Vegetation Monitoring on Idaho Department of Fish and Game Fish and Wildlife Mitigation Lands

Pilot Studies on the Albeni Falls Wildlife Mitigation Project, Pend Orielle and Boundary Creek Wildlife Management Areas

Steven K. Rust
Jennifer J. Miller
Edward Bottum
Christopher J. Murphy
Cynthia L Coulter
Juanita J. Lichthardt
Karen Gray
Luana McCauley

April 2003

Idaho Conservation Data Center
Department of Fish and Game
600 South Walnut, P.O. Box 25
Boise, Idaho 83707

Steven M. Huffaker, Director

Prepared through funding provided by:

Bonneville Power Administration
Northwest Power Planning Council,
Columbia River Basin Fish and Wildlife Program

Table of Contents

Introduction: The 1980 Northwest Power Act gives Bonneville Power Administration (BPA) the authority and responsibility to protect, mitigate, and enhance fish and wildlife populations and habitats that are affected by the development and operation of hydroelectric projects within the Columbia River Basin. This authority is implemented through the Northwest Power Planning Council (NWPPC) Columbia River Basin Fish and Wildlife Program. In 1996 the Act was amended (commonly referred to as the Gorton Amendment) to require the NWPPC to appoint project peer review panels. The Independent Scientific Review Panel (ISRP) was established to provide scientific peer review of projects proposed under the Columbia River Basin Fish and Wildlife Program.

The ISRP has raised concerns regarding Fish and Wildlife Program mitigation projects for their level of monitoring and evaluation of project results. The ISRP (1999a and 1999b; 1998; 1997) recommendations include:

- monitoring and evaluation of project effectiveness are necessary to establish full mitigation;
- monitoring and evaluation plans should occur within the context of adaptive management; and
- monitoring and evaluation are needed to complement HEP and should include species populations as well as habitats.

In response to ISRP recommendations, the BPA-funded wildlife mitigation projects within Idaho have worked to develop monitoring and evaluation plans (Albeni Falls Interagency Work Group 2001; Anderson 2002). Through these processes the goal has emerged of developing and implementing monitoring protocols that may be uniformly applied throughout Fish and Wildlife Program mitigation lands on which Idaho Department of Fish and Game (IDFG) is the manager or a cooperating manager.

In 2002, field sampling was initiated using the Albeni Falls Interagency Work Group (2001) monitoring and evaluation plan. Vegetation monitoring data and experience from the 2002 field season contributed to the development of a program-wide monitoring and evaluation plan (Unnasch et al. 2003). Conceptual refinements that emerged from the program-wide monitoring plan (Unnasch et al. 2003) are applied here. Thus, the work reported here both contributed to development of the program-wide monitoring plan and is prepared in response to the program-wide plan.

The objectives of this document are: (1) to report the results of vegetation monitoring pilot studies completed on the Albeni Falls Wildlife Mitigation Project during the 2002 field season; (2) evaluate progress toward meeting vegetation management objectives on the Albeni Falls Wildlife Mitigation Project; and (3) provide an example of specific aspects of, and recommendations for, the program-wide vegetation monitoring protocol for IDFG Fish and Wildlife Program mitigation lands.

The Albeni Falls Mitigation Project: The Albeni Falls Wildlife Mitigation Project was developed to protect, restore, enhance and maintain the long-term quality of wetland and riparian habitat in northern Idaho and eastern Washington as on-going mitigation for the construction and inundation of the Albeni Falls hydroelectric project. The interagency project consists of numerous independent mitigation acquisitions distributed throughout northern Idaho and eastern Washington (Figure 1).

Management goals for the Albeni Falls Wildlife Mitigation Project are identified by Albeni Falls Interagency Work Group (2001) as:

1. *To fully mitigate the wildlife habitat losses associated with the construction and operation of Albeni Falls Dam*.
2. *To protect, restore, enhance, and maintain wetland/riparian wildlife habitat within all of the Mountain Columbia Subbasins (except the Bitterroot, Flathead, and Blackfoot). Implicit in this*

goal is the maintenance or enhancement of wetland/riparian associated wildlife populations, maintenance or enhancement of wetland/riparian species diversity, and, to the extent possible, protection or restoration of native communities.

Site specific management plans and objectives are developed for each individual site within the Albeni Falls Wildlife Mitigation Project. For example, specific management objectives for Boundary Creek, Carter's Island, Denton Slough, Derr Creek, Rapid Lightening, and Trout Creek are described, respectively, by Cole et al. (2001), Hanna (1998a), Hanna (1998b), Hanna (1998c), Hanna (1999), and Leptich (2001a).

Methods: General rationale and methods for the selection of sampling sites is provided by Albeni Falls Interagency Work Group (2001; pages 5 - 7; reproduced in Appendix A) and Unnasch et al. (2003). Sampling points for the overall monitoring program are identified through a stratified-random method within a 200 m. grid. Vegetation sampling occurred within square, 4 hectare (200 x 200 m.) cells identified as the area surrounding and centered on the stratified-random selected sample points. An important consequence of the sample design is that the population (or area) of statistical inference may represent one large site with many sample points (e.g., Boundary Creek) or a group of small sites, each with few sample points (e.g., the mitigation properties within Pend Orielle WMA). Two populations of statistical inference are identified within the Albeni Falls study area: Boundary Creek and Pend Orielle (Unnasch et al. 2003).

Coarse-scale composition and structure were sampled on six 200 m. transects by measuring the boundary between each plant association (using classifications developed by Cooper et al. 1991; Daubenmire 1987; and Jankovsky-Jones 1997), covertype, and structural class (modified from Hall et al. 1995) (see Appendix B for detailed description of vegetation structural classes). Three transects each were placed at 50 m intervals perpendicular to the opposing sides of the square 4 ha sampling area (Figure 2).

Plant species composition and detailed stand structure data were collected on nine sample plots located at the intersections of the six 200 m. transects. Composition and structure data were collected on a series of nested plots. Tree composition and stem density data were collected on nested 0.04 ha. (11.3 m radius) and 0.1 ha (17.8 m radius) circular plots. Live tree stems, standing dead stems, and logs (of sapling size or greater, see Appendix B) were tallied by species, size class, and (where appropriate) decay class. Large live tree stems (> 20.9 inches diameter at 4.5 feet), snags, and logs were tallied on the 17.8 m. radius circular plot.

Two methods were employed to sample species composition: (1) The abundance of non-vascular, herbaceous, and graminoid species and tree seedlings was sub-sampled using ocular estimation of cover on five systematically placed 1 X 1 m. quadrat frames located within the 11.3 m. radius circular plot. Tree sapling and shrub abundance were sampled using ocular estimation of cover on the 11.3 m. circular plot. (2) The abundance of species (regardless of life form) was estimated as mean rooted frequency on three nested quadrat frames located systematically on each of four systematically located transects (Figure 2). Shrub canopy abundance was sampled as the percent canopy interception on four systematically placed 10.0 m lines (a 10 cm gap rule was applied).

Vegetation monitoring data were entered into a relational database and cleaned. Statistical analyses were conducted using Microsoft Excel or PC-ORD (McCune and Mefford 1999). Post-hoc classification of the composition data was conducted through an iterative approach using hierarchical cluster analysis, two-way-indicator species analysis (Hill 1979b), and detrended correspondence analysis (Hill 1979a) functions within PC-ORD.

Results: Twenty-four sample points were identified on IDFG mitigation lands within the Albeni Falls Mitigation Project. During the 2002 field season vegetation was sampled on nine sample points. Table 1 provides a summary of the sampling completed at these points. The location of the sample points is shown in Figure 3. The 2002 monitoring effort required 7.5 person-days per sample point.

Three additional sample points were located on the Boundary Creek site but not sampled. Two of these were dropped due to the depth of flood water. The third site (BOU07, Figure 3a) was marked on the ground but was not sampled due to time constraints.

Approximately 240 plant species were observed while sampling vegetation on the Boundary Creek, Rapid Lightning Creek, Trout Creek, and Westmond Lake sites. Vascular plant species observed during the 2002 field season are listed by site in Appendix C. One rare plant species was observed at Trout Creek: *Thalictrum dasycarpum* (purple meadow-rue).

Thalictrum dasycarpum is relatively wide-ranging in North America. The species is considered imperiled in British Columbia, Washington, and Idaho (NatureServe 2002). Two individuals of the species were observed within thicket stands of *Alnus incana/Cornus sericeous* (mountain alder/redosier dogwood) east and west of the center post of Trout Creek 1 (Figure 3). The species is considered a facultative wetland species (Reed 1988) of deciduous riparian woodlands and thickets (Washington Natural Heritage Program 2000). The primary threat to the species is alteration of the site hydrologic regime. Eight populations of the species are now known from Idaho (Idaho Conservation Data Center 2003).

Five noxious weed species were observed within the project area: *Centaurea diffusa* (diffuse knapweed), *Centaurea maculosa* (spotted knapweed), *Centaurea solstitialis* (yellow starthistle), *Cirsium arvense* (Canada thistle), and *Sonchus arvensis* (perennial sowthistle). *Centaurea diffusa* was observed on one quadrat frame on the plot located at Westmond Lake. *Centaurea maculosa* was recorded on three quadrat frames located on Rapid Lightening and Trout Creek. *Centaurea solstitialis* was observed on plot BOU04 located at the Boundary Creek site; but was not actually recorded on a quadrat frame. *Cirsium arvense* was observed on six plots on Boundary Creek and on the one Westmond Lake plot. The species occurs with 100 percent frequency on several of the Boundary Creek plots. *Sonchus arvensis* was recorded on five quadrat frames located on plot BOU08 at the Boundary Creek site.

Variation within the species abundance data is relatively high (Table 2). Variability in the abundance data appears largely due to variation in the species that are present on plots, rather than variation in the abundance of species (Table 2). Similar trends are observed in the community transect data (Table 2). Tree stems were only sampled on plots located within the Pend Orielle sample area (Table 2). Trees occur on Boundary Creek, but were not encountered on the plots sampled.

Vegetation within the study area encompasses a mix of relatively intact, mid- and late-seral, and severely altered, early-seral plant communities. The former includes, for example stands of the following plant associations[1]: *Abies grandis/Linnaea borealis, Linnaea borealis* (grand fir/twinflower, twinflower phase)*; Abies grandis/Physocarpus malvaceus, Physocarpus malvaceus* (grand fir/ninebark, ninebark phase)*; Crataegus douglasii/Symphoricarpos albus, Populus tremuloides* (black hawthorn/common snowberry, aspen phase)*; Populus trichocarpa/Calamagrostis canadensis* (black cottonwood/bluejoint)*; Populus trichocarpa/Cornus stolonifera* (black cottonwood/redosier dogwood)*; Populus trichocarpa/Symphoricarpos albus* (black cottonwood/common snowberry)*; Pseudotsuga menziesii/Physocarpus malvaceus, Physocarpus malvaceus* (Douglas fir/ninebark, ninebark phase)*;* and *Thuja plicata/Clintonia uniflora, Clintonia uniflora* (western redcedar/queen's cup beadlily, queen's cup beadlily phase) located on the Trout Creek and Rapid Lightning Creek sites. The later includes old fields and hay pastures located on the Boundary Creek, Trout Creek, and Westmond Lake sites. On mid- and

[1] The plant community classification and nomenclature used here and in the remainder of the report follows Cooper et al. (1991), Daubenmire (1987), or Jankovsky-Jones (1997) to the extent possible.

late-seral sites the potential natural vegetation was determined with relative ease. However, the potential natural vegetation was not determined and only an existing vegetation covertype or dominance type was determined on severely altered, early-seral sites within the study area. Twenty-four plant associations represented by numerous covertypes were observed within the study area. Sample points visited during the 2002 field season occur within ten plant associations. The number of plots observed within each is summarized in Table 3.

