ACRONYMS AND ABBREVIATIONS

4WD	4-wheel drive
ac	acres
AD	adipose fin clipping
ADAAG	Americans with Disabilities Act Accessibility Guidelines for Buildings & Facilities
APE	Area of Potential Effect
APEA	Applicant-Prepared Environmental Assessment
ARG	Aquatics Resource Group
ATS	Advanced Telemetry Systems
ATV	all terrain vehicle
BLM	Bureau of Land Management
BP	Before Present
CCCP	Cowlitz County Comprehensive Plan
CCSCP	Cowlitz County Shoreline Management Master Program
CDF	critical dewatering flow
CIT	Cowlitz Indian Tribe
cm	centimeters
Corps	U.S. Army Corps of Engineers
CRG	Cultural Resource Group
CS plants	culturally sensitive plants
dbh	diameter at breast height
DEQ	(Oregon) Department of Environmental Quality
DNR	Washington Department of Natural Resources
DO	dissolved oxygen
DSF	day-second feet
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FCC	Freshwater Chronic Criteria
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Map
FR	Forest Road
FWS	U.S. Fish and Wildlife Service
GIS	geographic information system
GPNF	Gifford Pinchot National Forest
GPS	global positioning satellite
ha	hectares
HCC	Hydro Control Center
HCP	Habitat Conservation Plan
HEP	Habitat Evaluation Procedure
Hg	mercury
HPC	Hydrometeorological Prediction Center
HPMP	Historic Properties Management Plan
HSC	Habitat suitability criteria

HSI	Habitat Suitability Index
HUD	Department of Housing and Urban Development
IDL	Instrument Detection Limits
IFIM	Instream Flow Incremental Methodology
IHA	Index of hydraulic alteration
IP	International Paper
KOP	Key Observation Point
KSFD	1,000 second feet per day
LAC	Limits of Acceptable Change
LVAD	left ventral adipose fin
LWD	large woody debris
NESC	Northwest Energy Services Company
NGO	non-governmental agency
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NOECs	No observable effects concentrations
NPDES	National Pollutant Discharge Elimination System
NPPC	Northwest Power Planning Council
NRHP	National Register of Historic Places
NRPA	National Recreation and Parks Association
NSOs	natural sequence orders
NTU	nephelometric turbidity unit
NWPP	Northwest Power Pool
NWS	National Weather Service
OAHP	Office of Archaeology and Historic Preservation
OHWL	Ordinary High Water Level
O&M	operations and maintenance
PAH	polycyclic aromatic hydrocarbon
PAOT	persons-at-one time
PCB	polychlorinated biphenyl
PCC	Portland Control Center
PHABSIM	Physical Habitat Simulation
PHS	Priority Habitat Species
PM&E	Protection, Mitigation, and Enhancement Measure
PPL	Pacific Power and Light
PSMFC	Pacific States Marine Fisheries Commission
PUD	Public Utility District
PWC	personal watercraft
QA/QC	Quality Assurance/Quality Control
QPF	Quantitative Precipitation Forecast
READ	Resource Enhancement Alternatives Document
RM	River Mile
RMAP	Road maintenance and abandonment program
ROS	Recreation Opportunity Spectrum
ROW	rights-of-way
RRG	Recreation Resource Group

RRMP	Recreation Resource Management Plan
RV	recreation vehicle
RVD	recreation visitor day
RVAD	right ventral adipose fin
SBR	Swift bypass reach
S/M species	survey and manage species
SCORP	Statewide Comprehensive Outdoor Recreation Plan
sd	standard deviation
SI	Suitability Indices
SOP	Standard Operating Procedures
SR	State Route
TCP	Traditional Cultural Property
TDG	total dissolved gas
TES	threatened, endangered, or sensitive species
TPH	total petroleum hydrocarbon
TPN	total persulfate nitrogen
TRG	Terrestrial Resource Group
TWG	Technical Work Group
TY	Target Year
USFS	United States Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VAF	velocity adjustment factors
VECC	Variable Energy Content Curves
WAC	Washington Administrative Code
WDF	Washington Department of Fisheries
WDFW	Washington Department of Fish and Wildlife
WDG	Washington Department of Game
WDOE	Washington Department of Ecology
WNHP	Washington Natural Heritage Program
WSDOT	Washington State Department of Transportation
WSEL	water surface elevation
WSWCB	Washington State Weed Control Board
WUA	Weighted Usable Area
WY	Water Year
YN	Yakama Nation

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5.8 FOREST HARVEST PRACTICES ASSESSMENT (TER 8)

Forest harvest practices widely influence the botanical and wildlife resources in the Lewis River watershed. Silvicultural treatments change the overstory species composition and density, as well as alter the availability of light and nutrients to understory species. Changes in vegetation species composition and their spatial arrangement may result in a corresponding change in wildlife species composition, density, and spatial distribution within the watershed. Because this assessment uses some terminology specific to silviculture and forest management practices, a glossary is provided in TER 8 Appendix 1.

5.8.1 Study Objectives

The objectives of the Forest Harvest Practices Assessment are as follows:

- Summarize existing forest practices in the Lewis River Basin, including those on PacifiCorp lands. Compare PacifiCorp's current forest management practices on lands designated for wildlife habitat management to standards defined by the Washington State Department of Natural Resources (DNR) Forest Practice Regulations (DNR 2000) and to the practices of other land managers in the Lewis River Basin.

- Describe how different forest harvest practices can affect habitat important to the analysis species selected for the Lewis River Projects (see Section 5.3, TER 3 for a discussion of analysis species). Such harvest practices include logging methods, silvicultural system (e.g., clearcut, shelterwood), area of harvest (e.g., clearcut size), road construction and maintenance standards, regeneration practices, and herbicide and fertilizer treatments.

- Identify silvicultural practices that may be used to improve wildlife habitat in the Lewis River Basin and other parameters of watershed health, such as large woody debris (LWD) recruitment, water quality, fish and wildlife habitat, flooding, and sediment transport.

5.8.2 Study Area

The study area for the Forest Harvest Practices Assessment includes the entire Lewis River watershed, which extends east from the Columbia River to Mount Adams, and covers about 693,703 acres (246,606 ha). This area encompasses a variety of landowners and associated forest harvest practices. Within this area, the assessment focuses specifically on the management of forest lands owned by PacifiCorp.

The topography of the Lewis River watershed ranges from approximately 40 feet (12 m) mean sea level near Woodland, WA, to 12,267 feet (3,734 m) at the summit of Mount Adams. The lower third of the watershed consists of flat to moderately rolling forested terrain. The upper two-thirds of the watershed consist of generally steep forested slopes as a result of the incision of numerous streams and rivers into the geologically young landscape.

The eastern two-thirds of the Lewis River watershed are located in the Southern Washington Cascades Province of the Pacific Northwest, with the western third of the watershed located in the Puget Trough Province (Franklin and Dyrness 1988). There are 2 vegetation zones within the Lewis River watershed—the Western Hemlock (*Tsuga heterophylla*) and the Pacific Silver Fir (*Abies amabilis*) Zones. The western hemlock zone comprises the western two-thirds of the study area and the lower elevation slopes in the eastern third. The Pacific Silver Fir Zone is limited to the upper elevations in the eastern third of the watershed (Franklin and Dyrness 1988).

The Lewis River watershed is forested with conifer stands, mixed conifer, and deciduous stands (Figure 5.8-1). Managed conifer stands dominate, with most of these comprised of second-growth Douglas-fir (*Psuedotsuga menziesii*). Stands dominated by western hemlock, western red cedar (*Thuja plicata*), and Pacific silver fir comprise a small percentage of the forested land in the study area. Big-leaf maple (*Acer macrophylum*) and red alder (*Alnus rubra*) are the dominant deciduous species and occur in pure stands or mixed with Douglas-fir.

Based on satellite imagery, wildlife habitat types have been identified in the Lewis River watershed (Figure 5.8-1 and Table 5.8-1). Nearly 80 percent of the watershed is comprised of 2 forest habitats—westside lowland conifer-hardwood forest and montane mixed conifer forest. See TER 1 for more information on vegetation in the study area and for detailed maps of the current cover types in the vicinity of the project reservoirs.

Table 5.8-1. Wildlife habitats in the Lewis River watershed.

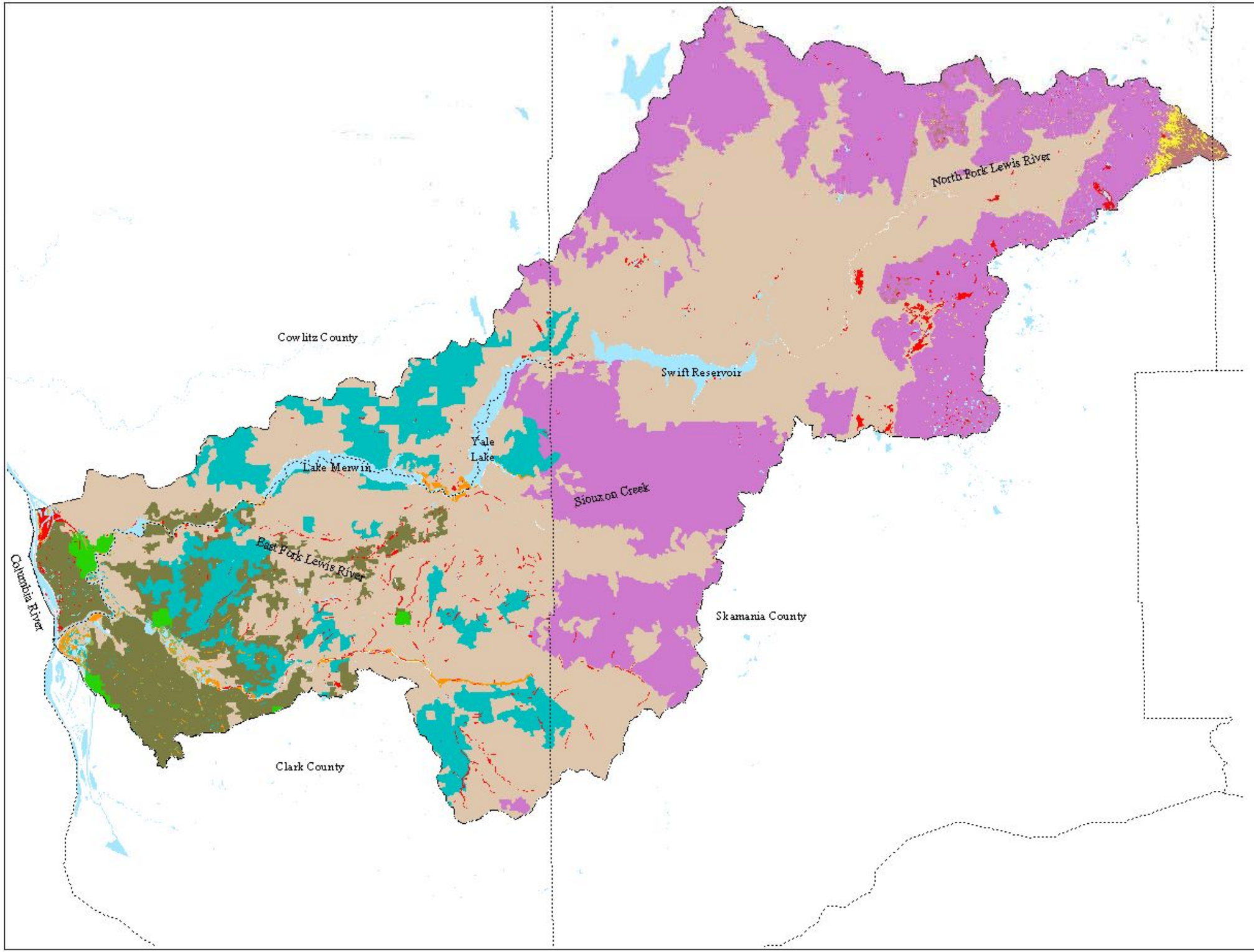
Vegetation Habitat Types	Acres	Percent
Westside Lowland Conifer-Hardwood Forest	348,024	50%
Westside Oak and Dry Douglas-fir Forest and Woodlands	57,147	8%
Montane Mixed Conifer Forest	201,601	29%
Interior Mixed Conifer Forest	683	< 1%
Lodgepole Pine Forest and Woodlands	192	< 1%
Subalpine Parklands	1,727	< 1%
Alpine Grasslands and Shrublands	3,992	< 1%
Agriculture, Pasture, and Mixed Environs	48,851	7%
Urban and Mixed Environs	3,250	< 1%
Lakes, Rivers, Ponds, and Reservoirs	13,411	2%
Herbaceous Wetlands	1,386	< 1%
Westside Riparian – Wetlands	3,531	< 1%
Montane Coniferous Wetlands	7,729	1%
Bays and Estuaries	2,178	< 1%
Total Watershed	**693,703**	**100%**

