		
I	*Prunus cerasifera*	2.6	3.3	4.8	71	4.93		
N	*Rosa woodsii*	2.5	7.1	19.0	1,587	1.19	317	0.21
N	*Artemisia tridentata*	1.8	4.8	4.8	286	0.80	190	0.28
N	*Prunus virginiana*	1.5	1.9	4.8	24	5.75		
	Grasses (7) [b]							
I	*Bromus sterilis*	3.5	26.2	42.9				
I	*Bromus japonicus*	1.7	19.5	42.9				
I	*Bromus tectorum*	1.0	21.0	66.7				
	Forbs (35) [b]							
N	*Solidago canadensis*	5.4	9.5	9.5				
I	*Lepidium latifolium*	4.8	21.4	28.6				
N	*Solidago occidentalis*	3.3	8.8	9.5				
I	*Dipsacus sylvestris*	2.0	8.1	23.8				
I	*Melilotus alba*	1.7	12.9	33.3				
I	*Solanum dulcamara*	1.5	3.8	4.8				
I	*Conium maculatum*	1.3	4.3	4.8				
N	*Montia perfoliata*	1.3	4.3	4.8				
N	*Artemisia biennis*	1.1	4.3	4.8				
	Litter	46.7	92.9	100.0				
	Rock	38.9	69.5	100.0				
	Bare Soil	5.3	34.5	100.0				
	Lichen	0.6	13.1	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Salix amygdaloides*/*Salix exigua (SAAM/SAEX)
(peachleaf willow/coyote willow) 17 stands

The *Salix amygdaloides*/*Salix exigua* plant assemblage is common in the *Scrub-Shrub Wetland* cover type. It was encountered at Weiser Reach (14 sites) and in the headwaters of Brownlee Reservoir (3 sites). Sites occurred between 2,077 and 2,090 ft on 0- to 32-degree slopes. No soil data were collected.

Porters Flat Plot: BA982057G2

Salix amygdaloides, a native of Idaho and Oregon, is usually a shrub, but on the Snake River Plain, and particularly in southwestern Idaho, it grows tall enough to be considered a tree (Johnson 1995). In Hells Canyon, it is a common tree species, but principally just in and below the Weiser Reach. *Salix amygdaloides* was encountered on 129 transects, in 4 cover types, and in the Weiser Reach (70 transects), the headwaters of Brownlee Reservoir (55 transects), and on 1 transect in the Hells Canyon Reservoir Reach. In this assemblage, it provides only a trace amount of cover (< 1%) in the tree layer (> 6 m tall); its average height is about 7.2 m. In the shrub layer, *Salix amygdaloides* provides about 13% cover, is present in about 17% of the plots along transects, and has an average height of about 2.7 m.

Salix exigua is native to Idaho and Oregon and is common on sandbars, gravel bars, and among rocks along rivers and larger streams, particularly at low to mid elevations. It forms dense, shrubby patches after flood disturbance and is an indicator of poor stream channel stability (Miller 1976). At times it can grow to become a small tree, most often along calm river stretches or on smaller streams (Johnson 1995). In Hells Canyon, it was encountered on 184 transects, in all 4 riparian cover types, and mostly in the Weiser Reach (86 transects) and the headwaters of Brownlee Reservoir (76 transects). In this assemblage, *Salix exigua* is the dominant shrub, providing over 86% cover and occurring in nearly all plots along transects (frequency = 92%). It has an average height of 2.2 m.

This assemblage is relatively species rich in shrubs (n = 13), graminoids (n = 7), and forbs (n = 24). Total cover of herbaceous species is relatively low. Herbaceous cover is dominated by *Lythrum salicaria*, a listed noxious weed in both Idaho and Oregon. Two other noxious weeds occur in trace amounts: *Conium maculatum* and *Lepidium latifolium*. About one-half the species in this assemblage are native. Litter covers almost 47% of the ground surface, and bare soil is exposed on over 28% of the ground.

Other Studies

This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

SAAM/SAEX Site Conditions

Elevation (ft): 2,081.8 (range 2,077.0–2,090.0)

Slope (°): 11.8 (range 0.0–32.0)

Aspect: E(1), F(4), N(4), NE(3), NW(1), S(1), SW(3)

[a] Soil Texture: 0

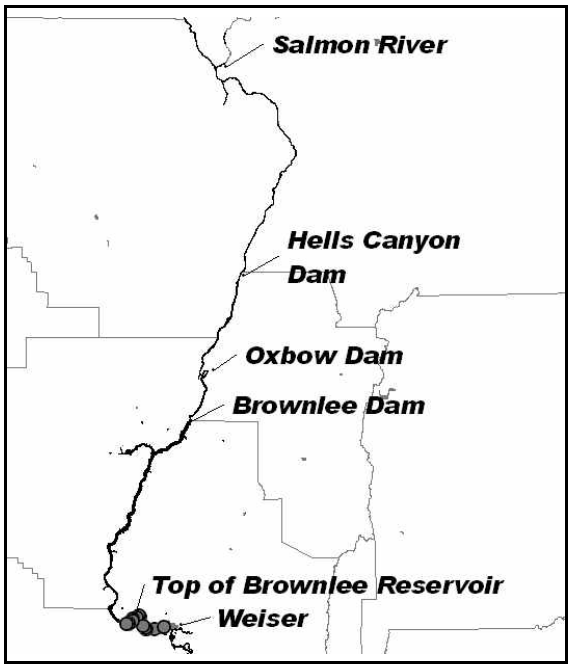
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAAM/SAEX Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (3) [b]							
N	*Salix exigua*	1.5	1.5	11.8	206	6.82		
	Shrubs (13) [b]							
N	*Salix exigua*	86.4	92.1	100.0	27,299	2.20	4,564	0.32
N	*Salix amygdaloides*	12.5	16.8	64.7	1,137	2.71	309	0.17
N	*Rosa woodsii*	8.7	13.1	47.1	1,382	1.28	441	0.37
N	*Ribes aureum*	7.4	10.9	29.4	686	2.13	2,108	0.34
I	*Salix alba*	1.4	1.8	17.6	588	1.28	1559	0.11
I	*Amorpha fruticosa*	1.1	1.8	17.6	588	1.28	1559	0.11
	Grasses (7) [b]							
N	*Phalaris arundinacea*	2.6	23.2	76.5				
	Forbs (24) [b]							
I	*Lythrum salicaria*	7.3	32.6	64.7				
N	*Apocynum cannabinum*	1.9	10.6	29.4				
I	*Solanum dulcamara*	1.5	7.6	29.4				
N	*Solidago occidentalis*	1.5	10.0	35.3				
I	*Nepeta cataria*	1.2	6.2	17.6				
	Litter	46.8	98.2	100.0				
	Bare Soil	28.1	86.8	100.0				
	Rock	1.1	6.5	100.0				
	Moss	0.5	8.8	100.0				
	Lichen	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Salix amygdaloides/Salix exigua/Xanthium strumarium (SAAM/SAEX/XAST)
(peachleaf willow/coyote willow/common cocklebur) 20 stands

The *Salix amygdaloides/Salix exigua/Xanthium strumarium* plant assemblage is common in the *Scrub-Shrub Wetland* cover type. It was encountered in the Weiser (4 sites) and the Brownlee Reservoir (16 sites) reaches. Sites occurred between 2,077 and 2,080 ft on 0- to 11-degree slopes. No soil data were collected.

Darrows Islands Plot: BR99DARBS3

Salix amygdaloides, a native of Idaho and Oregon, is usually a shrub, but on the Snake River Plain, and particularly in southwestern Idaho, it grows tall enough to be considered a tree (Johnson 1995). In Hells Canyon, *Salix amygdaloides* is a common tree species, but principally just in and below the Weiser Reach. It was encountered on 129 transects and in 4 cover types, in the Weiser Reach (70 transects), the headwaters of Brownlee Reservoir (55 transects), and in the Hells Canyon Reservoir Reach (1 transect). In this assemblage, *Salix amygdaloides* has not grown tall enough to reach tree height (> 6 m tall), but provides almost 43% cover and is present in just over one-half of all plots along transects (frequency = 51%). Its average height is about 2.1 m.

Salix exigua is native to Idaho and Oregon and is common on sandbars, gravel bars, and among rocks along rivers and larger streams, particularly at low to mid elevations. It forms dense, shrubby patches after flood disturbance and is an indicator of poor stream channel stability (Miller 1976). At times it can grow to become a small tree, most often along calm river stretches or on smaller streams (Johnson 1995). In Hells Canyon, *Salix exigua* was encountered on 184 transects and in all 4 riparian cover types, mostly in the Weiser Reach (86 transects) and in the headwaters of Brownlee Reservoir (76 transects). In this assemblage, *Salix exigua* is the dominant shrub, providing over 34% cover and occurring on about one-half of all plots along transects (frequency = 48%). Its average height is about 1.6 m.

Xanthium strumarium is an annual plant native to North America, but it now has worldwide distribution. It is common in cultivated fields, abandoned land, road ditches, and other disturbed areas. Its burs are irritating to both humans and animals, and both the seeds and seedlings are toxic to livestock (Whitson et al. 1992). In the study area, *Xanthium strumarium* is often one of the species to become temporarily established in the drawdown zone along Brownlee Reservoir in areas where muddy soils are exposed. It is a commonly occurring species and was encountered in 189 transects, in 6 cover types, and in all study reaches. Most encounters were along the Brownlee Reservoir Reach (115 transects). In this assemblage, *Xanthium strumarium* is the dominant herbaceous plant, providing almost 17% cover and occurring in

Appendix 3 (cont.).

nearly one-half of the plots along transects (frequency = 42%). *Heleochloa alopecuroides* is also common in the herbaceous layer.

This assemblage is relatively species rich in graminoids (n = 11) and forbs (n = 23). About one-half the species in this assemblage are native. One noxious weed occurs in the assemblage, *Lythrum salicaria*, providing over 2% cover and occurring in about 13% of all plots along transects. Bare soil is exposed on about 50% of the ground surface, and litter covers just over 14% of the ground.

Other Studies

This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

SAAM/SAEX/XAST Site Conditions

Elevation (ft): 2,077.6 (range 2,077.0–2,080.0)

Slope (°): 3.7 (range 0.0–11.0)

Aspect: F(7), N(5), NE(2), SE(1), SW(4), W(1)

[a] Soil Texture: 0

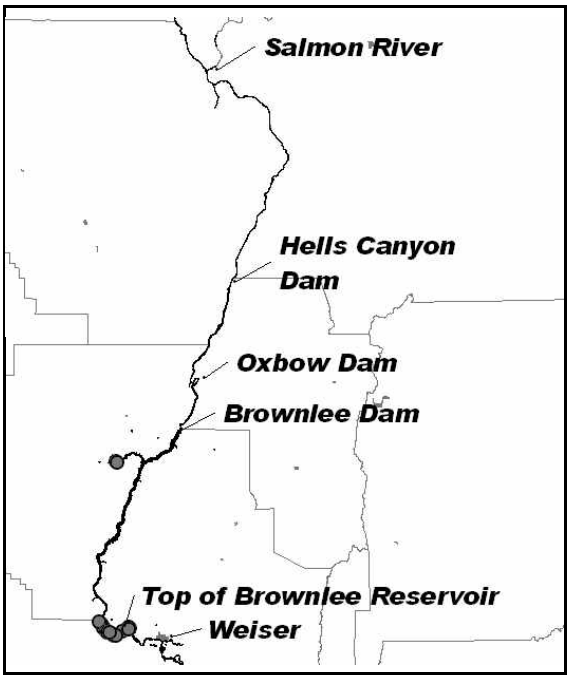
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAAM/SAEX/XAST Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
I	*Acer saccharinum*	1.1	1.3	5.0				
	Shrubs (6) [b]							
N	*Salix amygdaloides*	42.7	50.8	70.0	9,167	2.08	42,017	0.28
N	*Salix exigua*	34.1	47.6	75.0	14,425	1.55	20,942	0.30
I	*Tamarix pentandra*	6.7	8.5	10.0	1,600	0.50	69,150	0.10
	Grasses (11) [b]							
I	*Heleochloa alopecuroides*	14.8	45.5	95.0				
N	*Eragrostis pectinacea*	1.0	13.3	40.0				
N	*Cyperus erythrorhizos*	0.8	11.8	40.0				
N	*Phalaris arundinacea*	0.7	2.0	15.0				
N	*Eragrostis hypnoides*	0.7	7.8	40.0				
N	*Cyperus aristatus*	0.7	12.8	40.0				
	Forbs (23) [b]							
N	*Xanthium strumarium*	16.8	42.0	80.0				
I	*Amaranthus retroflexus*	2.5	22.8	65.0				
I	*Lythrum salicaria*	2.1	13.5	30.0				
I	*Chenopodium album*	0.8	16.5	60.0				
I	*Portulaca oleracea*	0.7	12.0	55.0				
N	*Mollugo verticillata*	0.7	15.8	80.0				
N	*Lindernia anagallidea*	0.5	9.8	20.0				
N	*Polygonum bistortoides*	0.5	5.0	5.0				
	Bare Soil	49.8	97.5	100.0				
	Litter	14.2	84.5	100.0				
	Rock	3.4	8.5	100.0				
	Moss	0.9	8.5	100.0				
	Lichen	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Salix amygdaloides*/*Rosa woodsii (SAAM/ROWO)
(peachleaf willow/Wood's rose) 4 stands

The *Salix amygdaloides*/*Rosa woodsii* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It was encountered at 2 sites in the Weiser and 2 sites in the Brownlee Reservoir reaches. Sites occurred between 2,077 and 2,080 ft on 3- to 40-degree slopes. No soil data were collected.

Across from Porters Island Plot: BA981860I3

Salix amygdaloides, a native of Idaho and Oregon, is usually a shrub, but on the Snake River Plain, and particularly in southwestern Idaho, it grows tall enough to be considered a tree (Johnson 1995). In Hells Canyon, *Salix amygdaloides* is a common tree species, but principally just in and below the Weiser Reach. It was encountered on 129 transects and in 4 cover types, in the Weiser Reach (70 transects), the headwaters of Brownlee Reservoir (55 transects), and in the Hells Canyon Reservoir Reach (1 transect). In this assemblage, *Salix amygdaloides* has not grown tall enough to reach tree height (> 6 m tall), but provides almost 74% cover and is present in most plots along transects (frequency = 78%). It has an average height of over 3.1 m.

Rosa woodsii is considered codominant in this assemblage. It is the most common Rocky Mountain *Rosa* species. The hips, or fruit, of any wild roses may be eaten and are often used to make jams and jellies. In Hells Canyon, *Rosa woodsii* was a commonly encountered riparian species, and it also occurred in several upland transects. It was encountered on 175 transects, in 10 cover types, and in all study reaches. It was more common in the Weiser Reach (58 transects) and headwaters of Brownlee Reservoir (54 transects). In this assemblage, *Rosa woodsii* provides almost 70% cover and occurs in 75% of all plots along transects. Its average height is about 1.4 m.

The herbaceous layer has no graminoid species and is dominated by the weedy forb *Lepidium latifolium*, listed a noxious weed species in both Idaho and Oregon. This species is abundant in many riparian plant assemblages along the headwaters of Brownlee Reservoir and in the Weiser Reach. Two other noxious weed species are present: *Cirsium arvense* and *Conium maculatum*. Litter covers more than 69% of the ground surface, and very little bare soil and rock are exposed. No mosses or lichens were observed.

Other Studies

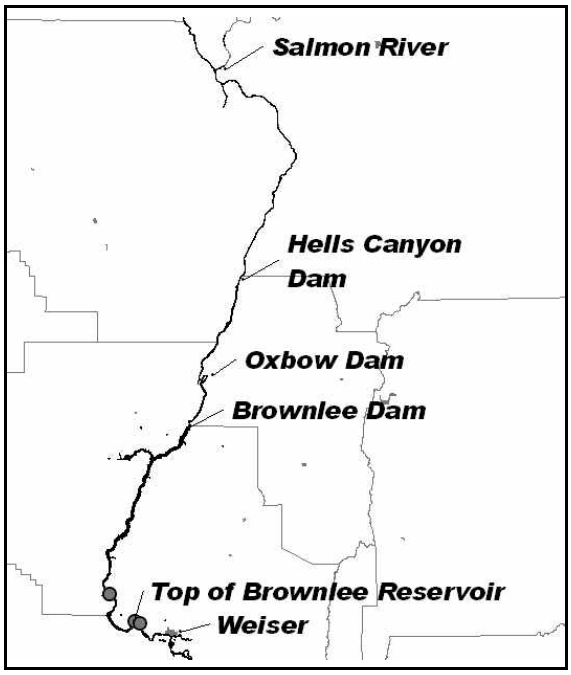
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

SAAM/ROWO Site Conditions

Elevation (ft): 2,078.5 (range 2,077.0–2,080.0)
Slope (°): 3.7 (range 3.0–40.0)
Aspect: E(1), NE(1), SE(1), W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAAM/ROWO Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
N	*Salix amygdaloides*	73.9	77.5	100.0	2,292	3.13		
N	*Rosa woodsii*	69.8	75.0	75.0	32,083	1.44	6,667	0.20
N	*Salix lutea*			25.0	833	0.70		
	Grasses (0) [b]							
	Forbs (8) [b]							
I	*Lepidium latifolium*	11.0	51.3	75.0				
I	*Cirsium arvense*	3.3	22.5	50.0				
N	*Solidago canadensis*	2.2	16.3	25.0				
N	*Solidago occidentalis*	0.7	15.0	25.0				
I	*Conium maculatum*	0.5	6.3	25.0				
	Unknown forb	0.3	3.8	25.0				
N	*Apocynum cannabinum*	0.2	1.3	25.0				
N	*Asclepias speciosa*	0.1	5.0	25.0				
	Litter	69.4	100.0	100.0				
	Rock	1.6	15.0	100.0				
	Bare Soil	1.2	16.3	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Philadelphus lewisii (PHLE)
(syringa) 17 stands

The *Philadelphus lewisii* plant assemblage is common in the *Scrub-Shrub Wetland* cover type. It was encountered in all study reaches except the Weiser Reach. Many sites (10 of 17) were found in tributary drainages to the Snake River (Table 9), suggesting this assemblage is also characteristic of tributaries in the study area and not just the Snake River riparian zone. Sites occurred between 1,340 and 2,300 ft on 4- to 35-degree slopes on a variety of aspects. Soil pH was neutral (pH = 6.9).

Near Ashby Creek Plot: HC970877I1

Philadelphus lewisii ranges from British Columbia north through Oregon and Washington and east to Montana. It is widely distributed in northern Idaho and is the state flower (Taylor 1992). This attractive shrub bears numerous, rather large, very fragrant white flowers. *Philadelphus lewisii* is a very common shrub in the canyon and is a codominant species in several plant assemblages. It was encountered on 173 transects, in 9 cover types, and in all reaches except the Weiser Reach. In this assemblage, *Philadelphus lewisii* is the dominant species, providing almost 38% cover and occurring in one-half of all plots along transects (frequency = 50%). Its average height is about 2.3 m in the mature height-class (> 0.5 m tall) and about 0.3 m in the seedling height-class. Several tree species occur occasionally in this assemblage but provide little cover.

This assemblage is species rich in all life forms and has a total of 49 species. Nearly all the tree and shrub species are native, while most of the herbaceous species are introduced. The rare endemic *Rubus bartonianus* was found at 2 sites in this assemblage. Five species of noxious weeds also occur: *Cynoglossum officinale*, *Conium maculatum*, *Lepidium latifolium*, *Dipsacus sylvestris*, and *Onopordum acanthium*. Litter covers 45% of the ground surface, and rock is exposed on about 43% of the surface.

Other Studies

This assemblage has not been previously described for the study area. A few authors identify *Philadelphus lewisii* as codominant in some assemblages in the study area and its vicinity (Asherin and Claar 1976, Miller 1976).

Appendix 3 (cont.).

PHLE Site Conditions

Elevation (ft): 1,766.3 (range 1,340.0–2,300.0)

Slope (°): 18.9 (range 4.0–35.0)

Aspect: E(2), N(1), NE(2), NW(6), S(2), SE(1), SW(1), W(2)

[a] Soil Texture: SALO(4), SILO(2)

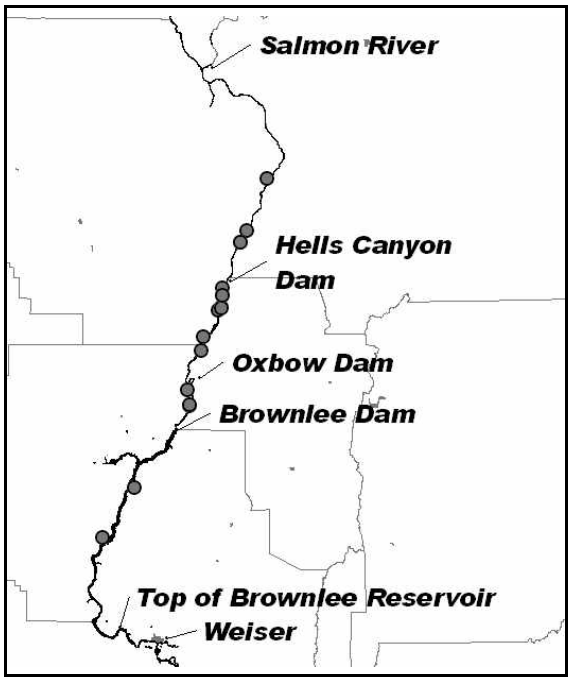
[a] Organic Matter %: 10.3 (range 4.2–17.0)

[a] pH: 6.9 (range 5.3–7.7)

[a] ON ppm: 55.8 (range 15.0–65.0

[a] CEC meq/100g: 18.2 (range 14.0–23.0

[a] Soil characteristic data available for 6 stands.



PHLE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (8) [b]							
N	*Betula occidentalis*	3.7	4.3	17.6	47	6.88		
N	*Celtis reticulata*	1.4	1.8	11.8	46	6.23		
N	*Alnus rhombifolia*	1.0	1.2	11.8	4	6.41		
	Shrubs (22) [b]							
N	*Philadelphus lewisii*	37.8	50.4	94.1	3,689	2.29	453	0.34
N	*Toxicodendron radicans*	20.4	31.4	58.8	6,749	0.79	15,807	0.29
N	*Sambucus cerulea*	17.0	24.1	58.8	429	3.55		
N	*Celtis reticulata*	14.6	20.8	47.1	824	2.89	4,226	0.13
N	*Prunus virginiana*	11.4	19.0	64.7	3,162	1.48	2,370	0.27
N	*Amelanchier alnifolia*	6.9	9.8	41.2	85	2.92	78	0.05
N	*Rubus bartonianus*	5.5	6.2	11.8	59	2.41		
N	*Cornus stolonifera*	4.3	5.1	17.6	317	2.63	235	0.22
X	*Salix* sp.	3.6	3.9	5.9	15	4.65	29	0.30
N	*Clematis ligusticifolia*	3.3	3.5	17.6	56	2.58		
N	*Prunus emarginata*	2.3	3.3	17.6	24	4.64		
I	*Rubus discolor*	1.1	1.2	11.8	209	0.95	118	0.17
	Grasses (7) [b]							
I	*Bromus sterilis*	3.3	24.0	64.7				
	Forbs (16) [b]							
I	*Anthriscus scandicina*	3.6	25.6	88.2				
N	*Galium aparine*	2.1	27.9	94.1				
I	*Cynoglossum officinale*	1.6	12.2	47.1				
I	*Conium maculatum*	1.5	6.3	11.8				
	Litter	45.0	95.3	100.0				
	Rock	43.2	82.4	100.0				
	Moss	9.2	58.4	100.0				
	Lichen	8.5	49.6	100.0				
	Bare Soil	1.9	26.4	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Rubus discolor (RUDI)
(Himalayan blackberry) 14 stands

The *Rubus discolor* plant assemblage is common in the *Scrub-Shrub Wetland* cover type. It was encountered in all study reaches except the Weiser Reach. It was most common in the Hells Canyon Reservoir Reach (10 sites). Sites occurred between 1,570 and 2,077 ft on 3- to 41-degree slopes on a variety of aspects. No soil data were collected from these sites.

Hunter Creek Plot: HC980962G3

Rubus discolor is introduced from the Old World and has become a serious pest in many areas, especially west of the Oregon Cascades (Hitchcock and Cronquist 1991). It can form impenetrable thickets and choke out most other vegetation. In the canyon, *Rubus discolor* is a somewhat common riparian species. It is both loved and hated by recreationists: loved for the berry picking opportunities but cursed for preventing shoreline access for camping and fishing. It was encountered in 43 transects, in all wetland cover types (4 cover types), and in all study reaches except the Weiser Reach. It was most often encountered along Hells Canyon Reservoir (34 transects) and below Hells Canyon Dam (7 transects). In this assemblage, *Rubus discolor* provides almost 97% cover and occurs in nearly every plot along transects (frequency = 98%). It has an average height of about 1.4 m and is very dense.

This assemblage is relatively species rich (n = 30), particularly in shrubs (n = 16), which occur infrequently and in low amounts of cover. Most of the shrubs are native species. Herbaceous cover is very low and consists of mostly introduced forbs and graminoids that occur infrequently and in trace amounts (< 1% cover). Two species of noxious weeds occur in trace amounts: *Taeniatherum caput-medusae* and *Lepidium latifolium*. Litter covers 50% of the ground surface, and rock covers almost 36% of the ground.

Other Studies

This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

RUDI Site Conditions

Elevation (ft): 1,723.1 (range 1,570.0–2,077.0)

Slope (°): 27.1 (range 3.0–41.0)

Aspect: E(2), NE(4), NW(2), SE(5), W(1)

[a] Soil Texture: 0

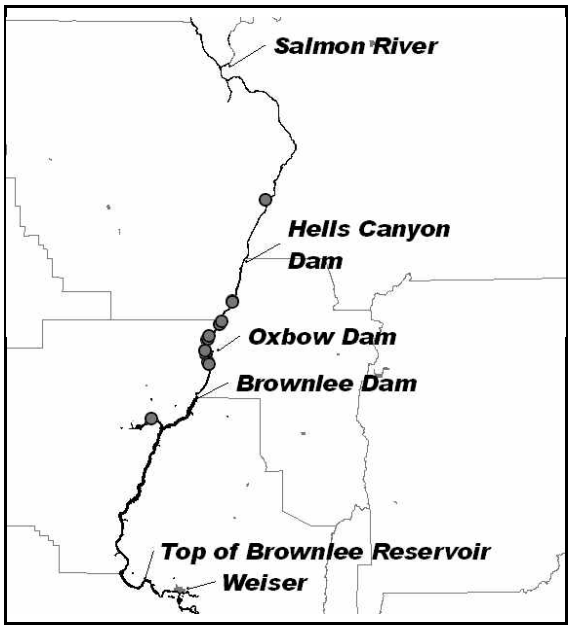
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



RUDI Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
I	*Ulmus pumila*	0.5	0.7	7.1				
	Shrubs (16) [b]							
I	*Rubus discolor*	96.9	98.1	100.0	55,262	1.43	4,726	0.36
N	*Celtis reticulata*	9.5	12.8	42.9	179	1.27	179	0.05
N	*Amelanchier alnifolia*	6.0	9.5	35.7	357	4.20		
N	*Cornus stolonifera*	2.8	3.6	14.3	429	2.25		
N	*Salix exigua*	2.6	2.9	7.1	71	0.60		
N	*Philadelphus lewisii*	2.1	3.6	21.4	1,012	1.41		
N	*Salix* sp.	2.0	2.4	7.1	95	2.93		
N	*Rhamnus purshiana*	1.3	1.9	7.1	143	2.73		
N	*Toxicodendron radicans*	0.6	1.1	21.4	429	0.51	714	0.20
N	*Rosa woodsii*	0.5	1.3	14.3	95	1.73		
	Grasses (8) [b]							
I	*Taeniatherum caput-medusae*	0.6	1.8	14.3				
I	*Bromus tectorum*	0.5	10.8	35.7				
	Forbs (5) [b]							
I	*Melilotus alba*	0.5	8.6	35.7				
	Litter	50.1	99.3	100.0				
	Rock	35.5	68.8	100.0				
	Bare Soil	4.4	25.2	100.0				
	Lichen	1.7	18.6	100.0				
	Moss	1.2	15.1	100.0				

[a] N = Native, I = Introduced

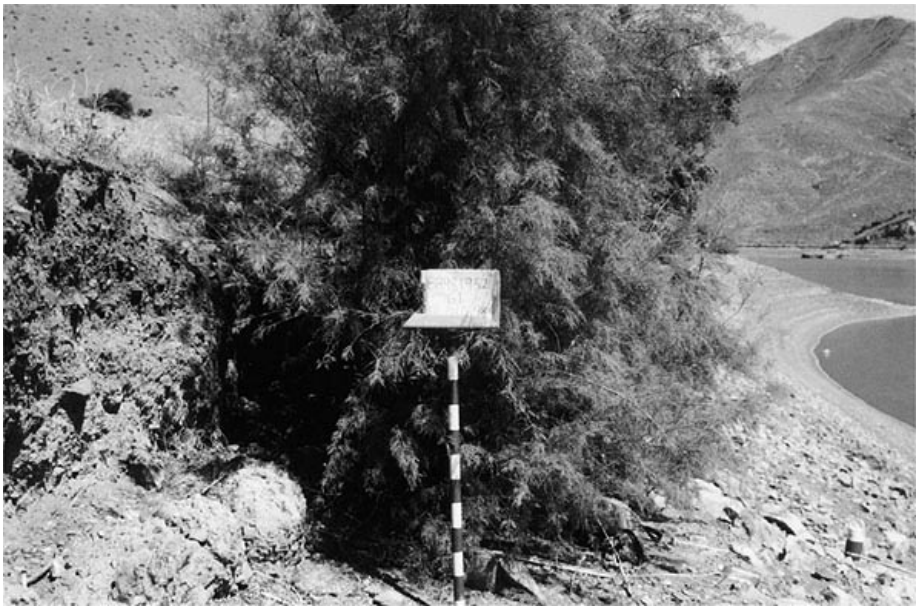
[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Tamarix parviflora (TAPA)
(tamarisk or salt cedar) 10 stands

The *Tamarix parviflora* plant assemblage is less common in the *Scrub-Shrub Wetland* cover type. It was encountered at 2 sites in the Weiser Reach and 8 sites in the headwaters of Brownlee Reservoir. Sites occurred at or near the high-water mark (2,077 to 2,080 ft) on 0- to 45-degree slopes on a variety of aspects. No soil data were collected.



Farewell Bend Plot: BR981952G1

Native to Eurasia, *Tamarix parviflora* was probably brought to Idaho and Oregon to serve as an ornamental tree. *Tamarix parviflora* has become naturalized in southwestern Idaho, mainly along the Snake River bottomlands or near the salt desert shrub type of vegetation. It is an aggressive invader that sprouts from the roots and also spreads by seed. In Hells Canyon at the upstream end of the study area, *Tamarix parviflora* appears to be rapidly increasing. It was encountered on 98 transects and in 5 cover types, in just the Weiser (33 transects) and the Brownlee Reservoir (65 transects) reaches. Apparently, this species has not yet invaded the lower reaches of the canyon. In this assemblage, *Tamarix parviflora* provides over 98% cover and is present in every plot along transects (frequency = 100%). Its average height is about 2.9 m. This assemblage is similar to the *Tamarix parviflora* plant assemblage in the *Forested Wetland* cover type, but *Tamarix* has not yet grown tall enough here to be classified as a tree (> 6 m).

This assemblage is species poor in all life forms, having a total of only 6 species. Total cover of herbaceous species is less than 1%. No rare plants or noxious weed species occur. Litter covers over 32% of the ground surface, and rock is exposed on about 28% of the ground.

