
Big Meadows Management Plan

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EXECUTIVE SUMMARY

The Kalispel Natural Resource Department (KNRD) continued to mitigate the wildlife habitat losses as part of the Albeni Falls Wildlife Mitigation Project by acquiring the entire Big Meadows area. Utilizing Bonneville Power Administration (BPA) funds, the Kalispel Tribe of Indians (Tribe) purchased this property over several years to include a total of 773 acres and will be managed to benefit wildlife habitat with associated species, populations, and guilds. It is the Tribe's intent to manage this property in Idaho as part of ongoing acquisitions to mitigate wildlife losses from Albeni Falls hydropower facility and include this site specific management plan as Appendix H in Habitat Conservation Plan for the Kalispel Tribe Idaho Conservation Area (Stovall, 2006).

This document is meant to serve as a wildlife management plan for Big Meadows and become an appendix to the Habitat Conservation Plan for Idaho lands under Kalispel Tribal management. This plan presents the management activities that will take place to protect, operate and maintain, and in some areas enhance wildlife habitat on Kalispel acquired lands in Idaho.

Habitat Evaluation Procedures (HEP) were applied to measure baseline habitat conditions. These procedures were the standard loss estimator in all hydroelectric loss statements submitted to the Northwest Power Planning Council (NPPC). Bonneville Power Administration required the use of HEP on a project-specific basis for increased detail and accuracy. In conjunction with the HEP analysis, a series of data was collected at permanent grid plots within each of the proposed habitat management types. This data will provide baseline composition and abundance information for avian, small mammal, and amphibian populations as well as additional vegetative composition detail for specific habitat types. These data will also serve as the means for evaluating the success and/or failure of management activities.

In addition the KNRD fisheries division developed a restoration plan for that portion of Goose Creek Watershed bisecting Big Meadows prior to its confluence with the Upper West branch of the Priest River. Goose Creek will be restored over time through phases designed to reconstruct the creek channel, provide fish passage barrier to eliminate Brook trout in the watershed, and restoration of native cutthroat trout above the barrier with associated aquatic and riparian habitats. A Copy of this restoration plan (Anderson, 2010) is included as an attachment to this document Appendix B.

INTRODUCTION

This plan addresses the management actions that will be conducted on the Big Meadows acquisitions which provide protection, mitigation, and enhancement for wildlife species affected by the construction and operation of the Federal hydroelectric facilities on the Columbia River System. The properties will be used for wildlife habitat and provides BPA with credits for partial mitigation of wildlife losses due to the construction of Albeni Falls Dam.

This property has both quality and quantity of habitat for both fish and wildlife. The KNRD Fisheries Division working with consultants have developed a strategy for Goose Creek stream restoration and habitat enhancement for trout species (see attachment Appendix B). Combined with this document designed to restore, protect, and enhance terrestrial wildlife habitat a total of 773 acres will be conserved.

The Kalispel Tribe of Indians, supported by BPA funding will manage these lands under this document for restoration, protection, and management of wildlife habitat and species and be included in the Tribes' management plan for acquired lands located in Idaho. The Big Meadows Project Area is located in Bonner County, Idaho. A general vicinity map of all Kalispel Tribe's managed lands both in Washington and Idaho is located below (Figure 1).

Big Meadows properties are located in Bonner County, Idaho. Bonner County is located in the Northern Panhandle of Idaho consisting of five counties bounded on the north by British Columbia, Canada; on the east by Montana; on the west by Washington State; and on the south by the remainder of Idaho. Within the Panhandle area are three of the largest natural fishing lakes in the nation as well as numerous smaller lakes and hundreds of miles of resident salmonid bearing streams. National forests within this area include the Panhandle, Kaniksu, Coeur d'Alene, and St. Joseph and are accessed by well-maintained paved highways. Land ownership in the surrounding area is largely federal US Forest Service lands.

The purpose of this Management Plan is to outline baseline habitat conditions and management strategies that would be employed in the management of these Kalispel mitigation lands over time. This plan after review and acceptance will be added as Appendix H in Habitat Conservation Plan for the Kalispel Tribe Idaho Conservation Area (Stovall, 2006).

