Hells Canyon Wildlife Habitat Assessment

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1. Introduction

Identifying impacts to wildlife is an important concern for relicensing the Hells Canyon Complex (HCC) (Federal Energy Regulatory Commission 1990, Idaho Power Company 1997). During relicensing consultation, state and federal resource agencies expressed several issues and concerns to Idaho Power Company (IPC) about potential impacts to wildlife habitat (Idaho Power Company 1997). Primary issues were that operations of the HCC 1) preclude the establishment of perennial low-elevation wildlife habitat between reservoir maximum operational drafting depths and full-pool shorelines (i.e., reservoir fluctuation zones), 2) prevent the establishment of perennial riparian habitat along reservoir and river shorelines (i.e., shoreline zones), 3) limit waterfowl brooding habitat in shoreline zones, and 4) decrease habitat for Threatened, Endangered, and Sensitive species in the shoreline zones (Idaho Power Company 1997).

Consequently, CH2M HILL conducted the Hells Canyon Wildlife Habitat Assessment (WHA) study on behalf of IPC. This study is part of IPC's Federal Energy Regulatory Commission (FERC) relicensing process for the HCC. IPC has completed a series of studies describing wildlife communities and existing wildlife habitat in Hells Canyon. Using eight species-habitat relationship models, the WHA study investigates potential future impacts of the HCC on wildlife resources in Hells Canyon by evaluating projections from two simulated operational scenarios: *Proposed Operations* and *Full Pool Run-of-River Operations*. This study was designed as a team effort (i.e., WHA Team) involving project proponents and interested parties. The WHA Team collaboratively defined the scope of a habitat assessment study and assisted with study tasks. This study was conducted in two phases: 1) scope definition based on a literature review and WHA Team meetings, and 2) the analysis of projected habitat value (i.e., extent and quality). A list of WHA team members and meeting notes are included in Appendix A.

2. Objectives

The overall study goal was to estimate impacts of IPC's *Proposed Operations* on wildlife habitat relative to *Full Pool Run-of-River Operations*. Using botanical data from Holmstead (2001) and hydrologic data from Parkinson (2002), specific objectives were to:

1. Describe current wildlife habitat values occurring within the reservoir fluctuation zones and along reservoir and river shoreline zones that have developed during *Historical Operations* (1958−1999) of the HCC.
2. Project the extent and quality of future habitat values simulated for *Proposed Operations* and *Run-of-River Operations.*
3. Compare the extent of habitats (i.e., cover types) between the two operational scenarios.
4. Analyze quality of projected habitat values for selected wildlife species.

3. STUDY AREA

3.1. Hells Canyon Complex

3.1.1. Location

The Hells Canyon reach of the Snake River is situated in west-central Idaho and northeastern Oregon. The HCC generation facilities are located on the Snake River in the southern portion of Hells Canyon and are comprised of three reservoirs: Brownlee, Oxbow, and Hells Canyon. The reach downstream of Hells Canyon Dam is unimpounded, although the three-dam complex seasonally influences river flows. The Hells Canyon Relicensing Study Area for evaluating terrestrial resources (Idaho Power Company 1997) is located between the city of Weiser and the confluence of the Salmon and Snake rivers (from approximately river mile [RM] 351 to RM 188).

The Snake River, a major tributary to the Columbia River, is the focal point of Hells Canyon. Its generally northward flow forms part of the boundary between Idaho and Oregon. Federal agencies, including the Bureau of Land Management (BLM) and the U.S. Forest Service (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; and Baker and Malheur FOs of the Vale District, BLM−Oregon. Other agencies with natural resource jurisdiction in the study area include the U.S. Department of the Interior (USDI) National Marine Fisheries Service, USDI Bureau of Indian Affairs, USDI Fish and Wildlife Service, and state agencies from Idaho and Oregon.

The study area for terrestrial resources associated with the HCC—referred to as the Terrestrial Relicensing Study Area—was broadly divided longitudinally (i.e., north to south) into five reaches, based on distinct geomorphic features, river characteristics, and legal HCC boundaries:

- Upstream of Brownlee Reservoir to the Weiser Bridge (approximately 12 mi; RM 351.2 to RM 339.2)
- Brownlee Reservoir (approximately 55 mi; RM 339.2 to RM 284.6). The WHA study further divided Brownlee Reservoir into 3 reaches: Headwaters, Powder River Pool, and Lower Brownlee.
- Oxbow Reservoir (approximately 12 mi; RM 284.6 to RM 272.2)
- Hells Canyon Reservoir (approximately 25 mi; RM 272.2 to RM 247.0)
- Downstream of Hells Canyon Dam to the confluence of the Snake and Salmon rivers (approximately 59 mi, RM 247.0 to RM 188.2)

The lateral (i.e., east to west) extent of the reaches includes all land within 0.5 mi of each shoreline for reaches upstream of Hells Canyon Dam and all land within 0.25 mi of the shoreline downstream of Hells Canyon Dam (Holmstead 2001).

In the upstream reach, the Snake River is characterized as a low-gradient (0.2 to 0.4 m/km) river, with several island complexes. Agriculture and rural development on flat to gentle topography surround this reach. Large amounts of irrigation returns cause high turbidities and increased nutrient loading.

Brownlee Reservoir is a steep-sided reservoir with a maximum depth approaching 300 ft near the dam. Large rock outcrops occur throughout its entire length. Oxbow Reservoir is a relatively small and shallow re-regulating reservoir surrounded by moderate to steep topography (20% to 75% slopes). Shorelines are primarily basalt outcrops and talus, except for alluvial fans created by small tributaries. Hells Canyon Reservoir is a re-regulating reservoir with maximum depths approaching 200 ft. Reservoir shorelines are generally very steep, and substrates are primarily composed of basalt outcrops and talus. The Snake River downstream of Hells Canyon Dam is a high-gradient river (1.8 m/km) bounded by nearly vertical cliff faces. The Snake River downstream of Hells Canyon Dam supports a diversity of aquatic habitats, including numerous large rapids, shallow riffles, and deep pools. Substrates are also diverse, ranging from large basalt outcrops and boulders to cobble/sand bars.

3.1.2. Physiography

Hells Canyon is the deepest and one of the most rugged river gorges in the continental United States. It ranges between 2,000 and 3,000 ft deep from Weiser to Oxbow Dam. Downstream of Oxbow Dam, the river enters a narrow, steep-sided chasm measuring up to 5,500 ft deep. From the confluence with the Grande Ronde River, the Snake River then flows into 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 above mean sea level (msl), descending to about 910 ft msl at the confluence of the Salmon River about 59 mi downstream of Hells Canyon Dam.

Throughout Hells Canyon, topography is generally steep and broken, with slopes often dominated by rock outcrops and talus slopes. At the deepest points, canyon walls rise almost vertically. Canyon walls are also deeply dissected by numerous side canyons with tributaries to the Snake River. The Seven Devils Mountains to the east and the Wallowa Mountains to the west form the upper reaches of the canyon walls. These mountains form a series of jagged peaks reaching almost 10,000 ft, with subalpine and alpine conditions (U.S. Department of Agriculture 1990).

3.1.3. Land Features and Geology

Hells Canyon consists of a series of folded and faulted metamorphosed sediments and volcanics overlain unconformably 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 those found today 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 eras by subduction of a tectonic plate beneath the North American continental tectonic plate (Asherin and Claar 1976, U.S. Department of Agriculture 1994).

In more recent geologic time, the Snake River formed Hells Canyon through erosion of the Blue Mountains in Oregon and Seven Devils Mountains in Idaho (U.S. Department of Energy 1985). The Snake River has existed since the Pliocene epoch and probably cut to its present level in Hells Canyon during the Pleistocene. During the Pleistocene, glacial meltwater provided abundant runoff for down-cutting, while regional uplifting created 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 of 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 drainage areas, and local granitic outcrops also occur.

3.1.4. Soils

The soils throughout Hells Canyon are derived primarily from Columbia 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 colluvium and talus deposited more recently. The amount of soil cover declines northward through Hells Canyon. Near Hells Canyon Dam (RM 247), most rock faces are nearly vertical with 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).

3.1.5. Climate

Climate in Hells Canyon, located in the High Desert region, is significantly influenced by the rain shadow of the Cascade Mountains to the west. 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, which is normally blocked by mountain ranges to the east. During the summer, a Pacific high-pressure system dominates weather patterns, resulting in minimal precipitation and more continental climatic conditions overall (Ross and Savage 1967).

Climatological information is summarized for Weiser, Richland, Brownlee Dam, and Lewiston. Average annual precipitation is lowest at the southern end of the study area (Weiser, 286 mm [11.3 inches]), increases northward (Richland, 298 mm [11.7 inches]), peaks around

Brownlee Dam (445 mm [17.5 inches]), and declines toward Lewiston (326 mm [12.8 inches]). The average annual precipitation ranges from about 380 to 500 mm (15 to 20 inches), depending on elevation. Nearly 45% of the average annual precipitation at Brownlee Dam falls from November through January, which 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 (51.2 inches).

Mean annual temperatures are similar among the four weather stations. Generally, the climate tends to become drier and warmer downstream of Brownlee Dam. Climatological information from Brownlee Dam (RM 284.6) is probably characteristic of the central section of the study area. The canyon bottom area is dry with seasonal temperatures ranging from lows of about −5 °C (23 °F) in January to highs of about 35 °C (95 °F) in July. Temperatures below freezing are normally experienced from mid-November through mid-April. As a rule, winters in Hells Canyon are relatively mild compared to surrounding areas, while summers on the canyon floor may be hot. Mean temperatures above 2,000 m (6,562 ft msl) range from –9 °C (16 °F) in January to 13 °C (55 °F) in July. By contrast, mean temperatures below 1,000 m (3,281 ft msl) elevation range from 0 °C (32 °F) in January to between 28 °C (82 °F) and 33 °C (91 °F) in July (Johnson and Simon 1987).

3.1.6. Vegetation

The types of vegetation growing along the canyon slopes of the middle Snake River are the result of 3 primary ecological factors: climate, topography, and soils. Climate exerts the strongest influence on the development of plant life. The relatively mild winters below the canyon rim have allowed the development of disjunctive species. For example, hackberry (*Celtis reticulata*), which is most often found in the southwestern states, commonly occurs in the middle and lower Snake River area (Tisdale 1979, DeBolt 1992).

Within the context of regional climate, topography is a major influence on the development and distribution of vegetation (Tisdale et al. 1969; Tisdale 1979, 1986). The topographical complexity of Hells Canyon has produced a mosaic of vegetation types (Tisdale 1979, Bonneville Power Administration 1984). Grassland, shrubland, riparian (or wetland), and coniferous forest communities exist in close proximity. Interfingering of grassland and forest, for example, occurs at a number of sites throughout the canyon due to variations in aspect (Tisdale 1979).

Twenty-six cover types—for natural features, land use, and vegetation—were identified along the Snake River in the Hells Canyon vicinity (Holmstead 2001). The area that was classified extended up to approximately 0.5 mi on both sides of the Snake River or associated reservoirs and extended from above Brownlee Reservoir at the town of Weiser, Idaho (RM 351.2), downstream to the confluence with the Salmon River (RM 188.2). The dominant cover types were *Grassland* (35.5%), *Shrub Savanna* (21.0%), *Lotic* (16.1%), *Shrubland* (6.6%), and *Cliff/Talus* (5.6%). All remaining cover types covered <5% of the area classified.

Wetland and Riparian Communities—A narrow band of diverse riparian communities intermittently follows the course of the Snake River and its many tributaries. Although limited in geographic area, this riparian zone is vital because of its biological diversity. Emergent wetland communities are composed mostly of broad-leaved pepperweed (*Lepidium latifolium*), marsh grass (*Heleochloa alopecuroides*), purple loosestrife (*Lythrum salicaria*), common cocklebur (*Xanthium strumarium*), hemp dogbane (*Apocynum cannabinum*), alkali saltgrass (*Distichlis stricta*), and purslane (*Portulaca oleracea*). Predominant shrub species in riparian areas include netleaf hackberry (*Celtis reticulata*), false indigo (*Amorpha fruticosa*), coyote willow (*Salix exigua*), common chokecherry (*Prunus virginian*a), poison ivy (*Toxicodendron radicans*), syringa (or mock orange, *Philadelphus lewisii*), Himalayan blackberry (*Rubus discolor*), and tamarisk (*Tamarix parviflora*).

Predominant tree species include water birch (*Betula occidentalis*), white alder (*Alnus rhombifolia*), black cottonwood (*Populus trichocarpa*), silver maple (*Acer saccharinum*), and peachleaf willow (*Salix amygdaloides*). Most weedy exotic species occur at and above the headwaters of Brownlee Reservoir (Holmstead 2001).

Many shoreline sections have no riparian vegetation. Rather, upland vegetation on steep canyon slopes simply meets the rocky shoreline. Grassland and shrubland communities are common along the Snake River and its tributaries.

Herbaceous-Dominated Vegetation Types—The dry climate and typically stony, shallow soils of the canyon have favored the development of grassland steppe communities at the lower and middle elevations (Tisdale 1979, 1986). Commonly occurring grass species in the study area include bunchgrasses, such as bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), Sandberg bluegrass (*Poa secunda*), and annual grasses, such as cheatgrass (*Bromus tectorum*) and medusahead wildrye (*Taeniatherum caput-medusae*) (Holmstead 2001). Other grasses, such as sand dropseed (*Sporobolus cryptandrus*) and red threeawn (*Aristida longiseta*), are locally common (Bonneville Power Administration 1984, Tisdale 1986).

Shrub-Dominated Vegetation Types—Shrub species comprise a large segment of the canyon's overall vegetation composition. Shrub-steppe vegetation types occur at mid-elevations in Hells Canyon, especially in its southern region (Bonneville Power Administration 1984). Commonly occurring shrubs include big sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), gray rabbitbrush (*Ericameria nauseosa*), hackberry, serviceberry (*Amelanchier alnifolia*), and bitter cherry (*Prunus emarginata*) (Bonneville Power Administration 1984, Tisdale 1986, Holmstead 2001). For the most part, sagebrush stands are limited to the area around Brownlee Reservoir. In these stands, the herbaceous layer is dominated by cheatgrass, with a variety of forbs also occurring.

Stands of hackberry can be found throughout the study area, either on lower slopes with rocky residual/colluvial soil or on alluvial terraces with sandy soil (Tisdale 1986). In these stands, hackberry is often mixed with a number of other shrub and tree species, including antelope bitterbrush, blue elderberry (*Sambucus cerulea*), and ponderosa pine (Bonneville Power Administration 1984). Poison ivy is also abundant. The herbaceous layer is most often dominated by bluebunch wheatgrass, with cheatgrass dominant in those areas moderately to heavily disturbed by past livestock use.

Tree-Dominated Vegetation Types—Although coniferous forest communities are generally restricted to the higher elevations of steep canyon slopes, they do reach down as far as the river at certain locations. For example, stands of ponderosa pine (*Pinus ponderosa*) or Douglas-fir (*Psuedotsuga menziesii*), typically with a common snowberry (*Symphoricarpos albus*) understory, extend to the river on north-facing slopes at sites around the main bodies of Oxbow and Hells Canyon reservoirs, and downstream of Hells Canyon Dam (Holmstead 2001).

3.1.7. Land Use

The study area and vicinity is still dominated by the land-use patterns established in the early 1900s: irrigated and nonirrigated agriculture, livestock grazing, mining, large areas of open space, and scattered rural development. Currently, bottomlands adjacent to the reservoirs are generally used for grazing, some farming, and recreation.

3.2. Hells Canyon Complex Operations

3.2.1. Current Operations

Hells Canyon, on the Oregon–Idaho border, is the deepest canyon in North America and home to IPC's largest hydroelectric generating complex, the HCC. The HCC includes Brownlee, Oxbow, and Hells Canyon dams, reservoirs, and power plants. Operations of the three projects of the complex are closely coordinated to generate electricity and to serve many other public purposes.

IPC operates the complex to comply with the FERC license, as well as to accommodate other concerns, such as recreational use, environmental conditions, and voluntary arrangements. Among these arrangements are the 1980 *Hells Canyon Settlement Agreement*, the Idaho Power *Fall Chinook Interim Recovery Plan and Study* adopted in 1991, and, between 1995 and 2001, the cooperative arrangement that IPC had with federal interests in implementing portions of the Federal Columbia River Power System (FCRPS) biological opinion flow augmentation, which is intended to avoid jeopardy of the FCRPS operations below the HCC.

Brownlee Reservoir is the only one of the three HCC facilities—and IPC's only project—with significant storage. It has 101 vertical feet of active storage capacity, which equals approximately 1 million acre-feet of water. On the other hand, Oxbow and Hells Canyon reservoirs have significantly smaller active storage capacities—approximately 0.5 and 1.0% of Brownlee Reservoir's volume, respectively.

Brownlee Dam's hydraulic capacity is also the largest of the three projects. Its powerhouse capacity is approximately 35,000 cubic feet per second (cfs), while the Oxbow and Hells Canyon powerhouses have hydraulic capacities of 28,000 and 30,500 cfs, respectively.

Target elevations for Brownlee Reservoir define the flow through the HCC. However, when flows exceed powerhouse capacity for any of the projects, water is released over the spillways at those projects. When flows through the HCC are below hydraulic capacity, all three projects operate closely together to re-regulate flows through the Oxbow and Hells Canyon projects so that they remain within the 1-foot per hour ramp rate requirement (measured at Johnson Bar below Hells Canyon Dam) and meet daily peak load demands.

In addition to maintaining the ramp rate, IPC maintains minimum flow rates in the Snake River downstream of Hells Canyon Dam. These minimum flow rates are for navigation purposes and IPC's compliance with Article 43 of the existing license. Neither the Brownlee Project nor the Oxbow Project has a minimum flow requirement below its powerhouse. However, because of the Oxbow Project's unique configuration, a flow of 100 cfs is maintained through the bypassed reach of the Snake River below the dam (a segment called the Oxbow Bypass).

3.2.2. Brownlee Reservoir Seasonal Operations

Brownlee Reservoir is a multiple-use, year-round resource for the Northwest. Although its primary purpose is providing a stable power source, Brownlee Reservoir is also used for flood control, fish and wildlife mitigation, and recreation.

Brownlee Dam is one of several Northwest dams that cooperates to provide springtime flood control on the lower Columbia River and, between 1995 and 2001, to regulate flow in the lower Snake River. For flood control, IPC operates the reservoir cooperatively with the U.S. Army Corps of Engineers (COE) North Pacific Division, according to Article 42 of the existing license.

After flood-control requirements have been met in early summer, the reservoir is refilled to meet peak summer electricity demands and provide suitable habitat for spawning bass and crappie. The full reservoir also offers optimal recreational opportunities through the Fourth of July holiday.

As part of the flow augmentation reasonable and prudent alternative (RPA) implemented by the 1995 and 2000 FCRPS biological opinions, the Bureau of Reclamation (BOR) periodically releases water from BOR storage reservoirs in the upper Snake River to assist with the migration of anadromous fish past the lower Snake River FCRPS projects. From 1995 through the summer of 2001, IPC cooperated with the BOR and other federal interests in these flow augmentation efforts by shaping (or prereleasing) water from Brownlee Reservoir (and later refilling the drafted reservoir space with water released by the BOR from the upper Snake River reservoirs) and by occasionally contributing water to flow augmentation efforts. To facilitate IPC's cooperation with the flow augmentation RPA, in 1996 the Bonneville Power Administration (BPA) entered into an energy exchange agreement with IPC. The agreement reimbursed IPC for any energy losses it incurred as a result of the company's participation through an energy exchange mechanism. The agreement expired in April 2001 and has not been renewed by BPA.

Later in the fall, Brownlee Reservoir's releases are managed to maintain constant flows below Hells Canyon Dam. These flow requirements, which are based on the *Fall Chinook Recovery Plan* that IPC adopted in 1991, as well as the minimum flow required by Article 43, help ensure sufficient water levels to protect even the shallowest spawning nests, or redds.

After fall chinook spawn, IPC attempts to have a full reservoir by the first week of December to meet winter peak demands.

Winter—December through February

Electricity demands in IPC's service territory—and throughout the Northwest—are critical during the winter. To meet peak winter demands and maintain system reliability, the water level in Brownlee Reservoir is approximately 2,075 ft msl by the first week in December. If the reservoir is filled to that level, the system can provide stable, reliable energy through the winter and reduce operating costs by minimizing the need for purchasing outside power.

During these months, IPC maintains minimum flows below Hells Canyon Dam to ensure sufficient water levels for fall chinook spawning nests. By January or February, IPC begins to draft the reservoir to meet elevation targets for flood control.

Spring—March through May

The COE's North Pacific Division defines flood-control requirements and coordinates flood-control efforts with IPC. During the spring, IPC complies with Article 42 and responds to the COE request to lower the water level in Brownlee Reservoir. The lower water level provides space for excess spring runoff and helps prevent flooding, primarily on the lower Columbia and lower Snake rivers.

In IPC's license, FERC requires that the reservoir's elevation be at or below 2,034 ft by March 1, a level that provides approximately 500,000 acre-feet of storage space for flood control. The license also stipulates that the COE may request an additional 500,000 acre-feet of storage space, if necessary. However, in past years when the snow pack was less than normal, the COE reduced the storage space requirement.

In the mid-1980s, the COE examined the reservoir's flood-control operation and developed a rule curve table for Brownlee Reservoir's target elevations. These target elevations define the space in the reservoir needed for flood control and are based on forecasted runoff at both the Brownlee and The Dalles projects. More recently, the rule curve procedure was improved. This new rule curve now provides a more gradual change in reservoir elevations to reach required storage volumes by targeted dates.

IPC initiated the new rule curve for water year 2000 flood-control requirements. Depending on the water year and COE mandates, flood-control requirements for Brownlee Reservoir may continue through June. In order to meet mandated target elevations for flood control, IPC may need to spill water through the HCC. Although there are no official refill target elevations, the COE controls how quickly the reservoir can be refilled once flood-control requirements are met.

Summer—June through August

After IPC is released from flood-control responsibilities, the company begins refilling Brownlee Reservoir. The refill target is 2,069 ft msl (about 8 ft below the full reservoir capacity of 2,077 ft) toward the end of May and full by the end of the June. Meeting these targets ensures that enough water is stored in Brownlee Reservoir to meet peak summer electricity demands, provide suitable spawning habitat for bass and crappie, and offer optimal recreational opportunities.

In an effort to cooperate with federal efforts to meet flow objectives at Lower Granite Dam outlined in the 1995 and 2000 FCRPS flow augmentation RPA, since 1996 IPC has released water from Brownlee Reservoir to contribute to the federal flow augmentation program. If Brownlee Reservoir is full by the first of July and projections indicate that the space will refill on time, IPC has contributed up to 237,000 acre-feet of water from Brownlee Reservoir during the summer. IPC's cooperative contribution has been generally defined by reservoir space rather than a specific amount of storage water. To effectuate its contribution, IPC drafts Brownlee Reservoir to an elevation of 2,059 ft msl, which, if the reservoir is full, equals a contribution of approximately 237,000 acre-feet.

Also during these months, BOR projects upstream begin releasing 427,000 acre-feet of water to increase Snake River flows in an effort to meet the Lower Granite Dam flow objectives. Because BOR cannot release all of that water within the augmentation period, some of the federal water doesn't reach Lower Granite Dam during the flow augmentation period specified in the RPA. So, during July and August, IPC shapes (or prereleases) water from Brownlee Reservoir and later refills the drafted reservoir space with water released by the BOR from the upper Snake River reservoirs. In a typical year, Brownlee Reservoir shapes approximately 130,000 acre-feet of BOR water. The volume of water shaped fluctuates depending on the type of water year the Snake River Basin is experiencing.

As mentioned earlier, the BPA agreed to an energy exchange with IPC for IPC's cooperation with the flow augmentation RPA. Under this agreement, BPA reimbursed IPC for energy losses resulting from shaping BOR water and contributing water from Brownlee Reservoir. Again, that agreement was not renewed by BPA after it expired in April 2001.

Historically, there were some years when weather, stream flow, and power demands required further drafting of Brownlee Reservoir.

Fall—September through November

During the fall, Brownlee Reservoir is operated largely to benefit fall chinook below the HCC. After the delivery of flow augmentation water, Brownlee Reservoir releases are managed to maintain a constant flow below Hells Canyon Dam to provide stable conditions for spawning fall chinook. The spawning flow is based upon a minimum reservoir elevation of approximately 2,040 ft msl when the program starts in October, and forecasted inflows such that Brownlee Reservoir is full, around elevation 2,075 ft msl, by the first week in December. The minimum flow below Hells Canyon Dam is maintained through fry emergence in the spring and established by maintaining water over the shallow-most redd. Once this flow is set, it is considered the minimum flow necessary to keep embryos from desiccating until they emerge as fry in the spring. In other words, the spawning flow is maintained as a minimum flow until emergence is complete. It should also be pointed out that the lower the reservoir elevation in Brownlee Reservoir, the lower the power production capability of the plant. This situation, in turn, may require IPC to purchase power from other sources if the load demand cannot be met due to the loss in net head at the reservoir.

3.2.3. Operational Scenarios Conducted for Relicensing

IPC operates the complex to comply with the FERC license, as well as to accommodate other concerns, such as recreational use, environmental conditions and voluntary arrangements. Among these arrangements are the 1980 *Hells Canyon Settlement Agreement*, the *Idaho Power Fall Chinook Interim Recovery Plan and Study* adopted in 1991, and, between 1995 and 2001, the cooperative arrangement that IPC had with federal interests in implementing portions of the Federal Columbia River Power System (FCRPS) biological opinion flow augmentation, which is intended to avoid jeopardy of the FCRPS operations below the HCC. *Proposed Operations* for the HCC provide for flood control in the spring, water releases for fall chinook, and other constraints to operations, such as reservoir fluctuation limits.

Operational analyses use *Proposed Operations* of the HCC as the base case scenario, which defines the operational parameters under which the complex would typically operate. Varying hydrologic conditions and numerous other factors influence the way hydropower projects operate. Daily operations are influenced by many factors, which may include project inflow, energy demand, market conditions, or emergency situations and are difficult to predict on a long-term basis with any certainty. Therefore, for the purposes of the relicensing studies, O*perations* is defined in general terms. In addition, IPC's definition of *Proposed Operations* looks forward into the new license term and provides a general point of comparison for other potential operating scenarios. It is important to note that, if the output of IPC's operations model were compared with historical conditions, differences would be apparent. Therefore, the output should not be compared with past conditions.

In order to capture the types of hydrology entering the project, *Proposed Operations* have also been defined in terms of low-, medium-, and high-water years. These distinctions are made to reflect variations in operations based on inflowing water conditions.

Parameters of *Proposed Operations* for the HCC differ considerably from the operating parameters of the original license. The reason for these differences is that over time energy and environmental conditions have altered how the HCC is operated. For example, when fall chinook salmon were designated as threatened under the Endangered Species Act, IPC modified its operations. In the fall of 1991, IPC started a program to protect spawning adults and emerging fry. IPC's *Proposed Operations* continue this special program.

Full Pool Run-of-River is the operational scenario IPC will compare with the base case scenario (*Proposed Operations*) to determine project impacts. *Run-of-River Operations* establishes a scenario where inflows to the HCC, as well as tributary inflows, equal outflows from the HCC. This scenario does not necessarily reflect conditions that would be most beneficial to environmental resources. Rather, it reflects a condition in which IPC could analyze impacts with the project in place but without project operations influencing the outflow hydrograph.
A complete description of input parameters for each scenario of the operations model is presented in Parkinson (2002).

4. METHODS

For analyzing operational impacts of the HCC on wildlife habitat, we spatially stratified the study area into three operational zones: 1) reservoir fluctuation zone, 2) reservoir shoreline zone, and 3) river shoreline zone (i.e., below Hells Canyon Dam). we further stratified the fluctuation and shoreline zones by reservoir, because each reservoir had unique operational constraints and habitat patterns. Thus, we estimated influences of the two operational scenarios relative to current habitat conditions (i.e., current conditions) within three reservoir fluctuation zones, three reservoir shoreline zones, and one river shoreline zone.

Holmstead (2001) described the current extent and distribution of vegetation cover types (i.e., wildlife habitat) and the botanical characteristics of each. we assumed that *Historical Operations* (1958−1999) determined the extent and characteristics of the current conditions of vegetation within fluctuation and shorelines zones. In the following sections, we describe methods for projecting future changes in the extent and value of wildlife habitat from current conditions under *Proposed Operations* and *Run-of-River Operations* and for comparing resulting habitat differences between these two operational scenarios.

4.1. Reservoir Fluctuation Zones

A reservoir fluctuation zone was defined as the maximum area of land that could be seasonally exposed during operational drafting. Historically, maximum seasonal drafting was 101 vertical ft for Brownlee Reservoir and 10 vertical ft for Hells Canyon and Oxbow reservoirs. *Proposed Operations* have the same maximum drafting depth of 101 ft for Brownlee Reservoir but only 5 ft for Oxbow and Hells Canyon reservoirs. *Run-of-River Operations* would maintain the 3 reservoirs at full-pool elevations yearlong. Parkinson (2002) provides a detailed description of operational constraints for the HCC reservoirs.

Seasonal and daily water-level changes inundated areas of each reservoir's fluctuation zone for various periods, which eliminated vegetation that historically provided riparian and upland wildlife habitats. To identify impacts to wildlife habitat within each reservoirs' fluctuation zone, IPC used GIS to estimate the maximum acreage of land where habitat was precluded from establishing during *Historical Operations*. IPC then qualitatively determined if the acreage of habitat annually precluded within the historical fluctuation zone would change under *Proposed Operations* and *Run-of-River Operations*.