Source: Northwest Habitat Institute, 2001

Lewis River
Hydroelectric Projects

Figure 5.8-1

Land Cover and Vegetation Classification



Washington Wildlife - Habitat Types

- Agriculture
- Alpine Grasslands and Shrublands
- Bays and Estuaries
- Eastside Mixed Conifer Forest
- Herbaceous Wetlands
- Lodgepole Pine Forest and Woodlands
- Montane Coniferous Wetlands
- Montane Mixed Conifer Forest
- Ponderosa Pine and East Side White Oak Forest and Woodlands
- Subalpine Parklands
- Urban and Mixed Environments
- Westside Lowland Conifer-Hardwood Forest
- Westside Oak and Dry Douglas-Fir Forest and Woodlands
- Westside Riparian Wetlands

- County
- Lewis River Watershed
- Lakes

3 0 3 6 Miles

PACIFICORP
Geographic Information System

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October 10, 2001

5.8.3 Methods

The Forest Harvest Practices Assessment consisted of distinct tasks: (1) review of existing forest management practices in the Lewis River Basin; (2) analysis of forest practices relative to habitat for wildlife, particularly for the analysis species selected for the project; and (3) development of recommendations using specific forest practices to improve habitat for the analysis species. More detail on these tasks is provided below

5.8.3.1 Review Existing Management Practices

Management practices used by landowners in the Lewis River watershed were reviewed to describe common silvicultural treatments. Forest practices conducted by private, industrial, state, and federal land managers were reviewed with an emphasis on lands owned by PacifiCorp. The inventory of management practices included review of management plans and a field review of selected sites. A range of management practices that could occur on PacifiCorp lands was also evaluated. These practices include a variety of logging methods, silvicultural systems, road construction standards, road maintenance practices, and herbicide and fertilizer treatments. This review focuses on practices that provide key habitat attributes for identified wildlife analysis species.

5.8.3.2 Analysis of Silvicultural Techniques and Effects on Wildlife Habitat

An analysis of stand characteristics resulting from different silvicultural treatments was made relative to specific habitat attributes for wildlife analysis species. In addition, other parameters indicative of watershed health (e.g., LWD recruitment, water quality, fisheries habitat, flooding, and sediment transport) were evaluated and described. Silvicultural treatments and other forest management activities on PacifiCorp lands were compared to treatments conducted by other forest land owners in the watershed to describe the relative effects of forest management activities upon other resources.

5.8.3.3 Develop Recommendations

Information on forest practices was used to identify a number of measures that could be used to improve the habitat quality of PacifiCorp's forest land for selected species. These measures will be combined with results of the Habitat Evaluation Procedure (HEP) Study (TER 2) to develop a Terrestrial Resources Habitat Management Plan for project lands. Consideration of forest practices of adjacent landowners will assist PacifiCorp in planning the types, spacing, timing, and location of forest management activities to minimize potential adverse impacts (e.g., habitat fragmentation) on analysis species, and maximize habitat benefits (e.g., protection of corridors and buffers).

5.8.4 Key Questions

Results of the Forest Harvest Practices Assessment can be used to address some of the "key" watershed questions identified during the Lewis River Cooperative Watershed Process:

- What are the current and projected future distributions of vegetation communities in the basin and how do these differ from historical (reference) conditions?

  The current habitat types in the Lewis River Basin are shown in Figure 5.8-1. This map shows the climax vegetation types in the basin but gives no indication of current successional stages. Although successional stages may have been different in the past and are likely to change in the future, the identified habitat types would be expected to remain the same, except those areas converted to agricultural and urban lands. The Vegetation Mapping Cover Type Study (TER 1) addresses current vegetation conditions on lands owned by the utilities and/or within 0.5 mile (0.8 km) of the Lewis River Projects. As part of the Riparian Habitat Synthesis Study (TER 9), the Lewis River between Merwin Dam and Eagle Island was mapped using 1939 and 1963 aerial photography to provide historical information on the distribution of cover types on the floodplain. The HEP Study (Section 5.2) projects future habitat conditions based on selected management scenarios.

- What are the existing policies, guidelines, and practices regarding fire suppression and fuels management in the basin and how might wildlife populations and ecosystems be affected by these?

  The Forest Harvest Practices Assessment focuses on existing timber harvest and wildlife management practices and does not address policies, guidelines, or practices regarding fire suppression and fuels management and effects on wildlife populations and ecosystems. However, a brief summary of fire history and ecology is provided in TER 8 Appendix 2. Wild fires in the Lewis River Basin are generally suppressed, but fire is often used to prepare sites for replanting following timber harvest.

- What are the existing policies, guidelines, and practices regarding chemical application on lands in the basin, and how might wildlife populations and ecosystems be affected by these?

  Existing policies, guidelines, and practices regarding chemical application on lands in the basin were not addressed by the Forest Harvest Practices Assessment or any other study. By policy, the U.S. Forest Service (USFS) does not use herbicides for vegetation management (USFS 1988). The DNR, PacifiCorp, and owners of private industrial forest lands do use chemicals to control noxious weeds and other unwanted vegetation. Herbicide use is governed by state Forest Practices Regulations, with the objective of minimizing effects to fish, wildlife, and non-target plant species.

- Where does livestock grazing occur in the basin, and what are its effects on terrestrial and riparian habitats and wildlife species?

  Livestock grazing occurs in relatively few locations in the Lewis River Basin and is concentrated near and west of the Merwin Project. Most cattle are confined to pastures on private lands that do not border the reservoirs or streams.

- How can PacifiCorp help to protect wildlife and habitat through support of county planning, zoning, or other measures?

Any existing planning or zoning measures designed to protect wildlife and habitat are addressed in the Land Use Study (Section 8.1). As a private entity, PacifiCorp must comply with existing plans and zoning laws.

- What kinds of silvicultural techniques might be best suited to different areas of the watershed for restoration of riparian vegetation?

  The Forest Harvest Practices Assessment does not identify the best techniques for restoration of riparian habitats in specific areas in the Lewis River watershed for restoration of riparian vegetation. As needed, site-specific techniques will be provided in the Wildlife Habitat Management Plan developed for restoration projects on utility owned lands.

5.8.5 Results and Discussion

The following sections describe the existing land management practices in the Lewis River Basin, as well as the effects of various forest practices on wildlife and habitat. The use of various forest practices to improve wildlife habitat on PacifiCorp lands is also discussed.

5.8.5.1 Existing Management Practices

Existing land management in the Lewis River Basin is influenced by ownership and regulations that govern forest practices. Thus, this section is divided into the following 3 subsections: (1) a review of land use and ownership in the basin; (2) a summary of forest practice regulations and policies; and (3) the current management practices of PacifiCorp and the 5 other major land owners/managers in the watershed.

Land Use and Ownership

The dominant land use in the Lewis River watershed consists of forest management and activities associated with the growth, harvest, and production of forest products. Figure 5.8-2 shows the land ownership in the basin. Lands managed by federal agencies, primarily the USFS, comprise 54 percent of the watershed area. State and county agencies manage approximately 12 percent of the watershed. Private industrial forest landowners manage approximately 14 percent; other private lands cover 17 percent of the basin. PacifiCorp land ownership consists of approximately 3 percent of the watershed and the project reservoirs and other waterbodies encompass another 3 percent (Table 5.8-2).

Ownership of private industrial forest land in the Lewis River Basin is dominated by 3 companies that control more than 90 percent of these lands: Weyerhaeuser, Pope Resources, and Longview Fibre. PacifiCorp's ownership includes approximately 10,400 acres of upland and another 8,920 acres inundated by project reservoirs (Table 5.8-2).

Table 5.8-2. Forest land ownership within the Lewis River watershed.

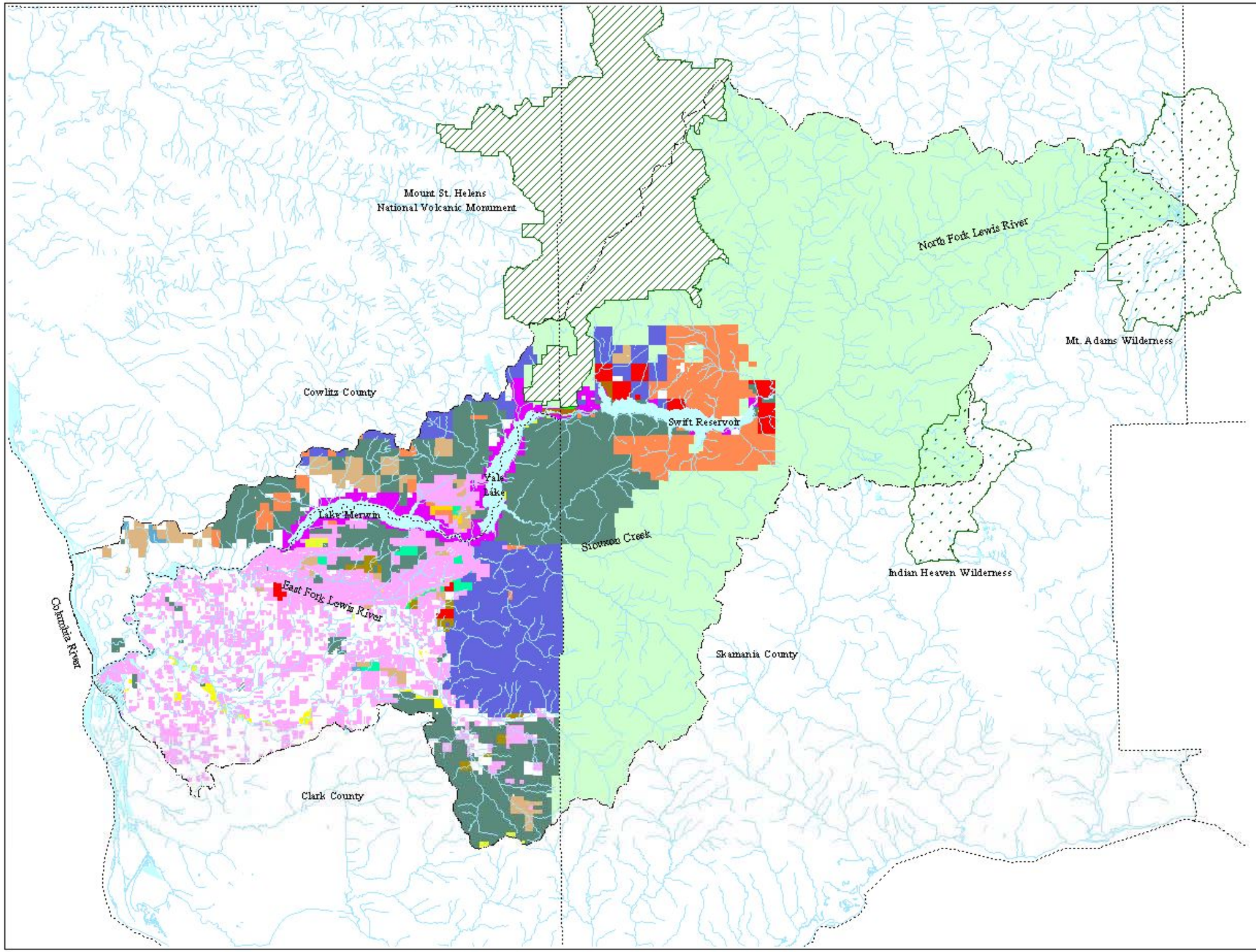
Ownership Classification	Landowner	Acres in Ownership Classification	Landowner Acres	Percent of Total Watershed
Federal Lands	Gifford Pinchot National Forest		353,660	47%
	Mount St. Helens National Volcanic Monument		32,712	4%
	Wilderness Areas		17,146	2%
	Other Federal Lands (BLM and USFWS)		924	< 1%
	Total	404,442		**54%**
State Lands	Department of Natural Resources and Other State Lands		87,747	12%
	Total	87,747		**12%**
County Lands	**Total**	1,670		**< 1%**
Private Industrial Forest Lands	ANE		4,881	<1%
	Hampton Tree Farms		739	<1%
	International Paper		61	<1%
	Longview Fibre		11,668	1.5%
	Mid-Valley Resources		1,532	<1%
	Pope Resources		28,570	4%
	Stimson Lumber		1,829	<1%
	Weyerhaeuser		48,761	7%
	Total	98,041		**13%**
Utility Lands	PacifiCorp		10,457	1.5%
	Cowlitz PUD[1]		577	<1%
	Total	11,034		1%
Private Lands	Non-Industrial Private Landowners		73,956	10%
	Other Private Landowners not Identified		50,216	7%
	Total	124,172		**17%**
Project Reservoirs	**Total**	12,366		**2%**
Lakes/Rivers	**Total**	9,607		**1%**
Total Watershed		**749,079**		**100%**