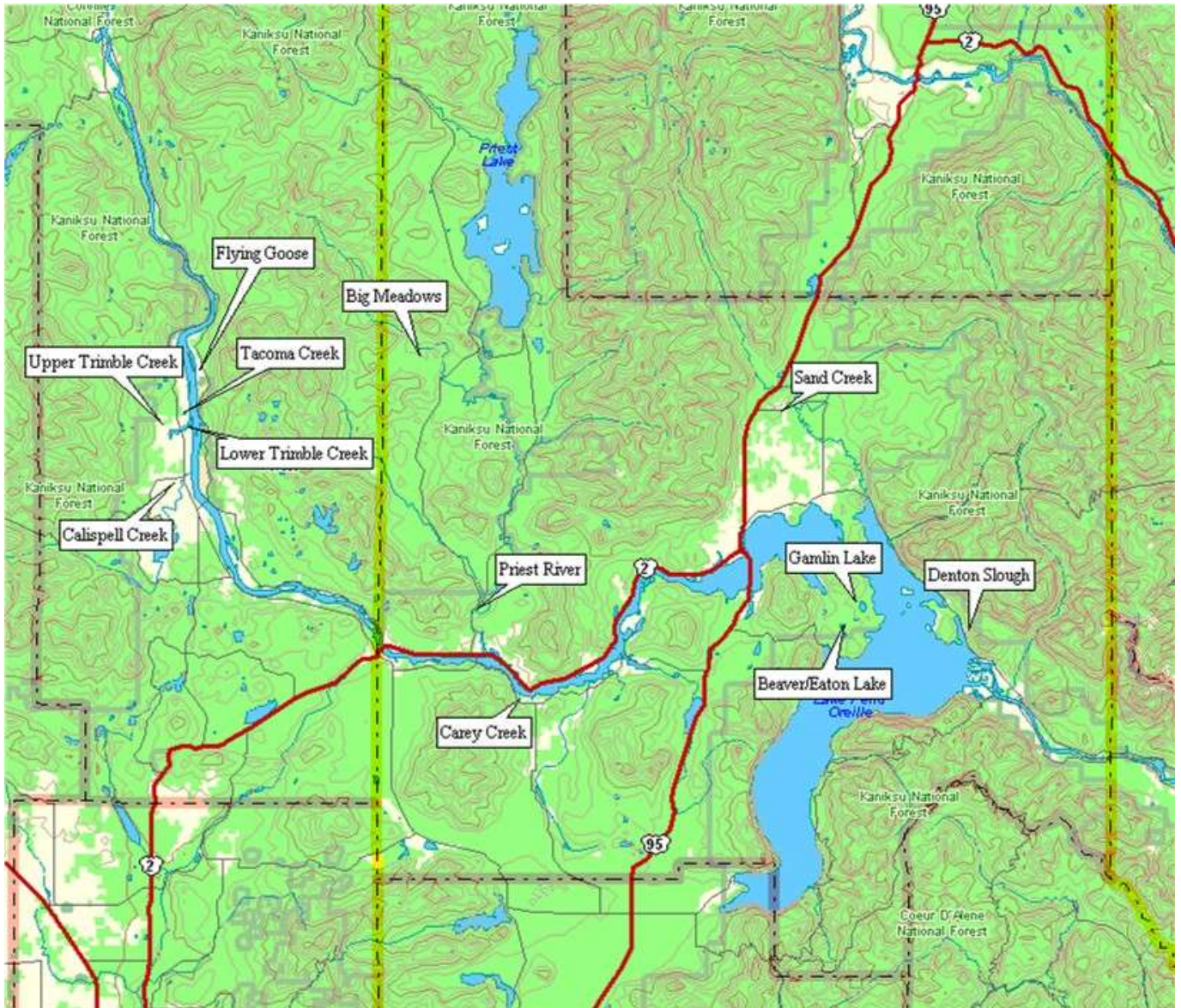


Figure 1. Project Area general vicinity map.

Project Scope

The Tribe followed an extensive process to formulate and prioritize wildlife resource goals. The KNRD provided guidance in identifying on-site opportunities. To prioritize specific goals, we consulted the Operations, Maintenance and Enhancement Guidelines (CBFWA 1998) for these Albeni Falls mitigation sites. From this consultation process, the Tribe identified the primary goal for the area:

“Protect and restore riparian deciduous forest and freshwater wetlands to mitigate losses resulting from reservoir inundation and operations at Albeni Falls and Box Canyon Dams.”

Indicator target species benefiting from management will include mallard, breeding and wintering bald eagle, Canada goose, black-capped chickadee, yellow warbler, pond breeding amphibians, white-tailed

deer, muskrat, and beaver. Additional plant and animal community data will give the Tribe a better understanding of ecosystem health and will aid the Tribe in deciding which management actions produce the desired results.

The construction Albeni Falls Dam in 1954 inundated approximately 9,000 acres of wetlands once used by the Tribe and area residents. Fluctuations in water levels both above and below the dams impacted riparian habitat and precluded the re-establishment of riparian plant communities. Habitat impacts have occurred for 50 years and caused cumulative wildlife impacts. These factors have resulted in both direct and indirect impacts to wildlife. Other limiting factors impairing wildlife habitat quantity, quality and function include habitat conversion and land use practices such as farming, grazing, and residential and recreational development.

The Project Areas are intended to partially mitigate wildlife habitat losses due to construction and inundation by Albeni Falls Dam. The Big Meadows property contains 773 acres (620 acres purchased in 2007 and 153 acres purchased in 2010) for wildlife mitigation purchased by BPA, contributes 621 baseline Habitat Units (HUs) as reported and an additional estimated 153 HUs. Any additional HU's realized through restoration and enhancement activities outlined in this Plan will be credited to BPA. The HU increases due to restoration and enhancement will be determined using Habitat Evaluation Procedure (HEP) evaluations conducted at five-year intervals. Vegetation and wildlife populations/guilds will be monitored to determine habitat function and an appropriate approach to adaptive management.

GENERAL SITE DESCRIPTION

The Big Meadows Project Area is two separate purchased parcels totaling 773 acres, with 620 acres (big parcel & small parcel) located in Sections 21, 22, 27, 28 and 29 of Township 59 North, Range 5 West, B.M. and 153 acres (middle parcel) in Sections 20 and 21 of Township 59 North, Range 5 West, B. M. All approximately three miles west of State Highway 57, and southwest of the town of Coolin in Bonner County, Idaho. As the name implies the majority of the land cover is composed of floodplain meadow habitat (grassland and wet meadow) with forested wetland, conifer forest, shrub-scrub wetland, and open water making up the rest of the area. The Upper West Branch Priest River, Goose Creek, and Blanc Creek flow west to east through the property. Blanc Creek and Goose Creek are subjected to drainage and channeling in the past for hay production and grazing. Past channelization and draining altered the hydrology of the stream and ecological function of the floodplain meadow communities and plant associations by causing the creeks to down cut and abandon the floodplain in most flood events. The remaining portions of the meadow not acquired here for mitigation, are in private ownership.

