Habitat Evaluation Procedures (HEP) Report;

Iskuulpa Wildlife Mitigation and Watershed Project

Technical Report 1998 - 2003

January 2003

DOE/BP-00007514-2

This Document should be cited as follows:

Quaempts, Eric, "Habitat Evaluation Procedures (HEP) Report;; Iskuulpa Wildlife Mitigation and Watershed Project", 1998-2003 Technical Report, Project No. 199506001, 95 electronic pages, (BPA Report DOE/BP-00007514-2)

Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

**Habitat Evaluation Procedures Report
Iskuulpa Wildlife Mitigation & Watershed Project
Baseline Mitigation Credits and Futures Analysis**

Confederated Tribes of the Umatilla Indian Reservation

Wildlife Program

**Eric J. Quaempts, Project Biologist
2003**

**Project Number 1995-060-01
Contract Number 00007514**

Abstract

U.S. Fish and Wildlife Service (USFWS) Habitat Evaluation Procedures (HEP) were used to determine the number of habitat units credited to evaluate lands acquired and leased in Iskuulpa Watershed, a Confederated Tribes of the Umatilla Indian Reservation watershed and wildlife mitigation project. The project is designed to partially credit habitat losses incurred by BPA for the construction of the John Day and McNary hydroelectric facilities on the Columbia River. Upland and riparian forest, upland and riparian shrub, and grasslands cover types were included in the evaluation. Indicator species included downy woodpecker (*Picoides pubescens*), black-capped chickadee (*Parus atricapillus*), blue grouse (*Dendragapus obscurus*), great blue heron (*Ardea herodias*), yellow warbler (*Dendroica petechia*), mink (*Mustela vison*), and Western meadowlark (*Sturnella neglecta*). Habitat surveys were conducted in 1998 and 1999 in accordance with published HEP protocols and included 55,500 feet of transects, 678 m² plots, and 243 one-tenth-acre plots. Between 123.9 and 10,794.4 acres were evaluated for each indicator species. Derived habitat suitability indices were multiplied by corresponding cover-type acreages to determine the number of habitat units for each species. The total habitat units credited to BPA for the Iskuulpa Watershed Project and its seven indicator species is 4,567.8 habitat units. Factors limiting habitat suitability are related to the direct, indirect, and cumulative effects of past livestock grazing, road construction, and timber harvest, which have simplified the structure, composition, and diversity of native plant communities. Alternatives for protecting and improving habitat suitability include exclusion of livestock grazing or implementation of rest/rotation grazing schemes, road de-commissioning, reforestation, large woody debris additions to floodplains, control of competing and unwanted vegetation, reestablishing displaced or reduced native vegetation species, and the allowance of normative processes such as fire occurrence. Implementation of these alternatives could generate an estimated minimum of 393 enhancement credits in 10 years. Longer-term benefits of protection and enhancement activities include increases in native species diversity and structural complexity in all cover types. While such benefits are not readily recognized by HEP models and reflected in the number of habitat units generated, they also provide dual benefits for fisheries resources. Implementation of the alternatives will require long-term commitments from managers to increase probabilities of success and meet the goals and objectives of the Northwest Power Planning Council's Fish and Wildlife Mitigation Program.

Evaluation Species	Evaluation Acres	Time to DFC (Years)	Existing Habitat Units	Habitat Units At Y=10
Downy Woodpecker	1,287.0	40	1,222.7	1,169.7
Black-Capped Chickadee	1,287.0	40	1,203.8	1,246.0
Blue Grouse	1,045.0	10	407.6	407.6
Great Blue Heron	123.9	40	30.5	36.5
Yellow Warbler	425.8	10	280.6	308.5
Mink	123.9	10	103.7	110.8
Western Meadowlark	10,794.4	100	1,318.9	1681.7
Total			4,567.8	4,960.8

Table of Contents

Introduction

The Need for Fish and Wildlife Mitigation.....	1
Wildlife Loss Assessments	1
Northwest Power Planning Council Goals & Objectives.....	1
The Iskuulpa Watershed Project	2
Cover Types and Target Wildlife Species.....	2
Crediting Habitat Units to BPA	2
Benefits to Fisheries Resources	4
Report Organization.....	4

Physical Environment

Project Location	4
Climate	4
Temperature & Precipitation	7
Topography	7
Fire Occurrence Rates.....	8
Hydrology	9
Streamflow Regime.....	9
Water Quality.....	11
Stream Morphology	11
B-Stream Types	12
C – Stream Types.....	12
Un-surveyed Tributaries	13
Floodplain, Channel, and Riparian Characteristics	13
Floodplain and Channel Manipulations - Reach 2	13
Floodplain and Channel - Reaches 3 – 5	14
Streambank Stability	14
Floodplain Connectivity	14
Width/Depth Ratio	14
Substrate Distribution.....	15
Pool Frequency and Area	15
Off-Channel Habitat	15
Soils	15

Biological Environment

Cover Type Characteristics	17
The Plant Association Concept	17
Plant Series	18
Plant Association Groups.....	18
Potential Vegetation Groups	18
Forested Communities	18
Upland Shrub Communities.....	19
Floodplain/Riparian Communities	19
Grassland Communities	21

Methods

Forest and Upland Shrub Habitat Surveys	22
Floodplain/Riparian Habitat Surveys.....	23
Grassland Habitat Surveys	24

Office Methods	25
Results	
Forest Structural Characteristics	26
Downy Woodpecker	27
Baseline Habitat Indices and Units	27
Habitat Limiting Factors	28
Desired Future Conditions	29
Enhancement Strategies	30
Black-Capped Chickadee	31
Baseline Habitat Indices and Units	31
Habitat Limiting Factors	31
Desired Future Conditions	32
Enhancement Strategies	33
Blue Grouse	33
Baseline Habitat Indices and Units	33
Habitat Limiting Factors	34
Desired Future Conditions	35
Enhancement Strategies	36
Floodplain/Riparian Habitat Characteristics	36
Great Blue Heron	36
Baseline Habitat Indices and Units	36
Habitat Limiting Factors	37
Desired Future Conditions	38
Enhancement Strategies	39
Yellow Warbler	39
Baseline Habitat Indices and Units	39
Habitat Limiting Factors	41
Desired Future Conditions	42
Enhancement Strategies	42
Mink	43
Baseline Habitat Indices and Units	43
Habitat Limiting Factors	43
Desired Future Conditions	43
Enhancement Strategies	44
Grassland Habitat Structural Characteristics	45
Western Meadowlark	45
Baseline Habitat Indices and Units	45
Habitat Limiting Factors	45
Desired Future Conditions	50
Enhancement Strategies	50
Habitat Units Summary	51
Consistency with NPPC Fish & Wildlife Program Goals	52
Literature Cited	56
Appendices	59

List of Maps

Iskuulpa HEP Crediting Lands.....	3
Project Location Map.....	5
Project Area Map	6
Iskuulpa Watershed Stream Network.....	10
Iskuulpa Watershed Project Area Cover Types	20
Forest Cover Type Transects	27
Floodplain/Riparian Cover Type Transects	39
Grassland Cover Type Transects	48

List of Figures

Figure 1. Example of Plant Association Organization	18
Figure 2. Forest and Upland Shrub Transect Diagram.....	23
Figure 3. Floodplain/Riparian Transect Diagram.....	24
Figure 4. Grassland Transect Diagram.....	25
Figure 5. Season Long Grazing and the Perennial Grass Life Cycle	48
Figure 6. Example of Plant Association Organization	53

Acknowledgements

Neal Anderson, Brandon Spencer, Walter Broncheau, Toby Patrick, Virgil Tsosie, Matt Farrow Jr., and Randy Alexander, CTUIR Wildlife Technicians, collected field data that form the basis of this analysis.

Paul Ashley, Wildlife Biologist, Washington Department of Fish and Wildlife, provided instruction in survey methodologies and advice in utilizing Habitat Evaluation Procedure models.

Matt Farrow Jr. conducted a file search of Oregon Department of Forestry, Pendleton Office records that provided the basis for the fire occurrence rate analysis.

Randy Alexander conducted file searches at the Bureau of Indian Affairs, Umatilla Agency Office, and discovered Soil Conservation Service reports and timber contract files that proved invaluable in identifying and quantifying historical causal factors affecting habitat structure and diversity in the Iskuulpa Watershed.

Allen Childs, CTUIR Wildlife Biologist, provided planning for HEP surveys, field instruction, assistance in running models, and provided valuable document review and editorial recommendations.

James Webster, CTUIR Hydrologist, provided document review and editorial recommendations.

Introduction

The Need for Fish and Wildlife Mitigation

The development of dams for hydropower, navigation, flood control, and irrigation in the Columbia River Basin resulted in widespread inundation of riparian, riverine, and upland wildlife habitats (NPPC 1994; BPA et. al., 1993). The 1980 Power Act established and charged the Northwest Power Planning Council (NPPC or Council) with the task of developing a comprehensive fish and wildlife mitigation program to protect, mitigate, and enhance fish and wildlife habitat in the Columbia Basin (Power Act 1980, Section 4 (H)(1)(A), page 12; NPPC 1994, Section 2, page 2-1). This program, initially adopted in 1982, was amended in 1984, 1987, 1991-1993, 1994, and 2000.

Consistent with Section 1003(7) of the Power Council Fish and Wildlife Program, BPA is authorized and obligated to fund implementation of projects that will help reach the Power Council wildlife mitigation goals and objectives. The 1997 Final Environmental Impact Statement for the Wildlife Mitigation Program (Bonneville Power Administration, 1997), states as follows:

"Bonneville Power Administration (BPA) is responsible for mitigating wildlife habitat loss caused by the development of the Federal Columbia River Power System. BPA meets this responsibility by funding projects submitted to and recommended by the Northwest Power Planning Council. "

Wildlife Loss Assessments

The *Wildlife Impact Assessments for the John Day and McNary Projects* (Rasmussen and Wright, 1990b and d), provide estimated losses of 36,555 and 23,545 Habitat Units resulting from the John Day and McNary Hydroelectric facilities, respectively. Habitat losses included mainland, island, and riverine habitats. Mainland habitats, totaling an estimated 20,858 acres for the John Day facility and 12,898 acres for the McNary facility, consisted of shrub/steppe grassland, riparian hardwood, riparian shrub, riparian herb, emergent wetland, sand dune, sand/gravel/cobble/mud, disturbed/bare/riprap, and open water cover types. Approximately 6,708 acres of island habitats associated with the John Day facility and 2,741 acres associated with the McNary facility were impacted.

Northwest Power Planning Council Goals and Objectives

In its 2000 Program, the Council adopted the following vision for its Fish and Wildlife Mitigation Program:

"The vision for this program is a Columbia River ecosystem that sustains an abundant, productive, and diverse community of fish and wildlife, mitigating across the basin for the adverse effects to fish and wildlife caused by the development and operation of the hydrosystem and providing the benefits from fish and wildlife valued by the people of the region. This ecosystem provides abundant opportunities for tribal trust and treaty right harvest and for non-tribal harvest and the conditions that allow for the recovery of the fish and wildlife affected by the operation of the hydrosystem and listed under the Endangered Species Act. Wherever feasible, this program will be accomplished by protecting and restoring the natural ecological functions, habitats, and biological diversity of the Columbia River Basin. In those places where this is not feasible, other methods that are compatible with naturally reproducing fish and wildlife populations will be used. Where impacts have irrevocably changed the ecosystem, the program will protect and enhance the habitat and species assemblages compatible with the altered ecosystem. Actions taken under this program must be cost-effective and consistent with an adequate, efficient, economical and reliable electrical power supply.

This is a habitat-based program, rebuilding healthy, naturally producing fish and wildlife populations by protecting and restoring habitats and the biological systems within them, including anadromous fish migration corridors."

The NPPC also established four biological objectives for the Fish and Wildlife Program. They are:

1. A Columbia River ecosystem that sustains an abundant, productive, and diverse community of fish and wildlife.

2. Mitigation across the basin for the adverse effects to fish and wildlife caused by the development and operation of the hydrosystem.
3. Sufficient populations of fish and wildlife for abundant opportunities for tribal trust and treaty right harvest and for non-tribal harvest.
4. Recovery of the fish and wildlife affected by the development and operation of the hydrosystem that are listed under the Endangered Species Act

With specific regards to the NPPC's commitment and obligation to mitigate for wildlife habitat losses, objectives are to:

1. Quantify wildlife losses caused by the construction, inundation, and operation of the hydropower projects.
2. Develop and implement habitat acquisition and enhancement projects to fully mitigate for identified losses.
3. Coordinate mitigation activities throughout the basin and with fish mitigation and restoration efforts, specifically by coordinating habitat restoration and acquisition with aquatic habitats to promote connectivity of terrestrial and aquatic areas.
4. Maintain existing and created habitat values.
5. Monitor and evaluate habitat and species responses to mitigation actions.

The Iskuulpa Watershed Project

The Iskuulpa Watershed Project (formerly Squaw Creek Watershed Project) was developed by the CTUIR to offset habitat losses related to the John Day and McNary hydroelectric projects. The project area is located outside the Columbia River corridor, and therefore provides off-site mitigation. Individual habitat types and species impacted by hydroelectric development will be addressed by this project, thereby providing in-kind mitigation. Iskuulpa is a fifth-order subbasin located in the Umatilla River Basin encompassing approximately 24,200 acres.

Cover Types and Wildlife Species

In-kind habitats and cover types provided by the project include riparian shrub and hardwood, sand/gravel/cobble/mud, and grasslands. Out-of kind cover types include coniferous forest. Primary HEP species selected to represent these habitats include the downy woodpecker (*Picoides pubescens*), yellow warbler (*Dendroica petechia*), great blue heron (*Ardea herodias*), mink (*Mustela vison*), Western meadowlark (*Sturnella neglecta*), black-capped chickadee (*Parus atricopillus*), and blue grouse (*Dendragapus obscurus*).

Crediting Habitat Units to BPA

The Iskuulpa Watershed Project includes three classes of land ownership; 1) fee lands, 2) CTUIR Tribal Trust lands, and 3) CTUIR-member allotments. The Iskuulpa Watershed Project emphasizes two strategies for acquiring, protecting, and enhancing habitat, including fee acquisitions and leasing Bureau of Indian Affairs (BIA) administered grazing allotments and resting them from livestock use. The 1997 Memorandum of Agreement between BPA and the CTUIR differentiates how BPA receives mitigation credit for acquired and leased lands. For fee lands acquired through the NPPC's Fish and Wildlife Mitigation Program, BPA receives full credit for acquisition, protection and enhancement. For leased lands (e.g. grazing leases), the CTUIR/BPA MOA states as follows:

"G. For Squaw Creek leases, BPA shall receive full credit for protecting HU's (habitat units) of rangeland species affected by grazing, and full credit for habitat improvements to all habitats in the leased area. For all other non-Interim Agreement leases, BPA shall receive full credit for improvement HU's. If an acre by acre crediting method is used, BPA shall receive 1 acre of credit for every 3 acres of improvements when the activities needed to bring about the improvements are complete."

Species with habitat parameters affected by grazing include the western meadowlark, yellow warbler, mink, and blue grouse and crediting for the benefits of acquiring grazing leases will be limited to these species. Parameters addressed in habitat models for the great blue heron, downy woodpecker, and black-capped chickadee are focused primarily on the structure and/or arrangement of tree stands, and are not therefore included. A map of land ownership and credited lands is displayed on page 3.

Benefits to Fisheries Resources

Though this report will summarize HU's for wildlife species, it is important to recognize that this watershed project was from the outset established to provide benefits to resident and anadromous fish resources as well as terrestrial wildlife. The project is consistent with the Council's stated objective of "coordinating habitat restoration and acquisition with aquatic habitats to promote connectivity of terrestrial and aquatic areas." The Iskuulpa subbasin contains approximately 23 miles of anadromous and resident fish habitat and over 50 miles riverine habitat. The subbasin supports the highest density of spawning Threatened summer steelhead in the Umatilla Basin, and provides habitat for bull trout, native redband and rainbow trout, and re-introduced spring chinook and coho salmon.

Report Organization

The remaining sections of this report are organized as follows: 1) Study Area – Physical Environment, 2) Study Area – Biological Environment, 3) Methods; 4) Results, and 5) Consistency with NPPC Program.

Study Area-Physical Environment

Project Location

The Iskuulpa Watershed Project area is located approximately 20 miles east of Pendleton, Oregon. The legal description of the project area is: Township 1 North, Range 35 East, all or portions of Sections 2 - 4, 11, 14, 16, 21 - 23, 26 and 28; Township 2 North, Range 35 East, all or portions of Sections 1- 3, 8 - 16, and 21 - 24; and Township 2 North, Range 36 East, portions of Section nineteen (see Project Location and Area Maps, Pages 5 and 6).

The confluence of Iskuulpa Creek at the Umatilla River occurs at approximately River Mile (RM) 78 of the Umatilla River.

Climate

The following climate description is excerpted from *Plant Associations of the Blue and Ochoco Mountains* (Johnson and Clausnitzer, 1992).

The relief of the Blue Mountains creates several localized climatic affects. The diversity of landscapes between mountain ranges, rolling topography and deep, dissected canyons influences local climatic patterns. The major influence to the regional climate is provided by the Cascade Mountains lying nearly 200 miles to the west. This mountain range forms a barrier against potential modifying effects of warm, moist fronts emanating out of the Pacific Ocean. As a result, the overall climate of the Blue Mountains is labeled Temperate Continental – cool summer phase (Trewartha, 1968). Mean temperature is less than 72 degrees F in the warmest month and 50 F for more than 3 months. Light precipitation, low relative humidity, rapid evaporation, abundant sunshine, and wide temperature and precipitation fluctuations are characteristic of this climate.

[illegible]

A break in the Cascadian barrier is provided by the Columbia River Gorge. This topographic feature and the associated Columbia River provide an opportunity for marine climatic conditions to reach the northern Blue Mountains and strongly influence the vegetation. This climate is labeled Temperate Oceanic (Trewartha, 1968) and differs significantly from the Temperate Continental climate in providing greater cloudiness, increased precipitation and higher relative humidities with less fluctuation in winter temperatures. The oceanic influence provides the environment for vegetation more common to the western Cascades to occupy portions of the northern and northwestern Blue Mountains. Examples of this vegetation are grand fir/sword fern-ginger, grand fir/oak fern and grand fir/false bugbane.

The high percentage of cloud days attributed to the temperate Oceanic climate, versus the high percentage of clear, winter days and nights of Temperate Continental climates, has dramatically influenced the kind of vegetation found in the northern Blue Mountains. Daubenmire (1956) determined that the oceanic climate promoted the grasslands and rhizomatous shrublands characteristically found in the foothills, slopes and ridgetops of the Blue Mountains adjacent to the Palouse. The continental climate, on the other hand, promotes sagebrush and juniper so commonly found in the Great Basin to the south of the Blue and Ochoco Mountains.

The majority of annual precipitation falls as snow during winter. Late summer and early autumn provide the area with convectional storms resulting from masses of cool air crossing the Cascades and passing over the Blue and Ochoco Mountains at high elevations. The hot, dry surface air violently mixes with this cool, moist upper air mass to provide lightning storms. These events have provided a cyclic, annual abundance of natural fires. The fires historically burned extensively and provided the renovating and rejuvenating force behind the development and composition of Blue Mountain and Ochoco Mountain vegetation.

Temperature and Precipitation

Temperature and precipitation records are available from two point sources near the project area. Data was recorded at Meacham, Oregon, located approximately 2 miles southeast of the watershed, for the period 1951-75. These records represent temperature and precipitation conditions in the upper portion of the study area (elevations > 3,800 feet), while lower elevations may be more closely represented by data collected at Pendleton, Oregon, approximately 20 miles to the west. Obviously a continuum of precipitation levels would occur along the elevational gradient, but the best available information is provided by these two points.

At Meacham, the average winter temperature for the period was 29 F, with an average daily minimum of 23 F, and an average daily maximum of 73 F. Lowest temperatures occur in January, and the highest temperatures in August. The total annual precipitation for the period was 33 inches, with 30 percent measured between April and September. The average seasonal snowfall was 146 inches.

At Pendleton, the average winter temperature for the period 1951-1981 was 36 F, with an average daily minimum of 29 F, and an average daily maximum of 71 F. Lowest temperatures occur in January, and the highest temperatures in August. The total annual precipitation at Pendleton for the period was 12 inches, with 30 percent measured between April and September. The average seasonal snowfall was 18 inches.

Topography

The project is located on the west slope of the Blue Mountains within the Umatilla River Subbasin. The Iskuulpa Watershed orientation is from south to north. Elevations within the project area range from approximately 1,660 feet at its confluence with the Umatilla River to approximately 4,200 feet on Gibbon Ridge. Slope classes were summarized for broad classes in Table 1.

Table 1. Slope Classes for the Iskuulpa Watershed.

Slope Class (%)	Percent of Watershed
< 5	8.1
5 < X < 25	53.9
> 25	38.0
Total	100.0

Topography of the Iskuulpa Watershed is typical of the Blue Mountain foothills, with broad flat ridges dissected by steep canyons with a variety of aspects. Aspect classes are distributed in the watershed as follows:

Table 2. Aspect Classes for the Iskuulpa Watershed.

Aspect Class	Aspect Degrees	Percent of Watershed
N	337.6 – 22.5	10.3
NE	22.6 – 67.5	15.4
E	67.6 – 112.5	12.8
SE	112.6 – 157.5	10.7
S	157.6 – 202.5	8.1
SW	202.6 – 247.5	14.8
W	247.6 – 292.5	13.8
NW	292.6 – 337.5	13.2
Flat		.8
Total		100.0

Aspect and elevation combine to provide similar or compensating environmental factors (temperature and moisture) that contribute to site productivity and the suitability of a site for a given plant community. As a combination of these factors is repeated across the landscape, a predictable plant community will occupy those sites given time and varying frequencies of disturbance (Johnson and Clausnitzer 1992).

Fire Occurrence Rates

A fire history analysis was conducted for Isuulpa Creek Watershed and adjacent Blue Mountain foothills. The analysis area included approximately 67,840 acres (106 square miles) bounded on the north by the Umatilla River, on the east by Meacham Creek, on the south by Interstate-84, and on the west by Highway 337 (Old Emigrant Highway). The evaluatin area was expanded beyond the Iskuulpa Watershed in an attempt to get a more representative fire occurrence rate.

The fire history analysis was conducted using Oregon Department of Forestry fire records for a 26-year period spanning from 1972 – 1998. During the period, 99 fires were recorded in the analysis area for an average of approximately four fires per year. Seventeen of 99 known fires (17.2%) were identified as lightening-caused, while the remaining 82 fires (82.8%) were human caused. Human-caused fires included railroad (23 fires), motor vehicles (14 fires), utilities (6 fires), lost agricultural burns (3 fires), and various other human-causes (36 fires).

Fourteen fires were recorded in Iskuulpa subbasin or on its boundary for the period. Fire sizes ranged from less than one-tenth acre to approximately 683 acres. Four of the fires were caused by lightening, with the largest growing to approximately 587 acres. Two of the fires were caused by utilities, two by vehicles, and six were classified as various other human causes. The largest fire, 683 acres, was caused by utilities.

Hydrology

Within its elevation range, the main hydrologic influence for the Iskuulpa Watershed is rainfall with a chance of flood events due to rain-on-snow in the upper elevations. The combination of relatively shallow soils, a perpendicular orientation to storm front movement, and the elongated, trellis flow pattern can result in erratic fluctuations in stream flow.

Streamflow Regime

Distinct streamflow regimes can be determined from streamflow records. Stream flow exerts a strong influence on channel morphology, aquatic habitat, and riparian vegetation. Streamflow categories include: (E) ephemeral, (I) intermittent, (P) perennial, and (S) subterranean; with specific notations for streamflow patterns dominated by 1) snowmelt, 2) stormflow, 3) glacial melt, 4) spring-fed, 5) ice flows, 6) tidal influence, 7) regulated flow, 8) streamflow patterns altered by development.

The mainstem of Iskuulpa has a perennial flow regime with variations in streamflow dominated primarily by snowmelt run-off. Its primary tributaries, Little Iskuulpa and Bachelor Canyon, possess intermittent regimes dominated primarily by snowmelt run-off. All three streams have segments with subterranean flow, where water flows below and parallel to the ground surface. In mainstem Iskuulpa, the greatest number of subterranean flow segments occurs in Reach 5 (see map, page 10).

A US Geological Survey stream-flow gaging station was installed at RM 2 in Squaw Creek in 1998. Data for water discharge for the 1999 and 2001 water years (October 1 – September 30) is available for the 32.6 square miles of drainage area located above the gaging station.

Table 3. Water Discharge Data for the Iskuulpa Gaging Station 14020520.

