Plum Creek Timber Company, Inc.

Central Cascades Habitat Conservation Plan

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Plum Creek

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I Background

Introduction

On June 27, 1996, the U.S. Fish and Wildlife Service and National Marine Fisheries Service (collectively, "Services") approved a Habitat Conservation Plan (HCP) and subsequently issued Incidental Take Permits ("Permits" or ITPs) to Plum Creek Timber Company ("Plum Creek" or the "Company"). The HCP covers a Planning Area of 418,900 acres and the ITPs originally covered activities on 170,500 acres owned or managed by Plum Creek.

In October 1998, a land exchange (called the I-90 Land Exchange) between Plum Creek and the U.S. Forest Service (Forest Service) was approved by the U.S. Congress. In November 1999, the I-90 Land Exchange was amended and signed into law by the President. The amended land exchange was comprised of 31,700 acres of Plum Creek land (30,900 acres in the land exchange and 800 acres donated) and 11,600 acres of National Forest System lands. 30,800 acres of the Plum Creek lands transferred to the Forest Service are in the HCP Planning Area. 8,600 acres of the land transferred from the Forest Service to Plum Creek are in the Planning Area with the balance of 3,000 acres in the Gifford Pinchot National Forest.

One of the reasons for the amendment of the Land Exchange was the removal of two sections originally going from the Forest Service to Plum Creek. While conducting Marbled Murrelet surveys required by the HCP for those sections containing suitable habitat, Plum Creek scientists discovered the presence of murrelets. Since the HCP requires a set-aside of acreage when murrelets are present, Plum Creek declined to accept the sections. Eight Plum Creek sections were withdrawn to offset the values in the two murrelet sections. However, since the Forest Service expressed a desire to still acquire these sections, Plum Creek agreed to place them in escrow for up to three years to allow the Forest Service the opportunity to obtain funding to purchase. These "Escrow" sections will remain in the HCP until they are sold to the Forest Service at which time they will be removed from the HCP. Sales to the Federal Government are covered in Section 5.3.4.2 of the HCP and Section 7.3.2(a) of the Implementation Agreement (IA).

Also included in the amendment was the withdrawal by the Forest Service of lands in the Gifford Pinchot National Forest due to concerns expressed by local residents and environmental groups. To offset the value of these sections Plum Creek had to withdraw 21 sections within the HCP Planning Area. Environmental groups expressed a desire to purchase these lands from Plum Creek and it was agreed that Plum Creek would give options for up to four years to buy the sections at the value established in the land exchange fair market appraisal. The 21 "Option to Buy" sections will remain in the HCP until they are purchased at which time they will be removed from the HCP. Sales to non-federal government parties are covered in Section 5.3.4.3 of the HCP and Section 7.3.2(d) of the IA.

As a condition for completing the land exchange, Plum Creek notified the Services that it proposed to modify its existing HCP to provide incidental take authorization for activities on the approximately 8,600 acres of land within the Planning Area that will be acquired by Plum Creek from the Forest Service. The 30,800 acres transferred to the Forest Service are no longer covered by the incidental take permit. Plum Creek did not propose, and the land exchange did not require, a change in the boundaries of the HCP Planning Area. Furthermore, Plum Creek did not propose to increase the level of incidental take analyzed and authorized for Permit Species under the existing ITPs.

The ownership before and after the land exchange is summarized below:

Table 1. Summary of Land Ownership in the HCP Planning Area Before and After the I-90 Land Exchange.

Ownership	Pre-Land Exchange	Post-Land Exchange	Escrow and Option to Buy Sections not owned by Plum Creek
Plum Creek *	170,500	148,300	130,000
Forest Service	196,500	218,700	237,000 **
Other (State and Private)	45,300	45,300	45,300
Water (Lakes)	6,600	6,600	6,600
TOTAL	**418,900**	**418,900**	**418,900**

*** Includes lands owned and lands on which Plum Creek has timber harvest rights.**

**** Not all the lands will necessarily be owned by the Forest Service but are expected to be managed comparably.**

The request for modification of the HCP was initiated with a document which described and analyzed changes in Plum Creek's HCP that occur as a result of the land exchange with the Forest Service. It discussed changes that either affect or potentially affect implementation of the HCP on Section 10(a) species and/or unlisted agreement species covered in the HCP. A draft document accompanied the Draft Supplemental Environmental Impact Statement (DSEIS) which was issued for public comment by the Services. A final document accompanied the Services' Final Supplemental Environmental Impact Statement (FSEIS). The modifications resulting from the land exchange, as well as other minor modifications, induced Plum Creek to revise the HCP and thereby alleviate the need for more than one document to be consulted. Both sets of documents (DSEIS and FSEIS) are incorporated by reference into this document which revises and replaces the June 1996 HCP. All ownership information in this document relates to the ownership post I-90 Land Exchange. In Section 3 of the HCP, ranges of values will be shown to reflect the range of ownership before and after the sale of the "Escrow" and "Option to Buy" sections.

Scope

Permittee

Plum Creek, headquartered in Seattle, Washington, is the second largest private timberland owner in the U.S. and the second largest in the Pacific Northwest. The Company owns approximately 7.9 million acres of timberland in 19 states of which 1.8 million acres of prime softwood timberland are located throughout Western Montana, northern Idaho, and Washington. Plum Creek owns and manages approximately 285,000 acres of primarily second growth forestland in the central Cascade Mountain Range.

Permit Length

Subsequent to the June, 1996, approval of the HCP, Plum Creek received two 100-year Permits from the Services which cover 50 years from the date of issuance and, under certain circumstances ("Safe Harbor" or "Phase II", Section 5.3.3), provide for up to an additional 50 years.

Covered Activities

The Permits authorize incidental take in connection with all aspects of commercial forest management (including, without limitation, administration and monitoring, road access, road building and maintenance, site preparation, planting, thinning, fertilizing, pest and brush control, timber harvest, slash control, fire control, administrative and commercial road use, administration and commercial use of gravel pits and rock quarries, and administration and maintenance of all existing buildings, radio towers, and associated telecommunication facilities) and ecosystem-based forest planning.

Covered Lands

Because of the checkerboard configuration of land ownership, the outer boundaries of the "Planning Area" encompass 418,900 acres, including 270,600-288,900 acres of other ownership. This HCP was written to support the issuance of ITPs to Plum Creek. The Permits authorize take on 130,000–148,300 acres of land owned by Plum Creek in the Interstate 90 (I-90) corridor of the central Cascades Mountain Range in Washington. Also covered are lands Plum Creek sold to the City of Tacoma but for which Plum Creek retained timber harvest rights. Refer to Table 1 and Figure 1.

Covered Species

At the inception of the HCP on June 27, 1996, the Permits allowed incidental take of the northern spotted owl (*Strix occidentalis caurina*), marbled murrelet (*Brachyramphus marmoratus*), grizzly bear (*Ursus arctos*), and gray wolf (*Canis lupus*) resulting from forest-management activities on Plum Creek lands. On July 14, 1998, the Permits were amended to include bull trout (*Salvelinus confluentus*) East of the Cascade Crest. Plum Creek has also requested the addition of Puget Sound chinook (*Oncorhynchus tsawytscha*), Mid-Columbia steelhead (*Oncorhynchus mykiss*), Puget Sound bull trout (*Salvelinus confluentus),* and Canada lynx (*Lynx canadensis*). To minimize and mitigate the impact of any permitted activities, Plum Creek instituted the mitigation measures set forth in this HCP. Plum Creek also entered into an agreement with the Services that stipulates that this HCP sufficiently minimizes and mitigates the impacts of forest management on all vertebrate species found within the Planning Area, such that if any of these species become listed during the 50- to 100- year period (Permit period; also HCP Phase), the Services would amend the ITPs to include such species without requiring additional mitigation.

Management Practices

Plum Creek is committed to using forest-management practices that are environmentally and economically sound. As part of this commitment, Plum Creek is implementing state-of-the-art management practices to preserve and protect wildlife habitat and forestland ecosystems. These advanced management practices protect resident and migratory wildlife and habitats while providing economically predictable harvests.

HCP Goals

The primary goals of this HCP are: (1) to comply with the requirements of section 10(a)(2)(A) of the Endangered Species Act (ESA); (2) to provide Plum Creek with predictability and flexibility to manage its timberlands economically while contributing in a meaningful way to the conservation of the spotted owl, marbled murrelet, grizzly bear, and gray wolf, and numerous other species; and (3) provide adequate habitat conditions in the Planning Area so that additional species may not need to be listed in the future. This HCP uses an adaptive management approach and contains measurable criteria for assessing the biological success of the conservation plan. This document is a multi-species HCP prepared to support the permits issued pursuant to section 10(a)(1)(B) of the ESA.

The Planning Area

The Company's ownership (land and timber rights) in the Planning Area (see Figure 1) is generally of the "checkerboard" configuration consisting of alternating sections bordered mainly by Federal lands administered by the U.S. Forest Service (Forest Service). Because of the checkerboard configuration of land ownership, the outer boundary of the Planning Area encompasses 418,900 acres, including 270,600 - 288,900 acres of other ownership. Plum Creek's timberlands West of the Cascades Crest are comprised primarily of Douglas fir. Other commercially important species include Western hemlock, noble fir, Pacific silver fir, Western red cedar, Sitka spruce, and red alder. The Eastern Cascades timberlands are comprised of mixed-conifer and Ponderosa pine forests. Commercially important species include Western larch, lodgepole pine, Ponderosa pine, Western hemlock, mountain hemlock, Douglas fir, Western white pine, grand fir, Pacific silver fir, noble fir, alpine fir, and Englemann spruce.

Federal lands in the Planning Area are subject to the regulations and guidelines established by the Northwest Forest Plan. Under the Northwest Forest Plan, all Federal lands within the range of the northern spotted owl are allocated into one of six designated categories (i.e., Congressionally Reserved Areas; Late-Successional Reserves; Adaptive Management Areas; Managed Late-Successional Areas; Administratively Withdrawn Areas; and Riparian Reserves), and one non-designated category referred to as Matrix.

The total acreage of each category for Federal and non-federal lands within the Planning Area is described in Section 1.5.1.

Northern Spotted Owl

The Federal listing of the northern spotted owl, as a threatened species became effective on July 23, 1990. The primary threat cited by the FWS in its decision to list the species was the reduction and fragmentation of forest habitat in Washington, Oregon, and northern California. As a primary means for achieving recovery of the spotted owl, the final draft Recovery Plan recommended establishing Designated Conservation Areas (DCAs) to provide Federal forest lands as primary habitat for spotted owls. Portions of four DCAs are located within the Planning Area (WD-7; WD-8; WD-39; and WD-40). In addition to the management strategies provided for Federal lands under the final draft Recovery Plan and Northwest Forest Plan, protection measures for spotted owls also include Special Emphasis Areas (SEAs), proposed by the FWS under section 4(d) special rule for non-federal lands. Among the six SEAs designated in Washington, the I-90 Corridor SEA incorporate the entire Planning Area.

Marbled Murrelet

The marbled murrelet in Washington, Oregon, and California was listed as a federally threatened species on October 1, 1992. Based on estimates of murrelet population size, Washington, Oregon, and California currently support lower densities of murrelets than other areas within the range of the species. Reductions in late-successional forests within the range of the species, especially at lower elevations in the coastal lowlands are thought to be at lEast partially responsible for the decline of murrelet populations. A total of 6,800 acres on Federal lands West of the Cascade crest have been proposed as marbled murrelet critical habitat in the HCP area.

Grizzly Bear

The grizzly bear was listed as threatened on July 28, 1975. Grizzly bear distribution has been reduced to less than 2 percent of its historical range in the lower 48 states due to reductions in habitat amount, habitat degradation, direct killing of bears, and increased human-bear conflicts. The northern portion of the Planning Area (115,472 acres) is within the Northern Cascades Grizzly Bear Recovery Area. The entire recovery area encompasses approximately 10,000 square miles. Overall, the recovery area is thought to be capable of supporting between 200 and 400 grizzly bears. Although at present, grizzly bears are not currently known to reside in the Planning Area.

Gray Wolf

The gray wolf was listed as endangered on July 1, 1977. Historically, gray wolves ranged widely throughout North America. However, by 1988, wolf populations were scattered throughout Alaska, Idaho, Minnesota, Michigan, Wisconsin, Montana, and Washington. Unlike the grizzly bear which has low reproductive potential or the northern spotted owl with its specialized habitat requirements, the gray wolf exhibits a high reproductive rate, flexible habitat requirements, and is less affected by forest management activities. There are currently no recovery areas for gray wolves in the Washington Cascade Mountains.

Listings Subsequent to June, 1996

Since the HCP was approved the following listings have occured: Columbia River bull trout were listed as threatened effective July 10, 1998; Puget Sound chinook salmon were listed as endangered on March 24, 1999; Middle Columbia River steelhead were listed as threatened on March 25, 1999; Puget Sound bull trout were listed as threatened effective December 1, 1999; and Canada lynx were listed as threatened effective April 24, 2000.

II Collection and Synthesis of Data

Stand Structural Stages and Spotted Owl Habitat Types

Plum Creek recognizes that there are numerous structural stages across a forested landscape, and that these structural stands vary among physiographic provinces, vegetation types, disturbance regimes, elevation, climatic conditions, and soil conditions. The eight structural stand stages chosen for use in the HCP represent major structural attributes in forest types across the physiographic provinces (i.e., Eastern Washington Cascades and Western Washington Cascades) incorporating the Planning Area (Sections 2.3 and 2.4).

1. Stand Initiation Stage — This stage is characterized by trees less than 1 inch Quadratic Mean Diameter (QMD). This structural stage is commonly found after a recent disturbance such as timber harvesting or fire, and is comprised predominately of newly planted trees and resident herbs, as well as some residual green trees and standing snags. Wildlife support and usage of these initiation stages depends upon the amount and type of residual trees left standing. For example, cavity nesting species may benefit greatly by the retention of snags and cull green trees in a recent harvest unit.

2. Shrub/Sapling Stage — This stage is characterized by trees between 1 and 2 inches QMD. Shrubs often predominate in this stage, commonly providing habitat for a wide array of wildlife species different from those species occupying the stand initiation stage.

3. Young Forest Stage — This stage is characterized by trees between 3 and 5 inches QMD. This structural stage is often the result of growth in stand initiation or shrub/sapling stages, or it may

be due to partial harvesting or removal of overstory trees which leaves a dense stocking of residual understory trees.

4. Pole Timber Stage — This stage is characterized in the Westside Cascades by trees between 6 and 9 inches QMD, and in the Eastside Cascades by trees between 6 and 8 inches QMD. On both sides of the Cascades trees in this stage exhibit a high degree of crown closure and relative density. These stands are typically densely stocked with little clearance between the shrub/sapling layer and the crown.
5. Dispersal Forest Stage — This stage was developed to encompass the stand conditions that are favorable to dispersal of spotted owls and that may be used regularly by a wide range of other wildlife species. On the Westside of the Cascades these stands are characterized by trees with a QMD between 10 and 13 inches. Dispersal forest is considered Westside foraging/dispersal (FD) habitat for spotted owls when stands achieve an average Relative Density of 30-48 in uplands, and 48 in Riparian Habitat Areas with a minimum canopy closure of 70 percent. On the Eastside of the Cascades, the dispersal forest stage is characterized by trees between 9 and 12 inches QMD. Dispersal forest is considered Eastside FD habitat for spotted owls when stands achieve an average Relative Density of 33, and a minimum canopy closure of 58 percent. Although these forest stands provide only minimal conditions for spotted owl roosting and foraging, they do provide adequate habitat for owls to move freely between more favorable nesting, roosting, and foraging habitat.
6. Mature Forest Stage — This stage is characterized on the Westside of the Cascades by trees with a QMD between 14 and 20 inches, and on the Eastside of the Cascades by trees with a QMD between 13 and 15 inches. For mature forest to be considered spotted owl nesting roosting and foraging (NRF) habitat, canopy closure in this stage is generally greater than 70 percent with a Relative Density in excess of 48 on the Westside of the Cascade crest and 44 on the Eastside. This stage provides adequate nesting, roosting, and foraging habitat for spotted owls and habitat for a wide range of other wildlife species.
7. Managed Old Growth Stage — This stage is characterized on the Westside of the Cascades by average stands greater than 21 inches QMD, and on the Eastside of the Cascades by trees greater than 16 inches QMD. The age of these stands is less than 200 years, and although these stands can occur naturally as dense, large diameter trees, most of them have been selectively harvested. In most cases, 50 percent of the merchantable volume was removed, while up to 80 percent of the trees were retained. The management objective for these stands is to extract economically valuable trees while retaining sufficient forest structure to maintain or accelerate development of NRF habitat for spotted owls and other wildlife species.
8. Old Growth Stage — This stage is characterized more by age than by a distinct diameter range. The old growth stage is defined in the Planning Area using the same QMD as the managed old growth stage, but these forests are 200 or more years old. These forests are characterized by an abundance of decadent live trees, snags, down woody debris, and a general replacement of some of the long-lived pioneer species, such as Douglas fir, and by climax species such as Western hemlock. In addition, canopy closure in this stage typically approaches 100 percent and there are generally two or more distinct layers to the canopy.

Plum Creek's Spotted Owl Surveys

Plum Creek has supported surveys and research on the spotted owl since 1982 (Section 2.10.1.4). More than 70 percent of the Planning Area and about 90 percent of suitable habitat has been surveyed for spotted owls, as of August 1994. A total of 109 spotted owl nest sites in or within 2.0-miles of the Planning Area have been identified. Among these, 40 are established site centers within the Planning Area where Plum Creek owns a significant portion of the habitat near the nest site. In addition to documenting the distribution of spotted owls, Plum Creek has documented and evaluated the forest stand structure characteristics at roosting locations and nest sites.

Since 1989, Plum Creek has regularly monitored known owl sites, and more than 95 percent of the spotted owls encountered during surveying and monitoring have been captured and given numbered and colored leg bands. Additional owl surveys and studies conducted by Plum Creek in the Planning Area include:

- estimates of spotted owl productivity;
- analysis of spotted owl survival/mortality;
- home range analysis based on spotted owl radio-telemetry;
- habitat selection in relation to habitat availability within the home range;
- juvenile dispersal studies;
- spotted owl co-occurrence with barred owls;
- habitat characteristics and distribution across ownerships;
- spotted owl habitat use following silvicultural activities; and
- prey densities in experimental harvest areas.

These efforts by Plum Creek have yielded a significant database that provides a better understanding of spotted owl demography and habitat requirements on the Westside and Eastside of the Cascade crest, and insight into how local conditions compare with those documented in other parts of the spotted owl's range. This in turn has allowed Plum Creek to develop an HCP based on the best scientific data available.

Other Wildlife Surveys

In addition to spotted owl surveys, Plum Creek has conducted surveys for other wildlife species and analyzed watershed and habitat conditions in various portions of the Planning Area (Section 2.10). Plum Creek has completed seven years of surveys covering over 2,500 acres of habitat to document absence or presence of marbled murrelets in Western portions of the Planning Area (i.e., up to the Cascade crest). Murrelets were detected during the surveys in the Planning Area on two sections of land originally included but later dropped from the Land Exchange. Fisheries surveys have been conducted by Plum Creek in streams in the Planning Area to determine the distribution of bull trout and other anadromous and resident fish species. Aquatic macro-invertebrates are also surveyed as part of an assessment of biotic integrity. Plum Creek has also incorporated the findings and surveys of university-sponsored research and agency surveys for other wildlife in the Planning Area, such as goshawks, forest herptiles, big game, and forest dwelling birds.