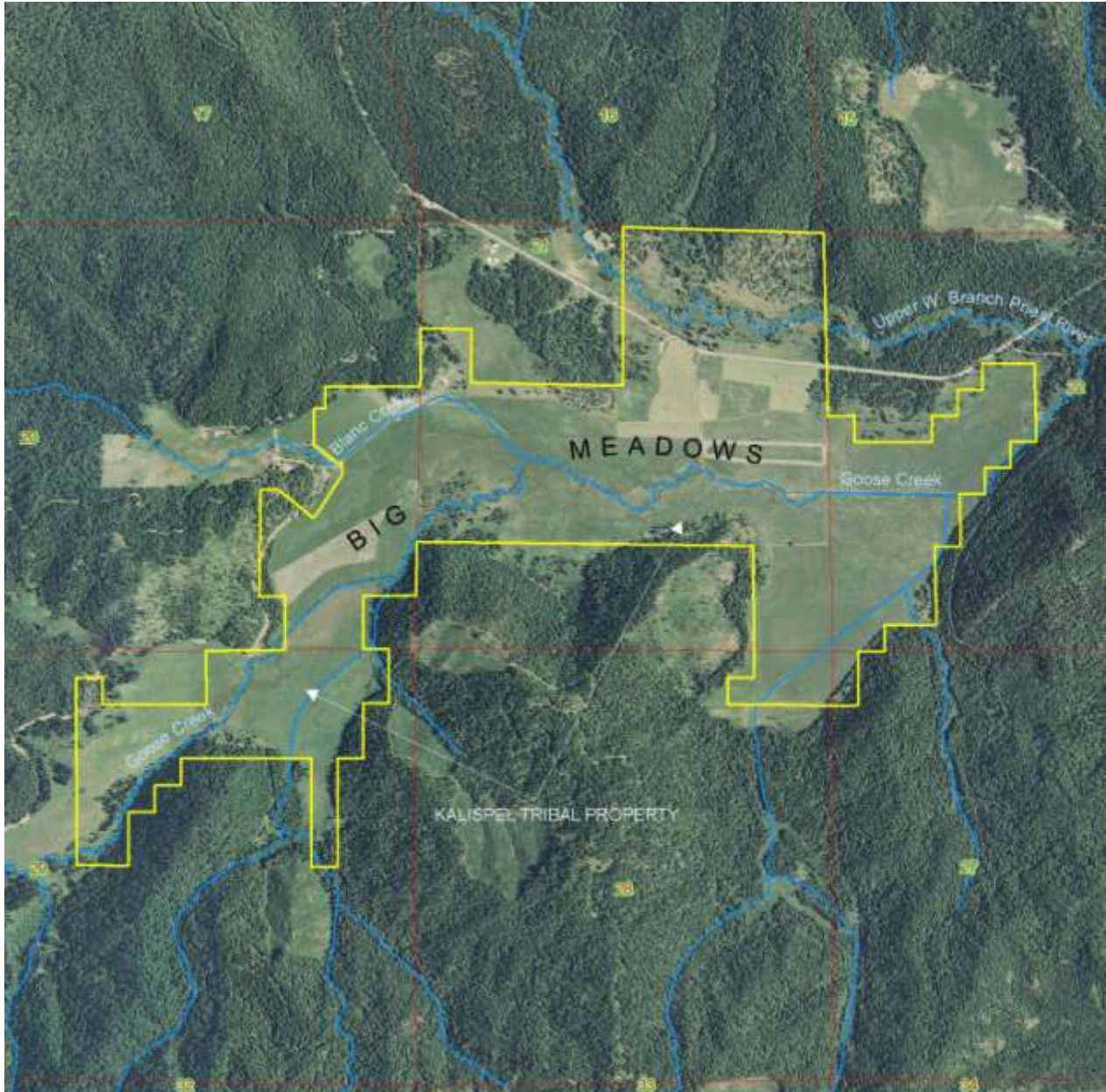


Figure 2. Big Meadows Project Area location map.

Climate

In Bonner County, summers are warm to hot in the valleys and much cooler in the mountains. Winters are generally cold. Valleys are cooler than the lower slopes of the adjacent mountains due to the drainage of cold air. Precipitation occurs in the mountains throughout the year, and a deep snow pack accumulates during winter. Snowmelt usually supplies more water than can be used for agriculture in the Project Area. In the valleys, summer precipitation falls in the form of isolated showers and thunderstorms. The mean temperature for winter is 25.9° F with some lows of below 0° F. The mean temperature for summer is 59.8° F with highs of over 100° F. The total annual precipitation is about 27 inches with about 9-11 inches, or 30-40 percent, occurring from April through September. Growing seasons also fall in this time frame and the average seasonal snowfall is about 50 inches.

Soils

The importance of soils to wetland establishment and function cannot be overlooked. The headwaters geology above the project area consists of Proterozoic-age Belt Super group rocks, as well as grand diorites that have been tentatively mapped as Cretaceous in age (Figure 2). Belt geology weathers to predominantly clay and silt sized particles (IDEQ, 2001). The Cretaceous-aged granites, which form the majority of the upper watershed area, weather to very fine gravel and sand-sized particles (1-8mm; IDEQ, 2001).

These sands and fine gravels are observed at depth in soil pits as well as within the current channel bed. In the soil pits a sharp boundary separates peat deposits from overlying fluvial sands and fine gravel. This fluvial sand unit reflects an abrupt transition from post-glacial peat bog conditions to a fluvial environment with a predominantly sand sediment source. Floodplain silts and clays typically overly the sand sequence.

The observed series of sands and overlying silts is consistent with soils mapping in the area. The soil unit mapped in the project reach is the Bonner General Soil Map Unit (IDEQ, 2001). The Bonner unit is of glacial outwash origin, with very deep, level to undulating, well drained soils. Its surface layer is silt loam, subsoil is gravelly silt or sandy loam, and the substratum is very gravelly loamy sand or very gravelly coarse sand.