1 Includes only acres associated with the hydroelectric projects; Cowlitz PUD also owns other lands in the watershed.
Source: PacifiCorp GIS 2001.

Lewis River
Hydroelectric Projects

Figure 5.8-2

Forest Land Ownership Classification



Federal Lands
- Gifford Pinchot National Forest
- Mount St. Helens National Volcanic Monument
- Wilderness Areas
- Other Federal Lands

State Lands
- Department of Natural Resources
- Other State Lands

County Lands
- Cowlitz County PUD
- Other County Lands

Private Industrial Lands
- ANE
- Hampton Tree Farms
- International Paper
- Longview Fibre
- Mid Valley Resources
- PacifiCorp
- Pope Industries
- Private
- Stimson Lumber
- Weyerhaeuser

- County
- Lewis River Watershed
- Lakes

3 0 3 6 Miles

PACIFICORP
Geographic Information System

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October 10, 2001

State-owned forest lands in the Lewis River Basin are primarily managed by the DNR, although there are some parcels managed by other state agencies, such as the Washington Department of Fish and Wildlife (WDFW). The Private Lands (Non-Industrial Private Landowners) classification contains many land parcels in the lower watershed that are either not forested, or do not include productive forest sites. Other land uses in the Lewis River watershed include agricultural, residential, recreational, and industrial, occurring primarily in the lower third of the watershed (Figure 5.8-2). Agricultural land uses include commercial cattle and dairy farming, as well as grain and vegetable production. Residential development is concentrated near the community of Woodland, with lower density rural housing in the vicinity of the projects. Recreational uses dominate near the project reservoirs and include developed and primitive camping facilities. Industrial development occurs primarily within the community of Woodland, with the exception of the Lewis River hydroelectric facilities.

Forest Practice Regulations, Policies, and Guidance

Forest management practices in the Lewis River watershed may be directed by one or more regulatory guidelines, depending on ownership. Forest practices on lands managed by the USFS are directed by standards and guidelines established in the Gifford Pinchot National Forest Land and Resource Management Plan (LRMP) (USFS 1990c) as amended by the Record of Decision for the Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl (USFS and BLM 1994, 2000), also known as the Northwest Forest Plan.

State and private forest lands in the Lewis River Basin are regulated by the Washington State Forest Practices Rules (DNR 2000). These regulations limit the size of clearcuts; require that some trees be left unharvested in areas to protect water quality, fish, and wildlife habitat; regulate construction of forest roads and the conduct of other forest management activities; require reforestation following timber harvest; and include procedures for state agencies to review and approve proposed forest practice activities. The current rules were updated in April 2000 in response to the listing of species under the federal Endangered Species Act (ESA) and the adoption of emergency rules consistent with the Forest and Fish Report (DNR 1999). For a detailed description of the Forest Practice Rules, refer to the current Forest Practices Rulebook and the associated Washington Administrative Codes (DNR 2000). In addition to the Washington State Forest Practice Rules, much of the PacifiCorp-owned land adjacent to Lake Merwin is regulated by a FERC license article for the operation of the Merwin Project.

County zoning regulations provide some guidance regarding allowable uses within the watershed for private landowners. Skamania County does not identify any land use designations within the upper watershed. The primary Clark County zoning designations for the watershed include Forest Tier I and Forest Tier II, which emphasize natural resource production and use (Clark County 1997, revised). The area of the watershed within Cowlitz County is primarily zoned Forestry-Open Space, although areas along the project reservoirs are zoned as Rural Residential-2, allowing for higher intensity uses (Cowlitz County 2002).

Current Management Practices

Several different methods of timber harvest are used within the Lewis River watershed. These are defined as clear cutting, shelterwood cutting, seed tree cutting, and selection cutting in the Final Forest Resources Plan (DNR 1992).

- **Clear cutting** is the removal of an entire stand of trees at one time. This practice is also referred to as even-age management because once new trees have been established they grow under full sunlight into a stand of trees that are all about the same age.

- **Shelterwood cutting** leaves approximately 20 to 40 trees per acre behind when cutting the rest of the stand. This cutting style is used to reforest harsh or steeply sloped sites, or when managing for more shade-tolerant tree species. The original shelterwood trees are often removed within 10 years.

- **Seed tree cutting** involves leaving approximately 10 trees per acre when cutting the rest of the stand. This harvest method is typically used on a site where manual reforestation is considered unnecessary, where the new trees are intolerant of shade, and are not sensitive to heat or cold.

- **Selection cutting** includes many different styles of forest harvest. The reasons for selective cutting can include harsh site conditions, salvage logging of dead or diseased trees, and aesthetic or wildlife habitat considerations. Shelterwood cutting is considered a type of selection cut.

The selection of specific silvicultural treatments to manage forest vegetation is dependent on desired site and landscape-level objectives. Silvicultural treatments are selected by evaluating the ecological, physical, and social characteristics that influence the site. The physical properties constrain how management activities can be conducted on the ground. Social characteristics are reflected in the management objectives of the landowner and state/federal laws and regulations governing forest practices. The ecological properties of the site are influenced by its physical properties and are documented in scientific research. These properties provide the guidelines that regulate how individual species or plant communities can be manipulated through treatments to produce the desired objectives.

The basic tenet of silviculture is the application of practices to promote the growth of desired plants at the expense of undesirable plants. These practices are designed to manage the composition, structure, and distribution of vegetative species within the stand. The selection of which plants are desired, and which plants are undesirable, is generally defined by the expectations of the landowner. These expectations provide the guidelines that define the management goals and objectives for different landowners. Silvicultural practices impose changes upon the 2 limiting resources for plants that can be managed indirectly by landowners: light and nutrients (including water). Light is managed by allocating the distribution of light throughout the vegetation canopy. The allocation of light to lower canopy levels is accomplished by thinning the upper canopy levels to allow light to penetrate to lower canopy levels. Nutrients and water are

managed between species by selectively removing the species that compete directly with more desirable species.

The silvicultural practices used by landowners in the Lewis River watershed are a reflection of the social expectations that create the management goals and objectives of the landowner. Current forest management practices for each of the major land ownership types in the Lewis River Basin are summarized in Table 5.8-3 and briefly described below.

Private Industrial Forest Land Management Practices – Approximately 98,000 acres of forest land are managed by private industrial timber companies in the Lewis River watershed (see Table 5.8-2). Silvicultural practices are conducted on these lands to maximize the economic growth of forested stands. Industrial forest landowners who have the goal of producing trees for conversion into lumber or pulp products at a minimum cost will generally implement silvicultural practices that allocate light and nutrients to the desired tree species at the expense of undesirable tree species, shrubs, and herb species. In particular, the silvicultural practices of these landowners are focused on increasing the diameter and height of the stem of the tree.

Clearcut and replanting silvicultural treatments are generally used to harvest and regenerate forested stands, although the specific practices vary by landowner and site. Intermediate treatments are generally conducted on each stand but vary by site, stand conditions, and ownership. Intermediate treatments range from herbicide treatment of hardwood species to promote conifer growth, to pruning and commercial thinning of selected crop trees.

The primary objectives of the 3 major industrial forest products companies in the Lewis River watershed are to provide products to consumers and maximize the return to their shareholders within the context of existing State Forest Practice Rules. In addition, some industrial forest companies have established corporate environmental principles that direct forest management activities on their lands. The following sections highlight the forest management practices for the 3 large private timber companies. This information has been obtained through corporate annual reports and communication with the companies' area land managers. The summary provides the overall goals and mission for land management, with occasional references to regional level objectives

- Longview Fibre – Longview Fibre owns and operates tree farms in Oregon and Washington that produce logs for sale, and as raw material for corporate manufacturing operations. The company operates its forest lands on a sustained-yield basis with rotations of 40 years for hardwood species, and 40 to 60 years for coniferous species.

Table 5.8-3. Current management practices.

Land Owner	Mandate	Primary Harvest Method	Harvest Rotation Period	Commercial Thinning	Pre-commercial Thinning	Snag Retention Per Acre	Reserve Trees Retained Per Acre	Riparian Management Zone Width
USFS	Multiple Use	Clearcut	120 years	Thinning is based on silvicultural exams & prescriptions on Matrix & Adaptive management lands.	Pre-commercial thinning is used when site conditions would restrict further growth of young stands.	Guided by the Northwest Forest Plan & the Gifford Pinchot National Forest LRMP.	Guided by the Northwest Forest Plan & the Gifford Pinchot National Forest LRMP.	Guided by the Northwest Forest Plan & the Gifford Pinchot National Forest LRMP.
DNR	School funds & other state trusts	Clearcut, commercial thinning[1]	60 years[1]	Commercially thinned to 230 stems/acre for most forested lands at 20 to 25 years of age.[1]	Trees are planted at 300-400 /acre & are not precommercially thinned.[1]	Not required & only implemented when it helps meet wildlife reserve tree requirements.	3 wildlife reserve trees (>12" dbh & >10 ft tall) & 2 green recruitment trees (>10" dbh & >30 ft tall) are required per acre.	Follows DNR State Forest Practices Rules.
Longview Fibre	Profit	Commercial thinning followed by clearcut [2]	50 - 60 years for conifer stands[2]	Aggressively commercially thin most forested lands at 30 years of age.[2]	No pre-commercial thinning unless the stand averages >1,000 stems per acre.[2]	Not required & only implemented when it helps meet wildlife reserve tree requirements.	3 wildlife reserve trees (>12" dbh & >10 ft. tall) & 2 green recruitment trees (>10" dbh & >30 ft tall) are required per acre.	Follows DNR State Forest Practices Rules.
Olympic Resource Manage-ment (Pope Resources)	Profit	Clearcut [3]	45 - 50 years for conifer stands[3]	Currently managing recently purchased commercially thinned stands, but will not be using commercial thinning as a management style.[3]	Trees are precommercially thinned at 8-15 years when stands average >800-900 stems per acre.[3]	Not required & only implemented when it helps meet the wildlife reserve tree requirements.	3 wildlife reserve trees (>12" dbh & >10 ft tall) & 2 green recruitment trees (>10" dbh & >30 ft tall) are required per acre.	Follows DNR State Forest Practices Rules.
Weyer-haeuser	Profit	Commercial thinning & then clearcut[4]	40 - 60 years for conifer stands[4]	Most stands are thinned from underneath at 30 years of age. This takes total forest canopy closure to 50-70%.[4]	Stands are not usually precommercially thinned, unless special site conditions warrant it.[4]	Not required & only implemented when it helps meet the wildlife reserve tree requirements.	3 wildlife reserve trees (>12" dbh & >10 ft tall) & 2 green recruitment trees (>10" dbh & >30 ft tall) are required per acre.	Follows DNR State Forest Practices Rules.
PacifiCorp	Wildlife Habitat Retention	Many harvest methods are used, including clearcut, shelterwood, seed tree, & selective	70 years	Some stands trees are thinned to 70% canopy cover (+/- 5%), when the stand is 30-35 years old.	Trees are girdled & pruned at approximately 10-12 years old & are left standing to reduce slash.	At least 2 snags are created per acre in clearcut areas. Snags average 36-40" dbh. At least 5 green trees >12" dbh are retained per acre in clearcut stands. Green trees average > 25" dbh.	3 wildlife reserve trees (>12" dbh & >10 ft tall) & 2 green recruitment trees (>10" dbh & >30 ft tall) are required per acre. Often up to 7 green recruitment trees are retained per acre averaging >25" dbh & >100 ft tall. Wildlife reserve trees are of similar proportions.	Follows DNR State Forest Practices Rules but also includes 200-ft buffers on lake shore & highways, except where the buffer would not provide adequate hiding cover for elk (in which case it can be cut to be improved).