III Habitat Conservation Plan (HCP)

Plum Creek's HCP is a multi-species, ecosystem-based habitat management plan which addresses the biological needs of the northern spotted owl, marbled murrelet, grizzly bear, gray wolf, and more than 310 other vertebrate wildlife species in the Planning Area (Section 3.0). By implementing the HCP, Plum

Creek can help to reduce conflicts over resource management by providing a mechanism for consideration of overall ecosystem health, habitat availability, and the needs of multiple species. The conservation plan: (1) focuses on ecosystems and habitats rather than species; (2) addresses impacts not only at the site scale, but also on an ecosystem scale; and (3) concentrates on potential long-term or future impacts rather than on immediate or short-term impacts.

The HCP incorporates a Riparian Management Strategy which identifies and protects riparian forests as priority habitat for fish and wildlife, and provides for management of special habitats such as snags, wetlands and talus slopes. The HCP is designed to complement the Northwest Forest Plan on Federal lands in the Planning Area. In this way, the HCP augments the protection extended to listed and unlisted species on Federal lands and provides a framework for future coordination with the Forest Service and private landowners.

A network of Riparian Habitat Areas, harvest deferrals, and dispersal corridors are proposed in the HCP to link habitat on federal lands and provide supplemental late-successional habitat to address anticipated needs during the first two decades of the Permit period. To address long-term habitat conditions, the HCP establishes projections for percentages of Plum Creek's land to be maintained in diverse forest structure stages ranging from stand initiation to old growth throughout the Permit period. Management practices in the HCP address a variety of other habitat-related concerns such as structural retention in harvest units, forest health and road location/closures. The HCP includes the following elements:

Multi-Species Approach

Plum Creek is including multiple species in the HCP in anticipation of future demands for landscape planning to address all general wildlife concerns (Section 3.2). Plum Creek has compiled information on 285 known vertebrate wildlife species associated with habitat in the Planning Area.

Plants are considered separately from the animals because the take prohibitions for federally listed plants under section 9 of the ESA are more limited than for animals. The ESA prohibits the removal of listed plants or the damage of such plants in areas under Federal jurisdiction, or the destruction of listed plants on non-federal areas in violation of State law or regulation. Although there are no prohibitions under the ESA preventing Plum Creek from taking listed plants, the Company considers listed plants in the HCP. The management strategies and mitigation measures outlined in the HCP will ensure that implementation of the conservation plan will not likely jeopardize the continued existence of the federally listed plants found within the Planning Area.

The section 10(a) Permit Species include the four federally listed Incidental Take Permit species: spotted owl, marbled murrelet, grizzly bear, and gray wolf.

Northern Spotted Owl (Section 3.2.1.1)

To address the biological requirements of northern spotted owls in the Planning Area, the following actions will be taken:

1. Identify and classify NRF, FD, and non-habitat in the 418,690 acres within the Planning Area throughout the Permit period.
2. Provide spotted owl NRF habitat throughout the Permit period. Plum Creek will maintain, at a minimum**,** 6-8 percent of its ownership in the Planning Area as spotted owl NRF habitat.
3. Prioritize owl nest sites to protect NRF habitat and develop dispersal habitat corridors for the most productive and strategically located (i.e., high density "cluster areas") owl nest sites on Plum Creek's lands in the Planning Area.

4. Defer harvest activities on approximately 1,100 – 1,900 acres of NRF habitat.
5. Use selective harvest on approximately 1,300 – 2,300 acres to create and retain FD corridors.
6. Provide NRF and dispersal habitat between and within the Designated Conservation Areas (i.e., WD-7, WD-8; WD-39, WD-40) in the Planning Area in support of the biological goals for non-federal lands outlined in the final draft Recovery Plan for the spotted owl in the I-90 corridor.
7. Protect and maintain 7,200 - 8,500 acres in riparian habitat areas to provide NRF and FD habitat between upland deferrals on Plum Creek's lands and habitat on Federal lands.
8. Demographic surveys will be conducted to evaluate the effectiveness of Plum Creek's harvest deferrals and dispersal corridors in maintaining the viability of spotted owl nest sites.
9. Small mammal surveys will be conducted to verify that populations of spotted owl prey species, such as flying squirrels, are adequate within the dispersal forest and managed old growth structural stand classifications to provide a prey base sufficient to sustain resident spotted owls.
10. When entering owl sites to conduct harvesting operations, Plum Creek will consider prioritizing owl sites by first entering those stands with less biological value (i.e., unoccupied sites) and secondly, those stands furthest from an owl site center.
11. Known owl sites with active spotted owl nests in the Planning Area will receive protection within a 0.25-mile radius from March 1 through August 31.

Marbled Murrelet (Section 3.2.1.2)

The murrelet management plan was developed in conjunction with the Services, and includes the following four actions:

1. Harvest Deferrals — Harvest was deferred through 1996 on 257 acres of potential murrelet nesting habitat while surveys were completed to identify possible murrelet nesting activity in the Planning Area. Harvest was also deferred on potential murrelet nesting habitat acquired in the land exchange until surveys were completed.
2. Murrelet Surveys — Plum Creek conducted murrelet surveys in the Planning Area 1994 - 1996 to fulfill environmental requirements for access requests from the Forest Service. Between 1994 and 1995 surveys were conducted related to the original HCP land base and again in 1999 and 2000 for the lands acquired in the land exchange. Therefore, by the end of 2000, when these surveys were completed, Plum Creek has surveyed for murrelets on approximately 2,500 acres on the Westside of the Cascade crest, in the Planning Area
3. Nest Site Protection — Occupied stands found during the survey period will be protected by deferring a specific block of habitat surrounding the site. Criteria that will be used to designate the habitat block are as follows:
   - Suitable habitat will be protected in all directions from an occupied stand until a 100-meter break in suitable habitat is encountered; and
   - An upper limit of 500 acres will be established per nest site. Plum Creek and FWS will cooperatively determine " the best 500 acres".

   The protection period for all nesting stands will be the period of occupancy plus five years.
4. Seasonal Protection — Protect "future" murrelet sites by deferring harvest in the stands within a 0.25-mile radius during the nesting season from March 1 to August 31.

Grizzly Bear (Section 3.2.1.3)

Although grizzly bears may not currently occur in the Planning Area, they may eventually emigrate and reside in the Planning Area. Plum Creek's strategy for addressing grizzly bears focuses on analysis of two major habitat-related concerns: (1) open road density; and (2) habitat diversity (i.e., hiding/thermal cover and forage/prey habitat). To address habitat concerns, Plum Creek will implement a series of Best Management Practices (BMPs) to maintain habitat in a condition that allows bears to meet their essential biological needs.

Phase I BMPs will include:

1. Restrict Public Use — Restrict public use and minimize the potential for grizzly bear disturbance and displacement by installing gates on roads which Plum Creek has total administrative control.
2. Open Road Density — Reduce open road density to 1.0-mile per square mile on Plum Creek's lands in the I-90 Lakes Subunit.
3. Visual Screening — Maintain visual screening along open roads on Company property to minimize disturbance and potential illegal killing of grizzly bears.
4. Prohibit Firearms — Prohibit firearms in all Company and contractor vehicles.

Phase II BMPs will be implemented by Plum Creek once the Services verify that grizzly bears have successfully recolonized and reside in the I-90 Lakes Subunit. Verification will consist of successful denning by grizzly bears in the subunit and/or multiple sightings of female grizzly bears with cubs. Phase II BMPs will be implemented within one year of FWS verification and include the following actions.

Phase II BMPs will include:

1. Road Closures — Plum Creek will provide additional road closures and barriers on roads managed jointly by Plum Creek and the Forest Service in the I-90 Lakes Subunit.
2. Road Location and Construction — Avoid aligning main haul or other roads, that will remain open, through the center of clear-cuts and seedtree harvest units. Road management criteria will include: (1) minimizing the number of miles of road needed to achieve the objectives of each timber sale; and (2) maximizing the use of local roads, and minimizing the use of arterials and collectors.
3. Cover — Provide effective cover that: (1) allows bears to move between foraging areas and seasonal ranges; (2) reduces mortality risk; and (3) provides for thermal regulation.
4. Size of Openings — Design all even-aged and seed-tree harvest units within the I-90 Lakes Subunit (Grizzly Bear Recovery Zone) so that no point in the unit is more than 600 feet from effective hiding cover for bears.
5. Timing of Operations — Coordinate timber harvesting operations in time and space so that activities will occur in areas and at times that have the lEast biological importance to the bears.
6. Riparian Habitats — Institute silvicultural prescriptions that provide habitat for a wide variety of wildlife species including grizzly bears.

Gray Wolf (Section 3.2.1.4)

Although the status of gray wolves in the Planning Area is unknown, wolves may eventually emigrate and reside in the Planning Area during the Permit period. As with the grizzly bear, Plum Creek will avoid or minimize potential impacts to gray wolves by maintaining habitat in a condition that allows wolves and their important prey species to meet their essential biological needs while residing in the Planning Area. The three features of the gray wolf management plan are:

1. Den Site Protection — In the event that wolves den on Plum Creek's land in the Planning Area during the Permit period, Plum Creek will restrict forest management activities within a 0.25-mile radius of an active den site during the denning period (i.e., April 1 through June 15). Plum Creek will coordinate all activities planned for the area within 0.5-miles of active dens with the Services to determine if potential adverse impacts would occur. Known rendezvous sites will be protected. Management activities in a management unit containing a den site will be deferred for a period of 2 years following the last known denning.
2. Provisions for Prey Habitat Conditions — Habitat management for wolves is primarily directed at habitat for its prey species. The most important prey species for wolves in the Planning Area are deer, elk, and snowshoe hares. The creation and maintenance of edge habitat through forest management activities (e.g., harvest units) will provide adequate habitat for wolf prey species, although primary habitat for some species will likely decline from current levels during the Permit period.
3. Road Management — Plum Creek will increase road management to provide more secure conditions for both prey species and wolves that use the available habitat. An important area for cooperative road management is the Taneum Creek watershed where Plum Creek has established hunting season road closures on major roads controlled by the Company. The Taneum Creek watershed is also the area where most of the historical and recent sightings of wolves in the Planning Area have been recorded. Plum Creek will maintain these closures and increase road management efforts in the future. Road management for grizzly bears in the I-90 Lakes Subunit will provide similar protection benefits for wolves.

Lifeform Analysis (Section 3.2.2)

The remaining 311 vertebrate wildlife species were prioritized, for convenience of discussion, by their legal status and were grouped into one of 16 Lifeforms based on similarities in breeding and feeding habitat preferences. The three groups include:

1. Special Emphasis Species: This group includes 21 species (five amphibians, four fish, four birds, and eight mammals), all of which are Federal candidate species, with the highest likelihood of becoming federally listed during the Permit period.
2. Species of Concern: This group includes eleven species (10 birds and one reptile) that occur in the Planning Area but are likely not inhabitants of forest types that will be affected by the HCP or they are protected by other regulatory processes outside of the HCP.
3. Associated Species: This group includes the remaining 280 species (i.e., 68 mammals, 162 birds, 12 reptiles, 8 amphibians, and 30 fish) that potentially inhabit the Planning Area.

For each Lifeform, primary and secondary habitat preferences were assigned from eight forest structural classes developed for the Plan. This approach allowed Plum Creek to link the potential impacts of the HCP to habitat availability and suitability for each Lifeform. Monitoring and research strategies in the HCP are designed to evaluate the association of key Lifeforms to forest structure classes.

Riparian Management Strategy

In addition to the multi-species approach, the HCP is also built upon a Riparian Management Strategy which focuses on protecting fish habitat while maintaining a diversity of habitat for wildlife (Section 3.3).

This strategy will provide an array of habitats for a wide variety of wildlife species. Additionally, the Riparian Management Strategy is designed to protect instream habitat for resident and anadromous fish and maintain habitat for wildlife species in adjacent Riparian Habitat Areas (RHAs). This strategy also incorporates watershed analysis and Plum Creek's ongoing experimentation with New Forestry techniques in the design of RHAs. Plum Creek's Riparian Management Strategy and overall ecosystem approach to forest management has been designed to accommodate and incorporate inter-ownership cooperation with the Forest Service and other landowners in the Planning Area.

Specific elements of the Riparian Management Strategy include:

- ***Washington State Forest Practices Rules and Regulations:*** The Washington Forest Practices Act (RCW 76.09) and implementing Forest Practices Rules and Regulations (WAC 222-08) are the principal means of State regulation of activities on private forest lands in Washington (e.g., culvert sizing, erosion control measures, chemical applications) (Section 3.3.1). All timber harvests conducted by Plum Creek under the HCP will be in compliance with local, State, and Federal laws and regulations governing the management of forested lands.
- ***Watershed Analysis***: Watershed analysis is a major component of Plum Creek's Riparian Management Strategy (Section 3.3.2). It is a site-specific, science-based, analytical tool for the protection of water quality, with collateral benefits to riparian habitats and fish and wildlife species. These analyses have been underway since 1993 and by the end of 1999 Plum Creek has completed analyses in 13 of 17 watersheds in the Planning Area. As a part of the HCP, Plum Creek will complete and submit its watershed analysis evaluations in the remaining watersheds in the Planning Area within 10 years after Permit issuance.
- ***Riparian Habitat Areas***: In addition to watershed analysis, the Riparian Management Strategy also includes the maintenance and protection of RHAs (Section 3.3.3). These riparian areas are among the most ecologically significant components of the forested landscape, and management focused on maintenance and protection of RHAs is extremely important because of the extensive number of species that use these areas. They form boundaries between different ecosystems and provide connectivity for interchange and dispersal for plants and animals. RHAs total approximately 7,200 - 8,500 acres on Plum Creek's lands in the Planning Area.

Plum Creek will use the Company's scientific experience and experiments and watershed analysis to establish prescriptions for RHAs along streams that support a wide array of wildlife species including bull trout and anadromous fish. In general, all RHAs will be designed to achieve the following ecological objectives:

1. Maintain stable stream channels and natural functioning of physical stream processes (e.g., sediment transport and storage);
2. Allow for adequate input of large woody debris into stream channels, maintain stable stream channels and adequate in-stream structures to minimize sediment movement downstream, and maintain a diversity of aquatic habitats and high quality fish habitat;
3. Provide adequate vegetation to minimize entry of non-point sources of pollution from upslope activities, and to provide stream shading to maintain normal water temperatures or reduce summer maximum water temperatures where raised by alterations;

4. Provide adequate NRF or FD habitat for spotted owls; and
5. Maintain a diversity of riparian habitat and provide primary/secondary habitat for riparian-dependent Lifeforms throughout the Planning Area.

In classifying stream systems in the Planning Area, Plum Creek's major consideration is whether a particular stream is fish-bearing or nonfish-bearing, and perennial or seasonally intermittent. Plum Creek will implement the following interim (i.e., these guidelines will be considered interim until completion of watershed analysis) and minimum guidelines in RHAs:

1. **Fish-bearing streams—** Establish 200-foot RHAs (measured as horizontal distance from the edge of the Channel Disturbance Zone) on each side of fish-bearing streams. Two hundred-foot RHAs will provide at lEast one tree height of protection for fish-bearing streams because the average tree height for late-seral riparian vegetation within the Planning Area typically ranges between 80 and 140 feet for Eastside conditions and between 140 and 200 feet for Westside conditions.

   One of the primary management objectives within RHAs for aquatic resources is to provide an adequate number of large-diameter conifers to maintain natural functioning of the stream ecosystem. The entire RHA will be retained as spotted owl habitat, or if not currently functioning as spotted owl habitat, the area will be managed to provide forest conditions equal to or greater than FD habitat for spotted owls (see Section 2.4). A 30-foot (horizontal distance), "no-harvest" area will be situated in RHAs adjacent to fish-bearing streams to maintain bank integrity, provide nutrients, and contribute large woody debris to the stream. (No-harvest is intended to mean no commercial harvest of conifer trees. Limited silvicultural prescriptions for conifers and harvest of deciduous trees will be allowed to address watershed and wildlife concerns [e.g., excessively high tree density or undesirable coarse woody debris species]). Beyond the 30-foot, no-harvest zone, management objectives will be to meet large woody debris goals, maintain a late-successional forest structure, accommodate channel migration, slope stability, and/or additional wildlife considerations, and to implement a "feathering treatment" whereby more "large trees" will be left at the inner portion (i.e., the area closest to the stream) of the RHA. Structural features within RHAs will be tracked to determine the extent and distribution of structural stand stages. One-time (i.e., one harvest during the Permit period) selective or partial harvests will be allowed in RHAs, if Plum Creek can ensure that post-harvest conditions in the RHAs will provide, at a minimum, the equivalent of spotted owl habitat (i.e., FD habitat or greater). These harvests could incorporate removal of up to 50 percent of the merchantable (i.e., commercial) timber volume available for harvest in the 200-foot RHA, but, in practice, significantly less than 50% can be removed and still meet FD habitat requirements. Seasonally intermittent streams found to be fish-bearing would receive special consideration under watershed analysis.

   Nonfish-bearing perennial streams with a high likelihood of fish presence or near the confluence of a perennial fish-bearing stream will be tested prior to harvest to verify presence or absence of fish to ensure the proper buffers are utilized. Additionally, if a fish-bearing stream has a blockage and the source of the blockage is removed, the stream up to the nearest natural blockage will be treated as a fish-bearing stream.

2. **Nonfish-bearing, perennial streams—** Along nonfish-bearing perennial streams within Federal Late-Successional Reserves, Adaptive Management Areas, and where elevation (up to 5,000 feet) and topography are suitable for owl dispersal, Plum Creek will provide 100-foot RHAs on each side of these streams with a 30-foot, no ground-based equipment zone. In addition, nonfish-bearing perennial streams East of the Cascade crest containing 303(d) streams and/or bull trout or

anadromous fish would receive 100-foot RHAs along nonfish-bearing pereennial streams above 5,000-foot elevation and outside of Late-Successional Reserves and Adaptive Management Areas. Also, ground-based equipment is prohibited in the 30-foot zone nearest the stream for all RHAs. No-harvest zones will not be maintained on nonfish-bearing perennial streams. The primary purpose of the RHAs along nonfish-bearing perennial streams will be to protect downstream fish habitat, water quality, and habitat for other aquatic and riparian-dependent wildlife species, such as frogs and salamanders (i.e., Lifeform 2). These RHAs will also be managed to maintain NRF or FD habitat through harvest deferral or partial harvesting, as well as achieve the objectives depicted in Tables 31b and 31c for stand structures within RHA's.

Along perennial, nonfish-bearing streams outside Late-Successional Reserves, Adaptive Management Areas, or in drainages where owl habitat maintenance is not feasible, Plum Creek will provide 25-foot wide Riparian Leave Tree Areas (RLTAs) on each side of the streams. Plum Creek will retain a minimum of 25 live conifer trees, greater than 12 inches DBH, per 1,000 feet of stream (i.e., about 44 conifer trees per acre). Plum Creek will also retain all snags, culls, and "leaners" that do not present a safety hazard. The RLTAs will be designated for a distance of at lEast 2,000 feet upstream from the junction of a nonfish-bearing perennial stream with a perennial fish-bearing stream. RLTA requirements may be met alternatively through "clumping" the required number of leave trees into Upland Management Area (UMA)-like patches adjacent to the streams. Shrubs, small trees, and other streamside vegetation within the areas between the clumps will be retained. The width of each patch will not exceed 150 feet from the stream. Ground-based equipment will be excluded from the 25-foot RLTAs. Because of the Environmental Principles, Plum Creek will cluster some leave trees in areas adjacent to many smaller streams, which otherwise would receive no specific protection under State Forest Practices Rules and Regulations.