Species composition data is summarized by sample area, plant association group, and species group in Table 4. Variability in species abundance is relatively high throughout the study area. Significant changes in species composition are detectable, however, when the abundance data are summarized by plant association (or plant association group) and species group (Table 4).

Tree stems were present only on plots sampled on the Pend Orielle sites. Data for the density of live, dead and down (logs), and standing dead (snags) tree stems are summarized in Table 5 by deciduous versus evergreen forest plant associations. Relatively few giant and large trees were observed. Rather, stands on the mitigation sites are dominated by sapling-, pole-, or medium-sized trees. This is reflective of past timber harvest and fire disturbance histories of the Trout Creek and Rapid Lightning Creek sites. The giant standing dead stems observed within deciduous forest (Table 5) are *Thuja plicata* stumps. No *Thuja plicata* regeneration was observed on the site.

Discussion: Two objectives of this report are addressed in the following discussion: (1) evaluate progress toward meeting vegetation management objectives on the Albeni Falls Wildlife Mitigation Project; and (2) provide an example of specific aspects of, and recommendations for, the program-wide vegetation monitoring protocol for IDFG Fish and Wildlife Program mitigation lands.

Are site specific management objectives on the Albeni Falls Wildlife Mitigation Project being met? How are aspects of the program-wide monitoring plan applied to the Albeni Falls Wildlife Mitigation Project?

An important element of the sample design identified by Albeni Falls Interagency Work Group (2001) and subsequently refined by Unnasch et al. (2003) is definition of the applicable population, or area, of statistical inference. That is, while numerous sample points represent one large area, Boundary Creek, one to two sample points are located within each of the numerous small sites encompassed by the Pend Orielle sampling area. A consequence of this monitoring strategy is that site specific management objectives are not specifically addressed on small sites. Rather, monitoring related management objectives for these sites need to be re-scaled to the perspective of the sample area of inference.

Site specific habitat/vegetation related management objectives for Boundary Creek, Rapid Lightening, Trout Creek, and Westmond Lake wildlife mitigation properties (from Cole et al. 2001; Hanna 1999; Leptich 2001a; Leptich 2001b) are listed below:

Boundary Creek:

1) Restore and maintain wetland hydrology to approximately 1,039 acres of Kootenai River floodplain.
2) Restore and maintain seven wetland basins totaling approximately 400 acres.
3) Restore and maintain native vegetative communities, including approximately 250 acres of grass/forb habitat; approximately 400 acres of herbaceous wetlands; and approximately 300 acres of scrub-shrub habitat and floodplain cottonwood forest.
4) Protect and maintain existing native vegetative communities, including approximately 150 acres of floodplain cottonwood forest and scrub-shrub wetlands; and approximately 140 acres of mixed conifer forest.
5) Control noxious weeds.

Rapid Lightening Creek:

1) Eliminate livestock grazing.
2) Control noxious weeds.
3) Increase seasonal flooded wetlands
4) Maintain pasture for Canada goose brook rearing and foraging.

Trout Creek:

1) Increase shrub-scrub wetland shrub structural and species diversity.
2) Increase structural and compositional diversity of herbaceous uplands.
3) Control noxious weeds.
4) Maintain pasture for Canada goose brood-rearing and foraging.

Westmond Lake:

1) Increase extent and duration of seasonal inundation.
2) Increase shrub cover.
3) Control noxious weeds.
4) Maintain pasture of Canada goose brood-rearing and foraging.

Site specific management objectives identified by Cole et al. (2001) for Boundary Creek may be addressed by the program-wide monitoring plan (Unnasch et al. 2003). The relatively large number of stratified-random sample points located in this large area will likely address site specific management objectives. A consequence of the sampling protocol for the relatively small Pend Orielle mitigation properties, however, is that site specific management objectives are not addressed. Rather, management results are monitored for the entire area of statistical inference. For example, 2002 monitoring data for Rapid Lightening, Trout Creek, and Westmond Lake are combined for statistical analysis. For the purpose of monitoring, management objectives for these small sites need to be combined to the scale of the sample area of inference. For example, management objectives for Pend Orielle may be re-stated as follows:

1) Eliminate livestock grazing.
2) Control noxious weeds.
3) Increase extent and duration of seasonal flooding in wetlands habitats.
4) Maintain pasture for Canada goose brook rearing and foraging.
5) Increase shrub-scrub wetland shrub structural and species diversity.
6) Increase structural and compositional diversity of herbaceous uplands.
7) Increase shrub cover.

Boundary Creek: The vegetation monitoring strategy did not specifically address physical characteristics of wetland hydrology or the areal extent of wetland habitats. Monitoring data do, however, address these objectives indirectly. Four of the five points sampled are partially inundated. An additional two points were not sampled due to the depth of flood waters. A third sample point (BOU07, Figure 3) was located on the ground. The sample point was partially inundated. Thus of eight sample points visited 87 percent are partially or fully flooded by water. Sixty-two percent of the plots sampled represent wetland vegetation (Table 4a). Forty-five percent of the transect length sampled on the site is currently wetland vegetation (Table 6a). Based on monitoring results, it is apparent that wetland habitats have been successfully re-established and that wetland vegetation is becoming established in these habitats.

Much of the Boundary Creek site is former cultivated field. While native species are most frequent on sites classified as the *Potemogeton* sp. association, other vegetation on the site is clearly dominated by exotic graminoid and herbaceous species (Table 4a). Stabilization of the site by these exotic species may contribute to the eventual establishment of vegetation dominated by native species. While native

deciduous tree and shrub plantings were observed on the site, these species are essentially absent in the monitoring data (Table 4a). None of the points sampled occur in existing native plant communities (though three of the 14 stratified-random points are located in native vegetation). With the exception of stands classified as the *Potemogeton* sp. association, progress toward restoration and maintenance of native plant communities on the site is not apparent in the stands sampled.

Efforts to control noxious weed growth and establishment were apparent on Boundary Creek. Three noxious weed species are, however, present on the site: *Centaurea solstitialis* was observed on plot BOU04 (Figure 3a) but was not actually recorded on a quadrat frame. *Cirsium arvense* was observed on six plots. The species occurs with 100 percent frequency on several plots. *Sonchus arvensis* was recorded on five quadrat frames located on plot BOU08. *Cirsium arvense* and *Sonchus arvensis* were important components on 17 percent of the transect sample (Table 6a).

Pend Orielle: Thirty-six percent of the plots sampled on the Pend Orielle area are wetland vegetation. Seasonally flooded wetland vegetation is present on 30 and 65 percent the transect length, respectively, in combined data for *Crataegus douglasii/Symphoricarpos albus, Populus tremuloides* and *Populus trichocarpa/Symphoricarpos albus* and combined data for *Populus trichocarpa/Calamagrostis canadensis* and *Populus trichocarpa/Cornus stolonifera* (Table 6b). While these data provide a basis for evaluating an increase in the extent of seasonally flooded wetlands, no observation on the *increase* of these habitats was made.

On many sites within Pend Orielle WMA objectives to maintain areas of pasture and to increase shrub cover are potentially competing. Species composition monitoring data (Table 4b) suggest that graminoid and herbaceous species are most abundant in both pasture and dense riparian shrublands. The vegetation structure data (Table 6b), however, provide a more accurate representation of the relative abundance of pasture versus shrub cover. While herbaceous and graminoid vegetation is predominant within pasture covertypes, medium-tall shrub species are currently becoming established on these sites. Current shrub establishment (as represented by the low shrub structure class, Table 6) is occurring over approximately 11 percent of sites dominated by pasture. It is unlike, however, that dense tall shrub cover characteristic of the combined data for *Populus trichocarpa/Calamagrostis canadensis* and *Populus trichocarpa/Cornus stolonifera* (Table 6b) will progress toward increased pasture habitat without aggressive management.

Noxious weed species were recorded on Pend Oreille. *Centaurea diffusa* was observed on one quadrat frame; *Centaurea maculosa* was recorded on three quadrat frames. Noxious weed species were not observed to be dominate within the vegetation. Two exotic species of concern, *Hypericum perforatum* and *Tanacetum vulgare*, do, however, form dominant stands within the area (Table 6). No evidence of livestock grazing was observed.

How did these vegetation monitoring methods work?

The objective of monitoring vegetation is to assess progress toward achieving a desired vegetative condition. This assessment should occur with an understandable level of certainty that real changes have been detected. Statistical power to detect changes in vegetation is a function of (1) the chance of detecting change that has not really occurred (false-change error rate), (2) the size of the change that needs to be detected (the minimum detectable change), (3) the sample size, and (4) the standard deviation of the sample (Elzinga et al. 1998).

The distribution and abundance of plant species is often closely associated with environmental factors. Many species, however, may have similar environmental growth requirements. The distribution and abundance of these species within a given habitat may result from chance factors of dispersal and establishment. Two strategies to increase statistical power (to detect changes in species composition) involve minimizing variance in estimates of species abundance: (1) stratifying sampling within discrete plant habitats, and (2) grouping ecologically or taxonomically similar plant species. The first approach,

use of stratified-random sampling, is an element of the sampling design -- stratification units should be based on relatively stable environmental factors. The second approach, grouping similar species, is a potential outcome of stating monitoring objectives in operational terms.

Many of the 4 ha units sampled in 2002 encompass a range of different plant habitats. For example, single plots located at the Boundary Creek site encompass both seasonally/temporarily flooded and semi-permanently flooded habitats. These habitats support different plant species. When the species composition data for these discrete habitats are combined, variance is high. The power to detect meaningful changes is low. At Boundary Creek variance in species composition resulting from the placement of plots within discrete habitat gradients is compounded by the fact that the species habitat gradients are relatively recent. Plant species composition on Boundary Creek is rapidly responding to recent changes in the flooding regime.

The application of objective species and habitat groupings to the composition data has clear benefits (Table 4). With application of these groupings reasonable values for minimum detectable change (calculated for $\alpha = 0.1$ and $\beta = 0.1$) are derived for the most frequently observed species groupings. These results provide clarification of how attainment of objectives might be interpreted from the monitoring results. For example, it is relatively clear that the monitoring protocol will address the objective to restore and maintain native vegetative communities. Alternative species groupings with respect to specific monitoring objectives, however, may assist interpretation of the monitoring results. For example, an alternative plant species grouping strategy (to that applied in Table 4) may be more suited to address objectives for the maintenance of Canada goose brood rearing and forage habitats.

Conclusions and Recommendations: The ISRP has raised concerns regarding the level of monitoring and evaluation of NWPPC Fish and Wildlife Program mitigation project results. In response to ISRP recommendations, BPA-funded wildlife mitigation projects within Idaho have worked to develop monitoring and evaluation plans. Through these processes the goal emerged of developing and implementing monitoring protocols that may be applied throughout IDFG Fish and Wildlife Program mitigation lands.