Summary Statistics	1999	2000	2001	Mean
Annual Mean (cfs)	33.3	35.5	19.0	29.3
Highest Daily Mean (cfs)	830	285	132	415.7
Lowest Daily Mean (cfs)	.89	.91	.86	.89
10-Day Minimum (cfs)	.96	.94	.92	.94
Annual Runoff (Acre/Feet)	24,140	25,750	13,760	21,216.7
Annual Runoff (inches)	13.89	24.81	7.9	15.5

Regression equations based on other gaging stations in the vicinity have been utilized to estimate flow discharge for specific return intervals on Iskuulpa Creek. The most reliable of these equations are published in *Magnitude and Frequency of Floods in Eastern Oregon* (Harris and Hubbard, 1983). The equations used to calculate the return flow discharges shown in table 1 are for the North Central Region of Eastern Oregon and include data from 43 gaging stations. The stations range from areas southeast of Bend, Oregon to Hood River, Oregon and over to Walla Walla, Washington. The large area of coverage and the variability in the stream types and flow regimes explains the high range of error for calculated flow estimates.

Table 4. Flow discharge calculations for Squaw Creek.

Return Interval	Discharge (cfs)	Standard Error			Range of Error	
		Log Units	%+	%-		
2-year	147.14	0.342	120	55	323.70	66.21
5-year	344.40	0.279	90	47	654.35	182.53
10-year	503.26	0.281	91	48	961.23	261.70
25-year	781.65	0.293	96	49	1532.03	398.64
50-year	1005.00	0.315	107	52	2080.34	482.40
100-year	1321.48	0.34	119	54	2894.04	607.88

Experience in the Umatilla River basin has shown that calculated discharges are significantly lower than actual discharge. Analyzing data collected for 64 years from the Umatilla River above Meacham Creek

near Gibbon, Oregon produced a 100-year return interval discharge of 5880 cfs. Using USGS regression equations, a calculated 100-year flow event for the same site is 3677 cfs. The actual flow at this site was a 60% positive error from the calculated value. Actual discharges in Squaw Creek may be closer to the upper limit of the error range shown in Table 4 for each return interval; applying a positive error of 60% yields a discharge of 2,113 CFS.

The following table summarizes the number of dry units recorded during 1994 fish habitat surveys. Dry units are defined as sections of stream separating wetted channel units. Typical examples included riffles with subsurface flow or portions of side channels separated by isolated pools. The greatest number of dry units occurred in Reach 5 of the survey area.

Table 5. Iskuulpa Creek Dry Channel by Stream Reach.

Reach	1994 Survey Period	No. Dry Units	% Area
1	6/8	0	0
2	6/21 – 7/7	6	2.3
3	7/7 – 7/13	2	.4
4	7/13 – 7/14	2	1.7
5	7/18 – 7/22	37	35.5

Other tributaries are typically ephemeral, with patterns dominated by snowmelt.

Water Quality

Water quality data is somewhat limited for the Squaw Creek. In 1997, stream temperatures were recorded at RM 2 and RM 9. Water temperature at RM 2 (in Reach 2), recorded from May 21 to October 26, had a seven day maximum average temperature of 24.1⁰ C (75.4⁰ F) and a high of 25.0⁰ C (77.0⁰ F) on August 6th. At River Mile 9 (break of Reaches 4 and 5) a seven day maximum average temperature of 26.8⁰ C (80.2⁰ F) and a high of 28.1⁰ C (82.6⁰ F) on August Sixth. Temperatures at RM 9 were recorded from May 22 to November 6, 1997.

Stream Morphology

Fish habitat surveys conducted in 1984 provide surrogate information for developing a preliminary morphological description of the mainstem of Iskuulpa Creek. Approximately 11.8 stream miles of the mainstem were surveyed as illustrated on page 10. The morphological description summary is based on the Rosgen (1996) stream classification, and is intended to be useful in identifying areas of sediment supply, stream reaches sensitive to disturbance, potential channel response to changes in flow regime, fish habitat potential, and potential for natural recovery (Rosgen, 1996).

Table 6. Summary of Morphological Attributes of Mainstem Iskuulpa Creek.

Attribute	Reach 1	Reach 2	Reach 3*	Reach 4	Reach 5
Segment Length (Mi)	.43	4.45	2.21	1.27	3.45
Width/Depth Ratio	78.4	26	30.8	25	31.4
Sinuosity	>1.2	>1.2	>1.2	>1.2	>1.2
Slope	.013	.012	.012	.013	.013
Channel Material					
Bedrock	0	3.0	1.0	6.0	3.0
Boulders	.01	.01	4.0	10.0	9.0
Cobble	23.0	23.0	39.0	42.0	73.0
Gravel	60.0	60.0	46.0	37.0	39.0
Sand	12.0	12.0	9.0	6.0	5.0
Silt/clay	5.0	3.0	1.0	0.0	1.0
Rosgen Classification	C	C	C/B	B	B

*Reach 3 contains a transition from the B-Type to C-Type. The original reach breaks in the habitat survey were not based the Rosgen classification system.

B-Stream Type

The "B" stream as described by Rosgen (1996) exists on moderately steep to gently sloped terrain, with the predominant landform seen as a narrow and moderately sloping basin. These types are moderately entrenched, have low channel sinuosity, and exhibit a "rapids"-dominated bed morphology. Bedform morphology, which may be influenced by debris constriction and local confinement, typically produces scour pools (pocket water) and characteristic rapids. Streambank erosion rates are normally low, as are the channel aggregation/degradation process rates. Pool-to-pool spacing generally decreases with slope increases.

Reach 3, which includes a transition between channel types, includes what might best be categorized as a B4 channel, which includes moderately entrenched systems in narrow, moderately steep, colluvial valleys, with gravel-dominated channel materials, and width/depth ratios greater than 12. This type is considered to be relatively stable and is not a high sediment supply stream. Large, woody, debris is an important component for fisheries habitat when available.

Based on the dominance of the channel material by cobble, these reaches might be categorized as B3 stream types. Channel bed morphology in these types is dominated by cobble materials and characterized by a series of rapids with irregular spaced scour pools. The average pool-to-pool spacing for this type is 3-4 bank-full widths. Pool-to-pool spacing is generally 4-5 bank-full channel widths. Pool to pool spacing adjusts inversely to gradient. This type has a moderate width/depth ratio and sinuosity greater than 1.2. Channel materials are composed primarily of cobble with a few boulders, lesser amounts of gravel and sand. The bed and bank materials are stable and contribute only small quantities of sediment during run-off events. Large woody debris is an important component of fisheries habitat when available.

C-Stream Type

These types are located in narrow to wide valleys, constructed from alluvial deposition. They have a well-developed floodplain (slightly entrenched), are relatively sinuous with a channel slope of 2% or less, and a bed-form morphology indicative of a riffle/pool configuration. Primary features of this type are a sinuous, low-relief channel, well-developed floodplains built by the river, and point bars within the active channel. Channel aggradation/degradation and lateral extension processes are dependent on the stability of streambanks, upstream watershed conditions, and flow and sediment regime. Channels of this type can be significantly altered and rapidly de-stabilized when the effects of imposed changes in bank stability, watershed condition, or flow regime combine to cause an exceedence of a channel stability threshold.

The valley bottom below the confluence of Bachelor Canyon is composed of a deep layer of alluvial material that was moved from the upper watershed and tributaries. Depositional processes through this stream reach are influenced by a combination of roughness elements in the stream and gradient changes. The removal or addition of large material within the active floodplain greatly influences the spatial and temporal distribution of fluvial sediments. This is especially true on the alluvial fan that has developed at the canyon opening near the confluence of Iskuulpa Creek and the Umatilla River.

Reaches 1 and 2 might best be preliminarily categorized as a C4 stream type. Rosgen (1996) describes these types as follows:

These types have gentle gradients of less than 2%, a high width-depth ratio, and generally possess higher meander width ratio than C1, C2, C3 stream types. Streambanks are generally composed of unconsolidated, heterogeneous, non-cohesive, alluvial materials that are finer than the gravel-dominated bed material. Consequently, the stream is susceptible to accelerated bank erosion. Rates of lateral adjustment are influenced by the presence and condition of riparian vegetation. Sediment supply is moderate to high, unless stream banks are in a very low erodibility condition. This type, characterized by point bars and other depositional features, is very susceptible to shifts in both lateral and vertical stability caused by direct channel disturbance and changes in flow and sediment regimes of the contributing watershed.

Un-surveyed Tributaries

Major tributaries, which include Bachelor Canyon Creek and Little Iskuulpa Creek while not surveyed, would probably best be categorized as B3 types, as they are located in narrow, moderately steep valleys, cobble-dominated channel materials with lesser amounts of boulder, gravel, and sand. The stream banks of these tributaries are also stable due to their coarse material.

Numerous, non-fish-bearing tributaries contributing to these streams are typically A-type channels. These types are generally ephemeral, flowing only in response to precipitation, or intermittent, flowing seasonally or sporadically. A-type channels are characterized as entrenched channels with low width/depth ratios, low sinuosity, and steep slopes generally ranging from 4 – 10%, and sometimes exceeding 10%. In the Iskuulpa watershed, the dominant materials in A-type channels may include cobble, gravel, or residual soils for the A3, A4, and A5-Types. These types may provide relatively high sediment supply.

The table below summarizes Rosgen's management interpretations for classifications occurring in Iskuulpa Watershed. Stream types occurring in Iskuulpa are shown in **bold**.

Table 7. Stream Type Management Interpretations (Rosgen 1996).

Stream Type	Sensitivity to increases in: 1) streamflow magnitude, 2) streamflow timing, 3) sediment.	Sediment Supply	Streambank Erosion Potential	Vegetation Controlling Influence	Recovery Potential
A3	Very High	Very High	Low	Negligible	Very Poor
A4	Extreme	Very High	Low	Negligible	Very Poor
A5	Extreme	Very High	Moderate	Negligible	Very Poor
A6	High	High	Low	Negligible	Poor
B3	Low	Low	Low	Moderate	Excellent
B4	Moderate	Moderate	Low	Moderate	Excellent
C4	Very High	High	Very high	Very high	Good

Floodplain, Channel, and Riparian Structural Characteristics

Riparian conditions in the wildlife area range from very poor to fair. Past road construction (associated primarily with timber harvest and scattered, infrequent housing) has disconnected streams from their floodplains, constrained hydrologic processes, removed/reduced structural stability provided by both live and dead vegetation (large woody debris), and increased potential for erosion and sediment delivery to streams.

Floodplain and Channel Manipulations – Reach 2

Railroad and highway grades are constructed across the top of the developed alluvial fan and perpendicular to Iskuulpa Creek approximately .75 miles upstream of its confluence with the Umatilla River (within Reach 2). Although the stream channel across this fan is a single channel that is well developed, its historic location and form on the fan was likely transient with the possibility of multiple braid-form due to frequent changes and shifts in bedload stores. Bridges constructed over Iskuulpa Creek for both the railroad and highway, have locked the location of the channel in one place.

The highway bridge is able to pass a larger discharge with less hydraulic pressure than the railroad bridge due to the larger cross-sectional area. With frictional resistance taken into account, the highway bridge was calculated to pass 330% more flow than the railroad bridge. The calculated absolute discharge value of 3479.8 cfs for the highway bridge appears to be adequate to pass a 100-year flow event while the calculated discharge of 809.1 cfs for the railroad bridge would only pass an estimated 5-10 year flow event.

Additional problems exist with a situation where the most downstream of two structures is the most constrictive. During flow events that approach the capacity of the limiting structure, hydraulic head increases from that structure and moves upstream. Flow velocity is reduced at the structure and also moves upstream. This causes sediment and bedload being moved by higher velocities to drop out and be

deposited above the structure. In this situation, much of the material is deposited under and adjacent to the upstream structure and increases the potential for overbank flow upstream of both structures. As material builds in elevation under the upper structure, its capacity is reduced; flow velocity is further reduced, hydraulic head increases, and the potential for overbank flow increases.

Overbank flow above the two bridge crossings provides significant energy relief for the stream channel. A floodplain with healthy vegetation provides a relatively low elevation, near channel region that slows flow velocity and diverts flow energy in multiple directions without eroding. A floodplain with healthy soils also should provide a large storage area for overbank flow.

Creating large structures in the floodplain that concentrate flows and increase hydraulic head should be avoided at all cost. Efforts with the purpose to improve floodplain function should focus on breaking up stream energy, reducing overland flow velocities, and minimizing erosion. Dikes and levees above the bridges will not increase discharge capacity through the bridge crossings. Dike construction within the floodplain will protect the dwelling and roadways by providing additional ponding storage in the floodplain only during stream discharge events that do not exceed the dike elevation. Once the dikes are overtopped, flow velocities will be higher than before due to the increased hydraulic head and local gradient; erosion and scour would be much worse than before. The existing roadbeds currently act as dikes and already limit the floodplain significantly.

A gravel-surfaced road parallels the length of Reach 2 on the east side of the stream, providing access to four dwellings. The roads and associated development reduce available floodplain habitat in this Reach. Each mile of road equates to approximately 4 acres of floodplain habitat, therefore the road occupies approximately 17.8 acres of floodplain.

Floodplain and Channel Manipulations – Reach 3 - 5

From Reach 3 to Reach 5, the road reverts to a non-maintained, native-surface road (soil) with multiple, undeveloped stream crossings. The road occupies an estimated 27.72 acres of habitat. While most of the road is located in the floodplain, portions are located on the adjacent toe slope. The initial construction of this road, primarily for timber harvest, resulted in the removal of present (dead trees) and future (live tree) sources of large-wood supplies to the Iskuulpa Creek floodplain. Restoration and reforestation of flood plain terraces is recommended to address the deficient supply of large wood in the long term and to create intact, near channel areas that slow water velocities and divert stream energies during high flow events.

Streambank Stability

1994 Fish habitat surveys documented that approximately 18% of the streambanks of Iskuulpa Creek were actively eroding. Approximately 2-9% of the streambanks in the surveyed reaches were classified as undercut.

Floodplain connectivity

A road parallels Iskuulpa Creek for approximately 11.4 miles of the surveyed total length. The first three miles of the road are gravel-surfaced and are infrequently maintained, the remainder however is native surfaced. The maintained portion constrains the movement of the stream flow, particularly in Reaches One and Two. The roads also intercept flow from adjacent springs. In Reaches Three through Five, the native surface road is not maintained. The road has multiple stream-crossings, is capable of channelizing stream flow during flood events, and contributes to sediment production and delivery to streams.

Width/depth ratio

The following table summarizes channel width and depth characteristics for each surveyed reach, and provides an average for the entire survey area.

Table 8. Iskuulpa Creek Channel Characteristics.

Reach	Wetted Channel Width (ft)	Active Channel Width (ft)	Depth (Ft)	Active Width:Depth
1	10.2	79.7	1	79.7
2	9.2	25	1	25
3	10.5	25	.8	31.3
4	8.9	18	.7	25.7
5	7.5	14.4	.5	28.8
Average	9.3	32.4	.8	40.5

Reach 1 is very wide and shallow and well outside the Rosgen range of values for width:depth ratios

Substrate Distribution

No direct measurements of substrate embeddedness were made. However habitat surveys indicated gravel (2-64mm) was the most abundant type of substrate, ranging from 39 – 64%, while silt and organic matter (< 2mm) ranged from 0 - 5%.

Pool Frequency and Area

To provide an index of pool frequency, the number of pools per mile is reported in the following table. The percent area of pools indicates the percent of each reach comprised of pool habitat, and conversely the percent area of dry units.

Table 9. Iskuulpa Creek Pool Habitat Characteristics.

Reach	Pools/Mile	% Area	% Area in Dry Units
1	46.5	29.6	0
2	62.9	36.5	2.3
3	42.5	26.4	.4
4	44.1	25.8	1.7
5	32.2	13.9	35.5
Average	45.6	26.4	n.a.

Low amounts of pool habitat are generally a result of fluvial processes, riparian habitat conditions, and lack of large woody debris.

Off-channel habitat

Off channel fish-rearing habitat is somewhat limited in the mainstem Iskuulpa. However, seasonal availability of backwater habitats is available during flood flows, particularly at the confluence of braided stream channels. Backwater habitat available during the June to August survey period is extremely limited, with survey results ranging from less than one percent to approximately 4.1 percent.

Soils

The following soil description is excerpted from *Plant Associations of the Blue and Ochoco Mountains* (Johnson and Clausnitzer, 1992).

Soils of the Blue Mountains are quite variable and may range from those on thin, rocky, low-productivity ridgetops to deep ash accumulations in very productive forested sites. Soil differences result from variations in climate, topography, parent material, vegetation, and time. Perhaps the greatest influence on Blue Mountain soils has come from ash deposited primarily from Mt. Mazama and Glacier Peak approximately 6,000 and 12,000 years ago respectively (Fryxell, 1965). Perhaps of equal impact, especially in the dissected basalt plateau, has been the deposition of loess from central Washington. Continued weathering of basalts and other rock

types has resulted in a mixing of wind-borne ash and loess with rocky colluvium in many areas. Consequently, soils fall under one of the following broad categories:

1. *Residual* – derived in place from predominately bedrock or colluvial rock materials.
2. *Ash-Loess* – derived from deposited and accumulated ash and/or loess over older buried soil material.
3. *Mixed* – derived from colluvium, ash and/or loess mixed well in surface layers over older buried soil material (Johnson and Simon, 1987).

Of the varied geologic material available for soil formation, basalt and andesite are the most common in the Blue Mountains (Johnson and Clausnitzer, 1994). Residual soils formed from these material differ from the volcanic ash and loessial soils in several respects: 1) finer textured in the upper profile, 2) increased structure, 3) higher coarse fragments, 4) lower water-holding capacity, and 5) higher bulk densities. Other materials may provide locally important substrates that impart characteristic attributes to soils.

In the Blue Mountains, the productivity or expression of plant communities is closely related to ash and loess content in soils (Johnson and Clausnitzer, 1994). Ash soils possess properties of 1) high water holding capacity, 2) high water infiltration rates, 3) low compactability, 4) high detachability, and 5) high amounts of nutrients in upper surface layers. Under undisturbed conditions, these soils support good vegetative cover which protects the ash from erosion (USDA, 1985).

Other soil properties that appear important to plant community distribution and productivity include rock fragment content, depth of surface soil material, rooting depth, and presence of clay concentrations. All of these properties have some influence on water holding capacity which is especially critical where summer precipitation is often limited. Rock fragments of all sizes detract from the total soil volume and can substantially reduce the water storage capacity of soils. Rock fragment sizes affect the movement of water through the soil. Size and percentage of rock fragments can be used as indicators of dryness of sites. Total soil depth may be misleading when determining productivity differences between sites because soil water and nutrients are held most abundantly in only upper portions of the soil. Depth of surface soil material and rooting depth are used to indicate this zone of more available soil and water. Rooting beyond these levels into subsurface water sources is also indicated in some types. The last property to demonstrate soil moisture capability is clay content. Clay layers tend to hold large quantities of water, although some of this water may be unavailable to plants. On otherwise rocky, dry soils, clay may ameliorate site conditions making it possible for less drought tolerant plants and communities to exist.

Loess also provides many important qualities to soils. Loessial deposits are usually 1) high in base saturation (can hold a large amount of nutrients), 2) have a high content of weathered minerals and thus are high in nutrient reserve, and 3) generally have excellent physical properties.

Soils mapped in the Iskuulpa subbasin are highly variable, reflecting both parent material and soil development. Upland soils have formed over dissected basalt and andesitic bedrock, and tend to be shallow on steep slopes and moderately deep to deep on benches and flats of uplands. Riparian flood plain soils are formed in deep alluvium and colluvium. Ash is a major component of all soils and is most apparent in deeper soils of forested areas.

Floodplain soils are recent and variable and consist primarily of xerofluvents. The surface layer ranges from loamy sand to very cobbly loam, and the underlying layer ranges from extremely gravely sands to very cobbly loams. The substratum is a coarse sand, and permeability therefore ranges from moderate to very rapid. A seasonal high water table is common, and soils are subject to periods of flooding in the winter and spring.

Soils on steep side slopes adjoining the main valley are typically shallow on the south slopes and moderately deep to deep on the north slopes. Coarse fragments are common throughout the profile, particularly on shallow soils. The surface layer is a silt loam over a heavier cobbly silty clay loam subsoil. The substratum is fractured bedrock.

Upland soils range from shallow on rangelands to deep on woodlands. Shallow and moderately deep soils typically they have a silt loam or silty clay loam surface with a pickup of clay in the subsoil. Deep soils are formed in ash and have a silt loam surface and subsoil over a buried silt loam subsoil.

Soil complexes mapped for the subbasin include Waha-Rockly and Albee-Bocker-Anatone, as well Tolo-Klicker Association and Umatilla-Kahler-Gwin Associations. If the understory of plant communities of these soils is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases. Livestock grazing, if prescribed, should 1) be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure, and 2) include a rest-rotation system to allow preferred forage plants seasons of non-use by domestic livestock.

Soils characteristics interact with other environmental factors (aspect, slope position, and precipitation) to define the distributional limits of plant communities and their individual species (Johnson and Clausnitzer, 1986).

Biological Environment

Cover Type Characteristics

For the purposes of this analysis, the biological environment will be described by the amount of forested, upland shrub, grassland, and riparian cover types, and their species composition and ecological condition. The basis for defining and mapping the cover types in the study area was a 1998 polygon-class, existing vegetation theme utilized in the Arcview Geographic Information Systems (GIS) program. The theme includes classifications for vegetation size, structure, and species. A detailed listing of the "existing vegetation theme" properties is provided in Appendix A. A map of the cover types and their relative amounts is shown on page 20.

Plant communities will be described within the plant association concept (Johnson Clausnitzer, 1994) and grouped within biophysical environments and potential natural vegetation communities.

The Plant Association Concept

The plant community is a general term for an assemblage of plants living together and interacting among themselves in a specific location (Johnson and Clausnitzer 1992). It is not a taxonomic unit, has no successional status, and may not be recognized by all investigators.

The plant association concept differs in that its purpose is to segment the temperature-moisture gradient through recognition of indicative plant species so as to provide easier recognition of similar environments across the landscape (Johnson and Clausnitzer 1992). As a combination of similar or compensating environmental factors is repeated across the landscape (e.g. elevation, slope position, aspect), a predictable plant community will occupy those sites given time and varying frequencies of disturbance (Johnson and Clausnitzer 1992). This community will then have similar physiognomy (form and structure) and floristics; and may also be called a climax community (Allaby, 1994). It is believed that: 1) the individual species in the association are, to some extent, adapted to each other; 2) the association is made up of species that have similar habitat requirements; and 3) the association has some degree of integration (Kimmins, 1997).

Because environmental conditions vary continuously across the landscape, the resulting plant composition also varies. For that reason, a plant association is not an exact assemblage of species from one location to another. However, sites in the same plant association differ less than sites from different associations (Powell, 1998).

Plant associations are named for their dominant overstory (tree) and undergrowth (herb or shrub) plants, such as Grandfir/Twinflower plant association. It is assumed that the dominant tree species (grand fir)

represents an area's macroclimate, and the undergrowth indicator plant (twinflor) the area's microclimate and soils.

Plant Series

Plant associations are grouped into series, which are aggregates of *taxonomically related* plant associations. The name of the series is that of the climax species dominating the principal layer. The naming convention is based on temperature/moisture regimes of the environment supporting the plant association. An example would be the *grand fir* series in which all ABGR plant associations are arrayed, as well as the seral plant community types related to grand fir climax vegetation (Johnson and Clausnitzer, 1994).

Plant Association Groups

Plant associations may be aggregated into plant association groups (PAG), classifications that have similar *ecological environments*. A Grand Fir/Pacific Yew/Twinflower plant association would occur in the Grand Fir series, and would be grouped into the "Cool Wet" plant association group.

Potential Vegetation Groups

Finally, plant associations may be classified into Potential Vegetation Groups (PVG), a group of potential vegetation types that have similar *environmental conditions* and are dominated by *similar types* of plants. Groupings are often made using similar *life forms*. Continuing with the example, the "Cool Wet" PAG is located within the "Moist Forest" Potential Vegetation Group. This organization is illustrated in Figure 1.

Figure 1. Example of Plant Association Organization.

Forested Communities

Forest cover types are generally located on easterly to northwesterly aspects, resulting in a grass-timber mosaic characteristic of the Blue Mountains. The study area contains approximately 3,539 acres of forested habitat. Forested plant associations observed during the course of surveys (n= number of observations) and their relation to plant association groups and potential vegetation groups are displayed in the following table. Detailed descriptions of each plant association are presented in Appendix B.

Table 10. Observed Forested Plant Associations.

Potential Vegetation Group	Plant Association Group	Plant Association	n=
Moist Forest	Cool Very Moist	Grand fir/sword fern	2
	Cool Moist	Grand fir/beadlilly	4
	Cool Moist	Grand fir/Twinflower	1
	Warm Very Moist	Grand fir/Rocky mountain maple	6
	Warm Moist	Douglas fir/Pacific Oceanspray	7
	Warm Moist	Ponderosa Pine/Oceanspray*	2
Dry Forest	Warm Dry	Grand fir/Birchleaf spirea	1
		Douglas fir/Pine Grass	1
		Douglas fir/ninebark	10
		Douglas fir/Common Snowberry	6
		Ponderosa Pine/Common Snowberry	3

*This association with productive oceanspray growth in the absence of more mesic tree species is not yet classified. Its prevalence at elevations below 3,000' and the stature of oceanspray on these sites suggests it occurs higher on the moisture gradient than ponderosa pine/common snowberry, but lower than Douglas fir/oceanspray.