[1] pers. comm., Ron Schutie, DNR, January 27, 2003

[2] pers. comm., Dan Fink, Longview Fibre, January 23, 2003

[3] pers. comm., Bill Mackelwich, Area Manager, Olympic Resources Management, January 23, 2003

[4] pers. comm., Ross Graham, Forest Land Use Manager of the St. Helens Tree Farm, Weyerhaeuser, January 23, 2003

- Weyerhaeuser – In the United States, Weyerhaeuser owns and operates 5.7 million acres 1(2.3 million ha) of forest land in 10 states for sustainable wood production. The forests are managed to increase the quality and volume of wood produced, as well as to protect important natural resources. Weyerhaeuser emphasizes producing the most volume and value from the trees through the use of advanced silvicultural practices. These practices will allow Weyerhaeuser to increase the amount of timber harvested in the next 10 years, and comes at a time when private, managed woodlands are being called upon to play a greater role in meeting the demand for softwood saw timber. To sustain the timber supply from its lands, the company is engaged in an extensive program of planting, suppression of non-merchantable species, pre-commercial and commercial thinning, fertilization, and operational pruning. All of these practices are designed to increase the yield from its forest land acreage.

- Pope Resources / Olympic Resource Management – Olympic Resource Management (ORM) is the division within Pope Resources that is responsible for the management of forest lands, and also provides forest land investment management services to other large landowners throughout the Pacific Northwest. ORM manages the land for a variety of end uses that balance and integrate the growth, harvest, and reforestation with the protection and enhancement of air and water quality, wildlife and fish habitat, soils, and scenic values.

  Pope/ORM lands in the Lewis River watershed were previously owned and managed by Plum Creek Timber Company. These lands were covered under a Habitat Conservation Plan (HCP) and Incidental Take Permit agreement with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) signed in September 2000. In the event of any change in land ownership, the HCP agreement provided the new landowner the option of continuing to manage the lands pursuant to the HCP and its regulatory conditions. ORM has not notified the USFWS that it would continue to follow the guidelines established in the HCP; therefore, the USFWS treats these lands as if they no longer are covered under an HCP.

Private Non-Industrial Forest Lands – Non-industrial private forest lands are owned by a variety of individuals not associated with commercial timber companies. It is estimated that there are approximately 74,000 acres (29,950 ha) of forest land within this ownership classification, occurring predominately in the lower third of the watershed. The forest management objectives for these lands depend upon the social and economic values of the individual landowners. As a group, the management style of these owners is considered episodic; they tend to harvest when timber prices are high, or when a personal need for cash arises. Other than harvesting and the required reforestation, active management of these lands is generally limited, especially on a landscape scale.

Department of Natural Resources (DNR) and Other State Lands – The DNR manages state trust lands to provide income for the benefit of schools and other state trusts. On behalf of the trust beneficiaries, the DNR strives to produce the most substantial support possible for the trust over the long term, while exercising prudent management and preserving the trust estate (DNR 1992).

Management of approximately 87,000 acres (35,208 ha) of DNR forest land in the Lewis River watershed is directed by 2 planning documents, a Forest Plan and an HCP. The Forest Resource Plan (DNR 1992) identifies and describes key policies that guide decisions about all state-managed forest lands. The HCP was developed to conserve threatened and endangered species on DNR-managed forest lands within the range of the northern spotted owl (*Strix occidentalus*) (DNR 1997). In addition, DNR lands within the Siouxon Creek drainage (approximately 32,000 acres [12,950 ha]) are managed following the site-specific guidelines developed in the Siouxon Landscape Plan (DNR 1996). The DNR also provides direction to the district managers and field foresters through a handbook (DNR 2000) describing implementation procedures for resource management activities, such as timber harvest planning and silvicultural prescriptions.

The DNR's forest management practices generally reflect a slightly less intensive approach than private industrial forest landowners, yet a more intensive approach than that used by the USFS. The rotation age for forest lands managed by the DNR is approximately 60 years. Forests within the Siouxon Creek drainage originated after the Yacolt burn in 1902 (and subsequent re-burns) and show a narrow range of stand ages and structural diversity. To protect other resources within this area when these stands reach management maturity, more flexibility has been provided in harvest scheduling to prevent the harvest of all mature stands within a relatively short time period. This scheduling will help maintain an even flow of harvest volume throughout the rotation.

Many of the stands in the Siouxon Creek drainage are mature (small saw timber size class), overstocked stands that have achieved and maintained 100 percent canopy closure for approximately 20 to 40 years. This successional path has created habitat with very little understory shrub or conifer development and provides limited value for wildlife. Recent silvicultural practices have focused on thinning to create more diverse stand structure attributes that will benefit wildlife habitat, with the greatest emphasis placed on northern spotted owl nesting, roosting, and foraging habitat. Implementation of riparian management guidelines and road management planning has resulted in greater protection of aquatic resources. Current road management practices in the Siouxon Creek drainage target a "no net gain" road mileage policy, and include an extensive road abandonment program. More specific timber harvest information for the USFS is included in Table 5.8-3.

USFS Non-Wilderness Lands – The USFS manages approximately 321,000 acres (129,905 ha) of non-wilderness Federal forest lands within the Lewis River watershed. These lands are managed following the principles of multiple use to provide a sustained yield of wood, water, forage, wildlife, and recreation. Management of non-wilderness USFS land in the Lewis River watershed is directed by two planning documents: the Gifford Pinchot LRMP and the Northwest Forest Plan. The Northwest Forest Plan designates 6 management zones within the Gifford Pinchot National Forest: Congressionally Reserved Areas; Late-Successional Reserves; Adaptive Management Areas; Managed Late-Successional Areas; Administratively Withdrawn Areas; and Riparian Reserves (USFS 1995). The areas not included in any of these 6 zones are known as Matrix lands. Opportunities for harvest on Federal forest lands are limited to areas designated for timber production in the Forest Plan. The vast majority of timber

harvest takes place on Matrix, and Adaptive Management lands (USFS 1995). Within the Lewis River watershed, there are additional identified constraints on harvest for the protection of fish habitat, vegetation stages to support wildlife habitat, and soils resources. These constraints limit harvest in designated sub-basins to protect these resources, and to move the area toward historical reference conditions (USFS 1996). Where timber harvest is conducted, the USFS generally uses a rotation age of 120 years, depending on site conditions (Table 5.8-3).

USFS Wilderness and National Monument Lands – The USFS also manages wilderness and national monument lands within the Lewis River watershed: the Mount St. Helens National Volcanic Monument (the Monument), the Mount Adams Wilderness Area, and the Indian Heaven Wilderness Area. The Monument occupies approximately 32,700 acres (13,233 ha) and there are 17,100 acres (6,920 ha) are within the 2 wilderness areas. These areas include forested and non-forested lands that are managed for the protection of natural resources and unique resource values. Commercial forest management activities are prohibited, and silvicultural practices for wildlife habitat management are restricted. The intent is for forest lands to follow a natural successional pathway toward development of a climax plant community, barring significant landscape-scale disturbances such as fire.

PacifiCorp Lands – While PacifiCorp might be considered a private industrial forest landowner, its primary management objective is not timber production, but the protection and enhancement of wildlife and terrestrial resources. This separates PacifiCorp from other landowners in the watershed who have objectives for either multiple use management or economic returns. Just under half (approximately 5,600 acres [2,266 ha]) of the 10,380 upland acres (4,200 ha) in PacifiCorp's ownership is currently managed under the Merwin Wildlife Habitat Management Program (PacifiCorp 1998). Forest management practices are conducted on approximately 4,100 acres (1,659 ha) (less special management sites such as riparian, wetland, lakeshore, and highway buffers) of the 5,600 acres (2,266 ha) within the Merwin Wildlife Habitat Management Area. The predominant tree species are Douglas-fir, red alder, and big-leaf maple, although western hemlock and western red cedar also occur on more mesic sites. The ages of mature stands are typically 60 to 70 years old.

The management of PacifiCorp's forest land adjacent to Lake Merwin is directed by the Standard Operating Procedures (SOP) for implementing the Merwin Wildlife Habitat Management Program (PacifiCorp 1998). Upon award of the FERC license for the Merwin Hydroelectric Project in 1983, PacifiCorp agreed to implement the Merwin Wildlife Habitat Management Plan (WHMP), which was developed in collaboration with the WDFW (FERC License Article 48). A management plan has not been developed for PacifiCorp's other lands within the basin, and forest management activities have been limited on those lands pending plan development. In addition, PacifiCorp owns forest land adjacent to the Yale and Swift Projects.

The SOP manual for the Merwin lands is organized by habitat or wildlife feature. Most of the information regarding PacifiCorp's forest harvest practices is contained in the section titled Forest Management, although additional information is also included in the

Old-Growth Management, Snag Management, Wetland Management, and Raptor Management sections. Forest management practices for timber harvest, reforestation, application of forest chemicals, and road construction and management are designed by a consulting forester in coordination with PacifiCorp staff to ensure that forest practice regulations are met. Overall management is coordinated by PacifiCorp's wildlife biologist who ensures that silvicultural practices meet the short- and long-term objectives of the WHMP, while also ensuring compliance with State Forest Practice regulations.

Timber harvesting on PacifiCorp's forest land in the basin is conducted to meet wildlife habitat management objectives and planned in a manner that ensures cost-effective treatments. Specific techniques and practices related to planning, harvest, and replanting are summarized as follows:

- Harvest Unit Planning and Logging Systems – Harvest unit boundaries and roads are designed to fit the topography and avoid the potential for restricting access to adjacent stands in the future.

- Unit Size and Timing – Harvest units are generally <30 acres (12 ha), except in special situations such as blowdown salvage. The timing of harvest for contiguous areas is determined based on the allocation of cover/forage habitat within a management area and the desire to provide the greatest distribution of cover and forage areas. Harvests are planned to maintain a minimum of 8-10 years between adjacent harvest areas, or to provide approximately 200 feet (61 m) of cover between harvests less than 8-10 years old. It is estimated that conifer regeneration will reach approximately 10 feet (3 m) in height and provide hiding cover for elk at 8-10 years of age.

- Cable Yarding and Tractor/Wheeled Skidding – The selection of cable yarding versus ground-based skidding for harvest units is determined on a site-specific basis. A yarding system is selected based on the topography of the site, existing or planned road network, the silvicultural treatment proposed, and the economic cost of yarding. PacifiCorp generally selects the least-cost yarding system for the site to meet their silvicultural objectives and forest practice regulations. The type of silvicultural treatment can often be the most limiting factor for the selection of a yarding system when non-clearcut harvest treatments are proposed.