Other Studies

This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

TAPA Site Conditions

Elevation (ft): 2,077.6 (range 2,077.0–2,080.0)

Slope (°): 12.0 (range 0.0–45.0)

Aspect: F(2), NW(1), SE(1), SW(4), W(2)

[a] Soil Texture: 0

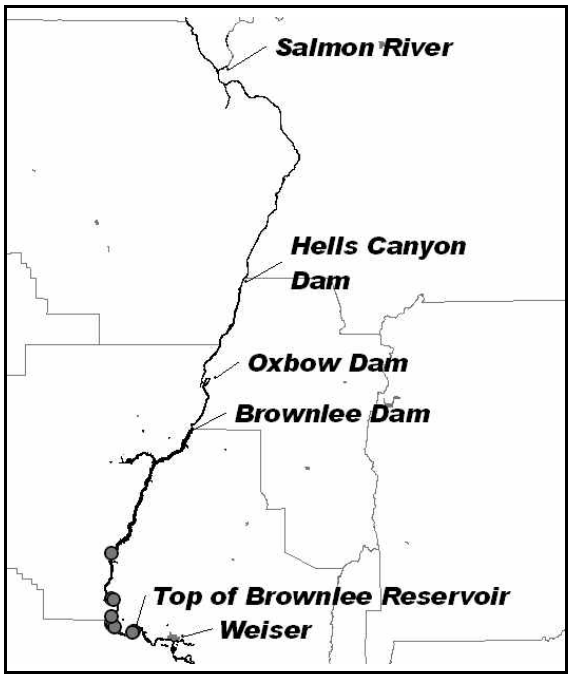
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



TAPA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
I	*Tamarix parviflora*	98.1	100.0	100.0	13,550	2.88	1,350	0.18
I	*Amorpha fruticosa*	0.9	1.5	20.0			1,900	0.05
N	*Salix exigua*	0.2	0.5	10.0	250	2.30		
	Grasses (1) [b]							
I	*Heleochloa alopecuroides*	0.2	6.0	20.0				
	Forbs (2) [b]							
N	*Solidago occidentalis*	0.4	6.5	20.0				
N	*Xanthium strumarium*	0.2	5.0	30.0				
	Litter	32.4	100.0	100.0				
	Rock	28.3	66.5	100.0				
	Bare Soil	18.4	42.5	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Tamarix parviflora*/*Solidago occidentalis (TAPA/SOOC)
(tamarisk or salt cedar/western goldenrod) 12 stands

The *Tamarix parviflora*/*Solidago occidentalis* plant assemblage is uncommon in the *Scrub-Shrub Wetland* cover type. It is one of the several plant assemblages dominated by *Tamarix parviflora*. It was encountered at 8 sites in the Weiser Reach and 4 sites in the Brownlee Reservoir Reach. Sites occurred at or near the high-water mark from 2,077 to 2090 ft on 0- to 22-degree slopes on a variety of aspects. No soil data were collected.

Islands above Cobb Rapids Plot: BA98ADRB56

Tamarix parviflora is native to Eurasia and was probably brought to Idaho and Oregon to serve as an ornamental tree. *Tamarix parviflora* has become naturalized in southwestern Idaho, mainly along the Snake River bottomlands or near the salt desert shrub type of vegetation. It is an aggressive invader that sprouts from the roots and also spreads by seed. In Hells Canyon at the upstream end of the study area, *Tamarix parviflora* appears to be rapidly increasing. It was encountered on 98 transects and in 5 cover types, in just the Weiser Reach (33 transects) and the Brownlee Reservoir Reach (65 transects). Apparently, this species has not yet invaded the lower reaches of the canyon. In this assemblage, *Tamarix parviflora* provides almost 75% cover and is present in most plots along transects (frequency = 82%). Its average height is over 2.3 m in the mature plant height-class (> 0.5 m tall) and about 3 cm in the seedling plant height-class. This species' density is very high, with over 63,000 seedling plants per ha. *Salix exigua* is the second most common shrub species in this assemblage.

Solidago occidentalis is a native to the area and grows in moist lowlands. A perennial that grows to heights of 4 ft, it spreads by creeping roots and seeds and has yellow flowers that occur from August to October. *Solidago occidentalis* is widespread in western North America. In this assemblage, it provides over 17% cover and occurs in more than one-half of the plots along transects (frequency = 55%).

This assemblage is species rich in shrubs (n = 7) and forbs (n = 18). It is relatively species poor in graminoids (n = 5), which occur infrequently and none with more than 0.2% cover. Three species of noxious weeds occur: *Lepidium latifolium*, *Lythrum salicaria*, and *Cirsium arvense*. *Lepidium latifolium* provides an average cover of more than 5% and occurs in nearly 13% of all plots along transects. Litter covers over 43% of the ground surface, and bare soil is exposed on over 30% of the ground.

Other Studies

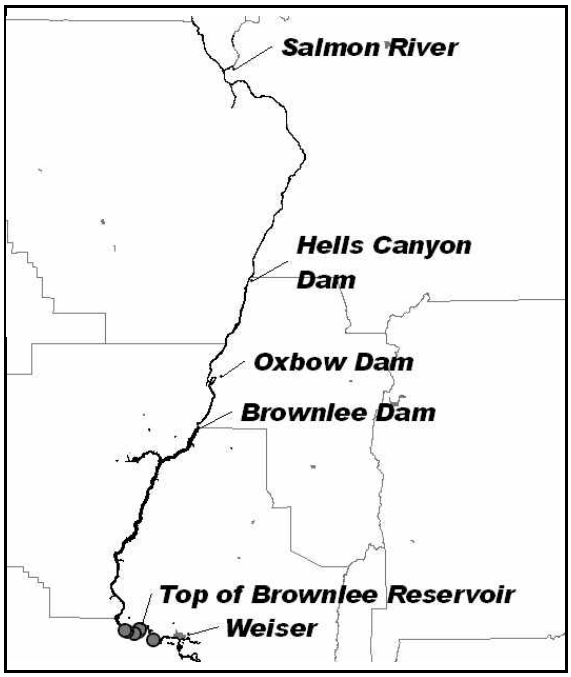
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

TAPA/SOOC Site Conditions

Elevation (ft): 2,079.8 (range 2,077.0–2,090.0)
Slope (°): 6.5 (range 0.0–22.0)
Aspect: E(2), F(1), N(2), NW(5), SE(2)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



TAPA/SOOC Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
	Shrubs (7) [b]							
I	*Tamarix parviflora*	74.9	82.3	100.0	21,097	2.33	63,194	0.03
N	*Salix exigua*	10.6	17.9	58.3	5,889	2.03	3,333	0.19
N	*Salix amygdaloides*	6.9	10.2	41.7	837	3.67		
I	*Amorpha fruticosa*	6.2	8.1	33.3	375	1.78	83	0.30
I	*Elaeagnus angustifolia*	1.5	1.7	8.3	42	4.30		
	Grasses (5) [b]							
	Forbs (18) [b]							
N	*Solidago occidentalis*	17.3	55.4	91.7				
N	*Apocynum cannabinum*	7.9	8.3	8.3				
I	*Lepidium latifolium*	5.5	12.9	41.7				
N	*Xanthium strumarium*	1.7	10.4	41.7				
I	*Atriplex heterosperma*	1.5	4.2	8.3				
I	*Lythrum hyssopifolium*	1.1	5.4	8.3				
I	*Lythrum salicaria*	1.1	15.4	41.7				
	Litter	43.2	93.8	100.0				
	Bare Soil	30.4	77.1	100.0				
	Rock	3.8	8.8	100.0				
	Moss	0.1	0.8	100.0				
	Lichen	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Tamarix parviflora*/*Xanthium strumarium (TAPA/XAST)
(tamarisk or salt cedar/common cocklebur) 3 stands

The *Tamarix parviflora*/*Xanthium strumarium* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It is one of the several plant assemblages dominated by *Tamarix parviflora* and was encountered at 1 site in the Weiser Reach and 2 sites in the Brownlee Reservoir Reach. Sites occurred at or near the high-water mark from 2,077 to 2,080 ft on 4- to 6-degree slopes on southern facing aspects. No soil data were collected.

Near Darrows Islands Plot: BR981837I2

Tamarix parviflora is native to Eurasia and was probably brought to Idaho and Oregon to serve as an ornamental tree. *Tamarix parviflora* has become naturalized in southwestern Idaho, mainly along the Snake River bottomlands or near the salt desert shrub type of vegetation. It is an aggressive invader that sprouts from the roots and also spreads by seed. In Hells Canyon at the upstream end of the study area, *Tamarix parviflora* appears to be rapidly increasing. It was encountered on 98 transects and in 5 cover types, in just the Weiser (33 transects) and the Brownlee Reservoir (65 transects) reaches. Apparently, this species has not yet invaded the lower reaches of the canyon. In this assemblage, *Tamarix parviflora* provides almost 56% cover and is present in most plots along transects (frequency = 76%). It has an average height of about 0.6 m in the mature plant height-class (> 0.5 m tall) and about 0.2 m in the seedling plant height-class. This species' density is very high, with over 600,000 seedling plants per ha.

Xanthium strumarium, an annual that grows 2 to 4 ft tall, is native to North America, but now has worldwide distribution. It is common in cultivated fields, abandoned land, road ditches, and other disturbed areas (Whitson et al. 1992). In Hells Canyon, *Xanthium strumarium* commonly grows in the drawdown zone of Brownlee Reservoir. Its burs are irritating both to humans and animals, and the seeds and seedlings contain a substance toxic to livestock. In this assemblage, *Xanthium strumarium* provides over 56% cover and occurs in most plots along transects (frequency = 67%). *Lythrum salicaria*, a listed noxious weed in both Oregon and Idaho, occurs in this assemblage.

This assemblage is species rich in graminoids (n = 13) and forbs (n = 16), but most occur in trace amounts of cover (< 1%) and infrequently. The rare plant *Cyperus difformis* was encountered on 2 sites, and the noxious weed *Lythrum salicaria* was encountered on all 3 sites. Bare soil is exposed on 29% of the ground surface.

Appendix 3 (cont.).

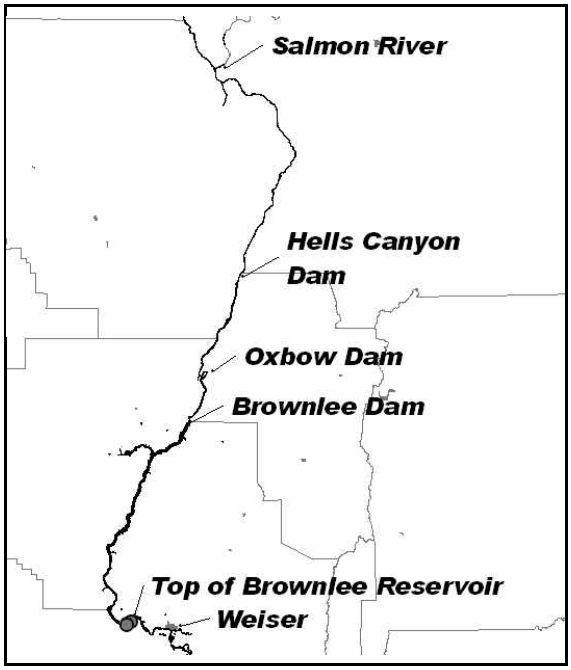
Other Studies

This assemblage has not been previously described in the study area.

TAPA/XAST Site Conditions

Elevation (ft): 2,078.0 (range 2,077.0–2,080.0)
Slope (°): 4.7 (range 4.0–6.0)
Aspect: S(2), SE(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



TAPA/XAST Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
I	*Tamarix parviflora*	55.8	75.8	100.0	13,333	0.55	600,000	0.17
N	*Salix amygdaloides*	2.2	5.8	66.7	3,333	0.72		
	Grasses (13) [b]							
N	*Cyperus erythrorhizos*	26.5	76.7	100.0				
N	*Eragrostis hypnoides*	21.8	66.7	100.0				
I	*Heleochloa alopecuroides*	5.3	48.3	66.7				
N	*Cyperus aristatus*	4.3	56.7	100.0				
I	*Echinochloa crus-galli*	2.3	41.7	100.0				
N	*Leersia oryzoides*	1.1	26.7	66.7				
N	*Cyperus strigosus*	0.8	15.0	66.7				
N	*Eragrostis pectinacea*	0.5	10.0	33.3				
	Forbs (16) [b]							
N	*Xanthium strumarium*	56.3	66.7	66.7				
N	*Mollugo verticillata*	3.8	18.3	33.3				
N	*Lindernia anagallidea*	3.2	58.3	100.0				
N	*Bidens cernua*	0.5	18.3	66.7				
I	*Rumex conglomerates*	0.5	18.3	33.3				
	Bare Soil	29.0	68.3	100.0				
	Litter	2.0	71.7	100.0				
	Rock	0.9	3.3	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Tamarix parviflora/Heleochloa alopecuroides (TAPA/HEAL)
(tamarisk or salt cedar/marsh grass) 3 stands

The *Tamarix parviflora*/*Heleochloa alopecuroides* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It is one of the several plant assemblages dominated by *Tamarix parviflora*. It was encountered at 3 sites in the Weiser Reach. Sites occurred at or near the high-water mark (2,080 ft) on 3- to 8-degree slopes on north and west aspects. No soil data were collected.

Islands above Cobb Rapids Plot: BA98ADRBSI

Tamarix parviflora is native to Eurasia and was probably brought to Idaho and Oregon to serve as an ornamental tree. *Tamarix parviflora* has become naturalized in southwestern Idaho, mainly along the Snake River bottomlands or near the salt desert shrub type of vegetation. It is an aggressive invader that sprouts from the roots and also spreads by seed. In Hells Canyon at the upstream end of the study area, *Tamarix parviflora* appears to be rapidly increasing. It was encountered on 98 transects and in 5 cover types, in just the Weiser (33 transects) and the Brownlee Reservoir (65 transects) reaches. Apparently, this species has not yet invaded the lower reaches of the canyon. In this assemblage, *Tamarix parviflora* provides over 96% cover and is present in every plot along transects (frequency = 100%). In the mature plant height-class (> 0.5 m tall), it has an average height of just over 0.5 m, and in the seedling plant height-class, a height of about 0.1 m. Its density is very high, with over 1.3 million seedling plants per ha.

Heleochloa alopecuroides is a European invader thought to have been introduced primarily in the ballast of ships. It is now established along the sand dunes and arid banks of many rivers in the northwest (Hitchcock and Cronquist 1991). In Hells Canyon, it is a commonly occurring riparian species. It was encountered in 171 transects, but only in the Weiser (79 transects) and the Brownlee Reservoir (92 transects) reaches. It was encountered in 6 cover types, but most often in the *Emergent Herbaceous Wetland* cover type (97 transects). In this assemblage, *Heleochloa alopecuroides* is the dominant herbaceous species, providing over 18% cover and occurring in most plots along transects (frequency = 60%).

This assemblage is species rich in graminoids (n = 13) and forbs (n = 15), but most occur in trace amounts (< 1% cover) and infrequently. One rare plant species occurs in trace amounts at 2 sites in this assemblage: *Cyperus difformis*. One noxious weed species also occurs: (*Lythrum salicaria*), providing over 2% cover and occurring in over one-half of all plots along transects (frequency = 52%). Bare soil is exposed on over 17% of the ground surface, and rock is exposed on about 11% of the ground.

Other Studies

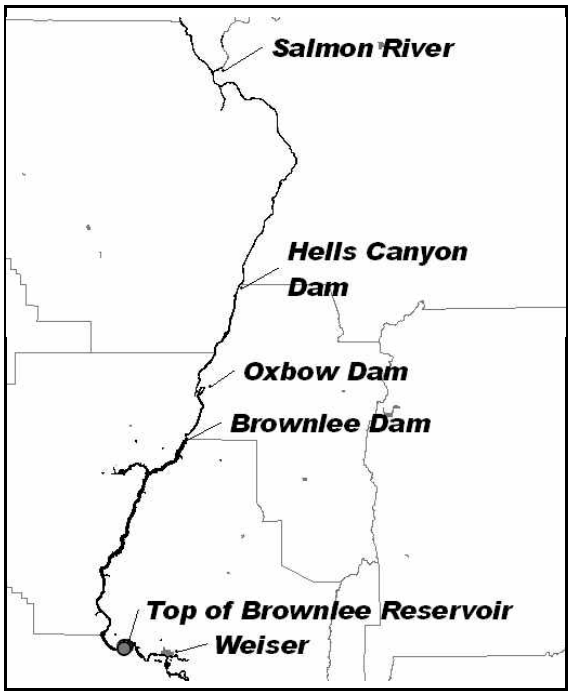
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

TAPA/HEAL Site Conditions

Elevation (ft): 2,080.0
Slope (°): 5.3 (range 3.0–8.0)
Aspect: N(1), NW(1), W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



TAPA/HEAL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (4) [b]							
	Shrubs (13) [b]							
I	*Tamarix parviflora*	96.4	100.0	100.0	13,333	0.53	1,330,000	0.08
N	*Salix exigua*	9.7	36.7	100.0			173,333	0.08
N	*Salix amygdaloides*	3.4	29.2	100.0	1,667	0.55	338,333	0.23
	Grasses (13) [b]							
I	*Heleochloa alopecuroides*	18.1	60.0	66.7				
N	*Cyperus aristatus*	4.9	66.7	66.7				
N	*Eragrostis hypnoides*	3.0	43.3	100.0				
N	*Cyperus erythrorhizos*	0.8	30.0	66.7				
I	*Echinochloa crus-galli*	0.7	18.3	100.0				
N	*Panicum capillare*	0.7	26.7	100.0				
N	*Cyperus acuminatus*	0.6	23.3	33.3				
	Forbs (15) [b]							
I	*Lythrum salicaria*	2.5	51.7	100.0				
N	*Xanthium strumarium*	2.5	16.7	33.3				
I	*Chenopodium album*	1.3	41.7	66.7				
N	*Mollugo verticillata*	1.3	25.0	66.7				
I	*Rumex crispus*	0.9	3.3	33.3				
X	*Chenopodium* sp.	0.7	26.7	33.3				
I	*Portulaca oleracea*	0.7	25.0	100.0				
N	*Solidago occidentalis*	0.5	10.0	66.7				
	Bare Soil	17.2	100.0	100.0				
	Rock	10.8	60.0	100.0				
	Lichen	4.4	35.0	100.0				
	Litter	2.6	70.0	100.0				
	Moss	2.2	55.0	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Rosa woodsii (ROWO)
(Wood's rose) 2 stands

The *Rosa woodsii* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It was encountered at just 2 sites along the Brownlee Reservoir Reach. *Rosa woodsii* occurs as a dominant or codominant species in several assemblages in riparian cover types. Both of the sites in this assemblage occurred at 2,077 ft on 2- and 10-degree slopes on northerly aspects. No soil information was collected.

Long Hollow Plot: BR981437G8

Rosa woodsii is the most common Rocky Mountain *Rosa* species. The hips, or fruit, of any wild roses may be eaten and are often used to make jams and jellies. In Hells Canyon, *Rosa woodsii* was a commonly encountered riparian species, and it also occurred in several upland transects. It was encountered on 175 transects, in 10 cover types, and in all study reaches; it was more common in the Weiser Reach (58 transects) and headwaters of Brownlee Reservoir (54 transects). In this assemblage, *Rosa woodsii* dominates the woody layer, providing 100% cover and occurring in all plots along transects (frequency = 100%). It has an average height of about 2.3 m in the mature plant height-class (> 0.5 m) and 0.3 m in the seedling height-class. *Rosa woodsii* density is quite high, with over 23,000 mature plants per ha.

The herbaceous layer has just 1 graminoid species and 6 weedy forb species. Three species of noxious weeds occur: *Cardaria draba*, *Cirsium arvense*, and *Cynoglossum officinale*. Litter covers over 76% of the ground surface, and rock covers about 12% of the ground. No mosses or lichens were observed.

Other Studies

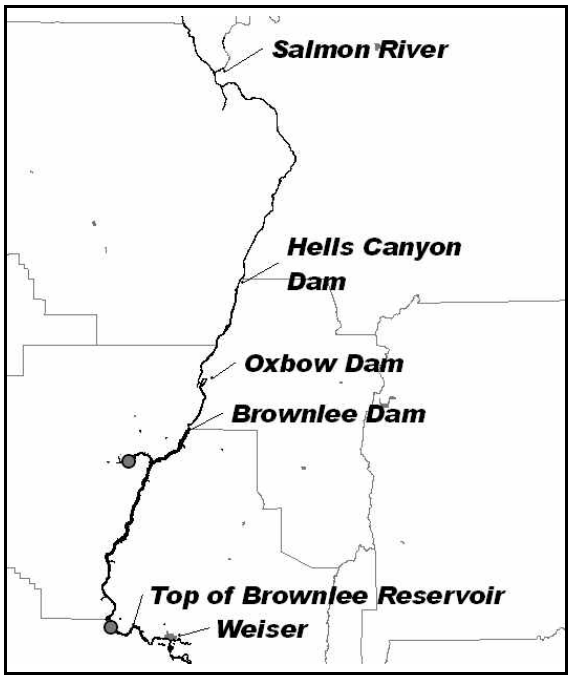
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

ROWO Site Conditions

Elevation (ft): 2,077.0
Slope (°): 6.0 (range 2.0–10.0)
Aspect: NE(1), NW(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ROWO Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (2) [b]							
N	*Rosa woodsii*	100.0	100.0	100.0	23,125	2.35	1,667	0.30
I	*Elaeagnus angustifolia*	9.5	10.0	50.0				
	Grasses (1) [b]							
N	*Phalaris arundinacea*	7.1	10.0	50.0				
	Forbs (6) [b]							
I	*Solanum dulcamara*	9.7	20.0	50.0				
I	*Cardaria draba*	7.9	17.5	50.0				
I	*Cirsium arvense*	3.2	25.0	50.0				
	Unknown forb	0.9	10.0	50.0				
I	*Cynoglossum officinale*	0.9	7.5	50.0				
I	*Verbascum blattaria*	0.2	5.0	50.0				
	Litter	76.1	100.0	100.0				
	Rock	12.2	50.0	100.0				
	Bare Soil	0.0	0.0	0.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Rosa woodsii-Ribes aureum (ROWO-RIAU)
(Wood's rose-golden currant) 11 stands

The *Rosa woodsii-Ribes aureum* plant assemblage occurs occasionally in the *Scrub-Shrub Wetland* cover type. It was encountered at 8 sites along the Brownlee Reservoir Reach, 2 sites in the Hells Canyon Reservoir Reach, and 1 site in the Weiser Reach. *Rosa woodsii* occurs as a dominant or codominant species in several assemblages in riparian cover types. Sites in this assemblage occurred between 1,683 and 2,080 ft on 0- to 50-degree slopes on a variety of aspects. No soil information was collected.

Near Ruth Gulch, Powder River Plot: BR981460G5

Rosa woodsii is the most common Rocky Mountain *Rosa* species. The hips, or fruit, of any wild roses may be eaten and are often used to make jams and jellies. In Hells Canyon, *Rosa woodsii* was a commonly encountered riparian species, and it also occurred in several upland transects. It was encountered on 175 transects, in 10 cover types, and in all study reaches; it was more common in the Weiser Reach (58 transects) and headwaters of Brownlee Reservoir (54 transects). In this assemblage, *Rosa woodsii* dominates the woody layer, providing over 56% cover and occurring in most plots along transects (frequency = 72%). It has an average height of about 1.4 m in the mature plant height-class (> 0.5 m) and about 0.3 m in the seedling height-class. The species density is quite high, with over 31,000 mature plants per ha.

Ribes aureum is the codominant woody species. It is a native shrub that occurs in moist soils along stream banks and washes in grassland or sagebrush desert habitats to ponderosa pine forests (Hitchcock and Cronquist 1991). In Hells Canyon, *Ribes aureum* is a fairly common riparian species. It was encountered in 61 transects, in 5 cover types, and in all study reaches except below Hells Canyon Dam. It was most common in the Weiser Reach (36 transects). In this assemblage, *Ribes aureum* provides over 43% cover and occurs in about one-half of all plots along transects (frequency = 48%).

The herbaceous layer has few graminoid species (n = 5) and is mostly dominated by *Lepidium latifolium*, a listed noxious weed in both Idaho and Oregon. This species is common in many riparian assemblages, especially in the upper reaches of the study area. Five other noxious weeds occur: *Dipsacus sylvestris*, *Conium maculatum*, *Cardaria draba*, *Cirsium arvense*, and *Convolvulus arvensis*. Litter covers 70% of the ground surface, and rock covers over 16% of the ground.

Other Studies

This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

ROWO-RIAU Site Conditions

Elevation (ft): 2,005.6 (range 1,683.0–2,080.0)

Slope (°): 14.6 (range 0.0–50.0)

Aspect: F(3), N(1), NE(1), NW(1), S(1), SW(1), W(3)

[a] Soil Texture: 0

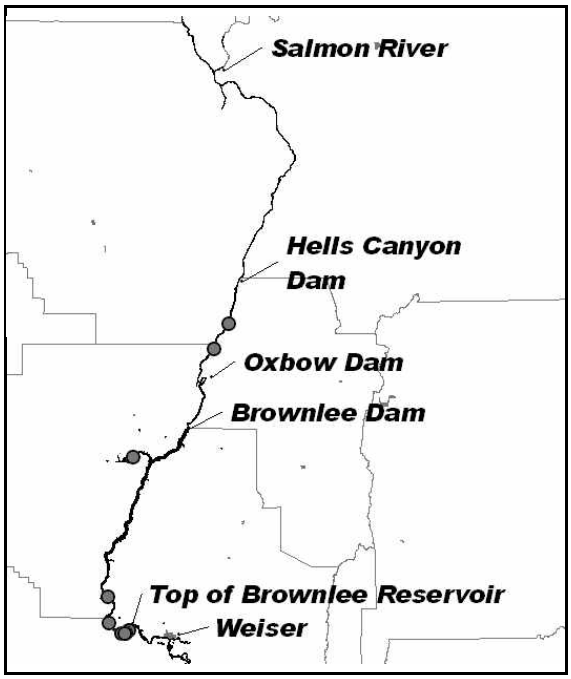
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ROWO-RIAU Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (6) [b]							
N	*Rosa woodsii*	56.1	71.8	90.9	31,818	1.37	9,394	0.27
N	*Ribes aureum*	43.4	47.7	54.5	12,061	2.25	1,364	0.38
N	*Toxicodendron radicans*	8.9	12.3	18.2	2,788	0.90	4,000	0.27
N	*Clematis ligusticifolia*	1.7	7.3	18.2	364	1.08	182	0.40
N	*Prunus virginiana*	0.5	0.9	9.1	182	2.10		
	Grasses (5) [b]							
I	*Bromus sterilis*	0.8	8.6	9.1				
	Forbs (12) [b]							
I	*Lepidium latifolium*	10.0	35.5	54.5				
I	*Dipsacus sylvestris*	3.8	14.5	18.2				
I	*Conium maculatum*	2.9	20.5	36.4				
N	*Asclepias speciosa*	2.8	12.3	18.2				
I	*Nepeta cataria*	1.8	8.6	27.3				
I	*Cardaria draba*	1.3	8.2	9.1				
N	*Equisetum hyemale*	1.0	6.4	9.1				
I	*Cirsium arvense*	0.7	4.5	9.1				
I	*Convolvulus arvensis*	0.7	6.8	9.1				
N	*Galium aparine*	0.5	0.9	9.1				
	Litter	70.0	99.5	100.0				
	Rock	16.1	29.5	100.0				
	Bare Soil	4.0	35.9	100.0				
	Lichen	0.3	3.2	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Elaeagnus angustifolia (ELAN)
(Russian olive) 3 stands

The *Elaeagnus angustifolia* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It was encountered at just 2 sites in the Weiser and 1 site in the Brownlee Reservoir reaches. Sites occurred at the high-water mark between 2,077 and 2,080 ft on 10- to 25-degree slopes on north and west aspects. No soil data were collected from these sites.

Birch Creek Plot: BR981985G7

Elaeagnus angustifolia, from the steppes of central Asia, was initially brought to the interior of the western United States for use as a drought-resistant windbreak (Johnson 1995). Once promoted as a desirable ornamental shade tree and source of food and protection for wildlife, it was later recognized as a nuisance (Whitson et al. 1992). Commonly cultivated in Oregon and Idaho, *Elaeagnus angustifolia* has escaped and naturalized, particularly where the soil is wet in spring, such as along small streams, irrigation ditches, and on river terraces and bottomlands (Johnson 1995). Often it is now so prevalent in low-lying pastures, meadows, and waterways that it has become a serious weed problem.

In most of Hells Canyon, *Elaeagnus angustifolia* plants are relatively uncommon. This species was encountered on 36 transects in 3 riparian cover types, in the Weiser Reach (32 transects) and the headwaters of Brownlee Reservoir (4 transects). In this assemblage, *Elaeagnus angustifolia* dominates the overstory, providing over 99% cover and is present in all plots along transects (frequency = 100%). Its average height is about 3.6 m.

The herbaceous layer contains few species (n = 6) and is mostly dominated by *Lepidium latifolium*, an introduced forb species that is a listed noxious weed species in both Idaho and Oregon. This species is common in many riparian plant assemblages along the headwaters of Brownlee Reservoir and in the Weiser Reach. Most species in this assemblage are introduced. Bare soil is exposed on nearly 43% of the ground surface, and litter covers over 42% of the ground.

Other Studies

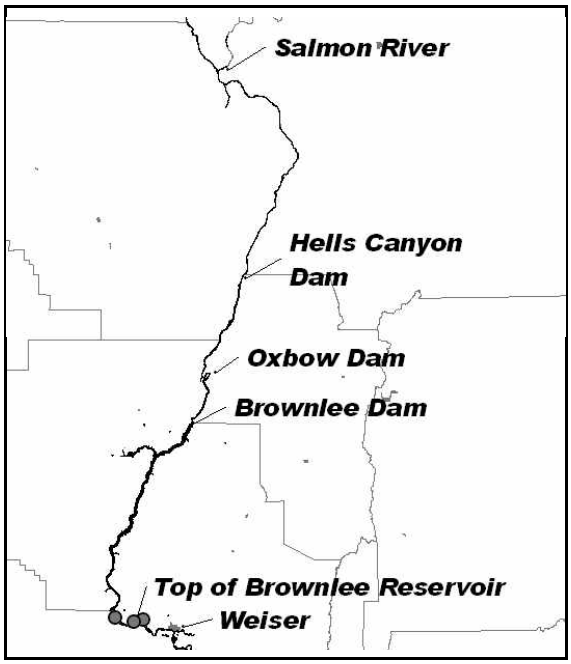
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

ELAN Site Conditions

Elevation (ft): 2,079.0 (range 2,077.0–2,080.0)
Slope (°): 16.0 (range 10.0–25.0)
Aspect: NE(1), NW(1), W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ELAN Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
I	*Elaeagnus angustifolia*			66.7	1,583	7.96		
N	*Salix amygdaloides*			33.3	28	8.50		
	Shrubs (6) [b]							
I	*Elaeagnus angustifolia*	99.3	100.0	100.0	1,278	3.66	333	0.38
N	*Rosa woodsii*	2.5	6.7	66.7	194	1.80		
I	*Ulmus pumila*	2.3	3.3	33.3	167	2.70		
N	*Salix amygdaloides*	2.0	3.3	33.3	28	3.00		
N	*Ribes aureum*	0.3	1.7	33.3	83	2.50		
I	*Ulmus americana*			33.3			56	0.05
	Grasses (4) [b]							
I	*Eragrostis cilianensis*	0.9	18.3	33.3				
I	*Agropyron intermedium*	0.3	3.3	33.3				
I	*Heleochloa alopecuroides*	0.3	10.0	33.3				
N	*Eragrostis hypnoides*	0.1	5.0	33.3				
	Forbs (2) [b]							
I	*Lepidium latifolium*	11.6	33.3	33.3				
N	*Marsilea vestita*	5.3	13.3	33.3				
	Bare Soil	42.8	73.3	100.0				
	Litter	42.3	98.3	100.0				
	Rock	0.3	11.7	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Clematis ligusticifolia (CLLI)
(virgin's bower) 3 stands

The *Clematis ligusticifolia* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It was encountered at 2 sites in the Brownlee Reservoir Reach and 1 site in the Hells Canyon Reservoir Reach. Sites occurred between 1,683 and 2,077 ft on 8- to 25-degree slopes on a variety of aspects. Soil data were not collected from these sites.