Upland Shrub

Upland shrub cover types occupy approximately 1,045 acres of the study area. Predominant shrub associations include mallow ninebark/common snowberry and common snowberry/rose.

Table 11. Observed Upland Plant Associations.

Potential Vegetation Group	Plant Association Group	Plant Association	n=
Moist Shrubland	Warm Moist	Common snowberry/rose	10
		Ninebark/common snowberry	5

Detailed descriptions of these communities are provided in Appendix B.

Floodplain/Riparian Communities

Floodplain and riparian communities in the study area include approximately 9.3 acres of riparian hardwood forest and approximately 335 acres of riparian shrub. Most of the riparian shrub cover is provided by black hawthorn shrubs, either in stream bottoms, or in draw bottoms and swales of ephemeral streams.

Floodplain communities in Reaches 1 and 2 of mainstem Iskulpa are dominated by Black Cottonwood/Snowberry and Ponderosa Pine/Snowberry associations, and transitory alder communities. In these reaches, willow communities are expected, but were highly suppressed at project initiation due to recent grazing activity. Himalayan blackberry, an introduced shrub, is prevalent in the shrub layer in these reaches. Moving upstream to Reaches 3 – 5, the floodplain narrows, topographic shade influence from Telephone Ridge increases, communities become dominated by coniferous associations, and hardwood frequency decreases. Detailed descriptions of the associations listed in Table 12 are provided in Appendix B.

Table 12. Floodplain/Riparian Plant Communities (Crowe, 1997).

Potential Vegetation Group	Plant Association Group	Plant Community	Reach*
Wet Riparian Forest	Warm Wet RF, Moderate soil moisture	Grand fir/Rocky Mtn. Maple – floodplain	4-5
	Warm Wet RF, Low soil moisture	Douglas-fir/common snowberry-floodplain	3-4
Dry Riparian Forest	Hot Dry RF, Moderate Soil Moisture	Black cottonwood/common snowberry - floodplain	1-2
	Hot Dry RF, Low Soil Moisture	Ponderosa pine/common snowberry – floodplain	2-3
Dry Riparian Shrub	Hot Dry, Low Soil Moisture	Black hawthorn	2

*Iskuulpa Creek reach breaks as described previously.

Grassland Communities

Grasslands are the dominant cover type in the study area, comprising approximately 10,991 acres. Associations surveyed in the Iskuulpa Watershed included the Bluebunch Wheatgrass/Sandberg's bluegrass and Idaho fescue /Bluebunch wheatgrass associations. Grassland communities typically occur on westerly to southeasterly slopes and ridgetops.

Generally, grassland communities in the watershed have regressed into annual-dominated grass communities as a result of past grazing.

Detailed descriptions of these communities are included in Appendix B.

Table 13. Observed Grassland Plant Associations.

Potential Vegetation Group	Plant Association Group	Plant Association	n=
Moist Grassland	Warm Moist	Idaho Fescue/Bluebunch Wheatgrass	3
Dry Grassland	Hot Dry	Bluebunch Wheatgrass/Sandberg's Bluegrass	28

Methods

A preliminary HEP analysis for Iskuulpa Watershed was conducted for use in the development of the BPA/CTUIR Memorandum of Agreement. Conducting the preliminary HEP analysis included development of base maps, cover typing, and estimating habitat suitability indices. Cover types were delineated utilizing aerial photos and 1:24,000 USGS quad maps based on the presence of tree, shrub, and grass cover. The minimum number of credits estimated for the Iskuulpa Watershed was 3,128 habitat units.

More detailed cover type data was obtained through the development of a Geographic Information System (GIS) vegetation data theme in 1998. The theme is a polygon-feature class them with "good" data confidence (accuracy of vegetation identification) and "excellent" locational confidence. The theme was scaled at 1:24,000, and projected in Universal Trans Mercator (UTM) 11.

Prior to conducting field surveys, wildlife technicians were trained in the appropriate survey protocols for each model. Surveys were conducted consistent with Habitat Evaluation Procedures models for each species. To improve survey efficiency, an attempt was made to combine measurements for as many species' habitat variables as possible for each cover type. Surveys were conducted with teams of 2-4

technicians, generally with one team member recording data as other team member(s) conducted variable measurements, species identification, and ocular estimates of cover.

Forested and Upland Shrub Habitat Surveys

The protocol for forested and upland shrub cover types was based on Habitat Evaluation Procedures (HEP) models for blue grouse, and downy woodpecker. Habitat variables and measurement techniques are displayed in the following table. Habitat suitability curves for all mitigation species are presented in Appendix C.

Table 14. Forested and Upland Shrub Habitat Variables and Measurement Techniques

Species	Model Variables	Measurement Techniques
Blue Grouse	V2: Percent Shrub Crown Cover V3: Average Height Shrub Canopy V4: Percent Herbaceous Cover V5: Average Height Herbaceous Canopy V6: Diversity Herbaceous Species V7: Distance to Forest Cover	Line intercept Line intercept, rod. Square Meter, Ocular Estimate Graduated Rod or Tape Count GIS Software
Downy Woodpecker	V1: Basal Area (Sq Ft) V2: Snags/Acre	Prism, 10 factor Count within fixed radius plot

Starting points for line transects were generally established in a pre-field review. Line intercept transects were established at a starting point 300 feet within the cover type to avoid the influence of ecotone gradients and anthropogenic factors such as roads. Transects were a minimum of 1000 feet in length with 100 foot sub-segments. Final transect lengths were determined using a "running mean" to estimate variance, with a sampling goal of 95% probability of being within 10% of the true mean for percent herbaceous cover.

Shrub intercept, measured in 10ths of a foot (i.e. 1.6 feet), was recorded by species along entire transect. A graduated rod was used to measure shrub height where shrub foliage intercepted the transect line.

Circular plots and associated robel pole location points on transects were selected from a random numbers table. For example, if the first number selected from the random numbers tables was 23, then circular plot/robel pole measurements were taken at the 23rd ft mark of the first 100' sub-segment. Two square meter plots and one robel pole point were measured in each 100' sub-segment. The circular plots, used to make ocular estimates of herbaceous cover, were offset 5' perpendicular to the transect line. The robel pole was used to measure visual obstructions and hiding cover. At a distance of 15 feet, two measurements were taken from the transect line in opposite directions from the robel pole, and two measurements perpendicular to the transect line in opposite directions from the pole. For each point, the percentage of the robel pole obscured by vegetation or other cover was measured, then the mean obstruction value was calculated from the four measurements.

Tree basal area was measured from plot center using a factor 10 prism, and the square feet of basal area summed for the plot. Measurements were taken facing in the transect line direction of travel, then counts were made rotating clockwise, making sure to keep *prism* over plot center. Basal area was recorded for live trees only.

Tree canopy closure was recorded at 10 foot intervals along transect using moosehorn densiometer, and a running tally maintained for the entire transect length. Average canopy closure was calculated for each 100 foot intercept segment (i.e., 6 hits/10 readings = 60% canopy closure) and the entire transect.

Using the random numbers table as described above, fixed radius plot (37.5 feet) were established at random points on each 100' sub-segment of the transect. Facing transect origin, surveyors rotated clockwise and collected and recorded square feet of basal area and snags within the plot. For each plot, tree species, average tree diameter, and average tree height were recorded.

Figure 2. Forest and Upland Shrub Transect Diagram.

In the forested cover type, 20,300 feet of transects, 101 one-tenth acre plots, and 406 square meter plots were completed.

Floodplain/Riparian Habitat Surveys

Floodplain/Riparian survey protocols were based on HEP models for the yellow warbler, downy woodpecker, and mink. Associated habitat variables and measurement techniques are displayed in the following table. Habitat suitability curves for all mitigation species are presented in Appendix C.

Table 15. Floodplain/riparian Habitat Variables & Measurement Techniques.

Species	Model Variables	Measurement Techniques
Yellow Warbler	V1: Percent Deciduous Shrub Crown Cover V2: Average Height Deciduous Shrub Canopy V3: Percent Shrub Canopy Composed of Hyrophytic Shrub	Line Intercept Line Intercept, Rod. Line Intercept
Downy Woodpecker	V1: Basal Area (Sq Ft) V2: Snags/Acre	Prism, 10 factor Plot Count
Mink	V1: Percent of year with surface water present V2: Percent Tree Canopy Cover V3: Percent Shrub Canopy Cover V4: Percent Canopy Cover of Emergent Vegetation V5: Percent Cover Trees/Shrubs w/in 100 meters of Water's Edge. V6: Percent Shore Line Cover w/in 1 M of High Water Mark.	USGS Guage, Fish Habitat Surveys Moosehorn Densiometer Line Intercept Line Intercept Moosehorn Densiometer Line Intercept
Great Blue Heron	V1: Distance between potential nest sites/foraging areas V2: Presence of water body with suitable prey population V3: Disturbance free zone w/in 100 meters of foraging area V4: Presence of tree cover type within 250 meters of water body V5: Presence of disturbance free zone around potential nest sites V6: Proximity of active/potential nest sites	Aerial Photo Interpretation Fish Population Surveys GIS Software GIS Software Aerial Photo Interpretation GIS Software

Initial survey starting points were identified during pre-field review, then finalized in the field by establishing line-intercept transects at the high water mark. Transects were run in 100 foot lengths with a total length of 1000 feet. Intercept was recorded in 10ths of feet (i.e., 1.6) for all objects providing hiding cover for mink (i.e., tree, shrub, grass, overhang, rock, etc) within 3 feet of high water mark.

Percent canopy closure was recorded at 10 foot intervals along transect using the moosehorn densiometer and maintaining a running tally for transect length. Average canopy closure was calculated by dividing the total number of tree canopy "hits" (when tree canopy obscured the center point of the densiometer) by the total number of readings taken (i.e., 6 hits/10 readings = 60% canopy closure).

At 250-foot intervals of the shoreline transect, 250-foot *lateral* transects were established at right angles to the shoreline in order to characterize the adjacent floodplain. Tree and shrub intercept and height were recorded on these lateral transects. The direction of subsequent lateral transects was alternated to characterize the floodplain on both sides of the stream (see Figure 2).

Recognizing that lateral migration of stream channels and stream sinuosity are natural factors that might limit floodplain widths to less than the lateral transect length, lateral transects were extended beyond the floodplain and up the adjacent toeslope 100 feet where necessary (i.e. within the adjacent floodplain was less than 250 feet wide).

Intercept measurements on lateral transects began at the edge of high water mark. Data was not recorded within the channel, and the width of the channel was not included in the 250' transect. Rather, lateral transect were initiated on opposite side of the channel at the high water mark.

Fixed radius plot (37.5 feet) were established at a random point on each lateral intercept. Square feet of basal area was measured for the plot, and a count of snags (> 6 feet high, > six inches in diameter).

Where vegetation (blackberry/other) presented a barrier to extending lateral transects a full 250 feet, a random point was established on the lateral to serve as the center of a fixed radius plot, and four 25 foot transects were established at 45 degree angles to collect line intercept data.

Figure 3. Floodplain/Riparian Transect Diagram.

Eight thousand feet of transect and 32 one-tenth acre plots were completed in the floodplain/riparian cover.

Grassland Habitat Surveys

The protocol for measuring grassland habitat variables is based on the western meadowlark HEP model. Habitat suitability curves for all mitigation species are presented in Appendix C. The following variable parameters measured to characterize grassland habitats:

Table 16. Grassland Habitat Variables & Measurement Techniques.

Species	Model Variables	Measurement Techniques
Western Meadowlark	V1: Percent Cover Herbaceous Plants. V2: Percent Cover Composed of Grass. V3: Average Height Herbaceous Canopy. V4: Distance to Perch Site. V5: Percent Shrub Canopy Cover.	Square meter hoop Square meter hoop Robel Pole Square meter hoop Meter tape

Starting points for grassland surveys were established during pre-field reviews. Transect length was determined using a "running mean" to estimate variance with a sampling goal of 95% probability of being within 10% of the true mean for percent herbaceous cover. Every 50 meters, a square meter plot was established to measure cover values.

Square meter hoop plots were established perpendicular to main transect, offset by one meter, and placed on alternating sides of the main transect during the survey. The square meter hoop was used to provide a visual reference to allow surveyors to estimate percent cover of herbaceous plants by species, shrub canopy cover by species, and percent of plot composed of grass vs. non-grass species.

A meter tape was used to measure the distance to the nearest perch from plot center. Perch sites were defined to include rock outcrops, fence posts, shrubs, with a height greater than the measured average height of the herbaceous canopy within the square meter plot.

The robel pole was erected at plot center to measure visual obstructions/hiding cover. At a distance of 10 feet, two measurements are taken from the transect line in opposite directions from the robel pole, and two perpendicular to the transect line in opposite directions from the pole. For each point, surveyors determined the percentage of the robel pole obscured, and calculated a mean value for all four measurements.

The average and greatest height of the herbaceous canopy was measured within the plot using graduated rods or folding rule-tapes

Figure 4. Grassland Transect Diagram.

Office Methods

Transect and plot data were entered into spreadsheet s developed using Microsoft Excel. Data management and production of habitat suitability indices, habitat units, and tables were also accomplished using Excel.

Arcview Geographic Information Systems software, 1:24,000 USGS topographic data, and digital orthoquad images was used to develop cover type maps and acreages for cover types and crediting classes. Some subjective analysis of cover type conditions was based on a combination of professional judgment and best available published literature. Details involving subjective analysis is detailed in the "Results – Baseline Habitat Indices and Units" section below for each wildlife mitigation species.

Transect and plot data were used to identify plant associations and communities provided in the "Biological Environment" section of this report. Published data for plant association structural characteristics was used to identify habitat limiting factors for wildlife mitigation species and to develop objectives for improving habitat suitability in the futures analysis.

Results – Forest Structural Characteristics

Forested surveys were initiated July 7, 1999, and completed August 17, 1999. Transects were completed on 12 fee-tracts purchased for mitigation purposes. A summary of the survey accomplishments is provided in Table 17. Timing of surveys in tree and shrub communities is less time-sensitive because perennial, woody, deciduous species have a much later senescence period than forbs and grasses. Survey effort is summarized below.

Table 17. Forest Survey Accomplishments.

Number of Transects	Linear Ft of Transect	Number of M² Plots	No. 1/10 Acre Plots
12	20,300	406	101

Survey results for upland forest overstory and understory structural attributes are summarized by transect and habitat parameter and displayed in Tables 18 and 19.

Table 18. Upland Forest Cover Overstory Structural Characteristics.

Transect	Tree Basal Area (Ft²/Ac)	% Canopy Cover	Tree Height (ft)	Snags/Ac
1	88	33	103	26
2	116	56.3	102	12
3	80	90	100	10
4	25	25	59	3.8
5	72	47	95	2.0
6	26	8	51.2	0
7	0	0	0	0
8	76	28	96	4
9	107.5	65	100	6.3
10	84	89	86	6
11	72	52.5	84	7
12	114	83	96	10
Mean	71.7	48.1	81.0	7.3

Table 19. Upland Forest Cover Understory Structural Characteristics.

Transect	% Shrub Cover	Shrub Height (ft)	% Herbaceous Cover	Diversity Herbaceous Spp
1	25.3	2.6	41.0	16
2	41.8	2.8	18.4	40
3	69.9	4.7	8.5	21
4	54.8	5.0	4.4	23
5	57.1	5.0	10.1	15
6	25.3	1.9	18.7	36
7	60	8.2	8.4	9
8	43.2	5.6	22.0	27
9	85.9	5.9	6.4	22
10	19.1	3.4	11.4	14
11	80.5	4.4	5.2	13
12	101.5	3.4	2.9	10
Mean	55.4	4.4	13.1	20.5

Survey results for floodplain forests are summarized by transect in Table 20.

Table 20. Floodplain Forest Overstory and Understory Structural Characteristics.

Transect	Tree Basal Area (Ft ² /Ac)	Tree Canopy Cover (%)	Snags/Acre	% Total Shrub Cover	Ave. Shrub Height (ft)
1	22.5	61.0	0	64.1	3.2
2	22.5	53.0	0	30.0	5.6
3	23.8	54.0	0	15.5	5.0
4	30.0	60.0	0	19.7	6.1
5	40.0	74.0	.5	17.6	4.5
6	60.0	66.0	.5	25.4	6.5
7	90.0	41.0	.5	5.6	2.4
8	77.5	62.0	.5	7.8	3.1
Mean	45.8	58.9	.3	23.2	4.6

Downy Woodpecker

Baseline Habitat Indices and Units

For crediting purposes, the Downy Woodpecker Model only applies to fee lands acquired for wildlife mitigation. On fee lands acquired for mitigation purposes, there are approximately 1,254 acres of forested habitats. While BPA leases additional Bureau of Indian Affairs-administered grazing lands, the benefits of those leases (grazing rest and subsequent changes in herbaceous and shrub communities) do not extend to forested habitats and the Downy Woodpecker model, where habitat variables include tree basal area and snag density.

For the forest cover types, snag density data and corresponding Habitat Suitability Indices were separated for floodplain forests and upland forests. This was necessary to reflect the marked differences in Habitat Suitability Indices between the two sites. Habitat suitability indices and habitat units for the downy woodpecker are presented in Table 21.

Table 21. Downy Woodpecker Habitat Suitability Indices and Units.

Area and Suitability Indices	Evergreen Forest	Evergreen Forested Wetland*
Area (acres)	1221.0	33.0
V1: Basal Area (Sq Ft/Ac)	1.0	1.0
V2: Number Snags/Ac (≥ 6 " diameter)	1.0	.05
H.S.I = Lower of V1 and V2	1.0	.05
Relative Area	97.4%	2.6%
Weighted H.S.I =	$(1.0)(.974) + (.05)(.026)$	
Weighted H.S.I.=	.98	
Number of Habitat Units (.98 * 1,254 ac)	1222.7	

*Floodplain Forest

Habitat Limiting Factors

The habitat limiting factor for the downy woodpecker on forested floodplains is the number of snags per acre for forested floodplains (0.3/ac). The optimum suitability is defined in the model as 5 snags per acre. On forested floodplains, the lowest life requisite value was 0.05, while on forested uplands the lowest value was 0.62, twelve times greater. The difference in values is attributed to differences in the intensity of past timber harvest, road construction, and woodcutting between the two sites. Upland forests had greater snag densities, and though some upland coniferous forest stands have experienced timber harvest in the past, their steep slopes likely discouraged the intensity of activities associated with timber harvest (road construction, snag removal, and subsequent woodcutting) when compared to the floodplains within the project area.

A review of past timber harvest contracts provides an example of the impact of timber harvest on snag habitat in the study area. A 1959 timber sale contract between the CTUIR and a private purchaser for the "Squaw Creek Logging Unit" included more than 10,000 acres of tribal lands in the subbasin, and contained a provision requiring the following: "The purchaser shall fell all snags that are more than 14 inches in diameter at breast height and more than 16 feet in height on the area cut over unless relieved in writing by the Superintendent on specifically designated areas of tribal land at the request of the tribal governing body, or on specifically designated allotments at the request of allotment owners, when snags are desired for firewood by the local enrolled Indian residents."

A 1964 "Summary of Operations" for the Squaw Creek Logging Unit indicates approximately 12 million board feet of timber was scaled from the Unit between 1959 and 1963. The harvested volume consisted of ponderosa pine (50%), Douglas fir (37%), grand fir (5%), and western larch and engelman spruce (8%). The road network to support the removal of timber included an "improved dirt road" paralleling the entire length of the mainstem, and an unimproved road up the entire length of Bachelor Canyon Creek. Field surveys indicate logging skid trails and downhill tractor skidding extended up many side drainages from the road network to support timber removal. As road construction requires the removal of trees, and typically the subsequent removal of hazard trees (snags) within falling distance of the road, these activities combined to produce the low number of snag levels observed in floodplain habitats. Harvest of non-Indian fee lands also occurred in the watershed, though records are not readily available.

Snags are a dynamic resource, with old snags falling and living trees dying to become new snags. Snag-dependent wildlife therefore need a continual supply of snags over time to meet their life history requisites. To provide that continuum of snag habitat, future snags must be planned for by leaving green trees to eventually become snags in managed stands (Bull, et al 1997). Because woodpeckers are territorial, snags need to be distributed across the landscape to attain the maximum density of cavity nesters. Retaining snags close to living trees provides cover for cavity users that are less likely to nest in open areas (Bull, et al, 1997).

Snag longevity, or the amount of time a snag stands, is an essential consideration in managing for snag habitat. Snag longevity is a function of many factors, including diameter and height, percentage of

heartwood, cause of death, soil type and moisture, forest type, surrounding stand conditions, and prevalence of windstorms (Bull et al, 1997). Most studies suggest that 50% of ponderosa pine snags killed by fire or beetles fall within 10 years (Bull et al, 1997).

Limited information is available on numbers of snags to retain for wildlife species in the interior Columbia Basin (Bull et al 1997). Thomas and others (1979) prescribed a snag density of 3 snags/acre greater than 6 inches in diameter for the downy woodpecker. However, those numbers were based on a hypothetical, untested model and did not include any snags for foraging. It is now known that the numbers presented by Thomas and others (1979) is inadequate because of a lack of foraging strata and invalid assumptions used in the model (Bull et al 1997). Three studies conducted in northeastern Oregon have shown that retaining foraging structure is essential, in addition to nest and roost trees (Bate 1995, Bull and Holhausen 1993, Dixon 1995).

Existing basal area values for both upland and floodplain forest are within the optimum 44-87 square feet per acre defined as optimum in the model. Considering the timber harvest that occurred in the watershed from 1959-1964, it is understandable that current, primarily second-growth forests are within the optimum basal area range. However, as forest stands mature and basal area increases, suitability for the downy woodpecker (in terms of basal area) will decrease according to the model. Table 22 below provides a range of naturally sustainable, basal area values that can be expected for forested plant associations in the Iskuulpa Watershed.

Table 22. Gross Basal Area Values (Square feet per acre) for Selected Forested Plant Associations.

Potential Vegetation Group	Plant Association Group	Plant Association	n=	Basal Area Range	Mean Basal Area
Moist Forest	Cool Very Moist	Grand fir/sword fern	12	126-379	237
	Cool Moist	Grand fir/beadlilly	15	148-367	274
	Cool Moist	Grand fir/Twinflower	29	49-292	180
	Warm Very Moist	Grand fir/Rocky mountain maple	7	127-392	220
	Warm Moist	Douglas fir/Pacific Oceanspray	5	153-208	184
Dry Forest	Warm Dry	Grand fir/Birchleaf spirea	4	116-156	138
		Douglas fir/Pine Grass	18	79-182	115
		Douglas fir/ninebark	10	74-204	117
		Douglas fir/Common Snowberry	26	48-254	124
		Ponderosa Pine/Comm.Snowberry	16	76-243	155

(Johnson and Clausnitzer, 1992).

Desired Future Conditions

Forested sites will possess an average of 5 snags per acre greater than 6" in diameter-at-breast-height within 40 years, and a corresponding snag habitat suitability level of 1.0. Current second-growth forest stands will continue to develop and stem exclusion will occur. Stem exclusion may occur on dry sites, where moisture is the limiting factor, or on moist sites, where light is the limiting factor. An expected consequence of stem exclusion is tree mortality and therefore snag recruitment. Other processes that may contribute to snag recruitment include root rot, endemic or epidemic populations of insects, floods, drought, and wildfire. These mortality agents may target different tree species and age classes; thus resulting in a mix of snag species and sizes across the landscape (Bull, et al. 1997). Events and decay processes that create dead tree habitat will maintain the snag resource through time.

Basal area on sites with dry forest vegetation potential will possess a minimum 60-80 square feet of basal area, and a with a corresponding suitability index of 1.0, while cool moist forest sites will possess a minimum of 100 – 140 square feet per acre, with a corresponding suitability index ranging from 0.4 – 0.8.

Table 23. Downy Woodpecker Futures Analysis Based on DFC's (time=40 years).

Area and Suitability Indices	Evergreen Forest	Evergreen Forested Wetland*
Area (acres)	1221.0	33.0
V1: Basal Area (Sq Ft/Ac)	.8	1.0
V2: Number Snags/Ac ($\Rightarrow$ 6" diameter)	1.0	1.0
H.S.I = Lower of V1 and V2	.69	.76
Relative Area	97.4%	2.6%
Weighted H.S.I =	$(.8)(.974) + (1.0)(.026)$	
Weighted H.S.I. =	.8	
Number of Predicted Habitat Units (.8 * 1,254 ac)	1,009.7	
Existing Habitat Units	1,222.7	
Estimated Change in Habitat Units for t=40	-213	
Estimated 10-Year Change in Habitat Units	-53.3	
Number Habitat Units in 10 Years	1,169.4	

If a suitability of 1.0 is attained for "V2: Number of snags/acre," then basal area becomes the determinant factor for habitat suitability. After basal area exceeds 130 square feet per acre, the suitability index for this variable maintains a value of 0.5. The higher basal area values are consistent with the site potential for these associations, are therefore regarded as naturally sustainable and appropriate for the desired future condition.