Using a series of assumptions about the spatial characteristics of the reservoir fluctuation zones and botanical data from Holmstead (2001), IPC also estimated the relative proportions of riparian and upland habitat that were theoretically precluded in the fluctuation zones during *Historical Operations*. Assumptions were developed during consultation with the Terrestrial Resource Workgroup and are presented in the document titled "Hells Canyon Complex Draft Impact Statements: Terrestrial Resource Workgroup" and dated 1 February 2001. The document is part of the meeting notes for the Terrestrial Resource Workgroup meeting on 7 February 2001. Essentially, it was assumed that, on average, approximately 6% of the reservoir fluctuation zones would have theoretically supported riparian habitat.

4.2. Reservoir Shoreline Zones

4.2.1. Shoreline Zone Projections

IPC projected the future extent of vegetation cover types that would be expected to occur within the reservoir shoreline zones. IPC defined the reservoir shoreline zone to extend 50 m planimetrically upslope from reservoir full-pool shorelines (i.e., Brownlee Reservoir = 2,077 ft above msl, Oxbow Reservoir = 1,805 ft above msl, and Hells Canyon Reservoir = 1,688 ft above msl). Projections were conducted separately for the shoreline zone of each reservoir because of reservoir-specific operational constraints of *Historical Operations* and *Proposed Operations* and unique assemblages of shoreline cover types.

The distribution of vegetation along reservoir shorelines is influenced by 1) substrate characteristics, 2) the timing and magnitude of changes in water-surface elevations, 3) soil-moisture gradients, and 4) other environmental factors. For projections, however, IPC assumed that the pattern of reservoir water-surface elevation (i.e., reservoir operations) was a primary factor determining the extent of shoreline habitat (i.e., vegetation cover types). Starting from current conditions, IPC projected future habitat conditions in the reservoir shorelines zones for each operational scenario. If constraints of an operational scenario significantly differed from *Historical Operations*, projected changes in the extent of shoreline cover types were expected. Conversely, if reservoir operations of a scenario were similar to *Historical Operations,* changes in the extent of cover types were not expected.

Implementation of an operational scenario was assumed to affect current conditions into the future over 30 years. Thirty years was assumed to represent the next license period for the HCC. A 30-year projection period also permits a reasonable length of time over which vegetation would respond to an operational scenario. However, the rate at which current conditions change would vary depending on vegetation life form (i.e., cover type). Thus, projections of habitat change were reported at year 30, when it was assumed that all habitat changes would be complete. Reach-specific methods for simulating cover type changes in the reservoir shoreline zones from current conditions for the two operational scenarios are described in the following sections.

4.2.2. Oxbow and Hells Canyon Reservoirs

Oxbow and Hells Canyon are re-regulating reservoirs that historically experienced relatively small but regular changes in water-surface elevations. Under *Historical Operations*, Oxbow Reservoir typically fluctuated daily within 5.6 ft of full pool (1,805 ft), and Hells Canyon Reservoir typically fluctuated within 3.8 ft of full pool (1,688 ft) (Parkinson 2002). The relatively stable water levels on both Oxbow and Hells Canyon reservoirs historically enhanced the establishment of riparian habitat in the shoreline zones (Holmstead 2001, Braatne et al. 2002). Where suitable substrate and topography occurred, a relatively wide band of riparian habitat was promoted by small daily and regular water-surface fluctuations that irrigated riparian vegetation during the growing season (Braatne et al. 2002, Blair et al. 2001).

Proposed Operations for these reservoirs are very similar to *Historical Operations*, except that maximum drafting of Oxbow and Hells Canyon reservoirs would be limited to 5 vertical ft (Parkinson 2002). Hence, small and regular changes in water-surface elevations under *Proposed Operations* would likely provide shoreline soil moisture similar to that of *Historical Operations*. *Run-of-River Operations* would maintain the water-surface elevation of the reservoirs at full pool yearlong. Because water levels of both Oxbow and Hells Canyon reservoirs returned to nearly full pool each day under *Historical Operations*, we expect that *Historical Operations* also influenced shoreline soil moisture similar to what would be expected of *Run-of-River Operations*. Therefore, we assumed that neither *Proposed Operations* nor *Run-of-River Operations* would alter the relative composition of riparian and upland cover types from current conditions within shoreline zones of Oxbow and Hells Canyon reservoirs.

4.2.3. Brownlee Reservoir

Under *Proposed Operations*, Brownlee Reservoir would be operated similar to *Historical Operations,* which included large-scale seasonal drafting (Parkinson 2002). Historically, drafting of Brownlee Reservoir during the growing season limited riparian vegetation because soil moisture in the shoreline zone was insufficient. Although drafting of Brownlee Reservoir has historically varied within and among years, relatively large seasonal fluctuations were historically common and rarely extended to 101 vertical feet below the full-pool elevation (2,077 ft) for flood-control during years with a large spring runoff. Because *Proposed Operations* would draft Brownlee Reservoir similar to *Historical Operations*, we assumed that *Proposed Operations* would maintain current conditions in the shoreline zone of Brownlee Reservoir, which is dominated by upland vegetation.

Differing substantially from both *Historical Operations* and *Proposed Operations*, *Run-of-River Operations* would maintain the water-surface elevation of Brownlee Reservoirs at full pool yearlong. The reservoir would wet the lower portion of the shoreline zone yearlong and would promote the future conversion of upland cover types to riparian cover types. Therefore, a portion of the upland cover types that currently occupy the shoreline zone of Brownlee Reservoir would likely convert to riparian cover types under *Run-of-River Operations*. However, the amount of upland habitat that is converted to riparian habitat would depend on shoreline topography and substrates (i.e., geomorphology). Because the shoreline geomorphology varies and would affect the type and extent of riparian habitat, we further stratified the shoreline zone of Brownlee Reservoir into 3 reaches: Headwaters Reach, Powder River Pool, and Lower Brownlee. We also characterized habitat conditions immediately upstream of Brownlee Reservoir (i.e., Weiser Reach), because cover-type changes in the Headwaters Reach would likely be influenced by upstream habitat conditions. Braatne et al. (2002) further characterized the Brownlee Reservoir reaches.

Using a set of reach-specific assumptions about relationships between shoreline geomorphology and the current extent of riparian vegetation along Brownlee Reservoir, IPC projected the expected extent of upland and riparian cover types under *Run-of-River Operations*. Assumptions were relatively liberal for estimating the amount of riparian habitat that might develop under *Run-of-River Operations*, resulting in possible overestimates of riparian habitat compared to current conditions. Furthermore, riparian habitat would only develop where suitable soil substrate is present and disturbance factors (e.g., grazing and development) are limited, which is not considered in projections.

Because hydrologic conditions supporting riparian habitat would be enhanced relative to current conditions, riparian cover types in the shoreline zone were projected to either be static or increase under *Run-of-River Operations*. Projections in the conversion of upland habitats to riparian habitats were conducted for each reach, but did not provide specific locations for habitat conversions within a reach. Therefore, it was assumed that the relative size, number, and juxtaposition of projected future riparian cover type polygons would be similar to patterns currently observed in each of the 3 reaches. Applying the methods described here and below resulted in projections in the extent of riparian cover types that would be expected in the shoreline zones of Brownlee Reservoir under *Run-of-River Operations*.

Weiser Reach—*Historical Operations* did not nor would either operational scenario affect flows in the Snake River in the Weiser Reach upstream of Brownlee Reservoir. Hence, riparian habitat in this reach developed in response to long-term flows in the Snake River that are governed by snow pack and upstream water management. Some variation in vegetation would be expected from year to year in response to short-term wet and dry precipitation cycles. However, under these conditions, riparian habitat is typically maintained in a state of dynamic equilibrium. In the absence of extended climate change, long-term vegetation patterns would not be projected to change substantially over time. Therefore, it was assumed that the current extent and distribution of riparian cover types would continue in the future under both operational scenarios (Holmstead 2001, Braatne et al. 2002).

Headwaters Reach**—**Shoreline topography of the Headwaters Reach is generally steeper than the Weiser Reach but flatter than that of Lower Brownlee and Oxbow Reservoir. Based on soil capillary action, flatter slopes would be projected to support a wider band of riparian habitat than steeper slopes. The current extent of shoreline cover types along the Weiser Reach and Oxbow Reservoir were not projected to change under either *Run-of-River Operations* or *Proposed Operations*. Therefore, under *Run-of-River Operations* we expect that the extent of riparian habitat in the Headwaters Reach would be somewhat intermediated between that in the Weiser Reach and Oxbow Reservoir.

The IPC cover-type maps for Oxbow Reservoir and the Weiser Reach were used to project the future extent and relative abundance of riparian cover types in the shoreline zone of the Headwaters Reach. To reflect the topographical differences, proportions of cover types for Oxbow Reservoir were averaged with the Weiser Reach. These average proportions for each cover type were applied to the shoreline zone of the Headwaters Reach to project the future area of each riparian cover type expected under *Run-of-River Operations*. This approach likely resulted in an overestimate of riparian habitat because of the presence of Highway 201 on the Oregon side of the reservoir and the railroad on the Idaho side. These transportation corridors would limit the up-slope area available to be occupied by riparian habitat in the shoreline zone.

Powder River Pool—The topography of the Powder River Pool is much flatter than either Lower Brownlee or the Headwaters Reach. Riparian cover types currently occupy 38% (i.e., 57 acres) of the approximately 150 acres of the shoreline zone in the Powder River Pool. An additional 17% of the 150 acres is used for agriculture, industry, parks, and roads, and would not be converted to riparian habitat under *Run-of-River Operations*. Therefore, the remaining 45% of the shoreline zone could potentially convert to riparian cover types under *Run-of-River Operations*. However, Braatne et al. (2002) estimated that only about 75% of the shoreline zone of the Powder River Pool shoreline zone would support perennial riparian habitat under *Run-of-River Operations*. Thus, we estimated that an additional 75% of the shoreline zone capable of supporting riparian habitat would be converted to (0.75 x 0.4485 x 148.828 acres = 50.06 acres) riparian cover types under *Run-of-River Operations*. We assumed that the relative proportions of additional riparian cover types would be the same as currently available.

***Lower Brownlee*—**Because of similar topographies, the extent and relative abundance of riparian cover types along Lower Brownlee is projected to resemble the current conditions of Oxbow Reservoir shoreline zone under *Run-of-River Operations* (Braatne et al. 2002). Therefore, the IPC cover type map for Oxbow Reservoir was used to project the future extent and relative abundance of riparian cover types in the shoreline zone of Lower Brownlee. Proportions of riparian cover types within the shoreline zone of Oxbow Reservoir were measured and then applied to the shoreline zone of Lower Brownlee to project the future area of each riparian cover type under *Run-of-River Operations*.

4.3. River Shoreline Zones

The two operational scenarios would have different effects on daily flows during the growing season downstream of Hells Canyon Dam. *Proposed Operations* would include daily fluctuations for load following and a general augmentation of natural flows as Brownlee Reservoir is lowered through the summer. Neither of these effects would occur under *Run-of-River Operations*. For each operational scenario, IPC estimated the quantity of riparian habitat adjacent to the Snake River downstream of Hells Canyon Dam (i.e., Hells Canyon Dam to Snake and Salmon river confluence). Effects of the two operational scenarios on future habitat availability were determined from projected future changes in current conditions (Holmstead 2001).

For simulating changes in the extent of wildlife habitat (i.e., vegetation cover types) for each operational scenario, IPC quantified the following:

- Dimensions and boundaries of the evaluation area (i.e., river shoreline zone)
- Hydrologic characteristics of *Historical Operations* and the two operational scenarios
- Composition and extent of cover types currently present within the evaluation area (i.e., current conditions)
- Relationships between historical hydrology (i.e., discharge-stage-inundation) and the current extent of vegetation cover types
- Projected changes in the acreage of vegetation cover types for the two operational scenarios

These analyses are described in the following sections.

4.3.1. Shoreline Zone Boundaries

The longitudinal (i.e., north to south) boundaries of the evaluation area were the tailrace of Hells Canyon Dam (RM 247.7) and the Snake and Salmon river confluence (RM 188.3). IPC used vegetation data collected by Braatne et al. (2002) and shoreline geometry and stage-discharge relationships described by Parkinson (2002) to define the lateral (i.e., east and west) boundaries of the evaluation area. Braatne et al. (2002) estimated that the river shoreline formed by a constant flow of 20,695 cfs was related to the lowest extent of perennial woody riparian vegetation along the Snake River below Hells Canyon Dam. Furthermore, the riparian zone extended to an 11-m vertical elevation above the water-surface elevation formed by the 20,695 cfs flow (Braatne et al. 2002). Using shoreline geometry and stage-discharge relationships, IPC used a GIS to map the lateral boundaries along the shoreline elevation contour (i.e., polygon) that was on average 11 m vertically higher than the 20,600 cfs water-surface elevation. The resulting evaluation area was approximately 59.4 RM long by an average of 145 m (478 ft) wide (including the river channel and both shoreline areas) and encompassed 1,374 ha (3,435 acres).

4.3.2. Historical and Scenario Hydrology

Flow-Stage-Inundation—Channel geometry determines river stage for a given water flow, and river stage defines the physical inundation of an area. Thus, the flow-stage-inundation relationship determines the physical process by which hydroelectric operations can directly manipulate river flows that directly (e.g., scour) and indirectly (e.g., shoreline soil moisture) interact with the shoreline vegetation. When projected into the future, the two scenarios represent operational constraints that would influence river flows and potential changes in the extent of vegetation cover types from current conditions. IPC assumed that the current conditions of cover types reported by Holmstead (2001) have resulted from flow-stage-inundation relationships of *Historical Operations*, starting when Brownlee Dam was completed in 1958 and continuing through 1999. *Historical Operations* was characterized on average by relatively large changes in water-surface elevation and stage change during summer because of load following (Parkinson 2002). *Proposed Operations* also specifies load following, but simulated daily maximum flows are constrained to be lower than *Historical Operations*. *Run-of-River Operations* has no load following, so simulated daily flows from Hells Canyon Dam reflect projected daily inflows to the HCC.

Flows—Modeling river stage and then channel inundation required estimating a characteristic (i.e., long-term average) Snake River flow for *Historical Operations* and the two scenarios. IPC used the average daily-maximum flow during summer (i.e., evaluation period: 1 July to 31 August) for estimating characteristic flows. IPC used historical discharges from Hells Canyon Dam measured in 15-minute time intervals (published IPC and USGS data) to calculate maximum-daily flows, which reflected summer load following on the Snake River. The daily-maximum flow represented the full extent that operations interacted with shoreline vegetation during the seasonal evaluation period. The evaluation period was defined to encompass the portion of the growing season that was most influenced by daily load-following patterns for

Historical Operations and *Proposed Operations*. The Run-of-River Scenario has no load-following provisions (Parkinson 2002).

Historical Operations—IPC characterized patterns typical of high, medium, and low runoff years for the Snake River (1997 = high, 1995 = medium, and 1992 = low; Parkinson 2002). IPC calculated the average maximum-daily flow for each of the 3 years. IPC then calculated a weighted average for the 3 years, based on the proportions that the three types of runoff years occurred over the period 1958 to 1999 (high = 17% of years >20 million acre-feet annual runoff, medium = 31% of years between 14 and 20 million acre-feet, and low = 52% of years <14 million acre-feet; Table 1). Weighting was required because 15-minute data were not available for the entire 42-year period of record.

To incorporate additional inflows and backwater effects from tributaries to the Snake River, IPC added average daily flows for the Imnaha and Salmon rivers, respectively, when estimating characteristic flows for *Historical Operations*. Daily flows vary relatively little on the Salmon and Imnaha, because these rivers are unimpounded. Therefore, IPC calculated unweighted average daily flows for the Salmon and Imnaha rivers for the period July 1 through August 31 from1958 to 1999 (Table 2). IPC assumed that the set of characteristic flows (i.e., Snake, Salmon, and Imnaha river flows) for *Historical Operations* represent the long-term average of maximum-daily flows that is associated with current shoreline cover type conditions along the Snake River downstream of Hells Canyon Dam.

Operational Scenarios—Parkinson (2002) described how 15-minute flow data were modeled and simulated for the two operational scenarios. Using these simulated data, IPC used the same approach as outlined for *Historical Operations* to estimate characteristic flows for each of the two future operational scenarios for the high, medium, and low runoff years. Weighting was done similar to that for *Historical Operations,* except that proportions of the three runoff years differed (i.e., high = 11% of years >20 million acre-feet annual runoff; medium = 31% of years between 14 and 20 million acre-feet; and low = 58% of years <14 million acre-feet), because the entire period of record was used (1928 to 1999; Table 1). IPC assumed the entire period of record was more likely to represent the projected distribution of runoff years in the future than the period used for *Historical Operations* (1958 to 1999). As with *Historical Operations*, IPC also added average daily flows for the Imnaha and Salmon rivers when estimating characteristic flows for the two scenarios, based on the entire period of record (1928 to 1999; Table 2). IPC assumed that scenario-specific characteristic flows would determine projected changes from the current cover type map into a future, hypothesized extent of shoreline cover types.

***Stage and Channel Inundation*—**The MIKE 11® one-dimensional hydrologic model was used to translate characteristic flows for *Historical Operations* and the two operational scenarios into estimates of cross-sectional stage for the Snake River from Hells Canyon Dam to the Salmon River confluence. Water surface elevations of *Historical Operations* and the two scenarios were then mapped with Mike11-GIS and converted into three inundation maps of the river channel. Using GIS, IPC calculated the planimetric area of the water surface within the evaluation area (i.e., inundation polygon) for each of the three inundation maps.

4.3.3. Hydrology and Cover Type Map Relationships

Complex relationships exist among the distribution of vegetation along river shorelines, soil moisture gradients, river flow and stage, and other environmental factors. Johnson et al. (1995) and Dixon and Johnson (1999) reported that the riparian vegetation along middle reaches of the Snake River spanned an elevational gradient above the river shoreline. Simulation models demonstrated that river water-surface elevation could significantly influence shoreline soil moisture. Soil moisture dynamics of shorelines is a primary determinant of riparian vegetation. Hence, factors affecting river stage (e.g., hydroelectric operations) could correspondingly affect shoreline soil moisture gradients and the associated riparian vegetation. For example, Johnson et al. (1995) projected that lower water flows (i.e., lower water-surface elevations) in the Snake River would likely reduce soil moisture at the upper extent of shoreline slopes and cause a concomitant downward contraction in the riparian vegetation.

Daily fluctuations in flow volumes—and thereby river stage—from hydroelectric load following operations occurred during 1958−1999 in the Snake River downstream of Hells Canyon Dam (Parkinson 2002). The daily and seasonal storage capabilities of the HCC have permitted short-term deviations between flows entering and exiting the HCC (i.e., flow/stage fluctuations for load following). During summer, daily to weekly river water-level fluctuations in Hells Canyon have been described as an irrigation effect and hypothesized to benefit riparian vegetation (Holmstead 2001, Braatne et al. 2002).

The irrigation effect downstream of Hells Canyon Dam is essentially a short-term elevation of the average summer base flows in the Snake River, which likely influences the extent of soil moisture up the shoreline slopes. Correspondingly, the irrigation effect has most likely contributed to increases observed in the upslope extent and robustness of the riparian vegetation (especially hackberry) that fringes the river downstream of Hells Canyon Dam (Blair et al. 2001, Braatne et al. 2002). Furthermore, the development of storage reservoirs on the Snake River upstream of Hells Canyon Dam has caused a decline in the intensity and duration of large scouring flows in Hells Canyon during runoff periods. Reduced scouring has encouraged the downslope extension of hackberry via root suckering (Braatne et al. 2002). Nonetheless, periodically large scouring flows likely limit the lower extent of permanent vegetation on the shoreline slope (Holmstead 2001, Braatne et al. 2002).

Considering concepts of Johnson et al. (1995) and observations in Hells Canyon (i.e., the irrigation effect and scour) by Braatne et al. (2002) and Blair et al. (2001), IPC constructed a conceptual model for projecting hypothesized cover type changes associated with river stage changes during summer. The model centered on the empirical relationship between the summer hydrology of *Historical Operations* and the current cover type map (i.e., current conditions; Holmstead 2001). A measured relationship between river flow-stage-inundation and the extent of riparian cover types indirectly captures the relationship between river stage and the shoreline moisture gradient supporting riparian vegetation. The model empirically relates channel inundation characteristics of *Historical Operations* to the upslope extent of riparian vegetation along the Snake River. The lowest extent of vegetation cover types on the shoreline slope is determined by river scour during high runoff flows. Therefore, IPC assumed the lowest extent of vegetation would not change from current conditions compared to scenario projections.

For evaluating the effect of a hypothesized operational scenario, the model proportionally extrapolates the measured relationship between channel inundation of *Historical Operations* and the current cover type map. Using estimated changes in inundation area between *Historical Operations* and a future operational scenario, the model specifically projects changes in the extent of cover types from current conditions to a simulated future condition. Using this model, IPC projected proportional cover type changes into the future for simulated hydrologic characteristics of the two scenarios.

4.3.4. Current and Scenario-Induced Cover Type Compositions

Using a GIS and the cover type map developed by Holmstead (2001), IPC estimated the current extent (i.e., current conditions) of vegetation cover types within the evaluation area. The planimetric area of each cover type was calculated by overlaying the polygon defining the evaluation area boundaries on the cover type map. All cover types falling within the evaluation area polygon were identified; acreages and proportions of each cover type were calculated.

In response to a changing flow regime in the Snake River, Dixon and Johnson (1999) and Braatne et al. (2002) proposed that the upslope boundaries of established riparian vegetation would change where the shoreline moisture gradient responds to river stage. IPC projected proportional changes in the current extent of cover types relative to differences in area inundated (i.e., irrigation effect) between *Historical Operations* and the characteristic flow of an operational scenario. To estimate differences in area inundated, the inundation polygons of each scenario were overlaid with the GIS on the current-condition cover type map. The amount of area inundated within the evaluation area by each scenario was then calculated with the GIS. The proportional change in the area inundated was projected and calculated between *Historical* and *Proposed Operations*, and *Historical* and *Run-of-River Operations*. IPC assumed that the proportional change in area inundated between *Historical Operations* and a scenario would have a corresponding proportional change in the irrigation effect, which would in turn have a proportional effect on the upslope extent of a soil moisture gradient.

Projections of cover type changes corresponded to the assumed shoreline moisture gradient. Conceptually, vegetation cover types along the Snake River shoreline are distributed in distinct elevation bands that correspond to the moisture gradient. Soil moisture typically decreases with increasing distance from the river. The following represents the general progression of cover types upslope from the river and the projected progression of cover type change resulting from shoreline moisture changes: 1) *Shore and Bottomland Wetland* (largely unvegetated cobble shoreline that is seasonally inundated and scoured by the river); 2) *Emergent Herbaceous Wetland*; 3) *Scrub-Shrub Wetland*; 4) *Forested Wetland*, 5) *Shrubland*; 6) *Shrub-Savanna*; and 7) *Grassland* (Johnson et al. 1995, Dixon and Johnson 1999, Holmstead 2001, Braatne et al. 2002). The primary exception is that IPC assumed *Forested Wetland* and *Scrub-Shrub Wetland* present under current conditions would both transition to upland *Shrubland* with long-term soil moisture decreases associated with lower scenario flows. The steep gradient of the slopes downstream of Hells Canyon Dam, coupled with the general absence of *Forested Wetlands,* except at the mouths of tributaries, suggested that a drying of the *Scrub-Shrub Wetland* vegetation under these conditions would result in conversion to *Shrubland*.

For example, if *Historical Operations* inundated 100 acres of the evaluation area and *Proposed Operations* would inundate 90 acres, then the shoreline irrigation effect would be decreased by 10%. The decreased irrigation effect would also result in decreased soil moisture at the upper extent of the shoreline slope. Correspondingly, projected cover type changes for *Proposed Operations* would be a 10% increase in the unvegetated shoreline (i.e., *Shore and Bottomland Wetland*), a 10% decrease in the extent of vegetated riparian cover types, and a 10% increase in upland cover types within the river shoreline zones. Upland vegetation would develop in areas no longer able to support riparian vegetation. Finally, it should be noted that the *Shore and Bottomland Wetland* cover type is primarily unvegetated and is situated in the river's scour zone. Following Cowardin et al. (1979), *Shore and Bottomland Wetland* may be better characterized as *Rock Bottom* (i.e., all wetlands and deepwater habitats with substrates having an areal cover of stones, boulders, or bedrock 75% or greater and vegetative cover of less than 30%). *Rock Bottom* typically has little or no habitat value to terrestrial wildlife.

4.4. Wildlife Habitat Value

The WHA team used essentially the same approach for evaluating current and future wildlife habitat value as the U.S. Fish and Wildlife Service's (USFWS) Habitat Evaluation Procedure (HEP), which rates the quantity and quality of habitat for wildlife species. HEP was developed to quantify impacts of habitat change from land and water development or new management actions. It can also be used to document baseline habitat conditions as a gauge for future habitat modification. HEP and its uses are described in USFWS (1980) and Stiehl (1993). The primary difference of this study from the HEP approach is that the WHA team selected evaluation species to focus more on habitat (i.e., cover types) than on the species themselves. In other words, Habitat Suitability Index (HSI) models for the evaluation species are used to assess current and future habitat value as measured by Habitat Units (HUs), rather than simple effects on the evaluation species.

The WHA team accomplished many of the same tasks typical of a traditional HEP study, including:

- Select appropriate evaluation species
- Determine future actions (i.e., operational scenarios)
- Specify modeling assumptions
- Calculate HUs for current conditions
- Calculate HUs and Average Annualized Habitat Units (AAHU) for future conditions
- Compare alternative scenarios (i.e., *Proposed Operations* and *Run-of-River Operations*)

4.4.1. Selecting Evaluation Species

Results of the traditional HEP process for selecting evaluation species are typically twofold. First, HEP focuses on wildlife species rather than on habitat, which often causes the habitat component to become lost. For the WHA study, variables within the evaluation species models were used to measure habitat condition and value, because the study focus was on effects to both species and cover types. Hence, we estimated existing HUs and future AAHUs for both cover types and evaluation species. Second, HEP can have low sensitivity to subtle changes in vegetation condition that may result from changes in land or water management activities. Therefore, the WHA team selected evaluation species with HSI models that would likely respond to alternative operational scenarios. That is, relatively minor habitat changes would likely be reflected in modeled results.

The WHA team prioritized the importance of riparian habitats (i.e., *Emergent Herbaceous Wetland*, *Scrub-Shrub Wetland*, and *Forested Wetland*), which are limited in Hells Canyon. Furthermore, the WHA team determined that hydroelectric operations would most likely impact riparian cover types within shoreline zones. Thus, the conversion of upland cover types to riparian cover types would generally be preferred to increase wildlife value habitat within shoreline zones. The WHA team assessed HSI models for 33 upland, wetland, and riparian species (Table 3). Of the 33 models, only 16 models, which contained 31 individual habitat variables, were appropriate for evaluating riparian cover types.

The list of 16 models was further refined through the development of selection criteria for important components of riparian cover types. The WHA team primarily attempted to identify models with variables that would indicate changing habitat values relative to effects of operational scenarios. Criteria for selecting an evaluation species/model included:

- Sensitivity to relatively minor changes in habitat conditions
- Riparian habitat specialists
- Single cover-type specialists
- Variables not redundant among models
- Specific wetland and riparian habitat variables
- Applicability to species for which models are unavailable
- Species of interest by WHA team members

To further assist in selecting evaluation species and models, the WHA team discussed general and specific habitat components of riparian cover types that are important to wildlife and might be affected by HCC operational scenarios. These components were then compared to the specific HSI model variables to determine which models would best measure these components. Components or measures of riparian cover types that might be expected to change relative to operational scenarios included:

- Available area of a cover type
- Vegetation cover values in different strata
- Vegetation height in different strata
- Presence and characteristics of snags
- Type of emergent herbaceous vegetation
- Water depth under vegetation
- Water level fluctuation
- Near-shore vegetative cover values
- Density of streamside cover
- Distance to cover from variable shorelines
- Growth form of emergent hydrophytes
- Mean height of deciduous shrub canopy
- Mean height of herbaceous canopy
- Mean height of overstory trees
- Mean water depth under emergent vegetation during spring
- Number of snags
- Percent canopy cover of emergent herbaceous vegetation
- Percent canopy cover of herbs
- Percent canopy cover of shrubs and trees
- Percent deciduous shrub crown cover
- Percent of shrub canopy comprised of hydrophytic shrubs

After considering the evaluation criteria and important habitat components, 8 evaluation species were ultimately selected by the WHA team (Table 4). Evaluation species were the 1) yellow-headed blackbird (*Xanthocephalus xanthocephalus*), 2) yellow warbler (*Dendroica petechia*), 3) marsh wren (*Cistothorus palustris*), 4) song sparrow (*Melospiza melodia*), 5) black-capped chickadee (*Poecile atricapillus*), 6) mallard (*Anas platyrhynchos*), 7) river otter (*Lutra canadensis*), and 8) mink (*Mustela vison*). Table 4 lists Suitability Index (SI) variables of each species model. Model structure and variables for each evaluation species model are briefly reviewed in Appendix B. Methods used and assumptions made during application of the model to the HCC study area are also described in Appendix B.

4.4.2. Operational Scenarios

The current condition of wildlife habitat is assumed to have developed under *Historical Operations*, and current conditions, as described by Holmstead's (2001) cover-type map, formed the basis for projecting future habitat conditions expected under the two operational scenarios: *Proposed Operations* and *Run-of-River Operations*. Changes in shoreline soil hydrodynamics from implementation of new HCC operations could cause changes in botanical processes within shoreline zones that would result in the conversion of cover types (e.g., a polygon of *Grassland* converted to *Scrub-Shrub Wetland*). When an area was projected to convert to a new cover type, we assumed that vegetation would mature and at year 30 would have structural and floristic characteristics typical of the cover type within the same reach under current conditions. That is, only the relative extent of cover types within a reach was projected to change under an operational scenario, not the botanical characteristics defining a cover type. Therefore, we applied structural vegetation measurements from Holmstead (2001), as stratified by river and reservoir shoreline zone, to HSI models when estimating current and future habitat values within a cover type. Furthermore, we were unable to project the future spatial arrangement of individual cover type polygons. Therefore, we assumed the relative size, number, and juxtaposition of projected riparian cover type polygons would be similar to the patterns currently observed in each of the river and reservoir shoreline zones.