Oxbow Dam Plot: HC97098712

Clematis ligusticifolia is a woody vine that ranges from the sagebrush deserts to ponderosa pine forests in the western United States (Hitchcock and Cronquist 1991). It is easily recognizable in fall because of the conspicuous fluffy white, ball-shaped flowers covering the female vine. It sprawls over bushes, trees, rocks, or other structures. In Hells Canyon, *Clematis ligusticifolia* is a common species. It was encountered on 64 transects, in 7 cover types, and in all study reaches, although rare in the Weiser Reach (1 transect). In this assemblage, *Clematis ligusticifolia* dominates the overstory, providing 86% cover and occurring in nearly all plots along transects (frequency = 90%), growing on *Prunus virginiana* and rock for support.

This assemblage is species poor (n = 5), and the herbaceous layer is dominated by *Lepidium latifolium*, an introduced forb listed as a noxious weed in both Idaho and Oregon. This species is common in the canyon, especially in riparian plant assemblages in the upper end of the study area. Rock covers almost 60% of the ground surface, and litter covers about 35% of the ground.

Other Studies

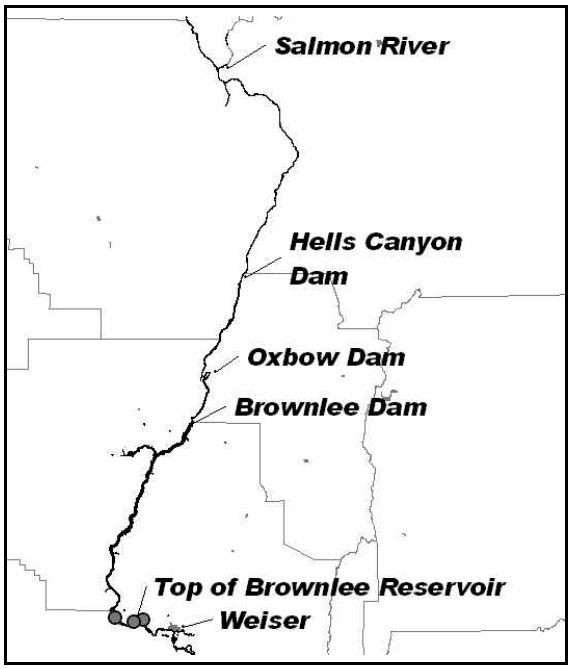
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

CLLI Site Conditions

Elevation (ft): 1,945.7 (range 1,683.0–2,077.0)
Slope (°): 18.7 (range 8.0–25.0)
Aspect: E(1), NW(1), W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



CLLI Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (2) [b]							
N	*Clematis ligusticifolia*	86.0	90.0	100.0	8,778	0.71	3,667	0.32
N	*Prunus virginiana*	20.7	33.3	33.3	7,333	1.31	667	0.45
	Grasses (1) [b]							
I	*Bromus tectorum*	0.2	8.3	66.7				
	Forbs (2) [b]							
I	*Lepidium latifolium*	11.3	33.3	33.3				
N	*Asclepias speciosa*	2.1	10.0	33.3				
	Rock	59.8	73.3	100.0				
	Litter	34.7	100.0	100.0				
	Lichen	1.8	35.0	100.0				
	Bare Soil	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Rosa canina (ROCA)
(dog rose) 2 stands

The *Rosa canina* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It was encountered at just 2 sites along the Brownlee Reservoir Reach. Both of the sites occurred at 2,077 ft on 0- to 16-degree slopes on flat or east aspects. No soil information was collected.

Near RM 324 Plot: BR981847G2

Rosa canina is a Eurasian species that has become naturalized west of the Cascade Mountains, in northern Idaho, and in the eastern United States (Hitchcock and Cronquist 1991). It occurs mostly along roadsides and in other disturbed places. In Hells Canyon, *Rosa canina* is locally rare but widely distributed. It was encountered on 16 transects, in 6 cover types, and in all study reaches except the Oxbow Reservoir Reach. It was more common in the Brownlee Reservoir Reach (8 transects). In this assemblage, *Rosa canina* is the only woody species, providing 95% cover and occurring in nearly all plots along transects (frequency = 95%). It has an average height of about 1.4 m in the mature plant height-class (> 0.5 m) and 0.3 m in the seedling height-class. This species' density is quite high, with over 23,000 mature plants per ha.

The herbaceous layer has no graminoid species and only 2 forbs. It is dominated by *Lepidium latifolium*, listed a noxious weed in both Idaho and Oregon. This species is common in riparian habitats in the canyon, especially in the upper reaches of the study area. In this assemblage, litter covers over 60% of the ground surface, and rock covers about 32% of the ground. No mosses or lichens were observed.

Other Studies

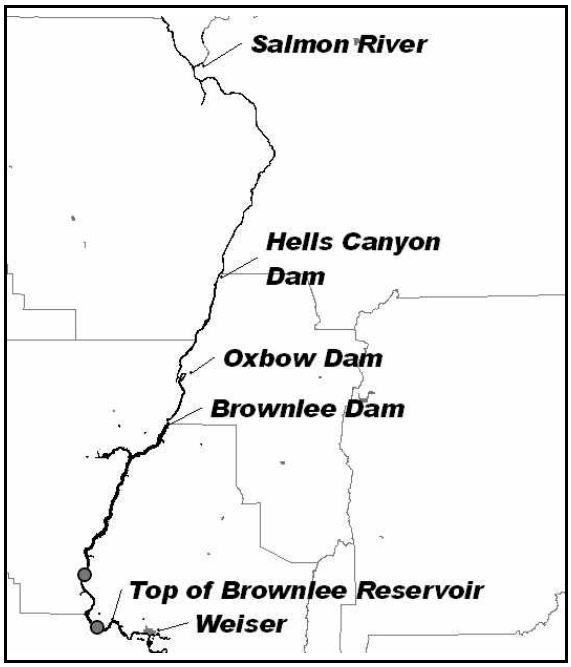
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

ROCA Site Conditions

Elevation (ft): 2,077.0
Slope (°): 8.0 (range 0.0–16.0)
Aspect: E(1), F(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ROCA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (1) [b]							
I	*Rosa canina*	95.0	95.0	100.0	23,334	1.43	1,667	0.30
	Grasses (0) [b]							
	Forbs (2) [b]							
I	*Lepidium latifolium*	10.4	22.5	50.0				
N	*Cuscuta indecora*	0.4	2.5	50.0				
	Litter	60.3	100.0	100.0				
	Rock	32.1	47.5	100.0				
	Bare Soil	1.0	25.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Ulmus pumila (ULPU)
(Siberian elm) 2 stands

The *Ulmus pumila* plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It was encountered at 1 site in the Weiser Reach and 1 site in the Hells Canyon Reservoir Reach. Sites occurred at 1,690 and 2,080 ft on 9-degree slopes on eastern aspects. No soil data were collected.

Islands above Cobb Rapids Plot: BA98ADRBS1

Ulmus pumila is the most common elm planted in the interior of the western United States. From eastern Siberia and northern China, it was brought for use as a windbreak, especially around farms and ranches, and as an ornamental (Johnson 1995). In Hells Canyon, *Ulmus pumila* has probably escaped from old homestead sites and now occasionally occurs in the mouths of tributaries or along shorelines. It was encountered in 36 transects, 3 cover types, and in all study reaches except below Hells Canyon Dam. It was fairly common in Hells Canyon Reservoir (15 transects), in the headwaters of Brownlee Reservoir (6 transects), and in the Weiser Reach (12 transects). In this plant assemblage, it contributes over 60% canopy coverage and is present in most plots along transects (frequency = 70%).

This assemblage is species rich (n = 20), but about one-half the species are introduced. The herbaceous layer is dominated by *Apocynum cannabinum* and *Aster hesperius*. Two noxious weed species occur: *Lepidium latifolium* and *Rumex crispus*. Litter covers over 35% of the ground surface, and bare soil is exposed on about 21% of the ground.

Other Studies

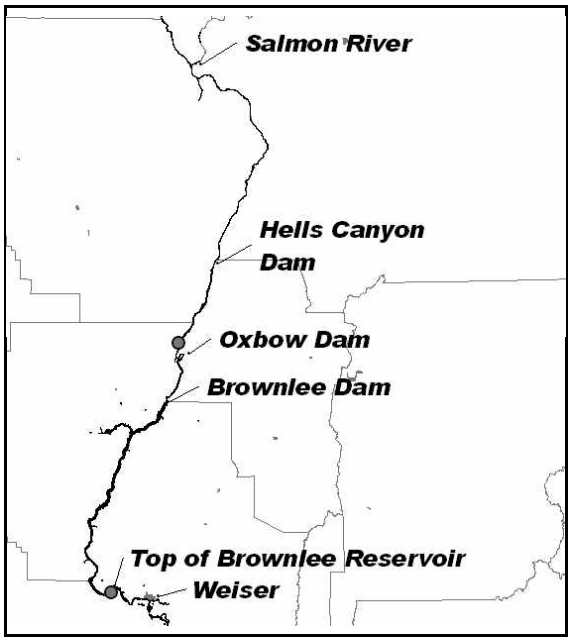
This assemblage has not been previously described in the study area.

Appendix 3 (cont.).

ULPU Site Conditions

Elevation (ft): 1,885.0 (range 1,690.0–2,080.0)
Slope (°): 9.0 (range 9.0–9.0)
Aspect: E(2)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ULPU Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (3) [b]							
	Shrubs (6) [b]							
I	*Ulmus pumila*	60.3	70.0	100.0				
N	*Ribes aureum*	13.5	25.0	50.0	17,500	0.90	5,000	0.30
I	*Salix alba*	12.5	12.5	50.0				
I	*Amorpha fruticosa*	8.8	40.0	50.0	5,000	0.82	16,000	0.22
I	*Elaeagnus angustifolia*	7.0	10.0	50.0				
N	*Rosa woodsii*	2.7	10.0	50.0	1,000	0.93		
	Grasses (3) [b]							
N	*Carex vulpinoides*	1.6	25.0	50.0				
I	*Poa pratensis*	0.5	17.5	50.0				
	Forbs (11) [b]							
N	*Apocynum cannabinum*	24.2	50.0	50.0				
N	*Aster hesperius*	14.7	50.0	50.0				
I	*Lepidium latifolium*	4.7	32.5	100.0				
I	*Anthriscus scandicina*	1.6	25.0	50.0				
N	*Artemisia lindleyana*	1.0	12.5	50.0				
N	*Solidago occidentalis*	0.9	10.0	100.0				
N	*Bidens frondosa*	0.5	20.0	50.0				
	Litter	35.2	97.5	100.0				
	Bare Soil	21.3	92.5	100.0				
	Rock	15.5	52.5	100.0				
	Moss	0.3	12.5	100.0				
	Lichen	0.2	5.0	100.0				

[a] N = Native, I = Introduced

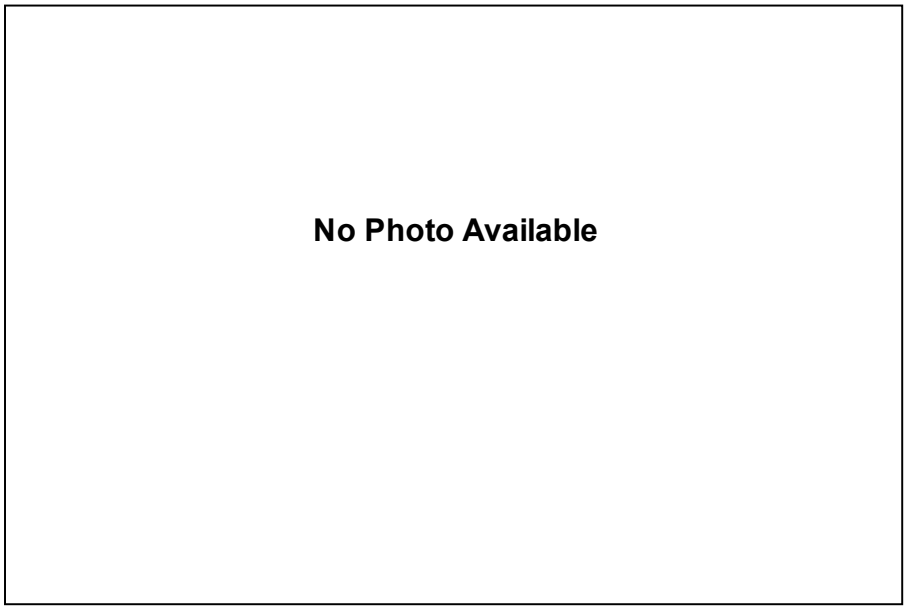
[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Scrub-Shrub Wetland

Populus trichocarpa (POTR2)
(black cottonwood) 1 stand

A *Populus trichocarpa*-dominated plant assemblage is rare in the *Scrub-Shrub Wetland* cover type. It was encountered at 1 site in the Brownlee Reservoir Reach. This site occurred at the reservoir high-water mark (2,077 ft), associated with a groundwater seep, on a 40-degree slope on a western aspect. No soil information was collected.



Populus trichocarpa is Hells Canyon's largest native broadleaf tree. It is one of the most widespread trees in Idaho and Oregon; few rivers lack stretches dominated by this tree. In Hells Canyon, *Populus trichocarpa* is an occasional tree species along tributary drainages. It was encountered on 57 transects, in 3 cover types, and in all reaches, but was most common in tributaries along the lower portions of the Brownlee Reservoir Reach (34 transects) and along the Oxbow Reservoir Reach (12 transects). *Populus trichocarpa* is adapted to, and dependent upon, dynamic flow patterns and repeated flooding and scouring of unconfined floodplains. It requires moist and barren fine substrates for recruitment sites and a gradual recession of flows that does not exceed about 5 cm per day (Mahoney and Rood 1998). In the canyon, such sites are limited to the larger tributaries to the Snake River. In this assemblage, *Populus trichocarpa* is the only woody species, providing 84% cover and occurring in all plots along transects (frequency = 100%). It has an average height of 1.3 m.

The herbaceous layer is dominated by *Bromus tectorum* and *Lomatium grayi*, both upland species. All other species occur in trace amounts (< 1% cover) and infrequently. No noxious weed species occur. Rock covers over 54% of the ground surface, and bare soil is exposed on about 13% of the surface.

Other Studies

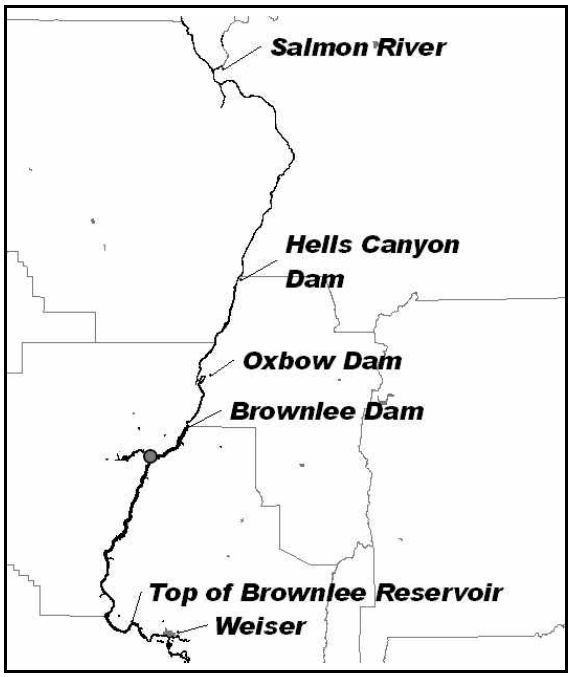
This assemblage has not been previously described in the canyon. Asherin and Claar (1976) mention a cottonwood vegetation type (*Populus deltoides* and *Populus trichocarpa*) that occurred in a few small areas in the study area, but they give no description. Crowe and Clausnitzer (1997) describe several assemblages in a *Populus trichocarpa* series on adjacent mid-montane National Forest lands in Oregon.

Appendix 3 (cont.).

POTR2 Site Conditions

Elevation (ft): 2,077.0
Slope (°): 40.0
Aspect: W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



POTR2 Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (1) [b]							
N	*Populus trichocarpa*	84.0	100.0	100.0	14,000	1.31	2,000	0.40
	Grasses (2) [b]							
I	*Bromus tectorum*	1.4	55.0	100.0				
I	*Bromus japonicus*	0.8	30.0	100.0				
	Forbs (7) [b]							
N	*Lomatium grayi*	7.7	20.0	100.0				
I	*Lactuca serriola*	0.4	15.0	100.0				
N	*Amsinckia* sp.	0.1	5.0	100.0				
N	*Chaenactis douglasii*	0.1	5.0	100.0				
N	*Penstemon deustus*	0.1	5.0	100.0				
	Unknown forb	0.1	5.0	100.0				
I	*Verbascum blattaria*	0.1	5.0	100.0				
	Rock	54.2	100.0	100.0				
	Bare Soil	13.1	90.0	100.0				
	Litter	10.1	100.0	100.0				
	Lichen	0.3	10.0	100.0				
	Moss	0.3	10.0	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Lepidium latifolium (LELA)
(broad-leaved pepperweed) 50 stands

The *Lepidium latifolium* plant assemblage is the most common assemblage encountered in the *Emergent Herbaceous Wetland* cover type. It was encountered in the upstream reaches of the study area, primarily in the Weiser Reach (26 sites) and the headwaters of Brownlee Reservoir (17 sites). Sites occurred between 1,800 and 2,130 ft on 0- to 40-degree slopes on a variety of aspects. No soil information was collected.

West Weiser Flat Islands Plot: BA97WWFCS4

Lepidium latifolium is a native of southern Europe and western Asia but is now found in many parts of the United States. It is a listed noxious weed in a number of western states, including Idaho and Oregon. Deep root resources make this plant difficult to control. *Lepidium latifolium* grows in wet areas, ditches, roadsides, croplands, and other disturbed sites (Whitson et al. 1992). It is increasing in the Hells Canyon area and at many riparian sites can become the dominant species. In Hells Canyon, *Lepidium latifolium* is the most common dominant herbaceous species in riparian plant assemblages. It was encountered in 224 transects, in 9 cover types, and in all study reaches, but primarily in the Weiser Reach (118 transects) and the headwaters of Brownlee Reservoir (76 transects). In this assemblage, *Lepidium latifolium* is clearly dominant, providing over 52% cover and occurring in almost every plot along transects (frequency = 90%). Most other species provide only trace amounts of cover (< 1%) and occur infrequently.

This assemblage is species rich (n = 61), and about one-half the species are introduced. Several other weed species listed as noxious by either Idaho or Oregon occur in this assemblage, including *Dipsacus sylvestris*, *Cynoglossum officinale*, *Cuscuta indecora*, *Conium maculatum*, *Lythrum salicaria*, *Cirsium arvense*, and *Onopordum acanthium*. Litter covers most of the ground surface (cover = 72%).

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

LELA Site Conditions

Elevation (ft): 2,043.6 (range 1,800–2,130.0)

Slope (°): 9.8 (range 0.0–40.0)

Aspect: E(4), F(24), N(2), NE(6), S(4), SE(4), SW(3), W(3)

[a] Soil Texture: 0

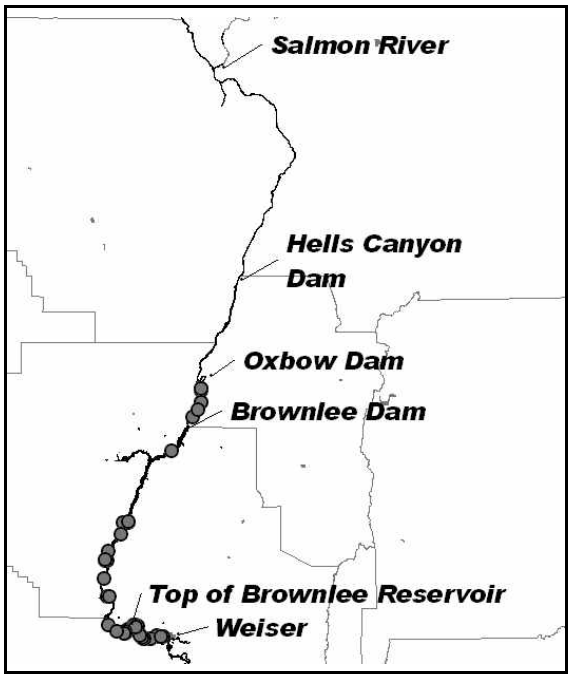
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



LELA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
	Shrubs (17) [b]							
	Grasses (7) [b]							
I	*Bromus tectorum*	1.9	18.2	38.0				
I	*Bromus japonicus*	1.5	10.8	22.0				
N	*Elymus triticoides*	1.0	2.5	6.0				
N	*Phalaris arundinacea*	1.0	3.0	10.0				
	Forbs (37) [b]							
I	*Lepidium latifolium*	52.3	89.9	98.0				
N	*Apocynum cannabinum*	5.0	8.8	14.0				
I	*Dipsacus sylvestris*	5.0	13.4	26.0				
N	*Solidago occidentalis*	4.1	12.4	30.0				
I	*Nepeta cataria*	2.3	7.6	22.0				
I	*Cynoglossum officinale*	1.7	7.4	14.0				
N	*Atriplex patula*	1.7	11.0	26.0				
N	*Equisetum hyemale*	1.6	5.9	6.0				
I	*Anthriscus scandicina*	1.4	4.0	8.0				
N	*Smilacina stellata*	1.4	3.4	6.0				
N	*Cuscuta indecora*	1.2	5.5	20.0				
I	*Conium maculatum*	1.2	7.1	26.0				
	Litter	72.4	100.0	100.0				
	Rock	7.8	19.5	100.0				
	Bare Soil	7.0	38.9	100.0				
	Lichen	0.3	5.2	100.0				
	Moss	0.1	2.6	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Lepidium latifolium-Conium maculatum (LELA-COMA4)
(broad-leaved pepperweed-poison hemlock) 17 stands

The *Lepidium latifolium-Conium maculatum* plant assemblage is common in the *Emergent Herbaceous Wetland* cover type. It was almost exclusively encountered in the upstream reaches of the study area, primarily in the Weiser Reach (10 transects) and the headwaters of Brownlee Reservoir (5 sites). Sites occurred between 1,800 and 2,090 ft on 0- to 40-degree slopes on a variety of aspects. No soil information was collected.

McRea Islands Plot: BA97MCRBS9

Lepidium latifolium is a native of southern Europe and western Asia but is now found in many parts of the United States. It is a listed noxious weed in a number of western states, including Idaho and Oregon. Deep root resources make this plant difficult to control. *Lepidium latifolium* grows in wet areas, ditches, roadsides, croplands, and other disturbed sites (Whitson et al. 1992). It is increasing in the Hells Canyon area and at many riparian sites can become the dominant species. In Hells Canyon, *Lepidium latifolium* is the most common dominant herbaceous species in riparian plant assemblages. It was encountered in 224 transects, in 9 cover types, and in all study reaches, but primarily in the Weiser Reach (118 transects) and the headwaters of Brownlee Reservoir (76 transects). In this assemblage, *Lepidium latifolium* provides over 22% cover and occurs in more than one-half of all plots along transects (frequency = 53%).

Conium maculatum is native to Europe but is now widespread in the United States. It is a noxious weed in a number of western states, including Idaho and Oregon. It tolerates poorly drained soils and frequents stream and ditch banks (Whitson et al. 1992). All parts of the plant are poisonous. Many people poisoned by *Conium maculatum* have mistaken it for parsley. In Hells Canyon, it was encountered in 109 transects, in 5 cover types, and in all study reaches except below Hells Canyon Dam. It primarily occurred in the Weiser Reach (77 transects) and the headwaters of Brownlee Reservoir (23 transects). In this assemblage, *Conium maculatum* provides over 14% cover and is present in more than one-third of all plots along transects (frequency = 34%).

This assemblage is species rich (n = 46), but one-half the species are introduced. Several other weed species listed as noxious by either Idaho or Oregon occur in this assemblage, including *Cirsium arvense*, *Cuscuta indecora*, *Centaurea repens*, *Cardaria draba*, and *Rumex crispus*. Litter covers most of the ground surface (cover = 76%).

Appendix 3 (cont.).

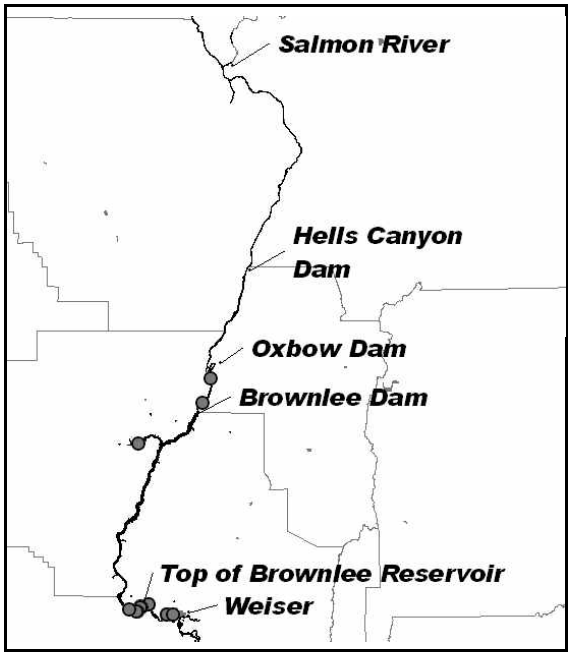
Other Studies

This assemblage has not been previously described for the Hells Canyon area.

LELA-COMA4 Site Conditions

Elevation (ft): 2,049.4 (range 1,800.0–2,090.0)
Slope (°): 6.1 (range 0.0–40.0)
Aspect: F(10), N(1), NE(2), NW(1), S(1), SE(2)
[A] Soil Texture: 0
[A] Organic Matter %: 0
[A] pH: 0
[A] ON ppm: 0
[A] CEC meq/100g: 0

[A] Soil characteristic data unavailable.



LELA-COMA4 Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (8) [b]							
	Grasses (8) [b]							
N	*Phalaris arundinacea*	3.2	11.2	29.4				
I	*Agropyron repens*	2.5	8.5	11.8				
	Forbs (30) [b]							
I	*Lepidium latifolium*	22.2	53.2	76.5				
N	*Solidago gigantea*	16.9	27.4	35.3				
I	*Conium maculatum*	14.1	33.8	64.7				
N	*Iva axillaris*	9.9	15.9	23.5				
N	*Lycopus asper*	5.4	5.9	5.9				
I	*Anthriscus scandicina*	5.2	23.5	29.4				
N	*Atriplex patula*	4.9	12.4	29.4				
I	*Cirsium arvense*	4.1	24.1	58.8				
N	*Apocynum cannabinum*	4.0	7.1	11.8				
N	*Galium aparine*	3.5	25.6	41.2				
N	*Glycyrrhiza lepidota*	3.0	12.1	23.5				
I	*Onopordum acanthium*	1.6	7.4	17.6				
N	*Solidago Canadensis*	1.3	2.9	5.9				
N	*Sisymbrium altissimum*	1.0	3.2	11.8				
	Litter	75.8	98.8	100.0				
	Bare Soil	7.1	49.7	100.0				
	Rock	5.3	11.8	100.0				
	Moss	0.4	3.2	100.0				
	Lichen	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Heleochloa alopecuroides (HEAL)
(marsh grass) 37 stands

The *Heleochloa alopecuroides* plant assemblage is common in the *Emergent Herbaceous Wetland* cover type. It was encountered in the upstream reaches of the study area, in the Weiser (9 sites) and the Brownlee Reservoir (28 sites) reaches. Sites occurred at or near the high-water mark between 2,077 and 2,090 ft on 0- to 22-degree slopes on a variety of aspects. No soil information was collected.

Across from Birch Creek Plot: BR981802I4

Heleochloa alopecuroides is a European species thought to have been introduced to the western United States in ship ballast. It is widely established in sandy soils and arid banks of the Columbia River in both Oregon and Washington (Hitchcock and Cronquist 1991). In Hells Canyon, *Heleochloa alopecuroides* is a commonly occurring species in the upstream reaches of the study area. It was encountered in 171 transects, in 6 cover types, and in the Weiser (79 transects) and Brownlee Reservoir (92 transects) reaches. In this assemblage, *Heleochloa alopecuroides* is clearly dominant, providing 44% cover and occurring in almost every plot along transects (frequency = 94%). Two other weedy species are somewhat common in this assemblage: *Xanthium strumarium* and *Amaranthus retroflexus*.

This assemblage is species rich in graminoids (n = 9) and forbs (n = 22), but most occur in trace amounts (< 1% cover) and infrequently. Most of the species in this assemblage are introduced. Three noxious weed species were found in trace amounts: *Convolvulus arvensis*, *Lythrum salicaria*, and *Tribulus terrestris*. Bare soil is exposed on 36% of the ground surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

HEAL Site Conditions

Elevation (ft): 2,078.0 (range 2,077.0–2,090.0)

Slope (°): 6.0 (range 0.0–22.0)

Aspect: E(1), F(12), N(6), NE(3), SE(2), SW(8), W(5)

[a] Soil Texture: 0

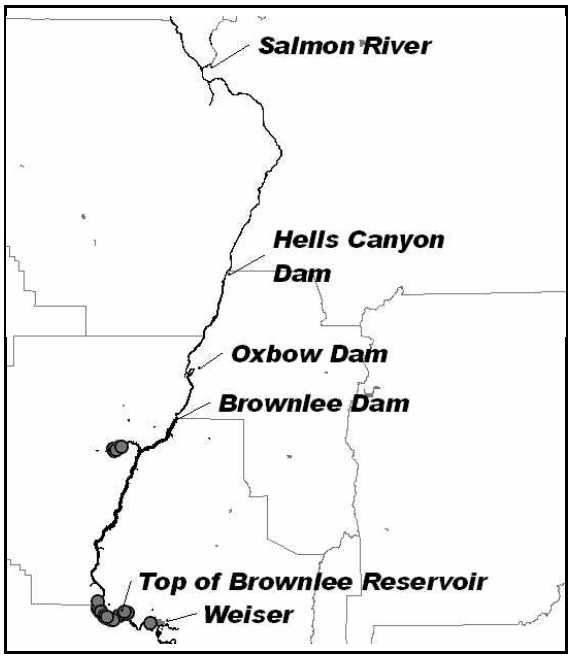
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



HEAL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (8) [b]							
N	*Salix exigua*	1.5	6.6	43.2	1,232	1.00	20,597	0.23
	Grasses (9) [b]							
I	*Heleochloa alopecuroides*	44.0	93.5	100.0				
N	*Cyperus aristatus*	2.9	31.8	59.5				
N	*Panicum capillare*	1.4	17.8	45.9				
N	*Eragrostis hypnoides*	1.0	9.7	24.3				
N	*Cyperus erythrorhizos*	0.5	8.9	24.3				
	Forbs (22) [b]							
N	*Xanthium strumarium*	12.5	40.8	64.9				
I	*Amaranthus retroflexus*	4.7	22.8	48.6				
I	*Portulaca oleracea*	2.1	40.0	70.3				
N	*Ammannia coccinea*	1.3	4.1	16.2				
I	*Lythrum hyssopifolium*	1.0	3.6	8.1				
N	*Mollugo verticillata*	0.9	11.4	40.5				
N	*Gnaphalium palustre*	0.7	25.9	62.2				
I	*Chenopodium foliosum*	0.7	3.8	5.4				
N	*Helenium autumnale*	0.7	3.0	5.4				
N	*Lindernia anagallidea*	0.6	19.9	43.2				
N	*Solidago occidentalis*	0.5	3.0	16.2				
I	*Chenopodium album*	0.5	15.0	35.1				
	Bare Soil	36.0	87.3	100.0				
	Litter	3.8	58.2	100.0				
	Rock	3.5	18.0	100.0				
	Lichen	1.4	9.1	100.0				
	Moss	0.5	11.2	100.0				

[a] N = Native, I = Introduced

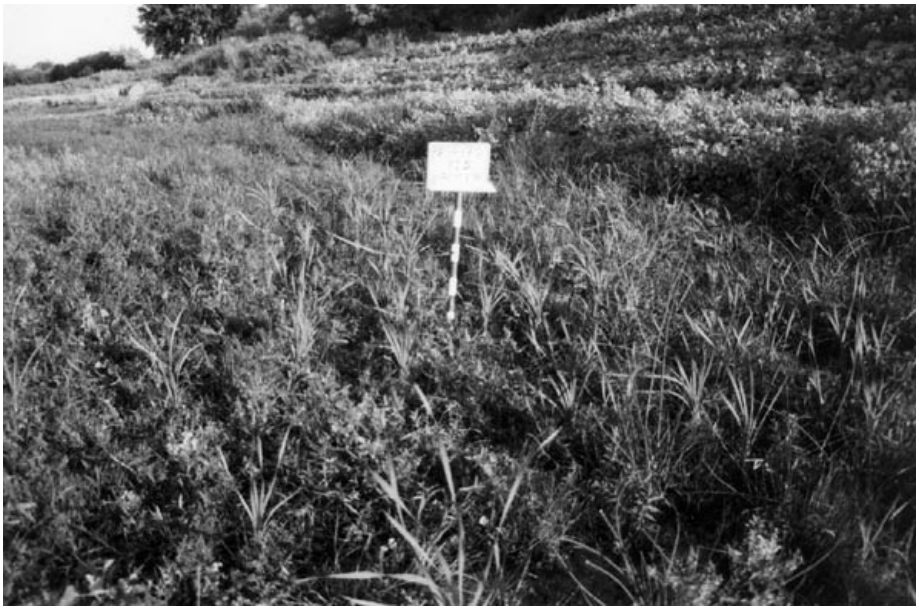
[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

***Lythrum salicaria*-**mixed herbaceous (LYSA-MIXED HERB)
(purple loosestrife-mixed herbaceous) 35 stands

The *Lythrum salicaria*-mixed herbaceous plant assemblage is common in the *Emergent Herbaceous Wetland* cover type. It was encountered in all reaches of the study area except the Oxbow Reservoir Reach. It primarily occurred in the upstream reaches: 14 sites in the Weiser and 18 sites in the Brownlee Reservoir reaches. Sites occurred between 1,110 and 2,130 ft on 0- to 12-degree slopes, but primarily on level aspects. No soil information was collected.