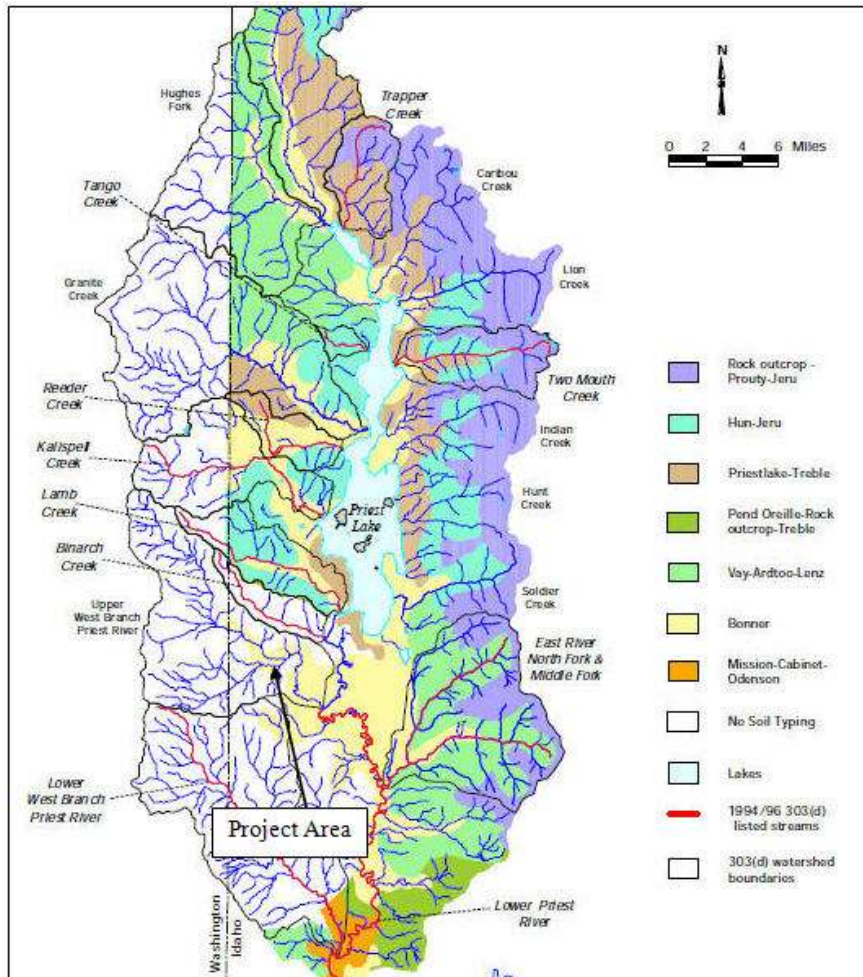


Figure 3. General soil types of the Priest River Basin (IDEQ, 2001).

Historic and Present Habitat Condition

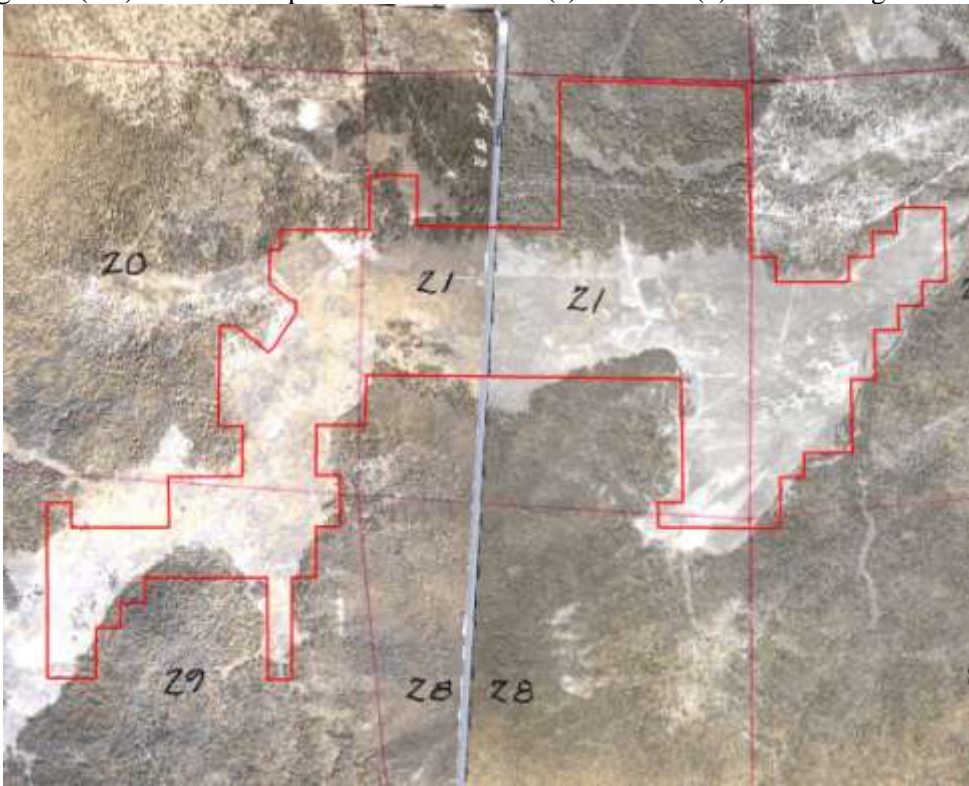
The onset of development for pasture and agricultural land drained seasonal wetlands and removed shrub and tree vegetation. Dikes and drainage ditches now control the hydrology of this portion of the floodplain. The remaining habitat available to wildlife is open pasturelands, the dominant landscape feature, pockets of deciduous and coniferous forest, and scattered shrubs. Prior land management practices dictate the habitat availability in the baseline condition. The Big Meadows property is largely pastureland, giving it the most restoration potential to benefit wildlife (Figure 4). The area in the past was grazed season long. Restoring the natural hydrology within the wetland areas can be the most effective way to bring back and protect the native vegetative assemblages of the entire area. Bordered by private agricultural lands, the Project Area will serve as important refugia in an area lacking protected tracts of native habitat. The Project Area also provides important connectivity with surrounding forestlands. Re-establishment of these corridors in their natural condition provides crucial links to habitats that have been largely fragmented due to past land use and development. Goose Creek was evaluated for potential native fish restoration and will be managed to promote the natural hydrologic process before draining and grazing impacts created abnormal development within the floodplain channel (lack of sinuosity, head cutting, poor creek profile, etc.). A detailed restoration plan for the aquatic systems is included in Appendix A of this report.