Enhancement Strategies

Management activities for maintaining and improving snag density on forested floodplains and therefore habitat suitability include: 1) discouraging woodcutting to prevent further losses of snag habitat; 2) maintaining green trees to allow for natural snag recruitment; and 3) creating snag habitat (e.g. topping, fungal inoculations).

Woodcutting generally occurs where roads and slopes provide motor vehicle access for the activity. The road paralleling the mainstem of Iskuulpa Creek has led to woodcutting in years past. Limiting access on this road, and rehabilitating unnecessary segments (road obliteration and floodplain reforestation) will contribute to the protection of existing snag habitat levels and improve future snag recruitment.

If stands are devoid of snags, the option is to alter or kill live trees. Three primary considerations in creating wildlife trees are: 1) the target wildlife species for which the structure is being created; 2) the tree characteristics (species, size, habitat locality most likely to be used by the target species); and 3) the method of altering or killing trees that is most likely to produce long-standing trees (Bull et al 1997).

Bull and Partridge (1986) investigated six methods of killing ponderosa pine. They determined topping trees with either a chainsaw or explosives produced snags that stood the longest and received the greatest nest use by woodpeckers. In the study, fungal inoculation and beetles attracted by pheromones did not consistently kill the tree. Trees killed by girdling or silvicides fell over too quickly to provide wildlife nest trees.

Recent work by Parks and others (1996a, 1996b) documents a new method of inoculating live trees with decay fungi. Six years after inoculation of 60 living western larch, 14% contained woodpecker cavities near the inoculation site. These trees may stand for decades, with a pocket of decay that woodpeckers can utilize for nesting. These study results indicate that for western larch, inoculation produces desirable wildlife trees at a lesser cost than killing trees to create snags.

Retaining existing snags and providing for snag recruitment are the most ecologically sound and economical approaches to providing wildlife trees (Bull et al 1997). Considering that only 2.6% of the analyzed area was deficient in snag habitat levels, and the high unit costs of snag creation, protecting

existing snags and allowing for natural snag recruitment is the prudent and preferred alternative for obtaining the desired future condition.

Black Capped Chickadee

Baseline Habitat Indices and Units

During riparian habitat surveys, tree heights were unintentionally omitted from data collection. To address this data need, average tree height data collected from upland forested sites was also used for forested floodplain cover types. In the absence of actual measured data, this surrogate data is deemed acceptable because the same species (Douglas fir, ponderosa pine, and grand fir) occur on floodplains and upland sites. While recognizing that floodplain sites may be more productive (due to soil depth and available soil moisture) and therefore may produce taller trees, the habitat suitability index curve is probably not sensitive enough to recognize differences in average tree height between the two sites, particularly when the suitability indices are weighted based on acreage, and the floodplain represents 2.6% of the cover type acreage and the forest 97.4% of the acreage.

For crediting purposes, BPA receives Black-capped chickadee credits for those lands acquired for fish and wildlife mitigation. Mitigation credits for this species will not be received for allotted lands included in livestock grazing leases as the benefits of leasing these allotments and resting them from livestock use do not extend to the tree component of forested cover types.

Table 24. Black-Capped Chickadee Habitat Suitability Indices and Units.

Area and Suitability Indices	Evergreen Forest	Evergreen Forested Wetland*
Area (acres)	1221.0	33.0
V1: Percent Tree Canopy Cover	.96	1.0
V1: Tree Height	1.0	1.0
V3: Number Snags/Ac (≥ 4 -10" diameter)	1.0	.13
Relative Area	97.4%	2.6%
Weighted HSI	.96	
Number of Habitat Units (.96 * 1,254 ac)	1203.8	

*Floodplain forest.

Habitat Limiting Factors

As for the downy woodpecker, the habitat limiting factor is the number of snags per acre on forested floodplains, where the habitat suitability index is 0.13. The explanation for the difference in snag density on the sites is explained in the downy woodpecker section above. The difference between snag habitat suitability index values for the downy woodpecker and black-capped chickadee is explained by differing life history requirements provided in their respective models. The downy woodpecker model requires 5 snags/acre for a habitat suitability of 1.0 while the black-capped chickadee model only requires 2 snags/acre for a habitat suitability of 1.0. Therefore, the snag habitat suitability value for the black-capped chickadee is .13, while for the downy woodpecker it was only .05.

Forested sites that do not meet the objective will be moved toward the objective by: 1) protecting existing snags; 2) maintaining remnant mature and second-growth green tree stands to provide replacement snag habitat; and 3) reforestation of previously harvested floodplains to provide future sources for snag recruitment.

Considering that only 2.6% of the analyzed area was deficient in snag habitat levels, and the high unit costs of snag creation, allowing for natural snag recruitment is prudent. When current, second-growth stands on floodplains enter the stem-exclusion stage of plant succession, mortality is expected to occur in the understory and provide suitable snag habitat for the black-capped chickadee. Additionally, stochastic

events, such as insect infestations, outbreaks of root rot, or wildfire, may occur and naturally increase snag density.

Acceptable ranges of tree canopy closure are displayed in Table 25. Comparing measured canopy closure values to values measured by Johnson and Clausnitzer (1992) for the same plant associations indicates that forested plant associations within Iskuulpa Watershed are within their expected range, and that increases in canopy closure for all forested associations in the Iskuulpa Watershed can be expected.

Table 25. Overstory Canopy Cover Values for Iskuulpa Forested Plant Associations.

Potential Vegetation Group	Plant Association Group	Plant Association	n=	Range (%)	Mean (%)
Moist Forest	Cool Very Moist	Grand fir/sword fern	12	45-90	72
	Cool Moist	Grand fir/beadlilly	15	41-115	83
	Cool Moist	Grand fir/Twinflower	29	41-140	77
	Warm Very Moist	Grand fir/Rocky mountain maple	7	44-98	71
	Warm Moist	Douglas fir/Pacific Oceanspray	5	35-70	57
Dry Forest	Warm Dry	Grand fir/Birchleaf spirea	4	47-123	73
		Douglas fir/Pine Grass	18	46-86	61
		Douglas fir/ninebark	10	10-84	48
		Douglas fir/Common Snowberry	26	19-92	53
		Ponderosa Pine/Comm. Snowberry	16	7-65	37

Desired Future Conditions

Tree canopy closure on dry forest potential sites will possess a minimum of 35% tree canopy closure, with a corresponding habitat suitability index of 0.7, while moist forest potential sites will possess a minimum average canopy closure of 50% with a corresponding habitat suitability index of 1.0.

Forested floodplains will possess an average of 5 snags per acre greater than 6" in diameter-at-breast-height within 40 years, and a corresponding habitat suitability level of 1.0. Events and decay processes that create dead tree habitat will maintain the snag resource through time. Current second-growth forest stands will continue to develop, and as stem exclusion occurs, resulting in tree mortality and snag recruitment. Other processes that may contribute to snag recruitment include root rot, endemic or epidemic populations of insects, floods, drought, and wildfire. These mortality agents may target different tree species and age classes; thus resulting in a mix of snag species and sizes across the landscape (Bull, et al. 1997).

For crediting purposes, BPA will receive credit for habitat enhancement occurring on Trust lands, which provides an additional 461 acres of forest cover type.

Table 26. Downy Woodpecker Futures Analysis Based on DFCs (time=40 years).

Area and Suitability Indices	Evergreen Forest	Evergreen Forested Wetland*
Area (acres)	1,682.0	33.0
V1: Percent Tree Canopy Cover	.96	1.0
V1: Tree Height	1.0	1.0
V3: Number Snags/Ac (>=4-10 " diameter)	1.0	1.0
Relative Area	98.0%	2.0%
Weighted H.S.I.	.97	
Estimated Habitat Units for t=40 years	1229.6	
Existing Habitat Units	1203.8	
Change in Habitat Units for t=40	+422.4	
10-Year Change in Habitat Units	42.2	
Number Habitat Units in 10 Years	1,246.0	

Enhancement Strategies

Strategies for improving habitat conditions for the black-capped chickadee are the same as those for the downy woodpecker.

Blue Grouse

Baseline Habitat Indices and Units

The blue grouse was included as an evaluation species to represent the upland shrub cover type because it is a native species common to the project area, a vertical migrant that utilizes the elevational range of the watershed, and because the other evaluation species in this analysis do not represent the upland shrub cover type. Use of the blue grouse as an evaluation species therefore expands the scope of this analysis and provides habitat crediting for the upland shrub cover type, which would not have been otherwise credited.

Using the Blue Grouse HEP model requires evaluating forested and non-forested (shrub and grass) cover types and their spatial arrangement – the model user cannot evaluate one cover type alone. However, for crediting purposes in this analysis, habitat credits for the blue grouse will only be applied to the upland shrub cover type. Therefore, the model was used to develop a suitability index for all cover types within the analysis area, that index value was then multiplied by the number of acres of upland shrub to determine the number of habitat units for the upland shrub cover type.

Table 27. Blue Grouse Habitat Suitability Indices and Units.

Habitat Area and Variables	Upland Shrub
Area (acres)	1,045
V1: Canopy Cover Evergreen & Aspen (project area)	.57
V2: Percent Shrub Crown Cover	.33
V3: Average Height of Shrub Canopy (inches)	1.0
V4: Percent Herbaceous Canopy Cover	.21
V5: Average Height of Herbaceous Canopy Cover	.75
V6: Diversity of Herbaceous Vegetation	.93
V7: Distance to Forest Cover Type	.88
Herbaceous Food/Cover Component	.3
Shrub Food/Cover Component	.6
Relative Area	8.1%
Mean HSI	.39
Number of Habitat Units	407.6

Habitat Limiting Factors

In reviewing the suitability indices for the blue grouse, it would appear habitat suitability limiting factors include "V2: Shrub Cover," and "V4: Herbaceous Cover." The suitability index for V2 is .33 based on the observed shrub cover value of 60%, far above the 10 – 30% cover value defined as optimum in the blue grouse HEP model. The observed value for V4 Percent Herbaceous Cover" on shrub sites in the ninebark/common snowberry plant association was 4.4%, while the model defines 40-75% as the optimum value for herbaceous cover.

A review of average values and the range of values for shrub and herbaceous cover values in the ninebark/common snowberry plant association indicate measured values are within the expected range for this association (Tables 28 and 29)

Note that shrub cover values for these plant associations greatly exceed the optimum value for shrub cover as defined in the blue grouse model. Often, these shrub communities are so dense that few plants can persist in deep shade beneath the shrubs (Johnson and Simon 1987). Idaho fescue, bluebunch wheatgrass, elk sedge, and yarrow are examples of herbaceous species that may be found where breaks occur in the shrub canopy, but they are unlikely to occur at the 40 - 75% defined as optimum in the blue grouse model. The values presented in the table above indicate the site potential for shrub cover is much greater than the optimum identified in the model.

Shrub cover may be reduced temporarily through the use of prescribed fire. Most of the shrub species in the association re-sprout vigorously after fire and quickly return to dominance (Johnson and Clausnitzer, 1994). In some cases, the ninebark/common snowberry plant association may in fact be the result of a stand replacing fire in Douglas-fir/ninebark plant associations, with the shrubs thwarting subsequent tree establishment (Johnson and Clausnitzer, 1992).

Table 28. Ninebark/Snowberry Plant Association Cover Values, n=5 (Johnson & Clausnitzer, 1992).

Species	Mean Cover (%)	Constancy (%)	Range of Cover (%)
Shrubs			
Ninebark	51	100	20-80
Snowberry	16	100	3-40
Serviceberry	3	100	1-7
Oceanspray	17	80	1-40
Spiraea	10	80	1-20
Rocky Mtn. Maple	2	60	1-3
Roses	7	60	3-10
Cherries	22	40	3-40
Syringa	2	40	1-2
Scouler willow	4	40	1-7
Herbaceous			
Bluebunch wheatgrass	11	100	1-40
Elk sedge	8	60	1-20
Yarrow	2	60	1-3
Red avens	1	40	1-1
Bedstraw	1	40	1-1

Table 29. Snowberry/Rose Plant Association Cover Values, n=10 (Johnson & Clausnitzer, 1992).

Species	Late Seral (n=3) Cover (%) / Constancy (%)	Mid Seral (n=4) Cover (%) / Constancy (%)	Early Seral (n=3) Cover (%) / Constancy (%)	Total Range of Cover
Shrubs				
Snowberry	80/100	88/100	82/100	65-95
Rose	35/100	18/75	5/67	0 - 75
Herbaceous				
Idaho Fescue	1/33	1/25	3/67	0-5
Bluebunch wheatgrass	1/33	2/75	3/67	0-5
Japanese brome	-	10/25	-	0-10
Rattlesnake brome	-	5/50	30/33	0-30
White stemmed fraseria	1/100	1/25	1/33	0-1
Red besseya	1/67	1/25	6/67	0-10
Red avens	5/33	1/25	3/67	0-5
Western hawkweed	1/67	2/50	3/33	0-3
Yarrow	1/67	5/25	8/67	0-15
Silky lupine	1/67	20/25	8/67	0-20
Common goatweed	10/33	1/50	15/67	0-25
Field chickweed	1/33	1/25	4/100	0-5
Gromwell	1/67	1/25	1/33	0-1
Goldenrod	5/33	1/50	3/33	0-5
Cleavers	5/67	22/75	38/100	0-60
Blue forget-me-not	-	6/50	2/100	0-10
Common speedwell	-	-	5/33	0-5
Tonella	-	1/25	39/67	0-75
Miner's lettuce	1/67	-	40/100	0-60

Desired Future Conditions

Because crediting for blue grouse habitat units is limited to the upland shrub cover type, desired future conditions for the species will be limited to the upland shrub cover type as well.

Shrub Cover Characteristics

Shrub crown cover will remain relatively high in the ninebark/snowberry plant association, generally ranging from 20-80% depending on the seral state of a particular site. Within four years of events such as wild or prescribed fire, shrub cover will range from 20-40% and two to three feet in height. Five or more years after such a disturbance event, shrub cover will range from 40-80% cover and average shrub height will be equal to or greater than three feet in height.

Herbaceous Cover Characteristics

Within shrub stands, herbaceous canopy cover will remain high in diversity, with eight or more species, but low in overall cover values due to high overstory shrub cover. In earlier seral stages (< 4 years) herbaceous canopy cover will range from 30 - 50%, but in later seres with increasing shrub canopy cover, herbaceous canopy cover will range from 5-30%.

The average height of herbaceous canopy cover will be determined by herbaceous species present.

Table 30. Blue Grouse Futures Analysis Based on DFC's (time=10 years).

Habitat Area and Variables	Upland Shrub
Area (acres)	1,045
V1: Canopy Cover Evergreen & Aspen (project area)	.57
V2: Percent Shrub Crown Cover	.33
V3: Average Height of Shrub Canopy (inches)	1.0
V4: Percent Herbaceous Canopy Cover	.21
V5: Average Height of Herbaceous Canopy Cover	.75
V6: Diversity of Herbaceous Vegetation	.93
V7: Distance to Forest Cover Type	.88
Herbaceous Food/Cover Component	.3
Shrub Food/Cover Component	.6
Relative Area	8.1%
HSI	.39
Number of Predicted Habitat Units	407.6
Existing Habitat Units	407.6
Change in Habitat Units for t=10	0
10-Year Change in Habitat Units	0
Number Habitat Units in 10 Years	407.6

Enhancement Strategies

Existing habitat suitability values can be maintained by 1) continuing to rest range units from livestock grazing, 2) employing livestock grazing with rest-rotation periods that allow for shrub recovery from herbivory on a scheduled basis, and 3) use of prescribed fire. Periodic use of prescribed fire in shrublands would provide a mix of conditions in which some shrublands are high in shrub cover and low in herbaceous cover and areas that are lower in shrub cover and higher in herbaceous cover. It should be recognized that the benefit of prescribed fire would be transient, as shrubs in these associations return to dominance rapidly and again limit the cover of herbaceous species.

Currently, land ownership patterns, consisting of tribal trust lands, tribal member allotments, and fee lands, and the lack of a Reservation prescribed fire policy and program, makes the application of prescribed fire for habitat enhancement difficult. Until the necessary policies and programs are developed, it is not anticipated that shrublands will be treated with prescribed fire. Therefore, no changes in habitat suitability are predicted, though stochastic events such as wildfire could occur to return shrublands to early seral states.

Floodplain/Riparian Structural Characteristics

Riparian habitat surveys were initiated September 2, 1998, and completed by September 16, 1998. Eight transects, each 1,000 feet long, were completed on fee parcels acquired for mitigation purposes. Additionally, 32 on-tenth acre plots were completed to characterize the shrub and tree layers of the floodplain. Survey results for riparian structural characteristics are summarized by transect and habitat parameter and displayed below.

Table 31. Structural characteristics of Iskuulpa Creek Floodplain/Riparian communities.

Transect	Tree Canopy Cover (%)	Tree Basal Area (Ft²/Ac)	Snags/ Acre	% Cover Deciduous Vegetation	% Cover Hydrophytic Shrubs	% Total Shrub Cover	Ave. Shrub Height (ft)
1	61.0	22.5	0	64.1	34.1	64.1	3.2
2	53.0	22.5	0	30.0	4.6	30.0	5.6
3	54.0	23.8	0	15.5	6.0	15.5	5.0
4	60.0	30.0	0	23.1	6.4	19.7	6.1
5	74.0	40.0	.5	17.6	6.3	17.6	4.5
6	66.0	60.0	.5	25.4	15.6	25.4	6.5
7	41.0	90.0	.5	5.6	2.1	5.6	2.4
8	62.0	77.5	.5	7.8	3.8	7.8	3.1
Mean	58.9	45.8	.3	23.6	9.9	23.2	4.6

Great Blue Heron

Baseline Habitat Indices and Units

For crediting purposes, the Great Blue Heron Model applies to floodplain habitats on fee lands acquired for mitigation by the Bonneville Power Administration, which total 123.9 acres.

Table 32. Great Blue Heron Habitat Suitability Indices and Units.

Habitat Area and Variable	Forested Wetland*
Area (Acres)	123.9
V1: Distance between potential nest sites & foraging areas.	.40
V2: Presence of water body with suitable prey population.	1.0
V3: Disturbance-free zone up to 100m meters around potential foraging areas.	0.56
V4: Presence of tree cover type within 250m of wetland.	1.0
V5: Presence of 250m (land) or 150m (water) disturbance-free zone around potential nest sites.	.90
V6: Proximity of potential nest site to active nests.	.30
HSI	.31
Number of Habitat Units (.31 X 123.9)	30.5

*Floodplain Forest.

Habitat Limiting Factors

Factors limiting great blue heron habitat suitability include; 1) the distance between potential nest sites and foraging areas, and 2) the proximity of potential nest sites to active nests.

The distance between potential nest sites and foraging areas (V1) is most limiting in Reach 5, which is located the farthest from suitable nest sites. Suitable nest trees are defined as trees within 250 meters of water having branches greater than or equal to 2.5 cm (1 inch) in diameter and open such that they would allow adult access to a nest site (Short and Cooper 1985). While current second-growth conifers within 250 meters of Iskuulpa Creek have branches meeting the size requirement, their crowns are not open enough for nesting activity. Stands of cottonwoods in Reach 2 of the creek provide large branches and open area adequate for nesting area. Therefore as the distance from these stands increase, (V1) habitat suitability decreases.

The variables used to evaluate a potential forage site include the presence of suitable forage fish, water conditions suitable for foraging activity, and the likelihood the aquatic habitat will be free from human disturbance (Short and Cooper, 1985). Based on fish population surveys conducted by the CTUIR Fisheries Program in 1994, Iskuulpa Creek was supporting approximately 37,600 fish in the surveyed reaches, consisting of summer steelhead, resident rainbow trout, Chinook and coho salmon smolts, and

sculpin. Water conditions throughout Reaches 1 – 4 are most stable and suitable for feeding habitat, and Reaches 3 – 5 have limited vehicle traffic due to seasonal road closures and primitive road conditions.

Reach 5 of mainstem Iskuulpa provides the lowest suitability for feeding habitat of all five surveyed reaches. The foraging behavior of the great blue heron is successful only in shallow (up to .5 m deep), clear water with a firm substrate and a huntable population of small fish (≤ 25 cm in length) (Short and Cooper, 1985). Stream flows are subsurface in much of Reach 5 during base flow periods, reducing the amount of potential feeding habitat. Approximately 35.5% of the reach was classified as “dry units” in the fish habitat survey, pool frequency (pools per mile) is the lowest of all five reaches at 32.2, and percent area of pools was the lowest of all five reaches at 13.9 percent. Table X displays data comparing pool conditions throughout five surveyed reaches of mainstem Iskuulpa Creek.

Table 33. Iskuulpa Creek – Pools per mile and dry channel area.

Reach	Pools/Mile	% Area	% Area in Dry Units
1	46.5	29.6	0
2	62.9	36.5	2.3
3	42.5	26.4	.4
4	44.1	25.8	1.7
5	32.2	13.9	35.5
Average	45.6	26.4	n.a.

At project acquisition, variable “V3: Disturbance-free zone up to 100m meters around potential foraging areas,” was a limiting factor in Reaches 1 and 2 of the study area. Reaches 1 and 2 contain permanent residences accessed by a maintained, county road. Reaches 3 – 5 contain an unimproved road infrequently accessed by four-wheel and off-road vehicles. Short and Cooper (1985) characterized a “disturbance-free” zone as potential foraging areas that are generally free from human disturbances during the four hours following sunrise and preceding sunset. Habitat suitability is scored as “1.0” if there is usually no human disturbance near the potential foraging zone during the four hours following sunrise or preceding sunset or the foraging zone is generally about 100 meters from human activities and habitation or about 50 meters from roads with occasional, slow-moving traffic. The suitability is scored as “0.0” if the above conditions are not met. Because of the narrow width of the Iskuulpa Creek floodplain, maintained and unimproved roads are within usually within 50 meters of the potential great blue heron feeding habitat.

To determine the suitability index for V3, potential foraging habitat in Iskuulpa Creek can be divided into areas that scored a “1.0” for disturbance-free areas, and “0.0” for areas not meeting the condition. Approximately 69.5 (56%) acres of floodplains in Reaches 3 – 5 would provide suitable foraging habitat free from disturbance or “occasional slow-moving traffic,” and 54.4 acres (44%) in Reaches 1 and 2 would not meet requirements for disturbance-free zones due to the presence of a county road and regular traffic to permanent residences. The weighted average for the floodplain habitats is therefore expressed as the following:

$$V3 = 1.0(.56) + 0.0(.44) = .56$$

Another limiting factor, “V6: Proximity of potential nest site to active nests” is based on a straight line-distance of 15 kilometers from a known rookery on the mainstem Umatilla River. Cottonwood galleries exist along the Umatilla River, including its confluence with Iskuulpa Creek, and provide suitable habitat for rookeries. These stands may be used in the future, though there is no predictive ability to estimate when such use might occur, what the distance to the rookery might be, and what the subsequent change in suitability for V6 might be.

Desired Future Conditions

In 40 years, great blue heron feeding habitat will be increased in Reach 5 of Iskuulpa Creek by reducing the amount of dry channel area from 35.5 percent to 20 percent. Ponderosa pine associations located within

250 meters of the stream will possess crowns suitable for heron nesting habitat. Disturbance in potential foraging areas will be reduced in Reaches 3 through 5 of Iskuulpa Creek through access and travel management so that motor vehicle disturbance does not reduce the suitability of potential feeding habitat.

Table 34. Great Blue Heron Habitat Suitability Indices and Units Based on DFC's (time=40 years).

Habitat Area and Variable	Forested Wetland*
Area (Acres)	123.9
V1: Distance between potential nest sites & foraging areas.	.80
V2: Presence of water body with suitable prey population.	1.0
V3: Disturbance-free zone up to 100m meters around potential foraging areas.	.56
V4: Presence of tree cover type within 250m of wetland.	1.0
V5: Presence of 250m (land) or 150m (water) disturbance-free zone around potential nest sites.	.90
V6: Proximity of potential nest site to active nests.	.30
Habitat Suitability Index	.44
Estimated Habitat Units for t=40	54.6
Existing Habitat Units	30.5
Change in Habitat Units for t=40.	+24.1
10-Year Change in Habitat Units	6.0
Number Habitat Units in 10 Years	36.5

Enhancement Strategies

The amount of potential great blue heron feeding habitat in the project area will be increased in Reach 5 of Iskuulpa Creek by increasing pool frequency and reducing the amount of dry channel in the reach. Floodplain enhancements will be achieved through large woody material additions and reduction of compacted areas (roadbeds) in the floodplain (sub-soiling, obliteration).

Floodplain restoration and enhancement will facilitate a reduction in stream width:depth ratios, improved access of the channel to the floodplain, and thus increased potential for seasonal flooding, subsequent water storage, increased groundwater elevation, and ultimately increased stream baseflows. By increasing baseflows, the amount of potential heron feeding habitat would increase, and the distance between potential nesting and feeding habitat would be reduced.