Near Olds Ferry Plot: BR981797I5

Lythrum salicaria, an herbaceous perennial native to Eurasian fens and riversides, is extremely successful in many parts of North America, where it has invaded almost any kind of wetland habitat (Whitson et al. 1992). In many cases, it has formed dense, homogeneous stands that restrict native plants (Hight and Drea 1991) and impede water flow in canals and ditches. Many authors have reported reduced habitat for wildlife. *Lythrum salicaria* is listed as a noxious weed in much of the United States, including Oregon and Idaho. In Hells Canyon, it was commonly found in upstream reaches of the study area. It was encountered in 224 transects, in 9 cover types, and principally in the Weiser Reach (95 transects) and the headwaters of Brownlee Reservoir (33 transects). In this assemblage, *Lythrum salicaria* is codominant with several other herbaceous species. It provides almost 10% cover and occurs in almost one-half of all plots along transects (frequency = 42%).

Commonly occurring native graminoids in this assemblage include *Eragrostis hypnoides*, *Panicum capillare*, *Cyperus erythrorhizos*, and *Phalaris arundinacea*. Common forbs include the introduced species *Chenopodium foliosum* and a native, *Lindernia anagallidea*. Nearly all other species provide only trace amounts of cover (< 1%) and occur infrequently.

This assemblage is species rich in graminoids (n = 18) and forbs (n = 34), and most are native. The rare plants *Cyperus difformis* and *Cyperus rivularis* were found in trace amounts (≤1% cover). In addition to *Lythrum salicaria*, 3 other noxious weed species occurred: *Lepidium latifolium*, *Rumex crispus*, and *Conium maculatum*. Bare soil is exposed on over 18% of the ground surface, and litter covers about 16% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

LYSA-MIXED HERB Site Conditions

Elevation (ft): 2,016.3 (range 1,110.0–2,130.0)

Slope (°): 2.5 (range 0.0–12.0)

Aspect: E(1), F(18), N(5), NE(3), NW(2), S(1), SE(1), SW(2), W(2)

[a] Soil Texture: 0

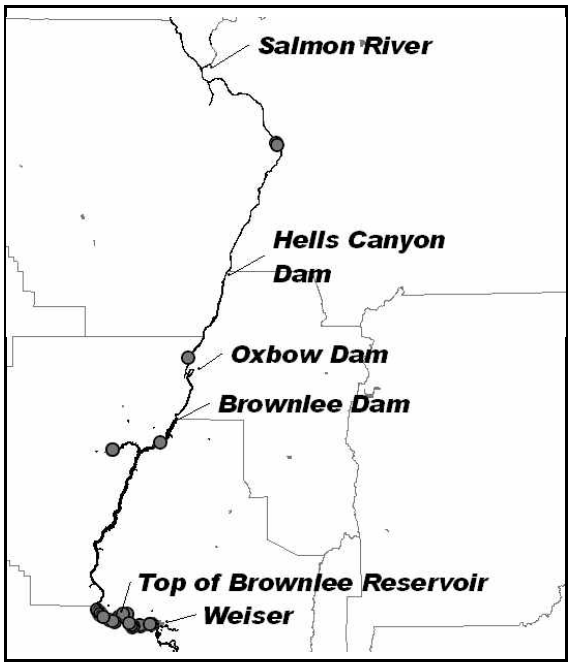
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



LYSA-MIXED HERB Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
	Shrubs (12) [b]							
	Grasses (18) [b]							
N	*Eragrostis hypnoides*	8.7	37.3	57.1				
N	*Panicum capillare*	7.1	25.6	57.1				
N	*Cyperus erythrorhizos*	6.6	30.1	37.1				
N	*Phalaris arundinacea*	5.2	11.1	31.4				
I	*Heleochloa alopecuroides*	4.8	35.7	62.9				
I	*Echinochloa crus-galli*	3.0	33.0	82.9				
N	*Cyperus aristatus*	2.1	32.7	48.6				
	Forbs (34) [b]							
I	*Lythrum salicaria*	9.9	41.6	65.7				
I	*Chenopodium foliosum*	6.2	16.6	31.4				
N	*Lindernia anagallidea*	4.7	38.0	65.7				
I	*Polygonum persicaria*	4.5	12.4	25.7				
I	*Amaranthus retroflexus*	3.6	16.7	42.9				
I	*Lythrum hyssopifolium*	2.8	5.9	8.6				
I	*Lepidium latifolium*	2.3	9.1	22.9				
N	*Polygonum lapathifolium*	2.2	11.6	25.7				
I	*Chenopodium album*	2.2	23.9	42.9				
N	*Solidago occidentalis*	2.1	7.4	25.7				
	Bare Soil	18.3	71.7	100.0				
	Litter	16.4	72.1	100.0				
	Rock	9.3	27.3	100.0				
	Moss	2.9	27.3	100.0				
	Lichen	0.1	4.1	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 2% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Xanthium strumarium (XAST)
(common cocklebur) 38 stands

The *Xanthium strumarium* plant assemblage is common in the *Emergent Herbaceous Wetland* cover type. A similar assemblage is also common in the *Shore & Bottomland Wetland* cover type. The *Xanthium strumarium* plant assemblage was encountered in all reaches of the study area except the Oxbow Reservoir Reach, but primarily in the Brownlee Reservoir Reach (22 sites). Sites occurred between 1,110 and 2,200 ft on 0- to 25-degree slopes, but primarily on level or gentle slopes. No soil information was collected.

Temperance Creek Plot: HB970482G5

Xanthium strumarium is native to North America, but is now worldwide in distribution. It is a weedy species common in cultivated fields, rundown pastures, road ditches, and riparian areas. Its burs are irritating to both humans and animals, and both the seeds and seedlings contain a substance toxic to livestock (Whitson et al. 1992). In Hells Canyon, *Xanthium strumarium* is commonly encountered in the drawdown zone and near the high-water mark along the river. It was encountered in 189 transects, in 6 cover types, and in all study reaches. It was most abundant in the Brownlee Reservoir Reach (115 transects).

This assemblage is characterized by a predominant cover of *Xanthium strumarium* on exposed fine sediments at or below the high-water mark. *Xanthium strumarium* provides over 39% cover and occurs in most plots along transects (frequency = 72%). Another native plant, *Solidago occidentalis*, is an important member of this assemblage.

This assemblage is species rich (n = 54), but most species are introduced, provide only trace amounts of cover (< 1%), and occur infrequently. Three noxious weed species are present: *Cuscuta* sp., *Lythrum salicaria*, and *Rumex crispus*. Bare soil is exposed on almost 35% of the ground surface, and litter covers about 22% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

XAST Site Conditions

Elevation (ft): 1,929.1 (range 1,110.0–2,200.0)

Slope (°): 6.4 (range 0.0–25.0)

Aspect: N(1), E(1), F(11), N(5), NE(3), NW(3), S(3), SE(3), SW(6), W(2)

[a] Soil Texture: 0

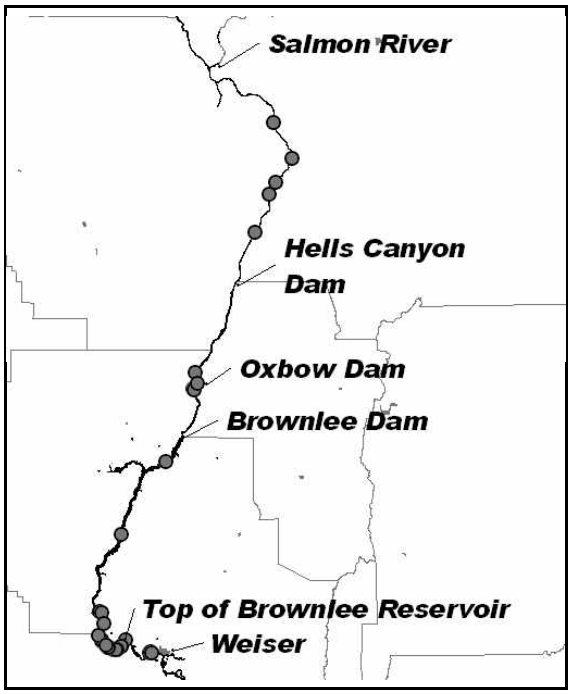
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



XAST Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (10) [b]							
N	*Salix exigua*	3.0	6.4	31.6	2,143	1.08	971	0.32
I	*Tamarix parviflora*	2.1	4.4	28.9	229	0.93	357	0.22
	Grasses (14) [b]							
I	*Heleochloa alopecuroides*	4.2	21.2	42.1				
N	*Scirpus acutus*	1.0	2.6	2.6				
N	*Panicum capillare*	1.0	13.6	44.7				
	Forbs (30) [b]							
N	*Xanthium strumarium*	39.2	72.1	89.5				
N	*Solidago occidentalis*	14.0	30.5	44.7				
I	*Amaranthus retroflexus*	5.1	13.3	36.8				
N	*Apocynum cannabinum*	4.6	9.9	15.8				
N	*Mollugo verticillata*	1.4	11.6	26.3				
I	*Portulaca oleracea*	1.3	17.8	42.1				
I	*Polygonum persicaria*	1.1	4.3	10.5				
	Bare Soil	34.6	78.0	100.0				
	Litter	21.6	88.2	100.0				
	Rock	17.9	33.8	100.0				
	Moss	0.4	3.2	100.0				
	Lichen	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Apocynum cannabinum (APCA)
(hemp dogbane) 24 stands

The *Apocynum cannabinum* plant assemblage is common in the *Emergent Herbaceous Wetland* cover type. It was encountered in the Weiser Reach (17 sites), the Brownlee Reservoir Reach (3 sites), and the reach below Hells Canyon Dam (4 sites). Sites occurred between 1,100 and 2,095 ft on 0- to 26-degree slopes on a variety of aspects. No soil information was collected.

Westlake Island Plot: BA97WSTAS7

Apocynum cannabinum is a widespread native species that often becomes weedy along roadsides and on noncultivated agricultural lands. It has been called Indian hemp because of its use by prehistoric tribes for high-quality fiber. It is poisonous to livestock (Whitson et al. 1992). In Hells Canyon, *Apocynum cannabinum* was encountered in 93 transects, in 7 cover types, and in all reaches of the study area, but principally in the Weiser Reach (55 transects). In this assemblage, *Apocynum cannabinum* is clearly dominant, providing almost 52% cover and occurring in most plots along transects (frequency = 85%). The listed noxious weed *Lythrum salicaria* is the second most abundant species in this assemblage.

This assemblage is species rich in herbaceous plants (n = 31), and about one-half these species are native. In addition to *Lythrum salicaria*, 2 other noxious weed species were present in low amounts (≤ 1% cover): *Lepidium latifolium* and *Rumex crispus*. Rock covers over 31% of the ground surface, and bare soil is exposed on about 27% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

APCA Site Conditions

Elevation (ft): 1,946.5 (range 1,100.0–2,095.0)

Slope (°): 7.8 (range 0.0–26.0)

Aspect: E(3), F(6), N(4), NE(5), S(2), SW(1), W(3)

[a] Soil Texture: 0

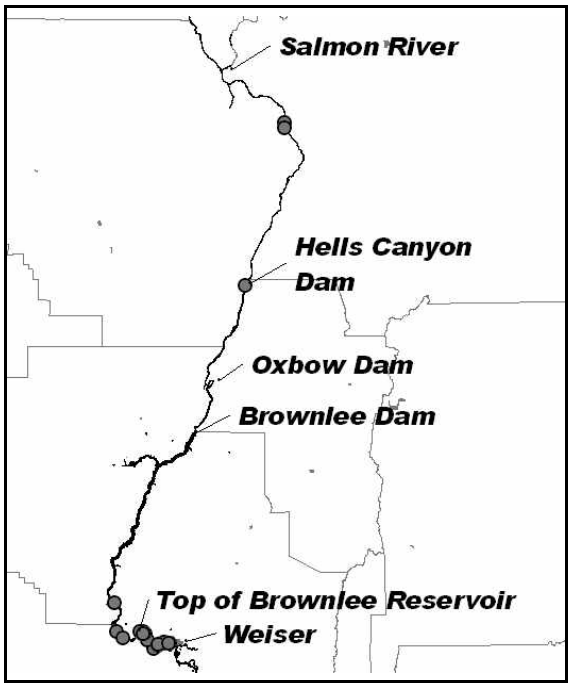
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



APCA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
	Shrubs (12) [b]							
N	*Salix exigua*	1.5	4.4	33.3	1,003	1.00	1,021	0.27
	Grasses (6) [b]							
N	*Phalaris arundinacea*	0.9	9.6	37.5				
N	*Cyperus erythrorhizos*	0.5	16.0	45.8				
	Forbs (25) [b]							
N	*Apocynum cannabinum*	51.8	85.4	95.8				
I	*Lythrum salicaria*	6.7	31.7	58.3				
N	*Glycyrrhiza lepidota*	4.5	8.3	12.5				
I	*Iris pseudacorus*	2.8	5.6	12.5				
N	*Solidago occidentalis*	2.5	20.4	62.5				
I	*Euphorbia esula*	1.6	7.3	29.2				
I	*Lepidium latifolium*	1.0	7.9	29.2				
I	*Portulaca oleracea*	0.7	7.3	33.3				
I	*Chenopodium album*	0.7	5.8	20.8				
N	*Potentilla rivalis*	0.6	7.9	16.7				
N	*Aster hesperius*	0.5	2.7	4.2				
	Rock	31.2	58.5	100.0				
	Bare Soil	26.8	85.0	100.0				
	Litter	16.0	91.0	100.0				
	Moss	0.9	12.7	100.0				
	Lichen	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Distichlis stricta (DIST)
(alkali saltgrass) 19 stands

The *Distichlis stricta* plant assemblage is common in the *Emergent Herbaceous Wetland* cover type. It was encountered in the Weiser Reach (13 sites) and the Brownlee Reservoir Reach (6 sites). Sites occurred at or near the high-water mark between 2,077 and 2,085 ft on 0- to 23-degree slopes, mostly on level aspects. No soil information was collected.

Porter Island Plot: BA98PORASD

Distichlis stricta is typically found growing on alkaline soils and sandy lakeshores in the western United States. Although native to Idaho and Oregon, *Distichlis stricta* is considered a weedy species that has spread to irrigated lands, ditches on the margins of cultivated fields, and drier soils in drainages and floodplains (Whitson et al. 1992). In Hells Canyon, it was encountered in 24 transects, in 5 cover types, and in the Weiser Reach (19 transects) and the Brownlee Reservoir Reach (5 transects). In this assemblage, *Distichlis stricta* provides almost 26% cover and occurs in more than one-half of all plots along transects (frequency = 52%). Another native graminoid, *Elymus triticoides*, is also fairly abundant in this assemblage.

This assemblage is species rich in herbaceous plants (n = 27), and about one-half of these species are native. Six noxious weed species occur, providing a substantial portion of the herbaceous cover: *Taeniatherum caput-medusae*, *Dipsacus sylvestris*, *Cardaria draba*, *Cirsium arvense*, *Onopordum acanthium*, and *Lepidium latifolium*. Litter covers over 66% of the ground surface, and bare soil is exposed on about 15% of the surface.

Other Studies

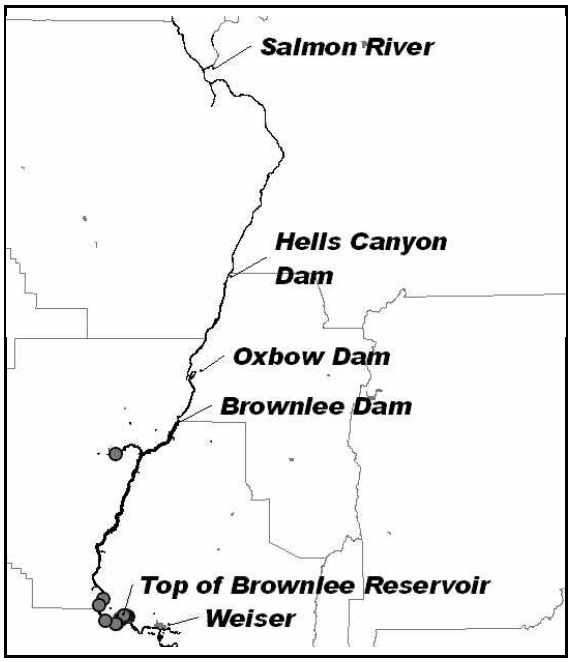
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

DIST Site Conditions

Elevation (ft): 2,079.6 (range 2,077.0–2,085.0)
Slope (°): 2.5 (range 0.0–23.0)
Aspect: F(15), NW(1), S(1), SE(2)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



DIST Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
	Grasses (7) [b]							
N	*Distichlis stricta*	25.8	51.8	63.2				
N	*Elymus triticoides*	14.0	31.8	42.1				
I	*Bromus inermis*	6.3	11.1	15.8				
N	*Elymus cinereus*	2.3	3.9	10.5				
	Forbs (20) [b]							
N	*Iva xanthifolia*	4.9	11.8	15.8				
I	*Dipsacus sylvestris*	2.7	5.8	10.5				
N	*Atriplex patula*	2.6	12.4	31.6				
I	*Cardaria draba*	2.4	13.2	31.6				
N	*Galium aparine*	1.9	4.5	5.3				
I	*Cirsium arvense*	1.7	6.8	15.8				
N	*Glycyrrhiza lepidota*	1.6	5.5	10.5				
N	*Iva axillaries*	1.5	13.9	31.6				
	Litter	66.4	99.7	100.0				
	Bare Soil	15.1	56.6	100.0				
	Rock	1.0	8.7	100.0				
	Moss	0.4	1.6	100.0				
	Lichen	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Portulaca oleracea (POOL)
(purslane) 11 stands

The *Portulaca oleracea* plant assemblage occurs occasionally in the *Emergent Herbaceous Wetland* cover type. It was encountered in the Weiser (6 sites), Brownlee Reservoir (4 sites), and Hells Canyon Reservoir (1 site) reaches. Sites occurred between 1,780 and 2,090 ft on 0- to 23-degree slopes on a variety of aspects. No soil information was collected.

Weiser Island Plot: BA98WSRBS3

Portulaca oleracea is a European invader that has become a troublesome weed in cultivated fields and gardens. It is especially persistent in soils that remain moist much of the time (Whitson et al. 1992). In Hells Canyon, *Portulaca oleracea* was commonly encountered in the upper reaches of the study area. It is one of the species that annually invade the drawdown zone of Brownlee Reservoir. It was encountered in 149 transects, in 5 cover types, and principally in the Weiser (58 transects) and Brownlee Reservoir (82 transects) reaches. In this assemblage, *Portulaca oleracea* is clearly the dominant species, providing almost 27% cover and occurring in most plots along transects (frequency = 81%). A native graminoid, *Eragrostis hypnoides*, is fairly abundant in this assemblage.

This assemblage is species rich in herbaceous plants (n = 29), and about one-half of these species are native. One noxious weed occurs in trace amounts (< 1% cover): *Dipsacus sylvestris*. Rock covers 27% of the ground surface, and bare soil is exposed on about 20% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

POOL Site Conditions

Elevation (ft): 2,053.5 (range 1,780.0–2,090.0)

Slope (°): 10.1 (range 0.0–23.0)

Aspect: E(1), F(3), S(1), SE(3), SW(2), W(1)

[a] Soil Texture: 0

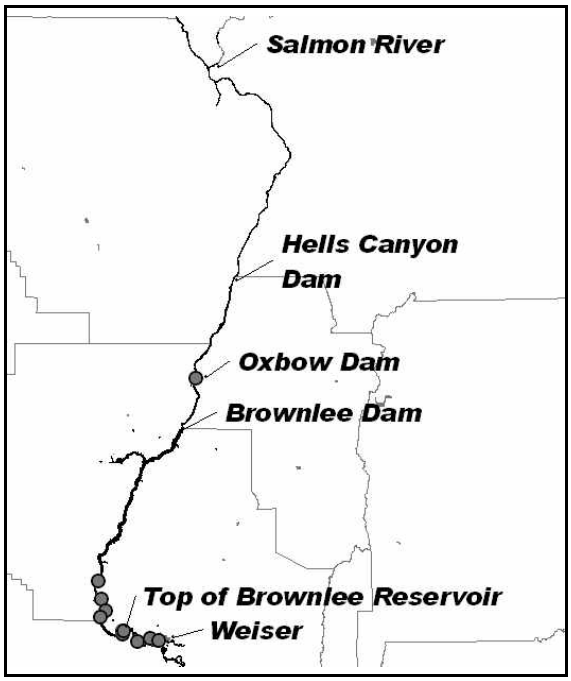
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



POOL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
N	*Salix exigua*	2.7	9.5	27.3	1,818	0.70	15,727	0.14
	Grasses (10) [b]							
N	*Eragrostis hypnoides*	9.9	34.1	36.4				
N	*Cyperus aristatus*	2.5	35.0	45.5				
N	*Cyperus erythrorhizos*	1.8	21.4	27.3				
I	*Heleochloa alopecuroides*	1.0	25.0	45.5				
	Forbs (19) [b]							
I	*Portulaca oleracea*	26.8	80.6	100.0				
N	*Mollugo verticillata*	4.2	42.7	54.5				
I	*Conyza bonariensis*	2.4	7.6	9.1				
N	*Lindernia anagallidea*	0.8	18.6	27.3				
I	*Chenopodium foliosum*	0.8	13.2	18.2				
N	*Xanthium strumarium*	0.7	12.0	54.5				
I	*Amaranthus retroflexus*	0.7	21.2	81.8				
I	*Chenopodium album*	0.5	14.1	27.3				
	Rock	27.0	53.2	100.0				
	Bare Soil	19.8	84.4	100.0				
	Litter	5.0	66.1	100.0				
	Moss	0.8	11.4	100.0				
	Lichen	0.1	4.1	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Phalaris arundinacea (PHAR)
(reed canarygrass) 10 stands

The *Phalaris arundinacea* plant assemblage occurs occasionally in the *Emergent Herbaceous Wetland* cover type. It was encountered in the Weiser Reach (2 sites) and the Brownlee Reservoir Reach (8 sites). Sites occurred at or near the high-water mark between 2,077 and 2,090 ft on 0- to 25-degree slopes on a variety of aspects. No soil information was collected.

Long Hollow Plot: BR981437G1

Phalaris arundinacea is an aggressive, weedy species found on wet ground, along streams, and in marshes in all the western states. It is especially problematic when growing in canals and irrigation ditches, where it can out-compete other species and grow so thick that it impedes water movement (Whitson et al. 1992). In Hells Canyon, *Phalaris arundinacea* was commonly encountered in the upper reaches of the study area. It was encountered in 109 transects, in 5 cover types, and in all study reaches, but principally in the Weiser (63 transects) and the Brownlee Reservoir (39 transects) reaches. In this assemblage, *Phalaris arundinacea* is clearly the dominant species, providing over 72% cover and occurring in all plots along transects (frequency = 100%).

This assemblage is relatively species poor (n = 16), and most species provide only trace amounts of cover (< 1% cover) and occur infrequently. Three noxious weed species occur in trace amounts: *Lepidium latifolium*, *Lythrum salicaria*, and *Cirsium arvense*. Litter covers over 47% of the ground surface, and rock covers about 27% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

PHAR Site Conditions

Elevation (ft): 2,078.6 (range 2,077.0–2,090.0)

Slope (°): 7.8 (range 0.0–25.0)

Aspect: E(1), F(1), NE(4), NW(1), S(1), SW(2)

[a] Soil Texture: 0

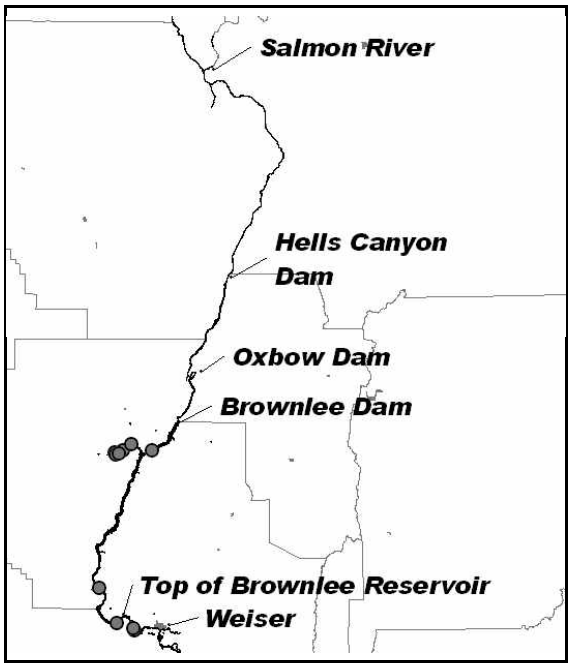
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



PHAR Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (8) [b]							
N	*Salix amygdaloides*	1.2	2.5	30.0	100	1.05		
N	*Rosa woodsii*	0.8	2.0	20.0	100	1.08		
I	*Morus alba*	0.1	0.8	10.0	13	0.83	17	0.35
N	*Salix exigua*	0.1	1.0	20.0	33	4.00	25	0.41
N	*Crataegus douglasii*	0.0	0.3	10.0	4	2.10		
I	*Acer saccharinum*			20.0	50	2.10	75	0.29
N	*Ribes cereum*			10.0	33	1.70		
N	*Toxicodendron radicans*			10.0			100	0.43
	Grasses (3) [b]							
N	*Phalaris arundinacea*	72.2	99.5	100.0				
N	*Scirpus maritimus*	2.5	10.0	10.0				
N	*Panicum capillare*	0.1	4.0	20.0				
	Forbs (5) [b]							
N	*Solidago occidentalis*	0.6	3.5	20.0				
I	*Lepidium latifolium*	0.3	8.5	20.0				
I	*Lythrum salicaria*	0.3	8.5	10.0				
N	*Urtica dioica*	0.2	0.5	10.0				
I	*Cirsium arvense*	0.1	1.5	20.0				
	Litter	47.4	99.0	100.0				
	Rock	26.7	39.5	100.0				
	Bare Soil	11.7	41.5	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Glycyrrhiza lepidota (GLLE)
(American licorice) 9 stands

The *Glycyrrhiza lepidota* plant assemblage occurs occasionally in the *Emergent Herbaceous Wetland* cover type. It was encountered in all study reaches, except the Oxbow Reservoir Reach, but principally below Hells Canyon Dam (6 sites). Sites occurred between 1,100 and 2,085 ft on 3- to 30-degree slopes on a variety of aspects. No soil information was collected.

West Weiser Flat Islands Plot: BA97WWFES2

Glycyrrhiza lepidota is a widely distributed native plant found in moist, sandy areas. The root of this species is sweet and was an important food for Native Americans (Whitson et al. 1992). In Hells Canyon, *Glycyrrhiza lepidota* was encountered in 44 transects, in 5 cover types, and principally in the reach below Hells Canyon Dam (27 transects). In this assemblage, *Glycyrrhiza lepidota* is clearly the dominant species, providing over 47% cover and occurring in most plots along transects (frequency = 84%). The most commonly associated species include *Paspalum distichum* and *Apocynum cannabinum*.

This assemblage is relatively species rich (n = 27), but most of the species occur in trace amounts (< 1% cover) and infrequently. No noxious weed species were found. Rock covers nearly 59% of the ground surface, and bare soil is exposed on about 18% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

GLLE Site Conditions

Elevation (ft): 1,448.0 (range 1,100.0–2,085.0)

Slope (°): 10.7 (range 3.0–30.0)

Aspect: E(1), NE(1), NW(1), S(1), SE(2), SW(1), W(2)

[a] Soil Texture: 0

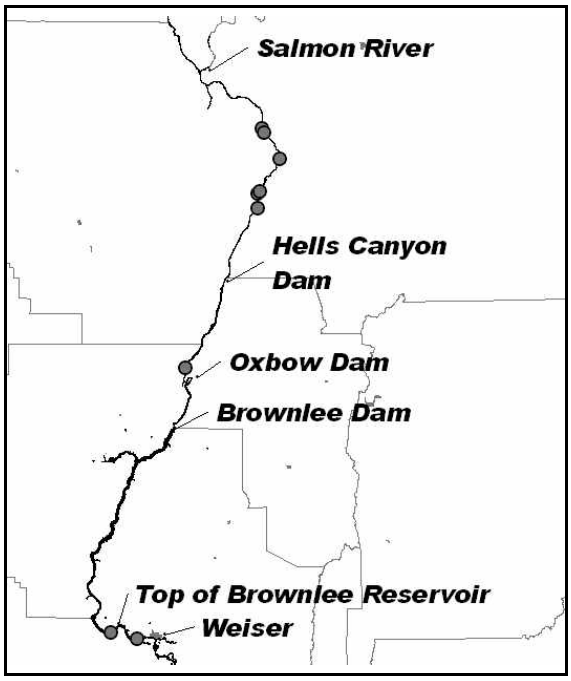
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



GLLE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (1) [b]							
I	*Salix alba*	2.1	2.2	11.1				
	Shrubs (5) [b]							
N	*Toxicodendron radicans*	1.4	4.4	11.1				
I	*Vitis riparia*	0.8	1.7	11.1				
	Grasses (7) [b]							
N	*Paspalum distichum*	3.3	23.3	44.4				
N	*Carex vulpinoides*	1.8	11.1	11.1				
I	*Cyperus esculentus*	0.6	7.8	11.1				
	Forbs (14) [b]							
N	*Glycyrrhiza lepidota*	47.3	84.4	88.9				
N	*Apocynum cannabinum*	3.8	16.1	22.2				
N	*Polygonum coccineum*	2.5	8.9	11.1				
N	*Verbena bracteata*	0.8	11.1	33.3				
N	*Asclepias speciosa*	0.5	5.0	22.2				
	Rock	58.8	80.6	100.0				
	Bare Soil	17.5	66.7	100.0				
	Litter	11.8	87.8	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

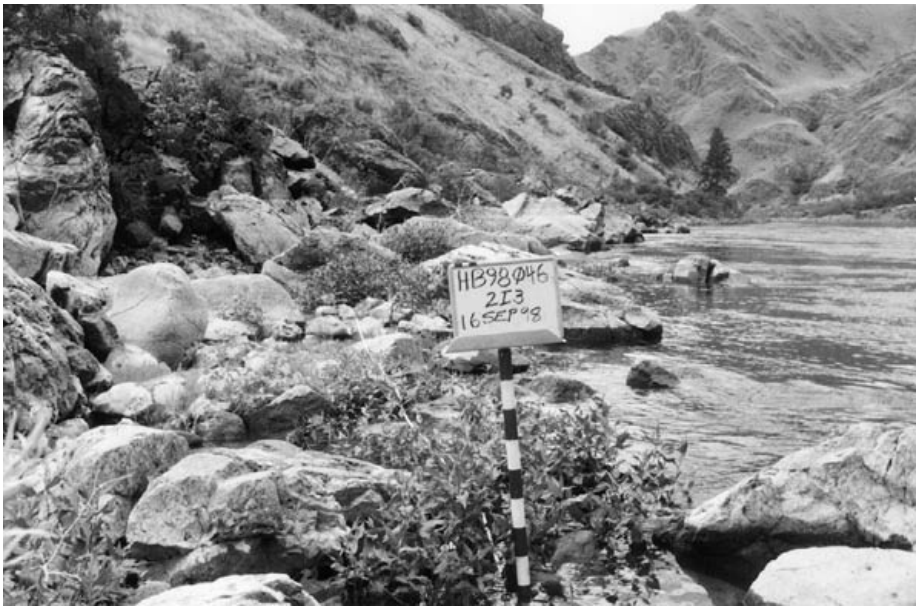
[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Polygonum coccineum (POCO3)
(water smartweed) 8 stands

The *Polygonum coccineum* plant assemblage occurs occasionally in the *Emergent Herbaceous Wetland* cover type. It was only encountered in the reach below Hells Canyon Dam (8 sites). Sites occurred between 1,100 and 1,460 ft on 0- to 22-degree slopes on a variety of aspects. No soil information was collected.