4.4.3. Habitat Value Assumptions

Mean Values—The large IPC data sets for each of the study reaches consist of a single set of pooled data collected within individual cover type polygons for each cover type (Holmstead 2001). These pooled data sets each represent hundreds of sample points. This large sample size suggests that the sample mean for any individual measured variable should be very close to the true mean for that variable. This basic statistical assumption applies to the WHA study. The data were reduced to sample means for each of the measured parameters within each cover type for each respective study reach. Sample means were used to calculate SI values unless the use of means was precluded for a variable-specific reason.

Weighted means were only used for multiple cover type variables or species. A multiple cover type species requires more than one cover type, and attributes of each cover type are evaluated as part of the model. Application of a model to evaluate more than one cover type does not constitute a multiple cover type species, and data for these cover types were not combined and weighted means were not calculated. One of the mink SI variables provides an example of a multiple cover type variable for which a weighted mean was calculated. This variable is the percent canopy cover of trees and shrubs within 100 m of a wetland's edge. To obtain this information, a weighted mean was calculated for all of the tree and shrub canopy cover data for each of the cover types present within this 100-m band.

Water Depths—IPC characterized hydrological patterns typical of years with high (1997) and low (1992) runoff in the Snake River Basin. Several HSI models assess habitat value based on distances between permanent water and desired shoreline cover types, or on the duration that water is present in the cover type during the growing season or throughout the year. Under *Proposed Operations,* these variables and the corresponding SI and HSI values vary between the high and low runoff years because of differences in Brownlee Reservoir operations. During low runoff years, Brownlee Reservoir would not be drafted as long or as deep as in years with high runoff. During high runoff years, flood control requirements would necessitate deeper and longer duration drafting (Parkinson 2002). Therefore, to present the full range of projected conditions under the *Proposed Operations*, SI and HSI values were determined for both high and low runoff years. Annual runoff conditions would not affect water-surface elevation of Brownlee Reservoir under *Run-of-River Operations*.

HSI variables that vary depending on Brownlee Reservoir water-surface elevation were calculated for the high runoff and low runoff years using average water surface elevation, or the 50% exceedence value on the modeled flow duration curves for those years (Parkinson 2002). This value represents the water surface elevation that is exceeded 50% of all days throughout each of the years. The 50% exceedence reservoir elevations for the high runoff and low runoff years, 2,074.8 and 2,055.1 ft, respectively, were used to calculate values for those model variables that evaluate yearlong habitat conditions. A second set of flow duration curves using only growing or breeding season (April through August) elevations were developed for the high and low runoff years to estimate growing or breeding season HSI model variable values. As above, the 50% exceedence water surface elevations for the growing season period of the high and low runoff years, 2,074.6 and 2,064.7 ft, respectively, were used to determine SI values during the growing season. This approach considers that when drafted, the habitat value of Brownlee Reservoir's shoreline zones would be degraded for species that require open water to be adjacent to riparian habitat. Under *Run-of-River Operations*, habitat value of the shoreline zone would be optimized for those species that require open water adjacent to riparian habitat.

Hackberry, Russian Olive, and Tamarisk Analyses—Hackberry occurs extensively throughout the study area in both upland and riparian settings. Its growth form varies considerably depending on age, fire history, and location relative to water during the growing season. It may occur as a small shrub suckering from a mature plant, as an intermediate to tall shrub, or as a small tree. For the purposes of this study, Cowardin et al. (1979) and the HSI models consider any woody plant <6 m tall to be a shrub. Hackberry plants <6 m tall occurring in *Emergent Herbaceous Wetlands*, *Scrub-Shrub Wetlands*, or *Forested Wetlands* were included in shrub measurements (e.g., average shrub height and shrub canopy cover). Hackberry plants >6 m tall were considered to be trees for HSI measurements. Similarly, Russian olives (*Elaeagnus angustifolia*) and tamarisk <6 m tall were considered to be shrubs, whereas those >6 m were considered to be trees.

The yellow warbler model includes the SI variable "percent of deciduous shrub canopy comprised of hydrophytic shrubs." Hackberry plants <6 m tall were included as hydrophytic shrubs in this analysis based on the following findings. The U.S. Army Corps of Engineers (1994) supplement to the national list of plant species that occur in wetlands (Northwest Region 9) assigns hackberry a facultative wetland indicator status (FAC or FACW*). The asterisk refers to a sub-region level. This appears to be in agreement with hackberry occurrence adjacent to the Snake River in the study area. Also, Turley and Holthuijzen (2000) found that both the song sparrow and yellow warbler had significant, positive associations with hackberry in the HCC study area. Therefore, hackberry plants <6 m tall were considered to be hydrophytic shrubs for this analysis. Regardless of size, neither Russian olive nor tamarisk was considered to be a hydrophytic shrub during the assessment of habitat value for the yellow warbler.

4.4.4. Analysis of Current Habitat Values

Current habitat values in the reservoir and river shoreline zones were estimated with the IPC cover type map and botanical data (Holmstead 2001). IPC summarized current acreages of each cover type present within individual reservoir and river shoreline zones. IPC then summarized botanical data (i.e., structural and floristic characteristics) for each cover type within individual river and reservoir shoreline zones and reaches of Brownlee Reservoir. Lastly, we applied these data to the HSI models for each evaluation species. Current habitat values formed the starting point for the analysis of future habitat values projected under the two operational scenarios. HSI, HU, and AAHU estimates are reported for each evaluation species and river and reservoir shoreline zone.

4.4.5. Analysis of Future Habitat Values

IPC botanical data describing current conditions of riparian cover types were also used for estimating future habitat value projected to occur under the two operational scenarios. An area with a current cover type could convert to a new cover type under a scenario projection. To estimate future habitat value for the evaluation species, analyses of temporal changes in habitat value of newly converted riparian cover types were conducted in several steps:

- Step 1: Current estimates of habitat values were used for initiating the projection of an operational scenario.
- Step 2: Reach-specific proportions of cover types were projected to change into the future in response to an operational scenario (see Sections 4.2.1 and 4.3.4).
- Step 3: The extent (i.e., habitat quantity) of cover types was estimated within each shoreline zone.
- Step 4: HSI values (i.e., habitat quality) of cover types were estimated for the evaluation species.
- Step 5: Projected future habitat value (i.e., habitat quality x habitat quantity) was estimated at 30 years for each evaluation species under each operational scenario.

Although vegetation changes causing a projected cover-type conversion would have specific life-form maturation rates, it was assumed that all vegetation maturation and projected cover-type conversions would be complete at projection year 30. The annual HU estimate for a species at year 30 was assumed to represent the AAHUs for each of the 30 years in the projection interval, and the total HU estimate was the summation of the AAHUs over the 30-year projection interval.

This approach overestimates total HUs, because projected changes in habitat value are assumed to occur during year 1 of the projection interval and remain changed during the entire projection interval. In reality, the floristic and structural characteristics of vegetation in an area would change gradually during a 30-year period as growing conditions would change under an operational scenario. Correspondingly, the relative extents of cover types would also change gradually as vegetation characteristics would change. Nonetheless, calculations of HUs and AAHUs are standardized between the two scenarios, and relative comparisons of operational scenarios remain valid even though absolute HU estimates are inflated.

The current condition of vegetation present in the reservoir and river shoreline zones has developed over a period of 40 or more years following construction of the HCC. Riparian habitat in portions of tributaries within shoreline zones has developed over an even longer period. Vegetation characteristics have also been influenced by land management activities (e.g., livestock grazing) and climatic conditions. For habitat projections, we assumed that historical patterns of land management and climate would not significantly change into the future. Therefore, IPC botanical data describing current conditions can reasonably be used for projecting future habitat conditions under an operational scenario.

The WHA approach for estimating wildlife habitat value assumes that current plant species and associations in each reach would be the same in the future. In the future, species composition by reach is likely to be similar as present because existing plants would provide propagules to colonize new areas through downstream drift or dispersal by wind or animals. However, this study is unable to evaluate how invasive plants or future land use changes may alter future habitat value.

5. Results and Discussion

5.1. Reservoir Fluctuation Zones

The HCC reservoirs inundated some of the lowest-elevation wildlife habitat in the region (Blair et al. 2001) and formed fluctuation zones where water levels were manipulated under *Historical Operations* (Parkinson 2002). During *Historical Operations*, water levels changed daily and seasonally. Brownlee Reservoir has been drafted by as much as 101 vertical ft below full pool. In contrast, Oxbow and Hells Canyon reservoirs are re-regulating reservoirs, where water levels fluctuated a maximum of 10 ft below full pool shorelines. Although some lands within the reservoir fluctuation zones were exposed for various periods during *Historical Operations*, perennial wildlife habitat was unable to develop because water levels returned to full pool shorelines at least annually. Thus, water-level fluctuations under *Historical Operations* continually precluded the establishment of low-elevation habitat in the reservoir fluctuation zones.

Proposed Operations would include daily and seasonal water-level fluctuations similar to what occurred historically, whereas *Run-of-River Operations* would maintain the 3 reservoirs at full-pool elevations yearlong. Nonetheless, reservoir fluctuation zones would be at least seasonally inundated with either *Proposed Operations* or *Run-of-River Operations*. Thus, the current preclusion of wildlife habitat (i.e., low-elevation habitat) in the fluctuation zones would persist into the future regardless of operational scenario. The seasonal and daily changes in reservoir water levels under *Proposed Operations* would also prevent riparian vegetation from establishing and persisting on tributary shorelines within the fluctuation zones. Upland vegetation would also be prevented from establishing elsewhere in the fluctuation zones. Estimated areas are 5,820 acres in the 101-ft fluctuation zone of Brownlee Reservoir, 89 acres in the 10-ft fluctuation zone of Oxbow Reservoir, and 240 acres in the 10-ft fluctuation zone of Hells Canyon Reservoir. *Proposed Operations* would theoretically continue to prevent the fluctuation zone of 1) Brownlee Reservoir from supporting 372 acres of riparian and 5,448 acres of upland habitats, 2) Oxbow Reservoir from supporting 7 acres of riparian and 82 acres of upland habitats, and 3) Hells Canyon Reservoir from supporting 9 acres of riparian and 231 acres of upland habitats.

5.2. Reservoir Shoreline Zones

The projected effects of *Proposed Operations* and *Run-of-River Operations* on the quantity and quality of riparian wildlife habitat were investigated within reservoir shoreline zones. Effects on the quality of habitat for 7 species were evaluated for riparian cover types, and effects on river otter habitat were assessed in all cover types within shoreline zones. Starting from current conditions, analyses projected acres of each cover type and HUs over the 30-year analysis period. Furthermore, a range of projected habitat conditions under *Proposed Operations* was evaluated for typical high and low runoff years. *Run-of-River Operations* would maintain a constant full pool for all reservoirs with system outflows equal to inflows regardless of runoff conditions. Results are presented as cover type acreages, HSI values, total HUs, and AAHUs for each evaluation species.

5.2.1. Projected Extent of Riparian Cover Types

Currently, shoreline zones for both Oxbow and Hells Canyon reservoirs contain most riparian cover types (*Forested Wetland*, *Scrub-Shrub Wetland*, and *Shore and Bottomland Wetland*; Holmstead 2001). Historically, relatively stable water levels on both Oxbow and Hells Canyon reservoirs enhanced the establishment of riparian habitat in the shoreline zones (Blair 2002, Braatne et al. 2002). Furthermore, where suitable substrate and topography occurred, a relatively wide band of riparian habitat was promoted above full pool shorelines by small daily water-surface fluctuations (Braatne et al. 2002, Blair et al. 2001). The future extent of riparian cover types was not projected to change from current conditions for either Oxbow Reservoir or Hells Canyon Reservoir (Table 5), because shoreline soil moisture and vegetation growing conditions under *Proposed Operations* or *Run-of-River Operations* of these reservoirs would be similar to *Historical Operations*.

In contrast to Oxbow and Hells Canyon reservoirs, large seasonal drafting of Brownlee Reservoir currently has limited the extent of riparian habitat in the shoreline zone of this reservoir (Holmstead 2001). Most existing riparian habitat in the shoreline zone of Brownlee Reservoir occurs near the mouths of tributary streams or springs, where the shoreline soil moisture is not dependent on reservoir water-surface elevation. In some locations, a narrow linear band of facultative riparian species (i.e., adapted to benefit from temporary mesic conditions) also exists along the full-pool shoreline (Braatne et al. 2002). Otherwise, upland habitat comprises most of the shoreline zone, extending to the reservoir full-pool shoreline (Holmstead 2001). Drafting of Brownlee Reservoir has also reduced the connectivity of riparian habitat (Rocklage and Edelmann 2002), which limits habitat value and contributes to habitat fragmentation.

Because of similarities to *Historical Operations*, *Proposed Operations* were not projected to alter the current extent of riparian cover types on the three reaches of Brownlee Reservoir (Headwaters Reach, Table 6; Powder River Pool, Table 7; Lower Brownlee, Table 8). At the full-pool shoreline of Brownlee Reservoir, *Run-of-River Operations* would maintain greater soil moisture throughout the growing season than *Proposed Operations*. Thus, a yearlong full pool water elevation was projected to stimulate the conversion of portions of the shoreline from the current upland cover types to riparian cover types (Tables 6, 7, and 8). The extent of *Forested Wetlands* and *Scrub-Shrub Wetlands* along Brownlee Reservoir was projected to increase 337 acres under *Run-of-River Operations*. *Emergent Herbaceous Wetlands* were projected to increase about 6 acres.

The projected increase of riparian habitat along Brownlee Reservoir would include both the expansion of existing riparian habitat patches and the formation of new riparian patches. The expansion of existing riparian patches together with new riparian patches would also decrease riparian habitat fragmentation along Brownlee Reservoir shorelines (Rocklage and Edelmann 2002). Larger and more continuous patches of riparian habitat would also benefit a wide range of wildlife species that require riparian habitat. Controlling livestock grazing and undesirable weeds would be essential for the development of riparian habitat.

5.2.2. Projected Habitat Values

Habitat value (i.e., HUs and AAHUs) is a combined measure of both habitat quality (i.e., HIS values) and quantity (i.e., acreage). Most HSI models evaluate both a food and a cover component when assessing habitat quality. HSI models use a combination of SI variables that assess these two basic habitat requirements. The HSI score is often based on the minimum value of either the food or cover component; this results in relatively low HSI values when one or more of the SI values are low, which is appropriate for evaluating overall habitat quality.

Because *Proposed Operations* and *Run-of-River Operations* do not differ much from *Historical Operation* of Oxbow and Hells Canyon reservoirs, no differences in habitat value were projected for these reaches. Likewise, the Weiser Reach is not influenced by HCC operations. Therefore, habitat values for Oxbow and Hells Canyon reservoirs and the Weiser Reach were estimated only for current conditions (Tables 9 and 10).

For Brownlee Reservoir, differences in habitat value between the two scenarios were due to the combination of both higher HSI values and additional riparian habitat projected to develop in the shoreline zone under *Run-of-River Operations*. For *Proposed Operations*, differences in HUs for Brownlee Reservoir also resulted from operational drafting differences between high and low runoff years (Tables 11, 12, and 13). These operational differences between runoff years of *Proposed Operations* and between *Proposed Operations* and *Run-of-River Operations* primarily affected HSI values of evaluation species (i.e., marsh wren, mink, and river otter) with models that consider water depth and distance from water to cover.

Under *Proposed Operations*, HSI values for marsh wren and river otter were relatively higher during years with low runoff, because Brownlee Reservoir would be drafted relatively less. Deeper drafting to allow for flood control during high runoff would create larger distances between shoreline riparian habitat and the water's edge. Deeper drafting also decreases the time that water is at the downslope edge of the shoreline zone. Both increased distances and decreased presence of water in riparian habitat typically degraded habitat value for several evaluation species (Tables 11, 12, and 13).

HSI values were highest under *Run-of-River Operations* for species models that consider water depth and distance to water. *Run-of-River Operations* would maintain a full reservoir, which optimizes HSI values for models that assess distance between water and riparian habitat and the length of time that water is present in riparian habitat. For example the constant full pool that would be maintained under *Run-of-River Operations* would optimize the presence of water within *Emergent Herbaceous Wetlands* during the breeding season in the marsh wren and yellow-headed blackbird models, and distances between water and cover in the mink and river otter models. Moreover, *Run-of-River Operations* would promote the establishment of additional riparian habitat along Brownlee Reservoir. Hence, *Run-of-River Operations* of Brownlee Reservoir would generally facilitate both increased habitat quality and quantity, which would promote increased habitat value for the evaluation species. Furthermore, increased extent of riparian cover types would increase habitat quality by decreasing habitat fragmentation (Rocklage and Edelmann 2002), which is evaluated by interspersion and juxtaposition SI variables (Appendix B).

These estimates of habitat value do not consider future changes in habitat perturbations (e.g., weed invasions and recreational development) other than HCC operations. Exotic plants, which include invasive and noxious weeds, were recently ranked as the greatest threat to the composition and structure of native plant communities in the Interior Columbia River Basin (Croft et al. 1997). Increases in the occurrence of invasive and noxious weeds were not considered in HSI estimates but would undoubtedly degrade wildlife habitat value. Furthermore, a constant full pool for Brownlee Reservoir under *Run-of-River Operations* might accelerate both the establishment of certain weeds along Brownlee Reservoir and their migration further downstream (Krichbaum 2000, Holmstead 2001, Braatne et al. 2002). Increased recreational development and activities would also degrade habitat values. New recreation facilities, which were not included in this analysis, would eliminate habitat and might displace wildlife during use periods. Increased levels of recreation activity might also have adverse impacts on the wildlife use of habitats. The extent of displacement would vary by species and depend on factors including recreation type, location, duration, and timing.

5.3. River Shoreline Zones

5.3.1. Projected Extent of Riparian Cover Types

The extent of wetland and riparian cover types is projected to decrease downstream of Hells Canyon Dam for both scenarios (Table 14). However, differences are projected to be relatively minor. Of the 3,435 acres in the river shoreline zone, 262 acres are currently of riparian cover types. *Proposed Operations* was projected to decrease the current extent of riparian cover types by 7.3 acres, and *Run-of-River Operations* was projected to decrease riparian cover types by 16.3 acres. Most changes were in the extent of *Scrub-Shrub Wetlands*.

The projected lower maximum daily-water-surface elevations during summer under both operational scenarios (Parkinson 2002) caused decreases in the extent of riparian cover types from current conditions. Maximum daily river flows and water surface elevation during summer are a function of load following. *Proposed Operations* project that summer flows for load following will be less than that occurring historically. Moreover, *Run-of-River Operations* do not provide for load following, and river flows during summer would not be manipulated above HCC inflows. The irrigation effect downstream of Hells Canyon Dam, which is a short-term elevation of summer base flows for load following, has most likely contributed to historical increases in the upslope extent and robustness of the riparian vegetation (Blair et al. 2001, Braatne et al. 2002). Thus, projected decreases in maximum daily summer flows (i.e., load following) from *Historical Operations* would lessen the irrigation effect under both *Proposed Operations* and *Run-of-River Operations* and decrease the estimated extent of riparian cover types.

5.3.2. Projected Habitat Values

HSI values were consistent between *Proposed Operations* and *Run-of-River Operations* (Tables 15, 16, and 17). Thus, differences of habitat value estimates are entirely a function of differences in the projected extent of riparian cover types. Because relatively minor changes in the extent of riparian habitat were projected to occur, AAHUs of *Proposed Operations* and *Run-of-River Operations* differed by only 2%, which can be considered insignificant.

6. SUMMARY AND CONCLUSIONS

Identifying impacts to wildlife is an important concern for relicensing the Hells Canyon Complex (HCC) (Federal Energy Regulatory Commission 1990, Idaho Power Company 1997). During relicensing consultation, primary concerns were that operations of the HCC would preclude the establishment of perennial low-elevation wildlife habitat between reservoir maximum operational drafting depths and full-pool shorelines (i.e., reservoir fluctuation zones) and would prevent the establishment of perennial riparian habitat along reservoir and river shorelines (i.e., shoreline zones) (Idaho Power Company 1997). Impacts were estimated for two potential operational scenarios—*Proposed Operations* and *Full Pool Run-of-River Operations*—by comparing projected changes in the extent and value of wildlife habitat from current habitat conditions between the scenarios. Furthermore, HCC impacts on wildlife habitat were identified within three operational zones: 1) reservoir fluctuation zone, 2) reservoir shoreline zone, and 3) river shoreline zone.

The HCC reservoirs inundated some of the lowest-elevation wildlife habitat in the region (Blair et al. 2001) and formed fluctuation zones where water levels were manipulated under *Historical Operations* (1958-1999) (Parkinson 2002). The reservoir fluctuation zones would be at least seasonally inundated with either *Proposed Operations* or *Run-of-River Operations*. Thus, the current preclusion of wildlife habitat (i.e., low-elevation habitat) in the fluctuation zones would persist into the future regardless of operational scenario. Estimated areas within the fluctuation zone would be 5,820 acres in Brownlee Reservoir, 89 acres in Oxbow Reservoir, and 240 acres in Hells Canyon Reservoir.

Historically, relatively stable water levels on both Oxbow and Hells Canyon reservoirs enhanced the establishment of riparian habitat in the shoreline zones (Blair 2002, Braatne et al. 2002). Where suitable substrate and topography occurred, a relatively wide band of riparian habitat was promoted above full-pool shorelines by small daily water-surface fluctuations (Braatne et al. 2002, Blair et al. 2001). Neither the future extent of riparian cover types nor the habitat value were projected to change from current conditions for either Oxbow Reservoir or Hells Canyon Reservoir, because shoreline soil moisture and vegetation growing conditions under *Proposed Operations* or *Run-of-River Operations* of these reservoirs would be similar to *Historical Operations*.

In contrast, large seasonal drafting of Brownlee Reservoir historically limited the extent and connectivity of riparian habitat in the shoreline zone of this reservoir (Holmstead 2001, Rocklage and Edelmann 2002). Because of similarities to *Historical Operations*, *Proposed Operations* were not projected to alter the current extent of riparian cover types along Brownlee Reservoir. At the full-pool shoreline of Brownlee Reservoir, however, *Run-of-River Operations* would maintain greater soil moisture throughout the growing season than *Proposed Operations*. Thus, a yearlong full-pool water elevation was projected to stimulate the conversion of portions of the shoreline from the current upland cover types to riparian cover types. Under *Run-of-River Operations*, the extent of riparian habitat along Brownlee Reservoir was projected to increase 343 acres, and the value of riparian habitat was correspondingly projected to increase 54−88%.

Downstream of Hells Canyon Dam, the projected maximum daily-water-surface elevations during summer under both scenarios (Parkinson 2002) were projected to decrease the extent and habitat value of riparian cover types from current conditions. However, differences are projected to be relatively minor. Of the 3,435 acres in the river shoreline zone, 262 acres are currently of riparian cover types. *Proposed Operations* was projected to decrease the current extent of riparian cover types by 7.3 acres, and *Run-of-River Operations* was projected to decrease riparian cover types by 16.3 acres. This equates to only a 1% and 3% decrease in habitat value under *Proposed Operations* and *Run-of-River Operations,* respectively.

Along the river and reservoir shorelines associated with the HCC, *Run-of-River Operations* were projected to overall provide more habitat value for wildlife than *Proposed Operations*. Therefore, appropriate protection, mitigation, and enhancement measures should be considered for offsetting impacts to riparian wildlife habitat if *Proposed Operations* are implemented for the HCC.

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Table 1. Characteristic average maximum-daily flows (cfs) of HCC *Historical Operations* and two operational scenarios for the Snake River downstream of Hells Canyon Dam, July 1 through August 31.

Category of Runoff Year	Snake River Flows (cfs)					
	Year	42-year[1] Weighting	72-year[2] Weighting	Historical Operations	Proposed Operations	Run-of-River Operations
Low	1992	0.52	0.58	8,199	6,626	6,109
Medium	1995	0.31	0.31	21,239	19,524	14,389
High	1997	0.17	0.11	23,412	23,007	18,105
Weighted Average				14,771	12,388	9,972

[1] Period of record (1958- 1999) for HCC *Historical Operations*.
[2] Entire period of record (1928- 1999) used for weighting projected flows of *Proposed Operations* and *Run-of-River Operations.*

Table 2. Characteristic average daily flows (cfs) of the Imnaha and Salmon Rivers, July 1 through August 31.

Period of Record	Imnaha River (cfs)	Salmon River (cfs)
42-year (1958-1999)	409	10,008
72-year (1928-1999)	384[1]	9,396

[1] No data for 1928.

Table 3. Models for habitat evaluation species potentially useful[1] for the HCC Wildlife Habitat Assessment of operational scenarios.

Model	Status			Cover Type																			
	Published U.S. FWS Model	Agency Developed Model	Other Model	Scrub-Shrub Wetland	Forested Wetland	Shore & Bottomland Wetland	Emergent Herbaceous Wetland	Non-Emergent Herbaceous Wetland	Cliff/Talus Slope	Shrubland	Shrub Savanna	Grassland	Desertic Shrubland	Desertic Herbland	Tree Savanna	Forbland	Forested Upland	Grazing Land/Pasture	Agriculture (Cultivated)	Forested/Orchard	Desertic Woodland	Lotic	Lentic
Birds																							
yellow-headed blackbird	x						x															x	
red-winged blackbird	x						x					x				x		x					
yellow warbler	x			x																			
marsh wren	x			x			x																
song sparrow	x			x	x		x																
hairy woodpecker	x				x																		
black-capped chickadee	x				x																		
great blue heron	x				x	x	x															x	
belted king fisher																						x	
osprey	x			x	x		x			x	x												
American coot	x						x															x	x
wood duck			x	x	x	x	x															x	
mallard			x				x																

Table 3. (Cont.)

Model	Status			Cover Type																						
	Published U.S. FWS Model	Agency Developed Model	Other Model	Scrub-Shrub Wetland	Forested Wetland	Shore & Bottomland Wetland	Emergent Herbaceous Wetland	Non-Emergent Herbaceous Wetland	Cliff/Talus Slope	Shrubland	Shrub Savanna	Grassland	Desertic Shrubland	Desertic Herbland	Tree Savanna	Forbland	Forested Upland	Grazing Land/Pasture	Agriculture (Cultivated)	Forested/Orchard	Desertic Woodland	Lotic	Lentic
Birds (cont.)																										
willow flycatcher		x		x																			
white-crowned sparrow			x															x	x				
California quail[3]			x	x	x					x	x	x				x			x				
Chukar[3]			x							x	x	x											
Lewis' woodpecker	x				x										x		x			x			
downy woodpecker	x				x												x			x			
western meadowlark		x								x	x	x				x							
Brewer's sparrow[2]	x									x	x												
western flycatcher		x			x																		
mountain quail[5]			x																				
rufous-sided towhee		x		x	x																		
golden eagle			x						x		x	x	x	x	x		x				x		

Table 3. (Cont.)

Model	Status			Cover Type																			
	Published U.S. FWS Model	Agency Developed Model	Other Model	Scrub-Shrub Wetland	Forested Wetland	Shore & Bottomland Wetland	Emergent Herbaceous Wetland	Non-Emergent Herbaceous Wetland	Cliff/Talus Slope	Shrubland	Shrub Savanna	Grassland	Desertic Shrubland	Desertic Herbland	Tree Savanna	Forbland	Forested Upland	Grazing Land/Pasture	Agriculture (Cultivated)	Forested/Orchard	Desertic Woodland	Lotic	Lentic
Mammals																							
river otter			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
mink	x			x	x	x	x															x	
muskrat	x			x	x	x	x																
Beaver[4]	x			x	x		x															X[4]	
black bear[6]		x			x					x	x				x		x			x			
mule deer[3]			x	x	x					x	x	x				x							
Reptiles and Amphibians																							
Leopard frog			x	x		x	x																
western rattlesnake			x							x	x												

[1] Flow scenarios would affect wetland and riparian communities. Therefore, most models focus on these vegetation types. Some upland species models that may be suitable for the HCC have also been added.

[2] Brewer's sparrow model can be applied in evergreen shrubland and evergreen shrub savanna only.

[3] Model applies to shrub/steppe; may or may not apply to shrubland or shrub savannah.

[4] The multi-cover type beaver model evaluates habitat in a 200-meter band around PSS, PFO, PEM, riverine, and lotic cover types.

[5] The mountain quail model was developed to evaluate Jeffery Pine and mixed conifer cover types in California. It would require substantial changes for the cover types being evaluated in the HCC area.

[6] The black bear model will require some modification for the Hell's Canyon area.