Vegetation composition and structure were sampled on 54 plots located on nine stratified-random sample points within four Albeni Falls Mitigation Project sites. Grouping plots into similar plant communities and grouping species into similar functional groups, resulted in reduction of variation in the data and increased power to detect real changes in vegetation composition over time. The data show that many mitigation objectives are being attained within the Albeni Falls Mitigation Project.

Management objectives are well developed for many of the mitigation properties within the Albeni Falls study area. For the purpose of interpreting vegetation monitoring results, site specific objectives for some properties should be combined upward to the associated scale of the area of statistical inference.

Monitoring strategies employed in this pilot study appear to provide meaningful results related to objectives identified for the mitigation lands. Unnasch et al. (2003), however, identify alternative approaches that will deliver equitable results with substantially lower efforts and cost. The ability to detect vegetation change over time can be improved by stratifying sampling within discrete, stable physical habitats. Interpretation of monitoring results may be improved by specifying management objectives in operational species- and site-specific terms. This pilot study may assist in completing this goal by providing site specific information on plant species occurrences.

Literature Cited

Anderson, D. 2002. Monitoring plan and report - Deer Parks Mitigation Unit. Unpublished report. Upper Snake Region, Idaho Department of Fish and Game, Idaho Falls. 32 pp.

Albeni Falls Interagency Work Group. 2001. Monitoring and evaluation plan for the Albeni Falls Wildlife Mitigation Project. Unpublished report prepared for Bonneville Power Administration. Panhandle Region, Idaho Department of Fish and Game, Boise. 27 pp.

Cole, P., P. Hanna, and J. Deal. 2001. Boundary Creek Wildlife Management Area management plan. Idaho Department of Fish and Game, Panhandle Region, Coeur d'Alene. 73 pp.

Cooper, S. V., K. E. Neiman, and D. W. Roberts. 1991. Forest habitat types of northern Idaho: a second approximation. USDA Forest Service General Technical Report INT?236. Intermountain Research Station, Ogden, UT. 143 p.

Daubenmire, R. 1970. Steppe vegetation of Washington. Washington State University Technical Bulletin 62. Washington Agricultural Experimental Station, College of Agriculture, Pullman. 131 pp.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1. 492 pp.

Hall, F. C., L. Bryant, R. Clausnitzer, K. Geier-Hayes, R. Keane, J. Kertis, A. Shlisky, and R. Steele. 1995. Definitions and codes for seral status and structure of vegetation. General Technical Report PNW-GTR-363. USDA Forest Service, Pacific Northwest Research Station, Portland. 39 pp.

Hanna, P. 1998a. Idaho Department of Fish and Game wildlife mitigation and restoration for Albeni Falls Dam. Draft management plan for the Carter's Island property, Bonner County, Idaho. 19 pp.

Hanna, P. 1998b. Idaho Department of Fish and Game wildlife mitigation and restoration for Albeni Falls Dam. Draft management plan for the Denton slough property, Bonner County, Idaho. 19 pp.

Hanna, P. 1998c. Idaho Department of Fish and Game wildlife mitigation and restoration for Albeni Falls Dam. Draft management plan for the Henderson Ranch property, Bonner County, Idaho. 29 pp.

Hanna, P. 1999. Idaho Department of Fish and Game wildlife mitigation and restoration for Albeni Falls Dam. Draft management plan for the Ginter property, lower Pack River, Bonner County, Idaho. 16 pp.

Hill, M. O. 1979a. DECORANA - a FORTRAN program for detrended correspondence analysis and reciprocal averaging. Ecology and Systematics, Cornell University, Ithaca.

Hill, M. O. 1979b. TWINSPAN - a FORTRAN program for arranging multivariate data in an ordered two-way table by classification of individuals and attributes. Ecology and Systematics, Cornell University, Ithaca.

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

Idaho Conservation Data Center. 2003. Biological and conservation database system: element occurrence record database file. Electronic database system. Idaho Conservation Data Center, Department of Fish and Game, Boise.

Independent Scientific Review Panel, Northwest Power Planning Council. 1997. Review of the Columbia River Basin Fish and Wildlife Program as directed by the 1996 amendment to the Power Act. ISRP Report 97-1. Unpublished report prepared for the Northwest Power Planning Council. Portland. 66 pp.

Independent Scientific Review Panel, Northwest Power Planning Council. 1998. Review of the Columbia River Basin Fish and Wildlife Program for Fiscal Year 1999 as Directed by the 1996 Amendment to the Northwest Power Act. ISRP Report 97-1. Unpublished report prepared for the Northwest Power Planning Council. Portland. 117 pp.

Independent Scientific Review Panel, Northwest Power Planning Council. 1999a. Review of the Columbia River Basin Fish and Wildlife Program for Fiscal Year 2000 as Directed by the 1996 Amendment of the Northwest Power Act, Volume 1. ISRP Report 99-2. Unpublished report prepared for the Northwest Power Planning Council. Portland. 137 pp.

Independent Scientific Review Panel, Northwest Power Planning Council. 1999b. Response Review of Fiscal Year 2000 Proposals. ISRP Report 99-4. Unpublished report prepared for the Northwest Power Planning Council. Portland. 96 pp.

Jankovsky-Jones, M. 1997. Conservation strategy for Northern Idaho wetlands. Conservation Data Center, Idaho Department of Fish and Game. 35 pp. plus appendices.

Leptich, D. 2001a. Idaho Department of Fish and Game wildlife mitigation and restoration for Albeni Falls Dam. Management plan for the Trout Creek property (formerly Hunter Ranch), Bonner County, Idaho. 22 pp.

Leptich, D. 2001b. Idaho Department of Fish and Game wildlife mitigation and restoration for Albeni Falls Dam. Management plan for the Westmond Lake property, Bonner County, Idaho. 38 pp.

McCune, B., and M. J. Mefford. 1999. PC-ORD. Multivariate analysis of ecological data, version 4. MjM Software Design, Gleneden Beach, Oregon.

NatureServe. 2002. NatureServe Explorer: An online encyclopedia of life [web application]. Version 1.6 . Arlington, Virginia, USA: NatureServe. Available: http://www.natureserve.org/explorer.

Reed, Porter B. Jr. 1988. National list of plant species that occur in wetlands: 1988 national summary. Biological Report 88(24). Washington, D.C.: U.S. Department of the Interior, U.S. Fish and Wildlife Service. 244 p.

Unnasch, R. S., S. K. Rust, D. Leptich, E. Bottum, M. Terra-Berns, G. Servheen, R. C. Martin. 2003. Monitoring and evaluation plan for Idaho wildlife mitigation projects. Idaho Department of Fish and Game, Conservation Data Center, Boise. 34 pp.

Washington Natural Heritage Program. 2000. Field guide to Washington's Rare Plants. Cooperative Challenge Cost-share Project, Spokane District, USDI Bureau of Land Management and Washington Natural Heritage Program, Washington State Department of Natural Resources. Not paged.

Figures

List of Figures

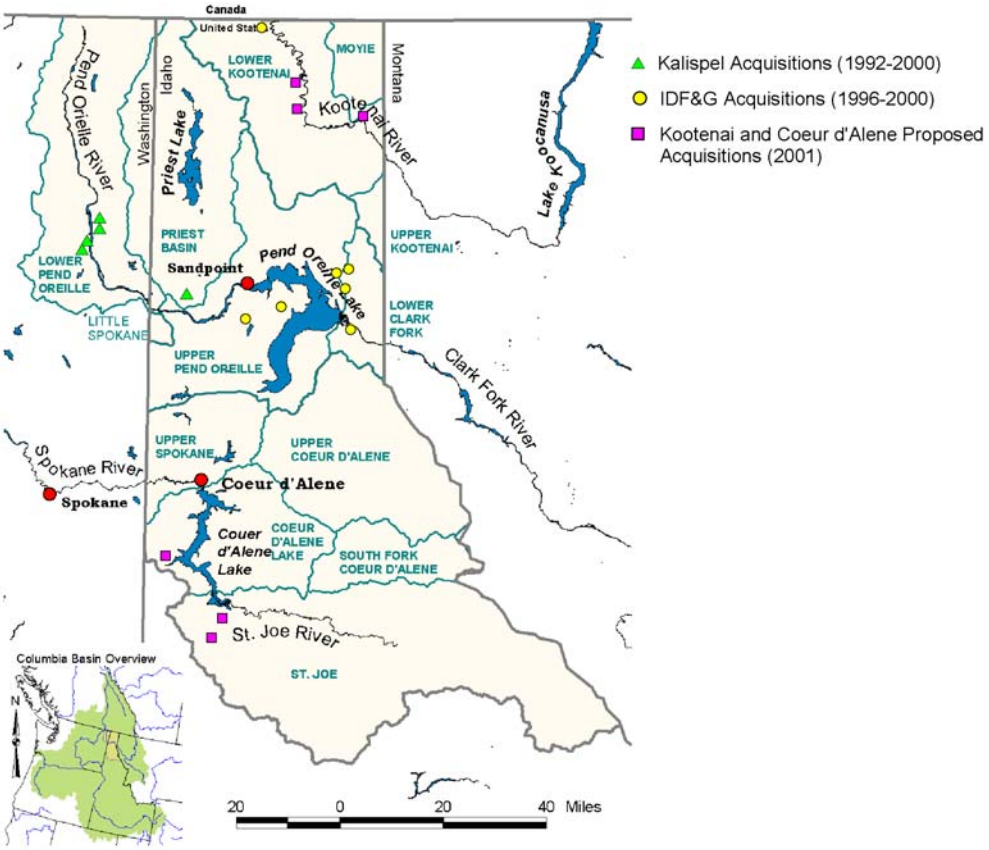


Figure 1. The location of Albeni Falls Mitigation Project study area is shown in relation to the Columbia Rivier Basin (inset), major hydrological features, cities, and state boundaries. The specific location of Kalispel Tribe, Idaho Department of Fish and Game (IDF&G), and Kootenai and Coeur d'Alene Tribal acquisitions is shown (from Albeni Falls Interagency Work Group 2001).