Near Suicide Point Plot: HB980462I3

Polygonum coccineum is a native aquatic species found in wet or moist sites, often partially submerged. It is found in undisturbed sites, but it can also become troublesome in cultivated fields and irrigated pastures (Whitson et al. 1992). In Hells Canyon, *Polygonum coccineum* is an uncommon species, encountered on 19 transects in 2 riparian cover types and in 3 reaches. It was primarily encountered below Hells Canyon Dam (12 transects), but also in the Hells Canyon Reservoir Reach (1 transects) and the Weiser Reach (6 transects). In this assemblage, *Polygonum coccineum* is the clear dominant, providing over 34% cover and occurring in most plots along transects (frequency = 72%).

There are relatively few species in this assemblage (n = 17), and most are native. One noxious weed species occurs in trace amounts (< 1% cover): *Lythrum salicaria*. Rock covers most of the ground surface (72% cover), and bare soil is exposed on about 10% of the surface.

Other Studies

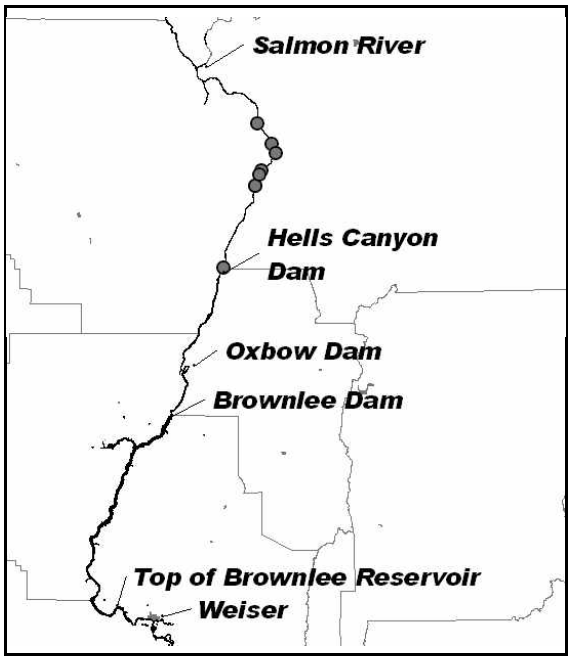
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

POCO3 Site Conditions

Elevation (ft): 1,228.8 (range 1,100.0–1,460.0)
Slope (°): 10.8 (range 0.0–22.0)
Aspect: E(1), F(1), NW(3), S(1), SW(1), W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



POCO3 Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
	Grasses (5) [b]							
N	*Paspalum distichum*	4.6	21.3	37.5				
	Unknown graminoid	0.8	8.1	12.5				
I	*Cyperus* sp.	0.6	5.6	12.5				
	Forbs (9) [b]							
N	*Polygonum coccineum*	34.2	71.9	87.5				
N	*Artemisia lindleyana*	2.7	12.5	25.0				
N	*Glycyrrhiza lepidota*	2.5	21.3	37.5				
N	*Equisetum laevigatum*	1.8	19.4	37.5				
I	*Equisetum arvense*	1.6	8.8	12.5				
I	*Physalis longifolia*	1.4	6.3	50.0				
N	*Xanthium strumarium*	1.4	6.3	50.0				
	Rock	71.9	98.8	100.0				
	Bare Soil	9.5	71.9	100.0				
	Litter	3.7	71.9	100.0				
	Lichen	1.5	13.1	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Equisetum laevigatum (EQLA)
(smooth scouring rush) 7 stands

The *Equisetum laevigatum* plant assemblage is uncommon in the *Emergent Herbaceous Wetland* cover type. It was encountered in at least 1 site in all study reaches except the Oxbow Reservoir Reach. Sites occurred between 1,100 and 3,200 ft on 0- to 32-degree slopes on a variety of aspects. Soil pH was moderately acidic (pH = 5.7) according to a soil sample at 1 site.

Porters Island Plot: BA98PORAS0

Equisetum laevigatum is a native grass-like plant that occurs in wet places from lowland to mid-montane elevations in the western United States (Hitchcock and Cronquist 1991). In Hells Canyon, *Equisetum laevigatum* is an uncommon species that was encountered in 28 transects and in 6 cover types. It was found in all study reaches, but was most common in the reach below Hells Canyon Dam (12 transects). In this assemblage, *Equisetum laevigatum* provides over 24% cover and occurs in most plots along transects (frequency = 71%). The rare plant *Carex sheldonii* contributes an average cover of almost 12% in this assemblage.

This assemblage has a moderate number of species (n = 23), and about one-half are native. The noxious weed *Cirsium arvense* contributes over 6% cover. Three other noxious weeds occur in low amounts: *Taeniatherum caput-medusae*, *Cardaria draba*, and *Onopordum acanthium*. Litter covers about 64% of the ground surface, and rock covers about 15% of the surface.

Other Studies

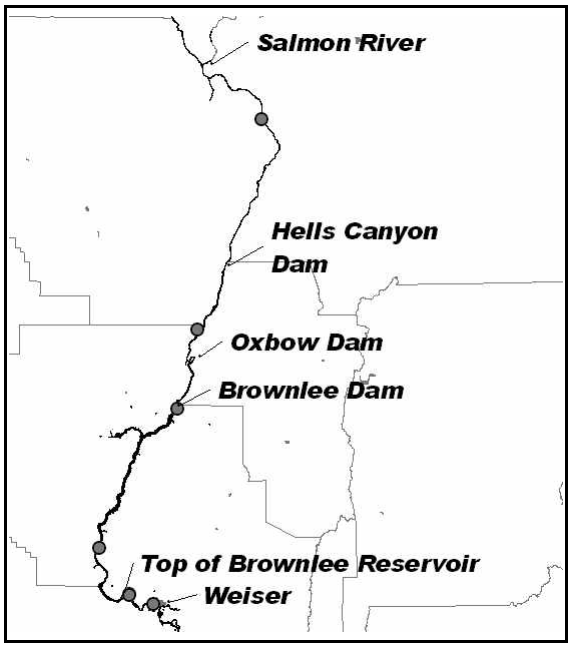
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

EQLA Site Conditions

Elevation (ft): 2,106 (range 1,100.0–3,200.0)
Slope (°): 11.4 (range 0.0–32.0)
Aspect: F(3), NE(1), NW(1), S(1), W(1)
[a] Soil Texture: sandy loam(1)
[a] Organic Matter %: 4.0
[a] pH: 5.7
[a] ON ppm: 13.0
[a] CEC meq/100g: 16.0

[a] Soil characteristic data available for 1 stand.



EQLA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
	Grasses (8) [b]							
N	*Carex sheldonii*	11.9	14.3	14.3				
I	*Poa pratensis*	5.7	25.0	28.6				
I	*Bromus tectorum*	3.9	26.4	28.6				
I	*Agropyron repens*	3.4	23.6	42.9				
	Forbs (12) [b]							
N	*Equisetum laevigatum*	24.2	71.4	71.4				
I	*Cirsium arvense*	6.1	17.9	28.6				
N	*Helianthus annuus*	1.3	16.4	42.9				
I	*Cardaria draba*	1.1	21.4	42.9				
N	*Verbena bracteata*	0.7	14.3	28.6				
N	*Euphorbia glyptosperma*	0.5	10.0	28.6				
	Litter	64.2	95.0	100.0				
	Rock	14.9	27.9	100.0				
	Bare Soil	4.6	52.4	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Typha latifolia (TYLA)
(common cattail) 6 stands

The *Typha latifolia* plant assemblage is rare in the *Emergent Herbaceous Wetland* cover type. It was encountered at 1 or 2 sites in each reach, except the reach below Hells Canyon Dam. All sites were found in tributary drainages to the Snake River (Table 9), suggesting this assemblage is characteristic of tributaries in the study area other than the Snake River riparian zone. Sites occurred between 1,683 and 2,240 ft on 0- to 4-degree slopes on a variety of aspects. No soil information was collected.

Fox Creek Plot: BR98FOX4OR

Typha latifolia is a native species commonly found in wet or marshy places throughout the West, where it provides valuable habitat for waterfowl and other wildlife. It can form dense, extensive stands in shallow water. Due to the steep topography in Hells Canyon, *Typha latifolia* distribution is very restricted. It was encountered on 10 transects in 1 cover type (*Emergent Herbaceous Wetland*). It occurred in a few transects in all study reaches, except below Hells Canyon Dam. Most occurrences were in the Weiser Reach (3 transects) and in the Brownlee Reservoir Reach (4 transects). In this assemblage, *Typha latifolia* provides over 40% cover and occurs in most plots along transects (frequency = 77%). Other somewhat common species in this assemblage include *Lemna minor*, *Eleocharis palustris*, *Rorippa nasturtium-aquaticum*, and *Polypogon monspeliensis*.

This assemblage is species rich (n = 34) and has mostly native plants, but most species occur in trace amounts (< 1% cover) and infrequently. Four noxious weed species were found: *Cardaria draba*, *Lythrum salicaria*, *Cynoglossum officinale*, and *Dipsacus sylvestris*. Litter covers 37% of the soil surface, and bare soil is exposed on 26% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area. Asherin and Claar (1976) reported that *Typha* vegetation was uncommon in the canyon and that it would undoubtedly never be widespread, except possibly at the mouths of tributary streams, because of the steep, rocky shorelines.

Appendix 3 (cont.).

TYLA Site Conditions

Elevation (ft): 1,983.0 (range 1,683.0–2,240.0)

Slope (°): 1.7 (range 0.0–4.0)

Aspect: E(1), F(1), NW(1), S(1), SW(2)

[a] Soil Texture: 0

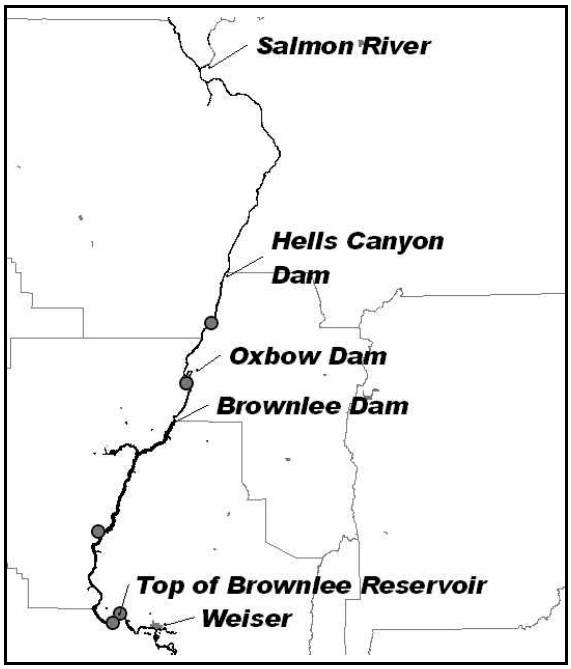
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



TYLA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (5) [b]							
	Grasses (12) [b]							
N	*Eleocharis palustris*	6.8	21.7	33.3				
I	*Polypogon monspeliensis*	2.6	24.2	33.3				
N	*Agrostis exarata*	1.6	15.0	33.3				
N	*Paspalum distichum*	1.4	9.2	16.7				
N	*Carex athrostachya*	1.3	5.0	33.3				
N	*Scirpus maritimus*	1.3	8.3	16.7				
N	*Glyceria striata*	1.1	14.2	16.7				
	Forbs (17) [b]							
N	*Typha latifolia*	40.5	76.7	100.0				
N	*Lemna minor*	7.3	40.0	66.7				
N	*Rorippa nasturtium-aquaticum*	3.8	16.7	33.3				
N	*Epilobium watsonii*	3.3	28.3	33.3				
I	*Cardaria draba*	3.2	17.5	33.3				
N	*Cardamine breweri*	1.6	11.7	16.7				
I	*Lythrum salicaria*	1.3	15.0	50.0				
I	*Veronica anagallis-aquatica*	1.3	14.2	33.3				
	Litter	37.4	83.3	100.0				
	Bare Soil	26.3	80.0	100.0				
	Moss	4.2	21.7	100.0				
	Lichen	0.0	0.0	0.0				
	Rock	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Scirpus maritimus (SCMA)
(seacoast bulrush) 6 stands

The *Scirpus maritimus* plant assemblage is rare in the *Emergent Herbaceous Wetland* cover type. It was encountered in the Weiser (3 sites) and Brownlee Reservoir (2 sites) reaches, but also at 1 site below Hells Canyon Dam. More than one-half of the sites (4 of 6) were found in tributary drainages to the Snake River (Table 9), suggesting this assemblage is also characteristic of tributaries in the study area other than the Snake River riparian zone. Sites occurred between 1,230 and 2,140 ft on 0- to 3-degree slopes on a variety of aspects. No soil information was collected.

Porters Island Plot: BA98POI41R

Scirpus maritimus is a widespread but rather irregularly distributed species in the Northern Hemisphere. It is commonly found along seacoasts, in marshes, wet meadows, and margins of ponds, especially where soils are alkaline or saline (Hitchcock and Cronquist 1991). *Scirpus maritimus* was encountered on 11 transects in 1 cover type (*Emergent Herbaceous Wetland*). It occurred in the Weiser Reach (5 transects) and the headwaters of Brownlee Reservoir (4 transects), but also in 2 transects below Hells Canyon Dam. In this assemblage, *Scirpus maritimus* provides over 28% cover and occurs in most plots along transects (frequency = 88%). Other common species in this assemblage include *Eleocharis palustris*, *Paspalum distichum*, and *Carex vulpinoides.* One-half of the sites contained *Lythrum salicaria*, and 1 site had *Lepidium latifolium*; both listed noxious weeds in Oregon and Idaho.

This assemblage is species rich (n = 27) and has mostly native plants, but most species occur in trace amounts (< 1% cover) and infrequently. Three noxious weed species occur in low amounts: *Lepidium latifolium*, *Lythrum salicaria*, and *Rumex crispus*. Litter covers over 55% of the soil surface, and rock covers 14% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area. Asherin and Claar (1976) reported that moist sites around springs or on tributary deltas support stands of *Carex* spp., but these areas are extremely limited in size and distribution in the Hells Canyon vicinity.

Appendix 3 (cont.).

SCMA Site Conditions

Elevation (ft): 1,965.3 (range 1,230.0–2,140.0)

Slope (°): 1.7 (range 0.0–3.0)

Aspect: E(1), F(1), N(1), S(2), W(1)

[a] Soil Texture: 0

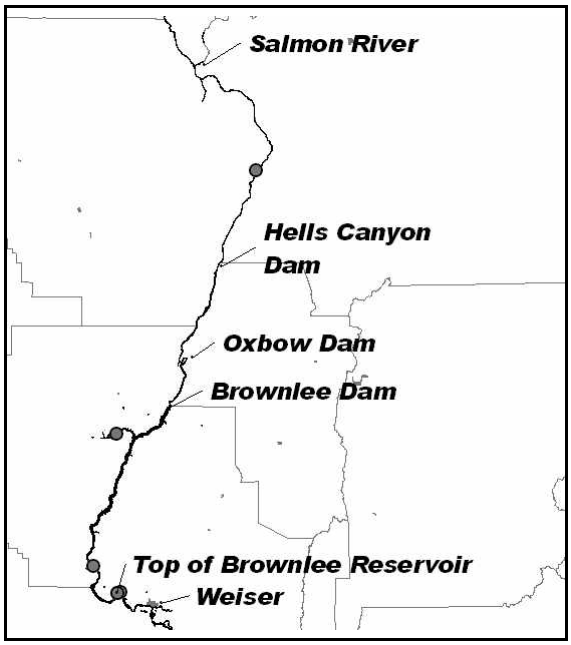
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SCMA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
	Grasses (11) [b]							
N	*Scirpus maritimus*	28.1	87.5	100.0				
N	*Eleocharis palustris*	15.1	64.2	83.3				
N	*Paspalum distichum*	13.0	32.5	33.3				
N	*Carex vulpinoides*	5.1	16.7	33.3				
I	*Agrostis alba*	3.7	15.8	16.7				
I	*Polypogon monspeliensis*	3.0	25.8	50.0				
N	*Glyceria borealis*	2.3	10.0	16.7				
N	*Juncus torreyi*	0.9	15.0	50.0				
	Forbs (13) [b]							
I	*Lepidium latifolium*	2.1	15.8	16.7				
N	*Lemna minor*	2.1	31.7	66.7				
N	*Rorippa nasturtium-aquaticum*	1.8	11.7	16.7				
N	*Ranunculus sceleratus*	1.3	13.3	16.7				
	Unknown forb	1.1	13.3	16.7				
I	*Lythrum salicaria*	0.9	11.7	50.0				
N	*Myosotis laxa*	0.6	5.8	16.7				
I	*Rumex crispus*	0.6	9.2	50.0				
	Litter	55.2	90.8	100.0				
	Rock	14.0	39.2	100.0				
	Bare Soil	8.2	50.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Dipsacus sylvestris (DISY)
(teasel) 6 stands

The *Dipsacus sylvestris* plant assemblage is rare in the *Emergent Herbaceous Wetland* cover type. It was encountered in the Brownlee Reservoir (3 sites), the Oxbow Reservoir (1 site), and the Hells Canyon Reservoir (2 sites) reaches. Sites occurred between 1,690 and 2,077 ft on 1- to 26-degree slopes on a variety of aspects. No soil information was collected.

Powder River Plot: BR981327G3

Dipsacus sylvestris is a European weed that has been widely introduced in North America (Hitchcock and Cronquist 1991). It is spreading rapidly in moist sites in the Pacific Northwest, especially along irrigation ditches and in disturbed sites (Whitson et al. 1992). *Dipsacus sylvestris* is a listed noxious weed species in Oregon. In Hells Canyon, it is a common, ubiquitous weed. It was encountered on 91 transects and in 9 cover types throughout the study area. In this assemblage, *Dipsacus sylvestris* provides over 26% cover and occurs in most plots along transects (frequency = 62%). It dominates somewhat xeric sites, where annual *Bromus* spp. and *Taeniatherum caput-medusae* occur, as well as mesic sites inhabited by species such as *Camassia cusickii*, *Asclepias speciosa*, and *Mimulus guttatus*.

This assemblage is species rich (n = 36) and has mostly introduced plants, but most species occur in trace amounts (< 1% cover) and infrequently. In addition to *Dipsacus sylvestris*, 4 other noxious weed species were found in trace amounts: *Taeniatherum caput-medusae*, *Rumex crispus*, *Cirsium arvense*, and *Cynoglossum officinale*. Litter covers over 41% of the soil surface, and rock covers 24% of the surface.

Other Studies

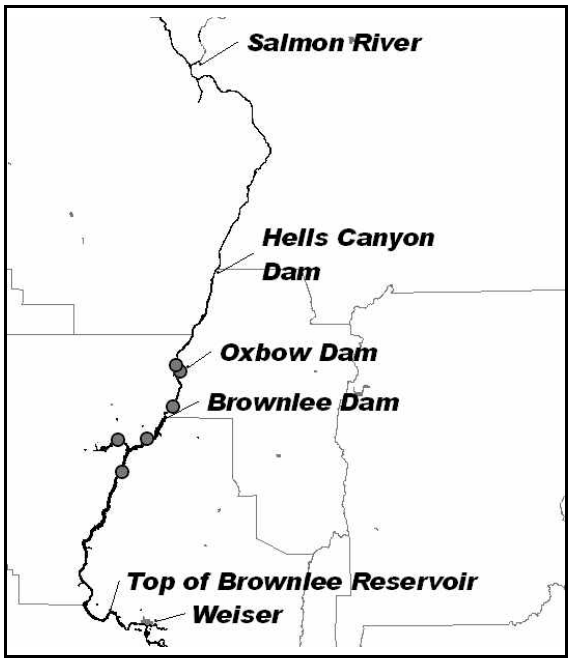
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

DISY Site Conditions

Elevation (ft): 1,930.0 (range 1,690.0–2,077.0)
Slope (°): 12.5 (range 1.0–26.0)
Aspect: NW(2), S(1), SW(1), W(2)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



DISY Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (7) [b]							
N	*Salix lutea*	4.3	6.3	16.7	61	1.81	6	0.30
N	*Celtis reticulata*	1.7	3.3	16.7	167	1.05		
	Grasses (7) [b]							
I	*Bromus japonicus*	1.6	55.0	66.7				
I	*Bromus sterilis*	1.5	25.8	33.3				
I	*Taeniatherum caput-medusae*	0.8	20.8	66.7				
N	*Carex* sp.	0.7	7.5	33.3				
I	*Poa pratensis*	0.6	6.7	33.3				
I	*Bromus tectorum*	0.6	21.7	66.7				
	Forbs (22) [b]							
I	*Dipsacus sylvestris*	26.3	61.7	83.3				
N	*Camassia cusickii*	6.0	16.7	16.7				
N	*Asclepias speciosa*	5.1	16.7	16.7				
N	*Mimulus guttatus*	4.4	15.8	16.7				
N	*Grindelia squarrosa*	3.6	17.5	33.3				
I	*Melilotus alba*	2.9	41.1	83.3				
I	*Verbascum thapsus*	1.0	5.6	16.7				
N	*Xanthium strumarium*	0.9	22.5	50.0				
N	*Lycopus americanus*	0.8	5.6	16.7				
N	*Helianthus annuus*	0.7	5.0	33.3				
I	*Polygonum aviculare*	0.6	12.5	16.7				
	Litter	41.1	90.0	100.0				
	Rock	23.9	77.5	100.0				
	Bare Soil	4.9	33.1	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.6% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Iris pseudacorus (IRPS)
(yellow flag) 4 stands

The *Iris pseudacorus* plant assemblage is rare in the *Emergent Herbaceous Wetland* cover type. It was encountered in the Weiser (1 site) and in the Oxbow Reservoir (3 sites) reaches. Sites occurred between 1,800 and 2,090 ft on 0- to 29-degree slopes on a variety of aspects. No soil information was collected.

Oxbow Boat Ramp Plot: OX960877G4

Iris pseudacorus is a European weedy species that can become well established around lakes and ponds and along stream banks in North America (Hitchcock and Cronquist 1991). In Hells Canyon, *Iris pseudacorus* occurs in small isolated stands along the high-water mark. It was encountered on 43 transects, in all riparian cover types, and in all study reaches except below Hells Canyon Dam. In this assemblage, *Iris pseudacorus* provides almost 47% cover and occurs in most plots along transects (frequency = 71%). *Phragmites communis* was also abundant at 1 site in this assemblage, but most other species provide little cover and occur infrequently. *Lepidium latifolium*, a listed noxious weed in Idaho and Oregon, occurred at 2 of the sites.

This assemblage is relatively species poor (n = 16) and with mostly introduced plants. Two noxious weed species occur: *Lepidium latifolium* contributes a substantial amount of cover (over 8%), while *Cirsium arvense* occurs in trace amounts (< 1% cover). Litter covers over 54% of the soil surface, and rock covers about 42% of the surface.

Other Studies

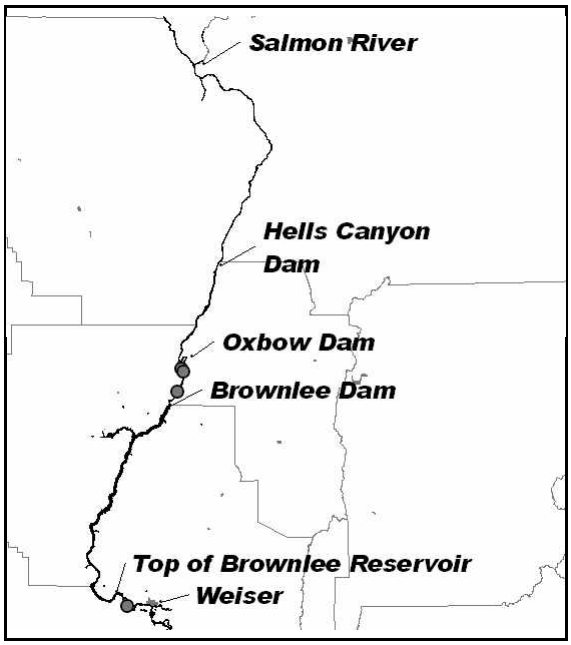
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

IRPS Site Conditions

Elevation (ft): 1,882.8 (range 1,800.0–2,090.0)
Slope (°): 11.3 (range 0.0–29.0)
Aspect: E(2), F(1), NE(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



IRPS Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (1) [b]							
	Grasses (7) [b]							
N	*Phragmites communis*	21.0	25.0	25.0				
N	*Elymus triticoides*	1.7	11.3	25.0				
I	*Bromus japonicus*	0.6	17.5	50.0				
I	*Avena fatua*	0.6	10.0	25.0				
	Forbs (8) [b]							
I	*Iris pseudacorus*	46.9	71.3	75.0				
I	*Lepidium latifolium*	8.1	32.5	50.0				
N	*Lycopus asper*	6.4	27.5	50.0				
N	*Galium aparine*	2.7	20.0	25.0				
I	*Solanum dulcamara*	1.4	11.3	25.0				
I	*Lactuca serriola*	0.6	5.0	25.0				
N	*Parietaria pensylvanica*	0.6	7.5	25.0				
	Litter	54.3	98.8	100.0				
	Rock	41.7	61.3	100.0				
	Bare Soil	3.7	40.0	100.0				
	Moss	0.3	5.0	100.0				
	Lichen	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Mixed herbaceous (MIXED HERB)
(mixed herbaceous) 3 stands

The mixed herbaceous plant assemblage is rare in the *Emergent Herbaceous Wetland* cover type. It was encountered at 1 site in the reach below Hells Canyon Dam and at 2 sites in the Hells Canyon Reservoir Reach. Sites occurred between 1,683 and 1,860 ft on 1- to 37-degree slopes on a variety of aspects. Soil pH was neutral (pH = 6.6).

Bernard Creek Plot: HB96BER07U

This assemblage of species was separated during TWINSPAN analyses because of its dissimilarity with other assemblages. It is weakly related to the *Distichlis stricta* plant assemblage. No single species is consistently dominant in more than 1 transect except *Celtis reticulata*. This assemblage probably has no ecological significance. It should simply be viewed as a weakly related group of miscellaneous riparian sites that meets the *Emergent Herbaceous Wetland* cover type criteria. No noxious weeds occur in this assemblage.

Other Studies

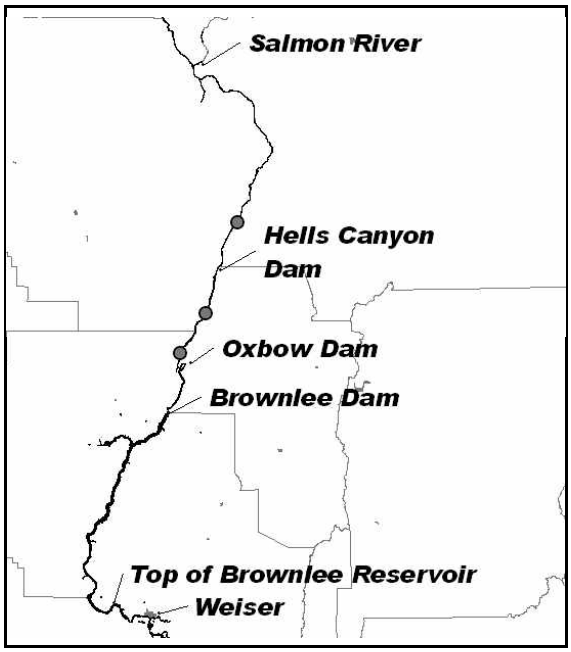
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

MIXED HERB Site Conditions

Elevation (ft): 1,754.3 (range 1,683.0–1,860.0)
Slope (°): 15.7 (range 1.0–37.0)
Aspect: N(2), SE(1)
[a] Soil Texture: SILO(1)
[a] Organic Matter %: 3.1
[a] pH: 6.6
[a] ON ppm: 12.0
[a] CEC meq/100g: 20.0

[a] Soil characteristic data available for 1 stand.



MIXED HERB Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (2) [b]							
	Shrubs (6) [b]							
N	*Celtis reticulata*	8.5	13.7	66.7	210	1.62	59	0.35
N	*Sambucus cerulea*	2.6	4.0	33.3	40	2.41		
	Grasses (10) [b]							
I	*Poa pratensis*	3.5	7.8	33.3				
N	*Sporobolus cryptandrus*	1.8	7.8	33.3				
N	*Agropyron spicatum*	1.5	18.3	33.3				
I	*Bromus tectorum*	1.1	25.0	66.7				
	Forbs (22) [b]							
I	*Polygonum cuspidatum*	32.5	33.3	33.3				
N	*Artemisia ludoviciana*	4.1	15.0	33.3				
I	*Anthriscus scandicina*	2.3	10.0	33.3				
N	*Epilobium paniculatum*	1.7	15.0	33.3				
	Other forb	1.6	28.3	33.3				
I	*Arenaria serpyllifolia*	1.3	17.8	66.7				
I	*Medicago sativa*	1.1	2.2	33.3				
	Litter	61.4	95.6	100.0				
	Bare Soil	6.6	45.6	100.0				
	Rock	2.9	33.9	100.0				
	Moss	1.9	26.7	100.0				
	Lichen	0.2	6.7	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 1% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Spartina pectinata (SPPE)
(prairie cordgrass) 3 stands

The *Spartina pectinata* plant assemblage is rare in the *Emergent Herbaceous Wetland* cover type. It was encountered at 1 site in the Weiser Reach and 2 sites in the reach below Hells Canyon Dam. Sites occurred between 1,240 and 2,080 ft on 5- to 35-degree slopes on a variety of aspects. No soil information was collected.

Dry Gulch Plot: HB970617I2

Spartina pectinata is an uncommon native graminoid in the Pacific Northwest that occurs along ditches, ponds, and freshwater marshes (Hitchcock and Cronquist 1991). In Hells Canyon, *Spartina pectinata* is a rare species, encountered in 6 transects and 3 riparian cover types. It was found in 5 transects in the reach below Hells Canyon Dam and in 1 transect in the Weiser Reach. In this assemblage, *Spartina pectinata* provides almost 48% cover and occurs in most plots along transects (frequency = 93%). *Glycyrrhiza lepidota* is highly prevalent in this assemblage.

This assemblage has a moderate number of species (n = 19), and most are native. No noxious weed species occur. Rock covers almost 45% of the ground surface, and litter covers about 33% of the surface.