Table 4. Habitat Variables for Selected HCC Evaluation Species.

yellow-headed blackbird (emergent herbaceous wetland)
- V1. Percent of open water area containing submerged vegetation
- V2. Length of edge of PEM cover type contacting open water (edge index)
- V3. Percent of vegetation that is robust
- V4. Mean water depth under emergent vegetation during spring

black-capped chickadee (forested wetland)
- V1. Percent tree canopy closure
- V2. Mean height of overstory trees
- V4. Number of snags 10 to 25 cm dbh/0.4 ha (4 to 10 inches dbh/1.0 acre)

marsh wren (emergent herbaceous wetland)
- V1. Growth form of emergent hydrophytes
- V2. Percent canopy cover of emergent herbaceous vegetation
- V3. Mean water depth
- V4. Percent canopy cover of woody vegetation

yellow-warbler (scrub/shrub wetland)
- V1. Percent deciduous shrub crown cover
- V2. Mean height of deciduous shrub canopy
- V3. Percent of shrub canopy comprised of hydrophytic shrubs

river otter (within 75 m of shoreline)
- V1. Availability of denning sites
- V2. Density of streamside cover
- V3. Distance to cover from shoreline

song sparrow (forested and scrub/shrub wetlands)
- V1. Distance to water
- V2. Percent canopy cover of shrubs
- V3. Mean shrub height

song sparrow (emergent herbaceous wetland)
- V1. Distance to water
- V2. Percent herbaceous canopy cover
- V3. Mean height of herbaceous vegetation

mallard (emergent herbaceous and scrub/shrub wetlands)
- V1. Wetland types in study area (flood duration)
- V2. Height and density of residual nesting cover
- V3. Percent of shoreline dominated by emergent or scrub/shrub vegetation
- V4. Interspersion index

mink (forested and scrub/shrub wetlands)
- V1. Percent of year with surface water present within cover type
- V2. Percent canopy cover of trees, shrubs, and emergent herbaceous vegetation
- V3. Percent canopy cover of trees and shrubs within 100 m of wetland’s edge

mink (emergent herbaceous wetland)
- V1. Percent of year with surface water present within cover type
- V2. Percent canopy cover of emergent herbaceous vegetation
- V3. Percent canopy cover of trees and shrubs within 100 m of wetland’s edge

Table 5. Current extent of cover types in the shoreline zones of the HCC that were not projected to change under *Proposed Operations* or *Run-of-River Operations*.

	Weiser Reach Upstream of Brownlee Reservoir		Oxbow Reservoir		Hells Canyon Reservoir	
Vegetation Cover Type	**Acreage**	**Proportion**	**Acreage**	**Proportion**	**Acreage**	**Proportion**
Other Upland[1]	23.9	3.3%	2.7	0.5%	64.4	6.0%
Grassland	116.0	16.0%	88.0	17.6%	110.3	10.3%
Tree-Savanna	0.0	0.0%	0.0	0.0%	20.7	1.9%
Shrub-Savanna	48.7	6.7%	194.7	39.0%	392.6	36.7%
Shrubland	0.4	0.1%	92.5	18.5%	134.7	12.6%
Forested Wetland	64.6	8.9%	8.9	1.8%	33.4	3.1%
Scrub-Shrub Wetland	164.0	22.6%	50.7	10.2%	78.6	7.3%
Emergent-Herbaceous Wetlands	48.9	6.7%	0.0	0.0%	0.0	0.0%
Shore and Bottomland Wetland[2]	21.1	2.9%	2.0	0.4%	2.7	0.3%
Water[3]	0.7	0.1%	0.0	0.0%	1.8	0.2%
Developed[4]	231.0	31.8%	45.1	9.0%	45.9	4.3%
Land Feature[5]	7.2	1.0%	14.3	2.9%	186.0	17.4%
Total	726.4	100.0%	498.9	100.00%	1071.1	100.0%

[1] Includes Desertic Herbland, Desertic Shrubland, Forbland, and Forested Upland cover types.
[2] Shore and Bottomland Wetland is better characterized as Rock Bottom (i.e., all wetlands and deepwater habitats with substrates having an areal cover of stones, boulders, or bedrock 75% or greater and vegetative cover of less than 30%; Cowardin et al. 1979).
[3] Includes Lentic and Lotic Cover types.
[4] Includes Agriculture, Disturbed, Industrial, Parks/Recreation, Residential, Grazing Land/Pasture, Roads, and Forested/Orchard cover types.
[5] Includes Barrenland, Cliff/Talus, and Unknown cover types.

Table 6. Projected effects of operational scenarios on the extent of cover types in the shoreline zone of the Headwaters Reach of Brownlee Reservoir.

	Current Conditions		***Proposed Operations***		***Run-Of-River Operations***	
Vegetation Cover Type	**Acreage**	**Proportion**	**Acreage**	**Proportion**	**Acreage**	**Proportion**
Other Upland[1]	96.6	12.1%	96.6	12.1%	74.9	9.4%
Grassland	39.1	4.9%	39.1	4.9%	30.3	3.8%
Tree-Savanna	0.0	0.0%	0.0	0.0%	0.0	0.0%
Shrub-Savanna	233.7	29.4%	233.7	29.4%	181.1	22.8%
Shrubland	75.7	9.5%	75.7	9.5%	58.7	7.4%
Forested Wetland	1.1	0.1%	1.1	0.1%	42.5	5.3%
Scrub-Shrub Wetland	41.8	5.2%	41.8	5.2%	130.4	16.4%
Emergent-Herbaceous Wetlands	67.7	8.5%	67.7	8.5%	67.7	8.5%
Shore and Bottomland Wetland[2]	130.3	16.4%	130.3	16.4%	101.0	12.7%
Water[3]	1.5	0.2%	1.5	0.2%	1.5	0.2%
Developed[4]	72.5	9.1%	72.5	9.1%	71.8	9.0%
Land Feature[5]	35.9	4.5%	35.9	4.5%	35.9	4.5%
Total	795.9	100.0%	795.9	100.0%	795.9	100.0%

[1] Includes *Desertic Herbland*, *Desertic Shrubland*, *Forbland*, and *Forested Upland* cover types.

[2] *Shore and Bottomland Wetland* is better characterized as *Rock Bottom* (i.e., all wetlands and deepwater habitats with substrates having an areal cover of stones, boulders, or bedrock 75% or greater and vegetative cover of less than 30%; Cowardin et al. 1979).

[3] Includes *Lentic* and *Lotic* Cover types.

[4] Includes *Agriculture*, *Disturbed*, *Industrial*, *Parks/Recreation*, *Residential*, *Grazing Land/Pasture*, *Roads*, and *Forested/Orchard* cover types.

[5] Includes *Barrenland*, *Cliff/Talus*, and Unknown cover types.

Table 7. Projected effects of operational scenarios on the extent of cover types in the shoreline zone of the Powder River Pool Reach of Brownlee Reservoir.

	Current Conditions		***Proposed Operations***		***Run-Of-River Operations***	
Vegetation Cover Type	**Acreage**	**Proportion**	**Acreage**	**Proportion**	**Acreage**	**Proportion**
Other Upland[1]	0.0	0.0%	0.0	0.0%	0.0	0.0%
Grassland	0.8	0.5%	0.8	0.5%	0.5	0.3%
Tree-Savanna	0.0	0.0%	0.0	0.0%	0.0	0.0%
Shrub-Savanna	20.0	13.3%	20.0	13.3%	13.0	8.6%
Shrubland	4.7	3.1%	4.7	3.1%	3.0	2.0%
Forested Wetland	13.4	8.9%	13.4	8.9%	17.9	11.9%
Scrub-Shrub Wetland	31.6	21.1%	31.6	21.1%	44.6	29.8%
Emergent-Herbaceous Wetlands	11.7	7.8%	11.7	7.8%	17.6	11.7%
Shore and Bottomland Wetland[2]	0.4	0.3%	0.4	0.3%	0.3	0.2%
Water[3]	0.9	0.6%	0.9	0.6%	0.9	0.6%
Developed[4]	61.9	41.3%	61.9	41.3%	49.1	32.8%
Land Feature[5]	4.6	3.1%	4.6	3.1%	3.0	2.0%
Total	149.8	100.0%	149.8	100.0%	149.8	100.0%

[1] Includes Desertic Herbland, Desertic Shrubland, Forbland, and Forested Upland cover types.

[2] Shore and Bottomland Wetland is better characterized as Rock Bottom (i.e., all wetlands and deepwater habitats with substrates having an areal cover of stones, boulders, or bedrock 75% or greater and vegetative cover of less than 30%; Cowardin et al. 1979).

[3] Includes Lentic and Lotic Cover types.

[4] Includes Agriculture, Disturbed, Industrial, Parks/Recreation, Residential, Grazing Land/Pasture, Roads, and Forested/Orchard cover types.

[5] Includes Barrenland, Cliff/Talus, and Unknown cover types.

Table 8. Projected effects of operational scenarios on the extent of cover types in the shoreline zone of the Lower Brownlee Reach of Brownlee Reservoir.

	Current Conditions		***Proposed Operations***		***Run-Of-River Operations***	
Vegetation Cover Type	**Acreage**	**Proportion**	**Acreage**	**Proportion**	**Acreage**	**Proportion**
Other Upland[1]	44.9	1.9%	44.9	1.9%	40.9	1.7%
Grassland	574.7	24.5%	574.7	24.5%	524.1	22.3%
Tree-Savanna	0.2	0.0%	0.2	0.0%	0.2	0.0%
Shrub-Savanna	1,266.2	53.9%	1,266.2	53.9%	1,154.8	49.1%
Shrubland	254.6	10.8%	254.6	10.8%	232.2	9.9%
Forested Wetland	10.5	0.4%	10.5	0.4%	42.1	1.8%
Scrub-Shrub Wetland	81.0	3.4%	81.0	3.4%	238.7	10.2%
Emergent-Herbaceous Wetlands	1.7	0.1%	1.7	0.1%	1.7	0.1%
Shore and Bottomland Wetland[2]	0.4	0.0%	0.4	0.0%	0.3	0.0%
Water[3]	0.4	0.0%	0.4	0.0%	0.4	0.0%
Developed[4]	88.9	3.8%	88.9	3.8%	88.1	3.7%
Land Feature[5]	26.6	1.1%	26.6	1.1%	26.6	1.1%
Total	2,350.1	100.0%	2,350.1	100.0%	2,350.1	100.0%

[1] Includes Desertic Herbland, Desertic Shrubland, Forbland, and Forested Upland cover types.

[2] Shore and Bottomland Wetland is better characterized as Rock Bottom (i.e., all wetlands and deepwater habitats with substrates having an areal cover of stones, boulders, or bedrock 75% or greater and vegetative cover of less than 30%; Cowardin et al. 1979).

[3] Includes Lentic and Lotic Cover types.

[4] Includes Agriculture, Disturbed, Industrial, Parks/Recreation, Residential, Grazing Land/Pasture, Roads, and Forested/Orchard cover types.

[5] Includes Barrenland, Cliff/Talus, and Unknown cover types.

Table 9. Estimated habitat value of current conditions[1] in the shoreline zones of Oxbow and Hells Canyon reservoirs.

Species	Cover Type[2]	Cover Type Acreage	HSI	Total Habitat Units	Average Annual Habitat Units
Yellow-headed blackbird					
	EHW	0.0	0.00	0	0
Marsh wren					
	EHW	0.0	0.00	0	0
Mallard					
	EHW & SSW	129.3	0.48	1,862	62
Song sparrow					
	EHW	0.0	0.00	0	0
	SSW	129.3	0.85	3,297	110
	FW	42.3	1.00	1,269	42
	Species Total			4,566	152
Mink					
	EHW	0.0	0.00	0	0
	SSW	129.3	0.68	2,638	88
	FW	42.3	0.68	863	29
	Species Total			3,501	117
Black-capped chickadee					
	FW	42.3	0.79	1,003	33
Yellow warbler					
	SSW	129.3	0.56	2,172	72
River otter					
	Shoreline Zones	1,570.0	0.35	16,485	549
Total				29,589	986

[1] Neither *Proposed Operations* nor *Run-of-River Operations* were projected to change habitat value from current conditions.
[2] EHW = *Emergent Herbaceous Wetland*, SSW = *Scrub-Shrub Wetland*, and FW = *Forested Wetland*.

Table 10. Estimated habitat value of current conditions[1] in the shoreline zone of the Weiser Reach upstream of Brownlee Reservoir.

Species	Cover Type[2]	Cover Type Acreage	HSI	Total Habitat Units	Average Annual Habitat Units
Yellow-headed-blackbird					
	EHW	48.9	0.13	191	6
Marsh wren					
	EHW	48.9	0.17	249	8
Mallard					
	EHW & SSW	212.9	0.56	3,577	119
Song sparrow					
	EHW	48.9	0.52	763	25
	SSW	164.0	0.86	4,231	141
	FW	64.6	0.92	1,783	59
	Species Total			6,777	226
Mink					
	EHW	48.9	0.82	1,203	40
	SSW	164.0	0.65	3,198	107
	FW	64.6	0.65	1,260	42
	Species Total			5,661	189
Black-capped chickadee					
	FW	64.6	0.75	1,454	48
Yellow warbler					
	SSW	164.0	0.61	3,001	100
River otter					
	Shoreline Zone	726.4	0.51	11,114	370
Total				32,024	1,066

[1] Neither *Proposed Operations* nor *Run-of-River Operations* were projected to change habitat value from current conditions.
[2] EHW = *Emergent Herbaceous Wetland*, SSW = *Scrub-Shrub Wetland*, and FW = *Forested Wetland*.

Table 11. Estimated habitat values of current conditions (high runoff years/low runoff years) and under *Run-of-River Operations* in the shoreline zone of the Headwaters Reach of Brownlee Reservoir.

		Current Conditions				***Run-of-River Operations***			
Species	**Cover Type[1]**	**HSI**	**Cover Type Acreage**	**Total Habitat Units**	**Average Annual Habitat Units**	**HSI**	**Cover Type Acreage**	**Total Habitat Units**	**Average Annual Habitat Units**
Yellow-headed-blackbird									
	EHW	0.04/0.08	67.7	81/162	3/5	0.08	67.7	162	5
Marsh wren									
	EHW	0.10/0.21	67.7	203/427	7/14	0.26	67.7	528	18
Mallard									
	EHW & SSW	0.02/0.02	109.5	66/66	2/2	0.02	198.1	119	4
Song sparrow									
	EHW	0.39/0.39	67.7	792/792	26/26	0.39	67.7	792	26
	SSW	0.79/0.79	41.8	991/991	33/33	0.79	130.4	3,090	103
	FW	1.00/1.00	1.1	33/33	1/1	1.00	42.5	1,275	43
	Species Total			1,816/1,816	61/61			5,157	172
Mink									
	EHW	0.00/0.00	67.7	0/0	0/0	0.79	67.7	1,604	53
	SSW	0.00/0.00	41.8	0/0	0/0	0.40	130.4	1,565	52
	FW	0.00/0.00	1.1	0/0	0/0	0.50	42.5	638	21
	Species Total			0/0	0/0			3,807	126
Black-capped chickadee									
	FW	0.00/0.00	1.1	0/0	0/0	0.00	42.5	0	0
Yellow warbler									
	SSW	0.66/0.66	41.8	828/828	28/28	0.66	130.4	2,582	86
River otter									
	Shoreline Zone	0.00/0.22	795.9	0/5,253	0/175	0.32	795.9	7,641	255
Total				2,994/8,582	101/286			19,996	667

[1] EHW = *Emergent Herbaceous Wetland*, SSW = *Scrub-Shrub Wetland*, and FW = *Forested Wetland*.

Table 12. Estimated habitat values of current conditions (high runoff years/low runoff years) and under *Run-of-River Operations* in the shoreline zone of the Powder River Pool Reach of Brownlee Reservoir.

		Current Conditions				*Run-of-River Operations*			
Species	**Cover Type[1]**	**HSI**	**Cover Type Acreage**	**Total Habitat Units**	**Average Annual Habitat Units**	**HSI**	**Cover Type Acreage**	**Total Habitat Units**	**Average Annual Habitat Units**
Yellow-headed-blackbird									
	EHW	0.03/0.03	11.7	11/11	<1/<1	0.03	17.6	16	<1
Marsh wren									
	EHW	0.17/0.37	11.7	60/130	2/4	0.47	17.6	248	8
Mallard									
	EHW & SSW	0.25/0.25	43.3	325/325	11/11	0.25	62.5	469	16
Song sparrow									
	EHW	0.37/0.37	11.7	130/130	4/4	0.37	17.6	195	7
	SSW	0.87/0.87	31.6	825/825	27/27	0.87	44.6	1,164	39
	FW	0.71/0.71	13.4	285/285	10/10	0.71	17.9	381	13
	Species Total			1,240/1,240	41/41			1,740	59
Mink									
	EHW	0.00/0.00	11.7	0/0	0/0	0.74	17.6	391	13
	SSW	0.00/0.00	31.6	0/0	0/0	0.56	44.6	749	25
	FW	0.00/0.00	13.4	0/0	0/0	0.57	17.9	306	10
	Species Total							1,446	48
Black-capped chickadee									
	FW	0.00/0.00	13.4	0/0	0/0	0.00	17.9	0	0
Yellow warbler									
	SSW	0.79/0.79	31.6	749/749	25/25	0.79	44.6	1,057	35
River otter									
	Shoreline Zone	0.00/0.20	149.8	0/899	0/30	0.32	149.8	1,438	48
Total				2,385/3,354	80/112			6,414	214

[1] EHW = *Emergent Herbaceous Wetland*, SSW = *Scrub-Shrub Wetland*, and FW = *Forested Wetland*.

Table 13. Estimated habitat values of current conditions (high runoff years/low runoff years) and under *Run-of-River Operations* in the shoreline zone of the Lower Brownlee Reach of Brownlee Reservoir.

		Current Conditions				*Run-of-River Operations*			
Species	**Cover Type[1]**	**HSI**	**Cover Type Acreage**	**Total Habitat Units**	**Average Annual Habitat Units**	**HSI**	**Cover Type Acreage**	**Total Habitat Units**	**Average Annual Habitat Units**
Yellow-headed-blackbird									
	EHW	0.02/0.02	1.7	1/1	<1/<1	0.02	1.7	1	<1
Marsh wren									
	EHW	0.23/0.18	1.7	12/9	<1/<1	0.23	1.7	12	<1
Mallard									
	EHW & SSW	0.14/0.14	82.7	347/347	12/12	0.14	240.4	1,010	31
Song sparrow									
	EHW	0.42/0.42	1.7	21/21	<1/<1	0.42	1.7	21	<1
	SSW	0.79/0.79	81.0	19/19	<1/<1	0.79	238.7	5,657	189
	FW	0.93/0.93	10.5	293/293	10/10	0.93	42.1	1,175	39
	Species Total			333/333	11/11			6,853	229
Mink									
	EHW	0.00/0.00	1.7	0/0	0/0	0.80	1.7	41	1
	SSW	0.00/0.00	81.0	0/0	0/0	0.39	238.7	2,793	93
	FW	0.00/0.00	10.5	0/0	0/0	0.55	42.1	695	23
	Species Total			0/0	0/0			3529	118
Black-capped chickadee									
	FW	0.73/0.73	10.5	230/230	8/8	0.73	42.1	922	31
Yellow warbler									
	SSW	0.63/0.63	81.0	1,531/1,531	51/51	0.63	238.7	4,511	150
River otter									
	Shoreline Zone	0.00/0.23	2350.1	0/16,216	0/541	0.32	2350.1	22,561	752
Total				2,454/18,667	82/622			39,399	1,313

[1] EHW = *Emergent Herbaceous Wetland*, SSW = *Scrub-Shrub Wetland*, and FW = *Forested Wetland*.

Table 14. Projected effects of operational scenarios on the extent of cover types in the shoreline zone of the Snake River downstream of Hells Canyon Dam.

	Current Conditions		***Proposed Operations***		***Run-Of-River Operations***	
Vegetation Cover Type	**Acreage**	**Proportion**	**Acreage**	**Proportion**	**Acreage**	**Proportion**
Other Upland[1]	30.5	0.89%	36.0	1.15%	42.8	1.3%
Grassland	196.9	5.73%	191.9	5.6%	185.6	5.4%
Tree-Savanna	16.9	0.49%	27. 9	0.8%	41.6	1.2%
Shrub-Savanna	412.0	11.99%	402.0	11.7%	389.5	11.3%
Shrubland	52.9	1.54%	58.7	1.7%	65.9	1.9%
Forested Wetland	33.6	0.98%	32.6	1.0%	31.5	0.9%
Scrub-Shrub Wetland	226.6	6.60%	220.4	6.4%	212.5	6.2%
Emergent-Herbaceous Wetlands	1.7	0.05%	1.6	0.1%	1.6	0.1%
Shore and Bottomland Wetland[2]	329.1	9.58%	385.3	11.2%	455.2	13.3%
Water[3]	2,009.7	58.50%	1,953.5	56.9%	1,883.6	54.8%
Developed[4]	20.5	0.60%	20.5	0.6%	20.5	0.6%
Land Feature[5]	105.0	3.06%	105.0	3.1%	105.0	3.1%
Total	3,435.2	100.00%	3,435.2	100.0%	3,435.2	100.0%

[1] Includes Desertic Herbland, Desertic Shrubland, Forbland, and Forested Upland cover types.

[2] Shore and Bottomland Wetland is better characterized as Rock Bottom (i.e., all wetlands and deepwater habitats with substrates having an areal cover of stones, boulders, or bedrock 75% or greater and vegetative cover of less than 30%; Cowardin et al. 1979).

[3] Includes Lentic and Lotic Cover types.

[4] Includes Agriculture, Disturbed, Industrial, Parks/Recreation, Residential, Grazing Land/Pasture, Roads, and Forested/Orchard cover types.

[5] Includes Barrenland, Cliff/Talus, and Unknown cover types.

Table 15. Estimated habitat value of current conditions in the river shoreline zone downstream of Hells Canyon Dam.

Species	Cover Type[1]	Cover Type Acreage	HSI	Total Habitat Units	Average Annual Habitat Units
Yellow-headed-blackbird					
	EHW	1.7	0.02	1	<1
Marsh wren					
	EHW	1.7	0.03	2	<1
Mallard					
	EHW & SSW	228.3	0.11	753	25
Song sparrow					
	EHW	1.7	0.32	16	<1
	SSW	226.6	1.00	6,798	227
	FW	33.6	1.00	1,008	34
	Species Total			7,822	261
Mink					
	EHW	1.7	0.85	43	1
	SSW	226.6	0.63	4,283	143
	FW	33.6	0.63	635	21
	Species Total			4,961	165
Black-capped chickadee					
	FW	33.6	0.77	776	26
Yellow warbler					
	SSW	226.6	0.63	4,283	143
River otter					
	Shoreline Zones	3,435.2	0.23	23,703	790
Total				42,301	1,410

[1] EHW = Emergent Herbaceous Wetland, SSW = Scrub-Shrub Wetland, and FW = Forested Wetland.

Table 16. Estimated habitat value under *Run-of-River Operations* in the river shoreline zone downstream of Hells Canyon Dam.

Species	Cover Type[1]	Cover Type Acreage	HSI	Total Habitat Units	Average Annual Habitat Units
Yellow-headed-blackbird					
	EHW	1.6	0.02	1	<1
Marsh wren					
	EHW	1.6	0.03	1	<1
Mallard					
	EHW & SSW	214.1	0.11	707	24
Song sparrow					
	EHW	1.6	0.32	15	<1
	SSW	212.5	1.00	6,375	213
	FW	31.5	1.00	945	32
	Species Total			7,335	245
Mink					
	EHW	1.6	0.85	41	1
	SSW	212.5	0.63	4,016	134
	FW	31.5	0.63	595	20
	Species Total			4,652	155
Black-capped chickadee					
	FW	31.5	0.77	728	24
Yellow warbler					
	SSW	212.5	0.63	4,016	134
River otter					
	Shoreline Zones	3,435.2	0.23	23,703	790
Total				41,143	1,371

[1] EHW = *Emergent Herbaceous Wetland*, SSW = *Scrub-Shrub Wetland*, and FW = *Forested Wetland*.

Table 17. Estimated habitat value under *Proposed Operations* in the river shoreline zone downstream of Hells Canyon Dam.

Species	Cover Type[1]	Cover Type Acreage	HSI	Total Habitat Units	Average Annual Habitat Units
Yellow-headed-blackbird					
	EHW	1.6	0.02	1	<1
Marsh wren					
	EHW	1.6	0.03	1	<1
Mallard					
	EHW & SSW	228.3	0.11	753	25
Song sparrow					
	EHW	1.6	0.32	15	<1
	SSW	220.4	1.00	6,612	220
	FW	32.6	1.00	978	33
	Species Total			7,605	254
Mink					
	EHW	1.6	0.85	41	1
	SSW	220.4	0.63	4,166	139
	FW	32.6	0.63	616	21
	Species Total			4,823	161
Black-capped chickadee					
	FW	32.6	0.77	753	25
Yellow warbler					
	SSW	220.4	0.63	4,166	139
River otter					
	Shoreline Zones	3,435.2	0.23	23,703	790
Total				41,805	1,394

[1] EHW = *Emergent Herbaceous Wetland*, SSW = *Scrub-Shrub Wetland*, and FW = *Forested Wetland*.

Appendix A. HCC WHA Resource Work Subgroup

This appendix includes a list of the agencies and individuals that participated in one or more of the WHA meetings. It also includes WHA team meeting agendas and notes, as well as notes from the Terrestrial Resource Work Group field trips that had a bearing on the content and direction of the WHA study

The following individuals participated on the WHA team at various times during the study.

Idaho BLM— Jim Clark	BLM—Vale District Eastside OR/WA— Dorothy Mason
Burns-Paiute Tribe	EDAW—representing FERC— Jim Keany
Friends of the Weiser Trail— Dick Pugh	Haace St. Martin
Idaho Department of Fish & Game— Ed Bottum and Dale Toweill	Idaho Department of Parks & Recreation— Mary Lucachick
Idaho Power Co. Allan Ansell and Toni Holthuijzen	The Nature Conservancy— Alan Sands
Nez Perce Tribe— Loren Kronemann	Oregon Dept of Fish & Wildlife— Errol Claire and Colleen Fagan
Rocky Mountain Elk Foundation— Bob Nelson and Errol Claire	Shoshone-Bannock Tribes— Anders Mikkelson
US Fish & Wildlife Service— Bob Kibler	Wallawa Whitman National Forest— Linda McEwan

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Appendix A. (Cont.)

MEETING NOTES CH2MHILL

HELLS CANYON COMPLEX WILDLIFE HABITAT ASSESSMENT TEAM MEETING NOTES
JANUARY 20, 1999

FROM: Chuck Blair/CH2M HILL

DATE: February 19, 1999

Meeting facilitated and notes prepared by: Chuck Blair/CH2M HILL

Attendees

1. Toni Holthuijzen/Idaho Power
2. Allan Ansell/Idaho Power
3. Dale Toweill/Idaho Department of Fish and Game
4. Mary Lucachick/Idaho Department of Parks and Recreation
5. Jim Clark/Boise District—Bureau of Land Management
6. Dorothy Mason/Vale District—Bureau of Land Management
7. Errol Clair/Oregon Department of Fish and Wildlife
8. Alan Sands/The Nature Conservancy—Idaho

Absent

Bob Kibler/USFWS; Linda McEwan/Wallawa Whitman NF

Additional People Present

Steve Rust/botanist at CDC/IDFG; Evan (Haace)/ St. Martin-Burns Paiute Tribe

Appendix A. (Cont.)

Introductory Remarks—Chuck Blair

Why are we here?

- To learn about the WHA process
- To work as a team through the process
- To get team members' thoughts on improving the process
- To answer questions regarding the HCC WHA process
- To prticipate in the study as an active team member

Working as a Team and Common Goals

Real teams must have a common goal if they are to succeed. Chuck suggested the following common goal for the HCC WHA team:

> **Prepare a complete and objective assessment of wildlife habitat values for the flow scenarios**

Recognize that individuals may have different personal or agency goals and agendas and may choose to use the results of the study in different ways. However, if we adopt this goal we will at least have a common objective for the study. We will discuss this goal at the next meeting and adopt a common goal on which we can agree for this process.

Consensus

We will try to reach consensus as a group at various decision points through the process. However, reaching consensus is not necessary for the process to proceed. Exceptions to group decisions and dissenting views will be noted in meeting notes and in the final report.

HCC WHA Process and Progress

There are numerous decision points we will encounter through this process. Once we reach a decision, we will need to move forward in order to get through the process. We will not have time to review old materials or decisions for new or substitute team members. Your opportunity to have input in the process is through your active participation.

Appendix A. (Cont.)

Chuck Blair's Roles in the HCC WHA Process

- Meeting facilitator.
- Worker bee—I will do all of the leg work, model runs, analysis, report preparation, etc., for the WHA study.
- Note taker—I will take notes during meetings and distribute these to the team members for their review and corrections. Notes will highlight key discussion topics, decisions, action items, etc. Meeting notes are not intended to provide a complete record of everything that is said.

I am **not** a team member from a decision-making perspective. However, I will provide my professional input to discussions as I believe is appropriate.

General Comments and Questions

Team Members/Meeting Attendance

What about team member substitutes—prefer one person, can substitute if needed but won't have time to fill the sub in—that is your responsibility. Also,won't be able to go back and revise earlier decisions if a sub has a different opinion.

East side EIS—predicted cover types that would be there without the dams—Toni

Dale Toweill: Secondary species impacts—Some species depend on riparian vegetation for some components of required habitat.

Mule deer, big horn sheep—depend on riparian vegetation in critical winter—How will this be assessed in HEP?

HEP would get at this habitat through species like the song sparrow or yellow warbler to assess riparian habitat changes. This is a direct change.

1:1 Direct impacts; Indirect—Secondary; Threshold factor—How will these be assessed?

There are HEP Models to get at some of this, but these would reflect direct changes only.

Cockleburr vs. willow—different suites of species—Future flow scenario assessments would predict these changes.

Indirect/Threshold type impacts—These impacts must be addressed somewhere—Chuck will review models for this possibility; but again, the models look at direct effects/changes.

Appendix A. (Cont.)

Where to address this (Indirect, Secondary, Threshold effects)? These types of impacts would be addressed in a license application and through NEPA. HEP not designed to assess (directly) these secondary or threshold impacts.

Errol asked—What about limiting factors; how can or will HEP address these?

Where is the best place/level to raise this question of Indirect, Threshold issues, and limiting factors?

These issues should be carried back to the Resource Work Group. That is the appropriate place for the discussion of how and where issues of Indirect, Secondary, and Threshold effects, and limiting factors will be addressed through the relicense process.