In perennial, nonfish-bearing streams that may be susceptible to landslides or debris flows (e.g., inner gorge topography), appropriately sized riparian buffers will be determined through watershed analysis. In the interim, State Forest Practices Rules and Regulations preclude harvest and road construction on slopes at risk of failure.

3. **Yarding Corridors —** Yarding corridors may be necessary in RHAs to accommodate full-suspension or, if necessary, partial suspension cable yarding systems. All yarding corridors will be placed at the discretion of Plum Creek. Plum Creek will minimize the removal of trees. During yarding operations, normal breakage of trees will occur and provide snags and downed material which will provide habitat for many wildlife species. In addition, the post-harvest yarding corridors will be comprised of young forest and residual trees which will provide multi-structural forests and habitats and enhance wildlife diversity in the RHAs. As an overall objective, Plum Creek will attempt to disturb no more than 15 percent of the stream corridor in a 1,000-foot reach. If site-specific conditions or safety considerations require larger yarding corridors, Plum Creek can, at its discretion, expand the yarding corridors, but will disturb no more than 20 percent of the stream corridor in a 1,000-foot reach. Plum Creek will also avoid, where possible, placing yarding corridors across fish-bearing streams. Plum Creek will attempt to minimize the necessity of yarding corridors. However, in some areas, yarding corridors would be preferable if the only alternative is construction of additional roads or landing areas.

4. **Road Management —** Plum Creek's management objective for roads will be to minimize disturbance of RHAs and to prevent sediment delivery to streams. If a road is required to be built through an RHA, Plum Creek will implement the Company's road building practices (Section

1.2.3.4) and implement specific measures to reduce the potential effects of road construction and use on streams and riparian habitat areas by.

Harvest Deferrals for 303(d) Stream Segments and Wetland Management Zones

To improve environmental conditions in streams in support of beneficial uses such as fisheries habitat, Plum Creek will defer harvest within 667 acres in RHAs adjacent to the 303(d) listed stream segments until watershed analysis is completed in each watershed, and within 1,100 acres in Wetland Management Zones (WMZs) surrounding wetlands (Section 3.3.4). Watershed analysis will address the water quality parameters typically impacted by forest practices such as stream temperature, turbidity, and sediment input.

Aquatic Resources Monitoring

Habitat monitoring will ensure that appropriate prescriptions have been implemented to protect fish and water quality (Section 3.3.5). All aquatic resources monitoring will be directed at specific technical questions and concerns addressed by the Riparian Management Strategy. The aquatic monitoring program was designed to achieve four main objectives:

1. Provide landscape-wide monitoring of habitat conditions over the Permit period.
2. Analyze the effects of the various Riparian Habitat Areas (RHAs) management strategies on steam temperatures.
3. Assess fish populations in the context of habitat association.
4. Assess the biological integrity of streams in the Planning Area over the Permit period.

Special Habitat Management

The Planning Area contains a number of special habitats that may be important to a wide range of wildlife species. Most of the species that use special habitats in the Planning Area, including wetlands, talus slopes, and caves, will not be affected by Plum Creek's forest management activities.

Wetlands (Section 3.4.1)

The riparian wetlands will be identified during watershed analysis and appropriate prescriptions to protect the functions and values of these wetlands will be developed. Most of the wetlands within the Planning Area are spatially and functionally associated with rivers and streams. Other wetlands may occur more or less in isolation. These isolated wetlands are generally small, but may have unique characteristics and provide habitat for numerous wildlife species. Plum Creek will implement, as minimum and interim guidelines, the Riparian Management Strategy and standard State Forest Practices Rules and Regulations to protect all wetlands.

Talus Slopes (Section 3.4.2)

Although these areas represent a relatively small portion of the landbase in the Planning Area, they are an important special habitat. Biological objectives are to maintain the integrity of these sites while retaining trees adjacent to talus slopes which provide shade and down logs for foraging and shelter. On talus slopes greater than 1.0 acre in size, Plum Creek will avoid road construction and rock extraction, where possible. Skidding and yarding activities will be avoided on talus slopes. Residual large green trees and snags will be left within 100 feet of the sites.

Caves (Section 3.4.3)

The potential impact to caves will be minimized by establishing a buffer around the entrance to hibernation and denning caves. This buffer will be designed around site-specific conditions, but will not be less than 100 feet from the entrance. Steps taken in the HCP to protect cave security should adequately address biological needs for most, if not all, cave-dependent species. For example, human disturbance near the entrance of known hibernation or denning caves will be prohibited, and Plum Creek will voluntarily prohibit spraying of herbicides or fertilizers within 100 feet of known hibernation or denning caves.

Snags and Snag Recruitment Trees (Section 3.4.4)

During all harvest operations, including even-aged harvests, post-harvest snag and recruitment tree conditions will exceed State Forest Practices Rules and Regulations . This will occur in several ways:

1. Watershed analysis. Where snags are lacking, additional green recruitment trees will be left instead.
2. The number of snags left will exceed State Forest Practices Rules and Regulations. Although not every harvest unit will have sufficient snags prior to harvest to meet these objectives, when considered in total, Plum Creek's even-aged harvest units will average three snags retained per acre harvested.
3. Larger snags will be given priority for retention, and Plum Creek will leave three green recruitment trees that are either dominants or codominants.
4. Snags and recruitment trees will be either clumped or scattered across harvest units depending on operational feasibility. Clumping and scattering offer differing benefits to different species. Over time and the landscape, the use of both distribution strategies will result in benefits to many species. A common strategy may be to clump leave trees along intermittent streams or adjacent to existing riparian protection areas. Under unusual situations, leave trees for a harvest unit may be left in adjacent riparian protection areas after consultation with the Services. These leave trees would be over and above the number required by the combination of the Riparian Management Strategy and watershed analysis.

Impacts

The Permit issued in conjunction with this HCP allows impacts on spotted owls, marbled murrelets, grizzly bears, and gray wolves and other species found within the Planning Area that are incidental to otherwise lawful commercial forest management and ecosystem-based forest planning in the Planning Area (Section 3.5). The management plans and mitigation set out in this HCP are intended to mitigate to the maximum extent practicable these impacts.

Northern Spotted Owl (Section 3.5.1.1)

The principal form of impact for which Plum Creek is seeking this Permit is displacement of spotted owls due to modification of owl habitat, including areas with nest sites. Actual death or injury to owls as a result of forest management is not anticipated. Spotted owl habitat may be harvested annually in the Planning Area, but due to the favorable distribution of suitable habitat on Plum Creek's lands and on adjacent Forest Service lands, no significant net loss of suitable habitat is anticipated measured over the Permit period, because habitat will be replaced through growth of younger forest stands on both Plum Creek's and Forest Service lands. Given the population monitoring efforts in the Planning Area, seasonal protection of specific owl site centers from disturbance, maintenance of adequate habitat acreage at selected sites, and incorporation of a dispersal strategy to reduce the likelihood of isolating owls across the I-90 corridor, Plum Creek anticipates minimal impact to local and regional populations of spotted owls over the Permit period.

Using two different analysis techniques, Plum Creek estimated the impact of HCP implementation on spotted owls in the Planning area. Assuming that owl site centers remain "static" or fixed in location for 50 years, a "worst case scenario" suggests that harvest activities under the HCP may impact one owl nest site per year for the Permit period. Using a predictive model for carrying capacity based on habitat quality and physical landscape variables (e.g., elevation) the number of spotted owl pairs is expected to decrease by 8 percent over the Permit period.

Marbled Murrelet (Section 3.5.1.2)

The current potential for murrelet activity in the Planning Area is very low. However, as part of the HCP, Plum Creek will identify potential habitat remaining in the Western portion of the Planning Area, defer harvest on that potential habitat, and survey the habitat for murrelet use. Should murrelets be found, Plum Creek will protect an adequate amount of habitat to maintain the nesting capabilities of the site or sites detected in the surveys. The FWS will be consulted in the selection of potential habitat, completion of surveys, and identification of habitat blocks to protect nest sites. Moreover, implementation of the HCP will prioritize additional planning and retention efforts to riparian areas, which provides a positive trend in potential habitat for murrelets in an area where such habitat is likely to be used. Consequently, impacts to murrelets as a result of implementation of the HCP will be minimal.

Grizzly Bear (Section 3.5.1.3)

Plum Creek recognizes that although grizzly bears may not currently occur in the Planning Area, they may eventually emigrate and reside permanently in the I-90 Lakes Subunit during the Permit period. Plum Creek has used the best information available to assess habitat and analyze impacts that could impede recovery of grizzly bears in the I-90 Lakes Subunit, which is included in the North Cascades Recovery Zone. In addition, implementation of the HCP will focus on retention of cover in riparian areas and wetlands, which are important areas for grizzly bears. An important aspect of the HCP is that some mitigation efforts will be implemented immediately to provide security habitat for bears and other mitigation efforts will be implemented upon confirmation of actual use by resident bears to further minimize impacts on bears. However, properly managed harvesting operations can result in an increase in bear foods (e.g., forbs, berries, and grasses) through silvicultural manipulation (e.g., tree removal, riparian management, prescribed burning)(USFWS 1993). Consequently, implementation of the HCP will be beneficial to grizzly bears.

Gray Wolf (Section 3.5.1.4)

These wolves are currently not known to permanently reside in the Planning Area, although several sightings suggest that transient wolves may have used the area in recent times. Despite the fact that no Federal recovery area has been designated for the gray wolf in the Planning Area, wolves may establish permanent residency in the Planning Area during the 50 year Permit period. Plum Creek's HCP strategy is to manage potential wolf habitat for prey species such as deer and elk, prioritize road management efforts in areas where possible wolf sightings have occurred to protect big game prey, and restrict seasonal operations around den sites, should den sites be detected during the Permit period. Therefore, implementation of the HCP may be beneficial to gray wolves if they occur in the Planning Area.

Other Wildlife Species (Section 3.5.3)

Potential impacts of the HCP on habitat conditions for other fish and wildlife species in the Planning Area, including the 21 Special Emphasis Species and the 11 Species of Concern, are addressed in the HCP. The impact of the HCP on the current and future habitat conditions for the remaining 280 Associated Species, using Lifeform analysis, was evaluated in terms of changes in primary and secondary habitat: (1) throughout the entire Planning Area; (2) in Plum Creek's riparian habitat areas (RHAs), Forest Service riparian conservation areas (RCAs), and wetlands; or (3) in management units containing significant rock and talus components. Special attention was given to Lifeform 6. Primary habitat for this Lifeform is early-successional structural stages near streams. Anticipated declines in habitat for this group were addressed by maintaining habitat where necessary through timber harvesting or vegetation management near streams.

Forest Health (Section 3.5.4)

Plum Creek developed two models to evaluate and quantify the risks to forest health posed by the forest management strategy. These models addressed the two most significant forest health issues affecting spotted owl habitat in the I-90 corridor: (1) fire risk and (2) spruce budworm (*Choristoneura occidentalis)* outbreaks. The models relate fire risk factors and insect infestation to forest inventory characteristics such as stand age, species composition and fuel loading. These risk factors are linked to the eight stand structural classes described earlier, thereby permitting Plum Creek to simultaneously evaluate wildlife habitat and forest health conditions under various alternatives at the stand and landscape level at various intervals during the Permit period.

The fire susceptibility model was based on "dead" fuel accumulation, fire potential, and other factors. An initial fuel loading estimate was generated for each tree species group, structural stage, and Fire Management Analysis Zone (FMAZ). Additional calculations were made to account for accumulations due to ingrowth over time and natural decomposition of fuel over the same time period. Implementation of the HCP, in conjunction with the Northwest Forest Plan, the percentage of the Planning area in high fuel loading condition will increase from 15 percent in 1996 to 34 percent in 2045.

The spruce budworm susceptibility model is driven primarily by the density of grand fir, Douglas fir and Engelmann spruce. Spruce budworm is primarily an Eastside forest problem. For this reason, the model was applied to forest stands in FMAZ 2, 3 and 4. Implementation of the HCP and Northwest Forest Plan will increase the percentage of the Planning Area, on the Eastside of the Cascades, with a high susceptibility rating (index greater than 100) for spruce budworm outbreaks, from 22 percent in 1996 to 31 percent in 2045.

The diminishing role of prescribed and natural fire, combined with forest succession and retention of wildlife habitat components (e.g., snags and downed woody debris) will result in an increase in the susceptibility of future forest fires and spruce budworm infestations. The trend in fuel loading and insect risk can be expected to increase over the Permit period as a result of implementation of the HCP. Plum Creek intends to mitigate this trend by employing silvicultural practices such as pre-commercial and commercial thinning where practical.

Additional Mitigation Measures

Mitigation measures are actions taken by Plum Creek to minimize and avoid impacts to species addressed in the HCP (Section 3.6). These actions include steps taken to develop the plan as well as actions proposed to monitor and address impacts after implementation of the plan. The following constitute some basic elements of mitigation for issuance of a Permit for Plum Creek's Planning Area. A majority of these actions contribute directly to the biological success of the HCP and are quantifiable.

Other Wildlife Species

- ***Goshawk Nest Protection*** — Plum Creek will defer harvest of 101-262 acres of habitat currently supporting 2 goshawk sites on Plum Creek's land, for at least 20 years.
- ***Bald Eagle Management Plans* —** Plum Creek will develop cooperative site management plans with the WDFW for bald eagle nest sites which may occur on Plum Creek's ownership during the Permit period.
- ***Peregrine Falcon Protection Plans* —** Plum Creek will implement steps outlined in the Pacific States Peregrine Falcon Recovery Plan to address forest management activities near peregrine falcon nests which may occur on or near Plum Creek's lands during the Permit period.
- ***Breeding Bird Surveys* —** Plum Creek will conduct breeding bird surveys at designated intervals during the Permit period to verify associations of various Lifeforms to stand structural classes developed for the HCP.
- ***Amphibian Surveys* —** Plum Creek will conduct amphibian surveys at designated intervals during the Permit period to evaluate the success of riparian management practices in providing habitat and protecting conditions for amphibians.

Riparian Management

- ***Ecological Classification* —** Plum Creek has completed a hierarchical ecological classification of the Planning Area, which incorporates geomorphology and hydrologic data necessary for watershed analysis.
- ***Aquatic Resources Monitoring* —** Stream reaches in key watersheds on Plum Creek land have been identified to evaluate aquatic habitat conditions and fish populations at periodic intervals over the Permit period.

Road Management

- ***Minimizing Road Building* —** Plum Creek will reduce road construction where economically and operationally possible by using other harvesting systems (e.g., cable yarding, helicopters).
- ***Closures/Abandonment* —** Plum Creek will close or abandon ("decommission") roads where feasible to address watershed concerns and habitat requirements for grizzly bears, wolves and other species included in the HCP.

Other Measures

- ***Forest Inventory* —** Plum Creek will revise its inventory procedures to incorporate measurement of wildlife habitat characteristics (e.g., snags, structural class) necessary to evaluate and monitor success of the HCP. The inventory schedule will be accelerated in the Planning Area to obtain more precise information on more acres of company ownership.
- ***Environmental Principles* —** Plum Creek will continue to employ its Environmental Principles to address aesthetic and environmental issues in the Planning Area.

Implementation of the Environmental Principles typically involves implementing practices in excess of State Forest Practices Rules and Regulations.

- **Employee/Contractor Training —** To facilitate implementation of the HCP, Plum Creek will conduct training programs for all professional foresters, engineers, scientists, and contractors. The program will train all employees and contractors involved in forest management in state-of-the-art techniques to integrate the management of all forest resources, and familiarize them with the details of the HCP along with the Company's plans, policies, and programs to implement the HCP. A "field manual" will be distributed which will summarize the mitigation implemented in the field and will provide specific instruction or directions on measurement criteria. The manual will be updated as necessary as changes in methodology are made in response to the need for clarification or improvements.
- ***Monitoring and Reporting* —** Plum Creek will monitor key criteria annually for the Permit period and provide reports to the Services at years: 2, 5, 10, 15, 20, 30, 40, and 50.

IV Alternatives Analyzed

Plum Creek considered various alternative strategies to meet the requirements of the ESA (Section 4.0). Three different conservation strategies were evaluated: one based on using current regulations to protect threatened and endangered species (No Action), one based on a Riparian Management Strategy to protect habitats along perennial streams (Riparian Management), and one based on a combined Riparian Management Strategy and protection of dispersal habitat (Dispersal Habitat). When developing the HCP, Plum Creek considered the advantages and disadvantages of the different alternatives. Plum Creek concluded that the best way to meet its goals would be to combine various aspects of all three alternatives. Specifically, the HCP emphasizes multi-species, habitat management in combination with spotted owl nest site protection and designation of areas where no timber harvesting or only partial harvesting will be allowed. Monitoring and research also are proposed in the HCP, both for use in evaluating habitat management over time and for their value in addressing uncertainty of the long-term effects of HCP implementation on fish and wildlife species and their habitats. Uncertainty can be addressed by implementation of an adaptive management approach which incorporates research and monitoring into a responsive program to evaluate the HCP as a "management experiment" that may be modified as necessary to meet objectives.

The three conservation strategies that were considered but rejected as being either economically infeasible for Plum Creek or less beneficial for spotted owls and other wildlife species in the Planning Area are described below:

- ***Current Regulations (No Action; Section 4.1)*** — Under this alternative, Plum Creek would quantify the economic and biological impacts of continuing to operate under current state and Federal guidelines to protect spotted owls. This alternative assumes no HCP and that the Federal 4(d) special rule to define "take" of spotted owls includes habitat modification below habitat thresholds within a 1.8-mile circle around all owl nest sites in the I-90 Special Emphasis Area. Under this alternative Plum Creek would be required to leave NRF habitat in circles below thresholds around all spotted owl pairs and resident single sites. Plum Creek would limit retention of timber in riparian areas to only that required by current forest practices regulations.
- ***Riparian Management (Section 4.2)*** — This alternative would implement and evaluate a riparian-based conservation strategy to develop RHAs along perennial streams crossing Plum Creek's lands in

the Planning Area. It would focus on providing supplemental stream protection to address fisheries concerns, enhance the success of the Federal Aquatic Conservation Strategy (ACS), and retain forest structure along streams where data suggest that spotted owls and other wildlife species would benefit. Forest stands outside of the RHAs would be harvested in accordance with current forest practices regulations. Within RHAs, timber harvest would be constrained to conservative partial harvesting. Post harvest RHAs would continue to serve as adequate FD habitat for spotted owls.

- ***Dispersal Habitat (Section 4.3)*** — Under this alternative, Plum Creek's contribution to spotted owl habitat protection would include components of the riparian management alternative and provisions for dispersal habitat. The objective of this strategy would be to complement the Northwest Forest Plan by providing opportunities for spotted owls and other wildlife species to successfully disperse across Plum Creek's lands to colonize the NRF habitat in Late-Successional Reserves and Adaptive Management Areas on adjacent Federal lands. Dispersal habitat would be specifically directed at forest stands currently constrained in 1.8-mile owl management circles to provide NRF habitat. Forest stand management would include maintaining small diameter, high density conditions conducive to spotted owl dispersal. Forest stands growing into larger diameter classes approximating mature and old growth conditions would be harvested.

V Plan Implementation

Monitoring

The section 10 regulations of the ESA require that an HCP specify the measures that will be taken to "monitor" the impacts of the taking resulting from implementation of the conservation plan (Section 5.1). Plum Creek's HCP will include: (1) habitat verification; (2) spotted owl monitoring; (3) marbled murrelet monitoring; (4) grizzly bear monitoring; (5) gray wolf monitoring; (6) aquatic resources monitoring; and (7) Lifeform habitat monitoring.