Other Studies

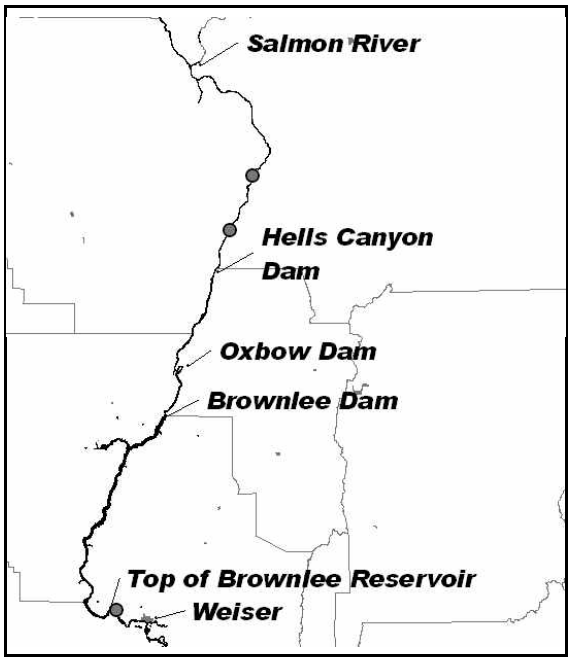
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

SPPE Site Conditions

Elevation (ft): 1,556.7 (range 1,240.0–2,080.0)
Slope (°): 17.7 (range 5.0–35.0)
Aspect: NW(1), S(1), W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SPPE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (4) [b]							
N	*Toxicodendron radicans*	7.5	12.5	33.3	3,333	0.75	83,333	0.15
I	*Ulmus americana*	4.2	10.0	33.3	1,167	0.76	500	0.33
	Grasses (7) [b]							
N	*Spartina pectinata*	47.7	93.3	100.0				
I	*Agropyron intermedium*	7.9	15.0	33.3				
N	*Carex vulpinoides*	4.1	25.0	66.7				
N	*Phalaris arundinacea*	2.9	6.7	33.3				
	Forbs (8) [b]							
N	*Glycyrrhiza lepidota*	15.2	40.0	66.7				
	Polygonum sp.	5.9	15.0	66.7				
N	*Equisetum arvense*	1.6	21.7	33.3				
N	*Asclepias speciosa*	0.9	10.0	33.3				
I	*Physalis longifolia*	0.6	5.0	33.3				
I	*Convolvulus* sp.	0.5	3.3	33.3				
	Rock	44.7	66.7	100.0				
	Litter	32.6	78.3	100.0				
	Bare Soil	4.4	58.3	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

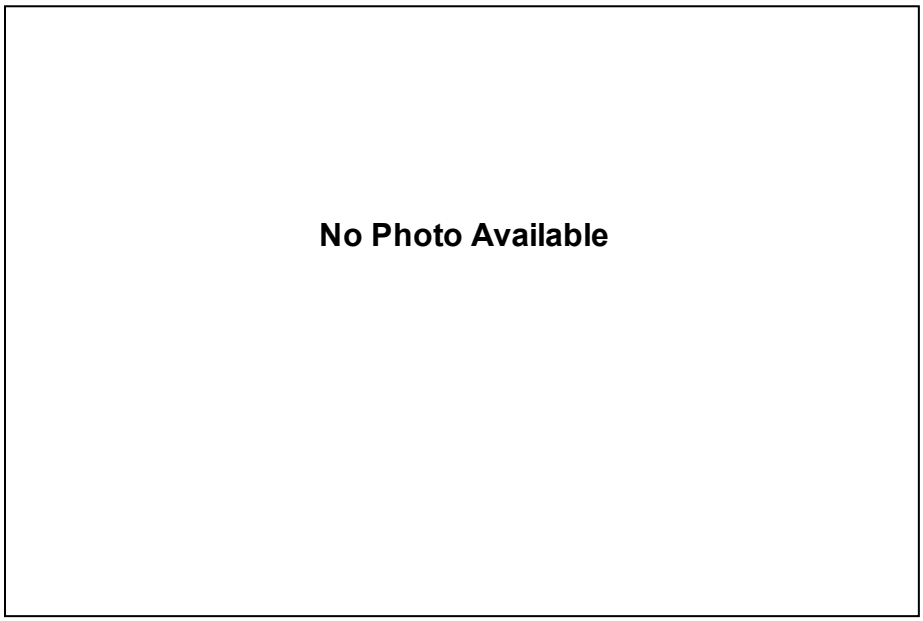
[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Emergent Herbaceous Wetland

Polygonum amphibium (POAM)
(water smartweed) 1 stand

The *Polygonum amphibium* plant assemblage is rare in the *Emergent Herbaceous Wetland* cover type. It was encountered at 1 site in the reach below Hells Canyon Dam. It occurred at 1,110 ft on a 3-degree slope on a west aspect. No soil information was collected.



Polygonum amphibium is a native aquatic species found in wet or moist sites, often partially submerged. It is found in undisturbed sites, but it can also become troublesome in cultivated fields and irrigated pastures (Whitson et al. 1992). In Hells Canyon, *Polygonum amphibium* is a rare species, encountered in just 4 transects and 2 cover types in the reach below Hells Canyon Dam. In this assemblage, *Polygonum amphibium* is clearly the dominant, providing almost 42% cover and occurring in every plot (frequency = 100%).

This assemblage is species poor (n = 3), and all species are native. Rock covers nearly 79% of the ground surface, and bare soil is exposed on about 7% of the surface.

Other Studies

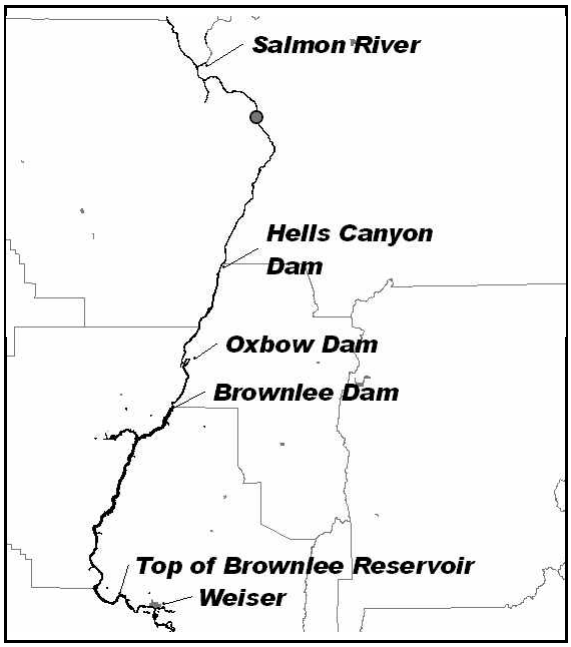
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

POAM Site Conditions

Elevation (ft): 1,110.0
Slope (°): 3.0
Aspect: W(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



POAM Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (0) [b]							
	Grasses (1) [b]							
N	*Paspalum distichum*	0.1	5.0	100.0				
	Forbs (2) [b]							
N	*Polygonum amphibium*	41.8	100.0	100.0				
N	*Euphorbia glyptosperma*	0.1	5.0	100.0				
	Rock	78.6	100.0	100.0				
	Bare Soil	6.7	95.0	100.0				
	Litter	0.9	35.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Shore & Bottomland Wetland

Portulaca oleracea (POOL)
(purslane) 18 stands

The *Portulaca oleracea* plant assemblage is the most common assemblage in the *Shore & Bottomland Wetland* cover type. It was mostly encountered in the Brownlee Reservoir Reach (16 sites), but also in the Weiser Reach (1 site) and the reach below Hells Canyon Dam (1 site). Sites occurred between 1,280 and 2,080 ft on 0- to 25-degree slopes on a variety of aspects. No soil information was collected.

Sheep Creek Rapids Plot: HB97054011

Portulaca oleracea is a European invader that has become a troublesome weed in cultivated fields and gardens. It is especially persistent in soils that remain moist much of the time (Whitson et al. 1992). In Hells Canyon, *Portulaca oleracea* was commonly encountered in the upper reaches of the study area. It is one of the species that annually invades the drawdown zone of Brownlee Reservoir. It was encountered in 149 transects, in 5 cover types, and principally in the Weiser (58 transects) and the Brownlee Reservoir (82 transects) reaches. In this assemblage, *Portulaca oleracea* provides 10% cover and occurs in most plots along transects (frequency = 82%). An introduced graminoid, *Heleochloa alopecuroides*, is also common in this assemblage.

This assemblage has a moderate number of species (n = 19), and most are introduced. Two listed noxious weed species occur: *Rumex crispus* and *Lepidium latifolium*. Bare soil is exposed on about 44% of the ground surface, and rock covers about 35% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

POOL Site Conditions

Elevation (ft): 2,032.8 (range 1,280.0–2,080.0)

Slope (°): 6.6 (range 0.0–25.0)

Aspect: E(1), F(3), N(2), NE(2), S(1), SE(2), SW(3), W(4)

[a] Soil Texture: 0

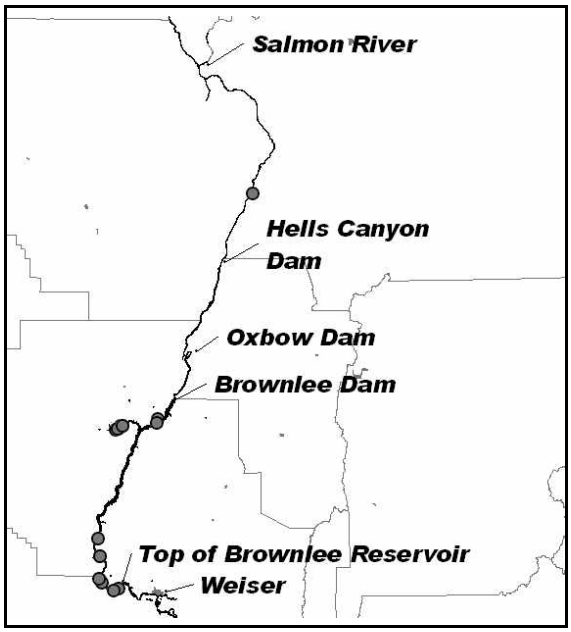
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



POOL Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (4) [b]							
	Grasses (3) [b]							
I	*Heleochloa alopecuroides*	2.5	42.2	61.1				
I	*Echinochloa crus-galli*	0.6	8.9	33.3				
N	*Panicum capillare*	0.6	18.1	44.4				
	Forbs (12) [b]							
N	*Portulaca oleracea*	10.0	82.2	94.4				
N	*Solidago occidentalis*	2.0	10.8	16.7				
N	*Xanthium strumarium*	1.5	22.2	55.6				
N	*Mollugo verticillata*	1.5	28.3	50.0				
I	*Chenopodium foliosum*	0.9	5.3	11.1				
I	*Rumex obtusifolius*	0.9	5.6	5.6				
I	*Rumex crispus*	0.6	5.3	5.6				
	Bare Soil	43.6	92.2	100.0				
	Rock	35.4	74.4	100.0				
	Litter	2.4	60.8	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Shore & Bottomland Wetland

Celtis reticulata (CERE)
(netleaf hackberry) 13 stands

Celtis reticulata is probably the most common woody species seen from the river in Hells Canyon, especially below Hells Canyon Dam. The *Celtis reticulata* assemblage is the second most common assemblage in the *Shore & Bottomland Wetland* cover type. It was encountered primarily in the reach below Hells Canyon Dam (12 sites) and also in the Hells Canyon Reservoir Reach (1 site). Sites occurred between 960 and 1,780 ft on 1- to 30-degree slopes on a variety of aspects. No soil information was collected.

Sheep Creek Rapids Plot: HB970540I3

Celtis reticulata occupies a wide variety of habitats in Idaho's western canyons. On rocky outcrops it may be a gnarled, twisted shrub, but in stream bottoms it has reasonably straight stems and may be 20 to 30 inches in diameter (Johnson 1995). In Hells Canyon, *Celtis reticulata* is a common component of several plant assemblages in riparian and upland cover types. It was encountered in 343 transects, 11 cover types, and in all study reaches.

This assemblage is characterized by a sparse cover of younger *Celtis reticulata* plants and a few other shrubs and herbaceous species occurring in the annual flood zone along the shoreline. The average height of *Celtis reticulata* is about 0.8 m. It contributes about 5% canopy coverage and occurs in about 11% of all plots along transects. These plants are usually succors, extending from the roots of more mature plants growing higher up the banks. *Artemisia ludoviciana* and *Artemisia lindleyana* are common components of this assemblage, but neither provides more than 3% cover.

This assemblage is relatively species poor (n = 10), and most species are native. No noxious weeds were found. Rock covers over 87% of the ground surface, and bare soil is exposed on about 5% of the ground.

Other Studies

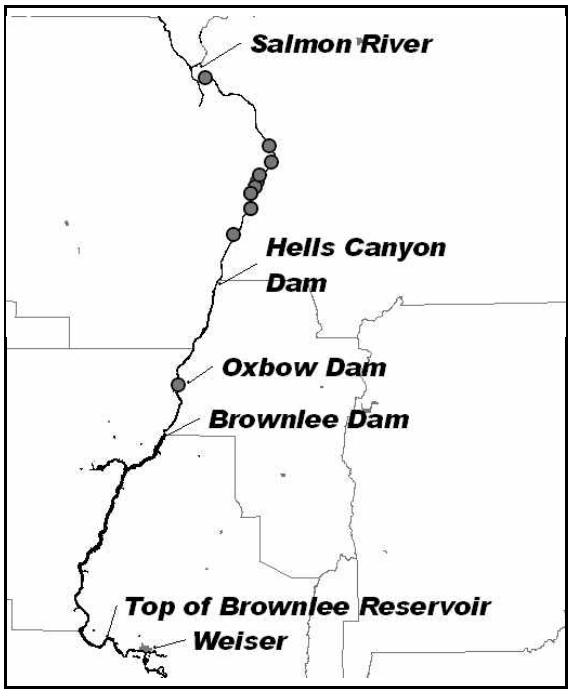
This plant assemblage has not been described for the Hells Canyon area. Other *Celtis reticulata* assemblages have been described (Asherin and Claar 1976, Miller 1976, Tisdale 1986, Johnson and Simon 1987), but not a type occurring on mostly barren shorelines in the annual flood zone.

Appendix 3 (cont.).

CERE Site Conditions

Elevation (ft): 1,264.6 (range 960–1,780.0)
Slope (°): 7.9 (range 1.0–30.0)
Aspect: E(3), N(2), S(1), SE(4), W(3)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



CERE Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (2) [b]							
N	*Celtis reticulata*	4.6	11.3	92.3	618	0.84	475	0.29
N	*Toxicodendron radicans*	0.0	0.2	23.1				
	Grasses (3) [b]							
I	*Setaria glauca*	0.1	5.6	7.7				
I	*Eragrostis cilianensis*	0.1	1.9	15.4				
N	*Panicum capillare*	0.1	1.9	15.4				
	Forbs (5) [b]							
N	*Artemisia ludoviciana*	2.9	17.4	30.8				
N	*Artemisia lindleyana*	1.9	20.0	61.5				
N	*Aster eatonii*	0.2	3.8	7.7				
N	*Verbena bracteata*	0.2	4.1	7.7				
N	*Grindelia squarrosa*	0.1	0.9	15.4				
	Rock	87.0	100.0	100.0				
	Bare Soil	4.6	57.7	100.0				
	Litter	2.4	66.9	100.0				
	Lichen	0.7	18.8	100.0				
	Moss	0.1	5.0	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Shore & Bottomland Wetland

Aster eatonii (ASEA)
(Eaton's aster) 7 stands

The *Aster eatonii* assemblage is common in the *Shore & Bottomland Wetland* cover type. It was encountered in the reach below Hells Canyon Dam (6 sites) and in the Hells Canyon Reservoir Reach (1 site). Sites occurred between 950 and 1,683 ft on 0- to 19-degree slopes on a variety of aspects. No soil information was collected.

Near Imnaha River Plot: HB980145I1

Aster eatonii is a native forb that occurs along stream banks and other moist places at lower valley to mid-montane elevations throughout the Pacific Northwest (Hitchcock and Cronquist 1991). In Hells Canyon, *Aster eatonii* is relatively rare. It was encountered in 12 transects, 4 cover types, and only in the Hells Canyon Reservoir Reach (5 transects) and the reach below Hells Canyon Dam (7 transects).

This assemblage occurs along the rocky shorelines and is characterized by a sparse cover of *Aster eatonii* and other herbaceous species, with an occasional *Celtis reticulata* plant. The average height of *Celtis reticulata* is about 1.1 m. *Aster eatonii* provides about 4% cover and occurs in about one-fifth of all plots along transects (frequency = 19%). This assemblage has a moderate number of species (n = 16), and most are native. One noxious weed was found: *Convolvulus arvensis*. Rock covers almost 61% of the ground surface, and bare soil is exposed on about 22% of the ground.

Other Studies

This plant assemblage has not been described for the Hells Canyon area.

Appendix 3 (cont.).

ASEA Site Conditions

Elevation (ft): 1,267.6 (range 950.0–1,683.0)

Slope (°): 7.3 (range 0.0–19.0)

Aspect: E(1), F(1), N(1), NE(1), NW(1), S(1), SE(1)

[a] Soil Texture: 0

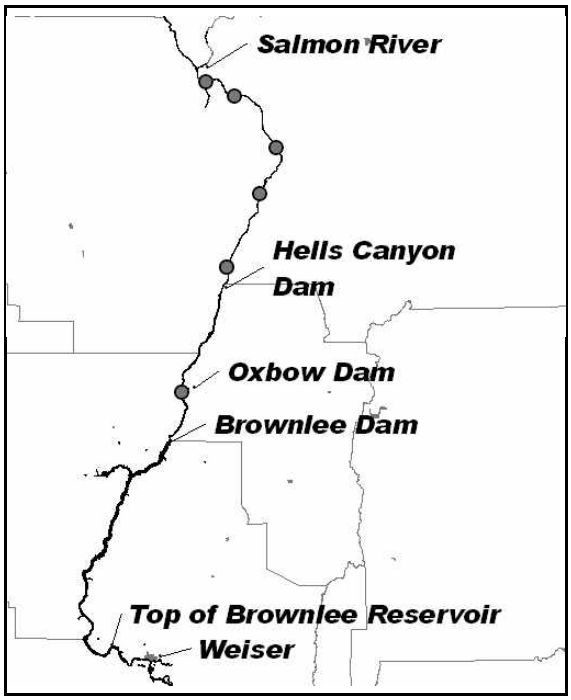
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ASEA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (1) [b]							
N	*Celtis reticulata*	0.3	1.4	42.9	158	1.14	189	0.19
	Grasses (2) [b]							
I	*Setaria viridis*	0.6	12.1	14.3				
N	*Panicum scribnerianum*	0.1	5.0	28.6				
	Forbs (13) [b]							
N	*Aster eatonii*	3.8	18.6	57.1				
N	*Glycyrrhiza lepidota*	3.4	19.3	42.9				
N	*Equisetum laevigatum*	3.3	19.3	28.6				
N	*Aster chilensis*	2.1	12.1	14.3				
N	*Helenium autumnale*	1.3	10.7	14.3				
I	*Physalis longifolia*	1.2	11.4	71.4				
N	*Artemisia lindleyana*	0.5	4.3	42.9				
N	*Xanthium strumarium*	0.5	9.3	42.9				
	Rock	60.9	85.0	100.0				
	Bare Soil	22.4	85.7	100.0				
	Litter	3.2	90.7	100.0				
	Lichen	1.1	8.6	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Forbs with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Shore & Bottomland Wetland

Xanthium strumarium (XAST)
(common cocklebur) 6 stands

The *Xanthium strumarium* plant assemblage is common in the *Shore & Bottomland Wetland* cover type. A similar assemblage is also very common in the *Emergent Herbaceous Wetland* cover type. The *Xanthium strumarium* was encountered in just the Brownlee Reservoir Reach (6 sites). Sites occurred between 2,070 and 2,077 ft on 4- to 28-degree slopes on a variety of aspects. No soil information was collected.

Porters Island Plot: BA97PORBS1

Xanthium strumarium is native to North America but is now worldwide in distribution. It is a weedy species common in cultivated fields, run-down pastures, road ditches, and riparian areas. The burs are irritating to both humans and animals. Both the seeds and seedlings contain a substance toxic to livestock (Whitson et al. 1992). In Hells Canyon, *Xanthium strumarium* is commonly encountered in the drawdown zone and near the high-water mark along the river. It was encountered in 189 transects, in 6 cover types, and in all study reaches. It was most abundant in the Brownlee Reservoir Reach (115 transects).

This assemblage is characterized by a predominant cover of *Xanthium strumarium* on exposed fine sediments at or below the high-water mark and with few other species present. *Xanthium strumarium* provides over 14% cover and occurs in most plots along transects (frequency = 86%).

This assemblage is relatively species poor (n = 11); most species are introduced, provide only trace amounts of cover (< 1%), and occur infrequently. No rare plants or noxious weeds were found. Rock covers almost 34% of the ground surface, and bare soil is exposed on about 27% of the surface.

Other Studies

This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

XAST Site Conditions

Elevation (ft): 2,073.2 (range 2,070.0–2,077.0)

Slope (°): 18.0 (range 4.0–28.0)

Aspect: E(1), S(1), SE(1), SW(2), W(1)

[a] Soil Texture: 0

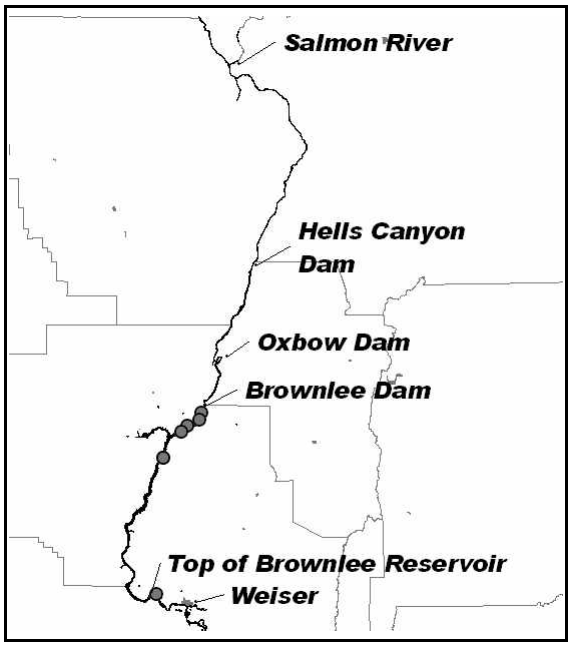
[a] Organic Matter %: 0

[a] pH: 0

[a] ON ppm: 0

[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



XAST Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (1) [b]							
I	*Amorpha fruticosa*	0.0	0.0	16.7	0	0.0	500	0.02
	Grasses (2) [b]							
I	*Bromus japonicus*	0.5	13.3	33.3				
	Unknown graminoid	0.3	9.2	50.0				
	Forbs (8) [b]							
N	*Xanthium strumarium*	14.2	85.8	100.0				
I	*Amaranthus albus*	1.2	34.2	50.0				
N	*Equisetum hyemale*	0.8	15.8	16.7				
I	*Portulaca oleracea*	0.8	29.2	50.0				
	Amaranthus sp.	0.7	18.3	33.3				
N	*Helianthus annuus*	0.6	2.5	33.3				
I	*Medicago sativa*	0.5	3.3	16.7				
I	*Tragopogon dubius*	0.1	5.0	33.3				
	Rock	33.7	85.8	100.0				
	Bare Soil	27.4	80.8	100.0				
	Litter	26.3	98.3	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

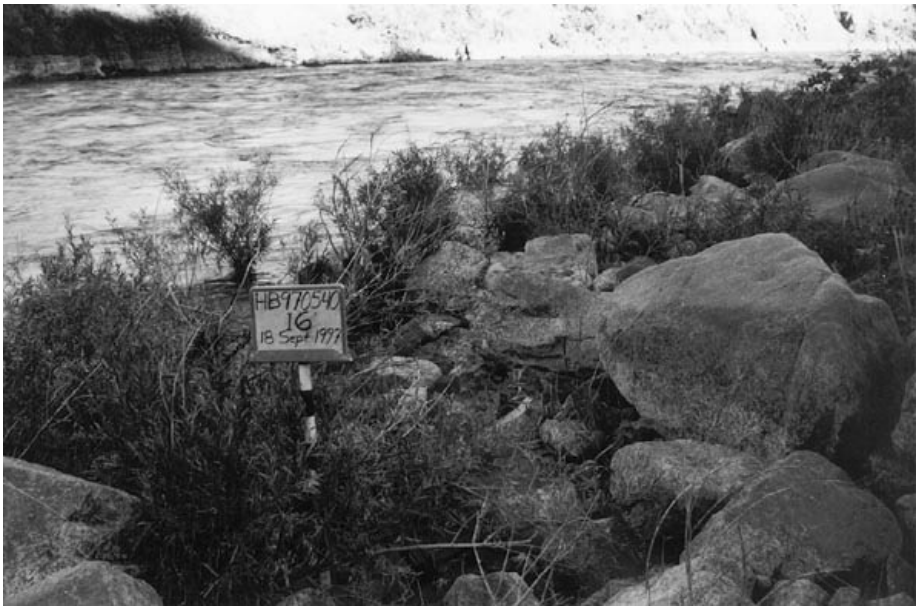
[b] Total number of species in a life form.

Appendix 3 (cont.).

Shore & Bottomland Wetland

Salix exigua (SAEX)
(coyote willow) 4 stands

The *Salix exigua* plant assemblage is uncommon in the *Shore & Bottomland Wetland* cover type. It was encountered at 1 site in the Brownlee Reservoir reach and at 3 sites below Hells Canyon Dam. Sites occurred between 950 and 2,077 ft on 3- to 13-degree slopes on a variety of aspects. No soil information was collected.



Sheep Creek Rapids Plot: HB970540I6

Native to Idaho and Oregon, *Salix exigua* is common on sandbars, gravel bars, and among rocks along rivers and larger streams, particularly at low to mid elevations. It forms dense, shrubby patches after flood disturbance and is an indicator of poor stream channel stability (Miller 1976). At times *Salix exigua* can grow to become a small tree, most often along calm river stretches or on smaller streams (Johnson 1995). In Hells Canyon, *Salix exigua* occurs as a dominant or codominant species in several plant assemblages. This species was encountered on 184 transects, in all 4 riparian cover types, and mostly in the Weiser Reach (86 transects) and the headwaters of Brownlee Reservoir (76 transects).

This assemblage is characterized by a moderate cover of *Salix exigua* on rocky, barren shorelines. Few other species are found. *Salix exigua* provides about 14% cover and is present in about one-third of all plots along transects (frequency = 35%). Its average height is about 1.2 m. This plant assemblage is relatively species poor (n = 11). *Scirpus acutus* and *Heleochloa alopecuroides* are the most common herbaceous species. All others occur in trace amounts (< 1% cover) and infrequently. Most species in this assemblage are native. No rare plants or noxious weeds are found in the assemblage. Rock covers over 44% of the ground surface, and bare soil is exposed on almost 41% of the surface.

Other Studies

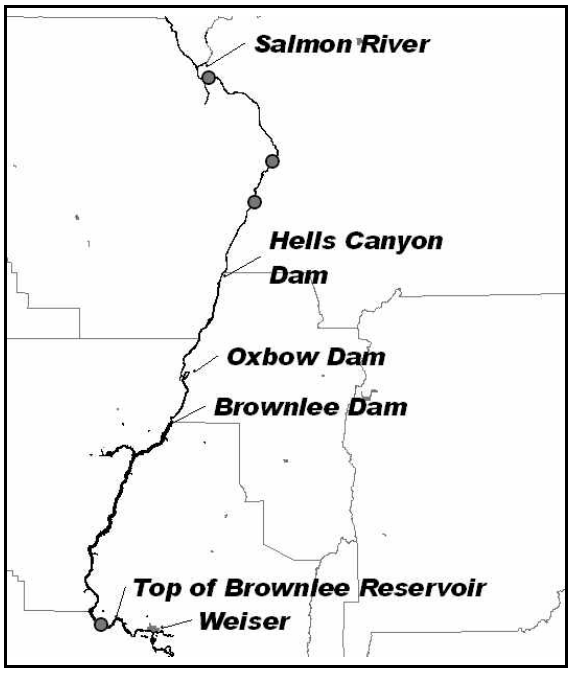
Asherin and Claar (1976) identified several *Salix exigua*-dominated plant communities based on one or two site investigations in the study area. Miller (1976) documented a *Salix exigua* community type, distinctive in its depauperate appearance, at the mouths of streams on both the Salmon and Snake rivers. Herbaceous flora associated with the community type include disturbance species, such as annual *Bromus* spp., *Artemisia ludoviciana*, and *Toxicodendron radicans*. Crowe and Clausnitzer (1997) identified a *Salix exigua*-dominated plant association that occurs at elevations of 3,000 to 4,340 ft throughout the Blue and Wallowa mountains.

Appendix 3 (cont.).

SAEX Site Conditions

Elevation (ft): 1,374.3 (range 950.0–2,077.0)
Slope (°): 8.5 (range 3.0–13.0)
Aspect: E(1), N(1), NW(1), SW(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



SAEX Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (2) [b]							
N	*Salix exigua*	14.4	35.0	100.0	3,958	1.18	2,000	0.29
N	*Celtis reticulata*	0.2	1.3	25.0	125	0.50	375	0.30
	Grasses (4) [b]							
N	*Scirpus acutus*	6.8	25.0	25.0				
I	*Heleochloa alopecuroides*	3.3	25.0	25.0				
I	*Bromus tectorum*	0.1	3.8	25.0				
N	*Eragrostis hypnoides*	0.1	3.8	25.0				
	Forbs (5) [b]							
N	*Amaranthus californicus*	0.7	15.0	25.0				
N	*Xanthium strumarium*	0.5	3.8	75.0				
N	*Lindernia anagallidea*	0.2	8.8	25.0				
N	*Apocynum cannabinum*	0.1	5.0	25.0				
I	*Portulaca oleracea*	0.1	5.0	25.0				
	Rock	44.5	52.5	100.0				
	Bare Soil	40.8	70.0	100.0				
	Litter	3.2	57.5	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Shore & Bottomland Wetland

Cyperus aristatus (CYAR)
(awned flatsedge) 3 stands

The *Cyperus aristatus* assemblage is uncommon in the *Shore & Bottomland Wetland* cover type. It was encountered in the Weiser (2 sites) and in the Brownlee Reservoir (1 site) reaches. Sites occurred between 2,077 and 2,085 ft on flat or gentle slopes. No soil information was collected.

West Weiser Flat Islands Plot: BA97WWFCS9

Cyperus aristatus is a native forb that occurs in wet soils. It is widespread in lowlands and valleys and rare at higher elevations (Hitchcock and Cronquist 1991). In Hells Canyon, *Cyperus aristatus* is a relatively common riparian species, but only in the upper study reaches. It was encountered in 93 transects, all 4 riparian cover types, and only in the Weiser (55 transects) and Brownlee Reservoir (38 transects) reaches.

This assemblage is characterized by a very sparse cover of vegetation along barren shorelines at or just below the high-water mark. *Cyperus aristatus* is present in low amounts and is accompanied by a wide variety of other species. *Cyperus aristatus* provides about 3% cover and occurs in most plots along transects (frequency = 88%).

This assemblage is species rich (n = 38), and most species are native. Two rare plants were found: *Cyperus difformis* (2 sites) and *Cyperus rivularis* (1 site). Two noxious weed species were also found: *Lythrum salicaria* and *Euphorbia esula*. Rock covers over 51% of the ground surface, and bare soil is exposed on about 15% of the ground.