What are effects of flows, drawdowns, etc., on vegetation in reservoir, river upstream, and below reservoir?

What is our charge (the WHA team)? To use HEP HSI models to estimate direct effects of flow scenarios on wildlife habitat values.

Actions

Matrix Species/variables—Chuck will review this for the models and prepare for WHA Team.

Chuck will look at the shrub variables in the mule deer models.

Toni: Will prepare a list of cover types, definition, extent by reach for distribution before the next meeting.

Gary Holmstead: Toni will ask Gary to make a presentation on vegetation cover types and IPC studies at the next meeting. A presentation on Charwid model would also be helpful. Chuck will check with Bob Simons.

Toni: IPC Vegetation data not yet divided into ecological units.

Contacts

Charlie Johnson—Baker—Botanist—Hell's Canyon

Call FWS—Jim/Bob Kibler (I talked to Bob and he will be participating in the process.)

Paul Ashley—Washington Wildlife, Spokane, possible additional HEP Models? Chuck will contact Paul.

Appendix A. (Cont.)

Proposed Meeting Rules

Here are the Resource Work Group/Collaborative Team rules with a few proposed changes due to our smaller WHA group:

Ground Rules

1. Everyone participates.
2. No complaining—No cheap shots.
3. Leave "baggage" at the door.
4. Have fun; be creative and solution oriented.
5. No side conversations.
6. Focus on the issues.
7. Take time to understand (active listening).
8. Once an issue has been discussed and an agreement reached, don't go back and discuss it again—move on.
9. Everyone is responsible for following the ground rules and for politely assisting in their consistent application.
10. Be on time for meetings; take and return from breaks on time.

Scheduled Meetings and Field Trips

April 2, at 9:00 a.m:	Next HCC/WHA Meeting at CH2M HILL, Boise
May 20, 21:	Upper River—1 Day Reservoir Section—1 Day (Weather Permitting)
September 13–17:	Float the canyon

Appendix A. (Cont.)

WHA TEAM MEETING PRESENTATION OVERHEADS
JANUARY 20, 1999

HCC WHA Study

Uses HEP Habitat Suitability Index (HSI) models to evaluate current wildlife habitat values and future values for six water management scenarios

Chuck Blair's Roles

- Facilitate the WHA process and meetings
- Conduct WHA assessment
- Keep us moving forward
- Call it like I see it
- Not a decision-maker or team member

HCC WHA Study Dependencies

- IPC Flow Scenarios—Water Department analyses
- IPC Field studies and vegetation mapping
- River environment modeling study
- Riparian vegetation study
- Riparian habitat fragmentation study

Hells Canyon Complex Wildlife Habitat Assessment

Study Objectives

- Describe the current wildlife resources occurring in Hells Canyon
- Select evaluation species to represent the wildlife community in Hells Canyon

Appendix A. (Cont.)

- Quantify habitat conditions for evaluation species under current hydropower operations
- Predict future landscape conditions under six alternative scenarios for managing river flow
- Quantify habitat values under each of six potential flow management scenarios
- Identify influences of flows on wildlife resources resulting from power generation, other hydropower operation, non-power water uses, and natural variations in flows

HEP Assessment of Habitat Value

Habitat Value = Habitat Quantity x Habitat Quality

Habitat Unit = Area x Habitat Suitability Index

or

HU = Area x HSI

50 Acres x 0.5 HSI = 25 HUs

25 Acres x 1.0 HSI = 25 HUs

Differences Between Traditional HEP Study And HCC WHA Study

Traditional HEP Study

- Focus on species
- "Pet" evaluation species often selected
- Evaluation species may not be sensitive to small changes
- Future trade-off analysis can become an endless do-loop
- Results reported by species

HCC WHA Study

- Focus on habitat types
- Selection based on affected habitats and HSI model variables

Appendix A. (Cont.)

- Selection criteria focuses on model variables sensitive to change
- Trade-off analysis can be completed more effectively
- Results reported by habitat and species

Parts of the HEP Process We Will Use

- Review current pertinent wildlife/habitat information
- Select evaluation species
- Conduct pre-field activities (IPCo completed)
- Collect field data (IPCo completed)
- Calculate HUs for current conditions
- Determine future actions (water management scenarios) and estimate variable changes (other IPC-sponsored studies)
- Calculate HUs for future conditions
- Identify effects of water management components on future wildlife habitat values

HCC WHA Study Tasks

Phase 1

- Literature review and report on current wildlife resources and HSI models
- Arrange field tour
- Conduct WHA team meetings to define the scope of the study
- Select evaluation species and determine needed model revisions or new models
- Revise study plan for Phase 2 of the study

Phase 2

- Revise evaluation species HSI models
- Analyze current wildlife habitat values

Appendix A. (Cont.)

- Report on current wildlife resources/values
- Determine habitat variables likely to change for future scenarios
- Evaluate data analysis assumptions
- Obtain the required results from other studies
- Conduct analysis of future conditions
- Report on future wildlife habitat conditions and values

WHA Team Activities

Phase 1

- Review current wildlife and habitat within the HCC study area
- Identify species, habitat types, and habitat components likely to be affected
- Select wildlife evaluation or target species for the WHA study
- Review data, data analysis and assumptions, and application of the data in the HSI models
- Assist IPCo in identifying impacts to wildlife resources from operational scenarios

Phase 2

- Determine current habitat values in the HCC study area based on the HSI models.
- Determine the expected future habitat values based on selected operational scenarios using HSI models.

Proposed Evaluation Species Selection Criteria

- Sensitivity or suitability of the evaluation species model variables to reflect relatively minor changes.
- Species that are habitat generalists (occupy a wide range of habitats) will likely be excluded because they are not sensitive to change.
- Species that are highly selective of certain cover types are preferred.

Appendix A. (Cont.)

- Potential species may be eliminated to avoid overlapping suitability index variables with other species.
- Species using those cover types likely to change.
- The inclusion of suitability index variables (from HSI models) to assess specific cover type characteristics that are likely to be affected.

Appendix A. (Cont.)

MEMORANDUM CH2MHILL

HELLS CANYON COMPLEX WILDLIFE HABITAT ASSESSMENT TEAM MEETING NOTES AND FIELD TRIP PLANS

APRIL 2, 1999

TO: **Hell's Canyon Complex WHA Team Members**

Toni Holthuijzen/Idaho Power

Dale Toweill/Idaho Department of Fish and Game

Mary Lucachick/Idaho Department of Parks and Recreation

Jim Clark/Boise District—Bureau of Land Management

Linda McEwan/Wallawa-Whitman National Forest

Dorothy Mason/Vale District—Bureau of Land Management

Errol Clair/Oregon Department of Fish and Wildlife

Alan Sands/The Nature Conservancy—Idaho

Bob Kibler/U.S. Fish and Wildlife Service

Bob Nelson/Rocky Mountain Elk Foundation

COPIES: Allan Ansell/Idaho Power

Frank Edlemann/Idaho Power

Gary Holmstead/Idaho Power

Bob Simons/Simons and Associates

FROM: Chuck Blair

DATE: April 2, 1999

MEETING DATE: Friday, April 2, 1999

Appendix A. (Cont.)

Meeting Purpose

The overall purpose of the meeting was to learn about ongoing studies and natural resources that will have an effect on the WHA study and to review potential evaluation species model variables.

Agenda Items

Flow/Vegetation Modeling

Bob Simons (Simons and Associates) began with a presentation about the riparian habitat/ flow/ reservoir level studies they are conducting. The results of these studies will provide the basis for the WHA future analysis. Copies of the overheads of his presentation are attached to this memo for WHA team members.

Some comments and questions during Bob's presentation include:

Model will predict vegetation based on flow & substrate—Other effects, such as grazing or noxious weeds, will be considered in the WHA.

Bob: What are the parameters that drive vegetation—are they at 100% to predict current vegetation, or are they less than 100%? If less, other effects are at work, and the model assumptions/parameters may be revised.

Bob: Next month, resolve with water management people how to deal with input flows to model. April 27th meeting to discuss flow scenarios.

HCC Vegetation and Wildlife

Gary Holmstead made a presentation about the descriptive botanical studies that IPC has conducted. He described preliminary results. Of particular interest to the WHA study were the following findings:

- A single cover type may consist of numerous community types (i.e., the shrub savannah cover type includes 11 different community types depending on the dominant shrub and herbaceous species).
- The distribution of community types depends on a number of parameters that may include slope, aspect, elevation, soil, disturbance history, and relative position within the HCC study area (upstream versus downstream).

Appendix A. (Cont.)

- The community variability within a cover type may result in highly variable species composition with a cover type within the HCC study area.

Evaluation Species Selection Criteria

Following Gary's presentation, we discussed species model selection criteria. The following points were made

The focus of the WHA assessment and model selection should be on a habitat and habitat components that are important to wildlife and may be affected by IPC actions (flow scenarios).

- Model selection needs to consider:

    1. Important habitats that could be affected by future IPC actions.
    2. Specific components of those habitats that are important to wildlife.
    3. Variables within species models that can help us measure specific components.
    4. Using a combination of existing models whose variables can infer valuable information about species of interest (i.e., can we learn about possible effects on Columbia spotted frog habitat through using the yellow-headed blackbird model, perhaps combined with others).

- Model variables are in the driver's seat for evaluation species selection.

We will discuss evaluation species selection more during the field trip and select species during our first meeting after the field visit.

Other Meeting Comments and Questions

Dale: For the flow/vegetation assessment, can we know which habitats are basically fixed and which vary a lot?

Bob Kibler: FWS interest—Were there effects that were not anticipated and are continuing? Was there mitigation for some of these?

Alan/Erroll: Discussed modified mitigation banking proposal.

Dale: Add bald eagle model. Aware of a bighorn sheep model; will provide to Chuck.

Appendix A. (Cont.)

Possible Bighorn Sheep Model

I reviewed a paper provided by Dale that discussed various desert bighorn sheep models and habitat components. My initial thoughts on these models and possible application to the HCC WHA study are as follows:

- We would need to determine how comparable desert bighorn habitat requirements are to mountain bighorn requirements to know if the desert sheep models can be adapted for our use.
- This was a review paper that discussed existing desert bighorn models, but it does not include those models. Specific models would need to be reviewed.
- The models described in the paper include descriptive "models" of preferred habitat, predictive models to assess the likelihood of species occurrence and, "models" that describe or predict habitat suitability.

Key habitat components for desert bighorns, as described in the paper, include:

1. Topographic cover as measured by slope, aspect and physiographic type, and ruggedness.
2. Water as measured by source characteristics and distance from water.
3. Forage characteristics as measured by percent cover of grasses, forbs, browse, and succulents—a wide range of plants are used by desert bighorns.
4. Thermal cover as indicated by the presence of shade.
5. The presence of mineral sources.

My first impressions are these:

- Several of these habitat components (topographic cover, water, and forage) would be rated as optimum for desert bighorns in the canyon portions of the HCC study area.
- The desert bighorn habitat requirements are not sensitive to the types of changes to vegetation that may result from an analysis of future flow scenarios.
- Unless mountain bighorns have special requirements for riparian cover types that may be affected (or has been discussed), this species would not be a good evaluation species for the WHA study because of the nature of the changes that may be predicted for the flow scenarios.
- Other evaluation species model variables are better suited to assess changes in riparian habitat

Appendix A. (Cont.)

- Any changes from flow scenarios that affect riparian habitat important to bighorns during severe winters should be addressed in the larger IPC license application documents where WHA study results would allow inferences concerning implications of habitat changes predicted from the WHA study to be made for species not directly assessed in the WHA study. We will discuss this during upcoming meetings.

Bald Eagle Model

Model variables for the USFWS breeding season bald eagle model include:

- Area covered by open water or adjacent wetlands.
- Morphoedaphic Index (a measure of water quality and mean depth.
- Percent of potential nesting area covered by mature timber.
- Building or camp-site density.

These model variables are intended to measure food, reproductive habitat, and human disturbance.

May 20–21 Field Visit

We will tour the upriver and reservoir portions of the HCC on May 20 and 21. Foot access to islands may be limited by high flows.

Field Trip

May 20–7:45 a.m.	Meet in Boise at the IPC headquarters parking lot (1221 West Idaho). Move personal vehicles to IPC locked parking area and depart Boise in IPC vehicles at 8:00 a.m. If you are driving your own vehicle, either meet us and caravan to Weiser, or meet us near Weiser at the Hwy. 201 Snake River crossing at 9:30. This crossing is located about 3 miles west of Weiser.
	Remainder of May 20th—Tour upper river and Brownlee reservoir by jet boat.
Lunch	Bring your own lunch and drinks. We will consolidate lunches into large coolers.
Dinner	I will purchase dinner with everyone sharing in the cost. I plan to purchase steaks, mushrooms, salad, potatoes, and dessert. If you have other needs, please let me know. We will all pitch in to prepare dinner. Bring your own water bottle, beer/wine/drinks for dinner.
Evening	Spend the night in IPC facilities at Oxbow (these are rooms with beds so no need for sleeping bags, etc.)
May 21	
Breakfast	At the IPC mess hall
	Tour Oxbow and Hell's Canyon reservoirs by boat and/or vehicle and return to Boise.
Lunch	I will purchase bagels, lunch meat, condiments, drinks, etc., with everyone sharing in the cost.

Appendix A. (Cont.)

Costs: I will total the costs for the lunch and dinner I am bringing for all to split evenly, so please bring some cash or your check book.

RSVP by May 12, whether you will attend or not, and with any special dietary needs. Respond to: cblair@ch2m.com or (208) 345-5310, ext. 254, or 700 Clearwater Lane, PO Box 8748, Boise, ID 83707-2748.

Also, bring your calendar so that we can schedule our next meeting.

Appendix A. (Cont.)

MEMORANDUM CH2MHILL

NEXT HCC WHA TEAM MEETING AND SEPTEMBER FLOAT TRIP

TO: **Hell's Canyon Complex WHA Team Members**

Toni Holthuijzen/Idaho Power

Dale Toweill/Idaho Department of Fish and Game

Ed Bottum/Idaho Department of Fish and Game

Mary Lucachick/Idaho Department of Parks and Recreation

Jim Clark/Boise District—Bureau of Land Management

Linda McEwan/Wallawa-Whitman National Forest

Dorothy Mason/Vale District—Bureau of Land Management

Errol Clair/Oregon Department of Fish and Wildlife

Alan Sands/The Nature Conservancy—Idaho

Bob Kibler/U.S. Fish and Wildlife Service

Bob Nelson/Rocky Mountain Elk Foundation

FROM: Chuck Blair

DATE: June 2, 1999

RESPOND BY: June 8, 1999

Thank you all for attending the field trip. I hope that you found it to be as informative and helpful as I did. I'll be getting some notes of my impressions from the trip out to you shortly.

Appendix A. (Cont.)

Next WHA Team Meeting

Now that we all have a better feel for some of the resources in the reservoir portions of the study area, it's time to select evaluation species so that I can prepare the assessment of current conditions. I'll be sending out a memo about that process in the near future. Right now, we need to schedule the next team meeting. This will be an all day session during which we will identify plant communities that are most likely to be affected by different flow scenarios, key components of those communities important to wildlife, and evaluation species model variables that will permit us to assess changes in those key components. **This will probably be the most important meeting of the entire WHA process as the rest of the assessment will be based on the decisions that we make that day!**

I am available for a meeting on the dates listed below. Please indicate the dates you are available and any preferred dates. I will try to find a date that works for everyone but may have to settle for one that works for the most people. I will be picking an earlier rather than a later date if more than one day works for everyone. **Please respond by June 8th.** My fax number is 208-345-5315, if you choose to reach me that way.

Available Meeting Dates

June 10, 11, 14–18, 29, 30

July 1, 12, 14–16, 19, 20, 21

September Float Trip

As you know, the float trip from Hell's Canyon dam to the mouth of the Salmon River is scheduled for September 13 through 17. To allow plenty of time for stopping along the way, we will need to launch early on the 13th. We haven't set a target launch time yet, but it will likely be around 9 a.m. That means that you should plan to either spend the night of the 12th in the canyon or drive in very early on the 13th. In either case, you will probably need to be at the launch site by 7:30 or 8:00 a.m. There will be a lot more details as we get closer to the day of the trip.

For now I need to get a preliminary, but pretty firm, head count so that we can arrange boats and the shuttle. **Please let me know whether you plan to attend by June 15.**

One of Toni's fellow IPC employees will be handling many of the logistics for the trip, including purchasing food for the entire trip. I know several of you have expressed the desire to prepare some of your favorite Dutch oven dishes and I, for one, am looking forward to enjoying them. We can still do that but you'll need to get a list of groceries for X people so that IPC can get the right stuff. There's plenty of time for that. I just wanted to let you know what's shaping up. I do have one requirement though. If you do have a favorite recipe to prepare, I want a copy, as I am sure others will too.

Appendix A. (Cont.)

MEMORANDUM CH2MHILL

HELLS CANYON COMPLEX
WILDLIFE HABITAT ASSESSMENT UP-RIVER AND RESERVOIR FIELD TOUR NOTES AND OBSERVATIONS
MAY 20–21, 1999

TO: **Hell's Canyon Complex WHA Team Members**

Toni Holthuijzen/Idaho Power

Dale Toweill/Idaho Department of Fish and Game

Mary Lucachick/Idaho Department of Parks and Recreation

Jim Clark/Boise District—Bureau of Land Management

Linda McEwan/Wallawa-Whitman National Forest

Dorothy Mason/Vale District—Bureau of Land Management

Errol Clair/Oregon Department of Fish and Wildlife

Ed Bottum/Idaho Department of Fish and Game

Alan Sands/The Nature Conservancy—Idaho

Bob Kibler/U.S. Fish and Wildlife Service

Bob Nelson/Rocky Mountain Elk Foundation

COPIES: Allan Ansell/Idaho Power

Frank Edlemann/Idaho Power

Jeff Braatne/Univ. of Washington

FROM: Chuck Blair

DATE: June 10, 1999

Appendix A. (Cont.)

The purpose of this memo is to pass along a few observations that I made during the field tour. These may serve as reminders of some of the things we saw and topics we discussed. The purpose of the field trip was to permit WHA team members to get a better feel for the plant communities and current setting in the project area above Hell's Canyon dam. The flows during the field trip were estimated to be between 35,000 to 40,000 cfs.

Summary of General Impressions

It was clear from the tour that there are substantial differences between the "shoreline" habitats associated with reservoir reaches and the "riparian" habitats associated with the Weiser reach. The shoreline habitats along Brownlee Reservoir are also very different from those along Oxbow and Hell's Canyon reservoirs. Riparian communities in the tributaries differ from all of these and change from the upper to the lower end of the study area. Having floated Hell's Canyon, and from talking to Jeff Braatne about his studies, the riparian communities along the Snake River below Hells Canyon Dam are different from those up-river, as we will see in September.

Up-river areas

The riparian community upstream of the influence of the reservoir is dominated by silver maple. Jeff Braatne confirmed that this is the case from their field studies. Jeff estimated that the riparian zone in the vicinity of the island on which we stopped for lunch consists of 70 to 80% silver maple. Jeff also identified an exotic European willow that is a major component of the riparian zone in this area. The island's herbaceous layer consists almost exclusively of weedy annual species. Jeff also noted that some plains cottonwoods are present in a few upriver locations, as is the case in many locations on the Intermountain West. Another component of the forest riparian community is Pacific willow (*Salix lasiandra*). It was estimated that over 80% of the river bank and island shoreline in this upriver reach support woody riparian communities, much of which consists of silver maple, American and Siberian elm, European, and native willows.

Potential habitat improvement measures were discussed. Silver maple has a relatively vertical branching structure and lacks horizontal branches common in native black cottonwoods. The reintroduction of cottonwoods to some of the more degraded islands and riparian areas was suggested as a way of improving habitat and species diversity. Jeff suggested that the best way to reintroduce cottonwoods is to plant several pole cuttings in a relatively small patch and to let the trees spread from there on their own. Getting more cottonwoods established would also provide a seed source for natural distribution downstream. Such an effort would require a maintenance period to control competing vegetation, and beavers are always a problem.

Porter Island is owned and managed by ODFW, although there is an IDFG tag on an old goose nesting structure—nothing like interstate agency cooperation. Much of the island has been farmed and is covered by a sod-forming grass. Some speculated that it was a smooth brome,

Appendix A. (Cont.)

which is not particularly valuable for wildlife. The area was recently burned, and there was evidence of a lot of poison hemlock on the site. Thistles and whitetop are also present. There are a few riparian forest and shrub stands present, along with some Russian olive.

The surface of the island appears to be about 6 feet (eyeball estimate) above the river surface elevation. The difference between these two elevations would increase as flows decline through the summer. There was some discussion of opportunities for habitat improvement/development. Water, of course, is a key issue. No one on the trip knew the water rights details for the island. There was some speculation that the groundwater was likely shallow enough to support deciduous trees and shrubs at locations some distance from the island's edge, and perhaps across the entire island. Management goals would, of course, determine planting prescriptions if any actions were undertaken. Ultimately, the depth to groundwater and moist soil conditions throughout the growing season would need to be confirmed before any specific actions are planned and undertaken. This information could easily be obtained by installing a series of groundwater monitoring wells and checking water levels through the summer and early fall (May–September 15). Any planting effort would require maintenance as discussed above. Other, formerly farmed, islands may have similar potential, but this is not known at this time.

Upper Brownlee Reservoir

The riparian community changes substantially into the upper end of Brownlee Reservoir. Silver maple is far less dominant and nearly disappears while Russian olive begins to show up. The riparian community is much less continuous than above the influence of the reservoir. Islands are dominated by sandbar willow (*S. exigua*) and probably the European willow species. Tamarisk is also more prominent. Toni noted that one of the islands we passed had been dominated by tamarisk until the last few years. He speculated that the high flows of recent years flooded the tamarisk, allowing the sandbar willow that is currently present to replace the tamarisk. Vegetation in the transition zone of the Weiser reach to upper Brownlee shifts from riparian to reservoir shoreline habitats, reflecting the significant changes in hydrologic regime.

Brownlee Reservoir Drawdown Zone

Brownlee Reservoir was down 50 to 70 feet, exposing former upland benches and sediment deposits. Tributary streams have eroded through sediment that has accumulated at their mouths. Several riders in the van, including Jeff Braatne, discussed the extreme difficulty of revegetating much of the drawdown zone under a future scenario where the pool would be kept below the current full-pool level. Many areas are very rocky and have few fines that could support plant growth. In fact, only annual weeds, such as tumbleweed, common cocklebur, and purslane are found in these barren exposed drawdown zones. Top soil has likely been eroded off all slopes. Those areas with remnant fine materials (likely sub-soils), as well as sediment deposition areas, would pose a serious challenge to revegetation efforts. Organic content and microbial activity in the remaining soils and depositional areas are probably very low. Substantial soil amendment

Appendix A. (Cont.)

would be needed to support growth of desired species. Upland areas adjacent to the reservoir support extensive stands of cheatgrass and medusa-head rye, and there are several noxious weeds present in the area. These existing plants would provide a significant and constant source of undesirable seeds, resulting in an unending maintenance effort to keep these plants at bay in favor of desired species.

At the end of the second day, most of the group gathered at Woodhead Park to discuss the Brownlee drawdown zone. The group discussed the feasibility of establishing riparian vegetation along the shores of Brownlee Reservoir. The annual drawdowns occurring at Brownlee Reservoir that are likely to occur also in the future make the establishment of riparian vegetation in the drawdown zone unlikely, if not impossible. Since revegetation options for the drawdown zones and uplands associated with shoreline are clearly limited given current hydroelectric operations and changes in soil conditions, the discussion of mitigation options was open with no clear consensus among the group.

The question was raised if the areal extent of the drawdown zone could be established using data collected by Simons and Associates. The vegetation sampling undertaken by Simons and Associates along the shores of Brownlee Reservoir will not be able to document the real extent of the barren zone, because the drawdown zone in the summer months does not extend down to the maximum draw down of 102 feet below full pool. However, it would be relatively simple and accurate to estimate the area of impact based on a drawdown scenario for Brownlee Reservoir using the GIS.

It was suggested that denudation of the drawdown zone could be considered an ongoing impact of operation of the Hells Canyon Project. The aerial extent of the zone could form the basis for identifying mitigation needs for reservoir related operations. There appeared to be consensus among the participants on this proposed approach.

Oxbow and Hell’s Canyon Reservoirs

Oxbow and Hell’s Canyon reservoirs are held at a relatively constant level compared to Brownlee Reservoir. Water levels typically fluctuate by 3 feet per day, with 5 feet being the maximum drawdown. These more constant pool elevations have permitted substantially more development of woody shoreline vegetation than occurs along Brownlee Reservoir. Woody shoreline communities include hackberry, rose, dogwood, poison ivy, and the exotic Himalayan blackberry, among the many species present. Storm patterns are different from the Brownlee area, resulting in more annual precipitation than farther upstream. Because of the higher precipitation, upland deciduous shrubs and bunch grasses are more prevalent along these reservoirs than along Brownlee. A few white poplar clones were also noted in a couple of the intact tributaries.

Appendix A. (Cont.)

Some of the tributaries support well developed riparian communities dominated by white alder and hackberry. However, many tributaries suffered severe channel blowouts during the January 1997 rain-on-snow event, and currently support little or no vegetation. IPC staff report that cobbles and gravels are more than 10 feet deep in some tributaries and that little fine material is present. Jeff estimated that at least 20 years could be required for recovery of the riparian communities on perennial streams if there are source plant materials upstream and barring further catastrophic events. Recovery of riparian communities along intermittent streams would likely require longer.

Thoughts on WHA Evaluation Species

It appeared from this trip that the predominant riparian communities along the upriver areas consisted of forest species (silver maple being the most common), while hackberry and a variety of shrub species were most common along the reservoirs (especially Oxbow and Hell's Canyon). These are also the communities that would be most affected by operational changes associated with different flow scenarios. Therefore, the selection of evaluation species should focus on those models with variables that measure important riparian and shoreline habitat components. I will also provide IPC data showing the acreage of each cover type within 25 feet of the water's edge for each of the reservoirs and along the river so that we will have a feel for the bigger picture as we select evaluation species.

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Appendix A. (Cont.)

MEMORANDUM

HELLS CANYON COMPLEX WILDLIFE HABITAT ASSESSMENT TEAM MEETING AGENDA

TO: **Hell's Canyon Complex WHA Team Members**

Toni Holthuijzen/Idaho Power

Dale Toweill/Idaho Department of Fish and Game

Mary Lucachick/Idaho Department of Parks and Recreation

Jim Clark/Boise District—Bureau of Land Management

Linda McEwan/Wallawa-Whitman National Forest

Dorothy Mason/Vale District—Bureau of Land Management

Errol Clair/Oregon Department of Fish and Wildlife

Ed Bottum/Idaho Department of Fish and Game

Alan Sands/The Nature Conservancy—Idaho

Bob Kibler/U. S. Fish and Wildlife Service

Bob Nelson/Rocky Mountain Elk Foundation

COPIES: Allan Ansell/Idaho Power

FROM: Chuck Blair

DATE: June 18, 1999

Meeting Notification

As you know, the next HCC WHA team meeting will be held on July 1. This date didn't work for everyone, but it was the date when the most people were available. The meeting will begin at 8:30 a.m. and will run until no later than 4:30 p.m. As usual, lunch will be provided by IPC.

Appendix A. (Cont.)

Meeting Location

We may have some new folks attend, so here are the directions to my office: CH2M HILL, 700 Clearwater Lane, Boise. Our office is located about half way between Morrison-Knudsen, on the corner of Park and Broadway and the Idaho Department of Fish and Game headquarters at the east end of Park. Take the Broadway exit from I-84, go north on Broadway and cross the Boise River, turn right (east) on Park St. (the first light after you cross the river), proceed about 2 blocks and look for two red brick buildings set back against the river on your right. CH2M HILL is on the left (the smaller of the two red brick buildings). Please tell the receptionist that you are here for the Idaho Power meeting, and she will direct you to the meeting room.

Agenda

Meeting Purpose

The main purpose of this meeting will be to select evaluation species for the habitat assessment. We will also be discussing qualitative evaluation for several other species passed along to us from the Resource Work Group (which is you). The specific objectives of this WHA team meeting include:

- Agreeing on important cover types that would be affected by operating scenarios.
- Selecting evaluation species to assess current conditions and future changes in cover type habitat components based on model variables appropriate to measure cover type component changes (see below).
- Discussing qualitative assessment of other species assigned from the Resource Work Group.

Desired Meeting Outcomes

The desired outcomes of the meeting include:

- Agreeing on the cover type habitat components (e.g., percent tree canopy cover, height of hydrophytic shrubs, herbaceous height or cover, etc.) that may change as a result of different operating scenarios and that are important to wildlife.
- Selecting 8 evaluation species with model variables that can measure the important habitat components.
- Determining how the other wildlife species from the RWG will be addressed.

Appendix A. (Cont.)

Pre-meeting Preparation

All of our efforts in meetings and in the field to date have been in preparation for this meeting. You need to go back and review the following information:

- Cover type presentation and literature information from previous meetings
- Geomorphology literature
- Cover type/evaluation species matrix
- Evaluation species/model variable matrix and table paying particular attention to those that may change in response to operating scenarios
- Previous meeting notes
- Evaluation species selection criteria (reviewed below)
- All field notes from the trip, including mine

In addition to this old material, I requested, and Toni has provided, the acreage of the cover types occurring within the river and reservoir reaches of the study area. This information is included with the hard copy of this memo that you will receive. This will permit you to get a feel for how many acres of each of the cover types occurs adjacent to the river and reservoirs.