METHODS

General

The evaluation of current habitat quality and quantity as well as the potential for restoration and/or enhancement required the use of multiple tools. Baseline conditions for both the vegetative and animal communities were assessed through the use of plot and transect data collection to describe community composition and distribution across the Project Area. Enhancement recommendations were derived by the use of comparative analysis. Remote sensing imagery (aerial photography) was compared to detect former vegetation and hydrologic composition prior to habitat alteration. Although completely undisturbed reference sites are virtually non-existent for comparison of composition and function, a limited number of predominantly undisturbed sites served as additional references toward which Tribal management actions should strive to achieve.

Figure 4 (a-b). Aerial comparison between 1932(a) and 2009(b) views of Big Meadows management area.



a.



b.

Habitat Evaluation Procedure (HEP)

The objective of the baseline HEP survey for the Project Area was to rate the quality of lands under consideration for easement and management as mitigation for losses to wildlife due to the construction of Albeni Falls Dam. The product of the baseline survey will determine the number of HUs, a measure of habitat quality and quantity, currently available for the indicator species and the amount that will become available through management. Indicator species were used to determine the habitat quality rating and available HUs. These species included bald eagle, Canada goose, muskrat, black-capped chickadee, yellow warbler and mallard. Martin *et al.* (1988) also used white-tailed deer in determining Albeni Falls Dam wildlife losses. The Tribe chose to include white-tailed deer as an indicator species because it is a major resource for the Tribe. The other species are more dependent on specific habitats and are better indicators of habitat condition. White-tailed deer should respond positively to habitat manipulations for the other indicator species because they are generalists and meet life requirements from various sources.

The KNRD assembled an interdisciplinary team to conduct the HEP. Habitat suitability models for the indicator species were used to aid the team in rating the quality of the habitat. These models describe the life requisites for each indicator species. The models are used to derive a Habitat Suitability Index (HSI), a numeric value between 0.0-1.0, which corresponds to the quality of the habitat. The HEP team conducted site surveys and collected data on habitat type, quantity, quality and wildlife use under existing conditions at established sites.

Monitoring and Evaluation

Several methods were employed to determine the baseline condition of wildlife guilds and vegetation. Baseline conditions for small mammals, neo-tropical migratory birds, migratory waterfowl, and vegetative characteristics for each representative habitat were collected in 2006. The data for the mitigation areas will be compared to the reference sites in order to provide the managers with information crucial to the function of each habitat type. In future years, comparisons will be made to determine habitat progress toward meeting the goals and objectives for the project. The Upper Columbia united Tribe’s (UCUT) Wildlife Monitoring and Evaluation Plan (M&E Plan), a modified monitoring plan from the Albeni Falls Wildlife Monitoring and Evaluation Plan which is contained in the Conservation Plan for Idaho mitigation projects (Stovall, 2006). This comprehensive M&E Plan was developed in response to the Independent Scientific Review Panel (ISRP) questions regarding project monitoring and adaptive management. The M&E Plan was revised and implemented in order to determine project success as compared to reference site conditions for the various habitats types under modification. This M&E Plan was also expanded regionally to include all wildlife mitigation projects for the five member tribes of UCUT.

RESULTS AND DISCUSSION

Utilizing field data, HSIs were calculated from models and multiplied by acres of habitat type, resulting in the number of baseline (current) HUs for each indicator species. See Appendices for a full explanation of HEP results, and identification of limiting factors that will be targeted under a management plan based on HEP results. The two properties exhibited fair to good habitat quality habitat for some selected species and poor to none for others. The HEP summary results are presented in Table 1 below.

Table 1. Summary of Big Meadows baseline HEP data and habitat types.

ACRES OF HABITAT BY COVER TYPE							
PROPERTY	Deciduous Forest	Conifer Forest	Shrub-Scrub Wet	Wet Meadow	Grassland	Open Water	TOTAL ACRES
Big Meadows	10	125	36	590	3	9	773

HEP RESULTS BY INDICATOR SPECIES (in Habitat Units)

PROPERTY	Bald Eagle	Black Cap Chickadee	WT Deer	Mallard	C. Goose	Y. Warbler	TOTAL HU's
Big Meadows	4	132	71	132	224	28	591

The HEP results identify the Big Meadows Wildlife Management project as an area with both high quality and restorable degraded habitats for protection and enhancement management actions.

These data indicate that protection actions applied to date have had beneficial results to wildlife populations. However enlightening these data appear, they are still preliminary and more will be known after time as these areas recover from past land uses. Collected baseline data for the mitigation properties are included in (Appendix A).

Implementation

Seven indicator species were chosen to gauge the current condition of the existing habitats and to set future improvement goals. The HEP process discussed earlier measured existing habitat condition. The HEP variables are used as the basis for management. However, additional data collected under the M&E Plan will be used to suggest management actions to increase both habitat and wildlife diversity in the Project Area as well as identify adaptive management principles for altering management course.

Land acquisition is the most critical step in the management process. In 2007 and 2010, the Tribe purchased these two pieces of land from private landowners. Following acquisition, property protection and management planning practices were implemented to eventually increase HUs. Numerous site visits, observations of wildlife, the HEP process and wetlands engineering were used to formulate objectives. These objectives will be met by performing a series of tasks (refer to annual Scopes of Work and budgets for detail). The order or level of task implementation was determined by a variety of factors such as ease of implementation, cost, and urgency. On the Big Meadows unit, changing the current farm/hay operation to restoring the natural processes wet meadow/floodplain and riparian forest habitat. The former is most urgent, due to its severe impact to the drained grass meadow areas for wildlife. It is clear that by eliminating the impacts to the meadow area, the wetlands and forest will begin to recover. However, fixing the riparian corridor on Big Meadows by restoring Goose Creek and the natural hydrologic cycle is an interactive, financial and time-dependent endeavor. KNRD Fisheries Division worked with a private consultant (Confluence) to develop a design to restore degraded fish habitat and install a fish barrier to keep out unwanted species (see Appendix B).

Management Objectives and Tasks

Goals

The goal of habitat conservation is to conserve the full range of species, natural communities, habitats, and ecological processes that are characteristic of an area. The initial goal of habitat management within each Conservation Unit (CU) is to ensure continued and/or enhanced use by targeted wildlife species.