Disturbance to suitable habitat will be minimized through access and travel management and road obliterations. Seasonal road closures will limit access beyond the first three miles of county road. The current road closure period is March 31 to July 31 of each year, though the closure has been extended during periods of extreme fire danger. Road segments extending beyond (upstream) of the end of the county road will be obliterated where feasible to reduce trespass, and will be returned to production of appropriate plant associations.

The distance to the nearest active rookery is not a variable that can be readily addressed through management actions other than protecting existing, potential nest habitat, and promoting hardwood and coniferous forest establishment and growth (tree planting, thinning and protection) where it is currently lacking.

Yellow Warbler

Baseline Habitat Indices and Units

The Yellow Warbler HEP model has three variables; 1) percent deciduous crown cover, 2) average height of deciduous shrub canopy, and 3) percent of deciduous shrub canopy comprised of hydrophytic shrubs. Hydrophytic vegetation is defined as follows:

“Hydrophytic Vegetation - The sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically

saturated soils of sufficient duration to exert a controlling influence on the plant species present (Corps of Engineers Wetland Delineation Manual, 1987)."

"Hydrophyte - Any macrophyte that grows in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content."

Determining hydrophytic vegetation requires identifying plant species that occur in wetlands at minimum levels of probability, and determining the dominance of those species for each vegetative stratum (i.e. herbaceous, shrub, or tree). The Corps of Engineers Wetland Delineation Manual (1987) was referenced for determination of hydrophytic vegetation. The Manual provides the following criteria:

More than 50% of the dominant plant species from all strata (herbaceous, shrub, tree) are obligate wetland plants (OBL), facultative wetland plants (FACW), or facultative plants (FAC).

OBL – Obligate wetland plants. Plants that occur almost always (estimated probability > 99%) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1% in non-wetlands).

FACW – Facultative wetland plants. Plants that occur usually (67% < probability <= 99%) in wetlands, but also occur (1% < probability <= 33%) in non-wetlands.

FAC – Facultative plants. Plants with a similar likelihood (33% probability 67%) of occurring in both wetlands and non-wetlands.

For each stratum in the plant community, dominant species are the most abundant plant species (when ranked in descending order of abundance and cumulatively totaled) that immediately exceed 50% of the total dominance measure for the stratum, plus any additional species comprising 20% or more of the total dominance measure for the stratum.

Table 35. Species Sampled in Iskuulpa Creek Riparian Habitat Surveys

Species Code	Common Name	Designation ¹
Alte	Alder	FACW
Crdo	Douglas hawthorne	FAC
Hodi	Oceanspray	n.a. ²
Pipo	Ponderosa pine	n.a.
PoXX	Cottonwood	FAC
Psme	Douglas-fir	n.a.
Rogy	Wood's rose	No Indicator ³
Rudi2	Himalayan blackberry	FACU-,
Salix spp	Willow	FAC/OBL
Sanic5	Elderberry	FAC-
Syal	Common snowberry	n.a.

¹ Reed, 1998.

² Not on National List – does not occur in wetlands in any region.

³ Insufficient information available to determine indicator status.

Therefore, based on the habitat survey results for Iskuulpa Creek riparian habitats, alder, Douglas hawthorne and willow species qualify as hydrophytic shrubs when and where they dominate the shrub strata. Dominance is based on a measure of percent cover obtained through line intercept transects.

Table 36. Species Qualifying as Hydrophytic Vegetation.

Species Code	Common Name	Stratum	Designation
Potr	Black Cottonwood	Tree	FAC
Alte	Alder	Shrub	FACW
Crdo	Douglas hawthorne	Shrub	FAC
Salix spp	Willow Species	Shrub	FAC/OBL

Riparian habitats on allotted lands were not surveyed as field surveys were focused on acquired fee (mitigation) lands. Therefore, to derive Habitat Suitability Indices for Riparian Shrubs on allotted lands, data was taken from the "Black Hawthorn (n=9) Community Type" as described by Crowe and Clausnitzer, 1997). Based on the field observations, professional judgment, and the plant community description, this Plant Community Types best represents the conditions of the un-sampled riparian shrub cover type on allotted lands. The description includes the following shrubs and cover values collected from nine, 1/10th acre plots.

Table 37. Shrub Cover Attributes in the Black Hawthorn Community Type.

Species	Percent Cover	Hydrophytic	Hydrophytic Shub: All Shrubs	Mean Height*
Black hawthorn	65	Yes	69.9	2.3m
Common snowberry	24	No		
Western Serviceberry	3	No		
Roses	1	No		
Total	93			

*Average height obtained from actual field data summaries of fee lands.

Table 38. Yellow Warbler Habitat Suitability Indices and Units

Habitat Area and Variables	Site 1*	Site 2*
Area (Acres)	90.2	335.6
V1: Percent shrub canopy.	.36	.80
V2: Average shrub height.	.69	1.0
V3: Percent of deciduous shrub canopy comprised of hydrophytic shrubs.	.43	.70
H.S.I.	.33	.75
Relative Area	21.2%	78.8%
Accumulated Acres	425.8	
Weighted H.S.I.	.66	
Number of Habitat Units	280.6	

*Site 1 includes riparian habitat of mainstem Iskuulpa, while Site 2 is comprised of black hawthorn shrublands in the Buckaroo Creek subbasin.

Habitat Limiting Factors

Black hawthorne-dominated shrub habitats currently provide high suitability for the yellow warbler. These associations are dominated by a hydrophytic species, and its natural stature (generally => 2 meters) provides high suitability for the warbler.

Factors limiting yellow warbler habitat suitability in Iskuulpa Creek floodplains include low shrub cover values and low percent composition of hydrophytic shrubs. Low suitability indices for these two variables are due primarily to domestic livestock grazing that occurred prior to project acquisition. Grazing permits for Range Units 1 and 3, which encompass Iskuulpa Creek, allowed for the stocking of up to 192 cattle between May 15 and October 31 of each year. Steep slopes in the project area tended to concentrate livestock use on ridgetops and floodplains. Livestock concentration further increased in July of each year with forage senescence and the lack of well-distributed water sources on uplands.

As cattle graze riparian areas, changes in herbaceous plant stubble heights and greenness become critical and cattle forage preference shift from grasses to shrubs. Preference begins to change as stubble heights are lowered to 3 inches, because vegetation is too short to be pulled in by the cow's tongue (Hall and Bryant, 1995). Foraging becomes less efficient, and as a result cattle shift to more readily eaten vegetation. If herbaceous vegetation dries, cattle preference for shrubs may even occur when grass stubble heights are greater than 3 inches (Hall and Bryant, 1995). This shift in foraging preference reduces total and hydrophytic shrub cover.

Desired Future Conditions

Black-hawthorne shrub communities will possess minimum deciduous shrub cover values of 50%, with 70% of the shrub layer composed of hydrophytic species. Shrub heights will average 6 feet or more.

Floodplains in Reaches 1 and 2 of Iskuulpa Creek will possess average deciduous shrub cover values of 60% with 70% of the shrubs composed of hydrophytic species. Plant associations in this reach include the black cottonwood/snowberry and ponderosa pine/snowberry associations, which include hydrophytes such as willow and black hawthorne. Average Shrub heights will range from 4 to 6 feet in these reaches.

Floodplains in Reaches 3 – 5 of Iskuulpa Creek will possess 50% average deciduous shrub cover, with hydrophytic shrubs comprising up to 50% of the total shrub cover. Plant associations in these reaches, including the Douglas fir/snowberry, Douglas fir/rocky mountain maple, and grand fir/rocky mountain maple associations, tend to be lower in hydrophytic species. Average shrub heights will range from 4 – 6 feet in these reaches.

Table 39. Yellow Warbler Futures Analysis Based on DFC's (t=10).

Habitat Area and Variables	Site 1*	Site 2*
Area (Acres)	90.2	335.6
V1: Percent shrub canopy.	1.0	.80
V2: Average shrub height.	.80	1.0
V3: Percent of deciduous shrub canopy comprised of hydrophytic shrubs.	.70	.70
Habitat Suitability Index	.63	.75
Relative Area	21.2%	78.8%
Accumulated Acres	425.8	
Weighted H.S.I. ((.212*.63)+(.788*.75)) =	.72	
Estimated Habitat Units in t=10 years	308.5	
Existing Habitat Units	280.6	
Change in Habitat Units	+27.9	
10-Year Change in Habitat Units	28	
Number Habitat Units in 10 Years	308.5	

Enhancement Strategies

Increases in deciduous and hydrophytic shrub cover will be achieved through acquisition of grazing leases and rest (livestock exclusion), large wood additions to floodplains, and obliterating floodplain roadbeds and planting deciduous and hydrophytic shrubs. Rest of the grazing units will reduce browse pressure and allow shrub canopy cover to increase. Additions of large woody debris are expected to increase sediment storage within the floodplain, increase channel sinuosity, and associated water storage area. This in turn will facilitate the establishment and development of riparian vegetation, including deciduous and hydrophytic shrubs.

Mink

Baseline Habitat Indices and Units

Riparian and floodplain habitat surveys did not include the collection of data for variable "V4: Percent cover emergent vegetation." Based on ocular estimates of Iskuulpa Creek and its tributaries, percent emergent vegetation is easily less than 5%. However, as the Habitat Suitability Index curve is not specific enough for a cover value this low, the closest Habitat Suitability Index value on the curve was used, 0.1.

According to the CTUIR/BPA MOA, *"For Squaw Creek leases, BPA shall receive full credit for protecting HUs of rangeland species affected by grazing, and full credit for habitat improvements to all habitats in the leased area."*

Therefore, for calculating baseline habitat units, BPA receives full credit for 123.9 acres of acquired floodplain lands (credits for acquisition and for future enhancements above baseline). For the 72.4 acres of floodplain of Trust lands protected through acquisition of grazing leases, BPA will receive credits for improvements above baseline, but not acquisition/baseline credits.

Table 40. Mink Habitat Suitability Indices and Units.

Habitat Area & Variables	RFS < 405 ha*
Area (acres)	123.9
V1: Percent of year with surface water present.	1.0
V2: Percent tree canopy cover.	0.8
V3: Percent shrub canopy cover.	0.4
V4: Percent canopy cover of emergent vegetation.	0.1
V5: Percent canopy cover trees/shrubs <= 100m waters edge.	1.0
V6: Percent shoreline cover <= 1m of water's edge	0.7
Water SI = V1	1.0
Cover SI = $(V5+V6)^{1/2}$	.84
Lowest life requisite value (lower of water SI or cover SI).	0.5
HSI	0.84
Number of Habitat Units	103.7

*Riparian/forest shrub less than 405 ha in area.

Habitat Limiting Factors

The primary factor limiting habitat suitability for mink is percent shrub canopy cover. Low suitability for the variable is due primarily to domestic livestock grazing as described earlier. Grazing permits for Range Units 1 and 3, which encompass Iskuulpa Creek, allowed for the stocking of up to 192 cattle between May 15 and October 31 of each year. Steep slopes in the project area tended to concentrate livestock use on ridgetops and floodplains. Livestock use in floodplains became increasingly concentrated after July of each year with forage senescence and the lack of well-distributed water sources on uplands. After livestock utilized available herbaceous forage in floodplains, they shifted to browsing of available shrubs. This cycle, repeated on an annual basis, greatly reduced total and hydrophytic shrub cover.

Desired Future Conditions

Floodplains in reaches 1 and 2 of Iskuulpa Creek will possess average shrub cover values ranging from 50 - 80%, with 70% of the shrubs composed of hydrophytic species. Plant associations in this reach include the black cottonwood/snowberry and ponderosa pine/snowberry associations, which contain hydrophytic shrubs such as willow and black hawthorne.

Floodplains in reaches 3 - 5 of Iskuulpa Creek will possess deciduous shrub cover ranging from 50 - 80%, with hydrophytic shrubs comprising up to 25% of the total shrub cover. Lower hydrophytic shrub cover values are expected because these reaches are dominated by plant associations low in hydrophytic shrubs, including the Douglas fir/snowberry, Douglas fir/rocky mountain maple, and grand fir/rocky mountain maple associations.

Total shoreline cover, including vegetation, large woody debris, herbaceous vegetation, and rock, will average 80 percent.

Table 41. Mink Futures Analysis Based on DFC's (time=10 years).

Habitat Area & Variables	RFS < 405 ha*
Area (acres)	123.9
V1: Percent of year with surface water present.	1.0
V2: Percent tree canopy cover.	0.8
V3: Percent shrub canopy cover.	0.4
V4: Percent canopy cover of emergent vegetation.	0.1
V5: Percent canopy cover trees/shrubs <= 100m waters edge.	1.0
V6: Percent shoreline cover <= 1m of water's edge	0.8
Water SI = V1	1.0
Cover SI = $(V5+V6)^{1/2}$	.89
H.S.I = Lowest life requisite value (lower of water SI or cover SI).	.89
Estimated Number of Habitat Units at t=10 years.	110.8
Existing Habitat Units	103.7
Change in Habitat Units for time=10 years	+7.1
Annual Change in Habitat Units (7.1 /10)	.71
10-Year Change in Habitat Units	.71
Number Habitat Units in 10 Years	110.8

Because the existing suitability values for "V5:Percent canopy cover of trees/shrubs" and "V6:percent shoreline cover within 1 meter of the water's edge" are optimum or near optimum, the model does not respond to increases in shrub and tree cover identified in the desired future conditions.

Enhancement Strategies

Increases in deciduous and hydrophytic shrub cover will be achieved through acquisition of grazing leases and rest (livestock exclusion), large wood additions to floodplains, and obliterating floodplain roadbeds and planting deciduous and hydrophytic shrubs. Rest of the grazing units will reduce browse pressure and allow shrub canopy cover to increase. Additions of large woody debris are expected to increase sediment storage within the floodplain, increase channel sinuosity, and associated water storage area. This in turn will facilitate the establishment and development of riparian vegetation, including deciduous and hydrophytic shrubs.

Grassland Habitat Structural Characteristics

Grassland surveys were initiated June 2, 1998, reinitiated on June 4, 1999, and completed June 15, 1999. Surveys in grassland cover types were conducted prior to senescence of forbs and grasses. Seventeen transects covering 27,200 linear feet were completed. Additionally, 272 square-meter plots and 110 one-tenth acres plots were completed.

Table 42. Survey Results – Grassland Structural Characteristics

Transect	% Cover Herbaceous	% Cover Grass	Mean Height Herbaceous (in)	Perch Distance (ft)	% Shrub Canopy Cover
1	38.3	31.1	15.6	157.6	12.0
2	22.4	16.2	9.6	121.6	2.0
3	27.7	4.5	7.6	3.8	3.6
4	14	12.4	7.1	18.6	0.0
5	37.7	21.4	12.6	14.9	0.1
6	37.8	23.0	11.3	11.1	0.0
7	31.5	29.1	8.4	11.5	3.0
8	30.9	27.1	13.2	6.6	0.6
9	26.0	19.8	11.1	3.6	1.7
10	27.2	12.9	18.8	8.5	0.5
11	26.2	18.4	11.2	3.5	0.3
12	33.8	28.9	8.4	12.4	4.6
13	0.2	16.5	8.4	18.0	0.2
14	26.5	12.0	9.7	2.7	0.9
15	26.0	16.6	7.8	31.1	0.3
16	19.9	11.3	8.4	15.2	0.5
17	18.3	15.8	12.3	1.0	0.3
Mean	26.1	18.7	10.7	26.0	1.8

Western Meadowlark

Credits for the western meadowlark apply to all grassland cover types of acquired lands and for all allotted lands included within Bureau of Indian Affairs-administered grazing leases.

Table 43. Western Meadowlark Habitat Suitability Indices and Units.

Habitat Area & Variables	Grassland
Area (acres)	10,991
V1: Percent cover herbaceous plants.	.16
V2: Percent canopy cover grass.	0.09
V3: Average height herbaceous canopy cover.	0.4
V4: Distance to perch.	1.0
V5: Percent shrub canopy cover.	1.0
HSI = (V1xV2xV3xV4)1/4xV5	0.12
Number of Habitat Units	1,318.9

Habitat Limiting Factors

Primary habitat suitability limiting factors include V1- percent cover of herbaceous plants, and V2- percent cover of herbaceous grasses, with the average height of herbaceous cover a secondary limiting factor.

In Iskuulpa habitat evaluation transects and ecological reconnaissance plots, observed plant associations included the Bluebunch wheatgrass/Sandberg's bluegrass association, recorded in 15 of 17 grassland transects (88%) and 13 of 14 one-tenth acre plots (93%), and the Idaho-fescue/Blue-bunch wheatgrass association was recorded in 2 of 17 transects (12%) and 1 of 14 tenth-acre plots (7%). However, annual

vegetation (Ventenata, Medusahead, Bromes) dominated the landscape, with bluebunch wheatgrass and Idaho fescue averaging only 4% cover.

Current grassland conditions are likely a result of the combined effects of severe over-grazing at the turn of the century, consequent invasions by annual, exotic vegetation, and more contemporary, season-long grazing practices that have inadvertently maintained perennial grasslands in their annual grass-dominated state.

A 1935 Soil Conservation Service report prepared by W.B. Nelson describes management practices at that time and consequent changes in vegetative conditions of the Iskuulpa (Squaw Creek) watershed:

“Vegetative Stage: Improper range practices over a long period of years on the Indian Reservation have resulted in a general regression of the vegetation of the area. Bedgrounds, driveways, trails to and from water holes, and many of the more accessible slopes and ridge tops have been divested of perennial grasses, and, in some cases, completely denuded of vegetation.

Weedy annuals dominate over a great majority of the area, and only on the more inaccessible slopes are found any of the once-dominant bunchgrasses. This type of range has been grossly mistreated by constant, long continued overgrazing.

In general the degree of utilization is largely dependent on the accessibility, and management practices, which, as a rule, have been extremely competitive, and without any semblance of proper range management.

History of Range Use: The Squaw Creek area has been subjected to grazing by Indian horses and wild game for many years before the advent of white settlers in 1860 or thereabouts. Numerous dilapidated cabins on the area at present bespeak of its early settlement. These settlers surged into the cattle business, grazing large herds throughout the area of which the Squaw Creek country is part; and gradually choked the Indians from their domain. However, the Government stepped in to set aside a large portion of the Squaw Creek area, and adjacent territory, as the Umatilla Indian Reservation, and thus protect the rapidly diminishing range resources of the Indians. Since that time, the area has been grazed by increased numbers of sheep. The cattle now on the area are largely I.D. cattle, given to the Indians by the federal government, in return for which each Indian, by the terms of the grant, must repay a calf for each breeding cow within a stipulated length of time. Cattle are marketed at all ages, and at varying weights according to age. Horses are allowed to run loose; the quality of this stock is so low that there is now market demand, except for canning or some such special purpose, and only a few are sold. The sheep on the area are the property of the permittees, and are sold as fall lambs at the age of six to eight months and an average weight of from 70 to 80 pounds.

Grasslands: Over most of the grassland type, the once dominant bunchgrasses have been supplanted by communities of invaders, because of overgrazing, trampling, erosion, and other contributing factors. Important species now found on the area include Bromus tectorum, Festuca pacifica, Poa secunda, Grindelia spp., Madia glomerata, Wyethia amplexicaulis, Cogswellia spp., with sub-dominants of Agropyron inerme, Festuca Idahoensis, Bromus mollis, Bromus brizaeformis, Epibolium spp., Achillea lanulosa, Balsamorhiza sagittata, Erigonium spp., Amsinokia intermedia, and other species of weedy forage. In localized inaccessible areas, the vegetation consists largely of Agropyron-Festuca-Poa association.

IV. Range and Pasture Management:

Past – Since the beginning of grazing on the area, the supervision and management practices have been too loosely organized for any benefits to accrue from such practices. From 4,000 to 8,000 head of sheep, together with 600 – 1,400 head of horses, and 800 to 1,000 head of cattle have greatly overgrazed the forage of the area. This heavy use has been given range having a very low percentage of ground cover. It has given rise to erosion of the thin rocky soil, accelerated run-off, reduction of the carrying capacity, and vegetative regression. Water development has been neglected. It is a common practice to bed bands sheep in one spot near a spring for three or four weeks at a time, resulting in

varying degrees of denudation of these bedground areas. No drift fences have been built, and no attempts made to secure the optimum utilization by proper salting practices. All in all, it appears that little consideration has been given to the upkeep of range for future use.

Present – *At present the numbers of stock have been somewhat decreased, principally because of a lack of forage rather than any consideration of future benefits. The land on the Indian reservation is leased to one sheep company, who are supposedly bonded to take care of the range. Aside from this stipulation, no limitations as to the number or season of use are set by the Indian service. The practice of early spring grazing and over-stocking has destroyed much of the original forage cover. Heavy fall grazing has reduced the amount of vegetation left on the area to hold the snow and retard run-off. In addition, the Indian allottees have run many horses on the range. None of the area is fenced, so all of the stock except herded sheep roam freely over the range.*

The Forest Service regulations have halted the regression of the vegetation within the boundaries of the Umatilla National Forest. However, evidences of excessive trailing and bedding for too long a time in one place are found in the forest. Twelve hundred head of sheep normally graze this area.

The privately owned land south of the Reservation is generally fairly well cared for. A few of the springs on this area have been partially developed, some drift fences constructed, and a few salt grounds established to afford better utilization of the area. The area is an example of the improvement possible even under a loose grazing plan. Small herds of cattle and flocks of sheep, and some pasture stock are now using the area. The late date at which the snow leaves the area, and the earliness of snow in the fall have protected this range to a large degree. Eighty-five cattle and 400 to 600 sheep in small flocks are grazed on this portion of the area. Stock is put on the area too early in the spring, and this practice has accelerated erosion of the ridge tops and higher slopes.”

Recent domestic livestock grazing practices have included stocking up to 192 head of cattle from May 15 to October 31 of each calendar year. The potential consequence of implementing such a grazing schedule on an annual, indefinite basis is the continued suppression of perennial grasses. Figure 5 illustrates this process with the grazing season (light blue zone) imposed over the perennial bunchgrass life cycle (yellow line). Note that the life cycle is impacted through all stages where reserves are developed. Season-long grazing can prevent seedhead elongation and seed set from occurring in bunchgrasses, and limit the development of reserves (proteins, carbohydrates, and fats) needed for leaf growth, seed development, and root system maintenance. If this occurs on an annual basis, the plant enters and emerges from dormancy with decreasing reserves, which can then result in a reduction of root masses, seed production, and plant vigor. Combined, these effects can reduce the ability of perennial grass stands to maintain themselves and compete with annual exotic grasses.

Figure 5. Season-Long Grazing and the Perennial Grass Life-Cycle (NRCS – Or, 1999).

As stated previously, annual vegetation (*Ventemata*, *Medusahead*, *Bromes*) dominates the grasslands of Iskuulpa Creek. The Bluebunch wheatgrass/*Sandberg's* bluegrass and Idaho fescue/Bluebunch wheatgrass associations that occur in the area average only 4% bunchgrass cover. These perennial bunchgrass associations, when occurring in less disturbed and more intact conditions, typically provide much higher cover values for perennial bunchgrasses and forbs as shown in the Tables 44 and 45 below.

Table 44. Cover Values Observed in Bluebunch Wheatgrass/*Sandberg's* bluegrass Plant Association n= 29 (Johnson and Clausnitzer, 1992).

Species	Mean Cover (%)	Constancy (%)	Range of Cover (%)
Grasses			
Bluebunch Wheatgrass	29	100	2-65
<i>Sandberg's</i> Bluegrass	10	96	1-30
Idaho Fescue	3	31	1-7
Prairie Jungegrass	6	31	1-20
Forbs			
Yarrow	3	79	1-10
Creamy Buckwheat	4	55	1-15
biquitroots	2	59	1-7

Table 45. Cover Values Observed in Idaho Fescue/Bluebunch wheatgrass Plant Association, n= 29 (Johnson and Clausnitzer, 1992).

Species	Mean Cover (%)	Constancy (%)	Range of Cover (%)
Grasses			
Idaho Fescue	23	100	3-75
Bluebunch Wheatgrass	17	89	1-30
Sandberg's Bluegrass	12	82	1-30
Prairie Junegrass	5	42	1-15
Annual Bromes	9	18	1-20
Forbs			
Yarrow	3	89	1-10
Creamy Buckwheat	8	53	1-20
Phlox	5	35	1-16
Biquitroots	3	50	1-7
Hawksbeards	1	32	1-3
Arrowleaf Balsamroot	1	21	1-2
Serrated Balsamroot	4	28	1-10
Pale Agoseris	2	25	1-4
Lupines	5	43	1-25
Fleabanes	1	43	1-3

When the native vegetation is replaced by aliens or when the potential dominant plants decline to a point where the cause of the change is so severe as to eliminate any opportunity for resurgence to former dominance – a threshold has been reached and passed (Johnson, 2001).