Study Focus

As a brief review, I'd again like to point out that the focus of the WHA analysis will be on habitat conditions rather than on specific wildlife evaluation species. Evaluation species and model variables will be used as the tool to measure habitat condition and value. Therefore, evaluation species that are not of particular interest may be selected because the model includes variables that measure change in an important wildlife habitat component. You could even use a species that doesn't even occur in Hell's Canyon if the model variables were well suited to measure change in a particular habitat component. Once the effects on habitat change are determined, they can be used by me or IPC to discuss effects on habitat for a wide range of other species.

Appendix A. (Cont.)

Evaluation Species Selection Criteria

The focus of the WHA assessment and model selection will be on a habitat and habitat components that are important to wildlife and may be affected by IPC actions (flow scenarios). Model selection needs to consider the following items:

- Important cover types that could be affected by future IPC actions
- Specific components of those cover types or habitats that are important to wildlife
- Variables within species models that can help us measure specific components
- Using a combination of existing models whose variables can infer valuable information about species of interest (i.e., can we learn about possible effects on Columbia spotted frog habitat through using the yellow-headed blackbird model, perhaps combined with others)
- Single cover type species are preferred because they are likely to tell us more about a particular cover type that may change

Habitat components and model variables are in the driver's seat for evaluation species selection.

Species from the RWG for our Discussion

The RWG met on November 20th, 1997 to discuss rare, threatened, and endangered species. They developed a list of species for further study, noting those for which there were ongoing IPC study efforts and those for which new studies were needed. The "new study" species listed below were to be referred to the WHA team for assessment. Toni has asked me to consider some sort of qualitative assessment of these species related to the WHA process, and I'd like to discuss this with you at the next meeting if time permits. An asterisk denotes those species for which there is an existing HEP model. You may recall my earlier discussion regarding the limitations of the bald eagle model.

- sharp-tailed grouse
- mountain quail*
- peregrine falcon
- bald eagle*
- gray wolf
- sage sparrow
- brewer's sparrow*
- N. Idaho ground squirrel
- S. Idaho ground squirrel
- fisher
- river otter*
- rocky mtn. bighorn sheep
- loggerhead shrike

Appendix A. (Cont.)

Future Activities

Following selection of the evaluation species, IPC will provide the needed model variable data from their field studies and GIS products, and I will conduct the WHA assessment of current habitat values. I will prepare a draft report on these activities and findings for WHA team review. Comments will be addressed in the final report following completion of the analysis of future habitat values.

Meeting Agenda

Time	Item
8:30–8:45	What are we doing here?
8:45–10:15	Cover types likely to be affected by operating scenarios
10:15–10:30	Break
10:30–11:45	Important habitat components of affected cover types
11:45–12:45	Lunch (provided)
12:45–2:45	Evaluation species selection
2:45–3:00	Break
3:00–4:00	Evaluation species selection (continued)
4:00–4:30	Discuss “new study“ species
4:30	Adjourn

Appendix A. (Cont.)

HELLS CANYON COMPLEX
WILDLIFE HABITAT ASSESSMENT TEAM MEETING NOTES
JULY 1, 1999

TO: **Hell's Canyon Complex WHA Team Members**

Toni Holthuijzen/Idaho Power

Dale Toweill/Idaho Department of Fish and Game

Mary Lucachick/Idaho Department of Parks and Recreation

Jim Clark/Boise District - Bureau of Land Management

Linda McEwan/Wallawa-Whitman National Forest

Dorothy Mason/Vale District—Bureau of Land Management

Errol Clair/Oregon Department of Fish and Wildlife

Ed Bottum/Idaho Department of Fish and Game

Alan Sands/The Nature Conservancy—Idaho

Bob Kibler/U. S. Fish and Wildlife Service

Bob Nelson/Rocky Mountain Elk Foundation

COPIES: Allan Ansell/Idaho Power

Anders Mikkelson/Shoshone Bannock Tribe

FROM: Chuck Blair

DATE: July 19, 1999

Meeting Purpose

The main purpose of this meeting was to select evaluation species for the habitat assessment. We also discussed a qualitative evaluation of several other species passed along to us from the Resource Work Group (which is you).

Appendix A. (Cont.)

The specific objectives of this WHA team meeting included:

- Agreeing on important cover types that would be affected by operating scenarios.
- Selecting evaluation species to assess current conditions and future changes in cover type habitat components based on model variables appropriate to measure cover type component changes (see below).
- Discussing qualitative assessment of other species assigned from the Resource Work Group.

These notes present meeting discussion topics focusing on the study area and evaluation species selection first, followed by other subjects that were discussed.

Evaluation Species Selection Process

I undertook a number of steps to help the WHA team move through the evaluation species selection process more efficiently. The assumptions underlying each step were explained as the number of potential evaluation species was reduced.

Evaluation Species Selection Criteria

The selection criteria discussed at earlier meetings were also reviewed. Evaluation species selection criteria included:

- Important cover types that could be affected by future IPC actions.
- Specific components of those cover types or habitats that are important to wildlife.
- Variables within species models that can help us measure specific components.
- Using a combination of existing models whose variables can infer valuable information about species of interest (i.e. can we learn about possible effects on Columbia spotted frog habitat through using the yellow-headed blackbird model, perhaps combined with others).
- Single cover type species are preferred because they are likely to tell us more about a particular cover type that may change.

Affected Cover Types and Related Topics

The first step in the evaluation species selection process was to agree on the cover types that may be affected by IPC actions regarding flow or water management scenarios. I suggested that wetland and riparian cover types are the only ones that have the potential of changing in response

Appendix A. (Cont.)

to water management scenarios. This is based on what we have heard of preliminary studies, the distribution of cover types, and the nature of the water management scenarios.

I distributed a table (attached) showing the acreage of these cover types within 25 m of the river or full-pool reservoir shorelines. A question was raised as to whether 25 m was wide enough, especially for the Weiser to Brownlee Pool reach. A wider area of consideration for this reach seems to make sense, and Toni and I will consider how to address it. However, it was agreed that in considering water management scenarios, the wetland and riparian cover types would be the focus as that is where changes may occur. Questions and comments related to upland cover types and other wildlife and habitat are discussed later in these notes.

Another question asked was if the study will be able to assess changes in the distribution and juxtaposition of wetland and riparian cover types in light of their patchy occurrence as a narrow band. In general, projecting those types of changes is the objective of the riparian habitat/flow study that Bob Simons and Jeff Braatne have discussed. However, they cannot predict specifically what will happen at every location within the study area in response to a flow scenario. Their predictive ability will be more along the lines of: cover type A occurs in certain situations governed by soil moisture, substrate, and hydrology. The flow scenario will affect these variables, resulting in a change in substrate and/or moisture. Cover type A will no longer be suited to these conditions and would be replaced by cover type B. This replacement would be projected for all locations where the original conditions would change to the new conditions.

I posed this question to Jeff Braatne to be sure that I had the answer correct, and here is his response: "We will not be calculating the areal extent of riparian vegetation patterns, nor will we assess longitudinal vegetation patterns and/or connectivity of vegetation patterns along the study corridor. Rather, our sampling will characterize current vegetation patterns in relation to major geomorphic types within the study corridor that developed in large part in relation to the hydrologic regimes following dam construction. On the basis of this sampling and historic reviews of vegetation patterns and hydrologic regimes, our modeling will focus upon distinct vegetation/geomorphic associations and how different flow regimes will affect vegetation patterns for each association; primarily, the shifting of plant communities along the riverbank/shoreline in response to changing hydrologic regimes."

A question was raised regarding the pool fluctuation in the three reservoirs and the ramping rates below Hell's Canyon dam. HC pool fluctuates from 3 to 5 feet, Oxbow from 10 to 12 feet, and Brownlee up to 110 feet. The ramp rate below HC is 3 feet per hour. What are the average and maximum fluctuations? Toni will get back to us on that.

There was some discussion concerning the limits of this study (wetland and riparian cover types) and a request that these limits be clearly stated in the report. I will carefully document all aspects of the study, including assumptions and limitations, so that the reader will know what we did and did not do. The WHA team will have an opportunity to review and comment on all sections of the study report.

Appendix A. (Cont.)

Evaluation Species Selection

With concurrence that the upland cover types would not be affected by flow scenarios, I eliminated the potential evaluation species that apply only to upland types and took the following steps. All referenced tables are included at the end of these notes.

- Eliminating upland species left 16 species suitable for evaluating habitat quality for various wetland and riparian cover types.

- I compiled a list of 8 general habitat components or measures that are important to a broad range of wildlife that might use wetland and riparian cover types.

- I expanded this list of 8 general components or measures to 15 specific components or measures by applying the general characteristics to different vegetation strata.

- This list of 15 components and measures was compared to 38 model variables of the 16 models noted in the first bullet above. The 38 variables are those likely to change in response to flow scenarios. This comparison determined which combination of species models best accounted for all or most of the important habitat components. Some species were eliminated because of considerable overlap of model variables with those of another model.

- Eight species that covered the range of important habitat components and measures discussed above were proposed for use in the study. These 8 species included 29 of the 38 variables likely to change in response to flow scenarios and didn't eliminate any important variables. Tables demonstrating this process are attached.

- The final table (All Habitat Variables….) includes all of the variables for the 8 selected evaluation species, including those that may not change in response to flow scenarios.

The WHA team discussed the model variables for these 8 species and generally agreed, with a few additions noted below, that they reasonably represent the important wildlife habitat components of wetland and riparian cover types in the HCC study area.

Note that I have corrected a few errors regarding habitat variables in the handouts from the meeting. The corrected sheets are attached. Please discard the meeting handouts to avoid future confusion.

Other Habitat Components Discussed

Some team members expressed specific interest in certain other habitat components that are not included as variables in any known HEP HSI models. Questions were asked concerning potential changes to substrates, woody and leaf litter, mosses, bryophytes, and down wood. These may be

Appendix A. (Cont.)

important habitat components for species such as the long-toed salamander or the Coeur D' Alene salamander and for a variety of invertebrates that provide food for amphibians. There are

no HEP HSI models that include variables to measure these components. Toni has some of this information and will provide it, but it will not be part of a species model. Toni can provide information regarding the amount of woody litter and occurrence of mosses and bryophytes, but he does not have data on size of down wood. I will also contact Chuck Peterson regarding important amphibian habitat parameters.

The towhee model was briefly discussed because it measures lateral vegetation screening, litter cover, and litter depth. Unfortunately, IPC does not have information regarding litter density or depth.

A question was also raised about habitat for land snails that are dependent on riparian zones with higher canopy cover values. I will contact a malecologist to discuss land snail habitat parameters to see what IPC has and can provide outside of the WHA process.

Species from the TRWG for our Discussion

The RWG met on November 20, 1997, to discuss rare, threatened, and endangered species. They developed a list of species for further study, noting those for which there were ongoing IPC study efforts and those for which new studies were needed. The species listed below were to be referred to the WHA team for assessment. You may recall my earlier discussion regarding the limitations of the bald eagle model.

- sharp-tailed grouse
- mountain quail*
- peregrine falcon
- bald eagle*
- gray wolf
- sage sparrow
- Brewer's sparrow*
- N. Idaho ground squirrel
- S. Idaho ground squirrel
- fisher
- river otter*
- rocky mtn. bighorn sheep
- loggerhead shrike

An asterisk denotes those species for which there is an existing HEP HSI model.

The WHA team discussed these species briefly and reached the following conclusions. The river otter was selected as one of the evaluation species by the WHA team. IPC is conducting studies on several of the species and the others do not occur in the study area. Therefore, no action will be taken by the WHA team regarding these species.

Appendix A. (Cont.)

HELLS CANYON COMPLEX WILDLIFEHABITAT ASSESSMENT TEAM SEPTEMBER FLOAT TRIP

TO: **Hell's Canyon Complex WHA Team Members**

Toni Holthuijzen/Idaho Power

Dale Toweill/Idaho Department of Fish and Game

Mary Lucachick/Idaho Department of Parks and Recreation

Jim Clark/Boise District—Bureau of Land Management

Linda McEwan/Wallawa-Whitman National Forest

Dorothy Mason/Vale District—Bureau of Land Management

Errol Clair/Oregon Department of Fish and Wildlife

Ed Bottum/Idaho Department of Fish and Game

Alan Sands/The Nature Conservancy—Idaho

Bob Kibler/U. S. Fish and Wildlife Service

Bob Nelson/Rocky Mountain Elk Foundation

COPIES: Allan Ansell/Idaho Power

Anders Mikkelson/Shoshone Bannock Tribe

FROM: Chuck Blair

DATE: July 19, 1999

Memo Purpose

The purpose of this memo is to provide a few more details concerning the September float trip and to finalize the head count so that we can arrange boats and the shuttle.

Appendix A. (Cont.)

Trip Purpose

The broad objective of this trip is to become familiar with the reach below Hells Canyon Dam and get a better feeling for the botanical and wildlife resources present. There will be discussions regarding the various studies IPC is conducting and the problems they are trying to solve. We will stop at specific locations to discuss issues and look at the environment. You should also plan to have some fun on the trip! I'll get that on the agenda.

Final Head Count

At this time the following people have indicated that they will attend the field trip: Dale, Ed, Linda, Dorothy, Errol, and Bob Nelson. What about the rest of you? Please let me know your final plans by July 29th.

Dates and Times

As you know, the float trip from Hell's Canyon Dam to the mouth of the Salmon River will occur between September 13 and 17. To allow plenty of time for stopping and looking, we will need to launch early on the 13th. We'll want to be at the launch site by about 8:30 a.m. to help get all of the gear loaded. That means you should plan to either spend the night of the 12th in the canyon or to drive in very early on the 13th. In either case, you will probably need to be at the launch site by 7:30 or 8:00 a.m. If you will camp out the night before, plan to stay at Hell's Canyon Park on Hell's Canyon Reservoir.

Dutch Oven Treats

One of Toni's fellow IPC employees, Kelly Wilde, will be handling many of the logistics, including purchasing food for the entire trip. I know several of you have expressed the desire to prepare some of your favorite Dutch oven dishes and I, for one, was looking forward to enjoying them. However, in talking with Kelly, he has this routine pretty well down after 20+ Hell's Canyon trips in 3 years and would prefer to set up the entire menu. He has all of the portions figured out and will have us eating at a reasonable hour each evening. He promises that we will eat well and all will be quite satisfied. That way we can look at some site once we hit camp and don't need to worry about cooking. Sorry that it's not going to work out to do our own menu items. Those of you who have been on a week-long trip will understand how setting up these logistics could be a problem.

Please let me know if there are any **special dietary needs** for the trip.

Appendix A. (Cont.)

Personal Equipment and Supplies

I have attached a modified copy of my personal river trip gear list to the end of this memo. Be sure that you've got all of the stuff on the list that is important to you. One thing to keep in mind is that we usually get a bit of the fall's first rain in September. It may be 90 degrees each day, but it could also be 60 degrees and raining for some of the time. **One item that you absolutely *must* have is good rain gear from head to toe, along with some warm clothes (not cotton) to go under the rain gear.** The rest is up to you. Please review the list and call me if you have any questions. A few of your personal items will be available during the day, but the bulk of your stuff will be packed in a dry bag until we hit camp at the end of the day. Also keep in mind that accidents do happen on river trips, and you may want to think about whether you want to bring your best fly rod or new camera—it's your choice.

Plan on bringing your own beer or other libations for the evenings. **NO GLASS** containers.

Tentative Agenda and Discussion Items

Toni has started to put an agenda together and is soliciting input from other IPC staff and from us. His preliminary list of things to look at and discuss follows. Please let me know if you have other ideas by July 29th. Toni's preliminary thoughts follow:

- Blown-out tributaries (e.g., Kirkwood)
- Hikable tributaries with sample locations (bird points, amphibians, reptiles, small mammals, etc.)
- Botanical Descriptive Studies
    1. Shoreline surveys
    2. Upland sample points "typical" of the area
    3. Noxious weeds (e.g., comparison Battle Creek, Temperance Creek, and Tin Shed)
    4. T&E species surveys
    5. Vegetation Map

Appendix A. (Cont.)

- Botanical Impact Studies

  Vegetation Sampling (transect)

  1. Bank Erosion
  2. T&E Plant Surveys
  3. Noxious Weed Surveys
  4. Future Desired Conditions (paired photographs)
  5. Vegetation Modeling

- Hells Canyon operations and impacts on the riparian zone
- Downed logs in riparian areas (amphibian habitat)
- Recreational impacts on riparian systems (popular campsites; Mary Lukachick—I need your help here for specific sites)

  1. T&E Plants and Animals (bats, bald eagles, peregrine falcon)
  2. Noxious weeds
  3. Riparian vegetation

- Sediment transportation

  1. Sand bars
  2. Substrate for plants
  3. Important riparian habitat
  4. Sources of sediment (Bonneville Flood Deposits, tributaries)

- Cultural resources
- Bats (spotted bats located at specific campgrounds), caves, impacts of recreation

Appendix A. (Cont.)

- WHA models
  1. Appropriate parameters modeled
  2. Zone of impact

  Natural versus operational fragmentation of the riparian zone

RIVER TRIP GEAR LIST—Personal stuff

sun screen	sun hat with visor
river sandals and/or tennis shoes	sleeping pad
sleeping bag	Shorts
long pants	polar plus top or sweater
long underwear bottoms and tops—for cold and rainy weather	waterproof rain suit and hat
warm hat	head lamp or flashlight, good batteries
towel	binoculars
camera, film, good batteries	no-blister socks
hiking boots	wool socks
back or hip pack	field guides
compass	maps
note or log book, pencil, pen	Leatherman tool or pocket knife
1 liter water bottle—2 each	swim suit
personal toiletries	fishing gear (smallmouth bass will be the primary quarry, but there are also some trout)
fishing license	specialty items, like hay fever drugs or other medication
Thermarest chair for your sleeping pad— sorry, no room for folding chairs	Dry bags—Some may be available from IPC. Please advise as to your needs
Tent—Some may be available from IPC. Please advise as to your needs	

I've been on and organized many river trips so if you have questions regarding clothes, equipment, or the trip in general, please don't hesitate to call me.

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Appendix A. (Cont.)

HELLS CANYON COMPLEX WILDLIFE HABITAT ASSESSMENT TEAM SEPTEMBER FLOAT TRIP

TO: **Hell's Canyon Complex WHA Team Members**

Toni Holthuijzen/Idaho Power

Dale Toweill/Idaho Department of Fish and Game

Mary Lucachick/Idaho Department of Parks and Recreation

Jim Clark/Boise District—Bureau of Land Management

Linda McEwan/Wallawa-Whitman National Forest

Dorothy Mason/Vale District—Bureau of Land Management

Errol Clair/Oregon Department of Fish and Wildlife

Ed Bottum/Idaho Department of Fish and Game

Alan Sands/The Nature Conservancy—Idaho

Bob Kibler/U.S. Fish and Wildlife Service

Bob Nelson/Rocky Mountain Elk Foundation

COPIES: Allan Ansell/Idaho Power

Anders Mikkelson/Shoshone Bannock Tribe

Loren Kroneman/Nez Perce Tribe

Lynn Roehm

FROM: Chuck Blair

DATE: September 7, 1999

Appendix A. (Cont.)

Memo Purpose

Here's the final information about the float trip. The attached file includes an itinerary. Recommended accommodations for Sunday night are the Hell's Canyon campground on the Idaho side of Hell's Canyon Reservoir. There are a few spots available at IPC's Brownlee Village Recreation house but that means a longer drive in the morning. Let me know if camping won't work for you Sunday night and you need a place to stay. **We'll be meeting as a group at 9:00 a.m. MDT Monday at the Hell's Canyon launch (located at the end of the road on the Oregon side).** The itinerary file is attached. I've also added the entire text, but the format isn't the greatest.

I sent the personal gear list out awhile ago, asking if anyone needed dry bags or a tent (IPC may have extras). I got no response, so I assume everyone has what they need in the way of this stuff. If not, I need to know by Wednesday!!!

See you Sunday evening or Monday morning.

Trip Purpose

The broad objective of this trip is to become familiar with the reach below Hells Canyon Dam and to get a better feeling for the botanical and wildlife resources present. There will be discussions regarding the various studies IPC is conducting and the problems they are trying to solve. We will stop at specific locations to discuss issues and look at the environment.

Potential Departure from Pittsburgh Landing

A couple of folks (Bob and Linda) will be leaving us at Pittsburgh Landing and a couple of others will be joining us there. Those leaving will drive back to their vehicles at the launch site. There is probably room for one more person to leave from Pittsburgh Landing, so let me know if you absolutely must get out there. However, I recommend that you stay for the entire trip as Jeff Braatne will be joining us at Pittsburgh.

Appendix A. (Cont.)

Personal Equipment and Supplies

I have attached a modified copy of my personal river trip gear list below. Be sure that you've got all of the stuff on the list that is important to you. One thing to keep in mind is that we usually get a bit of the fall's first rain in September. **It may be 90 degrees each day, but it could also be 60 degrees and raining for some of the time. One item that you absolutely *must* have is good rain gear from head to toe along with some warm wool or polar plus clothes (*not cotton!!!)* to go under the rain gear.** The rest is up to you. Please review the list and call me if you have any questions. A few of your personal items will be available during the day (in a small dry bag that you bring), but the bulk of your stuff will be packed in a dry bag until we hit camp at the end of the day. Also, keep in mind that accidents do happen on river trips, and you may want to think about whether you want to bring your best fly rod or new camera—its your choice.

Plan on bringing your own beer or other libations for the evenings. **NO GLASS** containers.

RIVER TRIP GEAR LIST—Personal stuff

sun screen	sun hat with visor
river sandals and/or tennis shoes	tent (see note below)
sleeping bag	sleeping pad
shorts	long pants
polar plus top or sweater	long underwear bottoms and tops—for cold and rainy weather
warm hat	waterproof rain suit and hat
head lamp or flashlight	towel
binoculars	camera, film, good batteries
light hiking boots	wool socks
no-blister socks	small back pack or hip pack
field guides	note or log book, pencil, pen
Leatherman tool or pocket knife	1 liter water bottle—2 each
personal toiletries	swim suit
sun shower	fishing gear (smallmouth bass will be the primary quarry, but there are also some trout)
fishing license	specialty items like hay fever drugs or other medication
Thermarest chair for your sleeping pad—sorry, no room for folding chairs	Dry bags—You'll need enough for your gear and perhaps a small one to keep with you during the day—some may be available from IPC. Pease advise as to your needs
Tent—some may be available from IPC. Please advise as to your needs	

Appendix A. (Cont.)

I've been on and organized many river trips so if you have questions regarding clothes, equipment, or the trip in general please don't hesitate to call me.

Itinerary Float Trip September13–17, 1999, Hells Canyon to the Salmon River. Note: all times are Mountain Daylight Time

Date	Location/Time	Activity
Monday, September 13	9:00 a.m. Hells Canyon Boat Ramp	• Safety Quick Course • Load and Launch float trip
	RM 242 Battle Creek	• Riparian Vegetation • Spotted Bat Site
	RM 241 Wild Sheep Rapids	• Scout Rapids
	RM 240 Granite Creek *Alternate Sites:* • RM 238 Oregon Hole • RM 236 Saddle Creek • RM 235 Bernard Creek	• Preferred Camp Site • Set up Camp • Tributary Riparian Vegetation • Bird Surveys • Riparian Vegetation Sampling • Downed Logs in Riparian • Amphibian and Reptile Sampling • Predator Survey
Tuesday, September 14	RM 238 Three Creeks	• Riparian (White Alder Along Mean High Water Mark)
	RM 236 Saddle Creek	• Upland Vegetation Sampling • Historic Cabin • Historic Photo
	RM 230 Johnson Bar	• Riparian (Age Structure Hackberry)
	RM 229 Sheep Creek	• Riparian Vegetation
	RM 228 Pine Bar	• Historic Photo
	RM 224 Temperance Creek	• Noxious Weeds • Shoreline Sampling • Shore Erosion • Amhibians and Reptiles • Historic Photo
	RM 223 Salt Creek *Alternate Site*: • RM 220 Kirkwood Creek	• Preferred Camp Site

Appendix A. (Cont.)

Date	Location/Time	Activity
Wednesday, September 15	RM 220 Kirkwood	• Historic Site • Blow-out Creek Mouth (erosion) • Riparian Vegetation • Noxious Weeds
	RM 215 Pittsburgh Landing	• Pick up Jeff Braatne, Lynette • Drop-off Patty, Bob, Linda, Others? • Water Stop • Discuss Recreation/Wildlife Issues • Noxious Weeds/Livestock Interactions • Historic Photo
	RM 209 Tryon Creek *Alternate Sites:* • RM 205 Ragtown Bar • RM 205 Bob • RM 202 Pine Bar	• Preferred Camp Site
Thursday, September 16	RM 202 Five Pine Rapids	• Amphibian Site • Noxious Weeds • Emergent Herbaceous Vegetation • Ephemeral Pools
	RM 197 Dug Bar	• Sand Bar Erosion • Noxious Weeds • Historic Photo • Hackberry Bands along River
	RM 192 Eureka Bar	• Historic Photo
	RM 192 Mountain Chief Tunnel	• Bats
	RM 188 Mouth Salmon River/Salmon Bar	• Preferred Camp Site

Appendix A. (Cont.)

Date	Location/Time	Activity
Friday, September 17	RM 188 Mouth Salmon/Salmon Bar	• Pack up Camp • Shaun Parkinson Arrival • Sediment Transportation Study • Geomorphology • Sand Bars (Large Sediment Pool)
	10:00 a.m. Mouth Salmon River	• Depart for Hells Canyon Dam
	2:00 p.m. Brownlee Field House	• Unpack, clean- p
	3:00 p.m. Brownlee Field House	• Depart for Boise

Meal Plan (*All other meals are also provided*)

Date	Meal Plan
Monday, September 13	Grilled Salmon, Rosemary Potatoes, Fruit, and Vegetables
Tuesday, September 14	Barbecued Steak and Chicken, Wild Rice Pilaf, Corn on the Cob, Fruit, and Vegetables
Wednesday, September 15	Lasagna, Fruit, and Vegetables
Thursday, September 16	Chicken Enchiladas, Fruit, and Vegetables
Friday, September 17	Boise

Appendix A. (Cont.)

HELLS CANYON COMPLEX WILDLIFE HABITAT ASSESSMENT TEAM HELLS CANYON FLOAT TRIP NOTES

SEPTEMBER 13–16, 1999

9-13-99

Battle Creek—Hiked up to the old cabin at Battle Creek. Hackberry has invaded the original hayfields. Many of the original rock walls are still in existence. High flows in Battle Creek in January 1997 destroyed much of the riparian vegetation lining the creek bed. We also looked at a couple of ponds downstream of Battle Creek that are extensively used by western toads for breeding. During high water in the spring, the ponds fill and are subsequently cut-off when the water recedes. These backwater ponds provide excellent breeding conditions for western toads.

9-14-99

Wilson Ranch—old cabin at Wilson homestead. Very little riparian vegetation in the old photo.

Johnson Bar—an old photo point. Little change apparent today compared to the historical photos; same 2 pine trees—not much larger in 40 years; hackberry now extends up into the clearing compared to its distribution in the old photo.

Pine Bar—Ponderosa pines similar to old photo—some less sand visible now than in the photo.

Temperance Ranch—discussed weed and rare plant surveys. Native *Spartina* along the water's edge here—also some *Salix exigua* patches in the area. Weeds are a really big problem here.

Spartina is scattered and locally common in dry to moist meadows and along smaller streams and rivers at low to mid elevations through the Intermountain West. Like many graminoids, *Spartina* is vulnerable to scour, hence its distribution along Hells Canyon is limited to a few isolated patches along the study corridor. The coarse nature of the foliage deters grazing by some ungulates, though not cattle.

Kirkwood Ranch—Landed at Kirkwood Ranch where we camped. Most people took the opportunity to tour the historic ranch. The area was pretty intensively used, with several thousand head of sheep and several hundred head of other livestock.

Appendix A. (Cont.)

9-15-99

Tin Shed (above Pittsburgh landing)—rich cultural site—5–7,000 years of occupation. Important sturgeon area as well. Bank erosion is causing problems here. The following issues were discussed:

- Project operations generally are < 30,000 cfs, and do not cause bank erosion.
- >30,000 cfs are generally non-project events, but the water is sediment starved, which increases erosive potential
- Large runoff events cause problems, but are not controlled by IPC.
- Groundwater flows toward river in this area and is also causing the bank to collapse.
- Recreation use is heavy, causing trampling of the vegetation and collapse of cut-banks.

IPC is conducting ongoing studies to address the erosion problem at Tin Shed in cooperation with the Forest Service and the tribes. The following actions have been considered or are taking place:

- The Snake River is designated as Wild and Scenic, therefore rock rip rap cannot be used to slow erosion.
- IPC is considering some native vegetation planting.
- IPC is conducting 2-dimensional hydraulic modeling to help plan vegetation plantings to try to stabilize the bank.
- A series of transects placed perpendicular to the river bank are monitored by the Forest Service to determine the rate and extension of the erosion.

The bench above the Tin Shed site is an old farmstead and is very weedy.

Pittsburgh Landing—Met with Jim Chatters, one of the principal investigators of the archaeological studies taking place downstream of Hells Canyon Dam. Dr. Chatters explained the goal and objectives of the investigations, their ground survey techniques employed and provided some examples of the type of information collected and reported. Hundreds of sites have been reported in the area below Hells Canyon Dam, both pre-historic and historic sites. Often these sites are superimposed on each other, because a limited number of locations are available for habitation. Only surface material is inventoried and catalogued. Materials are generally left were they are found. Any artifacts that would be destroyed or vandalized are collected and deposited at a university collection. Dr. Chatters discussed the change in food items remains discovered in the Hells Canyon reach, which changed considerably over time.

Appendix A. (Cont.)