Objective 1. Determine baseline plant and animal community composition, abundance and distribution.

Strategy 1.1. Determine baseline habitat availability by cover type.

In 2008, the Columbia Basin Regional Habitat Evaluation Team conducted habitat evaluation baseline surveys the Big Meadows CU. The objective of using the Habitat Evaluation Procedure (HEP) is to document the quality and quantity of available habitat for selected wildlife species.

Objective 2. Enhance biologically valuable but degraded habitat.

Strategy 2.1. Restore Natural Hydrology.

The Tribe will access and restore degraded stream and wetland hydrology within the project area.

Task 2.1.1. Identify streams and wetlands in which natural hydrologic function has been impaired.

A contract was implemented in 2009 to determine the feasibility of restoring Goose Creek to its floodplain. The engineering will establish the restoration actions for this floodplain system and guide restoration action over the next 5 to 10 years (Attachment 1).

Task 2.1.2. Restore identified areas to improve stream flow, improve floodplain function and increase riparian/wetland function/diversity.

The Tribe will implement the 30% design specifications as engineered. This will require a phased approach to restoration of Goose Creek and its floodplain. It will require additional design work to implement this approach, phase-by-phase. Items to be considered as restoration moves forward will include consensus support from surrounding land owners, including design and support for land use, infrastructure and access concerns.

Objective 3. Operate and maintain the CU as part of the ICA.

Strategy 3.1. Reduce human-induced wildlife disturbance through access management.

Hunting, fishing, and trapping would be allowed on each CU. Bag limits and season lengths follow Idaho regulations and are enforced by the Idaho Department of Fish and Game. Hunters and trappers are required to take whatever precautions are available to them to ensure public safety. Hunters may access each CU by foot, even for the purpose of retrieving harvested game.

Mountain biking and cross-country skiing would be subject to seasonal restrictions, and allowed on existing roads and by permission only.

Horses riding and horse trails would not be allowed on the CU. Dogs would be allowed throughout any CU as long as they are leashed at all times.

Overnight camping, camp fires, and outdoor barbeques would not be allowed on any CU.

Cutting of dead and downed trees for personal firewood use would be allowed on a limited basis and by permission only.

Commercial berry gathering and harvesting would not be permitted on any CU.

Hiking would be subject to seasonal restrictions and allowed by permission only.

There will be a 10 year agricultural lease to allow livestock grazing on up to 80 acres of grassed bottomlands on the CU. That lease will expire at the end of the 10th year and is non-transferrable. Annual hay farming, rodent and pest control, livestock numbers, and general operations will be negotiated between the Operator and the Wildlife Program Manager.

Task 3.1.1. Maintain, repair and replace entry gates and perimeter fencing on an as needed basis.

Strategy 3.2. Control noxious weeds

Weed species, life cycles, abundance, and dispersion will dictate the mechanism(s) for elimination.

Strategy 3.3. Increase deciduous tree density in forested wetland habitat.

Task 3.3.1. Manage and maintain deciduous tree stands.

Low density planting of annual cottonwood and understory shrub species such as willow and red-osier dogwood is intended to speed up both increased plant density and mean height following years of cattle grazing. The Tribe would collect local plant stock and root prior to spring planting to increase survival. During the summer prior to planting, the Tribe would follow targeted areas in each of 3 years to control weeds.

Task 3.3.2. Remove competition to release aspen.

The Tribe would remove competing vegetation, particularly conifer, from within and near aspen stands. Aspen prefer full sunlight and higher moisture than conifers. Aspen stands should sucker and expand following removal of competition and minor root disturbance.

Strategy 3.4. Practice sustainable forest management in a way that maintains biodiversity, productivity, and regeneration capacity, and that does not cause damage to other ecosystems.

Strategy 3.5. Implement controlled burning.

Controlled burning will be used to promote native vegetation renewal and decrease fire hazards. It will be used as a management tool to increase disturbance in riparian areas, wetlands, floodplain meadows, and deciduous tree stands.

Strategy 3.6. Manage and maintain open water wetland habitat.

In areas where appropriate and designed, maintain open water habitat to increase wetland diversity and quality. Open water areas should not exceed 40 inches in depth to avoid colonization by bull frogs.

Objective 4. Monitor and evaluate the effectiveness of management actions.

Strategy 4.1. Implement complete monitoring program.

Strategy 4.2. Conduct HEP updates every five (5) years to determine the appropriate amount of habitat units to be credited to BPA.

NATIVE FISH

Objective 5. The KNRD Fisheries Division recognizes the importance of locally adapted native fish populations and assemblages. To ensure a high probability of long-term species persistence, locally adapted assemblages will be the top priority for management where feasible.

GOAL:

Protect, rehabilitate, and enhance native resident fish populations through habitat enhancement, enforcement protection, and supplementation.

Objective 6. Determine native fish (game and non-game) abundance, distribution, and habitat selectivity for each age class.

Objective 7. Rehabilitate and protect locally adapted native assemblages.

NON-NATIVE FISH

The KNRD Fisheries Division recognizes that resource use practices have changed habitat conditions in some cases to conditions more suitable for non-native fish than native fish. The Fisheries Division also recognizes that sometimes introductions of non-native fish may threaten the existence and persistence of locally adapted native fish.

GOAL: Establish successful non-native fisheries where it is feasible and will not harm native fish populations. Remove exotic species if their presence threatens the existence of native fish.

Objective 8. Determine non-native fish (game and non-game) abundance, distribution, and habitat selectivity for each age class.

Table 2. Annual Kalispel Tribe Wildlife Management Area Budget.