In the example of bunchgrasses, annual forbs or annual grasses may eliminate the opportunity for perennial bunchgrasses to regain dominance of the site. This has occurred over large expanses of the ridgetops, canyon bottom and even on steep slopes of Iskuulpa Creek. In our classification of seral stages, when the perennial potential bunchgrasses cease to occur at 5% or greater coverage, we determine that the site can no longer sustain those bunchgrasses unless managers intervene with cultural practices to restore the grassland (Johnson, 2001).

Table 46 below provides approximate landscape acreage (or percentages) that may have been present prior to the 1800s. It is based on topographic setting – not vegetation groups per se. A predictable pattern involves the role of natural fire and native grazing animals to maintain the majority of a given landscape in mid seral stages of successional development. Another pattern that emerged is that the gentle ground (slope = 15% or less) tends to be where early and very early seral vegetation is most prominent. Steep canyon slopes and ridge tops (removed from water) tend to support the highest percentages of late seral vegetation.

Table 46. Proposed Historic Ranges of Variability* (Johnson, 2001).

Seral State	Ridgetops %	U.Slopes %	Benches %	L.Slopes %	Bottoms %
Late Seral	25-35(30)	30-40(35)	15-25(20)	25-35(30)	5-25(15)
Mid Seral	35-55(45)	40-60(50)	50-60(55)	40-60(50)	50-60(55)
Early Seral	10-30(20)	5-15(10)	20-30(25)	5-15(10)	10-30(20)
V.Early Seral	5-15(10)	3-7(5)	5-15(10)	5-15(10)	5-15(10)

* Figures are in percent with the HRV given first with the mean value shown in parentheses.

Seral stages for grasslands are defined as follows. In the case of Iskuulpa Creek, the decreasers are Idaho fescue, bluebunch wheatgrass, and to a limited extent, Sandberg's bluegrass.

Early Seral - Climax bunchgrasses are subordinate to increasers, absent, or so few as to make natural re-colonization unlikely (especially forbs); increasers and invaders usually dominate the community (bunchgrasses – 0-15% cover, increasers and invaders – greater than 50% cover).

Mid Seral - Climax bunchgrasses are present; increasers (especially forbs) are co-dominant or dominant (bunchgrasses – greater than 15% cover but less than 25% cover. Increasers and invaders – greater than 25% cover but less than 50% cover).

Late Seral - Climax bunchgrasses are dominant; invading and increasing species are subordinate (bunchgrasses – greater than 25% cover, increasers and invaders – less than 25% cover).

Recognizing that less than 10% of the grasslands are probably in mid to late seres now, a rational objective would be to seek a goal of 20% by the year 2100 (Johnson, 2001).

Desired Future Conditions

Approximately 20% of the grassland cover type will possess between 15 – 25% native perennial bunchgrass cover in approximately 100 years. Increasers and invaders (especially forbs) will be co-dominant at will occur at 25-50% cover. The remaining 80% of the grassland cover type will have perennial grass cover $\leq 15\%$, with annual, exotic grasses and forbs comprising approximately 50% of the vegetative cover. The estimated habitat units produced by achieving the desired future condition are displayed in the table below.

Table 47. Western Meadowlark Futures Analysis Based on DFC in 100 years.

Habitat Area & Variables	80% of Grasslands	20% of Grasslands
Area (acres)	8792.8	2198.2
V1: Percent cover herbaceous plants.	.16	.31
V2: Percent canopy cover grass.	0.09	.20
V3: Average height herbaceous canopy cover.	0.4	1.0
V4: Distance to perch.	1.0	1.0
V5: Percent shrub canopy cover.	1.0	1.0
HSI = $(V1 \times V2 \times V3 \times V4) / 4 \times V5$	0.12	.26
Weighted HSI	.15	
Number of Predicted Habitat Units	1,648.7	
Existing Habitat Units	1,318.9	
Change in Habitat Units for t=100 years	+329.8	
Annual Change in Habitat Units (329.8/100)	3.3	
10-Year Change in Habitat Units	33.0	
Number Habitat Units in 10 Years	1681.7	

The estimated increase in habitat units is based on an increase in average perennial grass cover from 4% to 15%, a total herbaceous cover of 40%, and increase in percent cover composed of grass from 18.7% to 30% on enhanced grasslands.

Enhancement Strategies

Once perennial bunchgrass cover drops below 5% in Idaho fescue and bluebunch wheatgrass plant associations, management intervention is the only salvation for initiating an upward successional trend. Grazing rest or grazing annual grasses early can help provide a competitive advantage for bunchgrasses where the grazing subsides prior to bunchgrass seed set and seedhead elongation. Prescribed burning may also be a tool to stimulate bunchgrass seedhead formation and reduce annual litter – thereby providing bare soil for seed germination.

The manager can also look beyond bunchgrasses for improving grassland ecosystems. Perennial forbs prominent at mid sere may be desirable for wildlife species. The grasslands of Squaw Creek and Rainwater

contain viable populations of lupine, balsamroot, and Mules ears, which add to the vitality of the overall perennial community.

Managers should emphasize segments of the landscape where the fastest improvements can occur (deep soils, stable, low ungulate impact) and seek to eliminate or minimize degrading disturbances. Restoration should focus on areas with the highest cover of desired perennials where the highest chance of success is afforded. Although lupine or balsamroot may dominate at undesired levels for a decade or two, they at least will be helping to provide insulation by retaining moisture and coolness to the site in promotion of the germinating perennial bunchgrass.

The road back toward a greater mix of seral stages where mid and late seres are increased will take many decades. It will only happen through adherence to a long term plan that goes beyond lives of resource managers (Johnson, 2001).

Habitat Units Summary

U.S. Fish and Wildlife Service (USFWS) Habitat Evaluation Procedures (HEP) were used to determine the number of habitat units credited to the Bonneville Power Administration (BPA) for lands acquired and leased in Iskuulpa Watershed, a Confederated Tribes of the Umatilla Indian Reservation watershed and wildlife mitigation project. The project is designed to partially credit habitat losses incurred by BPA for the construction of the John Day and McNary hydroelectric facilities on the Columbia River. Upland and riparian forest, upland and riparian shrub, and grasslands cover types were included in the evaluation. Indicator species included downy woodpecker, black-capped chickadee, blue grouse, great blue heron, yellow warbler, mink, and Western meadowlark.

Habitat surveys were conducted in 1998 and 1999 in accordance with published HEP protocols and included 55,500 feet of transect, 678 m² plots, and 243 one-tenth-acre plots. Between 123.9 and 10,794.4 acres were evaluated for each indicator species. Habitat suitability indices derived for each species model were multiplied by corresponding cover-type acreages to determine the number of habitat units for each species. The total habitat units credited to BPA for the Iskuulpa Watershed Project and its seven indicator species is 4,132 habitat units.

Table 48. Habitat Units Summary.

Evaluation Species	Evaluation Acres	Time to DFC (Years)	Existing Habitat Units	Habitat Units At Y=10
Downy Woodpecker	1,287.0	40	1,222.7	1,169.7
Black-Capped Chickadee	1,287.0	40	1,203.8	1,246.0
Blue Grouse	1,045.0	10	407.6	407.6
Great Blue Heron	123.9	40	30.5	36.5
Yellow Warbler	425.8	10	280.6	308.5
Mink	123.9	10	103.7	110.8
Western Meadowlark	10,794.4	100	1,318.9	1,681.7
Total			4,567.8	4,960.8

Implementation of enhancement strategies could generate an estimated 393 enhancement credits in 10 years. Longer-term benefits of protection and enhancement activities include increases in native species diversity and structural complexity in all cover types. While such benefits are not readily recognized by HEP models and reflected in the number of habitat units generated, they are consistent with the NPPC Program. Implementation of the alternatives will require long-term commitments from managers to increase probabilities of success and meet the goals and objectives of the Northwest Power Planning Council's Fish and Wildlife Mitigation Program.

Consistency With the NPPC Fish and Wildlife Program Goals

Additional analysis was conducted to insure consistency with the scientific principles developed by the Northwest Power Planning Council and incorporated into the Council's Program in 2000. Plant community conditions in the study area were compared to data collected from USDA Forest Service-maintained, permanent reference plots in the Blue Mountains. Plots and reference plots were characterized using the plant association concept, and data from reference plots was used as aid in characterizing the ecological condition of plant associations in the Iskuulpa Watershed. The approach used in this HEP analysis is consistent with the following NPPC Principles (NPPC Program, 2000):

Principle 1. The abundance, productivity and diversity of organisms are integrally linked to the characteristics of their ecosystems.

The physical and biological components of ecosystems together produce the diversity, abundance and productivity of plant and animal species, including humans. The combination of suitable habitats and necessary ecological functions forms the ecosystem structure and conditions needed to provide the desired abundance and productivity of specific species.

In this report we have attempted to characterize physical (climate, precipitation, soils) and biological (plant associations) components of habitats evaluated for mitigation wildlife species. The purpose of this effort was to; 1) identify how ecological functions and human activities have influenced present habitat suitability, and 2) determine appropriate habitat suitability indices (desired future conditions) within the context of site potentials of habitats within the project area.

Principle 2. Ecosystems are dynamic, resilient and develop over time.

Although ecosystems have definable structures and characteristics, their behavior is highly dynamic, changing in response to internal and external factors. The system we see today is the product of its biological, human and geological legacy. Natural disturbance and change are normal ecological processes and are essential to the structure and maintenance of habitats.

Inherent in the plant association concept is the recognition that plant communities move through seral stages over time depending on the frequency and intensity of disturbance. For example, in the Douglas fir/ninebark association, Johnson and Clausnitzer (1994) describe the role and effect of fire on overstory Douglas fir stands and the composition of the understory:

Successional Relationships: Stand replacing fir has been principal modifying event. Stands are replaced with shrubfields dominated by ninebark, oceanspray, Scouler willow, Rocky Mountain maple, cherry, and serviceberry. The pinegrass-elk sedge stand may also be promoted by tree-replacement burns. Forbs exhibiting an increase with fire...are fireweed, peavines, vetch, heartleaf arnica, and asters... Fire will promote shrubfields with a grass-sedge mosaic. These plants are rhizomatous and competition is intense. Very difficult to regenerate trees in less than 10 years. These early successional communities provide valuable browse for deer and elk. Older stands provide hiding or thermal cover. A relatively droughty forest; mistletoes and root rots are common.

Consistent with Principle 2, we have quantified, where possible, human activities that have influenced the structure, composition, and diversity of habitats within the study area. In effect, identifying habitat conditions that are a product of human influences as well as other biologic or geologic factors.

Principle 3. Biological systems operate on various spatial and time scales that can be organized hierarchically.

Ecosystems, landscapes, communities and populations are usefully described as hierarchies of nested components distinguished by their appropriate spatial and time scales. Higher-level ecological patterns and processes constrain, and in turn reflect, localized patterns and processes. There is no single, intrinsically correct description of an ecosystem, only one that is useful to management or scientific research. The hierarchy should clarify the higher-level constraints as well as the localized mechanisms behind the problem.

Powell (1998) described the organization of "Plant Associations" into "Plant Association Groups" that represent ecological environments (temperature and moisture gradients such as "cool/wet" or "warm/moist"), which are in turn grouped into "Potential Vegetation Groups," defined as vegetation types having similar environmental conditions and dominated by similar types of plants (for example "moist/forest" or "dry/shrubland"). An example of this organization is again presented in Figure 6 with selected plant association groups of the moist forest potential vegetation group.

Figure 6. Organization of Plant Associations within the Moist Forest Potential Vegetation Group.

The scale at which plant associations occur is determined by temperature-moisture gradients (spatial) and the role of disturbance regimes in plant succession (temporal). Disturbance regimes include characteristics of spatial distribution of disturbance, frequency (the number of disturbances that occur within a given time interval, or the probability of a disturbance occurring); return interval (mean time between disturbances); rotation period (how long it would be until an area equivalent to the size of the study area was disturbed); size; and the magnitude of force of the disturbance.

The plant association concept, when used to describe ecosystems, is useful to management because it segments the temperature-moisture gradient through indicative plant species and provides easier recognition of similar environments across the landscape (Johnson and Clausnitzer 1992). As a combination of similar or compensating environmental factors is repeated across the landscape, such as elevation, slope position, and aspect, a predictable plant community will occupy those sites given time and varying frequencies of disturbance (Johnson and Clausnitzer 1992). This community will then have similar physiognomy (form and structure) and floristics; and may also be called a climax community (Allaby 1994). It is believed that 1) the individual species in the association are, to some extent, adapted to each other; 2) the association is made up of species that have similar habitat requirements; and 3) the association has some degree of integration (Kimmins, 1997). Because environmental conditions vary continuously across the landscape, the resulting plant composition also varies. A plant association is therefore not an exact assemblage of species from one location to another. However, sites in the same plant association differ less than sites from different associations (Powell, 1998).

The hierarchy clarifies constraints on habitat suitability by characterizing the site potential of habitats based on their location along the temperature/moisture gradient and their current successional status as determined by disturbance events, or a lack thereof. For example, the ponderosa pine/bluebunch wheatgrass association, located in the "Hot, Dry Plant Association Group" within the "Dry Forest Potential Vegetation Group" would not be expected to produce as much basal area or canopy cover as a Grand Fir/Pacific Yew/Queen's Cup Beadlily plant association in the "Cool Wet Plant Association Group" of the "Moist Forest Potential Vegetation Group." Because moisture is more limited on the ponderosa

pine/bluebunch wheatgrass site, the site potential for basal area, and consequently canopy cover, decreases. Conversely, the open canopy nature of the "Ponderosa Pine/Bluebunch Wheatgrass" association allows greater light availability to the understory, and therefore the site potential for herbaceous cover is higher than in the Grand Fir/Pacific Yew/Queen's Cup Beadlily plant association .

Finally, application of the concept is useful to management because current HEP Models are only intended to relate life history requisites of selected species to habitat structure, they do not relate habitat structure to contextualized bio-physical environments and human influences.

Principle 4. Habitats develop, and are maintained, by physical and biological processes.

Habitats are created, altered and maintained by processes that operate over a range of scales. Locally observed conditions often reflect more expansive or non-local processes and influences, including human actions. The presence of essential habitat features created by these processes determines the abundance, productivity and diversity of species and communities. Habitat restoration actions are most effective when undertaken with an understanding and appreciation of the underlying habitat-forming processes.

This principle has been addressed in this report by characterizing the bio-physical environment and addressing human influences on current habitat conditions in forested, riparian shrub, and grassland habitats. Changes in structure and species diversity for these habitats were in part linked to historical timber harvest, livestock grazing, and contemporary grazing schemes.

Principle 5. Species play key roles in developing and maintaining ecological conditions.

Each species has one or more ecological functions that may be key to the development and maintenance of ecological conditions. Species, in effect, have a distinct job or occupation that is essential to the structure, sustainability and productivity of the ecosystem over time. The existence, productivity and abundance of specific species depend on these functions. In turn, loss of species and their functions lessens the ability of the ecosystem to withstand disturbance and change.

Principle 7. Ecological management is adaptive and experimental.

The dynamic nature, diversity, and complexity of ecological systems routinely disable attempts to command and control the environment. Adaptive management — the use of management experiments to investigate biological problems and to test the efficacy of management programs — provides a model for experimental management of ecosystems. Experimental management does not mean passive "learning by doing," but rather a directed program aimed at understanding key ecosystem dynamics and the impacts of human actions using scientific experimentation and inquiry.

In this study we have utilized the plant association concept to investigate the biological problems of: 1) determining normative ranges of habitat suitabilities; 2) identifying additive factors beyond site potential that are currently limiting suitability; and 3) developing sustainable habitat objectives (indices) within the constraints of the normative site potential. In doing so, we have improved the effectiveness of using HEP analysis as a means of developing objectives for habitat suitability.

Permanent plots provide the means for repeating ecological reconnaissance monitoring and understanding ecosystem dynamics (i.e. succession), the influence of normative processes, and the impacts of human actions such as timber harvest and livestock grazing.

Principle 8. Ecosystem function, habitat structure and biological performance are affected by human actions.

As humans, we often view ourselves as separate and distinct from the natural world. However, we are integral parts of ecosystems. Our actions have a pervasive impact on the structure and function of ecosystems, while at the same time, our health and well being are tied to these conditions. These actions must be managed in ways that protect and restore ecosystem structures and conditions necessary for the survival and recovery of fish and wildlife in the basin. Success depends on the extent to which we choose to control our impacts so as to balance the various services potentially provided by the Columbia River Basin.

This Habitat Evaluations Procedures report has attempted to document, where possible, the manner and magnitude in which human actions have affected the habitat structure and therefore biological and ecological functions in the Iskuulpa Watershed. Primary anthropological factors limiting ecosystem function, habitat structure, and biological performance are related to the direct, indirect, and cumulative effects of past livestock grazing, road construction, and timber harvest, which have simplified the structure, composition, and diversity of native plant communities.

Finally, use of the plant association concept to evaluate existing conditions and develop desired future conditions is also consistent with NPPC Habitat Strategies, which include the following:

“Use Native Species Wherever Feasible

Even in degraded or altered environments, native species in native habitats provide the best starting point and direction for needed biological conditions in most cases.

Restore Ecosystems, Not Just Single Species

Increasing the abundance of single populations may not, by itself, result in long-term recovery. Restoration efforts must focus on restoring habitats and developing ecosystem conditions and functions that will allow for expanding and maintaining a diversity within, and among, species in order to sustain a system of robust populations in the face of environmental variation.”

Using plant association classifications and the corresponding data allows managers to not only compare the structural characteristics of study and reference sites, but also species richness and diversity.

Achieving consistency with the NPPC’s Habitat Strategies implies that effective and responsible mitigation requires more than addressing habitat suitability for selected target species, it also requires commensurate efforts to restore ecosystem diversity.

Literature Cited

- Allen. 1986. Habitat Suitability Index Models: Mink. U.S. Fish Wildl. Serv. 6 p.
- Bonneville Power Administration. June 1997. DOE/EIS-0246. Final Environmental Impact Statement for the Wildlife Mitigation Program.
- Barret T.M. 2001. Models of Vegetative Change for Landscape Planning: A comparison of FETM, LANDSUM, SIMPPLLE, and VDDT. Gen. Tech. Rep. RMRS-GTR-76-WWW. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 14 p.
- Bate, L.J. 1995. Monitoring Woodpecker Abundance and Habitat in the Central Oregon Cascades. Moscow, ID: University of Idaho. 116 p. M.S. thesis.
- Bull, E.L. and Holthausen, 1993. Habitat Use and Management of Pileated Woodpeckers in Northeastern Oregon. *Journal of Wildlife Management*. 57: 335-345.
- Bull, E.L., Parks, C.G., and R.F. Torgersen. Trees and Logs Important to Wildlife in the Interior Columbia Basin. Gen. Tech. Rep. PNW-391. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 55 p.
- Bull E.L., and A.D. Partridge. 1986. Methods of Killing Trees for Use by Cavity Excavators. *Wildlife Society Bulletin*. 14: 142-146.
- Bonneville Power Administration. June 1997. DOE/EIS-0246. Wildlife Program Final Environmental Impact Statement and Record of Decision.
- Corps of Engineers Wetland Delineation Manual. 1987. Technical Report Y-87-1. January.
- Crowe, Elizabeth A., Clausnitzer, Rodrick R. 1997. Mid-montane wetland plant associations of the Malheur, Umatilla, and Wallowa-Whitman National Forests. Technical Paper R6-NR-ECOL-TP-22-97. Baker City, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest. 299 p.
- Daubenmire, R. 1956. Climate as a Determinant of Vegetation in Eastern Washington and Northern Idaho. *Ecol. Mono.* 26:131-154.
- Dixon, R.D. 1995. Ecology of white-headed woodpeckers in the Central Oregon Cascades. Moscow, ID: University of Idaho. 148 p. M.S. Thesis.
- Fryxell, R. 1965. Mazama and Glacier Peak Volcanic Ash Layers: Relative Ages. *Science*, Vol. 147.
- Hall, Fredrick and C. Bryant L. 1995. Herbaceous Stubble Height as a Warning of Impending Cattle Grazing Damage to Riparian Areas. Gen. Tech. Rep. PNW-362. Portland, Or. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 9 p.
- Harris, D.D. and L.E. Hubbard. 1983. Magnitude and Frequency of Floods in Eastern Oregon. *Water Resources Investigations Report 82-4078*, U.S.G.S. Portland, OR. 39pp
- Johnson, Charles G. 2001. Ecological Reconnaissance Survey Summaries. Final Report for the Iskuulpa and Rainwater Watershed Projects.
- Johnson, Charles Grier, Jr.; Clausnitzer, Rodrick R. 1992. Plant associations of the Blue and Ochoco Mountains. Publication R6-ERW-TP-036-92. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest. 164 p.

- Johnson, Charles G., Jr.; Simon, Steven A. 1987. Plant associations of the Wallowa-Snake province. Pub. R6-ECOL-TP-225b-86. Baker City, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest. 272 p.
- Johnson, Charles G. Jr. 2001. Final Report: Ecological Reconnaissance Survey Results for the Squaw Creek and Rainwater Wildlife Mitigation Projects. Confederated Tribes of the Umatilla Indian Reservation Wildlife Program . PO Box 638, Pendleton, OR. 97801. 3 p.
- Natural Resources Conservation Service. 1995. Oregon.
- Nelson, W.B. 1935. Erosion-Range Survey Report, Gibbon Project, Umatilla County Oregon. Soil Conservation Service. Pullman, Wa. 18 p.
- Northwest Power Planning Council. 1994. Columbia River Basin Fish and Wildlife Program.
- Northwest Power Planning Council. 2001. Draft Wildlife Mitigation Program, Basin-Wide Provisions and Strategies. <http://www.nwcouncil.org/library/2000/2000-19/basinwide.htm>
- Parks , C.G.; Bull, E.L.; Fillip, G.M. 1996. Using Artificially Inoculated Decay Fungo to Create Wildlife Habitat. In: Bradford, Perter; Manning, Todd; l'Anson, Bill, eds. Wildlife tree/stand-level biodiversity workshop proceedings; 1995 October 17-18; Victoria, BC. Victoria, BC: British Columbia Environment: 87-89.
- Powell, D. 1998. Potential Natural Vegetation of the Umatilla National Forest. Umatilla N.F. Supervisor's Office. Pendleton, OR. 31 p.
- Rasmussen, L. and P. Wright. 1990a. Wildlife Impact Assessment, Bonneville Project, Oregon and Washington. Prepared by U.S. Fish and Wildlife Service for U.S. Department of Energy, Bonneville Power Administration, Portland, OR. 37 p.
- Rasmussen, L. and P. Wright. 1990b. Wildlife Impact Assessment, John Day Project, Oregon and Washington. Prepared by U.S. Fish and Wildlife Service for U.S. Department of Energy, Bonneville Power Administration, Portland, OR. 27 p.
- Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO. 341 p.
- Schroeder, R.L. 1982. Habitat Suitability Index Models: Black-Capped Chickadee. U.S. Dept. Int., Fish Wildl. Serv. Biol. Rep. FWS/OBS-82/10.37. 12 p.
- Schroeder, R.L. 1982. Habitat Suitability Index Models: Downy Woodpecker. U.S. Dept. Int., Fish Wildl. Serv. Biol. Rep. FWS/OBS-82/10.38. 10 p.
- Schroeder, R.L. 1982. Habitat Suitability Index Models: Yellow Warbler. U.S. Dept. Int., Fish Wildl. Serv. Biol. Rep. FWS/OBS-82/10.27. 7 p.
- Short, H.L., and R.J. Cooper. 1985. Habitat Suitability Index Models: Great Blue Heron. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.99). 23 p.
- Thomas, J.W., Anderson, R.G., Maser, C., and E.L. Bull. 1979. Snags. In: Wildlife Habitats in Managed Forests: the Blue Mountains of Oregon and Washington. Agric. Handb. 553. Washington, DC: U.S. Dept. of Ag., Forest Service: 60 – 77.
- Trewartha, Glenn T. 1968. An Introduction to Climate. McGraw-Hill, New York New York. 408 p.

- Werner, K., Beukema, S., Merzenich, J., Arbaugh, M., and S. Schilling. 1999. Long Range Modeling of Stochastic Disturbances and Management Treatments Using VDDT and TELSA. Society of American Foresters National Convention: Landscape Analysis Session. Portland, Or. Sept. 14. 7p.
- USDA FS-R6 Staff. 1985. Draft Management Guidelines: for soils derived from volcanic ash in the Blue Mountains of Oregon and Washington – USDA Forest Service. 266 p.
- USDOI. Fish Wildl. Serv. 1984. Habitat Suitability Index Models: Blue Grouse. FWS/OBS-82/10.81. 19 p.
- USDOI. Fish Wildl. Serv. 1984. Habitat Suitability Index Models: Western Meadowlark. FWS/OBS-82/10.81. 3 p.
- USDOI USFWS. National List of Plant Species that Occur in Wetlands: Northwest (Region 9). Biological Report 88(26.9). May 1988.
- USGS. 1983. Magnitude and Frequency of Floods in Eastern Oregon.
- Reed, P.B. Jr. 1988. National List of Plant Species that Occur in Wetlands: Northwest Region (9). U.S. Fish Wildl. Serv. Biol. Rep. 88(26.9). 89 p.