- Post Harvest and Site Preparation – Standard operating procedures for harvest sites include the reduction of slash concentrations. General guidelines require that slash depths greater than 2 feet (0.6 m) be reduced by piling and selective burning; some piles may be left unburned to provide habitat for small animals. Broadcast burning and mechanical scarification are typically used to prepare the site for regeneration.

  All disturbed areas and clearcut harvest units are seeded with a grass-legume seed mix following the completion of harvest practices. The objective of seeding is to provide additional forage for wildlife species, reduce the potential for erosion, and reduce the future use of herbicides by controlling the establishment of alder.

- Sustained Yield – PacifiCorp maintains the forest and habitat inventory information in a geographical information system (GIS) application. GIS is used to plan and maintain a timber harvest schedule for the Lewis River forest lands based on a 70-year harvest cycle. Additional scheduling constraints ensure that a relatively even distribution of age classes is established. The distribution maintains a sustained yield of harvesting and the desired allocation of habitat features across the landscape and throughout the rotation.

- Reforestation - Douglas-fir is the primary species planted on PacifiCorp harvest units, with western red cedar, western hemlock, and ponderosa pine planted on a site-specific basis to improve stand diversity or to establish resistant species in areas infected with root rot. Planting is generally conducted at densities of approximately 350 – 400 trees per acre to meet stand establishment objectives and account for some mortality. Recently established stands are monitored during the first 3 to 5 years for survival, and to determine the influence of competing vegetation upon conifer seedlings.

- Road Design, Location, and Construction – Roads constructed on PacifiCorp lands for the purpose of managing forest lands and activities are designed to the minimum standard necessary to facilitate these activities. New roads are generally constructed immediately prior to timber harvest activities. On occasion, new roads may be constructed a year before harvest to facilitate proper timing of harvest activities.

- Road Construction and Maintenance – PacifiCorp limits the construction of roads for forest harvesting as much as possible, and restricts public access by gating these roads. This limitation reduces the cost of forest management practices, while minimizing the impacts to sensitive resources attributed to roads. PacifiCorp minimizes the amount of maintenance necessary on their forest roads by closing most roads immediately following harvest activities. PacifiCorp is developing a road maintenance plan to address the requirements of current forest practice regulations. This planning effort will allow PacifiCorp to identify any additional road maintenance needs.

- Water Crossing Structures – Water crossing structures (e.g., culverts, arched pipes, bridges) placed on streams crossing PacifiCorp roads are currently designed to pass the volume of water expected during a 100-year flood event and associated debris. Many culverts on PacifiCorp roads are designed to pass a 50-year flood event, the standard criteria in the State Forest Practice regulations at the time they were installed. The Tributary Stream Study (TER 7) documents all stream culverts that are tributary to the project reservoirs, and road cross drainage culverts on PacifiCorp land.

- Forest Chemicals - PacifiCorp uses forest chemicals (herbicides) for the silvicultural treatment of competing vegetation in young plantations, as well as to control undesirable vegetation along forest roads and under the transmission line rights-of-way (ROW). Forest chemicals are applied by manual hand application on a site-specific basis. Hand application of herbicides limits the amount applied and focuses

the application on desired target species. Mechanized and aerial application of forest chemicals is not done on PacifiCorp lands.

PacifiCorp's forest practices are primarily conducted for the purpose of maintaining or enhancing wildlife habitat features. Forest management objectives on the Merwin Wildlife Habitat Management lands are to: (1) improve big game (i.e., deer and elk) wintering areas by developing and maintaining an interspersed 50:50 cover:forage ratio; and (2) increase habitat diversity. Cover is defined as an area covered by trees ≥12 inches dbh and 40 feet high (30 cm dbh; 12 m high) with a canopy closure ≥70 percent. Forage is defined as areas with <70 percent canopy closure. Forest management is integrated with other wildlife habitat management practices (e.g., riparian management and snag development) to maximize benefits to wildlife. A sustainable 70-year rotation has been developed to meet and maintain the 50:50 cover:forage ratio (±10 percent).

Wildlife habitat on PacifiCorp land in the Lewis River Basin is managed at the species, stand, and landscape levels. Management practices are conducted to protect habitat features associated with individual species (e.g., nest sites), to provide habitat conditions for a variety of species within a small area (e.g., the conversion of an alder stand to conifer), and to provide a range of habitat types across the landscape (e.g., cover:forage ratio goals). In addition to big game habitat management, the Merwin WHMP outlines procedures implemented by PacifiCorp to ensure compliance with state and federal laws protecting raptor species. These procedures include guidelines for the protection of bald eagles, owls, ospreys, and accipiters, in addition to northern spotted owls, which are covered by State Forest Practice regulations.

Other management practices that PacifiCorp implements to protect and improve wildlife habitat in the Merwin Wildlife Habitat Management Area include:

- Retention and creation of large dbh (>25 inches [63 cm]) snags. The created snags are often in open viewing locations and have branches retained near the top of the tree to create nesting and perching habitat for osprey, eagles, and other raptors.

- Retention of wildlife reserve trees and green recruitment trees of at least the state minimum per acre and often more.

- Green recruitment trees and wildlife reserve trees average >25-inch dbh (63 cm) and more than 100 feet (30 m) tall, both well above the state requirements. In addition, green recruitment trees and wildlife reserve trees are retained in a distribution to provide some shelter and potential for seed dispersal across the stand.

- Pruning and thinning (by girdling) of young stands increases shrub and herb layers, and creates an open, useful, stand at an early age. Stands are thinned from an initial stocking of 360 trees per acre to an average of 200 trees per acre. This practice prevents stands from becoming too thick or from having too much slash on the ground, both of which would restrict understory growth.

- Experimental harvests such as shelterwood and seed tree are used in stands that would be clearcut if only economics were considered. These practices are an effort to

retain some residual stand component that will increase old-growth characteristics at an earlier age, while still providing forage for deer and elk. Unlike traditional shelterwood stands, the residual trees are not removed after 10 years.

- PacifiCorp restricts timber cutting within 1,500 feet (457 m) of occupied raptor nests during the nesting season. Surveys of proposed harvest stands are conducted prior to harvest unit design to document nest sites. PacifiCorp biologists also conduct surveys and provide protection guidelines for communal roosting sites.

- Protection of old-growth habitat - The SOP identifies 17 sites totaling 926 acres (374 ha) as old-growth. These lands are either set aside or selectively harvested to enhance old-growth features of the stand. The selective harvests that take place in old-growth reserves include conversion of alder to conifer, and selective thinning of stands that have an unfavorably high number of stems per acre. These old-growth reserves, along with riparian, wetland, and shoreline buffers, all provide habitat for old-growth obligate species such as the northern spotted owl, northern flying squirrel, and many others.

5.8.5.2 Silvicultural Techniques and Wildlife Habitat Enhancement

This section provides a generalized discussion of silvicultural practices for wildlife, followed by some techniques that might improve habitat for the analysis species identified for the Lewis River Projects (see TER 3).

Silvicultural Practices for Wildlife

The management of forested environments for wildlife requires an understanding of the ecology and management of forest vegetation, and wildlife habitat preferences. Characteristics of wildlife habitat must be described and quantified in terms of structural dimensions of the forest stand. The forest managers can then use their knowledge of the dynamics of forest growth to design treatments to direct the stand toward producing the preferred wildlife habitat. When managing for multiple wildlife species within a given area, there are often habitat features that cannot be achieved for one species without sacrificing the habitat features of another. This conflict generally results in the separation and distribution of distinct habitats across the landscape, rather than trying to develop habitat parameters for all species within all stands.

Forest landowners such as PacifiCorp, whose goal is to produce wildlife habitat, will generally implement silvicultural practices that balance the allocation of light and nutrient resources among the overstory tree species, the understory shrub species, and the forest floor herb species. These practices provide a greater range of habitat niches for wildlife than those of an industrial forest landowner. The most difficult task for a forest landowner is to understand the habitat needs of each wildlife species, and the conflicting silvicultural treatments that would result from managing for all species on each site. Forestry/wildlife managers have to balance different silvicultural treatments across the landscape, plant community types, and time series to ensure that they are maintaining the appropriate amount and distribution of habitat for the desired wildlife goals.

A range of silvicultural decisions can be made on any site. Table 5.8-4 identifies the site characteristics that a land manager must consider and the possible silvicultural treatments that might be applied alone or in combination throughout the life-cycle of a forest stand. Site characteristics, as well as the silvicultural treatments and timing chosen by the land manager will result in stand conditions and plant communities that support, or are preferred by, certain wildlife species. Consider, for example, a western Washington site managed with the following combination of decisions: clearcut; no retention of snags, green trees, or down logs; no site preparation; reliance on natural regeneration; no vegetation management; and no thinning treatments. The result would likely be a red alder stand with a forb understory. The same site, managed with a different silvicultural decisions (e.g., clearcut; retention of large snags' plant Douglas-fir and western hemlock; herbicide control of alder regeneration; and thin to 200 trees per acre after crown closure) would likely be a conifer stand with a minor shrub component and a sword-fern/forb understory. Each of these results produces habitat for a different suite of wildlife species.

Table 5.8-4. Potential site characteristics and silvicultural options.

Site Characteristics	Plant association, soil type, climate, elevation, slope, aspect, presence of natural disturbance	
Silvicultural Treatment	**Options**	**Considerations**
Harvest Type	Clearcut, seed tree cut, shleterwood cut, group selective cut, individual tree selective cut	
Site Preparation	None, broadcast burn, pile and burn, mechanical scarification, herbicide	Season of treatment
Regeneration	Natural, seeding, planting	Species composition, seeding rate, stocking density, survival rate, timing
Management of Competing Vegetation	None, target certain species	Control method (mechanical, manual, chemical); and timing, intensity, and frequency of control
Intermediate Stand Treatment	None, pre-commercial thinning	Residual density, target species, species composition, crown class, spacing, timing within rotation, interval between treatments

Silvicultural decisions for the purpose of wildlife habitat management are made on a site-specific basis, and are designed to address the habitat requirements of the desired wildlife species. In general, if the objective of the wildlife manager is to improve habitat conditions for a species that uses coarse woody debris on the forest floor as its predominant habitat, silvicultural decisions would follow a different pathway than those leading to improved thermal cover. Depending on the original stand condition, a single set of silvicultural decisions possibly could be used to achieve both of these objectives. Since there are many possible habitat objectives for the species being managed in the Lewis River Basin, there are multiple combinations of silvicultural decisions for each set of habitat objectives. Therefore, it is not reasonable to describe possible silvicultural prescriptions for forested stands within the context of this report. The purpose of forest and wildlife management planning is to provide the framework and guidelines under which site-specific silvicultural decisions can be made to achieve project-level goals.

Silvicultural Treatments to Enhance Habitat for Analysis Species

To understand the management of forests for wildlife habitat, it is important to know the habitat conditions preferred by the wildlife species to be managed. Sixteen wildlife analysis species have been selected for evaluation in this study:

- Cascade torrent salamander (*Rhyacotriton cascadae*),
- Larch Mountain salamander (*Plethodon larselli*),
- Northern red-legged frog (*Rana aurora*),
- Great blue heron (*Ardea herodias*) rookeries,
- Wood duck (*Aix sponsa*)
- Bald eagle (*Haliaeetus leucocephalus*),
- Cooper's hawk (*Accipiter cooperii*),
- Peregrine falcon (*Falco peregrinus*) eyries,
- Northern spotted owl (*Strix occidentalis*),
- Northern flying squirrel (*Glaucomys sabrinus*),
- Band-tailed pigeon (*Columba fasciata*) mineral sites
- Pacific Townsend's big-eared bat (*Corynorhinus townsendii*),
- Beaver (*Castor canadensis*),
- Marten/fisher (*Martes americana*/*M. pennanti*),
- Elk (*Cervus elaphus*),
- Papillose tail-dropper (*Prophysaon dubium*)

The sections below summarize the primary habitat characteristics and forested conditions that are preferred by the analysis species and suggest forest practices that could be used to improve habitat for each.