In early collections, suckers and marmots composed an important part of the collected materials, suggesting a wetter and milder climate than currently. Salmon were only a very minor component. Later, salmon, as well as big game animals, appeared to be more important in the diet of the early inhabitants of the canyon environment. Freshwater shells also were collected in large quantities. There was some discussion of the edibility of the mussels. Some people considered mussels to be starvation food: others argued that this food item was reliable and easily harvested, and, therefore, consumed regularly.

Ragtown Bar Camp—(Idaho side) great beach. Jeff talked about riparian communities, effects of seasonal and daily fluctuations (see attached summary of his discussion).

Five Pine Camp (Oregon side) backwater area—This area is connected to the river at flows above about 50,000 cfs. This backwater area has no water now—but moist conditions remain under rocks. This is great western toad habitat breeding habitat, and many small toads were seen. No piscivorous predators survive as water recedes.

Deep Creek—example of an area occupied by willow. The supply of fine sediment from the tributary provides suitable substrate for willow establishment and growth. Willows also occur at some eddies where suitable conditions exist.

Willow reproduction modes include sexual, asexual, and Clonal branch fragments (branches that break off and float downstream to suitable substrate).

Jeff Braatne indicated that there are about 35–40 willow stands from Hell’s Canyon Dam to the mouth of the Salmon River.

9-16-99

Last camp on the Oregon side below the mouth of the Salmon River. Lots more fine sediment here (sand) below the mouth of the Salmon River.

Appendix A. (Cont.)

Agency and WHA team members on the trip

Dale Toweill/Idaho Department of Fish and Game

Dorothy Mason/Vale District—Bureau of Land Management

Ed Bottum/Idaho Department of Fish and Game

Bob Nelson/Rocky Mountain Elk Foundation

Chad Colter/Shoshone Bannock Tribe

Anders Mikkelson/Shoshone Bannock Tribe

Loren Kroneman/Nez Perce Tribe

Allan Ansell/Idaho Power Company

Brett Dumas/Idaho Power Company

Toni Holthuijzen/Idaho Power Company

Kelly Wilde/Idaho Power Company

Heather Schwartz/Idaho Power Company

Chuck Blair/CH2M Hill

Jeff Braatne/University of Washington

Summary/update of Hells Canyon/Snake River Riparian Vegetation Field Studies by Jeff Braatne

A team of scientists, led by Dr. Stewart Rood, University of Lethbridge, and Dr. Jeffrey Braatne, University of Washington, has been sampling the narrow band of riparian vegetation along the Hells Canyon/Snake River corridor over the last two growing seasons (1998 and 1999). Permanent riparian vegetation belt-transects were established below Hells Canyon Dam at a density of approximately one sample transect per river mile. The intensity of this sampling effort appears to be adequate to describe the riparian plant communities. We are currently in the process of analyzing these data. However, we can offer a brief and preliminary summary of the field observations to date.

Appendix A. (Cont.)

In general, the areal extent and diversity of riparian plant communities in Hells Canyon are limited. The severely confined, deeply incised, bedrock-dominated geomorphic context of the canyon provides an environment in which riparian vegetation is currently sparse, was historically sparse, and almost certainly will continue to be relatively sparse compared to many other riparian corridors along rivers of western North America. For example, gallery forests of black cottonwood and/or white alder typically found along other western rivers could never develop along the main channel of the Hells Canyon/Snake River corridor because substrate suitable for germination and growth of cottonwoods is very sparse, large floods associated with spring runoff or warm winter storms generally tend to scour the confined river bed and the confined canyon, and lack of a floodplain. However, although the riparian vegetation is sparse, it is extremely important in providing terrestrial wildlife habitats, as well as contributing to the health and productivity of the aquatic, riverine ecosystems.

The geomorphic context of the canyon naturally limits channel migration, and the extent of riparian habitats is correspondingly restricted to very narrow and discontinuous bands of herbaceous and woody plants along the main channel. Conversely, side-tributaries have a high diversity and more continuous cover of riparian woody vegetation (i.e., white alder with associated shrubs and some black cottonwood). These vegetation patterns are fairly typical of some other western river canyons. The bedrock confinement of the canyon combined with the intense scouring by seasonal floods and storm-related flows limits the development of riparian vegetation within the river canyon.

Typical of most western rivers, the riparian corridor of Hells Canyon is composed of four different plant communities: 1) upland grass/shrub habitats (non-riparian/non-flow impacted), 2) facultative and/or transitional riparian zone (hackberry and shrubs), 3) obligate riparian zone of herbaceous perennial plants, and 4) barren low elevation zones. These plant communities can be found on a range of different geomorphic surfaces throughout the riparian corridor. Upland and facultative habitats occur at higher elevations, with a progressive transition to obligate and barren zones at lower stream bank elevations. In those portions of the canyon with constricted, steep bedrock walls, riparian vegetation is largely absent. Old, large hackberry shrubs and trees are found at or near the high water/scour mark. The upper portions of the facultative/transitional zone are dominated by hackberry with some associated upland grasses and forbs. The facultative zone extends down slope for several meters. At lower portions of the facultative zone, hackberry is replaced by perennial herbs, such as prairie sage/riverbank wormwood. Below the facultative zone is a very narrow zone of obligate riparian plants, such as hemp dogbane (*Apocynum cannabinum*), American licorice (*Glycyrrhiza lepidota*), sandbar or coyote willow (*Salix exigua*) (limited number of discrete populations), cocklebur (*Xanthium strumarium*), and water smartweed (*Polygonum amphibium*). Below this zone of obligate riparian vegetation, a fairly large zone of barren cobble, boulder and/or bedrock is exposed during seasonal low flows. This vegetative pattern is fairly typical of other river canyons, such as the adjacent lower

Appendix A. (Cont.)

Salmon River gorge. However, the relative abundance of sediment along the Salmon River has resulted in more abundant sandbars and more widespread and continuous zones of sandbar willow than currently occur along the Hells Canyon/Snake River Corridor (Rood/Braatne per. observations).

Small hackberry plants, derived primarily from root suckers, are found approximately one to six meters down slope from the older parent plants that are often growing at the high water/scour mark. These smaller plants appear to represent a recent expansion of the riparian fringe zone of hackberry within Hells Canyon. They sometimes occur at stream bank elevations that would probably be occupied by sandbar willow if fine sediments were more abundant and/or possibly if water stage patterns differed.

Higher summer base flows and the gradual erosion of fine sediments associated with the release of sediment-free water from Hells Canyon Dam may have promoted or permitted suckering by the hackberry plants. It appears that the pattern of lower elevation root suckering by hackberry is less common along some unregulated rivers, such as the lower Salmon River gorge (Braatne/Rood per. observations). Changes in flow operation patterns have the potential to significantly impact the health and vigor of both young and long-established riparian hackberry shrubs and trees.

About 40 patches of sandbar willow (100m^2 or larger) were observed along the Snake River between the Hells Canyon Dam and the Salmon River mouth. These small populations appear to be relatively healthy, although due to the lack of sediment deposition, they appear to be largely relict populations. We did not observe zones of active seedling or clonal recruitment by willows. These relict populations are typically found in protected zones associated with eddies below major rapids and below the inflow of side tributaries. On the basis of these observations, the type and volume of sediments contributed by side-tributaries are probably not sufficient to promote the active recruitment of fine-sediment dependent species, such as sandbar willow. Nevertheless, the sediment contributed by these side-tributaries may be important to the maintenance of willow populations found on and downstream of alluvial fans.

Finer sediments have a higher moisture retention capacity than the coarser gravel and cobbles associated with alluvial fans and many other stream-side zones along Hells Canyon. Increased moisture availability associated with areas of fine sediments are probably important for maintaining the health and vigor of the willows and other riparian plants, especially in mid- to late summer when high ambient temperatures create additional evapotranspirational demands.

The reduction of livestock grazing within Hells Canyon is probably particularly important for the maintenance of the riparian populations of willows and other obligate riparian plants that are typically highly palatable for livestock, as well as many wildlife species. Historic patterns (1880s to 1950s) of widespread sheep and cattle grazing would have clearly limited the areal extent of willow populations prior to dam construction in the late 1950s.

Appendix A. (Cont.)

Downstream of the confluence of the Snake and Salmon rivers, willow populations appear to be more abundant and beaches and sandbars are more common. The contribution of suspended sediments from the Salmon River has probably sustained the more active recruitment of willows through both seedlings and clonal branch fragments. An increase in the relative abundance of willow can be observed around Cook and Lower Jim Creek (RM 183/182), and below Cache Creek (RM 177) (Braatne/Rood per. observations). It should be recognized that the sediment budget along the Salmon River has been impacted by various human land-uses and the geologic and hydrogeologic histories of the Salmon and Snake rivers differ substantially. These and other factors undoubtedly confound the simple comparison of current conditions along the adjacent reaches of the Snake and Salmon rivers. Extensive sediment supply studies are currently underway and these data will greatly improve our knowledge of the sediment dynamics for the Hells Canyon corridor.

Our riparian vegetation sampling efforts have also characterized the nature and distribution of plants listed as noxious weeds as well as threatened and endangered plants within the Hells Canyon. To date, the areal extent of “listed” noxious weeds is generally limited to upland habitats and the upper portions of the facultative zone. In most cases, St. Johns wort (*Hypericum perforatum*) is the most common noxious weed within these zones. The small sedge, *Cyperus schweinitzii*, considered in Oregon to be a threatened species, is also limited to upper portions of the facultative zone. As a result, the current and proposed flow scenario will probably have limited effects upon the health and vigor of noxious or threatened plants. In our ecophysiological analyses, we will attempt to assess some aspects of the general distribution patterns of native vs. exotic (i.e., Eurasian and/or noxious) plants within the riparian corridor of Hells Canyon.

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Appendix A. (Cont.)

TERRESTRIAL RWG FIELD REVIEW SNAKE RIVER FLOAT TRIP FROM HELLS CANYON DAM TO SALMON RIVER

SEPTEMBER 18–22, 2000

FINAL EXECUTIVE SUMMARY

TRWG Float Trip Participants

Allan Ansell, IPC

Lori Barnes, NW Dynamics

Chuck Blair, CH2M HILL

Dave Bogie, IPC

Ed Bottom, IDFG

Jeff Braatne, U. of W (Pittsburg)

Errol Claire, RMEF

Brett Dumas, IPC

Cheryl Eneas, Nez Perce Tribe

Colleen Fagan, ODFW

Lisa Hahn, IPC

Gary Holmstead, IPC

Toni Holthuijzen, IPC

Jim Keany, FERC (EDAW)

Dennis Lopez, IPC

Dorothy Mason, BLM

Holly Neilson, IPC

Casey Peavy, IPC

Angela Sandenaa, Nez Perce Tribe (Pittsburg)

Sonia Swartz, IPC

Aaron Utz, IPC

Kelly Wilde, IPC

Field Review Objectives

- Examine first hand the environment below the Hells Canyon Complex
- Build relationships within the TRWG

Appendix A. (Cont.)

- Provide the opportunity for the work group members and IPC aquatic scientists to discuss the on-going studies
- Discuss impacts
- Discuss ideas for potential PM&E measures

Overview

The Terrestrial Work Group conducted a five day field review/float trip of the Snake River, fromHells Canyon Dam to the Salmon River. Attendees spent a great deal of time discussing impacts and potential PM&E measures.

Throughout the trip, the group stopped at various sites where historical photos (early 1990s to mid 1950s) had been taken and Chuck Blair, CH2M HILL, shared information from the report "Effects of Constructing and Operating the Hells Canyon Complex on Wildlife Habitat." The photos helped the group compare current and historic (early 1990' to mid 1950s) habitat conditions. The report was discussed during the trip.

Outlined below are some of the areas, which were visited, and some of the topics discussed.

Jeff Braatne, U of W joined the group at Pittsburgh Landing. Included here is the summary of his presentation:

Float trip discussions of riparian vegetation patterns along the Hells Canyon reach of the Snake River—September 2000.

> On the September float trip, past, the distribution and ecology of riparian vegetation along the Hells Canyon reach of the Snake River were reviewed by Dr. Braatne at Pittsburg Landing and Ragtown Bar. Major points of discussion included: a) nature of cumulative impacts on riparian vegetation within the canyon, b) comparing present patterns of plant distribution with historic reports/photos of riparian vegetation, c) hydrologic and geomorphic components resulting in the lack of black cottonwood within the canyon, d) potential effects of elevated baseflows and diurnal flow fluctuations on riparian vegetation, and e) hydraulic, geologic, and vegetation modeling efforts to assess past impacts and predict future responses of riparian vegetation to different flow regimes.

Appendix A. (Cont.)

Beginning at Pittsburg Landing, the nature of cumulative impacts on vegetation patterns was reviewed. It was noted that the distribution patterns of riparian vegetation within the canyon was the result of impoundments, agricultural diversions, and land-use activities throughout the Snake River Basin. In particular, current hydrologic and geologic studies suggest that sediment sources for the canyon reach are largely derived from five tributaries, Weiser, Payette, Boise, Malheur and Owyhee Rivers, upriver of Weiser, Idaho. Of these, Weiser, Payette, and Boise Rivers with headwaters arising in the Idaho Batholiths (granitic rocks) were the primary sources of coarser sand factions deposited in sandbars or as interstital sands among riverbank rocks within the Hells Canyon reach. These tributaries were largely impounded by the 1940s through the actions of the US Bureau of Reclamation. As a result, declines in sandbar willow and other vegetation related to the lack of riverbank sediments should be at least partially attributable to these tributary diversions and dams. Jim Keany (FERC representative) was later requested to inform the work group on methodologies to assess cumulative impacts that are currently being developed by FERC within the Snake River Basin.

Current sediment studies show that sediment supply/transport conditions within the canyon are somewhat static, with increased transport primarily limited to extreme flow events (discharges > 100,000 cfs). It was also noted that the erosional effects of jetboat wakes on sandbars should not be ignored.

Historic photos of Hells Canyon show highly fragmented stands of hackberry along the main stem of the river, with extensive barren zones during seasonal low flow periods (late summer through winter). These historic patterns are very similar to current conditions. Some noteworthy differences from comparing photo sequences include a) downslope extension of hackberry via root suckers into the barren scour zones, b),increase in coverage of hackberry canopies, c) moderate declines in sandbar willows related to sediment depletion, and d) significant increase of riparian forest vegetation (alder, cottonwood, syringia) along side tributaries and alluvial fans.

The effects of current/historic flow conditions on riparian vegetation were systematically reviewed at Pittsburg Landing and Ragtown Bar. Declines in the intensity and duration of scouring flows (i.e., flows > 100,000 cfs) by upriver impoundments throughout the Snake River Basin have encouraged the downslope extension of hackberry (via root suckers) and associated perennial forbs (i.e., *Aftemesia ludoviciana, Apocynum cannibinum, Glychrriza lepidota*). Elevated summer baseflows appear to have increased the health and vigor of riparian hackberry stands. In effect, the areal extant of hackberry canopies are larger and more robust than shown in historic photos. Impacts of diurnal flow fluctuations are being modeled, but such fluctuations within the barren streamside zones are likely to have minimal effects on riparian vegetation patterns.

Appendix A. (Cont.)

Black cottonwood has always been limited to side tributaries and alluvial fans within Hells Canyon. The lack of cottonwoods along the lower Snake River is largely attributable to intense seasonal scouring flows, and lack of channel migration within canyon environments. These factors, along with distinct stage/discharge requirements during seed dispersal, are critical to the establishment of cottonwood seedlings (Braatne et al 1996, Mahoney and Rood 1998). Throughout North America, cottonwoods are limited to large alluvial rivers (cobble to fine substrates) that meander across extensive floodplains and wide river valleys (Braatne et al 1996, Johnson 1994). These fluvial geomorphic conditions have always been absent from Hells Canyon. Ongoing modeling efforts will provide further documentation of the fluvial/geomorphic conditions resulting in the lack of cottonwood forests throughout the study corridor.

The Simons study team is extensively modeling the hydraulics, geomorphology, and ecology of riparian vegetation for all of the reaches within the study corridor. These modeling activities, commonly referred to as HCREM (Hells Canyon River Environment Model), explore multiple facets of vegetation-fluvial geomorphic interactions within river canyon and reservoir shoreline habitats. A large number of native and exotic plants (herbaceous and woody plants) are incorporated into this model in order to explore the potential responses of vegetation to different flow scenarios. The modeling effort provides linkages with HEP analyses of wildlife habitat conditions and dominant vegetation cover types mapped by IPC.

It is important to remember that Hells Canyon is an exceptionally harsh landscape. Deep, laterally confined canyon walls and the abundance of surficial bedrock and cobble provide a static streamside zone that is not conducive to the recruitment and survival of riparian woody plants. Riparian vegetation is adapted to and dependent upon dynamic flow patterns and the repeated flooding of unconfined floodplains. The unique fluvial landscape of Hells Canyon has always provided extremely limited opportunities for the recruitment and survival of riparian woody plants.

Citations

Braatne, J.H., S.B. Rood and P.E. Heilman. 1996. Life history, ecology and conservation of riparian cottonwoods in North America. Pages 57–85 in R.F. Stettler, H.D. Bradshaw, P.E. Heilman and T.M. Hinckley, eds., Biology of Populus: implications for management and conservation. National Research Council of Canada, Ottawa.

Mahoney, J.M. and S.B. Rood. 1998. Streamflow requirements for cottonwood seedling recruitment—An integrative model. Wetlands 18: 634–645.

Johnson, W.C. 1994. Woodland expansion in the Platte River, Nebraska: patterns and causes. Ecological Monographs 64:45–84.

Appendix A. (Cont.)

Paleoecology of Hells Canyon

Oral presentation by James C. Chatters, Ph. D.

With the exception of evidence for a catastrophic flood from pluvial Lake Bonneville around 14,500 calendar years ago, what we know about the paleoenvironments of Hells Canyon postdates approximately 8100 years ago (7200 radiocarbon years B.P.). It is derived from local geomorphology, palynology of the nearby Rocky and Blue Mountains, and faunal remains found in archaeological sites. The record is not yet complete, and many time periods are not represented by all types of evidence. Thus, it is only possible at this time to discuss conditions generally as they existed in the canyon between about 8100 and 5000 years ago and since about 3000 years ago. I shall refer to these as the middle Holocene and late Holocene records, respectively.

Middle Holocene

Throughout the northwest, climatic conditions were significantly warmer and drier than they are today. Effective precipitation was lower by between 1/3 and 1/2, and both summers and winters were relatively warmer. During this time, the lower tree line in the nearby Rocky and Blue Mountains was elevated by more than 100 meters and vegetation cover in general was much reduced. In Hells Canyon, we see the effects of poor ground cover and unforested watersheds in the development of massive alluvial fans. Such fans develop when catastrophic storms-localized thunder showers—rapidly erode small, poorly-vegetated basins, but the resultant floods do not have the power to carry mobilized sediment to the trunk stream for further transport. Many of the archaeological sites that date from this period, most notably Bernard Creek Rockshelter, Kirkwood Bar, and Tryon Creek, contain eolian sediment that was apparently blown up from the Snake River floodplain-further indication of the relative drought of the times. Flows in the Snake River were lower than they are now, and the high proportion of the rocky Mountain ridgeback *(Gonidea angulata)* in mussel collections from this time indicates the water was warmer and more turbid, with a sandy-to muddy bottom. Fish faunas from archaeological sites are dominated by nonsalmonid fish, including suckers *(Catostomus spp.),* squawfish *(Ptychochedus oregonensis),* peamouth *(Mylod7eilus caurinus),* and chiselmouth *(Acrocheilus alutaceus).* At Kirkwood Bar, *Oncorhyndus (* all of which was 0. *tschawytscha* [chinook salmon]) accounted for no more than 11% of the fish by number of individuals. If we assume that people were foraging optimally (i.e. preferentially harvesting the larger fish taxa) this seems to indicate that salmon resources were significantly depressed. We know little about vegetation cover in the canyon itself during this time, but the abundance of hackberry *(Celtis sp)* seeds in archaeological deposits indicates that vegetation may have differed little in kind from that of the present day. Mammalian faunas were similar also, with three notable exceptions. Yellow-bellied marmot *(MarTnota flaviventris),* jackrabbit *(Lepus sp.)* and Great Basin pocket mouse (Perognathus parvus) consistently occur in middle Holocene sites (marmots are quite common), but are absent in the late Holocene.

Appendix A. (Cont.)

Late Holocene

Conditions were much as they are today, with the obvious exception that stream flows were not controlled. Small tributaries incised their way deeply into the middle Holocene alluvial fans, and new alluvial fans were rarely built. Sedimentation along the canyon bottom is largely alluvial or colluvial, rather than eolian, indicating a moister environment with better vegetation cover. Higher flows in the Snake River are evident from the increase in the freshwater pearl mussel (*Margaritifera falcata*) relative to the Rocky Mountain ridgeback. The pearl mussel competes better when stream waters are colder, less turbid, and flow over gravel-to-cobble beds. Fish assemblages contain largely if not exclusively salmonids, which indicates an improvement in the productivity of salmon in the Snake River basin. During this time, the canyon's human occupants concentrated their hunting efforts on three species: bighorn sheep *(Ovis canadensis),* deer *(Odocoileus spp),* and cottontails *(Sylvilagus nuttaffi).* Elk *(Cetyus elaphus)* and mountain goat *(Oreamnos americanus)* were present, but rarely appear in sites. There seems to have been a focus at most sites on either bighorn or deer, depending on local topography.

Summary of Float Trip Continued

Sites Visited—Battle Creek, Granite, Oregon Hole, Saddle, Bernard, Salt Creek, Kirkwood, Fish Trap, Ragtown Bar, Bob Creek, Imnaha River and the Kirkwood Museum.

Topics of Discussion—Hackberry regeneration, blowouts, erosion, riparian cottonwoods, weeds, agriculture, archaeology, paleo-ecology, riparian habitat, sandbars, vegetation trends.

A short meeting was held Thursday evening to share thoughts and ideas for potential PM&Es. The notes from that meeting are included here.

Outlined here are observations, comments from various discussions among work group members during the week..

This is where I need attendees to add comments, specifically from the group discussion we had Thursday morning with Braatnes, and at Pittsburgh landing.

PM&E Discussion, Thursday, September 21, 2000

Discussion Participants

Allan Ansell, Chuck Blair, Lori Barnes (facilitator), Colleen Fagan, Toni Holthuijzen, Brett Dumas, Angela Sandenaa, Jim Keany, Errol Claire, Kelly Wilde, Soma Swartz (facilitation support), Jeff Braatne, Cheryl Eneas, and Dorothy Mason.

Appendix A. (Cont.)

Lori Barnes explained that the purpose of this meeting was to share insights gained during the trip and to discuss thoughts on potential PM&E measures. She reminded the group that no decisions would be made at the meeting and that all the information would be shared with the other WG members. Because the time for the meeting was so short, Lori told the group she would provide skeleton notes, but would like everyone to expand upon those when she emails them out in order to provide WG members not in attendance with as much information as possible.

The following introductory comments were made by Allan Ansell:

- Purposely asked each of the participants to ride in different rafts with different people each day to encourage varied discussions about potential PM&Es
- Would like for each of you to describe those discussions

The ground rules include:

- No arguing
- No judgment calls
- Will take this back to the larger group (RWG)
- Nothing is final tonight, but hopefully we will lay the ground work for more detailed discussions in a larger setting.

Colleen Fagan (ODFW):

- There is a realistic expectation that operations and flows will be managed for salmon
- The rest of the discussions centered around the purchase of land.

  ODFW expects land purchases to be part of the PM&E measures for terrestrial resources. At this time, ODFW supports IPC ownership of those lands with management conducted according to an agreed to management plan. ODFW is considering off-site parcels for inclusion in the Conservation Reserve and for purchase. The major questions are how much, where, and when.

This comment was followed by a discussion between Brett Dumas (IPC), Toni Holthuijzen (IPC), Dorothy Mason (BLM), and Colleen Fagan about the definition of onsite vs. offsite and reasons for pursuing off-site land. Reasons included the concern that it is too soon to narrow down the specifics of which tracks should be identified, the concern for integration of issues

Appendix A. (Cont.)

(not just terrestrial issues) for land acquisition, the desire to be very flexible in order to accomplish land acquisition goals and questions regarding the availability of suitable amounts of on- site land. Dorothy Mason explained the approach the BLM has taken recently in their planning process. The BLM uses a 50–100 year planning horizon and takes an integrated landscape approach. Dorothy suggested that this approach would be very useful for providing the framework for evaluating the suitability of potential mitigation sites.

Toni Holthuijzen (IPQ): Pass

Brett Dumas (IPQ):

- Looking at more management of operational changes in regards to relicensing transmission lines associated with the project
- Would like to hear Jim's (Jim Kearly, FERC) view of onsite vs. offsite land acquisition
- Also, see a lot of onsite land available that we need to discuss. Examples include the recent ranches for sale along the Imnaha River.
- What is the time frame in which we would envision to purchase lands?

Colleen Fagan asked if IPC would buy land prior to reaching a license agreement

Allan Ansell stated that IPC would expect to have a written agreement from appropriate State and Federal agencies that lands purchased would constitute acceptable mitigation. He encouraged the various work group representatives to approach their respective directors or administrators to discuss this issue.

Jim Keany (FERC) replied to the onsite vs. offsite lands question: onsite is preferable. Offsite, downriver is possible. Need to show how it is meeting mitigation needs for impacts. Riparian lands are an issue, if we don't see onsite opportunities for mitigation people will need to look offsite.

Jeff Braatne (University of Washington, Pittsburg) noted that we passed two parcels with for sale signs today.

Jim Keany added: come up with the number of acres for habitat (riparian and upland) loss and then negotiate to the best interest of all parties. Could all parties agree to priorities and then go back to decisionmakers in your agencies, let them know what the situation is, so IPC can be encouraged to proceed.

Colleen indicated priority parrels of land had been identified. She questioned how we move this process forward so we don't loose PM&E opportunities. Colleen asked what IPC was doing with priority recommendations.

Appendix A. (Cont.)

Jim Keany replied that the agency representatives are going to have to help IPC a bit by pushing IPC and agency decisionmakers. Jim also proposed an alternative: IPC could contribute to a longer term land fund (trust fund) that the agencies and IPC manage together for land acquisition.

Tony Holthuijzen noted that IPC is unlikely to have much information on offsite lands, except when such lands are situated within the canyon proper (i.e., rim-to-rim area). He supported Dorothy's suggestion that a larger landscape view should be taken.

Colleen Fagan suggested that both the agencies and IPC need to attempt to identify lands for potential acquisition. It should not be only an agency activity.

Chuck Blair (CH2M-HILL) asked if IPC and all parties reach agreement then does FERC care where the land is?

Jim Keany replied that he could not see FERC second guessing an agreement.

Angela Sandenaa (Nez Perce Tribe):

- Talked about land purchase and the management of the purchased land and questioned IPC's potential role as the mitigation property managers.
- Management of the purchased land from an ecosystem approach, including uplands IPC is missing opportunities
- All 3 states are growing and people are purchasing land
- Must get on it and purchase land now. Toni Holthuijzen commented that it is important to consider the connectivity of the land, to link it to the ecosystem.

Dorothy Mason added that we should look at it with the perspective of what do we need to pursue for the next 100 years.

Errol Claire (RMEF): First: would like it to go in the record that the point about long-term funding of land acquisition is one that he supports. Second, would like to say that he enjoyed the trip and the associations with everyone. Below HC, fish issues including enhancement of micro-habitats (safe places for fish to feed and rear), will require IPC's attention. Acquisitions of property will be the Terrestrial focus.

- Concerned that we will not get our greatest bang for the buck in the HCNRA
- We might want to consider dollars in good multiuse/access properties (game and non-game use).

Appendix A. (Cont.)

- RNIEF looks at all wildlife not just elk

- Need to look at Tier 3 area (the larger study area) for potential acquisitions. Need a long-term fund (trust fund) so we can have a legacy.

Kelly Wilde (IPC): Before we make high profile land acquisitions, IPC and FS should take care of the land we already have in our possession.

Jeff Braatne (University of Washington, Pittsburg): Agreed with what Kelly said

Dorothy Mason 03LM):

- FS is not adequately funded for dealing with weed issues There are units with active permit grazing. These should be big game grazing. Jeff specifically mentioned the winter gazing at Pittsburg Landing and how lands in this area are degraded by domestic livestock. He wondered whether native ungulates, specifically mule deer, would be excluded from Pittsburg and other active gazing allotments by winter gazing activities. Would it be possible for the company to purchase such grazing leases?

- Would like us to return to the RWG with a discussion of larger land purchase, like Recreation RWG did (using data base maps displayed using GIS/in focus technology and discussion at the same time)

Cheryl Eneas (Nez Perce Tribe): Pass

Allan Ansell:

- Discussions with Colleen Fagan and Ed Bottom (IDFG) were about land acquisition. Allan stated that both agencies indicated, during discussions on the float trip, they would prefer that the company would manage lands that would be purchased with an agreed to management plan.

- Question for the state agencies: is the focus on harvestable wildlife or is a broader ecological approach going to be requested?

Open Discussion

Colleen Fagan: How do we move ahead on a purchase?

Allan Ansell: Need to have RWG support and an agreement that targeted acquisitions are appropriate mitigation.

Appendix A. (Cont.)

Jeff Braatne: Could use an intermediate step of purchasing an option to buy the land

Chuck Blair: We have already covered this. Question for the BLM, Dorothy, is the BLM willing to change land management practices on Federal lands? I would like to see IPC buy out the permit and then the BLM change the management to wildlife management rather than grazing.

Dorothy Mason: Ask again after the election. Also, tying to get this type of view in the rim-to-rim context of the Resource Management Plan with Margaret Johnson (IPC) in the collaborative process. This is a step change approach rather than the bold step of challenging the whole plan.

Angela Sandenaa: Has the decision already been made that IPC would own and manage the purchased acreage?

Jim Keany: If IPC buys the land as part of a license application then how can they be held responsible if some else is managing the land and drops the ball?