Appendix A
Vegetation Theme Properties

EVEG99_1 Existing Vegetation

Feature Class: polygon, originally grids
Data source, date, and scale: Thematic Mapper Imagery, July, 1998
Data extent: all lands in Umatilla County, with a one mile buffer (all ownerships)
Data Confidence: good (see narrative)
Locational Confidence: excellent (see narrative)
Stable base used, date, and scale: 1:24,000
Date data transferred to base:
Projection: UTM 11 (original)
Name of final approval/approver: Scott O'Daniel
Resource responsible for updates: Scott O'Daniel

Vegetation Classification Scheme

Classification Scheme:

Size/structure:

Non-Forested

- 1.) Water
- 2.) Rock, Sparsely Vegetated
- 3.) Snow
- 4.) Herbaceous/Grass
- 5.) Agriculture
- 6.) Developed
- 7.) Shrub

Single Story:

- 8.) Seed-Sap
- 9.) Pole
- 10.) Small
- 11.) Medium
- 12.) Large
- 13.) X-Large

Multi-Storied:

- 14.) Pole/MS
- 15.) Small/MS
- 16.) Medium/MS
- 17.) Large/MS
- 18.) X-Large/MS

Species:

- 1.) Water
- 2.) Rock, Sparsely Vegetated
- 3.) Snow
- 4.) Herbaceous/Grass
- 5.) Agriculture
- 6.) Developed
- 7.) Dryland Shrubs 25-65%
- 8.) Dryland Shrubs 66-100%
- 9.) Riparian Shrubs 25-65%
- 10.) Riparian Shrubs 66-100%
- 11.) Douglas Fir
- 12.) Ponderosa Pine
- 13.) Lodgepole Pine
- 14.) Western Larch
- 15.) Englemann Spruce
- 16.) True Fir
- 17.) Wet Mix
- 18.) Dry Mix
- 19.) Juniper
- 20.) Hardwood
- 21.) Conifer/Hardwood Mix

Crown Closure

- 1.) Non-Forested
- 2.) 11-35%
- 3.) 36-60%
- 4.) 61-80%
- 81-100%

Classification Key:

Size/Structure:

Following are the tree diameters ranges corresponding to the size/structure classes identified in the classification key below:

Seedling-Sapling(SD-SP)	0-4.9" dbh
Pole (PL)	5.0 - 9.9" dbh
Small (SM)	10.0 - 14.9" dbh
Medium (MD)	15.0 - 19.9" dbh
Large (LG)	20 - 29.9" dbh
X-Large (XL)	30" + dbh

Non Forest - If the total tree crown closure is $\leq 10\%$
then the site is labeled with the appropriate Non Forest class

Canopy Layer - After making a call for total tree crown closure, allocate the percent cover into three layers by dividing the height of the tallest trees into 3 equal parts. The sum of the layers must equal the total tree crown closure.

If $> 85\%$ of the total tree crown closure is present in one canopy layer then single-story ELSE Multi-storied.

Single-Story

If $> 50\%$ of the total tree crown cover is in a single diameter class choose class for a label.
Else if $\geq 70\%$ of the total crown cover is in two adjacent classes choose the label based on the largest crown closure contribution. In cases of tie, choose the largest diameter class.
In cases where three adjacent diameter classes combine to make $\geq 70\%$ total tree crown closure choose the label based on the largest closure contribution. In cases of ties, choose the largest diameter class.

Multi-Storied (MS)

If X-Large (XL) $\geq 15\%$ crown cover,	then	X-Large
Else If Large (LG) $\geq 15\%$ crown closure, or if $\geq 25\%$ crown cover in LG and XL	then	Large/MS
ELSE If Medium (MD) $\geq 15\%$ crown cover <u>or</u> $\geq 25\%$ crown cover in MD.....XL	then	Medium/MS
ELSE If Small (SM) $\geq 15\%$ crown cover <u>or</u> $> 25\%$ crown cover in SM.....XL	then	Small/MS
ELSE If Pole (PL) $\geq 15\%$ crown cover <u>or</u> $> 25\%$ crown cover in PL.....XL	then	Pole/MS
ELSE choose the label based on the largest closure contribution		
IF SEED-SAP THEN SEED-SAP/SS		

Species:

Sites are described by percentage tree crown cover by species class as seen above (i.e., as seen from an aerial photo). Total crown cover can not exceed 100%. Sites with $< 11\%$ total tree crown cover are considered Non Forest. This includes both sites that do not naturally support tree crown cover and managed sites with less than 11% tree crown cover.

If total tree crown cover is $< 11\%$

then if $< 25\%$ herbaceous/grass or shrub

Label either

Water

Rock, Sparsely Vegetated

Snow

Agriculture and Developed as appropriate.

Else if 25% - 65% dryland shrub crown closure label as

Dryland Shrubs 25-65%

Else if > 65% dryland shrub crown closure label as

Dryland Shrubs 66-100%

Else if 25% - 65% riparian shrub crown closure label as

Riparian Shrub 25-65%

Else if > 65% riparian shrub crown closure label as

Riparian Shrub 66-100%

Else if $\geq 25\%$ herbaceous/grass crown closure label as **Herbaceous/Grass**

If total tree crown closure is $> 11\%$

Then $\geq 80\%$ of the total tree crown closure is in hardwood species then **Hardwood**

Else if $\geq 50\%$ of the total tree crown closure is in hardwood species then **Conifer/Hardwood Mix**

Else if $\geq 80\%$ of the total tree crown closure is in a single conifer species then label becomes that single species.

Else if 30-80% of the total tree crown closure True Fir then

Wet Mix

Else if $< 30\%$ True Fir of the total tree crown closure and $(PP+DF+WL+LP)$ of the total tree crown closure $\geq 50\%$ then

Dry Mix

Else Other Conifer Mix

Crown Cover:

Crown cover will be classified according to the sum of all conifer crown cover plus crown cover of hardwood species $> 5"$ dbh. However, if there is $> 11\%$ total crown cover in pole of larger hardwood, then all hardwood (including those $< 5"$ dbh) are considered as trees and tallied accordingly.

Shrub Types:

A. Major Eastern Oregon Dryland Shrubs

1. Bitterbrush
2. Manzanita
3. Ceanothus
4. Mt Mahogany
5. Low Sagebrush
6. Stiff Sagebrush
7. Big Sagebrush
8. Silver Sagebrush
9. Ninebark
10. Snowberry
11. Spiraea
12. Big huckleberry
13. Low huckleberry

B. Major Eastern Oregon Riparian Shrubs

1. Plum
2. Cherry
3. Serviceberry
4. Shrub aspen
5. Alder
6. Cottonwood
7. Willow
8. Rocky Mt Maple
9. Hawthorne

Appendix B
Plant Association Descriptions

Forested Associations (*in* Johnson and Clausnitzer, 1992)

Grand Fir/Sword Fern-ginger -- ABGR/POMU-ASCA3 (*Abies Grandis*/*Polystichum munitum*-*Asarum caudatum*)

Vegetation Composition: Low elevation sites, on steep, northerly slopes near canyon bottoms support this type of the northern Blue Mountains. Grand fir is associated with Rocky Mountain. Maple and a wealth of shrubs. Common snowberry and twinflower are usually abundant. Herbaceous vegetation is dominated by sword fern, ginger, queen's cup beadleily, Hookers fairybells, foamflower and starry Solomon's seal. The sword fern - ginger community reflects the influence of warm, maritime climate in the northern Blue Mountains and a species composition more common in the Cascades.

Typal Comparisons: The presence of Rocky Mountain Maple and Pacific yew here are not indicative of those types using these species as indicators. The indicators of ABGR/POMU-ASCA3 are sword fern- ginger herbs which reflect the environment as a warm, maritime climate. The association flora is more common to the west side of the Cascades to the Blue Mountains.

Successional Relationships: Douglas-fir and larch are seral to grand fir. Reflecting the drier canyon slope influence from adjacent communities are ninebark, oceanspray, and woods strawberry. Wet conditions of the riparian bottoms provide red alder, Pacific yew, and black cottonwood incursions. Shrublands of Rocky Mountain maple, big huckleberry, scouler willow, and Sitka alder may dominate in early seral stages following burns.

Management Considerations: The riparian nature of this type increases its management sensitivity. Appropriate management systems should consider wildlife, watershed, aesthetic, recreational, and biological diversity values inherent to sites supporting the Grand Fir/Sword Fern-ginger association. A diverse habitat provides for bear, deer, elk, grouse, and passerines. Thermal cover for ungulates during summer months may be provided. Forage production for domestic stock is low, although herbage production is high within these wet drainages.

Grand Fir/Cup Beadleily - ABGR/CLUN - (*Abies grandis*/*Clintonia uniflora*)

Vegetation Composition: Grand fir occurs with spruce usually associated. Shrubs are few with big huckleberry (VAME), baldhip rose (ROGY) and twinflower (LIBO2) often present. The herbaceous layer contains a variety of plants adapted to cool, moist environments. Queen's cup beadleily (CLUN), starry Solomon's seal (SMST), trail plant (ADBI) and foam flower (TITRU) are indicative of this environment.

Typal Comparisons: The tall shrub, AGCL - indicative of the ABGR/ACGL association, is usually absent from the ABGR/CLUN type. VAME may occur but queen's cup beadleily beneath the scattered shrubs indicate the mesic-site conditions of this plant association. Sites have moderate soil depth and are among the highest for tree production in the Blue Mountains (ABGR/CLUN) is very high in productive potential).

Successional Relationships: Western larch and Douglas-fir usually precede grand fir successional. Principal shrubs which are promoted with surface disturbance on these sites are big huckleberry (VAME), common snowberry (SYAL), Oregon boxwood (PAMY), Rocky Mountain maple (AGCL), spiraea (SPBE), swamp gooseberry (RILA) and Scouler willow (SASC). Disturbance of the herbaceous layer may promote heartleaf arnica (ARCO) strawberries, vetch (VIAM), lupines, bracken (PTAQ), coneflower (RUOC) and golden pea (THMO).

Management Considerations: Silvicultural options to utilize the productive capabilities of these sites are varied dependent upon the succession status of stands and management objectives. Concern for

competition with seedlings may be concentrated on seral shrubs promoted by ground disturbance and burning. Composition of late seral stands on some sites may lead to insect defoliation by spruce budworm or Douglas-fir tussock moth and pathogen problems. Notably Indian paint fungus. Later seral and climax stands as well as densely canopied stands produce low amounts of forage for domestic livestock; stands are used for cover and browse by deer and elk. Huckleberries provide food for grouse and bear. Fire leads to dominance by seral tree species, lodgepole pine, Douglas-fir, or western larch. Engelmann spruce is a mid to late-seral tree.

Relationship to Other Studies: Pfister, et al (1977) described ABGR/CLUN with 3 phases in Montana. Steele (1981) and Cooper et al (1987) described ABGR/CLUN in north central and central Idaho. Johnson and Simon (1987) described ABGR/CLUN as the most mesic of the grand fir associations in the Wallowa-Snake classification.

Grand Fir/Twinflower - ABGR/LIBO2 - *Abies grandis*/Linnaea borealis

Vegetation Composition: Grand fir is associated with Douglas-fir, larch, and spruce. Twinflower (LIBO2) is always present. Depending on tree canopy density, big huckleberry may dominate or be absent from ABGR/LIBO2 communities. Herbaceous vegetation is usually scattered at low coverage or in limited patches due to depauperate nature of many sites. The more prevalent shade-tolerant forbs are sidebells pyrola (PYSE), rattlesnake plantain (GOOB) and mitelia (MIST2).

Typal Comparisons: This type, ABGR/VAME, does not have the subshrub, twinflower (LIBO2), present; VAME may be abundant within the ABGR/LIBO2 association. This type occurs on mid-elevation slopes with moderate ash depths and is perhaps the most widespread plant association of the Blue and Ochoco Mountains.

Successional Relationships: Western larch, lodgepole pine, ponderosa pine, and Douglas-fir are key seral tree species. The PICO/VAME-LIBO2 plant community type is assigned to this plant association. Early seral ABGR/LIBO2 communities may be dominated by shrubfields of big huckleberry (VAME), common snowberry (SYAL), spiraea (SPBE), or pinemat manzanita (ARNE). Disturbed forest understory may result in the promotion of heartleaf arnica (ARCO), pinegrass (CARU), elk sedge (CAGE), meadowrue (THOC), fireweed (EPAN), aster, golden pea (THMO).

Management Considerations: Silvicultural options for these sites are varied dependent upon the successional status of stands and management objectives. Seral shrubs and huckleberry may compete with tree seedlings during establishment following clearcutting. Composition of late seral stands, where tolerant grand fir dominates, promote defoliation by spruce budwork and Douglas-fir tussock moth and pathogen problems (Indian paint fungus). The tree species, PSME, PICO, PIPO, and LAOC are favored by fire – ABGR is susceptible to fire. Little forage is available in late seral or climax standards; browse and cover are provided big game. Huckleberries are food source for grouse and bear.

Relationship to Other Studies: The ABGR/LIBO2 plant association was described by Hall (1973) in the Blue Mountains, by Pfister, et al (1977) in Montana, by Steele (1981) in central Idaho, by Cooper et al (1987) in N. Idaho, by Clausnitzer and Zamora (1987) in N. Washington, and by Johnson and Simon (1987) in the Wallowas and Seven Devils.

Grand Fir-Rocky/Mountain Maple – ABGR/ACGL - *Abies grandis*/Acer glabrum

Vegetation Composition: Grand fir dominates on mountain slopes with Rocky Mountain maple. Engelmann spruce may occur. Shrub layer also contains big huckleberry (VAME). Queen's cup beadlily (CLUN) and twinflower (LIBO2) are often associated.

Typal Comparisons: Less mesic than ABGR/POMU and ASCA3 of the low elevations in northern Blue Mountains. In the ABGR/ACGL plant association, the moist-site herbs, POMU and ASCA3, so

prevalent in the ABGR/POMU-ASCA3, are absent. The tall shrub, Rocky Mountain maple, is typical of the physiognomy presented by stands of this association. Stands have high timber production capability.

Successional Relationships: Larch and Douglas-fir are seral to grand fir. Occasionally, ponderosa pine may pioneer when the type occurs on seepage sites adjacent to warmer, drier slopes. Shrubfields may precede tree emergence and are dominated by Rocky Mountain maple (ACGL), big huckleberry (VAME), common snowberry (SYAL), Oregon boxwood (PAMY), spirea (SPBE), thimbleberry (RUPA), ninebark (PHMA), and/or oceanspray (HODI). Surface disturbance of the forest understory may promote heartleaf arnica (ARCO), strawberries (FRVI, FRVE), vetch (VIAM) fireweed (EPAN), bracken (PTAQ) or golden pea (THMO).

Management Considerations: Where this association occurs on the upland, opportunities for silvicultural treatments are varied; they are lessened when this type occurs as riparian stringers. Post-harvest tall and medium shrub responses indicate considerations of appropriate site preparation and conifer release methods for plantation establishment. The sites provide habitat for bear, grouse, big game, and passerines. Members of the understory readily sprout following fire, Douglas-fir, ponderosa pine, western white pine, larch, and spruce occur as seral trees.

Relationship to Other Studies: Steele (1981) described a ABGR/ACGL habitat type in central Idaho. Johnson and Simon (1987) described the ABGR/ACGL plant association in the Wallowas and Seven Devils.

Douglas Fir/Oceanspray - PSME/HODI - *Pseudotsuga menziesii*/Holodiscus discolor

Vegetation Composition: A common community on lower canyon slopes and bottoms in the Northern Blue Mountains. Douglas-fir and ponderosa pine co-dominate over a shrub-grass mosaic in the understory. Oceanspray (HODI). Serviceberry (SYAL), spiraea (SPBE), and common snowberry (SYAL) are the principal shrubs. Pinegrass (CARU) elk sedge (CAGE), Columbia brome (BRVU), woods strawberry (FRVE), and western fescue (FEOC) are the more common herbs.

Typal Comparisons: This plant association is found on moderately warm sites; elevations range lowest of the series and exposures are principally southerly. HODI dominates the tall shrub component; PHMA, if present, has less than 5% coverage. Basal areas, tree productivities, and stockability are the highest of the PSME series for Douglas-fir and ponderosa pine.

Successional Relationships: Ponderosa pine is seral to Douglas-fir. Ungulate disturbance to these communities may provide increased dominance by pinegrass, elk sedge, Oregon-grape (BERE), blue wildrye (ELGL), heartleaf arnica (ARCO), bracken (PTAQ) and long stalked clover (TRLO).

Management Considerations: Silviculturally, a wide range of even-aged and uneven-aged systems are appropriate. Other resource values of individual stands are considerations to limit application. Winter habitat for deer and elk, summer forage for ungulates, aesthetics, and recreation are a few associated with sites supporting this plant association. Plant species are fire-resistant; many resprout readily or, for tree species, are protected by thick bark. Competition from shrubs and grasses should be considered during regeneration activities.

Relationship to Other Studies: First described by Hall (1973) in the northern Blue Mountains; described by Clausnitzer and Zamora (1987) on the Colville Indian Reservation in northern Washington; and described in the Review Draft for the Yakima Indian Reservation of west central Washington by John and Tart (1986).

Grand Fir/Birchleaf Spiraea – ABGR/SPBE - *Abies grandis*/Spiraea betulifolia

Vegetation Composition: Grand fir and Douglas-fir tend to co-dominate. Birchleaf spiraea (SPBE) and common snowberry (SYAL) provide a shrub domination beneath grand fir stands. Pinegrass (CARU), elk sedge (CAGE) and heartleaf arnica (ARCO) are present; often at higher coverages than the shrubs. The ABGR/SPBE plant association has close affinities to the Douglas-fir series vegetation as exemplified by high constancies of species more regularly associated with Douglas-fir plant associations.

Typal Comparisons: The ABGR/SPBE association differs from ABGR/CARU in the occurrence and abundance of spiraea in the former type. The spiraea is the dominant and constant member of a diverse shrub group including snowberry, rose, huckleberry, boxwood, prince's pine, and willow. While these two associations are similar in distribution, ABGR/SPBE appears to have a deeper ash cap and greater soil water-holding capacity than ANGR/CARU. Tree productivities are similar.

Successional Relationships: Larch, Douglas-fir and ponderosa pine are all important seral tree species in this type. Oregon boxwood (PAMY), serviceberry (AMAL), and pinemat manzanita (ARNE) are important seral shrub species. Herbs which tend to increase with soil surface disturbance and ungulate use are northwestern sedge (CACO), heartleaf arnica (ARCO), strawberries, lupines, vetch (VIAM) peavines (LATHY) and long stalked clover (TRLO3).

Management Considerations: Droughty soils, warm aspects, and competition from rhizomatous understory shrubs and herbs are concerns for successful natural and artificial regeneration following harvest activities. Douglas-fir, ponderosa pine, and larch are seral trees in this association. Stand of grand fir and Douglas-fir are susceptible to the insect defoliators, spruce budworm and Douglas-fir tussock moth. Surface fires have historically favored the seral trees and the rhizomatous understory vegetation. There is seasonal use of the understory by both domestic livestock and big game; passerines, grouse, and bear find food in the associated shrubs.

Relationship to Other Studies: Steele (1981) described ABGR/SPBE in central Idaho; Cooper et al (1987) classified ABGR/SPBE as a minor habitat type in north Central Idaho; Johnson and Simon (1987) classified ABGR/SPBE in the southern Wallowa Mountains. Hall (1973) did not describe ABGR/SPBE but included this vegetation within the mixed conifer-pinegrass plant community type of the Blue Mountains.

Douglas-fir/Pinegrass – PSME/CARU - *Pseudotsuga menzeisii*/Calamagrostis rubescens

Veg. Composition: Ponderosa pine commonly dominates in PSME/CARU stands from its greater fire resistance. Douglas-fir is the climax dominant, however. Common snowberry (SYAL) and creeping Oregon-grape (BERE) are common but in low coverage within the pinegrass-elk sedge dominated ground cover. Heartleaf arnica (ARCO) is the most prevalent forb.

Typal Comparisons: Understory dominance by the rhizomatous grass and sedge, CARU and CAGE, typify stands representing this plant association. Low shrubs, while ubiquitous, are somewhat inconspicuous in the pinegrass dominated understory. Sites supporting this type represent some of the highest elevation occurrences of the PSME series in the Blue Mountains. Most sampled stands had soils with a mantle of volcanic ash. Overstory productivity is moderate.

Successional Relationships: Ponderosa pine is the principal seral tree species. Spiraea (SPBE) and Oregon-grape (BERE) may be more abundant in early seral stands. Pinemat manzanita (ARNE) and ceanothus (CEVE) are pioneers following fire along pinegrass-elk sedge. Peavines (LATHY), vetch (VIAM), tailcup lupine (LUCA) and heartleaf arnica (ARCO) are forbs that increase with disturbance in the type.

Management Considerations: Regeneration activities that consider competition from rhizomatous grasses and sedges, potential pocket gopher populations, wildlife and cattle damage of seedlings, and soil drought are appropriate in the PSME/CARU plant association. Big game and cattle make heavy seasonal use of the understory grasses, sedges and associated forbs. The association recovers quickly from fire; ponderosa pine, pinegrass, and seral shrubs (CEVE and SASC) are promoted by recurrent fire. Buckbrush serves as passerine habitat as well as a nitrogen-fixer for the site.

Relationship to Other Studies: Daubenmire (1968) described the PSME/CARU habitat type in eastern Washington; Hall (1973) incorporated PSME/CARU in the mixed conifer-pinegrass p.c.t. in the Blue Mountains; Pfister, et al (1977) describes PSME/CARU in Montana; (Stoele (1981) considered PSME/CARU a major habitat type in central Idaho; Cooper, et al (1987) found it to be incidental in northern Idaho; Williams and Lilybridge (1983) and Williams, et al (1991), described it in northern Washington. Clausnitzer and Zamora described PSME/CARU on the Colville Indian Reservation. Johnson and Simon (1987) described it in the Wallows.

Douglas Fir/Ninebark – PSME/PHMA - *Pseudotsuga menziesii*/Physocarpus malvaceus

Vegetation Composition: A steep canyon slope forested community dominated by Douglas-fir with ponderosa pine usually associated; larch is infrequent. Ninebark (PHMA), common snowberry (SYAL), spiraea (SPBE), serviceberry (AMAL), and baldhip rose (ROGY) are the principal shrubs. Principal herbs are pinegrass (CARU), elk sedge (CAGE), woods strawberry (FRVE), and heartleaf arnica (ARCO). Aspect strongly controls the distribution of these communities.

Typal Comparisons: Physiognomy and composition are similar to PSME/HODI stands but the tall shrub component is dominated by ninebark, not oceanspray. Three productivities are moderate in this association with PIPO, PSME, and LAOC all showing similar potential.

Successional Relationships: Stand replacing fir has been principal modifying event. Stands are replaced with shrubfields dominated by ninebark, oceanspray, Scouler willow, Rocky Mountain maple, cherry, and serviceberry. The pinegrass-elk sedge stand may also be promoted by tree-replacement burns. Forbs exhibiting an increase with fire in PSME/PHMA are fireweed (EPAN), peavines (LATHY), vetch (VIAM), heartleaf arnica (ARCO), and asters.

Management Considerations: Steep slopes and shrub grass competition create concerns for timber management. Silvicultural operations that consider stocking requirements, operability constraints, and animal-related problems are applicable in this type. Plant species are fire-resistant and post-fire recovery occurs relatively quickly in most situations. Fire will promote shrubfields with a grass-sedge mosaic. These plants are rhizomatous and competition is intense. Very difficult to regenerate trees in less than 10 years. These early successional communities provide valuable browse for deer and elk. Older stands provide hiding or thermal cover. A relatively droughty forest; mistletoes and root rots are common.

Relationship to Other Studies: Described in eastern Washington by Daubenmire (1968); by Hall (1973) in the northern Blue Mountains; by Pfister, et al (1977) in Montana; by Steele (1981) in central Idaho; by Cooper et al (1987) in northern Idaho; by Williams and Lilybridge (1983) and by Clausnitzer and Zamora (1987) in northern Washington; and by Johnson and Simon (1987) in the Wallowa Mountains.

Douglas Fir/Common Snowberry – PSME/SYAL - *Pseudotsuga menziesii* /Symphoricarpus albus

Vegetation Composition: Douglas-fir and ponderosa pine are common on these sites; ponderosa pine may dominate (but Douglas-fir demonstrates potential to succeed). Common snowberry (SYAL) and spiraea (SPBE) form a shrub layer, elk sedge (CAGE) and pinegrass (CARU) dominate the herbaceous vegetation. Baldhip rose (ROGY), creeping Oregon grape (BERE) and serviceberry (AMAL) are prominent shrubs at low coverage.