Implementation Agreement

Plum Creek's HCP will be governed by the provisions set forth in the Implementation Agreement (IA)(Section 5.3). This agreement is a specific requirement for an incidental take permit application. The IA is a legal contract that identifies the responsibilities of Plum Creek and the FWS, legally binds all parties, and provides a common understanding of actions that will be undertaken for the conservation of listed and candidate species and their habitats during the implementation of the proposed plan within the Planning Area.

The HCP contemplates on-going, active and adaptive management of habitat across the landscape for multiple species. As such, it is expected that changes in the time, place, and manner of mitigation may occur over the life of the Permit. Such changes arising in the course of implementing previously agreed upon provisions of the HCP will not be considered material, even if they result in material changes in the prescriptions governing Plum Creek's operations under the HCP. An amendment to the Permit will not be required unless the Services demonstrate that the net effect of the HCP amendment on listed species is significantly greater than that anticipated under the original Permit and associated NEPA documents.

Adaptive Management

Although a significant body of scientific information and expertise was used to develop Plum Creek's Cascades HCP, not all of the questions about the long-term effects of HCP implementation on fish and wildlife species and their habitats can be answered with total certainty (Section 5.4). However, uncertainty can be addressed by implementation of an adaptive management approach which incorporates research (Section 5.2) and monitoring into a responsive program to evaluate the HCP as a "management experiment" that may be modified as necessary to meet objectives.

Adaptive management is a process that can improve management practices incrementally by implementing plans in ways that maximize opportunities to learn from experience. Adaptive management can provide a reliable means for assessing the HCP, producing better ecological knowledge, and developing appropriate modifications to improve forest management. The primary challenge for using an adaptive management approach is to demonstrate simply and clearly why a change in management would be worthwhile. A process is described to incorporate important elements for adaptive management into the HCP. The process is linked to the research and monitoring program and the designated reporting intervals for Plum Creek and the Services to evaluate the HCP. Watershed analysis, the spotted owl strategy, the Riparian Management Strategy and cooperative experimental areas are important aspects of the HCP that are amenable to adaptive management.

VI National Environmental Policy Act

Although not a direct obligation of Plum Creek or a specific requirement of a permit application, the FWS must comply with the National Environmental Policy Act (NEPA) regarding the issuance of the Permit pursuant to the HCP. To comply with the statutory requirements of NEPA, the FWS must provide full disclosure of the environmental issues surrounding the proposed Federal action (i.e., issuance of an incidental take permit), encourage public involvement in planning, identifying, and assessing all reasonable alternatives, and generally explore all practical means to enhance the quality of the human environment and to avoid or minimize adverse environmental impacts that may arise from the Federal action. NEPA compliance will be initiated in the Plum Creek HCP process through the development of an environmental impact statement.

Section 1.0

The Planning Context

1.0 The Planning Context

1.1 Reason for Modification of the HCP

On June 27, 1996, the U. S. Fish and Wildlife Service and National Marine Fisheries Service (collectively, "Services") approved a Habitat Conservation Plan (HCP) and subsequently issued Incidental Take Permits ("Permits" or ITPs) to Plum Creek Timber Company ("Plum Creek" or the "Company"). The HCP addressed a Planning Area of 418,900 acres and originally covered activities on 170,500 acres owned or managed by Plum Creek.

In October 1998, a land exchange (called the I-90 Land Exchange) between Plum Creek and the U.S. Forest Service (Forest Service) was approved by the U.S. Congress. In November 1999, the I-90 Land Exchange was amended and signed into law by the President. The amended land exchange was comprised of 31,700 acres of Plum Creek land (30,900 acres in the land exchange and 800 acres donated) and 11,600 acres of National Forest System lands. 30,800 acres of the Plum Creek lands transferred to the Forest Service are in the HCP Planning Area. 8,600 acres of the land transferred from the Forest Service to Plum Creek are in the Planning Area with the balance of 3,000 acres in the Gifford Pinchot National Forest.

One of the reasons for the amendment of the Land Exchange was the removal of two sections originally going from the Forest Service to Plum Creek. While conducting Marbled Murrelet surveys required by the HCP for those sections containing suitable habitat, Plum Creek scientists discovered the presence of murrelets. Since the HCP requires a set-aside of acreage when murrelets are present, Plum Creek declined to accept the sections. Eight Plum Creek sections were withdrawn to offset the values in the two murrelet sections. However, since the Forest Service expressed a desire to still acquire these sections, Plum Creek agreed to place them in escrow for up to three years to allow the Forest Service the opportunity to obtain funding to purchase. These "Escrow" sections will remain in the HCP until they are sold to the Forest Service at which time they will be removed from the HCP. Sales to the Federal Government are covered in Section 5.3.4.2 of the HCP and Section 7.3.2(a) of the Implementation Agreement (IA).

Also included in the amendment of the Land Exchange was the withdrawal by the Forest Service of lands in the Gifford Pinchot National Forest due to concerns expressed by local residents and environmental groups. To offset the value of these sections Plum Creek had to withdraw 21 sections within the HCP Planning Area. Environmental groups expressed a desire to purchase these lands from Plum Creek and it was agreed that Plum Creek would give options for up to four years to buy the sections at the value established in the land exchange fair market appraisal. The 21 "Option to Buy" Sections will remain in the HCP until they are purchased at which time they will be removed from the HCP. Sales to non-federal government parties are covered in Section 5.3.4.3 of the HCP and Section 7.3.2(d) of the IA.

As a condition for completing the land exchange, Plum Creek notified the Services that it proposed to modify its existing HCP to provide incidental take authorization for activities on the approximately 8,600 acres of land within the Planning Area that will be acquired by Plum Creek from the Forest Service. The Permits no longer cover the 30,800 acres transferred to the Forest Service. Plum Creek did not propose, and the land exchange did not require a change in the boundaries of the HCP Planning Area. Furthermore, Plum Creek did not propose to increase the level of incidental take analyzed and authorized for Permit Species under the existing ITPs.

The ownership before and after the land exchange is summarized below:

Table 1. Summary of Land Ownership in the HCP Planning Area Before and After the I-90 Land Exchange.

Ownership	Pre-Land Exchange	Post-Land Exchange	Escrow and Option to Buy Sections Not Owned by Plum Creek
Plum Creek *	170,500	148,300	130,000
Forest Service	196,500	218,700	237,000 **
Other (State & Private)	45,300	45,300	45,300
Water (Lakes)	6,600	6,600	6,600
Total	**418,900**	**418,900**	**418,900**

*** Includes lands owned and lands on which Plum Creek has timber harvest rights**

**** Not all the lands will necessarily be owned by the Forest Service but are expected to be managed comparably.**

The request for modification of the HCP was initiated with a document which described and analyzed changes in Plum Creek's HCP that occur as a result of the land exchange with the Forest Service. It discussed changes that either affect or potentially affect implementation of the HCP on Section 10(a) species and/ or unlisted agreement species covered in the HCP. A draft document accompanied the Draft Supplemental Environmental Impact Statement (DSEIS) which was issued for public comment by the Services. A final document accompanied the Services' Final Supplemental Environmental Impact Statement (FSEIS). The modifications resulting from the land exchange, as well as other minor modifications, induced Plum Creek to revise the HCP and thereby alleviate the need for more than one document to be consulted. Both sets of documents (DSEIS and FSEIS) are incorporated by reference into this document which revises and replaces the June 1996 HCP. All ownership information in this document relates to the ownership post I-90 Land Exchange. In Section 3 of the HCP, ranges of values will be shown to reflect the range of ownership before and after the sale of the "Escrow" and "Option to Buy" sections.

1.2 Scope

Permittee

Plum Creek, headquartered in Seattle, Washington, is the second largest private timberland owner in the U.S. and the second largest in the Pacific Northwest. The Company owns approximately 7.9 million acres of timberland in 19 states of which 1.8 million acres of prime softwood timberland are located throughout Western Montana, northern Idaho, and Washington. Plum Creek owns and manages approximately 285,000 acres of primarily second growth forestland in the central Cascade Mountain Range.

Permit Length

Subsequent to the June, 1996, approval of the HCP, Plum Creek received two 50-year Permits from the Services which, under certain circumstances ("Safe Harbor" or "Phase II", Section 5.3.3), provide for up to an additional 50 years.

Covered Activities

The Permits authorize incidental take in connection with all aspects of commercial forest management (including, without limitation, administration and monitoring, road access, road building and maintenance, site preparation, planting, thinning, fertilizing, pest and brush control, timber harvest, slash control, fire control, administrative and commercial road use, administration and commercial use of gravel pits and rock quarries, and administration and maintenance of all existing buildings, radio towers, and associated telecommunication facilities) and ecosystem-based forest planning.

Covered Lands

Because of the checkerboard configuration of land ownership, the outer boundaries of the "Planning Area" encompass 418,900 acres, including 270,600-288,900 acres of other ownership. This HCP was written to support the issuance of ITPs to Plum Creek. The Permits authorize take on 130,000–148,300 acres of land owned by Plum Creek in the Interstate 90 (I-90) corridor of the central Cascades Mountain Range in Washington. Also covered are lands Plum Creek sold to the City of Tacoma but for which Plum Creek retained timber harvest rights. Refer to Table 1 and Figure 1.

Covered Species

At the inception of the HCP on June 27, 1996, the Permits allowed incidental take of the northern spotted owl (*Strix occidentalis caurina*), marbled murrelet (*Brachyramphus marmoratus*), grizzly bear (*Ursus arctos*), and gray wolf (*Canis lupus*) resulting from forest-management activities on Plum Creek lands. On July 14, 1998, the Permits were amended to include bull trout (*Salvelinus confluentu)* East of the Cascade Crest. Plum Creek has also requested the addition of Puget Sound chinook (*Oncorhynchus tsawytscha*), Mid-Columbia steelhead (*Oncorhynchus mykiss*), Puget Sound bull trout (*Salvelinus confluentus*), and Canada lynx (*Lynx canadensis*). To minimize and mitigate the impact of any permitted activities, Plum Creek instituted the mitigation measures set forth in this HCP. Plum Creek also entered into an agreement with the Services that stipulates that this HCP sufficiently minimizes and mitigates the impacts of forest management on all vertebrate species found within the Planning Area, such that if any of these species become listed during the 50- to 100- year period, the Services would amend the ITPs to include such species without requiring additional mitigation.

Management Practices

Plum Creek is committed to using forest-management practices that are environmentally and economically sound. As part of this commitment, Plum Creek is implementing state-of-the-art management practices to preserve and protect wildlife habitat and forestland ecosystems. These advanced management practices protect resident and migratory wildlife and habitats while providing economically predictable harvests.

HCP Goals

The primary goals of this HCP are: (1) to comply with the requirements of section 10(a)(2)(A) of the Endangered Species Act (ESA); (2) to provide Plum Creek with predictability and flexibility to manage its timberlands economically while contributing in a meaningful way to the conservation of the spotted owl, marbled murrelet, grizzly bear, and gray wolf, and numerous other species; and (3) provide adequate habitat conditions in the Planning Area so that additional species may not need to be listed in the future. This HCP uses an adaptive management approach and contains measurable criteria for assessing the biological success of the conservation plan. This document is a multi-species HCP prepared to support the permits issued pursuant to section 10(a)(1)(B) of the ESA.

1.2.1 The Planning Area

The Company's ownership (land and timber rights) in the Planning Area is located both East and West of the Cascade Mountain crest along the I-90 corridor in central Washington, between 60 to 100 miles East of Seattle. Plum Creek's ownership in the Planning Area is generally intermingled with Federal lands, and consists of 130,000 – 148,300 acres of alternating sections (1 square mile) bordered, mainly, by Federal lands administered by the Forest Service. The total area within the HCP boundary encompasses 418,900 acres, with the following ownerships:

• Forest Service	• 218,700-237,000 acres
• Plum Creek	• 130,00-148,300 acres
• Other (state and private)	• 45,300 acres
• Water (i.e., lakes, streams)	• 6,600 acres

In selecting the geographical boundaries for implementation of the HCP (Figure 1), Plum Creek considered proposed Growth Management Act (GMA) zoning in King and Kittitas Counties, the potential habitat of the species to be protected, and the anticipated future activities that might result in incidental take of the above mentioned species. Plum Creek's timberlands in the Planning Area incorporate portions of 11 Townships on the Western slopes of the Cascade range, and 19 Townships on the Eastern slopes of the Cascade range (Appendix 1).

The predominant nonfederal land use in the I-90 corridor and surrounding areas is commercial timber production. Federal lands are managed for multiple uses, but timber harvest has traditionally been one of the most significant land uses that has affected wildlife habitat.

1.2.2 Characteristics of the Planning Area

Plum Creek's timber base, West of the Cascades, is predominately Douglas fir (*Pseudotsuga menziesii)*. Other important commercial species include Western hemlock (*Tsuga heterophylla*), noble fir (*Abies procera*), Pacific silver fir (*Abies amabilis*), Western red cedar (*Thuja plicata*), Sitka spruce (*Picea sitchensis*), and red alder (*Alnus rubra*).

The pine-larch-Douglas fir forests of the Eastern Cascades receive limited precipitation except on the mountainous regions and much of that occurs as snow. With low summer precipitation, only tree species such as Douglas fir, lodgepole pine (*Pinus contorta*), and Ponderosa pine (*Pinus Ponderosa*) can tolerate the summer drought. Forest conditions at higher elevations of the East-side Cascades (i.e., the transition zone) are very similar to conditions in the West-side Cascades.

1.2.2.1 Physiographic Provinces

Forests East of the Cascade crest are typically comprised of a greater diversity of tree species (i.e., typically five or more species per stand) and size classes than the forests West of the Cascade crest, which are generally represented by only one or two tree species and greater uniformity in stand size structure. In the typical stands East of the Cascade crest it is relatively easy to maintain structural diversity and leave a diverse grouping of green-trees, including large, intermediates, and saplings, because of the multi-species components of the forest. In contrast, with the typically uniform stands West of the Cascades, limited tree species and size classes may restrict opportunities to create structural diversity.

Although the forests East and West of the Cascade crest differ in terms of tree species composition and structure, adjacent high elevation areas on both sides of the crest are very similar and are comprised predominantly of Pacific silver fir forests. There are other similarities as well. For example, within the

Eastern Cascade forests there are areas of relatively homogenous stands (i.e., lodgepole pine/ Ponderosa pine) which, like the Douglas fir/ Western hemlock dominated stands in the Western Cascade forests, are prone to being blown down by high winds, which creates structural diversity and habitat for a wide array of animals.

1.2.2.1.1 Western Washington Cascades Province

The central and southern portions of this province (Figure 2) are dominated by humid forests comprised primarily of Douglas fir and Western hemlock at mid-to-low elevations and noble fir, Pacific silver fir, and mountain hemlock at higher elevations. Pacific silver fir and mountain hemlock are also found at higher elevations on the Eastern side of the Cascade crest. Forest Service holdings in the region include extensive areas of late-successional forest. Although some national parks and wilderness areas within the region include significant areas of mid-elevation, late-successional forests, most are dominated by high elevation areas of relatively moist, cool upland slopes and subalpine vegetation.

Climatic conditions in this region are relatively mild, and moist winters provide excellent conditions for forest growth. Summers are normally short, dry, and sunny, while winters are characterized by abundant precipitation, including heavy snowfall at higher elevations.

1.2.2.1.2 Eastern Washington Cascades Province

The central and southern portions of this Province (Figure 2) are dominated by mixed-conifer (grand fir, Douglas fir, Western larch, Western white pine (*Pinus monitcola*), lodgepole pine) forests at mid-to-lower elevations. Forests at mid-to-lower elevations are predominantly Ponderosa pine and at higher elevations true fir (subalpine). Forests in this region are highly fragmented due to poor soils, high fire frequencies, alpine meadows, and timber harvesting.

Wildfire has played a major role in shaping the forests in both the Eastern and Western Cascades Region. Recent efforts at fire suppression, especially in the Eastern Cascades, and selective timber-harvesting practices have resulted in shifts in tree species composition in some areas. Certain forests in the region are more susceptible to catastrophic fires and epidemic attacks of insects and disease.

The interior climate East of the Cascade crest produces very little precipitation, except in a few isolated areas. Summer precipitation is very low, generally less than 20 inches annually. However, throughout the forested areas in the Eastern Cascades Province, precipitation varies between 20 to over 80 inches annually. In contrast to the Western region, winter precipitation in the Eastern Cascades is low and usually in the form of snow. Summers are sunny and warm and occasional spring showers provide early season moisture. Winters tend to be cold and sunny East of the Cascade range.

1.2.2.2 Major Subbasins

Two major subbasins are located within the Planning Area: the Green River Subbasin in the Western portion and the Yakima River Subbasin in the Eastern portion.

1.2.2.2.1 The Green River Subbasin

The Green River Subbasin encompasses 483 square miles. The main river system in the subbasin is the Green River. The Green River begins on the Western slopes of the Cascade Mountains near Blowout Mountain, and terminates at Elliott Bay in Puget Sound, 90 miles to the northwest (Figure 3). Thirty miles downstream from its source, the Green River encounters the Howard Hanson Dam at River Mile (RM) 64.5 and the Tacoma Water Diversion Dam at RM 61. Two major tributaries, Newaukum Creek (RM 40.7) and Big Soos Creek (RM 33.7) enter the Green River above the City of Auburn, and below Howard Hanson Dam. At its junction with the Black River the Green River becomes known as the Duwamish River. The Duwamish consists of 12 miles of the channel from the Black River to Elliott Bay.

Subbasin Characteristics — The upper Green River (generally above Howard Hanson Dam) is a Class I, fourth-order stream. The upper basin encompasses 36,073 acres with ownership almost equally divided between National Forest (48 percent) and private land (52 percent). The principal private landowners include Plum Creek and the City of Tacoma. Approximately 49 percent of the subbasin has been harvested within the past 50 years with an associated road density of about 4.5 miles per square mile. Timber harvesting has occurred within the riparian zone of many streams throughout the basin resulting in a lack of recruitment for new material.

Water Use — The primary use of water in the Green River Subbasin is for public supply and irrigation. Other uses include rural domestic and industrial demands. The City of Tacoma built the Tacoma Diversion Dam on the Green River in 1911. The dam, at RM 61, blocks all upstream migration of salmonids. The City of Tacoma diverts up to 113 cfs under a vested water claim. Future diversions will be managed under the City of Tacoma's HCP.

Currently, no natural spawning by anadromous fish, except steelhead, occurs upstream of the diversion dam, but juvenile salmonids have been outplanted by the Muckleshoot Tribe. The Muckleshoot Indian Tribe has been closely involved with the history of salmon and steelhead management in the Green River basin. The history of the basin's fish resources includes construction of dams, fish traps, hatcheries, and weirs. Plantings of salmon have been conducted in the upper Green River basin. This has included a large amount of effort and expense which signifies the importance of Green River steelhead, coho, and chinook to the Tribe. In earlier years, they planted approximately 2 million coho and chinook and 50,000 steelhead per year. In recent years, these numbers have been about 500,000 coho and chinook and 80,000 steelhead.

The U.S. Army Corps of Engineers (Corps) built the Howard Hanson Dam at RM 64.5 in 1961. It was originally authorized for flood control and conservation storage to augment low summer/ fall flows for fishery enhancement. The Corps delays filling the dams as long as possible each year to allow downstream passage of coho and chinook salmon, and steelhead trout smolts.

1.2.2.2.2 The Yakima River Subbasin

The Yakima River Subbasin encompasses 6,155 square miles and contains approximately 1,900 river miles of perennial streams (Figure 4). Predominant land use within the Yakima Subbasin includes irrigated agriculture (1,000 square miles), urbanization (50 square miles), timber harvesting (2,200 square miles), and grazing (2,900 square miles). Riparian corridors range from severely damaged to nearly pristine. Exceptional riparian corridors are generally located along forested, headwater reaches in the upper portion of the subbasin, whereas degraded riparian habitat is concentrated in the valleys in the lower portion of the subbasin, in areas frequently associated with agricultural operations (YIN et al. 1990).