Cascade Torrent Salamander – The Cascade torrent salamander is strongly associated with rocks bathed in a constant flow of cold water. They also inhabit cool rocky streams, lakes, and seeps, although they tend to remain in the splash and spray zone of streams and waterfalls. They are very dependent on nearly continuous access to cold water, although they can be found moving about in the forest during wet weather (Csuti et al. 1997). Several studies have found that members of the genus *Rhyacotriton* are more common in areas of mature forests than in younger forest stands (Bury and Corn 1988; Welsh 1990; Corn and Bury 1991).

Habitat requirements of this species would suggest a forest management plan favoring old-growth riparian areas. Preserving a wide enough riparian buffer to adequately shade creeks and minimizing road and timber harvest related erosion would help maintain cold clear water. Successively retaining mature trees when buffering streams would help ensure such conditions.

Larch Mountain Salamander – The Larch Mountain salamander prefers moist, cool talus slopes, often with sparse understories, high litter content, and little mineral soil. These talus areas usually have large rocks on the surface (>7 cm [2.75 inches]) and a layer of gravel underneath (Herrington and Larsen 1985). This species tolerates drier conditions

and is rarely found in saturated areas. Their distribution is most continuous on north-facing slopes (Csuti et al. 1997).

Potential management for the Larch Mountain salamander includes leaving forest buffers around existing (especially north-facing) talus slopes to keep the slopes shaded through hot summer months. To avoid fragmenting habitat for this species, roads should be constructed to avoid shaded talus slopes and their forested buffers. One of the most significant threats to this species is habitat destruction from the use of talus for forest road construction (Bull and Wales 2001). The use of native talus material from the Lewis River Basin, which supports several known populations of Larch Mountain salamanders, should be avoided.

Northern Red-Legged Frog – The northern red-legged frog breeds in wetlands, ponds, and other stillwater areas. Adults are found in meadows, woodlands, and forests associated with ponds, marshes, and streams. They favor areas with dense ground cover and aquatic or overhanging vegetation (Csuti et al. 1997). Red-legged frog tadpoles are greatly impacted in survival and micro-habitat selection by non-native fish and amphibians such as the small mouth bass and bullfrog (Kiesecker and Blaustein 1997).

Forest practices that retain wetland buffers wide enough to maintain suitable water temperatures during ovipostion, egg development, and tadpole maturation stage are probably the best ways to protect red-legged frog habitat. Riparian and wetland buffers should also ensure wood debris levels adequate to provide cover for adult frogs. Habitat improvements for this species in the Lewis River Basin might include efforts to eradicate the bullfrog from some critical wetland habitats. Ponds and wetlands used by the red-legged frog for breeding must have water that is very cold during the egg laying period but that warms quickly enough for egg development. Small wetlands and ponds that are currently surrounded by conifers and not used by red-legged frogs for breeding might be too cold to be suitable for egg development. These wetlands could be improved by selectively removing conifers to increase solar radiation and promote warmer water temperatures in the late winter/early spring (Febrary-March). Buffers could then be replanted with big-leaf maple, cottonwood, or green ash. These species provide habitat for a number of species but would allow sunlight to reach adjacent wetlands in the winter because they are deciduous.

Great Blue Heron Rookeries – Potential habitat for heron rookeries includes wetland or riparian areas with a sufficient overstory of dense structural vegetation capable of providing cover and physically supporting colonial wading bird nests (Csuti et al. 1997). Blue herons may occasionally nest on rocky ledges or in dense emergent vegetation. Suitable potential heron rookery habitat exists within the study area along Speelyai Creek, throughout the Swift No. 2 bypass reach, along the lower river in the vicinity of Eagle Island, and in the Beaver Bay wetland (see TER 3 - Analysis Species Assessment). Great blue herons could potentially use these areas for nesting as well as any of the larger forested wetlands and shoreline areas with a dense vegetative structure.

Great blue herons in the project vicinity are currently thought to nest in isolated pairs. No heron rookeries are known to exist in the project vicinity, and it is difficult to assess

the potential for establishment of one. Avoiding timber harvest in any areas that support large trees, particularly cottonwoods, near the project reservoirs and along Swift bypass reach is probably one of the best ways to protect potential rookery habitat for herons. Buffering these areas from disturbance from nearby timber harvest should also be considered.

Wood Duck – Wood ducks are most commonly found in riparian forests and forested wetlands. This species nests in tree cavities adjacent to lakes and marshes. Deciduous and coniferous trees >18 inches (46 cm) dbh, with cavity entrances of approximately 4 inches (10 cm) diameter, are preferred. Wood ducks use down logs and dense low shrubs for cover along shorelines. Suitable cavity availability and visibility are the primary predictors of nest site selection. Basal area and tree density have been shown to be secondarily important (Robb and Bookhout 1995).

When managing for wood duck habitat in the Northwest, it is important to retain natural hardwood thickets, especially near wetland areas. Large deciduous trees near wetlands, particularly big-leaf maples and cottonwoods, should be retained to become large enough to create cavities. Cottonwood trees often offer good nesting habitat at an early age (Robb and Bookhout 1995); thus, retention of this species near wetlands can be particularly beneficial to wood duck habitat. Preventing timber harvest activities in buffers around wetlands should ensure protection of large trees, down logs, and dense low shrubs. The WDFW recommends maintaining mast-producing trees and shrubs, such as oaks (*Quercus garryana*) and hazelnuts (*Corylus cornuta*) (Lewis and Kraege 2003). An additional management tool for this species might be the creation of large snags near wetlands. This could be accomplished in conjunction with timber harvests planned near forested wetlands.

Large woody debris and downed logs should be retained within wetlands managed for wood ducks, as well as low islands for breeding and brood use (Lewis and Kraege 2003). Flooded timber should not be logged, and woody vegetation along the shores of nesting and brood areas should be retained. In some situations, flooding standing or downed timber may be used to create snags and brood habitat (Lewis and Kraege 2003). The use of pesticides or herbicides may negatively affect this species and should be minimized near nesting areas.

Bald Eagle – The structure of individual trees in relation to the adjacent trees in the stand is the most important forest habitat characteristic for bald eagles. Forest habitat is used for nesting, roosting, and perching. Dominant trees with visual access to adjacent habitat are preferred for nesting and perching. Trees selected for roosting are often codominants that can provide shelter from adverse weather conditions (Stalmaster et al. 1985).

The creation of snags and the retention of existing snags and residual large trees are essential to providing perch, roost, and nest sites for the bald eagle (Stalmaster 1985). The WDFW recommends a “protected zone” of at least 400 feet (120 m) around nest sites for timber harvest or development, and an additional “conditioned zone” for further protection. This secondary zone should extend 330-800 feet (100-240 m) beyond the protected zone, with size dependent on screening vegetation and prevailing winds,

topography, and the sensitivity of the pair to disturbance (Watson and Rodrick 2001). A buffer should also be left around unoccupied nest sites to make sure that room is left for an expanding population. The recommended buffer width for timber harvest activities around roost sites is 400 feet (120 m). To protect perching habitat, WDFW recommends retaining trees >20 inches (51 cm) dbh within 246 feet (75 m) of shorelines that represent potential perch sites. Trees should be preserved in patches to protect from windthrow (Watson and Rodrick 2001). Mathisen et al. (1977) provide examples of site specific nest territory buffering.

Cooper's Hawk – In Washington, the Cooper's hawk is considered uncommon in low and middle elevation conifer forests, preferring hardwood stands when available (Smith et al. 1997). It can be also be found in younger mixed coniferous forest, riparian forest stands, and forested wetlands. This species appears to have adapted to habitat fragmentation associated with increased human development and is known to inhabit relatively urbanized areas (Ferguson et al. 2001).

Within the study area, Cooper's hawks are most likely to occur in the upland deciduous forests and mixed conifer-deciduous forests with large hardwoods such as big-leaf maple. These habitats are common, especially along Lake Merwin and Yale Lake. The Cooper's hawk was observed once during relicensing field studies–along Speelyai Creek in September 2000. Although somewhat common in appropriate habitat, Cooper's hawk density is often relatively low, with nests not located closer than 2 miles (3.2 km) from one another (Csuti et al. 1997).

Managing for mixed conifer-deciduous forests, particularly those with big-leaf maple and an open understory, would be a good general tactic for improving habitat for the Cooper's hawk. Silvicultural practices such as replanting with a mix of Douglas-fir and big-leaf maple, as well as thinning some pole and mid-successional stands with these 2 species, might be potential management tools. Given that this species is slightly more adaptable than some other analysis species, establishment of buffers that preserve stands of large deciduous trees in riparian areas and near wetlands would also benefit the Cooper's hawk.

Peregrine Falcon Eyries – The most critical habitat component for the regular occurrence of peregrine falcons is the presence of suitable nest sites, usually cliffs or rock ledges overlooking open areas with an ample food supply (Csuti et al. 1997). No peregrine eyries are known to exist in the study area, and none were detected during aerial helicopter surveys. Located at the northeast end of Swift Reservoir, Eagle Cliff represents the only potential peregrine nesting habitat in the study area. There are no silvicultural practices that would benefit potential peregrine falcon habitat. If an eyrie were established, suitable buffers around any nearby timber harvest activities would need to be established during the nesting season.

Northern Spotted Owl – Spotted owls are strongly associated with uneven-aged, multi-layered canopies. Overstory trees are typically greater than 200 years old, and understory trees are uneven in size and age, ranging from young saplings to large saw timber. Understory trees generally consist of shade-tolerant species such as western hemlock and

western red cedar. The composite canopy closure for all tree layers is generally greater than 70 percent. These stands typically have a moderate to high number of old trees with structural damage and decay, which are used for nest sites (Forsman et al. 1985). The most extensive stands of old-growth and late-successional conifer forest in the study area exist along the south shore of Swift Reservoir, especially in the vicinity of Drift Creek. Spotted owls are known to occur in the Lewis River Basin. WDFW and the USFS have mapped known territories in and around the study area, and the species was observed at least once during field studies for the Yale Project (see TER 3 and PacifiCorp 1999).

Possible silvicultural treatments to manage for northern spotted owl habitat have been heavily studied. Spotted owl density is thought to be positively correlated with mature forest patch (stand) size (Lehmkuhl and Raphael 1993). Home ranges for this species may be related to prey abundance and can be extremely variable. For example, minimum home rang sizes for spotted owls in the southern Oregon coast range were estimated at 2,849-9,748 acres (1,153-3,945 ha) and contained 1,793-2,624 acres (726-1,062 ha) of old-growth (Carey et al. 1990). Owls in mesic west side Washington forests rely on the northern flying squirrel as their primary prey source. In Oregon and California, which are at the southern limit of the northern spotted owl's range, wood rats and other small mammals are predated in addition to the northern flying squirrel. In places where the flying squirrel is the primary prey item, the area of "old forest" required in the home range is about 4,200 acres (1700 ha). This amount is almost double the area of "old forest" (1,977 acres [800 ha]) in the home ranges of owls that include a mix of wood rats and flying squirrels as prey (Carey et al. 1992). In areas where the flying squirrel is the primary prey source, prey densities averaged 0.9 oz/acre (61 g/ha); northern flying squirrel populations are depressed. Conversely, in areas where 2 prey species were commonly utilized, there was an average prey density of 2.5 oz/acre (244 g/ha), and neither small mammal population was depressed (Carey et al. 1992). In light of these studies, the management of spotted owl habitat in Washington should follow similar guidelines to the management of habitat for northern flying squirrels. Secure denning locations, adequate forage material, and a closed canopy are all important to the survival of the northern flying squirrel and therefore also the northern spotted owl.

A study in western Oregon compared the characteristics of randomly selected forest stands to areas known to be used by spotted owls. Forest stands used by spotted owls had more area covered by old growth, larger patches of old growth, and less area of younger trees than did randomly selected forest stands. However, the amount of clearcut did not differ between owl home ranges and random stands (Meyer et al. 1998). In addition, proximity to large diameter snags is a significant indicator of good spotted owl habitat (Mills et al. 1993). Forsman (1976) found that an average coniferous forest in the Northwest would take 175 to 200 years to produce characteristics suitable for spotted owl nesting. Therefore, management for the northern spotted owl in the Lewis River Basin should emphasize the retention and development of blocks of mature and old-growth timber. Clearcuts should not be replaced by extensive commercial thinning, as some owls do not seem to select against fragmentation within their home range (Meyer et al. 1998). Where possible, stands adjacent to existing mature and old-growth areas should be managed for early development of key old-growth forest characteristics. In addition, the retention of the oldest existing trees within a stand is critical.