Typal Comparisons: This plant association is characterized by the occurrence and abundance of rhizomatous low shrub layer dominated by common snowberry on warm, mesic sites. Tree productivities, basal area, and stockability are similar to the psme/phma plant association.

Successional Relationships: Ponderosa pine generally precedes Douglas-fir as the principal seral tree species. Forbs abundant in early seral stages are asters, peavines, heartleaf arnica (ARCO), tailcup lupine, (LUCA) vetch (VIAM), strawberries, and medowrue (THOC). Smooth brome (BRIN), mountain brome (BRCA) and Kentucky bluegrass (POPR) often increase with disturbance.

Management Considerations: As in the Douglas-fir/tall shrub association, competition from rhizomatous understory vegetation (syal, spbe, caru, and cage) and animal use are factors to consider in choosing appropriate timber management systems. Plant species are fire-resistant, recurrent fire promotes ponderosa pine and pinegrass on this type. Animal use is high – deer, elk, cattle, grouse, and passerines all utilize this habitat seasonally.

Relationship to Other Studies: Described by Daubenmire (1968) in eastern Washington; by Pfister, et al (1977) in Montana, by Steele (1981) in central Idaho; by Cooper, et al (1987) in northern Idaho, Williams and Lilybridge (1983) in north central Washington; Willimas, et al (1991) and Clausnitzer and Zamora (1987) in northeast Washington. Johnson and Simon (1987) described PSME/SYAL in the Wallowas of northeast Oregon.

Ponderosa Pine/Common Snowberry – PIPO/SYAL - *Pinus ponderosa*/Symphoricarpus albus

Vegetation Composition: Ponderosa pine is climax; Douglas-fir may occur at low coverage. Common snowberry, spiraea (SPBE), baldhip rose (ROGY) and serviceberry (AMAL) are principal, shrub components. Elk sedge is the principal herb. Shrubs are usually present at lower coverages unless the understory has been disturbed.

Typal Comparisons: PIPO/SYAL occurs at the lowest mean elevation of any PIPO plant association (3,995 ft). It occurs principally in the north and central Blue Mountains on gentle to steep slopes at all slope positions. It occurs on deep soils over varying geologic substrates. The PIPO/SYAL community occurs on the deepest soils of any PIPO series vegetation and is considered the most mesic of the PIPO plant associations. Site index, stockability, and the productivity index are the highest of the PIPO series.

Successional Relationships: Mountain brome (BRCA) and blue wildrye (ELGL) are grasses that tend to increase with disturbance. Forbs which may be more abundant at lower seral stages are vetch (VIAM), heartleaf arnica (ARCO), tailcup lupine (LUCA) and yarrow (ACMIL).

Management Considerations: Tree regeneration success is limited by SYAL, CARU, and CAGE competition. Clumps of pine regeneration can cause stagnation requiring stocking level control. Ungulate use is high (proximity to adjacent bunchgrass). CARU used late in season after frost; SYAL use is high by deer, elk, grouse, and passerines. Often used for bedding and shading. Fire promotes CARU, PIPO regeneration and bunchgrasses. Use of prescribed fire promotes vigor of rhizomatous shrub, grass, forb species. Additionally, fire maintains community vigor and develops the uneven-aged character of the PIPO/SYAL plant community. This is one of the highest herbage producing plant associations of the ponderosa pine series.

Relationship to Other Studies: The PIPO/SYAL habitat type was described by Daubenmire (1968) in eastern Washington and northern Idaho; Pfister, et al (1977) in Montana; Steele (1981) in central Idaho; Johnson and Simon (1987) in the Wallowa-Snake of northeast Oregon; Clausnitzer and Zamora (1987) on the Colville Indian Reservation of northern Washington.

Upland Shrub Associations (*in* Johnson and Simon, 1987)

Common Snowberry- Rose - (SYAL-ROSE) - *Symphoricarpus albus*/Rose spp.

These stands appear to have increased throughout the canyonlands of the Blue Mountains. This increase may be the result of fire removal from the ecosystem or as a response to overgrazing of deep-soil mesic grassland communities (i.e. Idaho fescue – prairie junegrass FEID-KOCR). It is also possible that the shrubs are responding to more favorable moisture, indicating either a wetter period of a climatic cycle, a change in distribution, timing of precipitation, or a combination of all three factors. These shrublands are not considered to be future ponderosa pine – common snowberry forest communities.

The amount of herbage produced in these communities is inversely related to canopy cover of the dominant shrubs. Dense common snowberry – rose shrub communities produce very little herbaceous forage. However, very early seral communities with low shrub cover may produce substantial amounts of forbs and grasses. Browse production by snowberry can also be significant in all seral stages.

These shrublands provide a diversity for wildlife habitat (i.e., browse, hiding cover). Common snowberry is palatable to cattle and big game. It can withstand normal grazing well, but heavy grazing will eradicate it. Periodic heavy grazing of some stands may promote production of favorable grasses. Common snowberry is resistant to fire and sprouts vigorously after burning. Roses are moderately resistant to fire and develop basal sprouts following fire.

Ninebark – PHMA - *Physocarpus malvaceus*

Vegetation Composition – The PHMA-SYAL shrubland may be the result of stand replacement fire in the PSME/PHMA communities or may be the result of severe competition imposed by ninebark to thwart tree establishment. The PHMA-SYAL shrubland may contain ponderosa pine and/or Douglas-fir trees at low coverage. Ninebark (PHMA), common snowberry (SYAL), oceanspray (HODI), spiraea (SPBE), and serviceberry (AMAL) are the most common shrubs of the community type. Roses, cherries, Rocky Mountain Maple (ACGL) and syringe (PHLE2) are often present. Beneath the shrubs, herbaceous growth is restricted. Elk sedge (CAGE) and Bluebunch wheatgrass (AGSP) occur from adjacent communities.

Typal Communities – Ninebark-snowberry shrublands occur primarily in the northern Blue Mountains on steep canyon slopes at upper, mid, and lower slope elevations. Soils are deep loess and ash over basalt. Sampled elevations ranged from 1,750 to 4,775 feet (mean = 2,635).

Successional Relationships – Fire periodically consumes PHMA-SYAL shrublands. Most of the associated shrub species resprout basally following fire, quickly returning the shrubland to vigorous growth. Cyclic fire events may help discourage tree establishment. Initial pioneering plants following fire are varileaf phacelia (PHHE), fireweed (EPAN) and annual bromes. Rocky Mountain maple presence indicates a moist phase of this type.

Management Considerations – Principal use is for big game cover and shading. These communities provide wildlife habitat and add diversity to the canyon landscape. Silvicultural activity may be cost ineffective based on the intense shrub competition and difficulty of access. Value to watershed for slope stability and water quality is high.

Grassland Associations (*in* Johnson and Clausnitzer, 1992)

Bluebunch Wheatgrass/Sandberg's bluegrass – AGSP/POSA - *Agropyron spicatum*/*Poa sandbergii*

The bluebunch wheatgrass/Sandberg's bluegrass association represents one of the highest elevational extensions of the AGSP-POSA3 communities. The highest bluebunch wheatgrass (mean: 54%) and Sandberg's bluegrass (mean: 7%) cover among these communities is usually found in late seral communities on basalt substrates.

Perennial grasses and forbs common to this plant association include yarrow, creamy buckwheat, and biquitroots.

When these communities degenerate, bluebunch wheatgrass and mosses decline. Early seral stages may show greater frequency of annual bromes (BRBR, BRTE), yarrow, arrowleaf balsamroot, tall annual willowweed, deerhorn, and blepharipapus. Sandberg's bluegrass is not able to persist well on steep slopes, and becomes less frequent as the slope length increases down from ridge tops.

Hot range fires and severe over-grazing by cattle will often promote dense homogeneous stands of cheatgrass in this type. If the bunchgrass seed source is not lost, these sites may succeed to the bluebunch wheatgrass/Sandberg's bluegrass domination again, but only after a very long period of time (estimate: 50 to 100 years).

Overall herbage production is moderately high in this association. However a significant decrease in production for all forage species may occur in early seral communities.

Cattle prefer bluebunch wheatgrass in these communities. They may also reduce the amount of Sandberg's bluegrass in the type through overgrazing and trampling. Sheep tend to utilize cheatgrass, the primary increaser in these communities. On sheep range, Sandberg's bluegrass may tend to increase as a result of sheep usage where preference is to competing succulent annual vegetation.

Bluebunch wheatgrass is the species to manage since it supplies a majority of the total forage produced and is the most preferred species for both domestic and wild ungulates. Utilization by winter grazing livestock should cease prior to onset of the boot stage (usually in May to early June). Use on summer ranges should be initiated following the flowering period of bluebunch wheatgrass.

Annual bromes in this association provide early spring grazing forage, especially in early seral communities where cheatgrass may dominate and desirable perennials are fewer. Fire cannot be used to convert annual brome stands to native bunchgrass vegetation. To reclaim perennial bunchgrasses herbicidal use, plowing under of the annual grasses and re-seeding with wheatgrass will be required.(Johnson son and Simon, 1987).

Management Considerations – Light burns occurring after seed maturity can enhance the competitive ability of Bluebunch wheatgrass. Where cattle, deer and elk graze, and use is heavy, Sandberg's often declines from continued overgrazing and trampling. Early season use on steep slopes can also negatively impact the smaller Sandberg's bunchgrasses. Especially impacted are the south slopes where elk and deer congregate in early spring when soils are saturated with moisture and plants are prone to damage. Plant loss from uprooting due to use by animals and slope movement is especially high at this time.

Idaho Fescue/ Bluebunch Wheatgrass – FEID/AGSP - *Festuca idahoensis*/*Agropyron spicatum*

This plant community is transitional between the Idaho fescue/bluebunch wheatgrass communities of the steep canyon slopes and the Idaho fescue/ (kocr) or Sandberg's bluegrass-(DAUN) gentle ridgetop communities. It is likely that associations on these ridgetops are a result of overgrazing with

subsequent soil loss such that the junegrass union of plants is unable to persist in the droughtier environment. These transitional Idaho fescue/bluebunch wheatgrass communities usually occur adjacent to thinner soil sites dominated by Sandberg's bluegrass-DUAN, other communities to droughty for fescue, or deeper soils dominated by GEID-KOCR communities. The occurrence of significant dry rocky site plants in a fescue community is significant. Onespike oatgrass occurring with fescue is very indicative of this type.

Total forage production in late seral communities is only slightly more than that measured in POSA-DAUN scablands. Bluebunch wheatgrass and Idaho fescue provide most of the forage in later seral stages. Very early seral communities typically provide half as much total forage with fescue often completely absent.

Trampling damage may be most severe in saturated soils early in the season resulting in compaction and/or plant upheaval. Repeated heavy use of these gentle slopes by wild and domestic ungulates at the early spring period may create retrogression. The principal increaser for the type is silky lupine which is toxic when seeds and fruits are eaten in quantity by cattle, horses, or sheep. These transitional communities are easily degraded with minimal use owing to their scant vegetative cover and location on wind-swept ridgetops. Fire may be difficult to use owing to the uneven nature of bunchgrass and the consequent difficulty in achieving consistent fire spread.

Degraded stands (overgrazing, rotational slumping) often show increases in annual bromes, bulbous bluegrass, Kentucky bluegrass, lupines, fleabanes, phlox, yarrow, creamy buckwheat, red avens, cinquefoils, and milkvetches. Balsam roots and mule's ears form extensive stands on some sites that have been severely overgrazed.

Early grazing may deter seed formation and be detrimental to bunchgrass vigor if continued over several seasons. Early seral stages are likely from continued grazing on gentle slopes and ridgetops. More diverse mid-seral vegetation may be promoted by dual use of fire and grazing to achieve increased forbs and annual vegetation.

Floodplain/Riparian Communities (*in* Crowe and Clausnitzer, 1997)

Grand Fir/Rocky Mountain Maple (Floodplains) -ABGR/ACGL - *Abies grandis*/Acer glabrum

Physical Environment - The grand fir/rocky Mountain maple-floodplain plant association occurs on low to mid-elevation streambanks, floodplains, and terraces in the northern and central portions of the study area. Elevations range from 2500 to 4500 feet. Low to moderate gradient, V-shaped valleys over 1000 feet wide. Soils are silt loams, sandy loams, and clay loams over gravel and cobbles. Depth to this coarse alluvium varies from 4 to 16 inches. Stream types identified include Rosgen's A2a, A4, B2, B4, C3, and C4 types. Stream widths range from 1-50 feet.

Vegetation Composition - Grand fir dominates the overstory in climax stands of the ABGR/ACGL-Floodplain association. Engelmann spruce is a late-seral overstory component with Douglas-fir, ponderosa pine, and western larch occurring earlier in the (Clausnitze 1992). A diverse group of tall shrubs is characterized by Rocky Mountain maple. Mallow ninebark is a late-seral/minor climax shrub on some sites. Common snowberry, bald-hip rose, Lewis' mockorange, and western thimble-berry are occasionally abundant. Western serviceberry, birch-leaved spirea, and oceanspray are common or well represented on about half the sites. While herbaceous richness is high in this association, most species have low abundance individually. Sweet-scented bedstraw is constant in the understory with mean coverage of 4%. Mountain sweet-cicily, woods strawberry, starry false-solomon's seal, trail plant, stream violet, heartleaf arnica, and baneberry are often associated in the understory.

Management Considerations - Rocky Mountain maple is an important browse species for wild ungulates and provides food cover for birds, squirrels, and chipmunks (Uchtyil 1989). Associated shrubs provide similar habitat for wildlife. These shrubs hinder rapid tree establishment in post-harvest communities. Silvicultural systems should consider appropriate treatments to affect plantation establishment. Streamside stands provide shade, woody debris, and stream bank stability for associated fish habitat.

USDI Wetland Classification

System - Palustrine

Class - Forested Wetland

Subclass - Needle-leaved Evergreen

Water Regime - (nontidal) Temporarily Flooded to Intermittently Flooded.

Other Studies

The ABGRT/ACGL-Floodplain is defined as the riparian element of the ABGR/ACGL plant association (Steele and others 1981, Johnson and Simon 1987, Johnson and Clausnitzer 1992).

Douglas-fir/Common Snowberry (Floodplains) - PSME/SYAL
Psedostuga menziesii* /*Symphoricarpus albus

Physical Environment

The Douglas-fir/Common Snowberry-Floodplain plant association was found in the northern portion of the study area at elevations from 3300-4500 feet. Floodplain and terrace sites are located in very narrow to very broad V-shaped valleys from 15 to 1000 feet wide. Low (1%) to very high (10%) gradient valleys were sampled. Soils generally consist of fine textured silt loam and loams over sandy loams, coarse sands, gravels, and cobbles. Distances from the surface to coarse alluvium range from 8 to 31 inches. Adjacent streams are 1 to 30 feet wide and classified as B3, C2, C3, or F4 stream types.

Vegetation Composition

This floodplain association is dominated by Douglas-fir in the overstory. Seral tree species such as ponderosa pine or western larch are important overstory components in successional stands. Common snowberry is the most abundant shrub species under late-seral or climax conditions. Two species are abundant in seral tall shrub layers: water birch and black hawthorn. These shrubs will diminish in importance as stands move successional toward Potential Natural Vegetation. Red-osier dogwood, bald-hip rose, and western thimbleberry are important shrub components of this plant association. Sampled stands generally consist of mountain sweet-cicely, broad-petal strawberry, yarrow, northern bedstraw, and sweet-scented bedstraw in the forb layer. Important grasses and sedges include blue wildrye, orcutt brome, Kentucky bluegrass, western fescue, elk sedge, and Dewey's sedge.

Management

The PMSY/SYAL-Floodplain plant association provides habitat for an assortment of wildlife species. Passerines, grouse, woodpeckers, deer, elk, squirrels, chipmunks, cattle all utilize this habitat seasonally (Johnson and Clausnitzer 1992). In addition, this streamside association provides shade, streambank stability, and woody debris for fish habitat in adjacent streams. Overuse by grazing animals will lead to reduction of snowberry abundance and an increase in Kentucky bluegrass. Some overgrazed sites are characterized by abundant western blue flag. Plant community components are fire-resistant and will resprout following fire. Insects and disease may impact overstory trees stressed by recurrent drought.

USDI Fish and Wildlife Service Classification

System - Palustrine

Class - Forested Wetland

Subclass - Needle-leaved Evergreen

Water Regime - (non-Tidal) Temporarily Flooded to Intermittently Flooded.

Other Studies

The PSME/SYAL-Floodplain plant association has not been described.

Black Cottonwood/Common Snowberry – Floodplains - POTR2/SYAL ***Populoides trichocarpa/Symphoricarpus albus***

Physical Environment – This type occurs on low elevation, gentle terraces along major rivers and streams. Valley widths are usually broad (300 – 1,000 feet), but this type has been sampled in the moderate width valleys of 100 feet. The community occupies deep alluvial soils of fine-textured surface horizons with sands, gravels, and rocks below. Sites are flooded infrequently, and the water table was below soil depths sampled on study plots. Mottling was evident, however, in one profile. Plots occurred along B2, C1, C4 and D3 Rosgen stream types. Stream widths varied from 5 – 100 feet.

Vegetation Composition – Black cottonwood dominates a tree overstory with conifers present in all layers. While irregular in occurrence, the conifer species (ponderosa pine, Douglas-fir, and grand fir) may indicate community potential on these terrace sites. The shrub component is dominated by common snowberry with scattered black hawthorn and western serviceberry creating a diverse shrub canopy beneath the cottonwood. The black hawthorn is seral in this community but may form climax riparian stringers at lower elevations. Starry false-solomon's seal is a regular member of the herbaceous understory. Less common in occurrence is butterweed groundsel, cowparsnip, sweet-scented bedstraw, and western meadowrue. Kentucky bluegrass, blue wildrye, and red fescue are abundant where they occur in the understory.

Management Considerations – The shrub understory of this community type provides nesting habitat and food for both nongame and game birds while the overstory is used by woodpeckers, raptors, and other bird species for foraging, nesting, and roosting (Snyder 1991). Understory cottonwood and shrubs are browsed by both domestic and wild ungulates. Continuous and severe grazing results in a decline in the snowberry component while Kentucky bluegrass increases in abundance. The overstory of cottonwoods will decline in vigor over time unless management alternatives are developed to maintain the seral nature of these stands.

USDI Fish and Wildlife Service Wetland Classification

System – Palustrine

Class – Forested Wetland

Subclass – Broad-leaved deciduous

Water Regime – (nontidal) Intermittently flooded.

Ponderosa Pine/Common Snowberry-Floodplains – PIPO/SYAL ***Pinus Ponderosa/ Symphoricarpus albus***

Physical Environment

The ponderosa pine/common snowberry-floodplain association occurs on floodplains and terraces throughout the study area. It is found principally from 2800 to 5300 feet in elevation in V-shaped, trough-shaped, or flat-shaped low gradient valleys. Valley widths range from very narrow (15 feet) to very broad (>1000). Soil texture varies from silt loams to sandy clay loams over sands, cobbles, and stones. Depth to cobble and stones ranges from 15 to 24 inches. Mottling was present in one-half of the sampled soil profiles. The water table was 27 inches below the surface in June-July. Rosgen stream types of B2, B3, B5, E3, and F4 were identified and stream widths varied from 5 to 30 feet.

Vegetation Composition

Stands representing this association are dominated by ponderosa pine in the overstory and common snowberry in the shrub layer. Other trees occur rarely; Douglas-fir, grand fir, and quaking aspen are scarce and western juniper occasionally well represented. Black hawthorn, a persistent early-seral shrub of this association, is abundant on some plots. The herbaceous layer is dominated by Kentucky

bluegrass, a naturalized Eurasian grass. Yarrow, broad-petal strawberry, northern bedstraw, northern cinquefoil, starry false-solomon's seal, and blue wildrye are occasionally well represented in the understory.

Management

This type is similar to the PIPO/SYAL plant association described in upland classifications, but is separated by its occurrence in stream bottoms and the occurrence of more music-site species (i.e., meadow rue and starry false-solomon's seal) in the community. These floodplain communities provide important habitat for deer, elk, game birds, songbirds, and woodpeckers. The streamside association may be a valuable source of shade, woody debris, and stream stability for fish habitat. Livestock use the understory layer and can cause common snowberry to decline if a pattern of overuse is established (Kovalich 1987). Kentucky bluegrass will eventually dominate such communities.

USDI Wetland Classification

System Classification – Palustrine

Class - Forested Wetland

Subclass - Needle-leaved Evergreen

Water Regime (NON-TIDAL) - Temporarily Flooded to Intermittently Flooded.

Other Studies

The PIPO/SYAL-Floodplain plant association was described for central Oregon by Kovalich (1987). It appears related to the PIPO/PRVI habitat type of Hansen and others (1991).

Black Hawthorn – CRDO - *Crataegus douglasii*

Physical Environment

The black hawthorn community type was sampled at low to moderate elevations in the Wallowa Mountains (Wallowa Valley and Pine RDs and Hells Canyon NRA Wallowa-Whitman NF). Valleys in which the black hawthorn community type occurs are low to gradient (1-7%), moderately wide, and V- or flat-shaped with moderately steep to steep side slopes. Fluvial surfaces are terraces, floodplains, and most basins. Soils and Mollisols, Andisols, Entisols, and Inceptisols, consisting of silt loam to loamy gravel mineral material that ranges from 0 to more than 60 cm deep over the old stream bed. These sites are infrequently flooded as the water table is 2-5 ft. below the soil surface by mid summer. Rosgen stream types of adjacent streams are A3, B3, B4, C2 and C3. Streams are 5-30 ft wide with less than 10% of the active channel affected by woody debris.

Composition - The black hawthorn communities that were sampled are disturbance-induced seral stages of various shrub and forest plant associations. Black hawthorn forms dense thicket over shrub understories of common snowberry, alder-leaved buckthorn, or mallow ninebark. These understory shrubs may indicate the potential vegetation on the site (e.g., ALIN/SYAL, PSME/SYAL, PIPO/SYAL, PSME/PHMA). Herbaceous species include sweet-scented bedstraw, mountain sweet-cicely, woods' strawberry, western meadowrue, feathery Solomonplume, blue wildrye, and Kentucky bluegrass. The grasses often increase in cover with grazing under these strands. Black hawthorn may be a climax species in non-forested landscapes.

Management - Total dry herbaceous biomass ranged from 100 to 2301 (avg. 962) lbs/acre. Black hawthorn foliage is readily eaten by livestock when it is available (Habeck 1991). Common strawberry is browsed by deer, elk, and cattle. It is a nutritious species for cattle late in the season but probably sustains the least damage if grazed in the spring. Common snowberry reproduces mainly by rhizomes and can increase or decrease following heavy grazing depending on the season and yearly moisture conditions (Snyder 1991). Mallow ninebark is little browsed by livestock and wild ungulates (Habeck 1992).

Although the above-ground plant parts of black hawthorn are killed by even low intensity fires, some plants may survive and resprout from the root crown. Fire can be used to reduce or contain a black hawthorn population (Habeck 1991). Fires of low to moderate intensity will generally cause snowberry to sprout vigorously from its rhizomes. Severe fires may kill snowberry plants (Snyder 1991). Mallow ninebark is fire resistant and will resprout vigorously from horizontal rhizomes following fire (Habeck 1992).

Black hawthorn is a valuable source of food and cover for wildlife. Fruits are eaten by blue and sharp-tailed grouse, mule deer, and small mammals. The dense branching in a hawthorn thicket provides good nesting for black-billed magpies and thrushes, long-eared owls, and other birds. Mice, voles, deer, and birds use hawthorn thickets for hiding and thermal cover (Habeck 1991). Snowberry provides good nesting cover for small mammals and many birds including grouse, wild turkeys, and various songbirds. The fruits are eaten by quail, pheasant, grouse, and other animals (Snyder 1991).

USDI Fish and Wildlife Service Wetland Classification

System - Palustrine

Class - Scrub-shrub

Subclass - Broad-leaved Deciduous

Water Regime - (non-tidal) Temporarily Flooded to Intermittently Flooded.

Other Studies

Hansen and others (1991) described a *Crataegus succelenta* community type for Montana that includes *Crataegus douglasii* stands and is essentially the same community type as that described above.

Appendix C
Habitat Suitability Curves

Downy Woodpecker Habitat Suitability Curves.

Black-Capped Chickadee Habitat Suitability Curves.

Blue Grouse Habitat Suitability Curves.

Blue Grouse Habitat Suitability Curves Con't.

Great Blue Heron Habitat Suitability Curves.

V2: No suitability curve. Presence of water body with suitable prey population and foraging substrate.

V3: No suitability curve. A disturbance-free zone up to 100 meters around potential foraging areas.

V4: No suitability curve. Presence of tree cover type within 250 meters of wetland. Trees provide suitable structure for nest sites.

V5: No suitability curve. Presence of 250 meter (land) or 150 meter (water) disturbance-free zone around potential nest sites.

Yellow Warbler Habitat Suitability Curves.

Mink Habitat Suitability Curves.

Mink Habitat Suitability Curves Con't.

Western Meadowlark Habitat Suitability Curves.

Western Meadowlark Habitat Suitability Curves Con't.