Subbasin Characteristics — The Yakima originates near the crest of the Cascade range above Keechelus Lake at an elevation of 6,900 feet and flows southeastward for 214 miles to its confluence with the Columbia River at river mile (RM) 335.2. Major tributaries to the Yakima include Kachess, Cle Elum, and Teanaway Rivers in the northern portion of the subbasin, and the Naches River in the West. The Naches River has four major tributaries including the Bumping, American, Tieton, and Little Naches Rivers. Ahtanum, Toppenish, and Satus Creeks enter the Yakima River in the lower portion of the subbasin.

The Yakima Subbasin contains six major reservoirs. The Yakima River flows out of Keechelus Lake (157,800 acre feet), the Kachess River flows from Kachess Lake (239,000 acre feet), the Cle Elum River flows from Cle Elum Lake (436,900 acre feet), the Tieton River flows from Rimrock Lake (198,000 acre feet), and the Bumping River flows from Bumping Lake (33,700 acre feet). The North Fork of the Tieton

River connects Clear Lake (5,300 acre feet) with Rimrock Lake. All reservoirs except Rimrock and Clear Lakes were natural lakes prior to impoundment (YIN et al. 1990).

The mainstem of the Yakima River contains six major diversion dams, and several smaller dams are located along the Naches River (Figure 4). The dams on the Yakima River include Easton (RM 203), Roza (RM 128), Wapato (RM 107), Sunnyside (RM 104), Prosser (RM 47), and Horn Rapids (RM 18). The primary dams on the Naches River include Wapatox (RM 17) and Naches Cowiche (RM 4).

Water Use — Withdrawal of water from the Yakima River and restriction of inflow during reservoir filling are the most significant factors limiting fish production in the Yakima Subbasin (YIN et al. 1990). Water supplies are severely overtaxed by the demands of irrigation that compete with flows needed for fish production. Except for a minimum flow below Prosser dam and a court-ordered minimum flow maintained for egg incubation in the Yakima from Easton dam to the Teanaway River, there are no binding minimum instream flows for fish (YIN et al. 1990). Consequently, instream flows are rarely optimal anywhere in the subbasin, including the streams and tributaries in the Planning Area, and may be critically low for fish production in drought years. In an average year, the total available water supply in the subbasin is barely adequate for irrigation and never adequate for maximum fish production (YIN et al. 1990).

The effect of water diversions and water withdrawal in tributary streams is more severe than in the mainstem of the Yakima River, because the diversions frequently lack effective fish passage and protective devices, and because proportionately more water is diverted. Water diversions in tributary streams can affect the entire life cycle of salmonids, from egg to returning adults. The effects are more significant on steelhead and coho than on chinook, since steelhead and coho spend an appreciably greater proportion of their life cycle as juveniles in the smaller tributary streams.

1.2.3 Plum Creek's Standard Management Practices

Plum Creek manages its timberlands in the central Cascade Mountain Range in Washington for the primary purpose of growing and harvesting commercial timber, using forest-management practices that are environmentally and economically sound. In order to preserve and enhance the productivity of its timberlands, and to protect other natural resources, Plum Creek is committed to testing and implementing state-of-the-art management techniques. In 1991, Plum Creek adopted a set of Environmental Principles (Appendix 2). These principles guide the conduct of Plum Creek on all of its ownership.

The following sections describe Plum Creek's standard forestry practices that are incorporated into the HCP and each alternative. The only exception is the No Action Alternative, which was specifically designed to illustrate an HCP using current State forest rules and regulations without benefit of Plum Creek's voluntary Environmental Forestry commitments.

1.2.3.1 Harvest Methods

Plum Creek uses even-aged and uneven-aged harvesting techniques in its ownership in the Cascade range. By definition, even-aged harvest methods include clear-cuts, seed-tree harvests (in which 20 or fewer trees per acre remain after harvest), and overstory removal (where more than 5,000 board feet per acre are removed and fewer than 50 trees per acre at least 10-feet in height remain after harvest). Shelterwood regeneration harvest is also considered by the State of Washington to be an even-aged harvest method when 20 or fewer dominant, vigorous trees per acre remain after harvest. However, Plum Creek's policy when using the shelterwood method is to leave more than 20 trees per acre. As such, the shelterwood method used by Plum Creek is considered, under State definition, an uneven-aged harvest method. Normally, shelterwood harvests are followed, 10 to 20 years later, by a shelterwood removal harvest. Under standard silvicultural practices, shelterwood prescriptions are usually followed by subsequent removal of shelterwood trees, 10 to 20 years following harvest and successful regeneration. However, because of Plum Creek's commitment to its Environmental Principles, the Company will conduct variations on the standard shelterwood method where necessary for site-specific objectives, such as to maintain structural diversity. To achieve this objective, Plum Creek would leave not only dominant, vigorous trees, but also leave trees with a variety of species, diameters, and vigor classes (i.e., dead and dying trees) to maximize structural diversity. Except where noted, trees counted by Plum Creek as remaining after harvest are those trees at least 10 inches in diameter at breast height (DBH) and have at least the top one-third of the stem supporting green, live crowns.

In 1994, Plum Creek used even-aged harvesting techniques in approximately 17 percent of its harvest operations East of the Cascades crest, and in about 65 percent of its operations West of the Cascades crest. These harvesting techniques favor tree species, such as Douglas fir, which grow best in open conditions with full sunlight. Shelterwood harvesting and other uneven-aged techniques favor shade-tolerant trees such as Western hemlock. Overstory removal involves harvesting trees that comprise the upper canopy layer to encourage rapid growth of trees in the understory, creating an even-aged stand. By selectively removing or leaving large, scattered, mature trees, overstory removal can be used as an effective uneven-aged harvesting method to maintain diverse wildlife habitat. Overstory removal is most effective in stands with distinct canopy layers or size classes.

Even-aged harvesting, particularly clear-cutting, is a widely used form of timber harvesting on the West-side of the Cascades. On the East-side of the Cascades, where arid conditions prevail and stand structure and species composition are more varied, uneven-aged techniques, such as shelterwood, overstory removal, and selective harvesting, are more common. Even-aged harvesting is also conducted on the East-side where appropriate.

To fulfill its commitment to the application of Environmental Forestry, Plum Creek leaves representative trees, either individually or in clumps, to provide habitat diversity for wildlife. Unlike seed-tree or shelterwood harvesting techniques done elsewhere, trees are left on-site until the next harvest. Regeneration is accomplished primarily through planting.

Plum Creek's foresters protect and enhance environmental values of the forests while providing economic timber growth and harvest. Timber falling contractors are required to: (1) avoid yarding downed logs through streams; (2) refrain from causing soil erosion or degradation of side slopes; (3) mitigate impacts to natural resources; (4) comply with special conditions (i.e., trail protection or visual sensitivity); and (5) maintain a cost-effective production level while meeting State and Federal safety guidelines. In addition, Plum Creek ensures that riparian buffers are maintained along all fish-bearing streams and along 20 to 30 percent of smaller, nonfish-bearing streams which normally do not require protection under State law. Trees are also left standing in designated Upland Management Areas (UMAs), as wildlife reserves and green recruitment trees, and for visual buffers, green-up strips, and wildlife corridors.

Current State Forest Practices Rules and Regulations adopted in 1992 stipulate that, as a minimum in Western Washington, three wildlife reserve trees (i.e., defective, dead, damaged, or dying trees which provide or have the potential to provide habitat for wildlife species dependent upon standing trees), two green recruitment trees (trees left to become future wildlife reserve trees), and two downed logs shall be retained for each acre harvested. In Eastern Washington, two wildlife reserve trees, two green recruitment trees, and two downed logs shall remain for each acre harvested. In the Planning Area, Plum Creek frequently exceeds these standards.

1.2.3.2 Reforestation

Plum Creek usually prepares for forest regeneration of harvested areas within one year. However, the extent of site preparation has been reduced over the last few years because of environmental concerns. As an example, Plum Creek seldom practices prescribed burning, and scarification and herbicide applications are used only when deemed necessary for plant establishment and seedling survival. Controlled burning of some debris and brush piles, left over from the harvest, are still conducted during the winter months. This step is followed by hand planting of Douglas fir or other species at a density of 300 to 400 seedlings per acre (State rules require 190 seedlings per acre).

Although Douglas fir is the primary species planted in Western Washington, other species are planted if they are better suited to the growing conditions or have a natural affinity for the geographic location. These trees include noble fir, Western hemlock, Western red cedar, and Sitka spruce. In Eastern Washington, Douglas fir comprises less than 50 percent of the planted stock. Other important species planted in the Eastern Cascades include Ponderosa pine, grand fir, Pacific silver fir, Western larch, lodgepole pine, Western white pine, Western red cedar, noble fir, and Engelmann spruce (*Picea engelmanni*).

1.2.3.3 Growth Enhancement and Maintenance

1.2.3.3.1 Tree Improvement Program

Plum Creek's involvement in tree improvement is built on a foundation of cooperative effort between major forest landowners in the Pacific Northwest. Plum Creek is a member of the Northwest Tree Improvement Cooperative (NWTIC), and the Company has designed its Douglas fir tree improvement program to take full advantage of the data and genetic resources available in five designated Douglas fir breeding zones in Western Washington and four zones in Eastern Washington. Each breeding zone was selected by geneticists at the beginning of the program, and each zone is defined by specific geographical and elevational boundaries which define climatic conditions for a species. The five Douglas fir breeding zones West of the Cascades include the following:

Zone	Elevation
Snoqualmie #1	500 — 1,500 feet
Snoqualmie #2	1,500 — 2,500 feet
Cowlitz #1	500 — 1,500 feet
Cowlitz #2 (southern portion)	1,500 — 2,500 feet
Cowlitz #3 (northern portion)	1,500 — 2,500 feet

The four Douglas fir breeding zones East of the Cascades include the following:

Zone	Elevation
Breeding Zone No. 17065	4,000 — 5,000 feet
Breeding Zone No. 17034	3,000 — 4,000 feet
Breeding Zone No. 17044	3,000 — 4,000 feet
Breeding Zone No. 17043	2,000 — 4,000 feet

Within the breeding zones, genetic data are derived from special field trials known as progeny tests. The Cooperative designs these tests to evaluate the adaptation and growth performance of groups of selected parents and their offspring (progeny) over a range of sites and environmental conditions.

Plum Creek's tree improvement program is designed to permit repeated cycling of selection, breeding, and testing to achieve incremental genetic improvement for particular traits. Plum Creek has chosen to emphasize the improvements in growth rate at its seed orchard facility on Whidbey Island. This facility, owned and operated by Plum Creek, was established in 1982. The facility is designed and managed to produce operational quantities of seed for each of the five Douglas fir breeding zones.

1.2.3.3.2 Stand Maintenance

Stand maintenance or vegetation management is essential in seedling establishment and involves the control of undesirable vegetative competitors. Vegetative competition for light is a major contributor to seedling mortality and growth in Western Washington, whereas strong competition for moisture is a major cause of seedling mortality in Eastern Washington.

Plum Creek uses traditional means of treatment including aerial and ground application of herbicides or mechanical cutting techniques to control competing vegetation. Newly established trees are inspected for several years following planting to ensure that the growth of trees is not impeded by vegetative competitors. However, the Company voluntarily minimizes its use of herbicides, and spraying is prohibited in riparian areas. During the period 1990 through 1994, herbicides were applied to less than 700 acres annually, less than one percent of the 170,500 original acres of Plum Creek's land within the Planning Area. The use of herbicides in site preparation and in stand release within the Planning Area remains low because:

1. High utilization of harvested material supports rapid reforestation prior to the establishment of potential competing vegetation;
2. Plum Creek uses high quality seedlings and seedling handling and planting techniques for reforestation;
3. Plum Creek is conducting more uneven-aged and partial harvests which do not require as much site preparation and replanting following harvesting, thereby reducing the need to use herbicides or other measures to control vegetative competitors;
4. Uneven-aged and partial harvests increase costs and reduce the effectiveness of spraying herbicides because of the snags and large, standing timber;
5. Under its Environmental Principles, Plum Creek voluntarily minimizes its use of herbicides, and the Company exceeds State forest practice rules and regulations by prohibiting spraying in riparian areas, and by not allowing spraying within 100 feet of water bodies;
6. Herbicides are used primarily on highly productive sites, at lower elevations. Because of decreased vegetative competition at higher elevations, herbicide use is minimal; and
7. All herbicides used by Plum Creek are registered for forest use by the Environmental Protection Agency. Forestry use of target specific herbicides is replacing broad-spectrum herbicides. One commonly used herbicide is registered for use in aquatic environments.

The Washington State Forest Practices Board has adopted regulations intended to ensure that the handling, storage, and application of forest pesticides and herbicides does not endanger public health or jeopardize water quality standards. Requirements of these regulations include:

1. a 50-foot buffer along all fish-bearing streams (Type 1-3 streams) and flowing nonfish-bearing streams (Type 4 and 5 streams);
2. no aerial application of pesticides or herbicides within Riparian Management Zones (RMZs);
3. parallel flight paths and use of drift control agents adjacent to stream buffers;
4. reconnaissance over-flight by pilots and landowner of target area prior to application;
5. shut-off of chemical spray during turns and over open water;
6. aerial pesticide application area shall be posted by the landowner; and
7. leave at least a 200-foot buffer strip around residences and 100-foot buffer strip adjacent to agricultural lands.

1.2.3.4 Road Building and Maintenance

All roads constructed by Plum Creek are located to minimize impact to the landscape and to facilitate forest-management activities. Almost all roads are designed as single lane, with occasional turnouts. Typical road construction techniques include installation of a 15-foot subgrade with a 2-foot drainage ditch. Nearly all roads are underlain with small-diameter rocks to enhance all-weather use. The typical running (driving) surface width for roads is 12 feet. Culverts and/ or bridges are placed at all water crossings. Where needed, additional culverts are installed for cross drainage or ditch-line relief. At sites requiring culverts greater than 30 inches in diameter, appropriate culvert size is determined by analyzing such factors as terrain, watershed area, annual precipitation, and rainfall intensity. Roadway grades are typically less than 15 percent with occasional variances determined on a site-by-site basis.

Excavated soils are typically used as fill material to form a portion of the subgrade on terrain under 60 percent sideslope; however, on slopes exceeding 60 percent, all excavated material is end-hauled and disposed of at a stable site. Erosion at road sites is controlled by a variety of techniques including frequent installation of cross drainage or ditch-line relief features to minimize water velocity, armoring (stabilizing) culvert head walls, and construction of stable cut-and-fill slope angles. Additional erosion control measures typically used at road construction sites include grass seeding, sediment filters, straw matting, ditch-line energy dissipaters, and appropriately placed riprap. Plum Creek inspects and maintains roads as needed to ensure proper drainage function and subgrade stability. The maintenance plan is developed in collaboration with the Washington State Department of Natural Resources (DNR), and is in compliance with Washington State's Forest Practices Board Rules and Regulations.

Plum Creek's road maintenance plans reduce the potential effects of road construction and use on streams and riparian habitat areas by:

1. **Minimizing road building activity —** In addition to posing potential environmental impacts to riparian and aquatic habitats, road networks are a major management cost both in terms of construction and ongoing maintenance. For these reasons, Plum Creek's policy is to construct the minimum amount of roadway necessary to harvest timber safely and economically and conduct subsequent management activities.
2. **Minimizing disruption of natural hydrologic flow patterns —** All roads constructed by Plum Creek are located to minimize impacts to natural hydrologic flow patterns. Culverts and/ or bridges are placed at all water crossings, and where needed, additional culverts are installed for cross drainage or ditch-line relief. At sites requiring culverts greater than 30 inches in diameter, appropriate culvert size is determined by analyzing such factors as terrain, watershed area, annual precipitation, and rainfall intensity.

3. **Restricting sidecasting during construction to prevent the introduction of sediment into streams and riparian habitat areas —** Excavated soils are typically used as fill material to form a portion of the subgrade on terrain under 60 percent sideslope; however, on slopes exceeding 60 percent, all excavated material is end-hauled and disposed of at a stable site, and sidecasting is prohibited.
4. **Minimizing erosion at road sites using advanced techniques —** Erosion at road sites is controlled by a variety of techniques including cross drainage or ditch-line relief features to minimize water velocity, armoring (stabilizing) culvert head walls, and construction of stable cut and fill slope angles. Additional erosion control measures typically used at road construction sites include grass seeding, sediment filters, straw matting, ditch-line energy dissipaters, and appropriately placed riprap.
5. **Identifying roads and associated drainage features that pose a potential risk —** Plum Creek inspects and maintains roads as needed to ensure proper drainage function and subgrade stability. The overall maintenance plan for all Plum Creek roads is developed in collaboration with the DNR, and is in compliance with Washington State's Forest Practices Board Rules and Regulations.
6. **Closing or stabilizing roads based on short-term and long-term transportation needs in each watershed —** Plum Creek conducts regular assessments of the Company's short-term and long-term transportation needs. Decisions regarding which roads need to remain open and maintained, and which roads should be decommissioned and stabilized are made on a watershed basis. Plum Creek's decision to decommission versus continuing to maintain a road is based on an environmental and cost/ benefit analysis. In any event, decommissioning plans must be approved by the DNR. Road decommissioning techniques include: (1) removal of culverts; (2) grass seeding; (3) strategic placement of biomatting; and (4) construction of sediment traps. With decommissioning, Plum Creek typically places a gate or barrier on the road to discourage public access, but leaves most of the road bed in place, facilitating reconstruction should the need arise (i.e., fire access, administrative use, or management emphasis change), but hydrologic risks are greatly reduced.

1.2.3.5 Watershed Analysis

Watershed analysis is used regularly by Plum Creek in watersheds on its lands in the central Cascade Mountain Range. Watershed analysis is also a major component of this HCP. Watershed analysis is a systematic procedure to assess local processes within a watershed and provides information for developing management guidelines that protect and restore aquatic and riparian habitat. Watershed analyses conducted in the Planning Area will assess the natural physical and biological processes operating in different watersheds and provide Plum Creek with the local information necessary to protect riparian and aquatic resources and allow for compatible timber management in the Planning Area. A detailed description of recommended methodologies for conducting watershed analysis can be found in the Washington Forest Practices Board Manual: *Standard Methodology for Conducting Watershed Analysis, Version 2.1* (1994).

Watershed analysis on State and private lands in Washington is a regulatory process administered by the DNR. The DNR has divided the State into approximately 800 watersheds ranging in size from 10,000 to 50,000 acres. These watersheds are termed Watershed Administrative Units (WAUs). Either the DNR or a private landowner with at least a 10 percent ownership in a basin can initiate a watershed analysis. There are 32 WAUs adjacent to or within the Planning Area. Plum Creek can initiate a watershed analysis on 17-18 (Toth 1995). All state watershed analyses consist of the following four distinct stages.

1. **Resource Assessment —** Scientific assessment of the watershed's conditions and resources.
2. **Prescriptions —** Methods of operating in the watershed to reduce or eliminate potential adverse impacts in the watershed. These are in addition to regular forest practice rules and regulations.
3. **Public Review and Comment —** Public review through the State Environmental Policy Act (SEPA).
4. **Monitoring —** Plans to track changes in watershed conditions and the effectiveness of the prescriptions.

A fundamental assumption of watershed analysis is that by applying standard forest practices in less sensitive areas and managing sensitive areas with appropriate prescriptions from watershed analysis, the overall watershed condition will be protected and cumulative effects will not occur. Watershed analysis not only requires local scientific assessments, but it also relies upon continuous revisions as monitoring activities provide feedback on the condition of the resources within the basin.