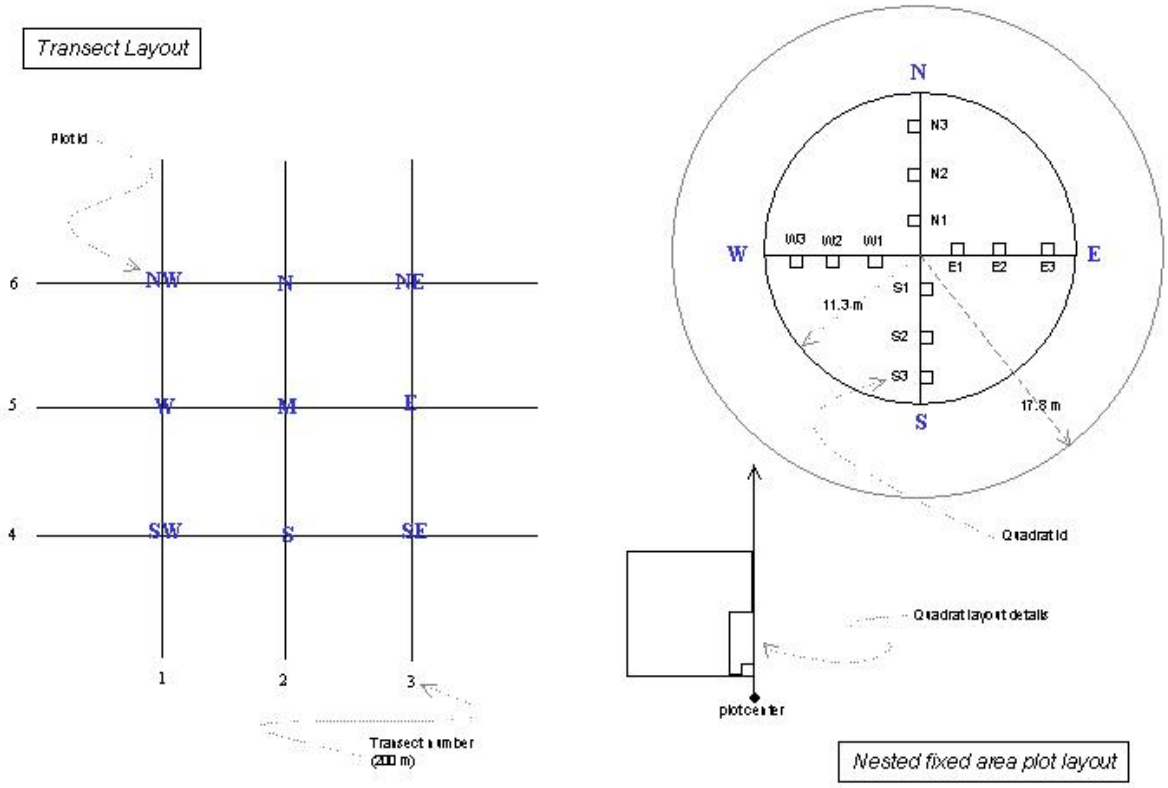
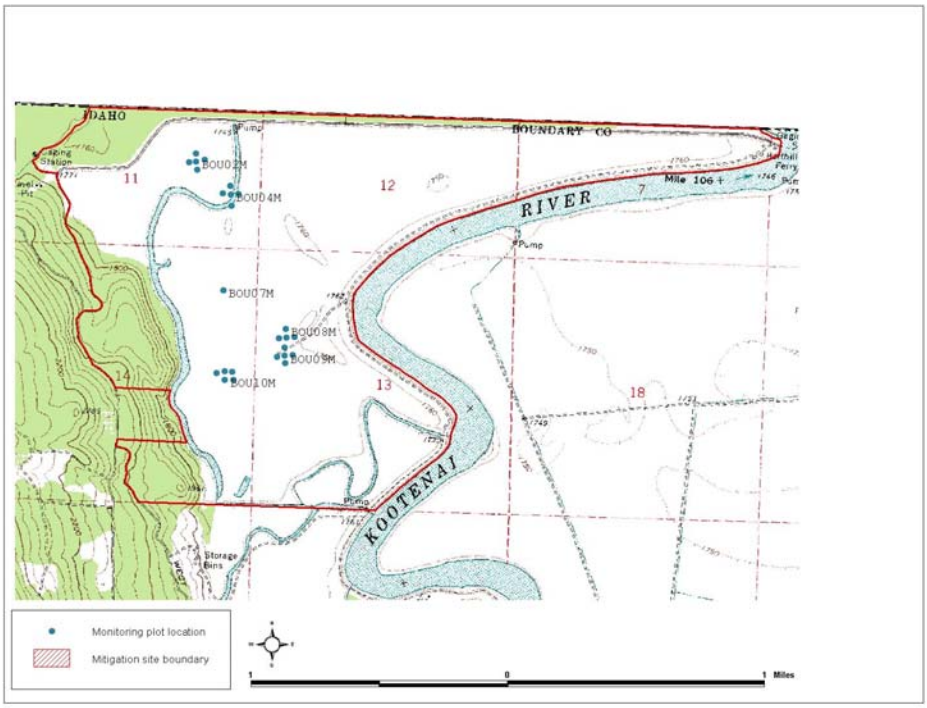
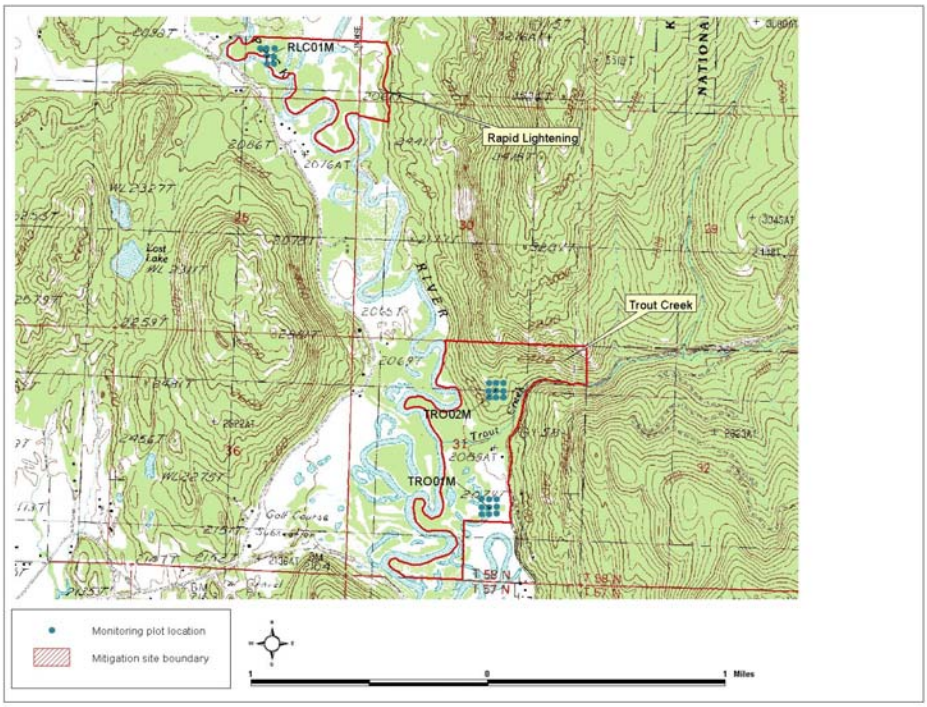


Figure 2. Vegetation sample plot layout. The layout of 200 m community composition and structure transects (left) and nested fixed area sample plots and quadrat frames (right) is shown.

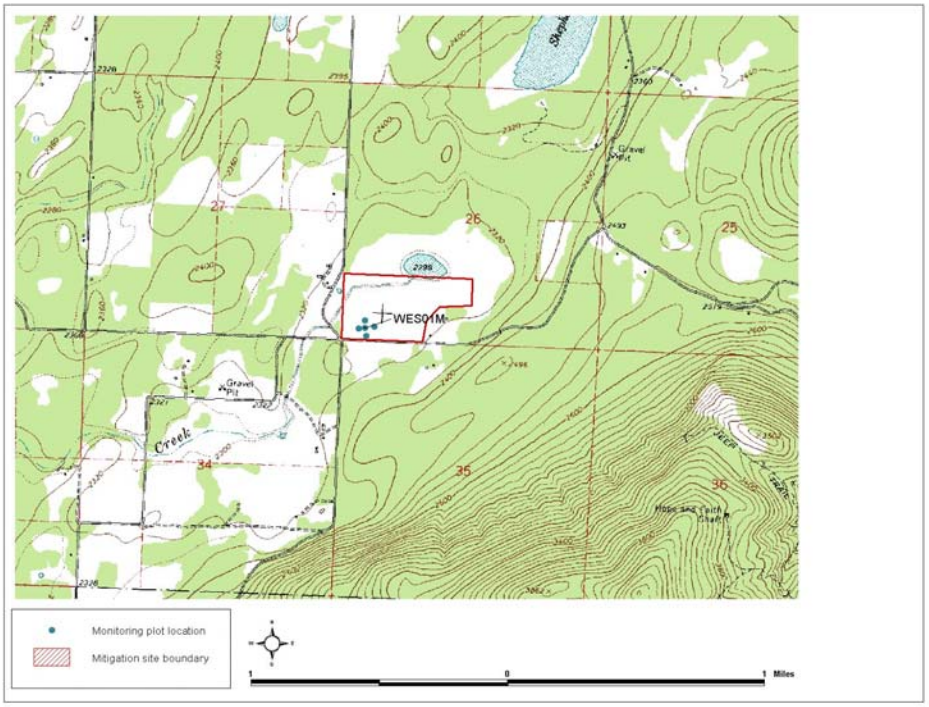
Figure 3. Location of sample points. The locations of sample points on which vegetation was sampled during the 2002 field season are shown: a) Boundary Creek, b) Rapid Lightening and Trout Creek, and c) Westmond Lake.



a) Boundary Creek.



b) Rapid Lightening and Trout Creek.



c) Westmond Lake

Tables

List of Tables

Table 1. Summary of 2002 vegetation sampling effort within the Albeni Falls Mitigation Project. a) The number of permanent plots and transects established are listed by parcel (site) with the dates data were collected. b) The locations of permanent plots are listed by site (Universal Transverse Mercator (UTM) coordinates are shown using the 1927 North American datum (NAD27)).

a)

Site	Points Sampled	Number of Plots	Number of Transects	Dates Sampling Occurred
Boundary Creek	5	24	16	10/01/2002 - 10/03/2002
Rapid Lightning Creek	1	7	6	08/01/2002
Trout Creek	2	18	12	07/29/2002 - 07/31/2002
Westmond Lake	1	5	2	10/04/2002

b)

Site	Plot Identification	UTM X	UTM Y
Boundary Creek	BOU02E	532649	5427010
	BOU02M	532596	5426999
	BOU02N	532592	5427049
	BOU02S	532604	5426947
	BOU02W	532551	5426992
	BOU04E	532869	5426805
	BOU04M	532821	5426797
	BOU04N	532817	5426853
	BOU04S	532828	5426728
	BOU04W	532771	5426804
	BOU08M	533197	5425970
	BOU08S	533203	5425915
	BOU08SE	533255	5425923
	BOU08SW	533158	5425908
	BOU09E	533248	5425806
	BOU09M	533198	5425800
	BOU09N	533196	5425853
	BOU09S	533203	5425754
	BOU09W	533149	5425793
	BOU10E	532884	5425638
	BOU10M	532829	5425635
	BOU10N	532825	5425689
	BOU10NE	532875	5425686
	BOU10NW	532776	5425674
Rapid Lightening Creek	RLC01E	544195	5356212
	RLC01M	544148	5356217
	RLC01N	544141	5356266
	RLC01NE	544196	5356268
	RLC01NW	544100	5356266

Site	Plot Identification	UTM X	UTM Y
	RLC01S	544150	5356161
	RLC01SE	544200	5356164
Trout Creek	TRO01E	545826	5353207
	TRO01M	545775	5353204
	TRO01N	545772	5353259
	TRO01NE	545823	5353259
	TRO01NW	545723	5353258
	TRO01S	545776	5353158
	TRO01SE	545827	5353161
	TRO01SW	545726	5353156
	TRO01W	545726	5353202
	TRO02E	545841	5353999
	TRO02M	545791	5354000
	TRO02N	545790	5354049
	TRO02NE	545837	5354050
	TRO02NW	545741	5354049
	TRO02S	545793	5353952
	TRO02SE	545842	5353953
	TRO02SW	545744	5353951
	TRO02W	545741	5353994
Westmond Lake	WES01E	534032	5334618
	WES01M	533977	5334609
	WES01N	533974	5334658
	WES01S	533985	5334560
	WES01W	533935	5334605

Table 2. Summary statistics for vegetation sampled on Albeni Falls Mitigation Project during the 2002 field season. A variety of summary statistics are listed by sample site (CV = coefficient of variation).