Other Studies

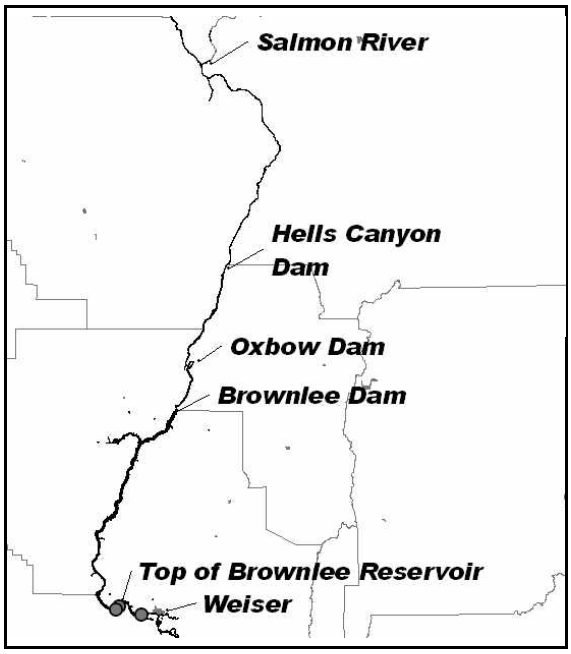
This plant assemblage has not been described for the Hells Canyon area.

Appendix 3 (cont.).

CYAR Site Conditions

Elevation (ft): 2,080.7 (range 2,077.0–2,085.0)
Slope (°): 1.0 (range 0.0–3.0)
Aspect: F(2), N(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



CYAR Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (3) [b]							
N	*Salix exigua*	3.3	30.0	100.0	250	0.64	133,750	0.11
	Grasses (13) [b]							
N	*Cyperus aristatus*	3.3	88.3	100.0				
N	*Cyperus erythrorhizos*	1.4	48.3	100.0				
I	*Echinochloa crus-galli*	0.6	25.0	66.7				
	Forbs (22) [b]							
N	*Lindernia anagallidea*	1.1	41.7	66.7				
I	*Chenopodium album*	1.0	38.3	66.7				
N	*Mollugo verticillata*	0.8	33.3	100.0				
N	*Lindernia dubia*	0.7	18.3	33.3				
I	*Lythrum salicaria*	0.7	26.7	66.7				
I	*Portulaca oleracea*	0.6	23.3	33.3				
I	*Amaranthus retroflexus*	0.6	21.7	66.7				
N	*Apocynum cannabinum*	0.5	3.3	33.3				
I	*Polygonum persicaria*	0.5	18.3	66.7				
N	*Ranunculus sceleratus*	0.5	18.3	33.3				
	Rock	51.5	100.0	100.0				
	Bare Soil	15.1	100.0	100.0				
	Moss	2.8	71.7	100.0				
	Lichen	2.4	35.0	100.0				
	Litter	0.8	31.7	100.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form. Species with less than 0.5% cover not listed in table.

Appendix 3 (cont.).

Shore & Bottomland Wetland

Mixed herbaceous (MIXED HERB)
(mixed herbaceous) 2 stands

Oxbow Dam Plot: HC970987I1

The mixed herbaceous plant assemblage is rare in the *Shore & Bottomland Wetland* cover type. It was encountered at 1 site in the Hells Canyon Reservoir Reach and at 1 site in the Brownlee Reservoir Reach. Sites occurred at 1,683 and 2,077 ft on 4- and 9-degree slopes on northwest aspects. No soil information was collected.

This assemblage of species was separated during TWINSPAN analyses because of its dissimilarity with other assemblages. No particular species is consistently dominant in more than 1 transect. This assemblage probably has no ecological significance. It should simply be viewed as a weakly related group of miscellaneous riparian vegetation transects that meets the *Shore & Bottomland Wetland* cover type criteria.

Other Studies

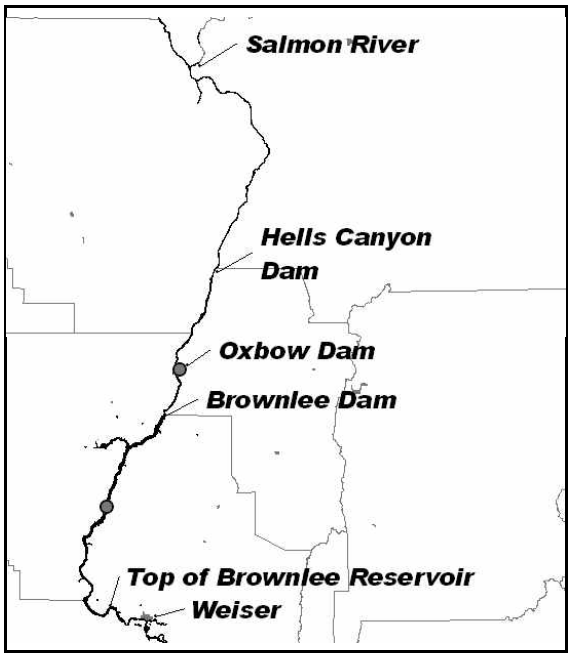
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

MIXED HERB Site Conditions

Elevation (ft): 1,880.0 (range 1,683.0–2,077.0)
Slope (°): 6.5 (range 4.0–9.0)
Aspect: NW(2)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



MIXED HERB Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (0) [b]							
	Grasses (5) [b]							
N	*Leersia oryzoides*	6.0	50.0	50.0				
N	*Eleocharis palustris*	1.4	27.5	50.0				
N	*Panicum capillare*	1.0	5.0	50.0				
I	*Cyperus* sp.	0.4	15.0	50.0				
I	*Echinochloa crus-galli*	0.2	7.5	50.0				
	Forbs (5) [b]							
I	*Chenopodium foliosum*	6.6	50.0	50.0				
N	*Lycopus asper*	0.5	7.5	50.0				
I	*Rumex crispus*	0.3	10.0	50.0				
I	*Convolvulus arvensis*	0.2	5.0	50.0				
	Oenothera sp.	0.2	5.0	50.0				
	Rock	80.9	100.0	100.0				
	Bare Soil	8.6	95.0	100.0				
	Litter	3.3	70.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Shore & Bottomland Wetland

Apocynum cannabinum (APCA)
(hemp dogbane) 1 stand

The *Apocynum cannabinum* plant assemblage is rare in the *Shore & Bottomland Wetland* cover type. A similar assemblage, however, is common in the *Emergent Herbaceous Wetland* cover type. The *Apocynum cannabinum* assemblage was encountered at just 1 site in the reach below Hells Canyon Dam. The site occurred at 990 ft on a 15-degree slope on a north aspect. No soil information was collected.

Springs Rapids Plot: HB980177G1

Apocynum cannabinum is a widespread native species that often becomes weedy along roadsides and on noncultivated agricultural lands. It has been called Indian hemp because of its use by prehistoric tribes for high-quality fiber. It is poisonous to livestock (Whitson et al. 1992). In Hells Canyon, *Apocynum cannabinum* was encountered in 93 transects, in 7 cover types, and in all reaches of the study area, but principally in the Weiser Reach (55 transects).

This assemblage is characterized by a moderate cover of *Apocynum cannabinum* on rocky shorelines with little bare soil and few other species present. *Apocynum cannabinum* provides about 14% cover and occurs in most plots along transects (frequency = 80%).

The assemblage is species poor (n = 8), and most species are native. One noxious weed species occurs in trace amounts: *Convolvulus arvensis*. Rock covers almost 88% of the ground surface, and little bare soil is present on the site (cover = 3%).

Other Studies

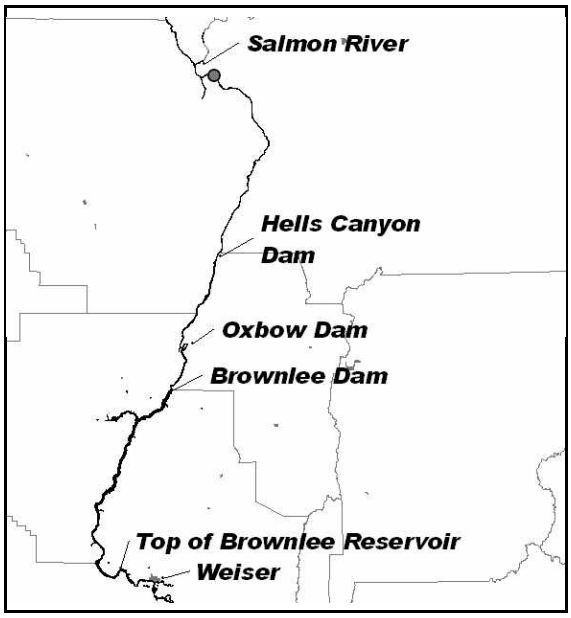
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

APCA Site Conditions

Elevation (ft): 990
Slope (°): 15.0
Aspect: N(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



APCA Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (2) [b]							
N	*Celtis reticulata*	0.0	0.0	100.0				
N	*Toxicodendron radicans*	0.0	0.0	100.0				
	Grasses (0) [b]							
	Forbs (6) [b]							
I	*Apocynum cannabinum*	14.2	80.0	100.0				
I	*Physalis longifolia*	1.7	15.0	100.0				
N	*Artemisia ludoviciana*	0.5	20.0	100.0				
N	*Aster eatonii*	0.1	5.0	100.0				
I	*Convolvulus arvensis*	0.1	5.0	100.0				
N	*Xanthium strumarium*	0.1	5.0	100.0				
	Rock	87.8	95.0	100.0				
	Lichen	4.3	5.0	100.0				
	Bare Soil	2.5	75.0	100.0				
	Litter	1.4	55.0	100.0				
	Moss	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

Shore & Bottomland Wetland

Asclepias speciosa (ASSP)
(showy milkweed) 1 stand

The *Asclepias speciosa* plant assemblage is rare in the *Shore & Bottomland Wetland* cover type. It was encountered at just 1 site in the Brownlee Reservoir Reach. The site occurred at the high-water mark (2,077 ft) on an 8-degree slope and on a north aspect. No soil information was collected.

Across from Big Deacon Creek Plot: BR971462I1

Asclepias speciosa is a widespread North American species that often becomes weedy along roadsides and in ditch banks, pastures, and cultivated fields (Whitson et al. 1992). In Hells Canyon, *Asclepias speciosa* was encountered in 59 transects, in 7 cover types, and in all reaches of the study area, but principally in the Weiser (26 transects) and the Brownlee Reservoir (18 transects) reaches.

This assemblage is characterized by a moderate cover of *Asclepias speciosa* with few other species present and on a site covered by litter. Very little bare soil is exposed. *Asclepias speciosa* provides about 25% cover and occurs in most plots along transects (frequency = 90%).

The assemblage contains only 5 species, and most are introduced. No rare plants or noxious weeds are found in the assemblage. Litter covers almost 96% of the ground surface, and little bare soil is present on the site (cover = 2%).

Other Studies

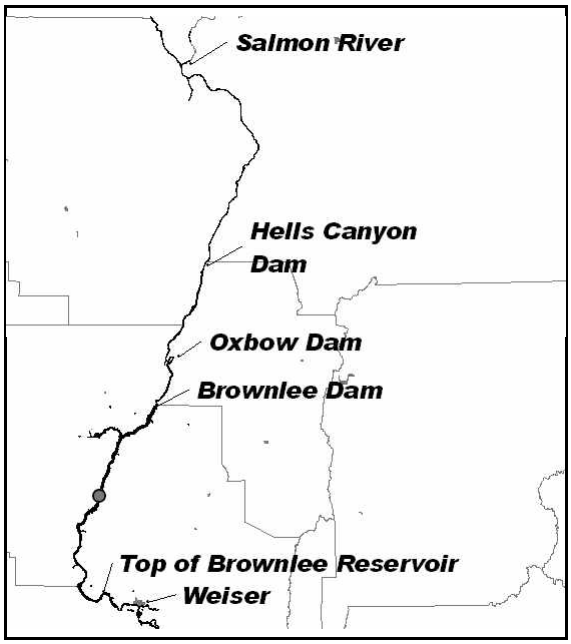
This assemblage has not been previously described for the Hells Canyon area.

Appendix 3 (cont.).

ASSP Site Conditions

Elevation (ft): 2,077
Slope (°): 8.0
Aspect: N(1)
[a] Soil Texture: 0
[a] Organic Matter %: 0
[a] pH: 0
[a] ON ppm: 0
[a] CEC meq/100g: 0

[a] Soil characteristic data unavailable.



ASSP Vegetation

Origin[a]	Life Form and Species	Mean Cover (%)	Mean Freq. (%)	Const. (%)	Avg. Density per ha	Mean Ht. (m)	Seedling Density per ha	Seedling Ht. (m)
	Trees (0) [b]							
	Shrubs (1) [b]							
I	*Rosa canina*	1.8	20.0	100.0	1,000	0.94		
	Grasses (1) [b]							
I	*Bromus japonicus*	0.8	30.0	100.0				
	Forbs (3) [b]							
N	*Asclepias speciosa*	25.1	90.0	100.0				
N	*Grindelia squarrosa*	0.9	10.0	100.0				
I	*Polygonum convolvulus*	0.9	10.0	100.0				
	Litter	95.7	100.0	100.0				
	Bare Soil	1.7	40.0	100.0				
	Lichen	0.0	0.0	0.0				
	Moss	0.0	0.0	0.0				
	Rock	0.0	0.0	0.0				

[a] N = Native, I = Introduced

[b] Total number of species in a life form.

Appendix 3 (cont.).

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Appendix 4. List of plant species found in each reach of the Hells Canyon Study Area sorted by lifeform and Latin binomial.

		Reach[2]				
IPCC[1]	**Binomial**	**BA[3]**	**BR[3]**	**OX[3]**	**HC[3]**	**HB[3]**
ABGR	*Abies grandis*	-	-	-	2	-
ACGL	*Acer glabrum*	2	9	7	21	17
ACNE	*Acer negundo*	47	1	1	5	1
ACSA	*Acer saccharinum*	71	3	-	-	-
AGAL	*Agrostis alba*	-	7	-	2	-
AGEL	*Agropyron elongatum*	1	1	-	-	-
AGEX	*Agrostis exarata*	-	-	3	-	-
AGGR	*Agoseris grandiflora*	-	1	-	1	-
AGHE	*Agoseris heterophylla*	-	1	2	4	1
AGIN	*Agropyron intermedium*	3	1	-	2	-
AGOSE	*Agoseris* sp.	-	2	1	-	-
AGRE	*Agropyron repens*	16	14	-	1	-
AGROS	*Agrostis* sp.	-	-	1	1	-
AGSP	*Agropyron spicatum*	1	79	14	75	70
AGUR	*Agastache urticifolia*	-	-	-	1	-
ALAC	*Allium acuminatum*	-	5	-	11	4
ALAL	*Alyssum alyssoides*	-	2	-	2	-
ALDE	*Alyssum desertorum*	4	49	3	10	4
ALLIU	*Allium* sp.	2	3	4	6	-
ALPA	*Allium parvum*	-	1	-	-	-
ALPR3	*Alopecurus pratensis*	-	1	-	-	-
ALRH	*Alnus rhombifolia*	-	10	13	42	27
ALTO	*Allium tolmiei*	-	1	-	2	-
ALYSS	*Alyssum* sp.	-	-	4	2	-
AMAC	*Ambrosia acanthicarpa*	-	-	-	-	2
AMAL	*Amelanchier alnifolia*	-	31	28	63	19
AMAL2	*Amaranthus albus*	14	45	1	-	1
AMAR2	*Ambrosia artemisifolia*	3	-	3	3	-
AMARA	*Amaranthus* sp.	2	9	-	-	-
AMBRO	*Ambrosia* sp.	-	1	3	-	-
AMCA	*Amaranthus californicus*	-	9	-	-	-
AMCO	*Ammannia coccinea*	19	11	-	-	-
AMFR	*Amorpha fruticosa*	39	56	2	16	1
AMPO	*Amaranthus powellii*	6	-	-	-	-
AMPS	*Ambrosia psilostachya*	-	-	-	2	-
AMRE	*Amsinckia retrorsa*	2	35	10	21	6
AMRE2	*Amaranthus retroflexus*	54	73	-	2	1
AMSIN	*Amsinckia* sp.	5	43	8	19	15

[1] IPCC = Idaho Power Company species code.

[2] Column numbers indicate the number of transects on which each species was encountered during field sampling measurements. Total transects sampled = 1,245 (386 upland, 859 riparian).

[3] BA = Weiser Reach, BR = Brownlee Reservoir Reach, OX = Oxbow Reservoir Reach, HC = Hells Canyon Reservoir Reach, and HB = the reach below Hells Canyon Dam.

Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
AMTE	*Amsinckia tessellata*	-	6	-	-	-
ANAN	*Antennaria anaphaloides*	-	-	-	1	-
ANCO	*Anthemis cotula*	18	-	-	2	-
ANDI	*Antennaria dimorpha*	-	2	-	-	-
ANLU	*Antennaria luzuloides*	-	-	-	1	-
ANSC	*Anthriscus scandicina*	15	43	25	45	68
APAN	*Apocynum androsaemifolium*	-	-	-	4	-
APCA	*Apocynum cannabinum*	55	13	2	11	12
AQUIL	*Aquilegia* sp.	-	-	-	1	-
ARABI	*Arabis* sp.	-	-	3	-	-
ARAC	*Arenaria aculeata*	-	-	-	1	-
ARAN	*Artemisia annua*	7	7	-	-	-
ARBI	*Artemisia biennis*	22	6	2	-	-
ARCO	*Arnica cordifolia*	-	1	1	9	1
ARCR	*Arabis crucisetosa*	-	-	-	2	-
ARDR	*Artemisia dracunculus*	2	20	1	-	2
AREL	*Arrhenatherum elatius*	-	-	-	1	-
ARGL	*Arabis glabra*	-	-	1	-	1
ARLI	*Artemisia lindleyana*	3	-	-	3	19
ARLO	*Aristida longiseta*	-	3	-	-	18
ARLU	*Artemisia ludoviciana*	1	9	10	6	10
ARMA3	*Arenaria macrophylla*	-	2	-	-	-
ARMI	*Arabis microphylla*	-	-	-	-	1
ARMI4	*Arctium minus*	-	16	9	1	10
ARRI	*Artemisia rigida*	-	4	-	-	-
ARSE	*Arenaria serpyllifolia*	-	7	26	49	70
ARSO	*Arnica sororia*	-	6	-	4	-
ARSP2	*Arabis sparsiflora*	-	-	-	1	-
ARTEM	*Artemisia* sp.	-	1	-	-	-
ARTR	*Artemisia tridentata*	2	109	-	-	1
ARTR2	*Artemisia tripartita*	-	1	-	-	-
ASAR3	*Astragalus arthuri*	-	-	-	-	4
ASBEW	*Astragalus beckwithii*	1	-	-	-	-
ASCH	*Aster chilensis*	-	-	-	-	2
ASCLE	*Asclepias* sp.	-	-	-	-	1
ASCO	*Aster conspicuus*	-	3	-	-	-
ASCU	*Astragalus cusickii*	-	4	-	4	1
ASEA	*Aster eatonii*	-	-	-	5	7
ASER	*Astragalus eremiticus*	-	2	-	-	-

[1] IPCC = Idaho Power Company species code.

[2] Column numbers indicate the number of transects on which each species was encountered during field sampling measurements. Total transects sampled = 1,245 (386 upland, 859 riparian).

[3] BA = Weiser Reach, BR = Brownlee Reservoir Reach, OX = Oxbow Reservoir Reach, HC = Hells Canyon Reservoir Reach, and HB = the reach below Hells Canyon Dam.

Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
ASFA2	*Asclepias fascicularis*	1	-	1	-	1
ASHE	*Aster hesperius*	1	-	-	4	-
ASIN2	*Astragalus inflexus*	-	18	1	3	13
ASOF	*Asparagus officinalis*	8	-	-	-	-
ASPR	*Asperugo procumbens*	-	27	1	2	4
ASPU	*Astragalus purshii*	-	3	-	1	-
ASSP	*Asclepias speciosa*	26	18	3	4	8
ASTER	*Aster* sp.	-	2	2	1	1
ASTRA	*Astragalus* sp.	-	3	1	2	3
ASVA	*Astragalus vallaris*	-	2	2	-	-
ATFI	*Athyrium filixfemina*	-	-	-	-	6
ATHE	*Atriplex heterosperma*	2	1	-	-	-
ATPA	*Atriplex patula*	58	34	-	-	-
ATPU	*Athysanus pusillus*	1	2	1	16	-
ATRIP	*Atriplex* sp.	4	-	-	-	-
ATRO	*Atriplex rosea*	1	-	-	-	-
AVFA	*Avena fatua*	1	-	-	-	-
AZME	*Azolla mexicana*	-	1	-	-	-
BAHY	*Bassia hyssopifolia*	-	1	-	-	-
BARO	*Bacopa rotundifolia*	1	2	-	-	-
BASA	*Balsamorhiza sagittata*	3	29	6	17	9
BEOC	*Betula occidentalis*	-	20	8	13	25
BERE	*Berberis repens*	-	-	-	1	-
BICE	*Bidens cernua*	16	20	-	1	-
BIDEN	*Bidens* sp.	1	1	1	2	-
BIFR	*Bidens frondosa*	18	15	4	3	-
BITR	*Bidens tripartita*	-	2	-	-	-
BIVU	*Bidens vulgata*	-	-	1	-	-
BLSC	*Blepharipappus scaber*	-	8	4	10	-
BORAG	*Boraginaceae*	3	5	3	9	4
BRASS	*Brassicaceae*	4	2	-	-	-
BRBR	*Bromus brizaeformis*	-	10	26	32	21
BRCA	*Bromus carinatus*	-	-	1	-	-
BRCAC	*Bromus carinatus* var. *carinatus*	-	-	1	-	-
BRCO	*Bromus commutatus*	-	11	2	8	-
BRDO	*Brodiaea douglasii*	1	19	8	30	28
BRIN	*Bromus inermis*	3	1	-	-	-
BRJA	*Bromus japonicus*	9	117	44	68	43

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[3] BA = Weiser Reach, BR = Brownlee Reservoir Reach, OX = Oxbow Reservoir Reach, HC = Hells Canyon Reservoir Reach, and HB = the reach below Hells Canyon Dam.

Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
BRMI	*Brickellia microphylla*	-	6	-	-	-
BRMO	*Bromus mollis*	6	11	2	6	3
BROMU	*Bromus* sp.	5	55	12	33	30
BRRI	*Bromus rigidus*	-	2	-	2	4
BRST	*Bromus sterilis*	2	29	17	49	66
BRTE	*Bromus tectorum*	33	205	56	94	59
CAAM	*Carex amplifolia*	-	1	-	-	-
CAAT	*Carex athrostachya*	-	-	4	1	-
CABA	*Carex backii*	-	4	14	4	4
CABR	*Cardamine breweri*	3	-	1	-	-
CABU	*Capsella bursapastoris*	2	-	1	-	-
CACU	*Camassia cusickii*	-	-	-	2	-
CADE	*Carex deweyana*	-	3	-	4	5
CADR	*Cardaria draba*	16	16	1	3	-
CAEL	*Calochortus elegans*	-	-	-	1	-
CAEU2	*Calochortus eurycarpus*	-	-	-	1	-
CAHI	*Castilleja hispida*	-	-	-	7	-
CAHY	*Carex hystricina*	-	-	1	1	-
CALA	*Carex lanuginosa*	-	3	-	-	-
CALOC	*Calochortus* sp.	-	8	1	4	12
CAMA	*Calochortus macrocarpus*	-	1	-	1	-
CAMI	*Carex microptera*	-	1	-	2	-
CAMI3	*Camelina microcarpa*	-	1	1	-	-
CANU	*Calochortus nuttallii*	-	-	-	1	-
CADL	*Cardamine oligosperma*	-	7	-	1	-
CAPR2	*Carex praegracilis*	-	-	-	-	1
CAREX	*Carex* sp.	6	6	5	8	7
CAREX2	*Carex* sp.	-	-	1	-	-
CARU	*Calamagrostis rubescens*	-	-	-	2	-
CARYO	*Caryophyllaceae*	-	2	-	2	1
CASH	*Carex sheldonii*	-	1	-	-	-
CASTI	*Castilleja* sp.	1	2	-	2	2
CAUT	*Carex utriculata*	-	-	2	-	-
CAVU	*Carex vulpinoides*	2	4	5	7	1
CEAR	*Cerastium arvense*	-	-	-	-	8
CELE	*Cercocarpus ledifolius*	-	-	-	3	1
CELO	*Cenchrus longispinus*	-	-	-	-	7
CENTA	*Centaurea* sp.	-	1	-	1	-

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
CERAS	*Cerastium* sp.	-	1	-	-	1
CERE	*Celtis reticulata*	3	33	34	89	184
CERE2	*Centaurea repens*	4	-	-	-	-
CESA	*Ceanothus sanguineus*	-	-	-	3	2
CEVI	*Cerastium viscosum*	-	-	2	6	15
CEVU	*Cerastium vulgatum*	9	9	-	1	9
CHAL	*Chenopodium album*	50	43	2	1	1
CHBO	*Chenopodium botrys*	9	4	-	-	2
CHDO	*Chaenactis douglasii*	2	20	3	4	7
CHENO	*Chenopodium* sp.	14	6	1	-	1
CHENO2	*Chenopodium* sp.	2	-	-	-	-
CHENO3	*Chenopodiaceae*	1	-	-	-	-
CHFO	*Chenopodium foliosum*	15	20	-	-	-
CHFR	*Chenopodium fremontii*	1	-	2	-	-
CHGL	*Chenopodium glaucum*	2	8	-	-	-
CHGR	*Cheilanthes gracillima*	-	-	-	-	1
CHHY	*Chenopodium hybridum*	2	-	-	-	-
CHNA	*Chrysothamnus nauseosus*	7	94	1	-	2
CHRU	*Chenopodium rubrum*	-	1	-	-	-
CHTE	*Chorispora tenella*	1	5	1	-	-
CHUM	*Chimaphila umbellata*	-	-	-	1	-
CHVI	*Chrysothamnus viscidiflorus*	-	8	-	-	-
CHVIH	*Chrysopsis villosa* var. *hispida*	-	-	-	-	1
CIAL	*Circaea alpina*	1	1	1	1	1
CIAR	*Cirsium arvense*	49	20	1	-	2
CIIN	*Cichorium intybus*	1	1	12	7	4
CIRSI	*Cirsium* sp.	9	4	3	3	7
CIUN	*Cirsium undulatum*	-	-	-	-	3
CIUT	*Cirsium utahense*	-	4	1	3	-
CIVU	*Cirsium vulgare*	3	4	3	3	4
CLLI	*Clematis ligusticifolia*	1	30	5	15	13
CLPU	*Clarkia pulchella*	-	3	6	14	-
COAR	*Convolvulus arvensis*	11	11	3	3	5
COBO	*Conyza bonariensis*	-	-	-	3	-
COCA	*Cornus canadensis*	-	-	-	1	-
COCA2	*Conyza canadensis*	13	6	4	1	5
COGR	*Collomia grandiflora*	-	12	9	20	-
COLI	*Collomia linearis*	-	1	-	5	1
COLLO	*Collomia* sp.	-	8	1	5	5

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
COMA4	*Conium maculatum*	77	23	6	3	-
COMPO	*Compositae*	-	1	-	-	4
CONVO	*Convolvulus* sp.	-	-	-	1	1
COPA	*Collinsia parviflora*	-	15	8	10	2
COSE	*Convolvulus sepium*	3	-	-	-	-
COST	*Cornus stolonifera*	-	15	8	8	13
COUM	*Comandra umbellata*	-	2	-	-	-
CRAC	*Crepis acuminata*	-	-	-	1	-
CRAT	*Crepis atrabarba*	1	-	-	-	-
CRATA	*Crataegus* sp.	-	-	1	1	-
CRCE	*Cryptantha celosioides*	-	1	-	-	-
CRCO	*Crataegus columbiana*	-	2	9	5	-
CRDO	*Crataegus douglasii*	-	21	27	27	18
CREPI	*Crepis* sp.	2	24	1	6	1
CRFL	*Cryptantha flaccida*	-	7	1	8	4
CRGR	*Cryptantha gracilis*	-	-	-	-	1
CRIN	*Crepis intermedia*	-	1	-	2	-
CRIN2	*Cryptantha intermedia*	-	3	5	10	3
CRIN3	*Cryptantha interrupta*	-	2	1	-	-
CROC	*Crepis occidentalis*	-	4	1	-	-
CROCP	*Crepis occidentalis* var. *pumila*	-	1	-	-	-
CRPT	*Cryptantha pterocarya*	-	1	-	-	-
CRTO	*Cryptantha torreyana*	-	-	-	1	-
CRWA	*Cryptantha watsonii*	-	2	-	-	-
CRYPT	*Cryptantha* sp.	-	1	1	2	2
CUIN	*Cuscuta indecora*	13	9	-	-	-
CUPE	*Cuscuta pentagona*	-	1	-	-	-
CUSCU	*Cuscuta* sp.	8	-	-	-	1
CYAC	*Cyperus acuminatus*	4	8	-	-	-
CYAR	*Cyperus aristatus*	55	38	-	-	-
CYDA	*Cynodon dactylon*	-	2	-	-	-
CYDI	*Cyperus difformis*	9	18	-	-	-
CYER	*Cyperus erythrorhizos*	52	22	-	-	1
CYES	*Cyperus esculentus*	4	6	-	1	-
CYFR	*Cystopteris fragilis*	-	-	3	12	3
CYOD	*Cyperus odoratus*	-	2	-	-	-
CYOF	*Cynoglossum officinale*	-	49	45	42	8
CYPER	*Cyperus* sp.	16	2	-	1	5
CYPER2	*Cyperaceae*	1	-	-	1	-

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
CYRI	*Cyperus rivularis*	7	11	-	-	-
CYSC	*Cyperus schweinitzii*	-	-	-	-	3
CYST	*Cyperus strigosus*	15	17	-	3	-
DAGL	*Dactylis glomerata*	-	4	1	1	9
DEDA	*Deschampsia danthonioides*	-	-	-	-	1
DEEL	*Deschampsia elongata*	-	4	4	2	1
DELPH	*Delphinium* sp.	-	1	2	1	2
DENU3	*Delphinium nuttallianum*	-	2	-	-	-
DEPI	*Descurainia pinnata*	3	3	-	-	-
DERI	*Descurainia richardsonii*	-	5	5	5	1
DESCU	*Descurainia* sp.	-	16	3	2	1
DESO	*Descurainia sophia*	-	9	-	-	1
DIAR	*Dianthus armeria*	-	-	-	-	7
DICU	*Dicentra cucullaria*	-	-	1	1	1
DISA	*Digitaria sanguinalis*	3	3	-	-	1
DISP	*Distichlis spicata*	1	-	-	-	-
DIST	*Distichlis stricta*	19	5	-	-	-
DISY	*Dipsacus sylvestris*	12	14	17	25	23
DITR	*Disporum trachycarpum*	-	-	-	2	-
DOCO	*Dodecatheon conjugens*	-	1	1	7	2
DRCU	*Draba cunefolia*	-	-	-	-	1
DRVE	*Draba verna*	7	91	19	47	31
ECCR	*Echinochloa crus-galli*	78	69	1	2	4
ECLO	*Echinocystis lobata*	6	1	-	-	-
ELAN	*Elaeagnus angustifolia*	32	4	-	-	-
ELCA	*Elymus canadensis*	-	1	2	1	-
ELCI	*Elymus cinerus*	4	3	-	-	1
ELEOC	*Eleocharis* sp.	1	-	-	-	-
ELGL	*Elymus glaucus*	2	27	26	30	30
ELOV	*Eleocharis ovata*	-	5	-	-	-
ELPA	*Eleocharis palustris*	5	14	1	4	5
ELTR	*Elymus triticoides*	16	2	-	-	-
ELYMU	*Elymus* sp.	-	-	-	1	1
EPGL	*Epilobium glandulosum*	-	-	-	1	-
EPGL2	*Epilobium glaberrimum*	-	-	1	-	-
EPILO	*Epilobium* sp.	7	1	-	11	2
EPPA	*Epilobium paniculatum*	11	123	22	56	26
EPTO	*Epilobium torreyi*	-	-	-	1	-