The watershed analysis process used by Plum Creek to complete, for example, the Quartz Mountain WAU watershed analysis is discussed by Toth (1995). Briefly, the Quartz Mountain watershed analysis included the area drained by the North and South Forks of Taneum Creek in mountainous forestland East of the Cascade crest. Approximately 40 percent of the 29,409 acres in the WAU was owned by Plum Creek. The remaining 60 percent was administered mainly by the Forest Service. The most pervasive problem identified in the WAU by watershed analysis is the excessive amount of fine sediment in Taneum Creek. Based on the resource assessment, 20 prescriptions were developed to improve the conditions of the watershed and to avoid potential problems in the future. A 5-year road improvement and maintenance plan was developed to reduce the amount of fine sediment entering the streams. The improvement and maintenance plan include placement of additional culverts, revegetation of cutslopes, and road closures. In addition, new roads will only be built if sediment production from all roads in the watershed is reduced to specified annual target levels.

By the end of 2000, Plum Creek has submitted or is in the process of submitting watershed analysis evaluations on 13 WAUs in the Planning Area. Under the HCP, the results of watershed analysis are implemented once the prescriptions are written. Since watershed analysis will be the primary procedure for developing and documenting scientifically-based information of the ecological structures, functions, processes, and interactions occurring within each watershed, Plum Creek plans to accelerate watershed analysis in the WAUs in the Planning Area, and proposes to submit, to the Services, the remaining 4-5 watershed analysis evaluations in the Planning Area by 2006.

1.2.4 Section 10(a) Permit Species

A primary objective of this HCP is to address the biological needs and regulatory constraints imposed by listed species. Section 10(a)(1)(B) of the ESA, as amended, provides a regulatory mechanism for private landowners to lawfully take federally listed species under carefully prescribed circumstances if certain statutory criteria are met. The Permits allow incidental take of spotted owls, marbled murrelets, grizzly bears, gray wolves, bull trout, lynx, steelhead and chinook on Plum Creek's lands (and lands on which Plum Creek retains timber rights) in the Planning Area for a 50- to 100- year period. The descriptions below are for those species listed as of June 1996.

1.2.4.1 Northern Spotted Owl

The Federal listing of the northern spotted owl, as a threatened species became effective on July 23, 1990 (55 FR 26114). The primary threat cited by the FWS in its decision to list the species was the reduction and fragmentation of forest habitat in Washington, Oregon, and northern California. Spotted owls use a variety of habitats, including late-successional and old growth forest, and other forests with similar characteristics, for roosting, foraging, nesting, breeding, and dispersal. The spotted owl ranges from southwestern British Columbia, Canada, south to Marin County, California; and Eastward from the Pacific coast to the forested edge of the Columbia Basin and Great Basin steppe regions in Washington, Oregon, and California (Figure 5). Although transient spotted owls have been found in urban areas and even near beach dunes, their primary breeding distribution is restricted to forested communities (Lujan et al. 1992b). Densities vary across the species' range according to habitat type, habitat quality, and habitat quantity. According to Thomas et al. (1990), the amount of suitable habitat for spotted owls has declined during the last 50 years and remaining habitats have become smaller and more isolated. As a result, the populations of spotted owls throughout its range are thought to have declined (Burnham et al. 1994).

Since 1988, Plum Creek has been working to protect spotted owl habitats throughout its ownership in the Western and Eastern Cascade Mountains by conducting extensive research and gathering data, which has been critical in enabling the Company to develop a scientifically sound and economically viable approach to spotted owl habitat protection within managed forests. Plum Creek's wildlife biologists use the latest technology to monitor the movements and habitat use of resident spotted owl pairs, and the Company is funding additional research on identification and evaluation of owl habitat in various forest types, and assessing annual productivity of all owl pairs in the Planning Area. Moreover, other independent research in the vicinity of the Planning Area has focused on the demographic characteristics of spotted owls in habitats East of the Cascade crest. As a result, the Company has developed a unique understanding of the needs of the spotted owl in the Planning Area, which is reflected in the management plan set forth in this HCP.

Throughout its forested lands in the Cascade Mountains, Plum Creek is tracking juvenile and adult spotted owls to monitor their movements throughout the year. This work allows Plum Creek to follow the movements of individual spotted owls and identify precisely various habitats used for nesting, roosting, dispersal, and foraging. By color-banding individual owls, Plum Creek is also able to monitor nesting and breeding activity, and verify reproductive success and juvenile survival and dispersal in different habitats and forest stand-structures in both the Western and Eastern portions of the Cascade range.

1.2.4.2 Marbled Murrelet

The marbled murrelet in Washington, Oregon, and California was listed as a federally threatened species on October 1, 1992 (USDI 1992c, 57 FR 45238). Based on estimates of murrelet population sizes, the Washington, Oregon, and northern California area currently supports lower densities of murrelets than other areas within the murrelet's range (i.e., British Columbia and Alaska). Proposed critical habitat designated for murrelets within and adjacent to the Planning Area is shown in Figure 6. Approximately 6,292 acres of Late-Successional Reserve on Federal lands West of the Cascade crest within the Planning Area have been proposed as critical habitat for murrelets (60 FR 40893; August 10, 1995).

Reductions in late-successional forests within the range of the marbled murrelet, especially at lower elevations in the coastal lowlands of Washington, Oregon, and California are thought to be at least partially responsible for the decline in murrelet populations. However, numerous other factors including nesting habitat, marine environments, mortality associated with net fisheries and contaminants, and prey population conditions must be considered in order to determine murrelet population status, distribution, productivity, and recovery projections. Approximately 89 percent of all suitable marbled murrelet habitat is contained on Federal lands already designated for protection, and approximately 87 percent of sites on Federal lands are contained in areas designated for protection within large reserve areas (USDI 1992c). In addition, a percentage of sites are probably yet unknown, and some of these are at lower elevations, which may be very important to marbled murrelets.

1.2.4.3 Grizzly Bear

The grizzly bear was listed as threatened on July 28, 1975 (40 FR 31736). The original recovery plan was approved on January 29, 1982, and a revised version of the recovery plan was issued on September 10, 1993.

Grizzly bear distribution has been reduced to less than two percent of its historical range in the lower 48 states due to a reduction in habitat available to bears, direct killing of bears, habitat degradation, and increased human-bear conflicts (USFWS 1993). The remaining populations are widely separated into six or seven remnants of suitable habitat of the once continuous range. The 1982 recovery plan referred to these remaining areas as “occupied habitat,” and the plan required documented evidence of the existence of grizzly bears in each area within the past 10-years (i.e., 1972 through 1982) as a criterion for inclusion of the area in the “occupied habitat” category. The revised recovery plan uses the term “recovery zones” to refer to six designated regions within each of the grizzly bear ecosystems. Recovery zones are defined as those areas within which habitat for grizzly bear populations is monitored and managed for recovery. Each of the recovery zones includes sufficient acreage and habitat to support a viable grizzly bear population. The six recovery zones are: Yellowstone, Northern Continental Divide, Cabinet-Yaak, Selkirk, Bitterroot, and Northern Cascades (Figure 7). The northern portion of the Planning Area is within the Northern Cascades Recovery Area (Figure 7). The Northern Cascades Recovery Area encompasses approximately 10,000 square miles and is centered around the North Cascades National Park and adjacent wilderness areas in north-central Washington and southern British Columbia. This recovery area is thought to be capable of supporting between 200 and 400 bears. Plum Creek recognizes that although grizzly bear sightings have not been confirmed in the Planning Area, bears may occasionally or eventually emigrate from the northern portions of the Northern Cascades Recovery Zone and, perhaps, reside permanently in Plum Creek’s ownership.

1.2.4.4 Gray Wolf

The gray wolf was listed as endangered on July 1, 1977 (42 FR 36420; July 14, 1977). In compliance with the ESA, the FWS released a Northern Rocky Mountain Wolf Recovery Plan in 1987 (USFWS 1987). The plan covers three recovery areas, including northwestern Montana around Glacier National Park, central Idaho, and Yellowstone (Figure 8). The criteria for selecting these three recovery areas include sufficient prey base to support 10 breeding pairs of wolves, and a minimum of 3,000 square miles, which contain less than 10 percent private ownership, except railroad grant lands (USFWS 1987). According to the plan, maintenance of at least 10 breeding pairs in an area for at least 3 years will result in reclassifying wolves in the area as threatened rather than endangered. When at least ten breeding pairs have been maintained for at least 3 years in all three areas, the species will be delisted (USFWS 1987). The recovery plan defines the methods for each region to re-establish viable populations of wolves and recommends recolonization through natural dispersal of wolves in the central Idaho and northwestern Montana recovery areas, and reintroduction for restoring wolves to Yellowstone. There are currently no recovery areas located in the Washington Cascade Mountains. However, the Washington Department of Fish and Wildlife (WDFW) is conducting a survey to determine the number and distribution of gray wolves in the Cascades. Historically, gray wolves ranged widely throughout North America (Paradiso and Nowak 1982; Bangs 1991). However, by the late 1930’s, few, if any, wolves remained in the Northern Rocky Mountain region (USFWS 1987), and as of 1988, wolf populations were scattered throughout Alaska, Idaho, Minnesota, Michigan, Wisconsin, Montana, and Washington. Unlike the grizzly bear (with low reproductive potential) or the northern spotted owl (with specialized habitat requirements), the gray wolf exhibits a high reproductive rate and flexible habitat requirements and is less affected by forest-management activities. Wolves require an adequate food supply, suitable denning and rendezvous sites, travel corridors, and protection from mortality caused by humans (USFWS 1987). The major causes of the decline in the populations wolves are trapping, poisoning, and shooting, as well as decimation of their prey base (primarily ungulates) (Mech 1970).

1.2.4.5 Listings Subsequent to June, 1996

Since the HCP was approved the following listings have occurred: Columbia River bull trout were listed as threatened effective July 10, 1998; Puget Sound chinook salmon were listed as endangered on March 24, 1999; Middle Columbia River steelhead were listed as threatened on March 25, 1999; Puget Sound bull trout were listed as threatened effective December 1, 1999; and Canada lynx were listed as threatened effective April 24, 2000.

1.2.5 Multi-Species Considerations (Unlisted Species)

In addition to addressing the impacts that are likely to result from the incidental taking of currently listed species, and the measures that will be undertaken to minimize and mitigate the impacts, this HCP is intended to serve as the basis for an ecosystem approach to conservation of a variety of other species. As a plan with an ecosystem focus, this HCP is a flexible and ongoing, adaptive-management plan that promotes species conservation and habitat protection for listed and unlisted species. As a result, the scope of the HCP, along with its Implementation Agreement, extends beyond currently listed species. This HCP has been designed to address the biological needs of more than 315 vertebrate species to the extent that the mitigation set forth in this HCP is sufficient for section 10(a) purposes should known or unknown vertebrate species in the Planning Area become listed subsequently as endangered or threatened. As a result, any such future listing would result in an amendment to the Permit for such species, absent extraordinary circumstances.

Congress intended that the section 10 process would establish a mechanism for conservation of unlisted species to protect section 10(a) permittees from uncertainties of future listings under the ESA:

> *Although the conservation plan is keyed to the permit provisions of the Act, which only apply to listed species, the Committee intends that conservation plans may address both listed and unlisted species. The Committee intends that the Secretary may utilize this provision to approve conservation plans which provide long-term commitments regarding the conservation of listed as well as unlisted species and long-term assurances to the proponent of the conservation plan that the terms of the plan will be adhered to and that further mitigation requirements will only be imposed in accordance with the terms of the plan. In the event that an unlisted species addressed in the approved conservation plan is subsequently listed pursuant to the Act, no further mitigation requirements should be imposed if the conservation plan addressed the conservation of the species and its habitat as if the species were listed pursuant to the Act. (H.R. Report No. 97-835, 97th Congress, Second Session, and 50 FR 39681-39691.)*

By considering the habitat requirements of unlisted species, the HCP can provide for early protection and, perhaps, prevent subsequent declines and ultimately the need to list such species, or designate critical habitat in the Planning Area. The HCP can also allow for the amendment to the HCP should these species become listed despite early conservation efforts.

This action is consistent with current Federal policy, “the Services shall not seek additional mitigation for a species from the HCP permittee where the terms of a properly functioning HCP agreement were designed to provide an overall net benefit for that particular species and contained measurable criteria for the biological success of the HCP which have been or are being met” (from: U.S. Department of Interior. August 9, 1994. No Surprises; Assuring Certainty for Private Landowners in Endangered Species Act Habitat Conservation Planning; as clarified by the recent FWS memo, Region 1 Guidelines for Determining Covered Species Lists and Assurances Relative to Habitat Conservation Planning, August 1, 1995; Appendix 4). The only exception to such amendments would result if there were extraordinary circumstances associated with such listing. The policy states, however that, "the Services shall have the burden of demonstrating that such extraordinary circumstances exist, using the best scientific and commercial data available. The Service's findings must be clearly documented and based upon reliable technical information regarding the status and habitat requirements of the affected species". "If additional mitigation measures are subsequently deemed necessary to provide for the conservation of a species that was otherwise adequately covered under the terms of a properly functioning HCP, the primary obligation for such measures shall not rest with the HCP permittee". (Codified as amended regulations in 50 CFR on February 23, 1998 (63 FR 52635): Appendix 4.)

By using an ecosystem-management approach that emphasizes the maintenance of a variety of wildlife habitats on a landscape basis, Plum Creek's HCP will become an effective, comprehensive planning document for a wide variety of resident forest wildlife species. Through conservation planning "in advance" rather than "patched in" after a species becomes threatened or endangered, and implementation of conservation measures by Plum Creek in concert with Federal considerations in the Planning Area, listing of additional species may, in some cases, be avoided.

In addition to the four Permit species, a total of 311 vertebrate fish and wildlife species either known or suspected to reside in the Planning Area have been prioritized, for convenience and organizational purposes, by their respective legal and biological status into three groups. These groups include:

1. **Special Emphasis Species —** This group includes 21 species, all of which were Federal candidate species during the development of the HCP. These include those species with the highest likelihood of becoming federally listed during the 50-year Permit period (Table 2). Since the HCP was approved, several listings occurred as described in section 1.2.4.5.
2. **Species of Concern —** This group includes 11 species, two of which are federally listed, two are Federal candidate species, and seven are state species of concern. This group (10 birds and one reptile) includes species that occur in the Planning Area but are not inhabitants of forest types that will be affected by the HCP or other regulatory processes outside of the HCP (e.g., bald eagle site management plans) protect them. This group also contains species that experts and local biologists believe are unlikely to occur in the Planning Area (Table 2).
3. **Associated Species —** Plum Creek has grouped the remaining 280 species of wildlife (i.e., 68 mammals, 162 birds, 12 reptiles, 8 amphibians, and 30 species of fish) that potentially inhabit the HCP Planning Area, into this general forest wildlife category. This category generally includes big game, small game, and other familiar forest wildlife species.

The 311 species that comprise the Special Emphasis Species, Species of Concern, and Associated Species have been designated as "Unlisted Agreement Species" and they are presented in Appendix 3.

Table 2. Section 10(a) Permit Species, Special Emphasis Species, and Species of Concern Associated with the Plum Creek HCP Planning Area in King and Kittitas Counties, Washington.

Species (Common/ Scientific)	Life Form[1]	Listing [2]		Occurrence within Area	Rationale/ Notes	Key Habitat Features
		Fed.	State			
SECTION 10(a) PERMIT SPECIES						
Northern spotted owl (Strix occidentalis caurina)	14	FT	SE	Present	Over 100 sites known in and near the HCP area (Plum Creek Spotted Owl surveys)	Medium-aged to old growth coniferous forest, generally below 5,000 ft. nesting; all elevations for dispersal and limited foraging
Marbled murrelet (Brachyramphus marmoratus)	12	FT	ST	Present*	1 record within HCP boundary, with another within 2 miles of HCP boundary; USFS, North Bend detection (WDFW priority habitat and species (PHS) database (1994)	Forest use limited to breeding; prefers old coniferous trees with larger, usually moss-covered branches, mistletoe, for nesting.
Grizzly bear (Ursus arctos)	15	FT	SE	Present*	Scattered records in North Cascades. Several records in HCP area per WDFW PHS database 1994.	Home range is extremely large; forested areas w/ openings. Successful omnivores consuming fish, rodents, carrion, insect larvae, vegetable matter, and garbage. The search for food is a major influence of bears' movement and home range. Averse to high road densities.
Gray wolf (Canis lupus)	5	FE	SE	Present*	Expanding in North Cascades (Mech et al. 1991). Several records in HCP area per WDFW PHS database 1994.	Not particular about habitat. Limited by available prey species. Protect known den sites and prey species.
SPECIAL EMPHASIS SPECIES						
AMPHIBIANS:						
Tailed frog (Ascaphus truei)	2	FSC	--	Present	Status per Federal Register November 15, 1994. Plum Creek staff, owl crew reports; Leonard et al. (1993).	Sea level to 6,500 ft. Fast flowing permanent cold streams buffered by dense vegetation.
Northern red-legged frog (Rana aurora aurora)	2	FSC	--	Likely	Expected (Hanley & Taber 1979; Guenther & Kucera 1978; Mt. Baker-Snoqualmie Natl. Forest 1994	Lower elevations to 2,800 ft. Western Washington and Western slopes of Cascades. Moist forests and riparian w/ dense vegetative cover.

Species (Common/ Scientific)	Life Form[1]	Listing[2]		Occurrence within Area	Rationale/ Notes	Key Habitat Features
		Fed.	State			
Cascades frog (Rana cascadae)	2	FSC	--	Present	Several records from local surveys (L. Tanke, pers. comm. October 1994)	Rarely below 2,000 ft. Cascade and Olympic Mountains. Subalpine meadows, ponds, bogs.
Oregon spotted frog (Rana pretiosa)	2	FC	SE	Unlikely	Expected (Nussbaum et al. 1983; Leonard et al. 1993; Mt. Baker-Snoqualmie Natl. Forest 1994; Wenatchee Natl. Forest 1994)	Currently lower elevations to reported 6,400 ft. Eastern Washington and East slopes of the Cascades. Historically in Western Washington lowlands. Streams and wetlands with herbaceous cover.
Larch Mountain salamander (Plethodon larselli)	4	FSC	SS	Present	7 sites found in the HCP Planning Area (1999) [Represents new range extension]	Found up to 3,400 ft. elevation. Steep, rocky or talus slopes where shaded and kept moist by overstory trees.
SPECIAL EMPHASIS SPECIES						
FISH:						
Bull trout (Salvelinus confluentis)	1	FT	SS	Present	None found through extensive surveys to date in the upper Green River watershed. Known to occur in the Yakima River System. Populations are thought to be declining throughout species range.	Medium to large river systems, with adequate pools and riffles for spawning and rearing. Migrate readily throughout river system.
Green River Rainbow/ , Yakima River Rainbow, Yakima River steelhead trout (Oncorhynchus mykiss)	1	C	SS	Present	Known to occur in the Yakima and Green River Systems. Steelhead planted in Green River above Howard Hanson Dam.	Small to large sized, well-shaded streams. High quality pools and riffles. Rearing habitat-limiting production in many streams. Recreationally important species. Vulnerable to habitat loss or degradation.
Coho salmon (Oncorhynchus kisutch)	1	C	SS	Present	Populations declining in Columbia River Basin and Lower Green River. Planted in Upper Green River. Wild coho functionally extinct in Yakima River basin.	Small to medium size, well shaded streams with adequate flow and small to medium size gravels. Prefer areas with side channels adjacent to mainstem.