Summary Statistic	Boundary Creek	Pend Orielle
Species Abundance Data		
Number of species observed	73	183
Mean species richness	19.7	16.6
Mean number of species occurrences	6.5	2.7
Number of cells in species/plots matrix	1752	5490
Percentage of empty cells	72.94	90.92
CV of totals of plots (%)	51.95	40.48
CV of totals of species (%)	136.48	172.50
Community Composition and Structure Data		
Number of covertypes observed	41	115
Number of plant associations observed	5	52
Number of structural classes observed	9	60
Number of cells in structure class/transect matrix	144	1200
Percentage of empty cells	61.8	85.3
CV of totals of structure class (%)	153.41	184.45
Tree Stem Density Data		
Number of plots with trees	0	19
number of species/size class/status combinations observed	na	99

Table 3. Summary of classification of plots. The numbers of plots classified within twelve broad plant communities observed during the 2002 field season on Albeni Falls Mitigation Project are listed by community and site.

Plant Association (scientific name)	Covertype(s) (scientific name)	Plant Association (common name)	Number of plots				
			Boundary Creek	Pend Oreille			
				Rapid Lightning Creek	Trout Creek	West-mond	Total
Abies grandis/Linnaea borealis, Linnaea borealis	*Pseudotsuga menziesii/Holodiscus discolor*	grand fir/twinflower			1		1
Abies grandis/Physocarpus malvaceus, Physocarpus malvaceus	*Pseudotsuga menziesii/Holodiscus discolor*	grand fir/ninebark			1		1
Crataegus douglasii/Symphoricarpos albus, Populus tremuloides	numerous pasture grass covertypes	black hawthorn/common snow berry-aspen				5	5
Eleocharis palustris	*Eleocharis palustris*	common spikerush		1	1		2
Populus trichocarpa/Calamagrostis canadensis	*Populus trichocarpa/Calamagrostis canadensis*	black cottonwood/bluejoint			3		3
Populus trichocarpa/Cornus stolonifera	*Populus trichocarpa/Spiraea douglasii*	black cottonwood/redosier dogwood		6			6
Populus trichocarpa/Symphoricarpos albus	*Festuca ovina*	black cottonwood/common snowberry			5		5
Pseudotsuga menziesii/Physocarpus malvaceus, Physocarpus malvaceus	*Pseudotsuga menziesii/Holodiscus discolor*	Douglas fir/ninebark			4		4
Thuja plicata/Clintonia uniflora, Clintonia uniflora	*Thuja plicata/Clintonia uniflora; Pseudotsuga menziesii/Coptis occidentalis*	western redcedar/queen's cup beadlily			3		3
Typha latifolia	*Typha latifolia*	cattail	5				
Unknown	*Agropyron repens-Avena fatua*	quack grass-wild oat	9				
Unknown	*Phalaris arundicacea*	reed canarygrass	6				
Unknown	*Potamogeton sp.*	pondweed	4				

Table 4. Summary of plant species composition data. Summary statistics (mean frequency, standard deviation (stdev), coefficient of variation (cv), minimum detectable change (MDC), and MDC as percent of the mean) for the abundance of broad species groups are shown by plant association (or covertype) and area of inference: (A) Boundary Creek and (B) Pend Orielle. MDC is calculated for $\alpha = 0.1$ and $\beta = 0.1$. Plant species groups were identified on the basis of lifeform, nativity, and habit (as shown in Appendix C). Species groups are listed by lifeform, nativity and habit. For example; *graminoid, exotic annual*; is the group of annual grasses that are not native to the Pacific Northwest. Species groups identified for non-vascular plant species are: algae, moss, and lichen.

A. Boundary Creek

Species Group	mean	stdev	cv	MDC	MDC as % of mean
Potamogeton sp. (n = 4)					
fern, native perennial	18.75	14.23	75.90	28.40	151.47
graminoid, exotic perennial	29.17	43.30	148.46	86.41	296.25
graminoid, native annual	27.08	32.90	121.46	65.64	242.38
graminoid, native perennial	25.00	28.87	115.47	57.61	230.42
herbaceous, exotic perennial	2.08	4.17	200.00	8.31	399.10
herbaceous, native perennial	77.08	10.49	13.60	20.92	27.15
soil	6.25	12.50	200.00	24.94	399.10
water	50.00	57.74	115.47	115.21	230.42
Phalaris arundicacea and *Typha latifolia* (n = 11)					
algae	0.76	2.51	331.66	2.41	318.40
fern, native perennial	28.03	33.18	118.38	31.85	113.64
graminoid, exotic annual	20.45	25.38	124.06	24.36	119.10
graminoid, exotic perennial	75.76	28.25	37.29	27.12	35.80
graminoid, native annual	4.55	12.56	276.39	12.06	265.33
graminoid, native perennial	53.03	32.97	62.17	31.65	59.69
graminoid, unknown	34.09	40.73	119.48	39.10	114.70
herbaceous, exotic annual	25.76	36.22	140.62	34.77	134.99
herbaceous, exotic biennial	37.12	36.58	98.55	35.12	94.61
herbaceous, exotic perennial	65.91	31.72	48.13	30.45	46.21
herbaceous, native annual	18.94	23.60	124.59	22.65	119.61
herbaceous, native biennial	34.09	29.92	87.77	28.72	84.26
herbaceous, native perennial	46.97	38.78	82.56	37.23	79.26
herbaceous, unknown	48.48	38.52	79.44	36.98	76.27
shrub, native perennial	0.76	2.51	331.66	2.41	318.40
liverwort	2.27	7.54	331.66	7.24	318.40
moss	3.79	12.56	331.66	12.06	318.40
soil	40.91	49.08	119.98	47.12	115.18
water	9.09	20.23	222.49	19.42	213.59
Agropyron repens-Avena fatua (n = 9)					
fern, native perennial	8.33	25.00	300.00	27.14	325.70
graminoid, exotic annual	78.70	14.50	18.42	15.74	20.00

Species Group	mean	stdev	cv	MDC	MDC as % of mean
graminoid, exotic perennial	100.00	0.00	0.00	0.00	0.00
graminoid, native annual	3.70	6.05	163.46	6.57	177.46
graminoid, native perennial	22.22	24.65	110.93	26.76	120.43
graminoid, unknown	37.96	33.10	87.19	35.94	94.66
herbaceous, exotic annual	76.85	18.99	24.71	20.62	26.83
herbaceous, exotic biennial	83.33	27.32	32.79	29.66	35.60
herbaceous, exotic perennial	96.30	7.35	7.63	7.98	8.29
herbaceous, native annual	20.37	29.50	144.80	32.02	157.20
herbaceous, native biennial	50.00	31.46	62.92	34.15	68.31
herbaceous, native perennial	55.56	35.84	64.52	38.91	70.04
herbaceous, unknown	79.63	22.48	28.23	24.41	30.65
moss	86.11	21.25	24.67	23.07	26.79
soil	99.07	2.78	2.80	3.02	3.04

B. Pend Orielle.

Species Group	mean	stdev	cv	MDC	MDC percent mean
Abies grandis/Linnaea borealis, Linnaea borealis; Pseudotsuga menziesii/Physocarpus malvaceus, Physocarpus malvaceus; and *Thuja plicata/Clintonia uniflora, Clintonia uniflora* (n = 9)					
fern, native perennial	1.7	5.3	316.2	5.7	343.3
graminoid, exotic perennial	5.7	13.2	232.1	14.3	252.0
graminoid, native annual	2.0	6.3	316.2	6.9	343.3
graminoid, native perennial	80.3	31.3	38.9	34.0	42.3
graminoid, unknown	3.3	10.5	316.2	11.4	343.3
herbaceous, exotic annual	9.3	12.6	135.5	13.7	147.1
herbaceous, exotic biennial	7.7	13.7	178.7	14.9	194.0
herbaceous, exotic perennial	9.7	16.8	173.9	18.3	188.8
herbaceous, native annual	6.0	13.5	225.0	14.7	244.3
herbaceous, native perennial	94.0	9.7	10.3	10.5	11.2
herbaceous, unknown	2.0	6.3	316.2	6.9	343.3
shrub, native perennial	37.0	32.7	88.3	35.5	95.9
lichen	54.3	31.7	58.3	34.4	63.3
liverwort	11.3	15.7	138.8	17.1	150.7
moss	90.3	19.3	21.3	20.9	23.2
Crataegus douglasii/Symphoricarpos albus, Populus tremuloides and *Populus trichocarpa/Symphoricarpos albus* (n = 10)					
fern, native perennial	13.5	31.1	230.6	31.6	234.5
graminoid, exotic annual	1.5	5.0	331.7	5.1	337.3
graminoid, exotic perennial	97.7	3.9	4.0	4.0	4.1
graminoid, native perennial	56.1	47.4	84.6	48.2	86.1

Species Group	mean	stdev	cv	MDC	MDC percent mean
herbaceous, exotic annual	6.1	14.0	230.8	14.2	234.7
herbaceous, exotic biennial	8.6	9.1	105.3	9.2	107.1
herbaceous, exotic perennial	56.8	31.9	56.1	32.4	57.1
herbaceous, native annual	6.1	13.5	222.5	13.7	226.3
herbaceous, native biennial	14.5	22.1	151.8	22.4	154.3
herbaceous, native perennial	59.2	27.2	45.9	27.7	46.7
herbaceous, unknown	3.8	6.8	180.4	7.0	183.5
shrub, native perennial	8.8	21.2	241.3	21.6	245.4
gravel	8.6	21.7	251.1	22.1	255.4
lichen	7.0	10.5	150.0	10.6	152.6
moss	63.6	37.1	58.2	37.7	59.2
rock	0.8	2.5	331.7	2.6	337.3
soil	14.8	27.3	183.8	27.8	186.9
Eleocharis palustris (n = 2)					
graminoid, native perennial	100.0	0.0	0.0		
herbaceous, native perennial	25.0	35.4	141.4		
Populus trichocarpa/Calamagrostis canadensis and *Populus trichocarpa/Cornus stolonifera* (n = 9)					
fern, native perennial	26.3	31.7	120.7	34.4	131.0
graminoid, exotic perennial	29.3	34.0	116.1	36.9	126.1
graminoid, native perennial	84.1	23.6	28.0	25.6	30.4
graminoid, unknown	3.7	11.1	300.0	12.1	325.7
herbaceous, exotic annual	8.1	16.3	199.5	17.6	216.6
herbaceous, exotic biennial	11.1	14.5	130.8	15.8	142.0
herbaceous, exotic perennial	43.7	29.8	68.3	32.4	74.1
herbaceous, native biennial	8.1	16.3	199.5	17.6	216.6
herbaceous, native perennial	76.7	26.5	34.5	28.7	37.5
herbaceous, unknown	6.3	9.5	150.8	10.3	163.7
shrub, native perennial	12.6	21.5	170.4	23.3	185.0
gravel	1.9	5.6	300.0	6.0	325.7
litter	1.9	5.6	300.0	6.0	325.7
moss	49.6	37.9	76.3	41.1	82.9

Table 5. Summary of tree stem data. Summary statistics (mean stems per hectare, standard deviation (stdev), and coefficient of variation (cv)) for tree stems classified by status group: live stems, dead and down stems, and standing dead; and size class are listed. Blank cells indicate no observation. Tree stems were only sampled on Pend Orielle WMA.