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
EPWA	*Epilobium watsonii*	2	3	5	1	1
EPWAP	*Epilobium watsonii* var. *parishii*	-	-	-	-	1
EQAR	*Equisetum arvense*	2	5	1	-	4
EQFL	*Equisetum fluviatile*	-	1	-	-	-
EQHY	*Equisetum hyemale*	6	3	6	2	19
EQLA	*Equisetum laevigatum*	8	6	1	1	12
EQUIS	*Equisetum* sp.	1	-	-	-	3
EQVA	*Equisetum variegatum*	1	-	-	-	-
ERAGR	*Eragrostis* sp.	2	-	-	-	2
ERAN	*Erigeron annuus*	-	-	3	1	-
ERAS	*Erysimum asperum*	-	-	-	-	1
ERCI	*Erodium cicutarium*	3	82	15	20	29
ERCI2	*Eragrostis cilianesis*	4	-	-	4	9
ERCO	*Erigeron compositus*	-	2	-	1	-
ERCO5	*Erigonum compositum*	-	18	3	6	-
EREL	*Erigonum elatum*	-	3	-	-	-
ERHE	*Erigonum heracleoides*	-	-	-	2	2
ERHY	*Eragrostis hypnoides*	34	31	-	-	-
ERIGE	*Erigeron* sp.	-	1	1	2	1
ERIOG	*Eriogonum* sp.	-	1	1	3	1
ERLA	*Eriophyllum lanatum*	-	5	3	13	1
ERLI	*Erigeron lineris*	-	1	-	2	-
ERMI	*Erigonum microthecum*	-	8	-	-	-
ERPE2	*Eragrostis pectinacea*	39	17	1	1	-
ERPU	*Erigeron pumilus*	-	6	-	6	7
ERSE	*Eremocarpus setigerus*	-	-	-	11	1
ERSP3	*Erigonum sphaerocephalum*	-	1	-	-	-
ERST2	*Eriogonum strictum*	1	46	6	2	6
ERST3	*Erigeron strigosus*	1	-	4	-	-
ERSTS	*Erigeron strigosus septentrionalis*	-	-	1	-	-
ERUM	*Erigonum umbellatum*	-	2	1	1	-
ERVI	*Eriogonum vimineum*	-	1	-	14	3
ERYSI	*Erysimum* sp.	-	-	-	-	2
EUES	*Euphorbia esula*	19	2	-	1	-
EUGL	*Euphorbia glyptosperma*	15	15	-	3	18
EUPHO	*Euphorbia* sp.	2	1	-	-	1
EUSE	*Euphorbia serpyllifolia*	15	14	-	-	2

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
FABAC	*Fabaceae*	-	1	2	-	1
FEAR	*Festuca arundinacea*	-	-	-	1	-
FEBR	*Festuca bromoides*	1	8	-	1	-
FEID	*Festuca idahoensis*	-	13	3	16	5
FEME	*Festuca megalura*	-	4	-	2	9
FEMI	*Festuca microstachys*	-	19	2	5	6
FEMY	*Festuca myuros*	-	-	-	-	2
FEOC	*Festuca octoflora*	-	-	-	4	4
FEOV	*Festuca ovina*	4	5	-	-	-
FEPR	*Festuca pratensis*	-	4	-	1	-
FESTU	*Festuca* sp.	2	33	2	8	7
FIAR	*Filago arvensis*	-	-	-	-	30
FRAT	*Fritillaria atropurpurea*	-	1	-	-	-
FRPE	*Fraxinus pennsylvanica*	11	7	2	2	2
FRPU	*Fritillaria pudica*	-	-	-	2	1
FRVE	*Fragaria vesca*	3	-	-	1	-
GAAP	*Galium aparine*	21	92	56	119	89
GAAR	*Gaillardia aristata*	-	-	-	-	3
GABI	*Galium bifolium*	-	-	-	-	1
GALIU	*Galium* sp.	-	-	-	1	1
GAMU	*Galium multiflorum*	-	5	-	1	-
GAPA	*Gaura parviflora*	3	12	1	-	11
GATR	*Galium triflorum*	-	1	-	-	1
GEBI	*Geranium bickellii*	-	-	-	-	1
GECA	*Geranium carolinianum*	-	-	-	-	3
GEMA	*Geum macrophyllum*	-	-	-	-	1
GEPU	*Geranium pusillum*	-	1	17	6	11
GERAN	*Geranium* sp.	1	1	2	1	3
GIAG	*Gilia aggregata*	-	-	-	-	2
GLEL	*Glyceria elata*	-	3	-	-	-
GLLE	*Glycyrrhiza lepidota*	12	4	1	-	27
GLNE	*Glossopetalon nevadense*	-	4	1	4	6
GLST	*Glyceria striata*	-	1	-	-	-
GNAPH	*Gnaphalium* sp.	-	-	-	1	-
GNMI	*Gnaphalium microcephalum*	1	-	-	1	-
GNPA	*Gnaphalium palustre*	52	36	-	-	-
GRSP	*Grayia spinosa*	-	5	-	-	-
GRSQ	*Grindelia squarrosa*	8	18	8	6	3
GUSA	*Gutierrezia sarothrae*	-	12	-	-	1

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
HACKE	*Hackelia* sp.	-	1	-	-	-
HAHI	*Hackelia hispida*	-	-	-	8	1
HARA	*Haplopappus radiatus*	-	3	-	-	-
HEAL	*Heleochloa alopecuroides*	79	92	-	-	-
HEAN	*Helianthus annuus*	36	56	10	8	30
HEAU	*Helenium autumnale*	4	-	-	3	-
HECY	*Heuchera cylindrica*	-	-	-	-	1
HELA	*Heracleum lanatum*	1	1	-	4	4
HEMI2	*Hemicarpha micrantha*	12	8	-	-	-
HERA	*Heterocodon rariflorum*	-	-	-	1	2
HEUN	*Helianthella uniflora*	-	1	-	-	-
HIAL	*Hieracium albiflorum*	-	-	-	1	-
HIAL2	*Hieracium albertinum*	-	-	-	1	-
HICY	*Hieracium cynoglossoides*	-	-	-	4	1
HIERA	*Hieracium* sp.	-	1	-	3	3
HODI	*Holodiscus discolor*	-	-	-	7	7
HOJU	*Hordeum jubatum*	-	16	-	-	-
HOLA	*Holcus lanatus*	-	-	-	3	-
HOLE	*Hordeum leporinum*	-	-	-	-	1
HORDE	*Hordeum* sp.	-	2	1	-	-
HOUM	*Holosteum umbellatum*	5	101	21	29	20
HYCA	*Hydrophyllum capitatum*	-	2	1	3	-
HYFE	*Hydrophyllum fendleri*	-	-	-	1	-
HYPE	*Hypericum perforatum*	-	-	2	6	51
IDSC	*Idahoa scapigera*	-	-	3	4	-
IRPS	*Iris pseudacorus*	15	14	10	4	-
IVAX	*Iva axillaris*	9	7	-	-	-
IVXA	*Iva xanthifolia*	8	-	-	-	-
JUBA	*Juncus balticus*	2	3	1	1	-
JUBU	*Juncus bufonius*	9	9	2	1	-
JUEN	*Juncus ensifolius*	1	2	1	-	-
JUKE	*Juncus kelloggii*	-	1	-	-	-
JUNCU	*Juncus* sp.	11	2	-	1	-
JUNI	*Juglanis nigra*	-	2	-	1	2
JURE	*Juglanus regia*	-	-	2	18	5
JUTE	*Juncus tenuis*	-	-	2	-	-
JUTET	*Juncus tenuis* var. *tenuis*	-	-	-	5	-
JUTO	*Juncus torreyi*	2	6	-	-	-

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
KOCR	*Koeleria cristata*	-	2	1	5	2
KOSC	*Kochia scoparia*	4	2	-	-	-
LAAM	*Lamium amplexicaule*	2	-	-	1	1
LACTU	*Lactuca* sp.	-	-	-	1	-
LAMIA	*Lamiaceae*	-	1	-	-	-
LANE	*Lathyrus nevadensis*	-	1	-	-	-
LAPA2	*Lathyrus pauciflorus*	-	1	-	-	-
LARA	*Lagophylla ramosissima*	-	16	-	2	-
LARE	*Lappula redowskii*	-	3	-	-	2
LASE	*Lactuca serriola*	32	139	49	65	66
LATHY	*Lathyrus* sp.	-	2	2	3	-
LEFA	*Leptochloa fascicularis*	22	18	-	1	-
LELA	*Lepidium latifolium*	118	76	19	10	1
LEMI	*Lemna minor*	7	5	2	-	-
LEOR	*Leersia oryzoides*	27	16	-	3	3
LEPE	*Lepidium perfoliatum*	4	4	-	-	-
LEPID	*Lepidium* sp.	-	-	-	1	1
LEVI	*Lepidium virginicum*	-	-	-	1	2
LEVIP	*Lepidium virginicum pubescens*	-	-	-	-	1
LIAN	*Lindernia anagallidea*	25	35	-	-	-
LIAR	*Lithospermum arvense*	1	4	8	28	1
LIBU	*Lithophragma bulbiferum*	2	29	5	5	-
LICHEN	*Lichen*	236	507	89	205	209
LIDA	*Linaria dalmatica*	-	6	-	1	-
LIDU	*Lindernia dubia*	22	-	-	2	-
LIGL	*Lithophragma glabrum*	-	-	-	1	-
LIPA	*Lithophragma parviflorum*	-	8	8	20	18
LIRU	*Lithospermum ruderale*	-	2	1	8	1
LITHO2	*Lithophragma* sp.	2	29	6	17	36
LITHO3	*Lithospermum* sp.	-	-	-	1	-
LITT	*Litter*	236	507	88	205	209
LOAM	*Lomatium ambiguum*	1	4	1	5	1
LOCO2	*Lomatium cous*	-	2	-	-	-
LODI	*Lomatium dissectum*	-	7	1	7	4
LOGR	*Lomatium grayi*	-	28	10	15	1
LOMA	*Lomatium macrocarpum*	1	10	4	7	9
LOMAT	*Lomatium* sp.	-	4	3	10	8
LONU	*Lomatium nudicaule*	-	2	1	-	-

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[3] BA = Weiser Reach, BR = Brownlee Reservoir Reach, OX = Oxbow Reservoir Reach, HC = Hells Canyon Reservoir Reach, and HB = the reach below Hells Canyon Dam.

Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
LOPU	*Lotus purshiana*	-	-	1	12	9
LOSE	*Lomatium serpentinum*	-	-	-	1	1
LOTR	*Lomatium triternatum*	3	10	2	4	1
LOUT	*Lonicera utahensis*	-	-	-	1	-
LUAR2	*Lupinus arbustus*	-	1	-	3	-
LUCA	*Lupinus caudatus*	-	4	4	3	-
LULA	*Lupinus laxiflorus*	-	2	1	3	-
LULAC	*Lupinus laxiflorus calcaratus*	-	1	-	1	-
LULAL	*Lupinus laxiflorus laxiflorus*	-	2	-	-	-
LUPIN	*Lupinus* sp.	-	29	-	6	-
LUSES	*Lupinus sericeus sericeus*	-	-	-	-	1
LYAL	*Lychnis alba*	-	-	-	-	2
LYAM	*Lycopus americanus*	5	2	-	2	2
LYAS	*Lycopus asper*	5	1	8	6	-
LYCO	*Lychnis coronaria*	-	-	-	-	5
LYHA	*Lycium halimifolium*	-	1	-	1	-
LYHY	*Lythrum hyssopifolium*	14	-	-	2	-
LYSA	*Lythrum salicaria*	95	33	-	-	1
LYTR	*Lythrum tribracteatum*	-	1	-	-	-
MACA2	*Machaeranthera canescens*	1	11	-	-	-
MACI	*Madia citriodora*	-	-	5	2	-
MAGR	*Madia gracilis*	-	1	2	-	-
MANE	*Malva neglecta*	3	3	-	1	1
MAPU	*Malus pumila*	-	-	1	-	-
MAVE	*Marsilea vestita*	7	+	-	-	2
MAVU	*Marrubium vulgare*	-	-	-	4	3
MEAL	*Melilotus alba*	10	28	13	14	-
MEAL2	*Mentzelia albicaulis*	-	5	1	2	-
MEAR	*Mentha arvensis*	2	2	-	1	-
MEBU	*Melica bulbosa*	-	4	-	11	-
MEDI	*Mentzelia dispersa*	-	5	-	2	-
MELA2	*Mentzelia laevicaulis*	-	-	-	1	-
MELIL	*Melilotus* sp.	4	7	9	7	12
MELO	*Mertensia longiflora*	-	-	-	2	-
MELU	*Medicago lupulina*	-	8	1	-	10
MENTH	*Mentha* sp.	-	1	-	-	-
MEOF	*Melilotus officinalis*	1	1	3	2	12
MEOF2	*Melissa officinalis*	-	-	-	-	4

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
MESA	*Medicago sativa*	2	5	3	4	2
MICU	*Mimulus cusickii*	-	2	-	-	-
MIGR	*Microsteris gracilis*	-	28	15	37	-
MIGU	*Mimulus guttatus*	-	4	2	2	4
MIMUL	*Mimulus* sp.	1	-	-	-	-
MINA	*Mimulus nanus*	-	-	1	-	1
MITR	*Microseris troximoides*	-	6	-	1	1
MOAL	*Morus alba*	2	3	1	7	2
MOAR	*Montia arenicola*	-	-	-	2	1
MOLI	*Montia linearis*	-	1	-	-	-
MONTI	*Montia* sp.	-	2	-	-	1
MOOD	*Monardella odoratissima*	-	-	-	1	-
MOPE	*Montia perfoliata*	4	42	29	57	46
MOSI	*Montia sibirica*	-	-	-	1	-
MOVE	*Mollugo verticillata*	50	46	-	1	8
MUME	*Muhlenbergia mexicana*	-	-	-	1	-
MYAR	*Myosotis arvensis*	-	-	-	-	1
MYLA	*Myosotis laxa*	-	2	-	2	-
MYMI	*Myosotis micrantha*	-	36	18	44	48
NAIN	*Navarretia inertexta*	-	-	1	-	-
NEBR	*Nemophila breviflora*	-	2	1	4	-
NECA	*Nepeta cataria*	21	30	21	12	8
NEKI	*Nemophila kirtleyi*	-	11	-	2	-
NEMOP	*Nemophila* sp.	-	6	2	7	-
NEPA	*Neslia paniculata*	-	-	-	1	-
OECA2	*Oenothera cespitosa*	-	2	-	-	-
OEHO	*Oenothera hookeri*	-	-	-	2	-
OENOT	*Oenothera* sp.	3	1	-	1	2
OEST	*Oenothera strigosa*	5	2	4	-	-
ONAC	*Onopordum acanthium*	22	20	11	5	4
OPPO	*Opuntia polycantha*	-	-	-	-	22
ORFA2	*Orobanche fasciculata*	-	1	-	1	-
ORHY	*Oryzopsis hymenoides*	-	2	-	-	-
ORUN	*Orobanche uniflora*	-	-	3	7	4
OSCH	*Osmorhiza chilensis*	-	14	18	24	16
OXCO	*Oxalis corniculata*	2	-	-	-	3

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
PACA	*Panicum capillare*	63	56	1	4	23
PADI	*Paspalum distichum*	9	3	-	2	14
PANIC	*Panicum* sp.	-	-	-	-	1
PAPE	*Parietaria pensylvanica*	7	7	24	30	22
PAQU	*Parthenocissis quinquefolia*	-	-	-	1	-
PASC	*Panicum scribnerianum*	-	-	-	-	11
PEBO	*Perideridia bolanderi*	-	1	-	-	-
PEDE	*Penstemon deustus*	-	11	3	3	-
PEEL	*Penstemon elegantulus*	-	-	-	1	-
PEGA2	*Perideridia gairdneri*	-	-	1	-	-
PEGL	*Penstemon glandulosus*	-	2	-	1	-
PENST	*Penstemon* sp.	1	2	1	-	1
PEOR4	*Petalostemon ornatum*	-	3	-	-	-
PETR	*Penstemon triphyllus*	-	-	-	3	-
PHACE	*Phacelia* sp.	-	3	2	-	1
PHAR	*Phalaris arundinacea*	63	39	1	4	2
PHCA2	*Phlox caespitosa*	-	-	-	-	1
PHCO	*Phragmites communis*	1	-	-	1	-
PHCO2	*Phlox colubrina*	-	1	-	8	6
PHHA	*Phacelia hastata*	-	5	1	5	-
PHHE	*Phacelia heterophylla*	-	10	1	7	5
PHHO	*Phlox hoodii*	-	1	-	-	-
PHLE	*Philadelphus lewisii*	-	35	21	61	56
PHLI	*Phacelia linearis*	-	3	2	2	2
PHLO	*Phlox longifolia*	3	30	1	2	-
PHLO2	*Physalis longifolia*	-	1	1	1	51
PHLOX	*Phlox* sp.	-	6	-	1	1
PHMA	*Physocarpus malvaceus*	-	6	5	12	1
PHOR	*Physaria oregona*	-	4	-	3	1
PHPR	*Phleum pratense*	-	-	-	1	1
PHRA	*Phacelia ramosissima*	-	4	-	-	-
PIPO	*Pinus ponderosa*	-	2	3	9	9
PLLA	*Plantago lanceolata*	-	1	6	10	2
PLMA	*Plectritis macrocera*	2	30	11	22	5
PLMA2	*Plantago major*	50	19	-	2	-
PLPA	*Plantago patagonica*	-	5	-	7	14
PLTE	*Plagiobothrys tenellus*	-	-	1	18	4
POA	*Poa* sp.	6	6	3	3	1
POAM	*Polygonum amphibium*	-	-	-	-	4

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
POAR	*Potentilla arguta*	-	-	-	2	-
POAU	*Polygonum austiniae*	-	-	-	1	-
POAV	*Polygonum aviculare*	14	12	5	3	2
POBI	*Polygonum bistortoides*	1	3	-	-	-
POBU	*Poa bulbosa*	6	97	14	47	13
POCO3	*Polygonum coccineum*	6	-	-	1	12
POCO4	*Polygonum convolvulus*	-	5	-	2	3
POCU4	*Polygonum cuspidatum*	-	-	-	1	-
PODE	*Populus deltoides*	2	9	-	1	-
PODO	*Polygonum douglasii*	-	5	18	8	4
POGR	*Potentilla gracilis*	-	-	-	1	-
POHY	*Polygonum hydropiper*	5	4	1	3	-
POHY2	*Polygonum hydropiperoides*	1	10	-	-	-
POLA	*Polygonum lapathifolium*	9	21	-	1	-
POLO	*Polystichum lonchitis*	-	-	-	1	-
POLYG	*Polygonum* sp.	20	8	5	8	3
POMA	*Polygonum majus*	-	-	1	6	1
POMI	*Polemonium micranthum*	-	5	1	-	-
POMO	*Polypogon monspeliensis*	30	2	7	2	-
PONE	*Poa nervosa*	-	-	-	2	-
PONO	*Potentilla norvegica*	1	-	-	-	-
POOL	*Portulaca oleracea*	58	82	-	4	5
POPE	*Polygonum persicaria*	35	11	1	3	1
POPR	*Poa pratensis*	1	32	31	38	32
POPU	*Polygonum punctatum*	1	-	-	-	-
PORA	*Polygonum ramosissimum*	-	2	-	-	-
PORE	*Potentilla recta*	-	-	-	1	1
PORI	*Potentilla rivalis*	18	-	-	-	-
POSE	*Poa secunda*	4	121	21	58	40
POTEN	*Potentilla* sp.	13	11	1	-	-
POTEN1	*Potentilla* sp.	-	-	1	-	-
POTR	*Populus tremuloides*	-	8	2	2	-
POTR2	*Populus trichocarpa*	1	34	12	4	6
PRAR	*Prunus armeniaca*	-	-	-	7	3
PRAV	*Prunus avium*	-	-	-	-	7
PRCE	*Prunus cerasifera*	-	-	1	16	1
PRDO	*Prunus domestica*	-	-	-	-	1
PREM	*Prunus emarginata*	-	10	13	14	2
PRSP	*Prunus spinosa*	-	-	-	2	1

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
PRUNU	*Prunus* sp.	-	-	-	-	2
PRVI	*Prunus virginiana*	-	41	28	55	34
PRVU	*Prunella vulgaris*	-	-	-	4	-
PSME	*Pseudotsuga menziesii*	-	1	3	7	2
PUTR	*Purshia tridentata*	1	33	15	39	-
PYAS	*Pyrola asarifolia*	-	-	-	1	-
PYCO	*Pyrus communis*	-	1	-	-	-
PYEL	*Pyrola elliptica*	-	-	-	1	-
RAAB	*Ranunculus abortivus*	1	-	-	-	-
RACY	*Ranunculus cymbalaria*	-	2	-	-	-
RAGL	*Ranunculus glaberrimus*	-	2	-	4	3
RANUN	*Ranunculus* sp.	20	-	-	-	-
RASC	*Ranunculus sceleratus*	1	13	-	-	-
RATE	*Ranunculus testiculatus*	4	18	-	-	-
RHGL	*Rhus glabra*	-	15	4	27	17
RHPU	*Rhamnus purshiana*	-	-	16	7	22
RIAU	*Ribes aureum*	36	21	2	2	-
RIBES	*Ribes* sp.	1	3	1	-	-
RICE	*Ribes cerum*	3	-	2	6	1
RICO	*Ribes cognatum*	-	1	-	-	-
RIHU	*Ribes hudsonianum*	-	-	-	-	1
RILE	*Rigiopappus leptocladus*	-	1	-	-	-
RINI	*Ribes niveum*	-	3	5	22	13
RIVEG	*Ribes velutinum* var. *gooddingii*	-	-	-	-	1
RIVI	*Ribes viscosissimum*	1	-	-	1	-
ROCA	*Rosa canina*	2	8	-	5	1
ROIS	*Rorippa islandica*	15	12	-	1	-
RONA	*Rorippa nasturtium-aquaticum*	2	10	1	-	4
RONU	*Rosa nutkana*	-	-	-	1	-
ROPS	*Robinia pseudoacacia*	1	4	-	4	2
ROSA	*Rosa* sp.	-	1	-	2	-
ROWO	*Rosa woodsii*	58	54	12	41	10
RUAC	*Rumex acetosella*	-	-	-	1	-
RUBA	*Rubus bartonianus*	-	-	-	5	-
RUBUS	*Rubus* sp.	-	-	-	1	-
RUCO	*Rumex conglomeratus*	-	1	-	-	1
RUCR	*Rumex crispus*	25	25	9	7	6
RUDI	*Rubus discolor*	-	1	4	31	7

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
RUID	*Rubus idaeus*	-	-	1	-	-
RULA	*Rubus laciniatus*	-	1	-	4	2
RULE	*Rubus leucodermis*	-	1	3	1	5
RUMA	*Rumex maritimus*	-	6	-	-	-
RUMEX	*Rumex* sp.	15	18	1	2	4
RUOB	*Rumex obtusifolius*	3	5	1	-	3
RUPA	*Rubus parviflorus*	-	3	-	5	5
RUPE	*Rumex persicaroides*	1	-	-	-	-
RUSA	*Rumex salicifolius*	-	2	-	-	-
RUVE	*Rumex venosus*	-	-	-	-	1
SAAL	*Salix alba*	41	3	-	-	-
SAALC	*Salix alba* var. *calva*	-	4	-	-	-
SAAM	*Salix amygdaloides*	70	55	-	1	-
SACE	*Sambucus cerulea*	-	21	6	34	27
SACU	*Sagittaria cuneata*	-	1	-	-	-
SAEX	*Salix exigua*	86	76	6	3	13
SAIN	*Saxifraga integrifolia*	-	1	-	1	-
SACU	*Sagittaria cuneata*	-	1	-	-	-
SAEX	*Salix exigua*	86	76	6	3	13
SAIN	*Saxifraga integrifolia*	-	1	-	1	-
SAINC	*Saxifraga integrifolia* var. *claytoniifol*	-	-	-	-	1
SAKA	*Salsola kali*	4	9	-	-	1
SALA2	*Sagittaria latifolia*	-	1	-	-	-
SALIX	*Salix* sp.	5	2	1	2	1
SALU	*Salix lutea*	-	2	2	1	-
SAOF	*Saponaria officinalis*	-	-	-	2	-
SASC	*Salix scouleriana*	-	2	2	-	-
SASC2	*Salvia sclarea*	-	-	-	2	1
SAVE	*Sarcobatus vermiculatus*	-	1	-	-	-
SAXIF	*Saxifraga* sp.	-	1	-	-	-
SCAC	*Scirpus acutus*	1	-	-	-	1
SCAM	*Scirpus americanus*	1	1	-	-	2
SCAN	*Scutellaria angustifolia*	-	9	1	16	11
SCAN2	*Scleranthus annuus*	-	-	-	5	-
SCIRP	*Scirpus* sp.	3	4	-	-	-
SCMA	*Scirpus maritimus*	5	4	-	-	2
SCMI	*Scirpus microcarpus*	1	-	-	-	-
SCVA	*Scirpus validus*	-	6	-	-	-

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
SECA	*Senecio canus*	-	-	-	2	-
SECE	*Secale cereale*	-	-	-	1	-
SEDUM	*Sedum* sp.	-	-	-	1	-
SEGL	*Setaria glauca*	-	-	-	1	-
SEIN	*Senecio integerrimus*	-	-	-	3	-
SELE	*Sedum leibergii*	-	-	-	1	-
SEST	*Sedum stenopetalum*	-	-	-	1	-
SEVI	*Setaria viridis*	3	-	-	4	3
SEWA	*Selaginella wallacei*	-	-	-	1	-
SIAL	*Sisymbrium altissimum*	13	42	6	3	11
SIAN	*Sisyrinchium angustifolium*	-	-	-	-	1
SIAN2	*Silene antirrhina*	-	-	3	9	24
SIHE	*Sida hederacea*	8	1	-	-	-
SIHY	*Sitanion hystrix*	3	60	2	12	-
SILEN	*Silene* sp.	-	1	-	-	-
SISC	*Silene scouleri*	-	-	1	-	-
SMILA	*Smilacina* sp.	-	1	-	-	-
SMRA	*Smilacina racemosa*	-	2	-	4	4
SMST	*Smilacina stellata*	12	-	-	-	-
SOAS	*Sonchus asper*	1	-	-	-	-
SOCA	*Solidago canadensis*	6	1	1	4	-
SODU	*Solanum dulcamara*	27	12	8	9	10
SOGI	*Solidago gigantea*	18	4	-	-	-
SOLAN	*Solanum* sp.	1	-	-	-	-
SOLID	*Solidago* sp.	2	2	-	1	4
SOMI	*Solidago missouriensis*	2	1	-	-	-
SOMIF	*Solidago missouriensis* var. *fasciculata*	-	-	-	1	-
SONCH	*Sonchus* sp.	1	-	-	-	-
SONI	*Solanum nigrum*	10	12	-	-	-
SOOC	*Solidago occidentalis*	84	37	3	7	6
SOOL	*Sonchus oleraceus*	1	-	-	-	-
SOSA	*Solanum sarrachoides*	7	-	-	-	-
SOSC	*Sorbus scopulina*	-	-	-	1	-
SPBE	*Spiraea betulifolia*	-	2	3	12	-
SPCR	*Sporobolus cryptandrus*	5	4	1	10	41
SPMU	*Sphaeralcea munroana*	-	3	-	-	-
STCO2	*Stipa comata*	-	1	-	-	-
STELL	*Stellaria* sp.	-	-	-	1	2
STME	*Stellaria media*	4	23	29	27	29

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Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
STNI	*Stellaria nitens*	4	50	9	38	31
STTE	*Stephanomeria tenuifolia*	-	-	-	-	2
STTH	*Stipa thurberiana*	-	1	-	-	-
STVI	*Stanleya viridiflora*	-	1	-	-	-
SYAL	*Symphoricarpos albus*	-	11	22	27	4
SYOR	*Symphoricarpos oreophilus*	-	-	-	2	-
SYVU	*Syringa vulgaris*	-	-	-	1	-
TACA	*Taeniatherum caput-medusae*	13	80	12	18	1
TAOF	*Taraxacum officinale*	3	27	19	15	25
TAPA	*Tamarix parviflora*	33	65	-	-	-
TAPE	*Tamarix pentandra*	7	-	-	-	-
TAVU	*Tanacetum vulgare*	11	3	-	-	-
TECA	*Tetradymia canescens*	-	2	-	-	-
THAR	*Thlaspi arvense*	2	-	-	-	-
THCU	*Thysanocarpus curvipes*	-	6	4	27	7
THLA	*Thelypodium laciniatum*	-	-	-	-	2
TOFL	*Tonella floribunda*	-	13	7	50	26
TORA	*Toxicodendron radicans*	2	42	26	51	75
TRDU	*Tragopogon dubius*	8	75	22	48	45
TRIFO	*Trifolium* sp.	5	6	2	8	4
TRMA2	*Triglochin maritimum*	-	1	-	-	-
TRPE2	*Triodanis perfoliata*	-	-	1	8	15
TRPR	*Trifolium pratense*	1	1	2	1	-
TRRE	*Trifolium repens*	-	-	-	1	-
TRTE	*Tribulus terrestris*	-	14	-	-	1
TRWO	*Trisetum wolfii*	4	-	-	-	-
TYLA	*Typha latifolia*	3	4	2	1	-
ULAM	*Ulmus americana*	48	2	-	-	-
ULPU	*Ulmus pumila*	12	6	3	15	-
URDI	*Urtica dioica*	18	14	3	10	11
VAGL	*Vaccinium globulare*	-	-	-	1	-
VALO	*Valerianella locusta*	-	-	-	-	3
VEAM	*Veronica americana*	3	13	-	-	-
VEAN	*Veronica anagallis-aquatica*	35	18	4	2	-
VEAR	*Veronica arvensis*	2	23	18	29	49
VEBI	*Veronica biloba*	2	1	2	3	-
VEBL	*Verbascum blattaria*	5	44	16	36	22

[1] IPCC = Idaho Power Company species code.

[2] Column numbers indicate the number of transects on which each species was encountered during field sampling measurements. Total transects sampled = 1,245 (386 upland, 859 riparian).

[3] BA = Weiser Reach, BR = Brownlee Reservoir Reach, OX = Oxbow Reservoir Reach, HC = Hells Canyon Reservoir Reach, and HB = the reach below Hells Canyon Dam.

Appendix 4 (cont.).

IPCC[1]	Binomial	Reach[2]				
		BA[3]	BR[3]	OX[3]	HC[3]	HB[3]
VEBR	*Verbena bracteata*	40	21	1	6	9
VEDU	*Ventenata dubia*	-	-	-	2	1
VEHA	*Verbena hastata*	-	2	-	-	1
VEPE	*Veronica peregrina*	-	1	-	-	-
VEPEX	*Veronica peregrina* var. *xalapensis*	1	-	-	2	-
VERON	*Veronica* sp.	2	1	3	1	1
VETH	*Verbascum thapsus*	18	8	21	14	27
VEVE	*Veronica verna*	-	-	-	-	2
VIAD	*Viola adunca*	-	3	-	-	-
VIAM	*Vicia americana*	-	-	-	2	-
VICAR	*Viola candensis* var. *rugulosa*	-	-	-	-	3
VIGL	*Viola glabella*	-	-	-	1	-
VINE1	Unknown vine	-	-	-	-	1
VINU	*Viola nuttallii*	-	2	-	-	-
VINUV	*Viola nuttallii* var. *vallicola*	-	1	-	-	-
VIOLA	*Viola* sp.	-	-	-	1	1
VIPU	*Viola purpurea*	-	-	-	1	-
VIRI	*Vitis riparia*	-	-	-	-	2
VITIS	*Vitis* sp.	-	-	-	1	-
VIVI	*Vitis vinifera*	-	-	-	-	1
VIVI2	*Vicia villosa*	-	-	-	-	1
WOOR	*Woodsia oregana*	-	1	-	17	23
WOSC	*Woodsia scopulina*	-	-	-	1	-
XAST	*Xanthium strumarium*	37	115	3	8	26
ZEGAD	*Zigadenus* sp.	-	-	-	3	-
ZIPA	*Zigadenus paniculatus*	-	-	-	1	-
ZIVE	*Zigadenus venenosus*	-	-	-	5	4

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[3] BA = Weiser Reach, BR = Brownlee Reservoir Reach, OX = Oxbow Reservoir Reach, HC = Hells Canyon Reservoir Reach, and HB = the reach below Hells Canyon Dam.