In general, the goal of silvicultural treatments to conserve the northern spotted owl should be to provide a closely spaced reserve of old forest for this species. However, dispersing spotted owls have been shown to range up to 69 miles (111 km), enabling them to move across fragmented landscapes (Foresman et al. 2002). Even in areas where it is not possible to maintain the large stands of old-growth necessary to provide breeding territories for spotted owls, avoiding the creation of extensive clearcuts and young forest can at least aid in the dispersal of this species between reserves (Forsman et al. 2002).

Northern Flying Squirrel – Northern flying squirrels require a forest mosaic with adequate denning and feeding areas. Flying squirrels are hypothesized to be limited by the presence of secure den locations, and adequate forage material (Carey et al. 1997). Den sites include tree cavities formed by wood rot, frost cracking, and woodpeckers, and witches brooms formed by mistletoe infection. These habitat features are more commonly found in mature and old-growth stands. Feeding areas may be in either young or old forests that contain fungi (mushrooms and truffles), berries, and tree lichens (ADFG 1994).

Retention and creation of snags that could support cavities for den sites could prove successful in improving habitat for the northern flying squirrel. Residual conifer trees and conifer snags are likely candidates for early successional cavity production. Thinning without the production or retention of residual trees or snags is detrimental to flying squirrel populations due to their high canopy closure needs (Carey et al. 1997).

Current logging practices in most commercially managed forests involves cutting 40- to 50-year old trees close to the ground, leaving few stumps, large snags, or logs. Thinning often removes all live trees with defects that could be used as future den sites for flying squirrels (Carey et al. 1997). Recommended silvicultural methods to benefit this species include the following: (1) leave large logs and tall, large diameter tall stumps to provide maternal dens; (2) retain green trees to provide future den sites; (3) retain existing flying squirrel den sites (i.e., live trees with cavities or platform branching); and (4) creating cavities in large live trees where needed (Carey et al. 1997).

Band-Tailed Pigeon (Mineral Sites) – Band-tailed pigeons inhabit coniferous forests throughout the Pacific Northwest and typically nest in conifers in mature, closed-canopy stands (Leonard 1998). The species forages on acorns, buds, blossoms, young leaves, needles, fruits, and berries (Jarvis and Passomore 1992). Aside from the importance of an ample food supply, the distribution of band-tailed pigeons is thought to be predicated upon the existence of natural or artificial mineral sites (Sanders 1999). It is hypothesized that ingesting mineral-laden substrate and/or mineral water provides band-tailed pigeons with necessary sodium, or potentially calcium, which they do not receive from a diet dominated by fruit and berries (Sanders and Jarvis 2000). These mineral sites are especially needed during the breeding season for egg and crop milk production. In the project vicinity, the nearest known mineral source for the band-tailed pigeon is in the Canyon Creek drainage south of Lake Merwin (pers. comm., L. Ackers, WDFW biologist, 2002).

The existing mineral site at Canyon Creek and any newly located sites should be protected from nearby timber harvest by buffers. Trees surrounding these sites are important for perching, and their removal should be avoided (Lewis et al. 2003). WDFW recommends avoiding large clearcuts in band-tailed pigeon habitat. Berry and mast-producing shrubs and trees should be planted in areas that are cut to enhance the food supply for this species (Lewis et al. 2003). The use of herbicides to control deciduous trees and shrubs on lands managed for timber production is thought to have potentially decreased forage plants for the band-tailed pigeon (Lewis et al. 2003).

Pacific Townsend's Big-Eared Bat – The presence of suitable roost sites is the primary factor in the distribution of the Pacific Townsend's big-eared bat. The type and structure of vegetation are not as important in habitat preference. This bat species will roost in buildings, caves, mines, and bridges. They tolerate relatively cold environments during hibernation because of their ability to drop their body temperature down to 34°F (1°C). They are, however, very intolerant of human disturbance during hibernation and at summer roosts, particularly those used as nursery sites (Csuti et al. 1997).

When managing for the Pacific Townsend's big-eared bat, it is important to restrict public access to known roosting sites and to preserve existing man-made roosting structures. Habitat management recommendations regarding vegetation include the following: (1) maintain or improve riparian areas and wetlands within 10 miles (16 km) of roost sites; (2) restrict burning within 0.5 mile (0.8 km) of roost sites to unoccupied periods; (3) avoid timber harvest within 0.25 mile (0.4 km) of maternity roosts between April 1 and October 1; (4) provide a buffer of at least 500 ft (152 m) at roost entrances; and (5) construct roads to minimized visibility of roost entrances (Pierson et al. 1999).

Beaver – The beaver can be associated with almost any type of vegetation cover type as long as there is adjacent year-round water. They prefer water bodies with a water depth of approximately 2-3 feet (0.6-0.9 m), or where such depth can be created by a dam. They are strictly herbivorous and consume all type of leaves, buds, and branches of woody plants, as well as aquatic and herbaceous plants growing near water. Willow is their preferred food species (Csuti et al. 1997). Beaver have been found more often on lower gradient streams, with higher percentages of hardwood species in the riparian zone (Beier and Barrett 1987).

Beaver can be beneficial in creating wetlands used by many wildlife species. When managing for beaver habitat in the Northwest, it is important to retain natural riparian hardwood thickets without conversion to conifer-dominated stands. In addition, clearcutting on steep and unstable slopes should be limited due to the potential for debris and sediment flow through downstream riparian areas. Planting small trees and shrubs, particularly red alder, willow, and red-osier dogwood, in buffers around streams and wetlands can improve poor quality habitat for this species.

American Marten – American marten are primarily associated with late-successional stands of mesic conifers, especially those with complex physical structures near the ground (talus, rock, large logs) (Buskirk and Ruggiero 1994). They generally den under logs or in hollow tree stumps and are intolerant of areas lacking overhead cover, which

provides protection from predators (Buskirk and Ruggerio 1994). The marten may be an inhabitant of the low mesic forest near the Merwin WHMP, but there are no observation records of this species in the study area.

Stands containing old-growth characteristics, including an open understory, and a dense configuration of down woody debris are critical to preserving marten populations. These characteristics can be created in younger stands by retaining large snags and residual green trees that have large cavities and other deformities. Small-scale heterogeneity of vegetation, including the availability of herbaceous patch within areas of large, old trees, are also important for producing prey species for marten (Buskirk and Ruggiero 1994). Seeding after harvest might also provide the herbaceous vegetation needed to support prey. Commercial thinning treatments should be minimized. Leaving LWD and keeping the canopy closure above 70 percent might help minimize the impact of thinning. Marten are easily disturbed, so human activity in stands containing habitat suitable for marten should be minimized (Buskirk and Ruggerio 1994). This includes recreational activities but particularly thinning and other disturbances related to timber management cycles.

Fisher – Fisher populations are extremely low in the Pacific Northwest, and this species is considered very rare in Washington and may be extirpated (Aubrey and Houston 1992). In the Pacific Northwest, fishers are considered closely associated with late-successional stands, although it appears that the species can inhabit any forested area with a suitable prey base and adequate denning and nesting sites. Riparian areas are considered important habitat for the fisher in Idaho and California (Powell and Zielinski 1994). Like marten, the fisher will avoid open areas whenever possible, although they will occasionally use recently harvested areas if there is adequate cover (Powell and Zielinski 1994). They use den sites in hollow logs, stumps, brush piles, or under rocks. If they occur in west-side Cascade forests, such as the Lewis River, fishers would be expected to be associated with low to mid-elevational forests dominated by late-successional and old-growth Douglas-fir and western hemlock forests (Aubry and Houston 1992, Powell and Zielinski 1994).

Forest management for fisher is much the same as that for marten. Late-successional forests with complex physical structures are preferred. Commercial thinning treatments and other forms of stand disturbance should be minimized. Coarse woody debris, an open understory, high canopy closure, and intact riparian areas are critical to the movement and survival of the fisher. Additionally, open hardwood forests are often avoided by fisher (Powell and Zielinski 1994). This would suggest that over time the conversion of red alder stands, especially in moderately sloped riparian areas, could be beneficial to fisher.

Elk – Elk and deer use of forested environments is one of the most studied of all wildlife species and habitat relationships. The primary reason for this interest is the economic value associated with the commercial harvest of forest products and revenue to state agencies and local communities from recreational hunting. Only a brief description of the habitat characteristics for elk is presented below. Additional information on elk habitat relationships can be found in Chappell et al. (2001), Csuti et al. (1997), and Witmer et al. (1985).

Elk use a wide range of habitat conditions, both forested and non-forested. Elk habitat is generally classified as either forage or cover, with cover further differentiated as hiding cover, thermal cover, or mature/optimal cover. The definitions of these types of habitats as described by Witmer et al. (1985) are listed below.

- Forage: Vegetated areas with less than 60 percent combined canopy closure of tree and tall shrubs greater than 7 feet (2 m) in height.

- Hiding Cover: Vegetation capable of hiding 90 percent of a standing adult elk at 200 feet (61 m) or less.

- Thermal Cover: A forest stand at least 40 feet (12 m) in height with a tree canopy cover of at least 70 percent.

- Mature/Optimal Cover: A forest stand that provides the functions of hiding and thermal cover, in addition to intercepting snow and providing forage during the winter.

These habitat definitions are not mutually exclusive, do not necessarily include all types of habitat used by elk, and do not describe all factors that influence the distribution, abundance, and survival of elk. Other factors that influence habitat use are roads, spatial distribution of habitats, and the level of disturbance by humans or predators. The optimal 50:50 cover:forage ratio that was recommended in the Merwin WHMP was derived by taking an average of the optimal coverage:forage ratios found in several studies done in the Rocky Mountains on optimal wintering habitat for elk (PacifiCorp 1998). This ratio may be unnecessarily skewed toward cover habitat in the lower elevations of the Lewis River drainage due to the relatively mild winter temperatures.

Silvicultural practices to benefit elk habitat are described in Witmer et al. (1985); those applicable to the Lewis River area include the following;

- **Harvest unit scheduling**

    - Schedule harvest units to cover the management area over the entire rotation period;

    - Disperse harvest units at low, mid-, and high elevations during the same timeframe to achieve a year-round balance of forage and cover;

    - Distribute harvest units throughout the management unit to avoid creating 1 large clearcut in forage condition;

    - Design harvest units to have no more than one-quarter of its border adjacent to hiding cover; at least one-half of its border adjacent to thermal cover stands >30 acres (12 ha); and

    - Locate harvest units to create forage blocks within large uncut forested areas.

- **Harvest unit design**
    - Schedule harvest activities to minimize disturbance to big game during critical periods (i.e., breeding, calving);
    - Design harvest units to conform to topographic features on the landscape;
    - Create harvest units where all portions are within 600 feet (183 m) of cover; if units must be larger, then patches of residual vegetation should be left to provide hiding cover;
    - Wait until clearcuts have reached the closed pole stage before harvesting adjacent units;
    - Leave buffer strips to screen natural openings; and
    - Provide travel corridors of hiding cover between natural opening and nearby cover.
- **Debris management**
    - Broadcast burn slash while ground is damp to protect root systems of forage species;
    - If the area is scarified, provide openings in debris every 200-300 feet (61-91 m) to allow passage routes for big game; and
    - Pile debris parallel to roads to serve as visual barrier and protective cover.
- **Precommercial thinning**
    - Thin before canopy closure eliminates forage species;
    - Thin when tress are 10-13 feet (3-3.9 m) in height to reduce barriers created by slash accumulation;
    - Lop and scatter or gather and stack trees removed when thinning older stands; and
    - Clear travel lanes for big game in no other slash disposal is planned.
- **Commercial thinning**
    - Alternate blocks thinned to less than 50 percent crown cover to those with greater amounts; and
    - Thin to the degree to permit the most rapid growth and structure development of overstory trees.