Status	Statistic	Stem size class				
		giant trees (≥ 33 inches dbh)	large trees (21.0 - 32.9 inches dbh)	medium trees (9.0 - 20.9 inches dbh)	poles (5.0 - 8.9 inches dbh)	saplings (1.0 - 4.9 inches dbh)
Deciduous forest						
Live	mean	1.4	10.0	81.2	63.5	77.7
	stdev	3.8	11.5	63.3	102.7	95.1
	cv	264.6	115.5	78.0	161.7	122.4
Dead and down	mean			88.2	74.1	
	stdev			66.7	84.4	
	cv			75.6	113.9	
Standing dead	mean	1.4	11.4	28.2	0.0	28.2
	stdev	3.8	10.7	17.1		56.0
	cv	264.2	93.5	60.4		198.4
Evergreen forest						
Live	mean		11.1	178.5	167.5	373.4
	stdev		10.5	162.4	160.0	335.1
	cv		94.9	91.0	95.6	89.7
Dead and down	mean		1.1	60.4	140.0	
	stdev		3.3	44.7	75.2	
	cv		300	74.1	53.7	
Standing dead	mean		8.9	43.9	43.9	41.2
	stdev		11.7	29.7	52.1	46.2
	cv		131.3	67.6	118.6	112.2
Overall						
Live	mean	0.6	10.6	135.9	122.0	244.0
	stdev	2.5	10.6	134.7	143.9	294.0
	cv	400.0	100.0	99.1	118.0	120.5
Dead and down	mean		0.6	72.6	111.2	
	stdev		2.5	55.2	83.7	
	cv		400.0	76.1	75.2	
Standing dead	mean	0.6	10.0	37.1	24.7	35.5
	stdev	2.5	11.0	25.5	44.2	49.4
	cv	400.0	109.5	68.9	178.9	139.1

Table 6. Summary of vegetation structure. Summary statistics (mean, standard deviation (stdev), and coefficient of variation (cv)) for the percent abundance of broad vegetation structure classes are shown by area of inference: (A) Boundary Creek and (B) Pend Orielle. On Pend Orielle results are summarized by dominant plant association.

A. Boundary Creek

Structure class	mean	stdev	cv
herbaceous, > 66 percent cover	54.55	30.01	55.01
herbaceous, > 25 and <= 66 percent cover	6.28	11.25	179.24
herbaceous, >= 10 and <= 25 percent cover	20.05	22.73	113.39
tall shrub, >= 10 and <= 25 percent cover	0.12	0.49	400.00
sapling, >= 10 and <= 25 percent cover	2.06	4.87	236.88
water	16.95	18.11	106.84
Wetland and riparian plant associations	45.42	33.93	74.70
Dominance by noxious weed species or selected exotic forb species	17.31	24.95	144.20

B. Pend Orielle

Structure class	mean	stdev	cv
Abies grandis/Linnaea borealis, Linnaea borealis; Pseudotsuga menziesii/Physocarpus malvaceus, Physocarpus malvaceus; and *Thuja plicata/Clintonia uniflora, Clintonia uniflora*			
herbaceous, > 25 and <= 66 percent cover	1.94	3.05	157.23
low shrub, >= 10 and <= 25 percent cover	2.64	4.09	154.93
medium shrub, >= 10 and <= 25 percent cover	1.61	2.65	164.74
medium shrub, < 10 percent cover	0.98	2.41	244.95
tall shrub, > 25 and <= 66 percent cover	1.33	2.14	160.69
tall shrub, >= 10 and <= 25 percent cover	2.32	2.89	124.75
sapling, > 66 percent cover	4.35	5.66	130.21
sapling, > 25 and <= 66 percent cover	3.91	2.68	68.61
sapling, >= 10 and <= 25 percent cover	10.17	4.91	48.33
pole, > 25 and <= 66 percent cover	1.68	2.60	155.15
pole, >= 10 and <= 25 percent cover	5.07	3.60	71.00
medium tree, > 66 percent cover	10.38	17.48	168.51
medium tree, > 25 and <= 66 percent cover	20.06	15.58	77.65
medium tree, >= 10 and <= 25 percent cover	13.08	11.41	87.19
large tree, > 25 and <= 66 percent cover	15.18	14.27	94.07
large tree, >= 10 and <= 25 percent cover	4.96	6.01	121.25
n/a	0.36	0.88	244.95
Wetland and riparian plant associations	0	0	0
Dominance by noxious weed species or selected exotic forb species	0	0	0

Structure class	mean	stdev	cv
Crataegus douglasii/Symphoricarpos albus, Populus tremuloides and *Populus trichocarpa/Symphoricarpos albus*			
herbaceous, > 66 percent cover	54.38	24.88	45.76
herbaceous, > 25 and <= 66 percent cover	0.77	2.17	282.84
herbaceous, >= 10 and <= 25 percent cover	3.28	9.28	282.84
low shrub, >= 10 and <= 25 percent cover	11.23	15.91	141.64
medium shrub, > 66 percent cover	0.98	2.78	282.84
medium shrub, > 25 and <= 66 percent cover	2.05	4.51	219.91
medium shrub, >= 10 and <= 25 percent cover	1.77	3.55	200.85
medium shrub, < 10 percent cover	1.96	3.98	202.95
tall shrub, > 66 percent cover	8.50	8.13	95.62
tall shrub, > 25 and <= 66 percent cover	3.53	4.22	119.39
medium tree, > 66 percent cover	0.58	1.63	282.84
medium tree, > 25 and <= 66 percent cover	1.63	2.81	172.68
medium tree, >= 10 and <= 25 percent cover	0.13	0.35	282.84
large tree, > 25 and <= 66 percent cover	2.39	4.43	185.21
large tree, >= 10 and <= 25 percent cover	0.59	1.68	282.84
water	6.23	7.90	126.86
Wetland and riparian plant associations	29.89	24.41	81.66
Dominance by noxious weed species or selected exotic forb species	1.81	5.11	282.84
Populus trichocarpa/Calamagrostis canadensis and *Populus trichocarpa/Cornus stolonifera*			
herbaceous, > 66 percent cover	0.96	1.50	156.40
herbaceous, > 25 and <= 66 percent cover	0.50	1.22	244.95
herbaceous, >= 10 and <= 25 percent cover	0.69	1.69	244.95
low shrub, >= 10 and <= 25 percent cover	5.77	11.93	206.88
medium shrub, > 66 percent cover	1.38	3.39	244.95
medium shrub, > 25 and <= 66 percent cover	11.33	15.60	137.65
medium shrub, >= 10 and <= 25 percent cover	3.18	2.60	81.89
medium shrub, < 10 percent cover	1.04	2.55	244.95
tall shrub, > 66 percent cover	30.01	12.00	39.97
tall shrub, > 25 and <= 66 percent cover	6.25	6.20	99.20
tall shrub, >= 10 and <= 25 percent cover	0.33	0.80	244.95
pole, > 25 and <= 66 percent cover	1.21	2.96	244.95
medium tree, > 25 and <= 66 percent cover	10.58	17.06	161.35
medium tree, >= 10 and <= 25 percent cover	3.39	6.26	184.52
large tree, > 25 and <= 66 percent cover	1.63	2.53	154.97
n/a	21.76	22.14	101.78
Wetland and riparian plant associations	64.95	23.93	36.84
Dominance by noxious weed species or selected exotic forb species	16.71	11.72	70.12

Appendix A - Sampling Strategy

The following discussion of the Albeni Falls Mitigation Project monitoring sampling strategy is reproduced from Albeni Falls Interagency Work Group (2001, pages 5 - 7).

Monitoring and Evaluation Sampling Strategy

The focus of this project is wetland mitigation. Monitoring will focus on wetland/riparian habitats. For the purpose of this monitoring plan upland monitoring will be limited to observational techniques and documentation of weed control. However, nothing constrains a manager from doing more intensive monitoring of uplands as deemed appropriate. For example, a high disturbance upland prescription to selectively log and prescribe burn an upland site to improve white-tailed deer forage availability should include a site-specific monitoring plan.

Using the Universal Transverse Mercator coordinate system a permanent grid with spacing of 200 m or less will be established by each Work Group cooperator on each mitigation property they own and manage. By ownership, grid points will be sequentially numbered and represent potential monitoring sample points that can be randomly selected by use of a random numbers generator. The 200-m spacing is equal to the preferred sample point separation for land bird point-count stations (Huff et al. 2000), and yields one potential sample point for every 4 ha of habitat. Closer grid-point spacing decreases the probability that data from adjacent sample points are independent and increases the risk of double counting birds when using variable-radius point-count sampling techniques in particular. Three wetland cover types will be monitored: emergent herbaceous, shrub-scrub, and forested wetlands.

Drawing the sample of points to be monitored is complicated by the fact that we are still in the implementation phase and additional properties will be added on an annual basis for the next 10+ years. The sampling scheme must be cost effective, provide a data set that provides a long-term perspective on meeting management objectives, and is flexible enough to incorporate new properties as they are acquired. Consideration must also be given to the fact that cover types do not occur in equal proportions and that some habitats are intact while others require restoration. Taking these concerns into consideration we have devised the following sampling scheme:

Sampling will be done with a constant intensity of 10% of all potential sample points. As additional properties are purchased, additional permanent sample points will be identified to maintain a sampling intensity of 10% of all possible sample points. One-third of the selected sample points will be visited each year on a three-year rotating basis. The use of rotating panels of sample points will allow us to effectively increase the sample size while still meeting the objectives of long-term monitoring within time and cost constraints (McDonald et al. 1998). Permanent sample sites that are visited every three years are revisited at a sufficient frequency to capture long-term trends in population and community change.

A stratified random sample of long-term monitoring sample points will be drawn from all possible sample points. Once identified as part of the sample to be monitored, these points will become part of a permanent subset of points to be used for long-term monitoring. The sample will be stratified on three wetland cover-types: emergent herbaceous wetlands, shrub-scrub wetlands, and forested wetlands. Furthermore, the sampling effort in each stratum will be weighted in proportion to that cover type's collective occurrence on mitigation parcels. A proportional stratified random sample has appeal because monitoring effort reflects the availability of habitats under management. However, this scheme may result in sample sizes that are too small to adequately detect changes in habitats and their associated wildlife communities for wetland habitats that comprise relatively smaller proportions of mitigation properties. Consequently, some adjustment in sample allocation may be needed when the Albeni Falls Dam HU ledger is fully mitigated.