Species (Common/ Scientific)	Life Form[1]	Listing [2]		Occurrence within Area	Rationale/ Notes	Key Habitat Features
		Fed.	State			
Chinook salmon (spring) (Oncorhynchus tshawytscha)	1	C	SS	Present	No known population in the Green River system at this time. Population in Yakima System declining.	Large, mainstem rivers with large rocks and minimum silt and turbidity.
SPECIAL EMPHASIS SPECIES						
BIRDS:						
Harlequin duck (Histrionicus histrionicus)	3	FSC	SG	Present	(Plum Creek Spotted Owl Crew detections; Rodrick and Milner 1991)	Breeds adjacent to mountain streams with adjacent dense cover of riparian or conifer vegetation. Maintain coarse woody debris; suggested 100 ft buffer for coarse woody debris recruitment.
Northern goshawk (Accipter gentilis)	11	FSC	SC	Present	(Plum Creek staff, owl crew detections; Washington 2010 1992)A number of incidental sightings in plan area, including several nests (WDFW PHS database 1994).	Uses a variety of forest types, forest ages, structural conditions, and successional stages, but seldom uses young, dense forests. Breeds in boreal to montane mature and old growth forests, not in younger, dense forest. Nest trees about 80 ft. tall, >20 in. dbh. Nests about 40 ft. above ground.
Little willow flycatcher (Empidonx traillii brewsteri)	7	FSC		Likely	Likely at low elevations in Green River drainage (Mt. Baker-Snoqualmie Natl. forest 1994).	This sub-specie is found West of the Cascade crest. Uses a variety of open brushy habitats and early successional stages below 3000 ft keying on the deciduous component. Often found near streams and wet areas.
Olive-sided flycatcher (Contopus borealis)	10	FSC		Present	Owl crew detections; Mt. Baker-Snoqualmie Natl. Forest 1994; Wenatchee Natl. Forest 1994; Sharp 1992.	Nests in trees in open, mature, montane forest up to true fir/ spruce zone, particularly in areas with abundant snags, often near edges and clearings. Uses prominent perches for singing and foraging

Species (Common/ Scientific)	Life Form[1]	Listing [2]		Occurrence within Area	Rationale/ Notes	Key Habitat Features
		Fed.	State			
SPECIAL EMPHASIS SPECIES						
MAMMALS:						
California Wolverine (Gulo gulo luteus)	5	FSC	SM	Possible*	(Wilson 1982; Groves 1988; Mt. Baker-Snoqualmie Natl. Forest 1994; Wenatchee Natl. Forest 1994) Single record (1983) in HCP boundary (WDFW PHS database 1994).	Habitat limited mainly by prey species. Protect alpine and subalpine habitat.
Pacific Fisher (Martes pennanti)	14	FSC	SE	Possible*	Single 1990 sighting from WDFW PHS database (1994) near the project area; low numbers in Washington. (Rodrick & Milner 1991; Mt. Baker-Snoqualmie Natl. Forest 1994; Wenatchee Natl. Forest 1994)	Maintain uneven-aged forests with continuous canopy cover. Maintain defective trees, snags and woody debris for den sites and to maintain prey populations.
Townsend's big-eared bat (Plecotus townsendii)	4	FSC	SC	Possible	(Garvey-Darda, USFS 1994; Mt. Baker-Snoqualmie Natl. Forest 1994; Wenatchee Natl. Forest 1994) Sightings (1988-89) in known cave near HCP boundary (WDFW PHS database 1994).	Roosts in caves & mines with winter temperature close to freezing; nursery caves approximately 50° F. Protect known roosting caves.
Long-legged myotis (Myotis volans) Long-eared myotis (Myotis evotis) Fringed myotis (Myotis thysanoides) Small-footed myotis (Myotis ciliolabrum) Yuma myotis (Myotis yumanensis)	14	FSC	--	Possible	Thomas and West 1991; Christy and West 1993; Mt. Baker-Snoqualmie Natl. Forest 1994; Wenatchee Natl. Forest 1994. Unknown distributions in Planning Area. Small-footed and fringed myotis primarily in Eastern Washington, but the latter may be uncommon in Washington (Perkins et al. 1990)	Caves and mines used by all these species for maternity roosts or hibernacula. Large snags and live trees, particularly in old-growth appear to be important for these purposes for some species, or for colonial or solitary day roosts. Roosts also in cliffs, talus, bridges, and buildings. Small-footed associated mainly with rocks and talus. Foraging occurs mainly over open water, some in open forest.

Species (Common/ Scientific)	Life Form[1]	Listing [2]		Occurrence within Area	Rationale/ Notes	Key Habitat Features
		Fed.	State			
SPECIES OF CONCERN						
REPTILES:						
Northwestern pond turtle (Clemmys marmorata marmorata)	3	FSC	SE	Unlikely	Limited in Washington; population confirmed only in Klickitat and Skamania Co. Individuals in King, Thurston, and Pierce Co. (Nordby 1992.)	Marshes, ponds, sloughs, and small lakes; basking sites necessary.
SPECIES OF CONCERN						
BIRDS:						
Black tern (Chlidonias niger)	3	FSC	SM	Unlikely	Not listed for Alpine Lakes or Mt. Baker-Snoqualmie or Wenatchee Natl. Forest (Hanley & Taber 1979; Guenther & Kucera 1978; Mt. Baker-Snoqualmie Natl. Forest 1994; Wenatchee Natl. Forest 1994.)	Nest in floating vegetation on prairie sloughs and lakes. Rarely West of Cascades.
Bald eagle (Haliaeetus leucocephalus)	12	FPD	ST	Present*	1 territory at north end of Cle Elum Lake (USFS)	Nests in large trees with large cross-limbs; near water, within several hundred ft. of large lake, reservoir, river or salt water body. Protect known nests and roost sites in large trees. Winter migrants collect around anadromous streams to feed off spawned out carcasses.
Golden eagle (Aquila chrysaetos)	4	--	SC	Present*	Plum Creek staff, owl crew detections; single nest located in HCP area (WDFW PHS database 1994); also Rodrick & Milner (1991) range map.	Feeds in large open areas. Nests in large trees or on cliffs near openings and water.
Peregrine falcon (Falco peregrinus)	4	FD	SE	Possible*	(Washington Dept. of Wildlife 1993)	Forages on the wing in open areas including fields, mud flats and marshes. Nests on cliffs over 150 ft. high. Avoid known nesting sites.

Species (Common/ Scientific)	**Life Form[1]**	Listing [2]		**Occurrence within Area**	**Rationale/ Notes**	**Key Habitat Features**
		Fed.	**State**			
Flammulated owl (Otus flammeolus)	14	--	SC	Present	(Owl crew detections; Rodrick & Milner 1991)	Above 3,000 ft. on East slopes of Cascades. Associated with Ponderosa-Douglas fir Forests. Nest in cavities 7 to 40 ft. above ground. Retain snags and defective trees >12 in. dbh.
Lewis' woodpecker (Melanerpes lewis)	13	--	SC	Possible	(Rodrick & Milner 1991; Wenatchee Natl. Forest 1994; Mt. Baker-Snoqualmie Natl. Forest 1994)	Transition zone, associated with Ponderosa pine and riparian forest with brushy understory. Parklike Ponderosa pine forest is the major breeding habitat with brushy undergrowth. Retain 48 snags or defective trees per 100 acres. Nest trees. >17 in. dbh.
Pileated woodpecker (Dryocopus pileatus)	13	--	SC	Present	Incidental local sightings (e.g., Plum Creek owl crew, WDFW PHS database 1994).	Nests in large, tall, hard snags. Forages for insects in defective trees, snags, stumps and woody debris in mature and old growth forests. Retain snags and defective trees, 14 per 100 acres, and >25 in. dbh.
White-headed woodpecker (Picoides albolarvatus)	13	--	SC	Possible	(Rodrick & Milner 1991; Wenatchee Natl. Forest 1994)	Mature and old growth forests; requires large decaying snags for foraging, primarily Ponderosa pine >24 in. dbh. Nests in cavities in trees >10 in. dbh. Maintain trees >25 in. dbh for nesting.
Vaux's swift (Chaetura vauxi)	14	--	SC	Present	(Lundquist & Mariani 1991; Owl crew observations; Rodrick & Milner 1991)	Nests in cavities in snags or defective trees in mature or old growth forests. Retain trees >30 in. dbh.

Species (Common/ Scientific)	Life Form[1]	Listing [2]		Occurrence within Area	Rationale/ Notes	Key Habitat Features
		Fed.	State			
Western bluebird (Sialia mexicana)	14	--	SC	Possible	(Rodrick & Milner 1991; Mt. Baker-Snoqualmie Natl. Forest 1994; Wenatchee Natl. Forest 1994)	Eastern Washington open oak-coniferous woodlands. Nests in snags or defective trees in cavities generally above 10 ft., in trees >15 in. dbh. Nests at forest edge and forages in openings or meadows.

1.2.5.1 Special Emphasis Species

Among the 21 Special Emphasis Species, there are eight mammals, four birds, five amphibians, and four fish (Table 2). One species, the spotted frog (*Rana pretiosa*) is a Federal Candidate species. Another species, bull trout (*Salvelinus confluentis*), is a Federal threatened species. The remaining 19 species are Federal species of concern.

The Federal Candidate species include: California wolverine (*Gulo gulo luteus*); Pacific fisher (*Martes pennanti*); Townsend's big eared bat (*Plecotus townsendii*); long-legged myotis (*Myotis volans*); long-eared myotis (*Myotis evotis*); fringed myotis (*Myotis thysanoides*); small-footed myotis (*Myotis ciliolabrum*); Yuma myotis (*Myotis yumanensis*); northern goshawk (*Accipter gentilis*); harlequin duck (*Historionicus historionicus*); little willow flycatcher (*Empidonx trallii brewsteri*); olive-sided flycatcher (*Contopus borealis*); Larch Mountain salamander (*Plethodon larselli*); the tailed frog (*Ascaphus truei*); northern red-legged frog (*Rana aurora aurora*); cascades frog (*Rana cascadae*); rainbow/ steelhead trout (*Oncorhynchus mykiss*); coho salmon (*O. kisutch*); and chinook salmon (*O. tshawytscha*).

On May 7, 1993 (58 FR 27260), the Services announced that the listing of the spotted frog as a threatened or endangered species in Western Washington was warranted under provisions of the ESA, but such listing was precluded by higher-priority species. In their decision, the Services indicated that spotted frog populations, throughout the species range, were being elevated from Category 2 candidate status to Category 1 candidate species status. Category 1 candidate species are species for which the Services have substantial information on hand to support the biological appropriateness of proposing to list as threatened or endangered, but for which such action has been precluded by other listings. In addition, based on scientific evidence spotted frog populations were separated into two distinct species. The Oregon spotted frog (*Rana pretiosa*) is state-listed in Washington, was emergency listed in British Columbia, and may be proposed in the near future for Federal listing.

On June 10, 1994 (59 FR 30254), the Services announced that the listing of the bull trout as a threatened or endangered species throughout the conterminous United States was warranted under provisions of the ESA, but such listing was precluded by higher priority species. In their decision, the Services indicated that bull trout populations in the lower 48 states were being elevated from Category 2 candidate species status to Category 1 candidate species status. The habitat needs of bull trout consist of Cold, Clean, Complex, and Connected water (the "Four C's"). Bull trout are habitat specialists, having more specific and demanding habitat requirements than other native salmonids. Water temperature is consistently recognized as a primary factor affecting bull trout distribution. Because bull trout eggs incubate for about seven months in the gravel, they are especially vulnerable to fine sediment. Habitat diversity in the form of large woody debris, undercut banks, or boulders, is important to bull trout. Connectivity is important for linkage of subpopulations, but also to link spawning and rearing streams with habitats containing adult bull trout.

On June 10, 1998, the Service announced the listing of the Columbia river and Klamath distinct Populations Segments (DPS) as threatened, followed by a publication of a final rule (63 FR 31647) with an effective date of July 10, 1998. At the same time, the Service proposed listing the remainder of bull trout species in the lower 48 states. This included the Puget Sound / coastal distinct population segment. The Coastal/ Puget Sound DPS of bull trout was proposed as threatened by the Service on June 10, 1998 (63 FR 31693).

On November 1, 1999 (64 FR 58909-58933), the Service announced the listing of the species bull trout within the conterminous United States. Using the best available scientific and commercial information, the Service identified five distinct population segments (DPSs) of bull trout in the coterminous United States-- (1) Klamath River, (2) Columbia River, (3) Coastal-Puget Sound, (4) Jarbidge River, and (5) St. Mary-Belly River. The final listing determination for the Klamath River and Columbia River bull trout DPSs on June 10, 1998 (63 FR 31647), includes a detailed description of the rationale behind the DPS delineation for those two population segments. The Jarbidge River DPS final listing determination was made on April 8, 1999 (64 FR 17110). However, the DPS policy, published on February 7, 1996 (61 FR 4722), is intended for cases where only a segment of a species' range needs the protections of the Act, rather than the entire range of a species. Although the bull trout DPSs are disjunct and geographically isolated from one another with no genetic interchange between them due to natural and man-made barriers, collectively, they include the entire distribution of the bull trout in the coterminous United States. In accordance with the DPS policy, authority to list DPSs is to be exercised sparingly. Thus, a coterminous listing is appropriate in this case. In recognition of the scientific basis for the identification of these bull trout population segments as DPSs, and for the purposes of consultation and recovery planning, the Service will continue to refer to these populations as DPSs. These DPSs will serve as interim recovery units in the absence of an approved recovery plan. These population segments are disjunct and geographically isolated from one another with no genetic interchange between them due to natural and man-made barriers. These population segments collectively encompass the entire range of the species in the coterminous United States.

On July 8, 1998, FWS proposed to list the Canada lynx as threatened throughout its range in the contiguous United States, (63 FR 36994). On March 24, 2000 (65 FR 16052) the Service listed the lynx as threatened effective April 24, 2000. The historic range of lynx includes the northern portions of the Western mountains, where environmental conditions at high elevations support boreal forest habitats similar to those found in northern regions. In Washington, lynx occur in favorable habitats above 3,200 feet elevation in Chelan, Okanogan, Ferry, Stevens, and Pend Oreille Counties (Brittel et al. 1989). In north central Washington, lynx occupy habitats consisting of Englemann spruce *(Picea engelmannii)*, subalpine fir *(Abies lasiocarpa)*, lodgepole pine *(Pinus contorta)*, and aspen *(Populus tremuloides)* above 4,791 feet (Koehler 1990). Lynx have been documented in the vicinity of the HCP Planning Area and portions of the Planning Area are probably used by lynx on at least an occasional basis.

Lynx habitat in the Western mountains consists of two structurally different forest types occurring at opposite ends of the stand-age gradient. Lynx require early successional forests that contain high numbers of prey (snowshoe hares) for foraging and late-successional forests that contain cover for their kittens and for denning (Brittel et al. 1989; Koehler and Brittel 1990). For denning, females select dense, mature forest habitats that contain large woody debris, to provide security and thermal cover for kittens. Important features of denning sites have been documented to be a high density of downed trees supported 1 to 4 feet above the ground, minimal human disturbance, and proximity to foraging habitat (early successional forests). Denning stands are usually at least 2 acres in size (Koehler and Brittel 1990).

A discussion of each of the Special Emphasis Species, including information on range, occurrence in the Planning Area, habitat requirements, and management considerations, is presented in Lundquist et al. (1995).

1.2.5.2 Species of Concern

To ensure that this HCP is not in conflict with the habitat needs of other species found within the Planning Area, Plum Creek has compiled information on eleven additional threatened, endangered, or candidate Species of Concern (Table 2). A discussion of each species including information on range, occurrence in the Planning Area, habitat requirements, and management considerations is provided in Lundquist et al. (1995).

The 11 Species of Concern were not included among the section 10(a) Permit Species or Special Emphasis Species for one of the following reasons:

1. Their occurrence in the Planning Area has not been confirmed (i.e., black tern, northwestern pond turtle);
2. Although State candidate species, they are unclassified federally (i.e., flammulated owl, golden eagle, Lewis' woodpecker, pileated woodpecker, white-headed woodpecker, Vaux's swift, Western bluebird); or
3. Although federally listed, there are other Federal and State programs already in place which adequately protect the species (i.e., bald eagle); or although federally listed, the forest-management plan designed in the HCP is not anticipated to harm or impact the species or its habitat (i.e., peregrine falcon).

Among the 11 Species of Concern there are 10 birds and one reptile. The peregrine falcon (*Falco peregrinus*) is State listed as endangered and was recently federally delisted, and the bald eagle (*Haliaeetus leucocephalus*) is federally and State listed as threatened in Washington but has been federally proposed for delisting.

Two species were Federal Candidate 2 species. These are northwestern pond turtle (*Clemmys marmorata marmorata*) and black tern (*Chlidonias niger*). Seven species, although not Federal candidate species, are listed as State candidate species. These include golden eagle (*Aquila chrysaetos*); flammulated owl (*Otus flammeolus*); Lewis' woodpecker (*Asyndesmus lewis*); pileated woodpecker (*Dryocopus pileatus*); white-headed woodpecker (*Picoides albolarvatus*); Vaux's swift (*Chaetura vauxi*); and Western bluebird (*Sialia mexicana*).

1.2.5.3 Associated Species

The conservation benefits of the HCP will be substantially enhanced through Plum Creek's consideration of potentially all vertebrate species that may, at one time or another during their life cycle, use or be associated with habitats occurring within the Planning Area during the life of the Permit. By considering the physical and biological needs of a large combination of animals that could potentially use the Planning Area, Plum Creek seeks to develop a comprehensive ecosystem-based management plan for more than 280 Associated Species, including 68 mammals, 162 birds, 12 reptiles, 8 amphibians, and 30 fish (Lundquist and Hicks 1995).

1.3 Regulatory and Planning Framework

1.3.1 Endangered Species Act (ESA)

The purposes of the ESA include conserving threatened and endangered species of plants and animals and the ecosystems upon which they depend. The ESA defines an endangered species as one that is "... *in danger of extinction throughout all or a significant portion of its range"* and a threatened species as one that "*is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range*."

The ESA contains two primary provisions for the protection of endangered or threatened species: section 7 and section 9. Under section 7, Federal agencies are required to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species. Section 7 also prohibits the destruction or adverse modification of designated critical habitat of listed species by Federal agency actions.

The designation of critical habitat is one of several measures available to the Services to contribute to the conservation of a listed species. Critical habitat includes areas that contain essential habitat features whether or not the habitats are currently occupied by the listed species. The Services also designate areas that may require special management or protection as critical habitat. Under section 7 of the ESA, critical habitat is given "consideration" when actions are carried out, authorized, or funded by a Federal agency. When a species is listed as threatened or endangered, the Services are required to identify critical habitat areas considered essential for the conservation of that species. None of Plum Creek's land in the Planning Area has been designated as critical habitat for any of the species covered by this HCP. However, certain Federal lands intermingled with Plum Creek's land have been designated as critical habitat for the spotted owl and marbled murrelet.

Section 9 prohibits any "person" from "taking" a threatened or endangered species. The term "take" is defined in the ESA to mean: "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct".

In 1982, Congress amended section 10(a) to authorize the issuance of a permit allowing "incidental taking" of listed species on non-federal lands if the permit applicant submitted a conservation plan satisfying the ESA's requirements. Under this provision, the Services are authorized to permit the taking of federally listed fish and wildlife if such taking is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity". Prior to the 1982 amendments to the ESA, individuals and non-federal agencies undertaking otherwise lawful actions that were likely to result in take of listed species risked violating the section 9 take prohibition and had no recourse under the ESA for exemption to the prohibition. Congress established the "incidental take permit" allowance under section 10(a)(1)(B) of the ESA to resolve this statutory conflict. Section 10(a)(2)(A) of the ESA requires any applicant applying for an incidental take permit to submit a "conservation plan" that specifies, among other things, the impacts that are likely to result from the taking and steps that will be undertaken to minimize and mitigate such impacts.