- **Seedling, planting, and fertilizing**
    - Seed forage that is palatable and nutritious to elk;
    - Fertilized seeded or planted forage twice, first for establishment and later to stimulate growth and increase nutritive value;
    - Establish tree stocking rates that will allow the longest period before canopies close and shade out understory forage species; and
    - Provide areas of permanent forage where other management consideration preclude timber harvest. Plant and fertilize preferred forage species.

Papillose Tail-Dropper – The papillose tail-dropper is found primarily in moist forests, normally late-successional or, if second-growth, with late-successional attributes. This slug seems to prefer sites containing hardwood logs and leaf litter, particularly those with fungal fruiting bodies (BLM 1999). They are sometimes found in second-growth stands that were not burned for slash disposal or site preparation if sufficient habitat elements remain. A typical site would contain an abundance of large and small woody debris (conifer and hardwood) scattered over the ground. Large logs in better habitats cover 1,000 or more linear feet per acre (753 m/ha). Logs in decomposition classes 2-4 (Maser et al. 1979) are probably most often used. The ground is shaded and covered by moist layers of duff and leaf litter. This species has been found in a range of forest canopy closure levels. In an analysis done in southwest Oregon, the majority of observations were in areas with canopy closure greater than 70 percent (BLM, 1999).

Forest management for the papillose tail-dropper could include the following: (1) reducing the scarification and burning of clearcut areas; (2) increasing the amount of down wood, especially in stands with old-growth characteristics by girdling red alder and big-leaf maple trees to create more abundant hardwood debris; (3) eliminating the harvest of big-leaf maple trees in an effort to provide abundant leaf litter; and (4) continuing to buffer and shade riparian areas to preserve moisture during dry periods (BLM 1999).

5.8.5.3 Recommendations

There are 3 habitats/element preferred by the majority of the analysis species. These include intact riparian corridors, abundant snags and down wood, and old-growth conifer stand components. All of the analysis species would benefit in various ways from a forest managed with those 3 habitats/element in consideration. In addition, these habitats/elements all contribute to water quality, fish habitat, and flood and erosion control. On project lands, other habitat preferences that could be managed for with little to no extra effort include preserving buffers around north-facing or other shaded talus slopes for the Larch Mountain salamander, especially at Yale Dam and Moss Cave where they are known to occur; restricting public access to known bat roost sites such as Moss Cave; and retaining cottonwood and other hardwoods around wetland areas.

Managing habitat on utility-owned land to provide the greatest benefit for the most species will require developing a Comprehensive Wildlife Management Plan (CWMP) for the Lewis River Projects. This plan should incorporate and expand the forest management practices proven successful under the Merwin WHMP. It should also target old-growth and riparian species as indicated by HEP Study (TER 2) and the Analysis Species Assessment (TER 3). The most extensive stands of old-growth and late-successional conifer forest exist along the south shore of Swift Reservoir, especially in the vicinity of Drift Creek. Although these lands are managed by the USFS, they should be included in the CWMP for lands around the reservoir to provide an integrated approach. Management of these stands could include, but not be limited to, the following: (1) maintaining large blocks of uncut late-successional forests that are managed to speed the development of old-growth characteristics; (2) preserving mixed and conifer-dominated riparian corridors through selective harvest techniques; and (3) retaining snags in harvest areas and creating snags in areas where they are notably absent.

Additionally, the management practices in place on the Merwin WHMP lands should be continued when harvest plans are developed for utility-owned lands around Yale Lake and Swift Reservoir under the CWMP. These practices include the following: (1) retention of ≥5 trees per acre (≥ 25 in. dbh [63 cm]) through successive timber harvests, with 2 developed as snags; (2) girdling and pruning of standing trees during pre-commercial thins to improve wildlife access; and (3) grass-legume seeding of all areas bared during timber production. Sites with a significant alder component should be converted to conifer-dominated stands. Residual conifer trees should be retained to increase stand diversity and keep the understory open. Pre-commercial and commercial thinning should primarily create healthy, late-successional forest stands. Stand entries for harvest treatments should be limited as much as possible. Management of Yale and Swift forest lands should also incorporate spatial and/or temporal buffers that meet or exceed Merwin WHMP requirements for timber operations and construction disturbance around wetlands, riparian areas, and known raptor nest locations.

Within the Merwin WHMP lands, forest management should continue to emphasize wildlife habitat preservation and economic sustainability. This process will manage for elk by default through the creation of clearcut and partial-cut areas where grass and browse will be present. The creation of elk thermal cover habitat should become less of a factor in forest management on the low elevational lands surrounding the Lewis River because forage and hiding cover are the limiting features for the local elk population.

The CWMP should also address disturbance to vegetation and wildlife in shoreline and riparian areas from recreation. Measures to reduce the number of dispersed campsites might include improved signage, enforcement, and restrictions in identified areas with high species diversity or density. Installing gates and closing some roads to motorized use would also reduce disturbance to identified sensitive habitat areas on project lands. Riparian and aquatic connectivity for wildlife could be improved by controlling runoff and implementing measures to reduce barriers to movement in appropriate locations along streams through project lands (e.g., replace small or blocked culverts with passage-friendly, open-bottom box culverts).

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TER 8 Appendix 1

Glossary of Terms

Appendix 1
Glossary of Terms

The following section defines many of the technical terms used in this report. Due to the multiple administrative jurisdictions that manage or regulate forest practices in the Lewis River Basin, a single term may have different definitions depending on the administrative agency. The terms listed below are identified by the administrative agency based on the context in which the term has been used in this report. For a complete description of terms associated with the Washington State Forest Practices Rules, please refer to the Forest Practices Rule Book (DNR 2000, WAC 222-16, Definitions). For additional information regarding forest management terms used by the USFS, refer to the Forest Plan for the Gifford Pinchot National Forest (USFS 1995).

Abandoned Road (DNR). A road in which the landowner has abandoned in accordance with the following procedures: removal of water crossing structures and fills on all typed waters, blockage of the road to prevent the passage of vehicles, ditches left in a condition to reduce erosion, and road surfaces outsloped, water barred, or otherwise left in a condition to reduce erosion and maintain water movement in natural waterways.

Abiotic. The non-living environment.

Biotic. The living environment.

Culmination of Mean Annual Increment. The age at which the average annual growth is greatest for a stand of trees.

dbh. Diameter at Breast Height

Equipment Limitation Zone (DNR). A 30-foot wide buffer on Type 4 and 5 waters measured horizontally from the bankfull width where the operation of equipment is restricted.

Orphaned Road (DNR). A road or railroad grade that has not been used for forest practices since 1974. These roads are generally overgrown or closed off, but have not satisfied the abandonment process.

Intermittent Stream (USFS). Any non-permanently flowing drainage feature having a definable channel and evidence of annual scour or deposition.

Riparian Management Zone (RMZ) (DNR). The area protected on each side of a Type 1, 2, or 3 water measured form the bankfull width or the channel migration zone, whichever is greater. The horizontal distance of this width is based on the site class and productivity of the adjacent forest land. The RMZ is further separated into "Core," "Inner," and "Outer" zones. Within Type 4 and 5 waters, the riparian management zone is the area within the equipment limitation zone.

Silviculture. The theory and practice of controlling forest establishment, composition, and growth.

Site Class (DNR). The site index classification of forest land productivity as mapped by the Washington State Department of Natural Resources State Soil Survey.

Water Type 1 (DNR). All waters inventoried as "shorelines of the state."

Water Type 2 (DNR). Segments of natural waters that are not classified as a Type 1 water and have a high fish, wildlife, or human use.

Water Type 3 (DNR). Segments of natural waters that are not classified as Type 1 or 2 water and have a moderate to slight fish, wildlife, or human use.

Water Type 4 (DNR). Segments of natural waters that are not classified as Type 1, 2, or 3 water and that are perennial waters of non-fish-bearing streams.

Water Type 5 (DNR). Segments of natural waters that are not classified as Type 1, 2, 3, or 4 water and that are seasonal non-fish-bearing streams.

Wetland Type A (DNR). A non-forested wetland with greater than 1/2 acre of open or standing water present during a 7 consecutive day period between April 1 and October 1.

Wetland Type B (DNR). All other non-forested wetlands greater than 1/4 acre in size.

TER 8 Appendix 2

Fire Ecology and History

Appendix 2
Fire Ecology and History

Fire disturbance is an important factor in the ecology of Northwest forest environments. Fire is considered the first major force employed by humans to alter the environment. The presence of fire in forested environments has provided both positive and negative effects to the social and ecological environment. Native Americans and early European settlers used fire to clear land for agriculture, improve vegetation for browsing or grazing, and to drive game for hunting. Society has also viewed fire as detrimental to the production of valuable timber resources and the protection of natural ecosystems.

Some plant species have physiological characteristics that resist the effects of fire or have adapted traits to take advantage of recurrent fires. These physiological factors and the patterns of fire have determined the distribution and development of plant communities in some areas of the west. Trees such as Douglas-fir, western larch (*Larix occidentalis*), and Ponderosa pine (*Pinus ponderosa*) develop a thick bark layer on the lower stem to insulate and protect the trees during ground fires. Other plant species, such as lodgepole pine, and evergreen ceanothus (*Ceanothus velutinus*), have cones or seeds that require the high temperatures usually present in fire-dominated ecosystems to expose or initiate germination of the seeds. The presence of Douglas-fir dominated stands in the lower Lewis River watershed is partly a result of the fire adaptation characteristics of this species compared to western hemlock and western red cedar, which are more susceptible to the effects of fire.

Fire has also been used as a tool for managing wildlife habitat. Understory and site preparation burns stimulate the production of forb and browse species and maintain early successional stage plant communities. These types of burns provide the greatest benefit for the management of ungulate species when conducted in appropriate vegetation types and within proximity to forest stands that can provide cover. The clearcut harvesting practices commonly used throughout the Northwest provide site conditions similar to natural large-scale disturbance events (e.g., wind throw, stand replacement fire, disease, and insect epidemics) that promote the development of early successional stage species.

Although western Washington is well known for the abundant rainfall that allows the growth of diverse forest vegetation and large trees, the weather conditions during June through September can be fairly dry, increasing the risk of forest fires. The natural fire return interval for the western hemlock zone is estimated at approximately 250 years, although it varies greatly within the region (Chappell et al. 2001). Research indicates that drier settings of the Douglas-fir and western hemlock forest types in the western Washington and Oregon region may have an historical fire return interval of approximately 50 years (Heyerdahl et al. 1994). Higher elevation forest types in western Washington, comprised of mountain hemlock and silver fir, have longer fire return intervals than lower elevation forests, extending up to 800 years.

Fires have occurred in the Lewis River area several times in the last 200 years including:

- 1826: Botanist David Douglas noted the presence of recent burned-over land and ongoing forest fires around Fort Vancouver and in the lower Willamette Valley (Morris 1934).

- 1868: Large-scale fires spread throughout western Washington and the Willamette Valley. One of the fires burned as close as Fern prairie, just south of the Lewis River (Morris 1934).

- 1902: In September 1902, 2 large fires swept through the Lewis River valley. These fires converged in the valley between Ariel and Yale. The size of the burned area is estimated at 240,000 acres (DNR 1977). Another fire occurred in the Siouxon Creek drainage near this same time period, and is estimated to have covered 70,000 acres (DNR 1977).

- 1927: Fires reburned parts of the same area that was burned in 1902. The 1927 reburn occurred in the Dole Valley area of the East Fork of the Lewis River and is estimated to have covered about 47,000 acres (DNR 1977).

- 1929: 155,000 to 210,000 acres were burned between Stevenson and Yacolt along the East Fork of the Lewis River (DNR 1977).

- 1952: In November, a fire occurred in the area near Bear Prairie and was estimated at 15,000 acres (DNR 1977).