This stratified random sampling design makes no a priori distinction between sample points that fall on intact wetlands where management is custodial and restoration sites where there is active management and community changes may be dramatic even in a short amount of time. At a programmatic and project scale this is appropriate to document the success or failure of conservation strategies from a long-term monitoring perspective. However, it may not provide managers with adequate feedback on the success of site specific management prescriptions. Managers may choose to supplement this basic sampling scheme with additional sample points randomly selected from within a site-specific prescription area. These supplemental sample points will not become part of the long-term permanent sample-point set. They may be revisited more or less frequently than every three years and/or dropped from monitoring altogether at any time at the manager's discretion.

Monitoring in an adaptive management context implies benchmarks or desired outcomes against which management success can be measured. The vegetative and wildlife community structure of intact wetland habitats can act as one benchmark for the effectiveness of restoration management. We will retrospectively (that is after the random sample has been drawn) identify a subset of the permanent sample points of intact wetlands from each cover type to serve as reference sites against which restoration management may be evaluated. Additional reference sites, both within and outside of the project boundaries, may need to be subjectively identified to secure a minimum of three reference sites for each cover type. Sample points selected as reference sites will initially be sampled for three consecutive years to establish a strong baseline data set. Based on initial results permanent baseline monitoring plots may also be established (to the extent possible) within formally designated ecological reference areas (e.g. USDA Forest Service Research Natural Areas) that are located in areas adjacent to mitigation properties but are functionally independent of mitigation properties and associated management. When available and applicable the scientific literature will provide an additional source of reference benchmarks for project evaluation.

Appendix B - Classification of Vegetation Structure

Vegetation structure codes. The code is a five character string incorporating code for diameter (for forest and woodland stands) or height (for shrubland and grassland stands), canopy cover, and canopy layering (strata) (from Hall et al. 1995).

Tree stem size class	SA	sapling	20 trees per acre 1 - 4.9 inches dbh*
	PO	pole	15 trees per acre 5 - 8.9 inches dbh
	MT	medium tree	10 trees per acre 9 - 20.9 inches dbh
	LT	large tree	10 trees per acre 21 - 31.9 inches dbh
	GT	giant tree	5 trees per acre > 31.9 inches dbh

* This applies to the largest trees present. A class is determined by the average dbh of the number of trees per acre indicated.

Shrub/Grass height class:	HE	Herbland. Grasses and herbs are the only lifeform present.
	LS	Low shrub. Shrubs are 0 - 1.5 feet tall.
	Ma	Medium shrub. Shrubs are 1.6 - 2.5 feet tall.
	Mb	Medium tall shrub. Shrubs are 2.6 - 4.0 feet tall.
	Ta	Tall shrub. Shrubs are 4 - 6.5 feet tall.
	Tb	Very tall shrub. Shrubs are ≥ 6.5 (and < 16.5) feet tall.
Cover class:	Na	< 10 percent canopy cover.
	Oa	≥ 10 and < 15 percent canopy cover.
	Ob	≥ 15 and ≤ 25 percent canopy cover.
	Ma	> 25 and ≤ 40 percent canopy cover.
	Mb	> 40 and ≤ 66 percent canopy cover.
	Da	> 66 percent cover.
Strata	N	No strata.
	E	One stratum with < 30 percent difference in height.
	U	Two or more strata (of the same life form) with > 30 percent difference in height. If shrubland, a second shrub strata must have ≥ 25 percent cover. If herbland or grassland, a second herb or grass strata must have ≥ 10 percent cover (including cryptograms).

Tree stem size classes.

Code	Size class	Range
S1	seedling 1	< 6.0 inches tall
S2	seedling 2	> 6.0 inches
SA	sapling	1.0 - 4.9 inches dbh
PO	pole	5.0 - 8.9 inches dbh
MT	medium tree	9.0 - 20.9 inches dbh
LT	large tree	21.0 - 32.9 inches dbh
GT	very large tree	33.0 and greater

Tree stem decay classes.

Code	Status	Description
Standing dead		
SD1	decay class 1	bark, stemwood, and fine branch structure is intact
SD2	decay class 2	few limbs and no fine branches are present; the bark is partially broken; some stem decay may be present
SD3	decay class 3	only limb stubs are present; the bark is broken and sloughing; stem decay is evident
SD4	decay class 4	few limb stubs are present; the stem is usually broken and with evident decay; little bark remains
SD5	decay class 5	no limb stubs are present; the stem is broken and rotten; no bark remains
Dead and down		
DD1	decay class 1	bark, stemwood, and fine branch structure is intact
DD2	decay class 2	few limbs and no fine branches are present; the bark is partially broken; some stem decay may be present
DD3	decay class 3	only limb stubs are present; the bark is broken and sloughing; stem decay is evident
DD4	decay class 4	few limb stubs are present; the stem is usually broken with evident decay and conforming to microtopography; little bark remains
DD5	decay class 5	no limb stubs are present; the stem is broken, rotten and partially integrated into the soil; no bark remains

Appendix C - Plant Species List

Vascular plant species observed on Albeni Falls Mitigation Project during the 2002 field season are listed by physiognomic group, symbol, common name, nativity (codes are: n, the species is native to the study area; e, the species is exotic or not native to the study area), habit (codes are: a, annual; b, biennial; and p, perennial), and the mitigation property at which the species was observed (a check mark ( ) indicates the species was observed; a blank cell indicates the species was not observed at the respective site). Nomenclature follows Hitchcock and Cronquist (1973) with minor exceptions.

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Trees								
Abies grandis	ABGR	grand fir	n	p		✓	✓	
Alnus	ALNUS	alder	n	p			✓	
Alnus rubra	ALRU2	red alder	n	p		✓		
Betula papyrifera	BEPA	paper birch	n	p		✓	✓	
Larix occidentalis	LAOC	western larch	n	p			✓	
Pinus contorta	PICO	lodgepole pine	n	p			✓	
Pinus monticola	PIMO3	western white pine	n	p			✓	
Pinus ponderosa	PIPO	ponderosa pine	n	p			✓	
Populus trichocarpa	POTR15	black cottonwood	n	p		✓	✓	
Pseudotsuga menziesii	PSME	Douglas-fir	n	p			✓	
Thuja plicata	THPL	western red cedar	n	p		✓	✓	
Tsuga heterophylla	TSHE	western hemlock	n	p			✓	
Shrubs								
Acer glabrum	ACGL	Rocky Mountain maple	n	p			✓	
Adenocaulon bicolor	ADBI	American trailplant	n	p			✓	
Amelanchier alnifolia	AMAL2	Saskatoon serviceberry	n	p			✓	
Berberis repens	BERE	Oregon grape	n	p			✓	
Ceanothus sanguineus	CESA	redstem ceanothus	n	p			✓	
Cornus stolonifera	COSE16	redosier dogwood	n	p		✓		

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Crataegus douglasii	CRDO2	black hawthorn	n	p		✓		✓
Holodiscus discolor	HODI	oceanspray	n	p			✓	
Lonicera ciliosa	LOCI3	orange honeysuckle	n	p			✓	
Lonicera utahensis	LOUT2	Utah honeysuckle	n	p			✓	
Paxistima myrsinites	PAMY	Oregon boxleaf	n	p			✓	
Philadelphus lewisii	PHLE4	Lewis' mock orange	n	p		✓	✓	
Physocarpus malvaceus	PHMA5	mallow ninebark	n	p			✓	
Prunus emarginata	PREM	bitter cherry	n	p			✓	
Prunus virginiana	PRVI	chokecherry	n	p			✓	
Rosa gymnocarpa	ROGY	dwarf rose	n	p			✓	✓
Rosa nutkana	RONU	Nootka rose	n	p		✓	✓	
Rubus leucodermis	RULE	whitebark raspberry	n	p			✓	
Rubus parviflorus	RUPA	thimbleberry	n	p		✓	✓	
Rubus ursinus	RUUR	California blackberry	n	p		✓		
Salix bebbiana	SABE2	Bebb willow	n	p		✓		
Salix drummondiana	SADR	Drummond's willow	n	p		✓		
Salix lutea	SALU2	yellow willow	n	p		✓		
Sambucus cerulea	SACE3	mountain ash	n	p		✓		
Sorbus scopulina	SOSC2	Greene's mountain ash	n	p			✓	
Spiraea betulifolia	SPBE2	white spirea	n	p			✓	
Spiraea douglasii	SPDO	rose spirea	n	p		✓	✓	✓
Symphoricarpos albus	SYAL	common snowberry	n	p	✓	✓	✓	
Symphoricarpos oreophilus	SYOR2	mountain snowberry	n	p				✓
Herbs								
Achillea millefolium	ACMI2	common yarrow	n	p			✓	✓
Alisma plantago-aquatica var. americanum	ALPLA	American waterplantain	n	p	✓			

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Angelica arguta	ANAR3	Lyall's angelica	n	p		✓		
Anthemis cotula	ANCO2	stinking chamomile	e	a	✓			
Apocynum androsaemifolium	APAN2	spreading dogbane	n	p			✓	
Aralia nudicaulis	ARNU2	wild sarsaparilla	n	p			✓	
Arnica	ARNIC	arnica	n	p			✓	
Arnica cordifolia	ARCO9	heartleaf arnica	n	p			✓	
Artemisia	ARTEM	sagebrush	n	p	✓			
Aster laetevirens	ASLA11	marsh aster	n	p		✓	✓	
Aster modestus	ASMO3	few-flowered aster	n	p		✓		
Atriplex	ATRIP	saltbush	n	p	✓			
Bellis perennis	BEPE2	lawndaisy	e	p				✓
Bidens cernua	BICE	nodding beggartick	n	a	✓			
Brassica alba	BRAL7	white mustard	e	a			✓	
Capsella bursa-pastoris	CABU2	shepherd's purse	e	a	✓			
Centaurea diffusa	CEDI3	white knapweed	e	b				✓
Centaurea maculosa	CEMA4	spotted knapweed	e	b		✓	✓	
Centaurea solstitialis	CESO3	yellow starthistle	e	a	✓			
Cerastium (annual)	CERAS	mouse-ear chickweed	e	a	✓		✓	✓
Cerastium (perennial)	CERAS	mouse-ear chickweed	n	p			✓	
Ceratophyllum demersum	CEDE4	coon's tail	n	p	✓			
Chimaphila umbellata	CHUM	pipsissewa	n	p			✓	
Chrysanthemum leucanthemum	CHLE80	oxeye daisy	e	p		✓	✓	
Cirsium	CIRSI	thistle	e	p	✓			
Cirsium arvense	CIAR4	Canada thistle	e	p	✓			✓
Cirsium vulgare	CIVU	bull thistle	e	b	✓			✓
Clematis columbiana	CLCO2	rock clematis	n	p			✓	