Item	Description	Total
Personnel		
Program Manager	.05 FTE	\$3,016
Biologist	.15 FTE	\$8,736
Bio-technician	.325 FTE	\$12,168
Benefits	40%	\$9,568
Annual Contract Needs		
Supplies, material, travel, etc.	Necessary O&M Items	\$2,500
Indirect Costs		
	17.6% of Annual Costs	\$6,334
Annual Subtotal		\$42,322
Strategy 1.1 Baseline Inventory		
Initial Data Collection	HEP and recurring HEPs	\$500
Strategy 2.1 Restore Hydrology		
Identify Impaired Ares	1 ea. @ \$50,000 (cost shared)	\$0
Restore Impairments	7.4 km at \$250,000/km (partial cost share)	\$500,000
Strategy 3.1 Access Management		
Motorized Vehicle Control	Gates and signage	\$2,500
Strategy 3.2 Control Noxious Weeds		
Long Term Annual Maintenance	Annual Weed Control	\$7,500
Strategy 3.3 Increase Deciduous Tree Density		
Aspen Release	20 acres @ \$250/acre/year	\$5,000
Cottonwood Release	20 acres @ \$250/acre/year	\$5,000
Strategy 3.4 Upland Forest Management		
Thinning	20 acres @ \$100/acre/year	\$2,000
Strategy 3.5 Controlled Burning		
Prescribed burning	50 acres on a revolving 5 to 10 yr basis	\$1,000
Strategy 3.6 Manage Open Water		
Create and/or Maintain	20 acres @ \$250/acre/year	\$5,000
Strategy 4.1 Monitoring and Evaluation		
M&E	UCUT/EWU Project	\$0
Strategy 4.2 HEP and recurring HEPs		
Recurring HEPs	Regional HEP Team	\$0
Total Improvements	Not Including Annual Costs Above	\$528,500
Annual Costs	Annual Costs/Acre	\$68

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Appendix A. HEP Results for the Big Meadows Project (Big Area).

Cover Type/ Target Species	HEP Variable	Var. Score	HSI Equation	HSI Score	Acres	HUs
Conifer Forest						
Bald Eagle (Wintering)	V ₁ - Food	N/A	$[(V_1)^2 * V_2]^{1/3}$	0	0	0
	V ₂ - Perch	N/A				
	V ₃ - Distance to Water	N/A				
	V ₄ - Human Disturbance	N/A				
Bald Eagle (Breeding)	V ₁ - Food	N/A	$(V_2 * V_3 * V_4)^{1/3}$	0	0	0
	V ₂ - Nest	N/A				
	V ₃ - Distance to Water	N/A				
	V ₄ - Human Disturbance	N/A				
Black-capped chickadee	V ₁ - % Canopy Closure	1	$(V_1 * V_2)^{1/2}$ or V ₃	1	90	90
	V ₂ - Avg. Tree Height	1				
	V ₃ - No. Snags/acre	1				
White-tailed deer	V ₁ - % Shrub Crown Cover	0.5	V ₁	0.5	90	45
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.3	14	4
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.6				
Deciduous Forest Wetland						
Bald Eagle (Wintering)	V ₁ - Food	0.5	$[(V_1)^2 * V_2]^{1/3}$	0.33	6	2
	V ₂ - Perch	0.5				
	V ₃ - Distance to Water	0.1				
	V ₄ - Human Disturbance	0.9				
Bald Eagle (Breeding)	V ₁ - Food	0.5	$(V_2 * V_3 * V_4)^{1/3}$	0.33	6	2
	V ₂ - Nest	0.4				
	V ₃ - Distance to Water	0.1				
	V ₄ - Human Disturbance	0.9				
Black-capped chickadee	V ₁ - % Canopy Closure	0.8	$(V_1 * V_2)^{1/2}$ or V ₃	0.89	6	6
	V ₂ - Avg. Tree Height	1				
	V ₃ - No. Snags/acre	1				
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.3	6	2
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.6				
White-tailed deer	V ₁ - % Shrub Crown Cover	1	V ₁	1	6	6
Grassland						
Canada goose	V ₁ - Island Nesting Habitat	0.4	$[(V_1 + V_2) * V_3]^{1/2}$	0.45	3	2
	V ₂ - Shoreline Nesting	0.3				
	V ₃ - Brood Rearing Habitat	0.5				
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.2	3	1
	V ₂ - Nesting Cover	0.3				
	V ₃ - Shoreline Cover	0.2				
Scrub-shrub						
Yellow warbler	V ₁ - % Shrub Cover	0.55	$(V_1 * V_2 * V_3)^{1/3}$	0.72	22	16
	V ₂ - Avg. Shrub Height	0.95				
	V ₃ - % Wetland Obligates	1				
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.3	22	7
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.6				
White-tailed deer	V ₁ - % Shrub Crown Cover	0.45	V ₁	0.45	22	10
Wet Meadow						
Canada goose	V ₁ - Island Nesting Habitat	0.4	$[(V_1 + V_2) * V_3]^{1/2}$	0.45	364	164
	V ₂ - Shoreline Nesting	0.3				
	V ₃ - Brood Rearing Habitat	0.5				
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.2	364	73
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.2				
Open Water						
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.2	5	1
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.2				
Canada goose	V ₁ - Island Nesting Habitat	0.4	$[(V_1 + V_2) * V_3]^{1/2}$	0.45	5	3
	V ₂ - Shoreline Nesting	0.3				
	V ₃ - Brood Rearing Habitat	0.5				
Muskrat	V ₁ - % Cover	0	Lowest of (V ₁ *V ₂)/2 or (V ₁ *V ₈)/2	0	5	0
	V ₂ - % of Year w/ Water	1				
	V ₈ - % Preferred Vegetation	0				
Total					490	434

Appendix A. HEP Results for the Big Meadows Project (Small Area).