Colleen Fagan: No, it has not been decided

Allan Ansell: No, it has not been decided. We have asked agencies about this and they have said that they would prefer that IPC manage the land.

Errol Claire: It takes a technical team to see that the management gets done

Brett Dumas: Would the BLM want the land turned over to the BLM, or would the BLM be content to let IPC manage it?

Dorothy Mason: It depends on where the land is, what the land needs, and who can best manage it. Then we would decide. There would not be an automatic decision that IPC or BLM would manage such lands. (Dorothy described the example at the mouth of the Grande Ronde. I did not make notes on this example.)

Jeff Braatne: I have a question about the identification of impacts. Cumulative impacts go well beyond these three projects—look at sediment the last three dams are responsible for only a small portion. What is FERC's view?

Jim Keany: I don't think they have a strategy on that yet. Mid-Snake view will soon have a cumulative look that excludes anadromous fish. They are working on it, and it will include all IPC projects.

Colleen Fagen: I understood that anadromous fish would be tied back in after the HCC was done. Do you know the scoping for the cumulative impact assessment?

Jim Keany: I don't know the scoping. This is an ongoing discussion. I will keep the RWG informed.

Appendix A. (Cont.)

TERRESTRIAL RESOURCES WORK GROUP
WILDLIFE HABITAT ASSESSMENT SUBGROUP MEETING
MAY 15, 2001, 1:00 PM TO 4:00 PM
IPC CAFETERIA CONFERENCE ROOM

TRWG/WHA Attendees

Allan Ansell, IPC

Chuck Blair, CH2M HILL[1]

Ed Bottum, IDFG

Errol Claire, RMEF

Colleen Fagan, ODFW

Toni Holthuijzen, IPC

Loren Kronemann, Nez Perce Tribe[1]

Dick Pugh, Friends of the Weiser Trail

Notes Prepared by Chuck Blair / CH2M HILL

Please note that some explanations and responses that were developed after the meeting are presented here for clarification of future activities.

WHA Meeting Objectives

- ***HSI Model and Analysis Assumptions***—Review each of the models to discuss assumptions so that everyone is comfortable with the approach.
- ***Assessment of Brownlee Reservoir*—**drawdownSeveral models include variables that assess water depth under vegetation or distance from water to cover. These values vary considerably depending on the water level in Brownlee Reservoir and the Powder River arm. Discuss Brownlee operational effects on HSI model variables—what type(s) of water year(s) to use in the assessment, etc.

Appendix A. (Cont.)

- ***HSI Minimum Polygon Size Requirements***—The yellow-headed blackbird and marsh wren models specify minimum cover type polygon sizes, which are not met by the emergent herbaceous wetlands in the study area. Discuss how to deal with this issue.
- ***Data Presentation***—formatDiscuss data presentation in the draft report.
- ***Review the Summary Results***—Review results of the current conditions analysis to see if they feel right.
- ***Relationship Between Current Conditions and Future Scenario Analysis***—Discuss how the current conditions relate to future scenarios and what comparisons will be made.

Meeting Notes

General Summary

Chuck Blair (CH2M HILL) reported on the progress of the Wildlife Habitat Assessment (WHA) Subgroup. Seven people attended the meeting. These same people are also members of the TRWG. The group reviewed evaluation species models and assumptions, and they discussed outcomes and needs. Some models did not meet minimum size area requirements, although there was still value in using those models to determine availability of habitat cover types.

Chuck Blair commented that the next step would be to get results from the flow/riparian habitat studies by Rood and Braatne. That information, along with the quantitative information from IPC, would be used to project changes in habitat area or components in the two operational scenarios (run-of-river full pool and proposed operations). Rood and Braatne would run the two scenarios and compare results of the modeling efforts to look at what riparian habitat looked like given project operations.

Specific Comments and Responses

Comments from WHA team members and responses where appropriate included:

HSI Models and Analysis Assumptions

Q: Why not include any upland HSI models?

A: The WHA team decided to focus on those cover types that would most likely be affected by future operations and concluded that this only included wetland and riparian cover types.

Q: What about a future scenario with a permanent Brownlee drawdown of say 30 feet?

Appendix A. (Cont.)

A: That is not one of the current scenarios being considered. Other future scenarios may be assessed following additional information requests (AIRS).

Q: How would recreation activities be considered in the WHA analysis?

A: Past and current recreation activities (or other disturbance factors such as grazing, etc.) do enter into the analysis to the extent that these effects are reflected in measured vegetation conditions. The general effects of potential future recreation or other land use changes on HSI values would be discussed in the WHA study report, but only qualitatively, unless specific actions at specific locations are identified. In this case, the affected acreage could be considered if disturbance foot prints are identified. At this time, the availability of this type of site specific information for use in the WHA study is not known.

Q: Add a statement indicating that additional model assumptions that are included in the HSI models are not restated in the report and reference the model. A: This will be done.

Q: Is hackberry considered to be a hydrophyte in the yellow warbler model?

A: Toni Holthuijzen thought that this would not be the case. However, after further discussions with IPC personnel, Natalie Sunderman (IPC) pointed out that the song sparrow and yellow warbler showed significant positive association with hackberry communities. However, the relative strength of this relationship compared to willow communities could not be answered, because willow communities in the canyon are rare and small in size. Consequently, bird communities in willow communities were not sampled by IPC personnel. Additional discussions among IPC staff (Holthuijzen and Holmstead) relative to the yellow warbler model concluded that hackberry should be considered a hydrophyte for purposes of this analysis where it occurs adjacent to the river.

Q: Marsh wren model—How does purple loosestrife affect the model SI values, and would more of this be expected in the future?

A: It is of no value to wrens. Chuck will look into this and review the noxious weed study results to address these questions and comments.

Q: River otter—Several comments were received. Include a description of what constitutes den sites from the HSI model, and the fact that there is a road along portions of the reservoirs would detract from habitat value, and the otter HSI value for Brownlee is too high considering the reservoir drawdown and the SI value for Variable 1 is likely less than 0.5. A: All these comments will be considered and addressed in the draft report of future conditions. The SI values for Brownlee current conditions will be reviewed before future scenarios are modeled.

Appendix A. (Cont.)

Assessment of Brownlee Reservoir Drawdown

Comment: The mallard and other models that would be affected by Brownlee drawdown—analyze more than one water year and assess the maximum drawdown.

A: Chuck will conduct the analyses for 3 water years: 1992—dry year, 1995—average water year, and 1997—wet year. This will reflect a full range of expected conditions. Historic data for these three years was run through the operations model to project future Brownlee water surface elevations for the IPC scenario. Fifty percent water surface elevation exceedence levels will be used for the analysis of future conditions for each of the water years. HSI models that consider only the breeding season will use fifty percent water surface elevation exceedence levels during the breeding season the analysis.

HSI Minimum Polygon Size Requirements and Number of Polygons in the Future Analyses

Q: The yellow-headed blackbird and marsh wren models specify minimum cover type polygon sizes, which are not met by the emergent herbaceous wetlands in the study area.

A: The report will describe this problem. However, while size is an issue, the quality of the other habitat components can still be assessed using these models. Chuck will use a minimal SI value for the area variable so that the HSI does not become 0, thereby allowing other habitat variables to be assessed.

Q: How will the number of polygons be determined of each of the cover types that will change in the future?

A: The number of polygons for each cover type was determined from the original IPC vegetation mapping data. The riparian modeling study by Braatne and Rood can only predict changes in cover types along the specific vegetation transects that they studied. Jeff will develop a transition matrix that extrapolates the transect data for each vegetation type / study area reach to IPC cover types by study reach based on vegetation/cover type over lap and geomorphology. Results in the transition matrix will be presented for 5-year intervals. Chuck will assume that the number of cover type polygons remains the same for future scenarios as in the past unless the transition matrix indicates that changes are warranted, in which case Braatne and Rood will be consulted for further guidance and clarification.

Data presentation format—No comments were received.

Review the summary results—A request was made that the cover type acreage data for each of the scenarios be presented in the final report, which will be done.

Appendix A. (Cont.)

Relationship Between Current Conditions and Future Scenario Analysis

The current habitat values were calculated from existing IPC quantitative vegetation data collected during the mid to late 1990s. These data were used along with historic hydrologic information, such as reservoir elevations, flow, etc., to estimate current habitat values using the HSI models. These current conditions represent the starting point for the analysis of both future scenarios and will be used for the initial data at Target Year (TY) 0. Future conditions for both scenarios would change from this common starting point. Future vegetation changes estimated by Braatne and Rood provided information for use in estimating the vegetative components of the HSI variables. Future hydrologic components were modeled using historic information and a projected inflow hydrograph and reservoir operational rules for each of the scenarios. At this time, the two future scenarios are called 1) run-of-river full pool and 2) proposed operations are based on the modeled input hydrograph.

The two scenarios represent the only two future conditions being analyzed at this time. These two future scenarios will be compared to each other to assess relative changes in habitat value between the two.

Appendix B. Description of Habitat Suitability Models Used for the Hells Canyon Wildlife Habitat Assessment

Mallard

An unpublished mallard (breeding) model developed by the USFWS (No Date) was used to evaluate the quality of breeding habitat for emergent herbaceous wetland and scrub/shrub wetland cover types. The model assesses these cover types as a single unit of habitat. Model variables, methods used to obtain data sets, and the HSI equation follow.

SIV1: Food as indicated by Duration of Flooding During the Breeding Season

For the Weiser Reach of Brownlee Reservoir and Oxbow and Hells Canyon reservoirs, I assumed that water was present during all of the growing season under both operational scenarios. For the Brownlee Reservoir reaches, the percent of the growing season that water is projected to be present in the cover type was based on the number of days between April 1 and August 31 that Brownlee Reservoir is full during typical low and high runoff years. Below Hells Canyon Dam, water was assumed to be present in the cover type on a temporary basis during the growing season with minor variation between the scenarios.

SIV2: Height and Density of Nesting Cover

The average height of herbaceous vegetation was measured using a modified robel pole. A mean was calculated by taking an average of the number of hits at each height. The mean number of hits was then multiplied by height. The sum (mean hits multiplied by height) was divided by the number of hits to obtain a mean.

SIV3: Percentage of Shoreline Dominated by Emergent Herbaceous Wetland or Scrub-Shrub Wetland Vegetation

Within each reach, the length of each cover type contacting the shoreline was calculated using the Geographic Information System (GIS). The sum of scrub/shrub wetland and emergent herbaceous wetland divided by the total length of the shoreline was calculated to obtain the percentage of shoreline dominated by the two cover types.

Appendix B. (Cont.)

SIV4: Availability of Several Types of Wetlands and Uplands Capable of Satisfying Specific Seasonal Needs (interspersion index)

The interspersion index was based on the number of wetland cover types (*Emergent Herbaceous Wetland, Scrub-Shrub Wetland*, and *Forested Wetland*) and upland cover types (*Shrubland, Shrub Savanna, Forested Upland*, and *Tree Savanna*) and their respective acreage. Therefore, the numbers of polygons and average polygon size were calculated for each reach. The reach with the smallest average polygon cover type was assigned a SI value of 1.0. Other reaches were assigned SI values in relation to this index number.

HSI Equation

HSI = minimum of (SIV1, SIV2, SIV3, and SIV4), (that is, the minimum of these four variables)

Mink

Two models developed by Allen (1986) were used for mink: one for *Forested Wetlands* and *Scrub-Shrub Wetland*s and the other for *Emergent Herbaceous Wetlands*. Both models are intended to evaluate the quality of year-long mink habitat and include water and cover components. The WHA team did not make any modifications to these models.

Model variables, methods used to obtain data sets, and the HSI equation for *Forested Wetland* and *Scrub-Shrub Wetland* cover types follow.

SIV1: Percent of Year with Surface Water Present within Cover Type

I assumed that for the Weiser Reach and Oxbow and Hells Canyon reaches, and below Hells Canyon Dam, water is present more than 75% of the year (SI=1) for both scenarios. Surface water was assumed to be present throughout the year in the Brownlee Reservoir reaches under the Run-of-River scenario. The modeled flow duration curves were used to estimate this variable for the IPC scenario for the Brownlee Reservoir reaches. Using these Brownlee Reservoir reaches, water elevations within 1 foot of full pool (2,076 ft) were considered to have water present within wetland and riparian communities adjacent to the reservoir under the IPC scenario.

SIV2: Percent Canopy Cover of Trees, Shrubs, and Emergent Vegetation

For FW and SSW occurring along tributaries to the Snake River and along shoreline and island vegetation surveys, IPC calculated the percent tree and shrub canopy cover using the line intercept method. For shoreline, island, and other known emergent herbaceous wetlands the total percent cover of herbaceous vegetation was based on line intercept.

Appendix B. (Cont.)

SIV3: Percent Canopy Cover of Trees and Shrubs Within 100 m of the Wetland's Edge

IPC calculated this based on the composition of cover types (number and acreage) within a 100-meter band of the river bank or reservoir shoreline employing the GIS and the vegetation cover type map of the Hells Canyon study area. The percent cover of trees and shrubs (woody vegetation) was calculated for each of the cover types. A weighted mean cover for trees and shrubs was calculated using the acreage of cover types within 100 m of the shoreline and the average percent woody cover within each cover type as weight.

On the Brownlee Reservoir reaches, the percent canopy cover of trees and shrubs within a 100-meter band of the shoreline was calculated for both the full pool under the Run-of-River scenario and at the 50% exceedence water levels for the wet and dry years under the IPC scenario as described above. For the IPC scenario, this resulted in the inclusion of unvegetated or barren lands in the fluctuation zone in these calculations, taking into account the fact that these barren lands provide no habitat value for the mink and lower the overall value of remaining trees and shrubs within 100 m of the respective fluctuation zone shoreline.

HSI Equation for Forested and Scrub/shrub Wetland:

HSI = Minimum value of the water or cover component = Minimum of either (SIV1) or the minimum of ((1.0; SIV2) + SIV3)/2)

Mink model variables, methods used to obtain data sets, and the HSI equation for Emergent Herbaceous Wetland cover type are as follows:

SIV1: Percent of Year with Surface Water Present within Cover Type

Methods were the same as above.

SIV2: Percent Canopy Cover of Emergent Herbaceous Vegetation

Methods were the same as above.

SIV3: Percent Canopy Cover of Trees and Shrubs within 100 m of the Wetland's Edge

Methods were the same as above.

Appendix B. (Cont.)

HSI Equation

HSI= Minimum value of the water or cover component = Minimum of either (SIV1) or the minimum of (4 SIV2 + SIV3)/5

Marsh Wren

The marsh wren model developed by Gutzwiller and Anderson (1987) was used to evaluate the quality of breeding season habitat of emergent herbaceous wetlands. The model rates both the cover and reproductive components of marsh wren habitat by evaluating vegetation cover and water depth. The wren model states that the minimum area of emergent wetland suitable for nesting marsh wrens is 40 ha and that if the wetland is <40 ha, the HSI value is 0. None of the emergent wetlands in the study area are >40 ha. Therefore, all emergent wetlands would have an HSI value of 0. This would likely also be true for future conditions, rendering the marsh wren model useless for this analysis. However, the variables in the model are useful for observing changes in emergent herbaceous wetland habitat components. Therefore, the minimum area criteria was not used in this analysis. Emergent wetlands were assessed based on the model variables and this exception is noted in the presentation and discussion of study results. Model variables, methods used to obtain data sets, and the HSI equation follow.

SIV1: Growth Form of Emergent Hydrophytes

Not all emergent herbaceous wetland polygons present in the study area are suitable for marsh wren. Only those plots that contain cattails (*Typha spp.*), cordgrass (*Spartina pectinata*), bulrushes (*Scirpus spp.*), bluejoint reedgrass (*Calamagrostis canadensis*), or reed canarygrass (*Phalaris arundinaceae*) are considered suitable. According to the HSI model, 40 ha is the minimum habitat area required for marsh wren. This requirement is not met in the study area, but calculations were made to evaluate the quality of the habitat present. All data collected on emergent herbaceous wetlands were used in this analysis. This included shoreline, island, and other known emergent herbaceous wetlands selected for vegetation sampling. Vegetation present at each site was evaluated. If a site contained cattails, cordgrass, or bulrushes, SIV1= 1 x (percent canopy cover of emergent species (SIV2)) was used. If a site contained bluejoint reedgrass or reed canarygrass SIV1= 0.5 x (percent canopy cover of emergent species (SIV2)) was used. If none of these species were present SIV1 = 0. A mean was taken of all the sites by reach.

SIV2: Percent Canopy Cover of Emergent Herbaceous Vegetation

This was determined by calculating the total percent cover of emergent herbaceous vegetation based on line intercept along shoreline, island, and other emergent herbaceous wetlands.

Appendix B. (Cont.)

SIV3: Mean Water Depth

For all but the Brownlee Reservoir reaches under the IPC scenario, and for all reaches under the Run-of-River scenario, it was assumed that sites with cattails, cordgrass, or bulrushes had a water depth of 10 centimeters during spring and sites with bluejoint reedgrass or reed canarygrass had a water depth of 5 centimeters; if none of these species were present, water depth was assumed to be 0 centimeters. For the Brownlee Reservoir reaches under the IPC scenario, it was assumed that sites with cattails, cordgrass, bulrushes, bluejoint reedgrass, or reed canarygrass had a water depth of 7.5 centimeters during spring in dry years and 1.5 centimeters during the spring in wet years. If none of these species were present, water depth was assumed to be 0 centimeters.

SIV4: Percent Canopy Cover of Woody Vegetation

Shoreline, island, and other emergent herbaceous wetlands sample points were used to calculate total percent cover of woody vegetation based on the line intercept transect data.

HSI Equation

$HSI = (SIV1 \times SIV2 \times SIV3)^{1/3} \times SIV4$

Black-Capped Chickadee

The chickadee model developed by Schroeder (1983) was used to evaluate the quality of breeding season habitat of forested wetlands. The model rates both the food and reproductive components of chickadee habitat by evaluating tree height, canopy closure, and snag density. No modifications were made to the model by the WHA team. Model variables, methods used to obtain data sets, and the HSI equation follow.

SIV1: Percent Tree Canopy Closure

IPC calculated percent tree canopy cover using the line intercept data for FW occurring along tributaries to the Snake River and along river and reservoir shoreline and island vegetation surveys.

SIV2: Average Height of Overstory Trees

IPC calculated the average height of the tree canopy in each reach using belt transect data. A mean was calculated for all trees greater than 6 m in height for each plot.

Appendix B. (Cont.)

SIV4: Number of Snags 10 to 25 Centimeters Diameter at Breast Height (dbh)/0.4 ha

The number of standing dead trees was calculated using the belt transect data and converted to per 0.4 ha.

HSI Equation

HSI = minimum of the food and reproduction components = Minimum of $(\text{SIV1 X SIV2})^{1/2}$ or SIV4

Song Sparrow

The song sparrow model (USFWS 1979) was used to evaluate the quality of breeding season habitat of forested, scrub/shrub, and emergent wetlands. The models rate habitat quality based on distance to water and vegetation canopy cover and height (representing cover and reproduction habitat value). No modifications were made to the models by the WHA team. Model variables, methods used to obtain data sets, and the HSI equation for *Forested Wetland* and *Scrub-Shrub Wetland* cover types follow.

SIV1: Distance to Water (m)

It was assumed that the distance to water was less than 300 m (SIV1 = 1) for the Weiser Reach, Oxbow/Hells Canyon, and Below Hells Canyon Dam reaches for both scenarios and for the Brownlee Reservoir reaches under the Run-of-River scenario. The GIS was used to determine projected distances along the Brownlee Reservoir reaches for drawdown conditions during the wet and dry years under the IPC scenario.

SIV2: Percent Canopy Scrub Crown Cover

This was calculated for scrub/shrub and forested wetlands occurring along tributaries to the Snake River and along the river and reservoir shoreline and island vegetation surveys. IPC calculated the total percent shrub crown cover using the line intercept transect data.

SIV3: Average Height of Overstory Shrubs

This was calculated for scrub/shrub and forested wetlands occurring along tributaries to the Snake River and along the river and reservoir shoreline and island vegetation surveys using belt transect data. Understory shrub heights (poison ivy [*Toxicodendron radicans*], snowberry [*Symphoricarpos albus*]) were excluded and a mean of all other shrubs was taken for each plot.

Appendix B. (Cont.)

HSI Equation

HSI = minimum of the water and the cover and reproduction components =

Minimum of SIV1 or $(SIV2 \text{ X } SIV3)^{1/2}$

Model variables, methods used to obtain data sets, and the HSI equation for emergent herbaceous wetlands follow.

SIV1: Distance to Water (m)

Same assumptions and approach as stated above.

SIV2: Percent Herbaceous Canopy Cover

IPC calculated the total percent cover of herbaceous vegetation based on line intercept transects along shoreline, island, and other emergent herbaceous wetlands.

SIV3: Mean Height Herbaceous Vegetation

The average height of herbaceous vegetation was measured using a modified robel pole.

HSI = minimum of the water and the cover and reproduction components =

Minimum of SIV1 or $(SIV2 \text{ X } SIV3)^{1/2}$

Yellow Warbler

A model developed by Schroeder (1982a) was used to evaluate the quality of *Scrub-Shrub Wetland* habitat during the breeding season. Three shrub measurements were used to assess yellow warbler habitat quality. Model variables, methods used to obtain data sets, and the HSI equation follow.

SIV1: Percent Deciduous Shrub Crown Cover

This variable was calculated for SSW occurring along tributaries to the Snake River within 50 m of river banks and full pool reservoir shorelines and along islands. IPC calculated total percent shrub crown cover using the line intercept.

Appendix B. (Cont.)

SIV2: Mean Height of Deciduous Shrub Canopy

IPC calculated the average height of shrub canopy using belt transect data. Understory shrub heights (poison ivy and snowberry) were excluded and a mean of all other shrubs was taken for each plot.

SIV3: Percent of Deciduous Shrub Canopy Comprised of Hydrophytic Shrubs

Hydrophytic shrubs were considered to be any shrub with a wetland indicator status rating of facultative minus (FAC-) or wetter. IPC calculated the total percent crown cover of hydrophytic shrubs using the line intercept transect method.

HSI Equation

$HSI = (SIV1 \times SIV2 \times SIV3)^{1/2}$

One model assumption was made: only hydrophytic shrubs (Fac- or wetter) were included in the calculation of cover values, thereby including hackberry plants <6 m tall and eliminating Russian olive and tamarisk from consideration in the yellow warbler model.

Yellow-headed Blackbird

The yellow-headed blackbird model developed by Schroeder (1982b) is used to evaluate the quality of breeding season habitat of emergent herbaceous wetlands. The model rates both the food and reproductive components of blackbird habitat by evaluating vegetation and water parameters and wetland complexity.

The blackbird model states that the minimum area of emergent wetland suitable for nesting yellow-headed blackbirds is 0.15 ha (0.38 ac) and that if the wetland is <0.15 ha, the HSI value is 0. Many of the emergent wetlands in the study area are <0.15 ha. Therefore, all of these emergent wetlands would have an HSI value of 0. This would likely also be true for future conditions, rendering the yellow-headed blackbird model useless for this analysis.

However, the variables in the model are useful for observing changes in emergent wetland habitat components. Therefore, rather than discount these smaller wetlands and the habitat variable data for these areas, all emergent wetlands within each study area reach were pooled and a single HSI value was derived for each study area reach. Emergent wetlands were assessed based on the model variables and this change is noted in the presentation and discussion of study results. Model variables, methods used to obtain data sets, and the HSI equation follow.

Appendix B. (Cont.)

SIV1: Percent of Open Water Area Containing Submerged Vegetation

For the IPC scenario, it was assumed that there was no submerged vegetation for the Brownlee Reservoir reaches, the Oxbow/Hells Canyon reach, or the unimpounded reach below Hells

Canyon Dam. No submerged vegetation was encountered during shoreline surveys of these areas. The SI value was set at 0.01 so that the model would not go to 0, and render the other variables meaningless. Because of the way the HSI value is calculated, an SIV1 value of 0.01 resulted in very low HSI values, which reflects the lack of submerged vegetation For the Weiser Reach, a limited amount of submerged vegetation was encountered. To determine the depth of potential macrophyte growth in this reach, 21 turbidity measurements collected from RM 340 (Porters Island) in June, July, and August 1995 to 1999 were averaged. The turbidity of the river ranged from 15 to 39 nephelometric turbidity units (NTU) with an average of 25.5 NTU. Eleven Secchi depth measurements were taken when turbidity was between 25 and 26. Within that turbidity range, Secchi depths ranged from 0.4 to 0.6 meter, with an average of 0.44 meter. Relationships exist between Secchi depth and the depth to which macrophytes extend, but the relationships are highly variable among water bodies. The average estimated Secchi depth was multiplied by 3 m to estimate the lower limit of the photic zone. This resulted in a photic depth estimate of 1.3 m. To obtain an estimate of the percent of open water less than 1.3 m in depth, bathymetric data were used. The Weiser Reach has a total surface area of approximately 1470.2 acres. Bathymetric data were only available for 340.7 acres of that area (Cobb Rapids to Porters Island). Querying for areas less than 1.3 m in depth determined there is about 39.6 acres of surface area meeting that condition.

Under the Run-of-River Scenario, it was assumed that a limited amount of submerged vegetation would develop in the Brownlee Reservoir reaches. Other reaches were the same as the IPC Scenario.

SIV2: Edge Index (between Emergents and Open Water) per 900-square-meter area

Two parameters are required: the length of an emergent wetland polygon contacting open water and the accompanying area (expressed in ha). These parameters were estimated using GIS. The edge index was computed as:

$$\frac{L}{2\sqrt{A\pi}}$$

where 1 = length

A = area of the herbaceous wetland cover type

Appendix B. (Cont.)

SIV3: Percent of Vegetation that is Robust (i.e., cattail, bulrush, and reed)

IPC calculated the total percent herbaceous cover of persistent vegetation using Daubenmire frame data.

SIV4: Average Water Depth Beneath Emergents during Spring

For all areas except the Brownlee Reservoir reaches under the IPC scenario and for all Run-of-River scenario reaches, it was assumed that sites with cattails, cordgrass, bulrushes, bluejoint reedgrass, or reed canarygrass had a water depth of 10 centimeters during spring. If none of these species were present, water depth was assumed to be 0 centimeters. For the Brownlee Reservoir reaches under the IPC scenario, it was assumed that sites with cattails, cordgrass, bulrushes, bluejoint reedgrass, or reed canarygrass had a water depth of 7.5 centimeters during spring in dry years and 1.5 centimeters during the spring in wet years. If none of these species were present, water depth was assumed to be 0 centimeters.

HSI Equation

HSI = minimum of the food and reproduction life requisites =

Minimum of $(\text{SIV1 X SIV2})^{1/2}$ or $(\text{SIV3 X SIV4})^{1/2}$

River Otter

The river otter model was developed by the USFWS (1984). This model, as modified for a USFWS HEP assessment of dams on the lower Snake River in 1990, was used to evaluate the quality of year-long habitat of a 75-meter-wide band along reservoir shorelines, river banks, and around islands. The model rates denning site quality and cover near the water. No modifications were made to the model by the WHA team for calculating the HSI values. When estimating habitat value (i.e., habitat quality x habitat quantity), however, IPC narrowed the 75 m band to a 50 m band to correspond to the dimensions of the river and reservoir shoreline zones that were used for the other evaluation species. This added consistency of the evaluation areas among the evaluation species and made estimates of HUs comparable among evaluation reaches and species. Model variables, methods used to obtain data sets, and the HSI equation follow.

Appendix B. (Cont.)

SIV1: Availability of Denning Sites (Presence and Distance)

The model indicates that the presence of a den site within 10 m of the edge receives a SI of 1.0, within 11 to 75 m receives a SI of 0.5, and if no den sites are present or present greater than 75 m from the shoreline, then the SI is 0.1. Under the IPC scenario, for all of the study area, except the Brownlee Reservoir reaches, and for all reaches under the Run-of-River scenario, I assumed that a den site was present within 11 to 75 m of the shoreline; therefore, SI = 0.5. Under the IPC

scenario along the Brownlee Reservoir reaches, distances were measured using the GIS from the edge of the 50% exceedence water level during drawdown for the wet and dry water years to the nearest FW or SSW cover type polygon, where it was assumed that a suitable denning site would be located. SI values were based on these distances.

SIV2: Density of Streamside Cover

This was calculated based on the length of shoreline cover present along each reach employing the GIS and the vegetation cover type map of the Hells Canyon Study Area. Cover was defined as scrub/shrub wetland, forested wetland, shrub savanna, and shrubland polygons. The percent cover of trees and shrubs (woody vegetation) was calculated for each of the cover types. A weighted mean cover value for trees and shrubs was calculated for each reach using the length of cover types and the average percent woody cover within each cover type as weight.

SIV3: Distance from Shoreline to Nearest Cover (m)

IPC used the GIS to calculate the distance from the shoreline to nearest cover. Cover in this analysis is defined as forested wetland, scrub/shrub wetland, shrubland, or shrub savanna polygons. The shoreline was buffered by 75 m (that is, only polygons less than 75 m from the shoreline were used in the analysis), and the centroid of each polygon was calculated. For each resultant woody cover polygon, the nearest distance from the centroid to the shore was computed. Full pool was assumed for the Weiser Reach, Oxbow and Hells Canyon reservoirs, and below Hells Canyon Dam reaches under the IPC scenario and for the Run-of-River scenario.

Under the IPC scenario for the Brownlee Reservoir reaches, the flow duration curves developed for the typical wet and dry year were used to establish average water surface elevations for these years. The GIS was used to calculate the average distance from the water's edge during the typical wet and dry year drawdowns as described above for SIV1 to forested wetland, scrub/shrub wetland, shrubland, or shrub savanna polygons to determine these SI values.

HSI Equation

HSI = $(SIV1 \times SIV2 \times SIV3)^{1/2}$

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