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Clematis ligusticifolia	CLLI2	western white clematis	n	p		✓		
Clintonia uniflora	CLUN2	queen's cup beadlily	n	p			✓	
Collinsia grandiflora	COGR2	giant blue eyed Mary	n	a			✓	
Collinsia parviflora	COPA3	maiden blue eyed Mary	n	a			✓	
Conyza canadensis var. glabrata	COCAG	Canadian horseweed	n	b	✓			
Coptis occidentalis	COOC	Idaho goldthread	n	p			✓	
Dianthus	DIANT	pink	e	b				✓
Disporum hookeri	DIHO3	drops of gold	n	p			✓	
Elodea	ELODE	waterweed	n	p	✓			
Epilobium	EPILO	willowherb	n	p	✓			
Epilobium glandulosa	EPGL4	common willowherb	n	p	✓			
Epilobium paniculatum	EPPA2	autumn willowherb	n	p			✓	
Fragaria vesca	FRVE	woodland strawberry	n	p			✓	✓
Fragaria virginiana	FRVI	Virginia strawberry	n	p			✓	
Galium	GALIU	bedstraw	n	p		✓		
Galium aparine	GAAP2	stickywilly	n	a	✓			
Galium trifidum	GATR2	threepetal bedstraw	n	p		✓	✓	
Geum macrophyllum	GEMA4	largeleaf avens	n	p			✓	
Gnaphalium palustre	GNPA	western marsh cudweed	n	a	✓			
Goodyera oblongifolia	GOOB2	western rattlesnake plantain	n	p			✓	
Habenaria unalascensis	HAUN	Alaska rein-orchid	n	p			✓	
Heracleum lanatum	HELA4	wild cowparsnip	n	p		✓		
Heuchera cylindrica	HECY2	roundleaf alumroot	n	p			✓	
Hieracium	HIERA	hawkweed	n	p				✓
Hieracium albiflorum	HIAL2	white hawkweed	n	p			✓	
Hypericum perforatum	HYPE	common St. Johnswort	e	p		✓		✓

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Impatiens aurella	IMAU	paleyellow touch-me-not	n	p		✓	✓	
Lactuca serriola	LASE	prickly lettuce	e	b	✓			
Lilium columbianum	LICO	Columbian lily	n	p			✓	
Linnaea borealis	LIBO3	twinflower	n	p			✓	
Lupinus	LUPIN	lupine	n	p			✓	
Lupinus arbustus	LUAR6	longspur lupine	n	p			✓	
Lycopus uniflorus	LYUN	northern bugleweed	n	p			✓	
Lysimachia ciliata	LYCI	fringed loosestrife	n	p	✓	✓	✓	
Madia	MADIA	tarweed	n	a				✓
Medicago	MEDIC	alfalfa	e	p	✓			
Medicago lupulina	MELU	black medick	e	a	✓			
Medicago sativa	MESA	alfalfa	e	p	✓			
Melica	MELIC	melicgrass	n	p			✓	
Mentha arvensis	MEAR4	wild mint	n	p			✓	✓
Montia	MONTI	minerslettuce	n	a	✓			
Navarretia	NAVAR	pincushionplant	n	a				✓
Nemophila	NEMOP	baby blue eyes	n	a				✓
Nepeta cataria	NECA2	catnip	e	p	✓			
Osmorhiza chilensis	OSCH	mountain sweet-cicely	n	p			✓	
Penstemon	PENST	beardtongue	n	p			✓	
Penstemon attenuatus	PEAT3	sulphur penstemon	n	p			✓	
Penstemon wilcoxii	PEWI	Wilcox's penstemon	n	p			✓	
Plantago lanceolata	PLLA	narrowleaf plantain	n	b		✓	✓	
Plantago major	PLMA2	common plantain	n	p	✓		✓	✓
Polemonium	POLEM	Jacob's-ladder	n	p				✓
Polygonum amphibium var. stipulaceum	POAMS	water smartweed	n	p				✓

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Polygonum aviculare	POAV	prostrate knotweed	e	a	✓			
Polygonum douglasii	PODO4	Douglas' knotweed	n	a			✓	
Potamogeton	POTAM	pondweed	n	p	✓	✓	✓	✓
Potentilla biennis	POBI7	biennial cinquefoil	n	b	✓			
Potentilla glandulosa	POGL9	sticky cinquefoil	n	p			✓	
Prunella vulgaris	PRVU	common selfheal	n	p		✓	✓	
Pyrola asarifolia	PYAS	liverleaf wintergreen	n	p			✓	
Ranunculus aquatilis	RAAQ	whitewater crowfoot	n	p	✓			
Ranunculus repens	RARE3	creeping buttercup	e	p	✓		✓	
Rhamnus purshiana	RHPU	cascara	n	p			✓	
Rorippa	RORIP	yellowcress	n	b	✓			
Rubus idaeus	RUID	American red raspberry	n	p		✓	✓	✓
Rumex	RUMEX	dock	e	p	✓			
Rumex acetosella	RUAC3	common sheep sorrel	e	p		✓	✓	✓
Rumex crispus	RUCR	curly dock	e	p	✓			
Rumex salicifolius	RUSA	willow dock	n	p	✓			
Satureja douglasii	SADO5	yerba buena	n	p			✓	
Sedum stenopetalum	SEST2	wormleaf stonecrop	n	p			✓	
Senecio	SENEC	ragwort	n	p		✓		
Senecio canus	SECA2	woolly groundsel	n	p				✓
Sisymbrium	SISYM	hedgemustard	e	b	✓			
Smilacina racemosa	SMRA	western solomon-plume	n	p			✓	
Smilacina stellata	SMST	stary solomon-plume	n	p		✓	✓	
Solanum dulcamara	SODU	climbing nightshade	n	p			✓	
Solidago canadensis	SOCA6	Canada goldenrod	n	p		✓		
Sonchus arvensis	SOAR2	field sowthistle	e	p	✓			

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Sonchus asper	SOAS	spiny sowthistle	e	p	✓			
Sparganium emersum	SPEM2	simplestem bur-reed	n	p			✓	
Stellaria jamesiana	STJA3	sticky starwort	n	p				✓
Stellaria media ssp. media	STMEM	common chickweed	e	p	✓		✓	✓
Tanacetum vulgare	TAVU	common tansy	e	p		✓	✓	✓
Taraxacum officinale	TAOF	common dandelion	e	b	✓	✓	✓	✓
Thalictrum dasycarpum	THDA	purple meadow-rue	n	p			✓	
Thalictrum occidentale	THOC	western meadow-rue	n	p		✓		
Trautvetteria caroliniensis	TRCA	Carolina bugbane	n	p		✓	✓	
Trifolium agrarium	TRAG	clover	e	a		✓	✓	
Trifolium pratense	TRPR2	red clover	e	p	✓			✓
Trifolium repens	TRRE3	white clover	e	p			✓	
Typha latifolia	TYLA	broadleaf cattail	n	p	✓			
Verbascum thapsus	VETH	common mullein	e	b	✓			
Veronica	VERON	speedwell	e	p				✓
Veronica serpyllifolia	VESE	thymeleaf speedwell	n	p			✓	
Vicia americana	VIAM	American vetch	n	p		✓	✓	
Viola	VIOLA	violet	n	p				✓
Viola adunca	VIAD	hookedspur violet	n	p			✓	
Viola glabella	VIGL	pioneer violet	n	p			✓	
Viola orbiculata	VIOR	darkwoods violet	n	p			✓	
Grasses, rushes and sedges								
Agropyron	AGROP2	wheatgrass	e	p	✓		✓	
Agropyron repens	AGRE2	quack grass	e	p	✓	✓	✓	✓
Agrostis	AGROS2	bentgrass	e	p	✓		✓	
Agrostis exarata	AGEX	spike bentgrass	n	p	✓			

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Agrostis stolonifera	AGST2	creeping bentgrass	n	p		✓	✓	✓
Avena fatua	AVFA	wild oat	e	a	✓			
Bromus inermis	BRIN2	smooth brome	e	p				✓
Bromus japonicus	BRJA	Japanese brome	e	a	✓			✓
Bromus tectorum	BRTE	cheatgrass	e	a	✓			
Bromus vulgaris	BRVU	Columbia brome	n	p			✓	
Calamagrostis canadensis	CACA4	bluejoint	n	p		✓	✓	
Calamagrostis rubescens	CARU	pinegrass	n	p			✓	
Carex	CAREX	sedge	n	p			✓	✓
Carex aquatilis	CAAQ	water sedge	n	p		✓	✓	
Carex arcta	CAAR2	northern cluster sedge	n	p		✓	✓	
Carex concinnoides	CACO11	northwestern sedge	n	p			✓	
Carex deweyana	CADE9	Dewey sedge	n	p		✓	✓	
Carex geyeri	CAGE2	Geyer's sedge	n	p			✓	
Carex lanuginosa	CALA30	woolly sedge	n	p		✓		
Carex pachystachya	CAPA14	chamisso sedge	n	p		✓	✓	✓
Carex vesicaria	CAVE6	blister sedge	n	p		✓		
Dactylis glomerata	DAGL	orchardgrass	e	p	✓	✓	✓	
Danthonia spicata	DASP2	poverty oatgrass	n	p			✓	
Echinochloa crus-galli	ECCR	barnyardgrass	e	a	✓			
Eleocharis	ELEOC	spikerush	n	p	✓			
Eleocharis palustris	ELPA3	common spikerush	n	p	✓	✓	✓	
Elymus	ELYMU	wildrye	n	p			✓	
Elymus glaucus	ELGL	blue wildrye	n	p		✓	✓	
Festuca	FESTU	fescue	n	a			✓	
Festuca idahoensis	FEID	Idaho fescue	n	p			✓	

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Festuca occidentalis	FEOC	western fescue	n	p			✓	
Festuca ovina	FEOV	sheep fescue	e	p			✓	
Glyceria borealis	GLBO	small floating mannagrass	n	p			✓	
Juncus	JUNCU	rush	n	p				✓
Juncus bufonius	JUBU	toad rush	n	a	✓			
Juncus tenuis	JUTE	poverty rush	n	p			✓	
Melica subulata	MESU	Alaska oniongrass	n	p			✓	
Panicum capillare	PACA6	witchgrass	n	a	✓			
Phalaris arundinacea	PHAR3	reed canarygrass	n	p	✓	✓	✓	✓
Phleum pratense	PHPR3	timothy	e	p	✓	✓	✓	✓
Poa	POA	bluegrass	n	p	✓			
Poa compressa	POCO	Canada bluegrass	e	p	✓		✓	
Poa palustris	POPA2	fowl bluegrass	n	p	✓	✓		
Poa pratensis	POPR	Kentucky bluegrass	e	p	✓	✓	✓	✓
Polypogon monspeliensis	POMO5	annual rabbitsfoot grass	e	a	✓			
Scirpus	SCIRP	bulrush	n	p	✓			
Scirpus cyperinus	SCCY	woolgrass	n	p		✓	✓	
Trisetum canescens	TRCA21	tall trisetum	n	p			✓	
Triticum aestivum	TRAE	common wheat	e	a	✓			
Zizania aquatica	ZIAQ	wild rice	n	a	✓			
Ferns and fern allies								
Athyrium filix-femina	ATFI	common ladyfern	n	p			✓	
Botrychium multifidum	BOMU	leathery grapefern	n	p				✓
Cryptogramma crispa ssp. acrostichoides	CRCRA2	rock-brake	n	p			✓	
Equisetum	EQUIS	horsetail	n	p	✓			
Equisetum arvense	EQAR	field horsetail	n	p	✓	✓	✓	

Species	Symbol	Common Name	Nativity	Habit	Boundary Creek	Rapid Lightning Creek	Trout Creek	Westmond Lake
Equisetum laevigatum	EQLA	smooth horsetail	n	p			✓	
Pteridium aquilinum	PTAQ	western brackenfern	n	p		✓	✓	✓