Cover Type/ Target Species	HEP Variable	Var. Score	HSI Equation	HSI Score	Acres	HUs
Conifer Forest						
Bald Eagle (Wintering)	V ₁ - Food	N/A	$[(V_1)^2 * V_2]^{1/3}$	0	0	0
	V ₂ - Perch	N/A				
	V ₃ - Distance to Water	N/A				
	V ₄ - Human Disturbance	N/A				
Bald Eagle (Breeding)	V ₁ - Food	N/A	$(V_2 * V_3 * V_4)^{1/3}$	0	0	0
	V ₂ - Nest	N/A				
	V ₃ - Distance to Water	N/A				
	V ₄ - Human Disturbance	N/A				
Black-capped Chickadee	V ₁ -% Canopy Closure	0.8	$(V_1 * V_2)^{1/2}$ or V ₃	0.89	25	23
	V ₂ - Avg. Tree Height	1				
	V ₃ - No. Snags/acre	1				
White-tailed deer	V ₁ - % Shrub Crown Cover	0	V ₁	0	25	0
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.3	10	3
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.6				
Deciduous Forest Wetland						
Bald Eagle (Wintering)	V ₁ - Food	0.5	$[(V_1)^2 * V_2]^{1/3}$	N/A	0	0
	V ₂ - Perch	0.5				
	V ₃ - Distance to Water	0.1				
	V ₄ - Human Disturbance	0.9				
Bald Eagle (Breeding)	V ₁ - Food	0.5	$(V_2 * V_3 * V_4)^{1/3}$	N/A	0	0
	V ₂ - Nest	0.4				
	V ₃ - Distance to Water	0.1				
	V ₄ - Human Disturbance	0.9				
Black-capped Chickadee	V ₁ -% Canopy Closure	0.8	$(V_1 * V_2)^{1/2}$ or V ₃	0.89	4	4
	V ₂ - Avg. Tree Height	1				
	V ₃ - No. Snags/acre	1				
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.3	0.63	0.18
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.6				
White-tailed deer	V ₁ - % Shrub Crown Cover	0.3	V ₁	0.3	4	1
Grassland						
Canada Goose	V ₁ - Island Nesting Habitat	0.4	$[(V_1 + V_2) * V_3]^{1/2}$	0	0	0
	V ₂ - Shoreline Nesting	0.3				
	V ₃ - Brood Rearing Habitat	0.5				
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0	0	0
	V ₂ - Nesting Cover	0.83				
	V ₃ - Shoreline Cover	0.63				
Scrub-shrub						
Yellow warbler	V ₁ - % Shrub Cover	0.7	$(V_1 * V_2 * V_3)^{1/3}$	0.82	14	12
	V ₂ - Avg. Shrub Height	0.97				
	V ₃ - % Wetland Obligates	1				
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.3	14	5
	V ₂ - Nesting Cover	0.83				
	V ₃ - Shoreline Cover	0.63				
White-tailed deer	V ₁ - % Shrub Crown Cover	0.63	V ₁	0.63	14	9
Wet Meadow						
Canada goose	V ₁ - Island Nesting Habitat	0.4	$[(V_1 + V_2) * V_3]^{1/2}$	0.45	86	39
	V ₂ - Shoreline Nesting	0.3				
	V ₃ - Brood Rearing Habitat	0.5				
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.2	86	18
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.2				
Open Water						
Mallard	V ₁ - Wetland Type	0.3	Lowest Value	0.2	1	0.2
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.2				
Canada goose	V ₁ - Island Nesting Habitat	0.4	$[(V_1 + V_2) * V_3]^{1/2}$	0.45	1	0.45
	V ₂ - Shoreline Nesting	0.3				
	V ₃ - Brood Rearing Habitat	0.5				
Muskrat	V ₁ - % Cover	0	Lowest of $(V_1 * V_2)^{1/2}$ or $(V_1 * V_8)^{1/2}$	0	1	0
	V ₂ - % of Year w/ Water	1				
	V ₈ - % Preferred Vegetation	0				
Total					130	115

Appendix A. HEP Results for the Big Meadows Project (Middle Area).

Cover Type/ Target Species	HEP Variable	Var. Score	HSI Equation	HSI Score	Acres	HUs
Conifer Forest						
Bald eagle (Wintering)	V ₁ - Food	N/A	$[(V_1)^2 * V_2]^{1/3}$	0.00	0.00	0.00
	V ₂ - Perch	N/A				
	V ₃ – Distance to Water	N/A				
	V ₄ – Human Disturbance	N/A				
Bald eagle (Breeding)	V ₁ - Food	N/A	$(V_2 * V_3 * V_4)^{1/3}$	0.00	0.00	0.00
	V ₂ - Nest	N/A				
	V ₃ – Distance to Water	N/A				
	V ₄ – Human Disturbance	N/A				
Black-capped chickadee	V ₁ -% Canopy Closure	0.80	$(V_1 * V_2)^{1/2}$ or V ₃	0.89	10.00	8.90
	V ₂ – Avg. Tree Height	1.00				
	V ₃ – No. Snags/acre	1.00				
White-tailed deer	V ₁ - % Shrub Crown Cover	0.00	V ₁	0.00		
Mallard	V ₁ - Wetland Type	0.30	Lowest Value	0.30	10.00	3.00
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.60				
Grassland/Meadow						
Canada goose	V ₁ – Island Nesting Habitat	0.00	$[(V_1 + V_2) * V_3]^{1/2}$	0.10	140.00	14.00
	V ₂ – Shoreline Nesting	0.20				
	V ₃ – Brood Rearing Habitat	0.10				
Mallard	V ₁ - Wetland Type	0.10	Lowest Value	0.10	140.00	14.00
	V ₂ - Nesting Cover	0.20				
	V ₃ - Shoreline Cover	0.10				
Open Water						
Mallard	V ₁ - Wetland Type	0.30	Lowest Value	0.20	3.00	0.60
	V ₂ - Nesting Cover	0.85				
	V ₃ - Shoreline Cover	0.20				
Canada goose	V ₁ – Island Nesting Habitat	0.40	$[(V_1 + V_2) * V_3]^{1/2}$	0.45	3.00	1.35
	V ₂ – Shoreline Nesting	0.30				
	V ₃ – Brood Rearing Habitat	0.50				
Muskrat	V ₁ - % Cover	0.00	Lowest of $(V_1 * V_2)^{1/2}$ or $(V_1 * V_8)^{1/2}$	0.00	3.00	0.00
	V ₂ - % of Year w/ Water	1.00				
	V ₈ - % Preferred Vegetation	0.00				
Total					153	42