Although recovery of listed species is not the primary objective of the conservation planning process, it is an important consideration in the development of an HCP. Criteria for approval of an HCP, as stated in the ESA and draft guidelines prepared by the Services for HCPs, have been established to ensure that all approved HCPs are consistent with recovery goals prepared for each listed species. Specifically, the ESA states that an approved HCP must demonstrate that the permitted acts "will not appreciably reduce the likelihood of the survival and recovery of the species in the wild". In cases where a recovery plan has not been prepared, finalized or adopted for a species, the HCP should ensure that recovery opportunities are thoroughly "considered" and based on known limiting factors for the species.

It is important to realize, however, that the HCP is not a surrogate, nor should it become a substitute, for a recovery plan. While an HCP should be consistent with recovery objectives, an HCP is only a small part of what should be a much larger federally supported effort to "recover" a species.

1.3.2 HCP Requirements

1.3.2.1 Criteria for Issuance of a Permit for Incidental Taking

In deciding whether to issue section 10(a) permits for the taking of federally listed species, the Services may consider six issuance criteria provided for under section 10(a)(2)(B) of the ESA. If the applicant submits a conservation plan that meets the requirements of these six criteria, the Services shall issue the permits. The six criteria include the following:

1. **The taking will be incidental —** All taking of listed fish and wildlife species as detailed in the conservation plan must be incidental to otherwise lawful activities and not the purpose of such activities.
2. **The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking —** Under this criterion, the Services will determine whether the mitigation program the applicant proposes in the HCP is adequate to "protect" the species and meets statutory requirements.
3. **The applicant will ensure that adequate funding for the HCP and procedures to deal with unforeseen circumstances will be provided** — It is the responsibility of the Services to ensure that funding sources and levels proposed by the applicant are adequate to meet the purposes of the HCP and are reliable; and that measures to deal with unforeseen circumstances are adequately addressed in the HCP. Congress recognized that circumstances may change over time due to unforeseen circumstances (i.e., fire), generating pressure to reconsider the mitigation commitments in an HCP agreement. Congress intended that additional mitigation requirements not be imposed upon an HCP permittee who has fully implemented its conservation commitments except as may be provided for under the terms of the HCP itself. Consistent with this Congressional intent, it is the policy of the Services that they shall not require the commitment of additional land or financial compensation beyond the original level of mitigation, which was otherwise adequately provided for a species under the terms of a properly functioning HCP. Moreover, it is the policy of the Services to not seek any other form of additional mitigation from an HCP permittee except under extraordinary circumstances. Rather, if the Services show, based on the best available scientific information, that an extraordinary circumstance exists and that additional mitigation measures are subsequently deemed necessary to provide for the conservation of a species that was otherwise adequately covered under the terms of a properly functioning HCP, the primary obligation for such measures shall not rest with the HCP permittee. If extraordinary circumstances warrant the requirement of additional mitigation from an HCP permittee who is in compliance with the HCP's obligations, such mitigation shall limit changes to the original terms of the HCP to the maximum extent possible and shall be limited to modifications within the Planning Area. Additional mitigation requirements shall not involve the payment of additional compensation or apply to parcels of land available for land management under the original terms of the HCP without the consent of the HCP permittee.

4. **The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild** — This criterion involves the effects of the project on the likelihood of survival of affected species.
5. **The applicant will ensure that other measures that the Services may require as being necessary or appropriate will be provided** — Because the conservation planning process deals with numerous kinds of proposals, developments, and species, this requirement and issuance criterion gives the Services flexibility to negotiate additional measures as necessary or appropriate.
6. **The Services must receive such other assurances as may be required that the HCP will be implemented —** The applicant must ensure that the HCP will be carried out in the manner specified. Implementation Agreements or other contracts between parties to the HCP are the principal ways of ensuring that the HCP will be implemented.

1.3.2.2 General Guidance For HCPs

Under ESA section 10(a)(2)(A) and Federal regulations 50 CFR 17.22 (b)(1)(iii) and 17.32(b)(1)(iii)(C), the conservation plan submitted in support of an incidental take permit application must specify the following:

1. Impacts likely to result from the proposed taking of one or more federally listed wildlife species;
2. Measures the applicant will undertake to monitor, minimize, and mitigate such impacts; the funding that will be made available to undertake such measures; and the procedures to deal with unforeseen circumstances;
3. Alternative actions to the proposed taking that were considered but not selected, and the reasons why such alternatives are not being utilized; and
4. Additional measures the Services may require as necessary or appropriate for purposes of the plan.

From a process and timing perspective, the section 10(a) permit process consists of three basic phases. The first is the pre-application phase. During this phase, the applicant consults with the Services and other affected interests to ensure that the conservation plan will minimize and mitigate effects of the project on listed species, and prepares the HCP which satisfies requirements of the ESA. In addition, an Implementation Agreement (IA) is prepared which serves as the binding contract between the permittee and the government pursuant to which the HCP is implemented. This phase is considered completed when a complete application package is submitted to the Office of the Regional Director of the FWS. Typically, a complete application package includes the permit application (Form 3-200), a completed draft HCP, a draft NEPA document, and a draft IA.

The second phase in the process is the formal application-processing phase. During this phase, the Services review the application package for biological and statutory completeness, announces in the Federal Register the availability of the draft HCP, IA, and NEPA documents for a 30-day public review and comment period, and conducts an internal consultation as required under section 7 of the ESA. Once the documents are determined to be complete, and public comments are received and considered, the Services determine whether the section 10(a) permit issuance criteria have been satisfied (Section 1.3.2.1), finalizes the NEPA documents, and makes a determination of permit issuance or denial.

The final phase in the permit process is the post-application phase. This involves notification of the outcome of the permit application to the public and for the administrative record. The Services may publish notification of issuance of the permit in the Federal Register, although this is not required in the

ESA. This phase also includes monitoring of implementation of the conservation plan, if required by the HCP or IA, and any adaptive actions that may be stipulated.

1.3.3 Other Legal Requirements

1.3.3.1 National Environmental Policy Act (NEPA)

1.3.3.1.1 General Framework

Although not a direct obligation or requirement of the applicant for the section 10(a) permits, the Services must comply with the National Environmental Policy Act of 1969 (NEPA), as amended, and the regulations of the Council on Environmental Quality (CEQ) in evaluating impacts of issuance of section 10(a) permits. The requirements of NEPA, which are described in section 102 of the statute (42 U.S.C.A. section 4332(C)), are normally triggered by any major Federal action that significantly affects the quality of the human environment. Under the Department of Interior's departmental manual, section 10(a) permits are categorically excluded under NEPA unless the issuance of the permit may have cumulative or adverse effects on federally listed species, or it has or may have significant environmental, economic, social, historical, cultural, or cumulative impacts, or unless environmental effects are controversial.

1.3.3.1.2 Applicability to Plum Creek's HCP

In the context of this HCP, the NEPA process is intended to foster an appropriately complete and full disclosure of the environmental issues surrounding the proposed Federal action (i.e., issuance of Permits), to encourage public involvement in planning, identifying, and accessing a range of reasonable alternatives, and generally to explore all practical means to enhance the quality of the human environment and avoid or minimize adverse environmental impacts that may arise from the issuance of the Permits. NEPA may also be required when amending a permit or modifying an HCP, depending on the circumstances and the level of effects to the human environment.

The Services determine through an internal scoping process the appropriate course of action relating to a proposed action and NEPA. Depending upon the scope and impact of the action, NEPA requirements can be satisfied by one of three actions: (1) categorical exclusion; (2) environmental assessment; or (3) environmental impact statement. NEPA compliance will be accomplished in the Plum Creek HCP process through the development of an Environmental Impact Statement (EIS).

NEPA requires an evaluation of environmental impacts to inform the Federal decision-maker. NEPA also requires an examination of environmental effects, including those not specifically addressed by other laws. This integrative assessment is an important aspect of the relationship between NEPA and HCPs. Together, these processes allow Federal agencies, and applicants, to evaluate environmental impacts as a part of their planning and decision-making process.

1.3.3.2 Washington State Forest Practices Act

The Washington Forest Practices Act (RCW 76.09) and the implementing Forest Practices Rules and Regulations (WAC 222-08) are the principal means of State regulation of activities on private forestlands in Washington. Administered and enforced by the DNR, the Forest Practices Rules and Regulations address most issues of concern on forested lands, including harvest practices, regeneration, pesticide application, road construction, and the protection of other public resources such as water quality, fisheries, and wildlife (Appendix 5). All harvest activities on private forestlands require a Forest Practices Notification or Approval from the DNR, the issuance of which is contingent upon compliance with provisions of the Act and regulations. Most or all provisions within the Forest Practices Rules and Regulations ultimately influence fish and wildlife habitat by regulating how and when certain activities may take place on private forestlands. Management under the HCP will proceed in full compliance with applicable State regulations.

1.4 Historical Spotted Owl Management

Initial concern for the well being of the spotted owl began in the Pacific Northwest in the mid-1970's. These early attempts to manage the spotted owl focused primarily on protection of habitat for individual pairs on Federal lands (Oregon Endangered Species Task Force 1977; Oregon-Washington Interagency Spotted Owl Subcommittee 1981). Following review, this approach was abandoned when it became apparent that this management strategy would not adequately protect the long-term viability of owl populations.

In May 1984, the draft Regional Guide and draft EIS for the Pacific Northwest for Protection of the Spotted Owl in National Forests was published. The Preferred Alternative suggested maintaining 375 pairs of spotted owls on national forest lands in Oregon and Washington. To achieve this goal, the plan specified that sufficient Spotted Owl Habitat Areas (SOHAs) of 1,000 acres each would be provided, and that each of the national forests in the Pacific Northwest would be assigned a portion of the 375 pairs of spotted owls. Later revisions to this land management plan proposed inclusion of an additional 550 SOHAs of 1,000 acres each. The final Regional Guide and final EIS were published in October 1984. The document was challenged by several conservation organizations as "inadequate for assuring long-term viability of the bird in the Pacific Northwest Region". At the same time, the timber industry intervened and claimed that the Forest Service was protecting more habitat than was necessary for maintaining a viable population of spotted owls. Subsequently, the Department of Agriculture reversed the decision concerning the adequacy of the final Regional Guide and final EIS, thereby forcing the Forest Service to issue a Supplemental Environmental Impact Statement. These events intensified the interest on the part of private industry, conservation groups, and various governmental agencies concerning the spotted owl in the Pacific Northwest (Dawson et al. 1989).

The continuing controversy concerning the management, protection, and threat of listing of the spotted owl led to the formation of the Interagency Scientific Committee (ISC), headed by Jack W. Thomas, in 1990 (Thomas et al. 1990). The ISC process resulted in the identification of various geographic units termed Habitat Conservation Areas (HCAs) which were thought to be capable of supporting owl pairs. The HCAs were divided into two categories: Category 1 HCAs included habitats capable of supporting 20 pairs of owls; and Category 2 HCAs included habitats capable of supporting 2 to 19 pairs of owls. Under this context, intervening habitat between HCAs was given management consideration for dispersal habitat and connectivity, which resulted in the development of the "50-11-40 rule" (i.e., timber harvesting on Federal lands shall be permitted when more than or at least 50 percent of the forest landscape consists of forest stands with a mean diameter at breast height (DBH) of 11 inches and a canopy closure of 40 percent).

The next phase in the evolution of management options for spotted owls was development of the final draft Recovery Plan (Lujan et al. 1992b), and the subsequent reorganization of HCAs into Designated Conservation Areas (DCAs). As a primary means for achieving recovery of the spotted owl, the final draft Recovery Plan (Lujan et al. 1992b) recommends establishing 192 (DCAs) to provide more than 7.6 million acres of Federal forest lands as the primary habitat for the northern spotted owl. The DCA network represents approximately 46 percent of the total remaining spotted owl nesting, roosting, and foraging (NRF) habitat on Federal lands. As of December 1992, the DCAs contained 1,445 known owl pairs on Federal lands, or about 51 percent of the total pairs known on all Federal lands (Lujan et al 1992b). The final draft Recovery Plan concluded that when the DCAs become fully developed owl habitat, they will contain habitat sufficient to support a population of approximately 2,340 owls (Lujan et al. 1992b). The DCAs were derived from and were intended to replace the HCAs proposed by Thomas et al. (1990). The overall objective of the re-mapping was to provide a level of protection in DCAs at least as high as that provided by the HCAs, while increasing the biological and economic efficiency of the network and effectively providing protection of habitat for other species. The DCA network remedied the deficiencies that had been identified in the old HCA network. The final draft Recovery Plan also recommended a broad landscape approach to spotted owl protection, covering 7.6 million acres of Federal forestland as primary habitat for the spotted owl, with 53 Category 1 DCAs and 139 Category 2 DCAs. The final draft Recovery Plan adopted the HCA Category 1 and Category 2 convention of Thomas et al. (1990) for DCAs. However, some of the Category 2 DCAs were designed to support only a single pair of owls (Lujan et al. 1992a).

Within the Western Washington Cascades Province the final draft Recovery Plan identified 24 DCAs, varying in size from 9,600 to 175,000 acres, and totaling 1,433,600 acres of Federal and non-federal lands, although the final draft Recovery Plan did not apply to non-federal lands (Figure 9). As of 1992, approximately 335 spotted owl activity centers, including 290 confirmed owl pairs, were known to exist in the province. Among these activity centers, 303 centers and 263 owl pairs were located on Federal lands (Lujan et al. 1992b).

In the Eastern Washington Cascade Province, the final draft Recovery Plan identified 20 DCAs, varying in size from 9,200 to more than 104,000 acres, totaling 864,200 acres of Federal and non-federal lands. As of 1992, approximately 230 spotted owl pairs were located in the province; most are on Federal lands in the central and southern parts of the province. In the northern portion of the province, high mountains and a greater preponderance of lodgepole pine create naturally fragmented habitat with low potential for development of large clusters of spotted owls.

Two of the 24 DCAs designated in the Western Cascades Province (WD-7 and WD-8) and two of the 21 DCAs designated in the Eastern Cascades Province (WD-39 and WD-40) occur within the Planning Area (Figure 9). Table 3 summarizes the habitat types within each DCA by major ownership within the Planning Area. Most of the nesting, roosting, and foraging (NRF) and foraging and dispersal (FD) habitat within each DCA is on Forest Service land with smaller percentages of habitat occurring on Plum Creek's ownership.

Table 3. Habitat Type Within Major Ownerships in Designated Conservation Areas (DCAs) Within the Planning Area Post-Land Exchange, Escrow and Option Sections PC.

OWNERSHIP	HABITAT TYPE (ACRES) Non-Habitat	FD	NRF	TOTAL
WESTERN WASHINGTON CASCADES PROVINCE				
WD-7 Plum Creek	7,980	2,582	3,028	**13,590**
USFS	3,005	4,264	7,236	**14,505**
Other	170	185	144	**499**
Water	0	0	0	**0**
TOTAL	**11,155**	**7,031**	**10,408**	**28,594**
WD-8 Plum Creek	2.236	177	40	**2,453**
USFS	2,206	28	2,766	**5,000**
Other	1,461	178	1,182	**2,821**
Water	0	0	0	**0**
TOTAL	**5,903**	**383**	**3,988**	**10,274**
EASTERN WASHINGTON CASCADES PROVINCE				
WD-39 Plum Creek	10,157	3,783	3,488	**17,428**
USFS	19,620	11,270	22,601	**53,491**
Other	132	120	12	**264**
Water	0	0	0	**0**
TOTAL	**29,909**	**15,173**	**26,101**	**71,183**
WD-40 Plum Creek	6,775	1,897	5,594	**14,266**
USFS	7,096	5,029	12,957	**25,082**
Other	88	0	190	**278**
Water	0	0	0	**0**
TOTAL	**13,859**	**6,926**	**18,741**	**39,626**

NOTE: FD - Foraging and Dispersal Habitat; NRF - Nesting, Roosting, and Foraging Habitat
This table includes only that portion of each DCA inside the boundaries of Plum Creek's HCP Planning Area

The recommended biological goals for non-federal lands within WD-7 and WD-8 (i.e., the I-90 corridor) include: (1) providing for nesting, roosting, and foraging habitat within or directly adjacent to the DCAs in the checkerboard ownership; (2) providing nesting, roosting, and foraging habitat to support the owl pairs that are established on Federal lands in the checkerboard ownership between the DCAs; (3) provide dispersal habitat between DCAs; and (4) provide opportunities to negotiate for land exchanges to increase the level of protection of spotted owls in the checkerboard ownership (Lujan et al. 1992b; pages 117-119).

The recommended biological goals for non-federal lands within WD-39 and WD-40 (i.e., the I-90 corridor) include: (1) provide nesting, roosting, and foraging habitat for spotted owls in or directly adjacent to WD-39 and WD-40; (2) provide dispersal habitat among the DCAs; and (3) manage habitat to provide characteristics necessary for roosting and foraging, but not necessarily for nesting. However, some nesting habitat may be needed in the short term, especially since the DCAs are deficient in owl pairs (Lujan et al. 1995b; pages 126-128).

The next phase in spotted owl management was the formation of the Forest Ecosystem Management Assessment Team (FEMAT) in 1993, which resulted in the latest commitment by the Federal government to the concept of ecosystem management (USDA 1993). As in the final draft Recovery Plan, habitat requirements of other species is a major consideration under the options presented in the FEMAT report. The final result of FEMAT was selection of Option 9 as a management strategy to protect the spotted owl and other forest wildlife. Option 9 (now known as the Northwest Forest Plan) developed an integrated reserve system based largely on the protection of habitat within multiple purpose watersheds. Concepts such as Late-Successional Reserves and Riparian Reserves were incorporated to assure the viability of threatened and at-risk species, and Adaptive Management Areas evolved to test technical and social objectives associated with the overall FEMAT strategy of ecosystem management. Further, FEMAT allocated more than 24 million acres of Federal lands into six designated categories (i.e., Congressionally Reserved Areas, Late-Successional Reserves, Adaptive Management Areas, Managed Late-Successional Areas, Administratively Withdrawn Areas, and Riparian Reserves) and one non-designated category referred to as Matrix. The Northwest Forest Plan is described in detail in Section 1.5.1.

These same Federal lands were also allocated into watershed categories (i.e., Tier 1, Tier 2 Key watersheds, and Non-Key watersheds). Specific management directions for the designated areas, Matrix, and watersheds were then established, and environmental conditions or levels of environmental protection to be achieved and maintained on Federal lands were developed. FEMAT also resulted in an Aquatic Conservation Strategy to restore and maintain the ecological health of watersheds within the range of the spotted owl.

Under the Northwest Forest Plan, the designated categories and Matrix include Federal lands within the DCAs established in the final draft Recovery Plan (Lujan et al. 1992b). The total acreage for each designated category and Matrix within the DCAs in the Planning Area (i.e., WD-7; WD-8; WD-39; and WD-40) is shown in Table 4. Although located in different Washington Cascade Provinces, DCAs WD-8 and WD-39 are located primarily within Adaptive Management Areas, whereas most of WD-7 is within the Matrix, and WD-40 is almost completely within Late-Successional Reserves.

In addition to the management strategies described under the Northwest Forest Plan for Federal lands, proposed protection measures for the spotted owl involve Special Emphasis Areas (SEAs) proposed by the Services under an ESA section 4(d) special rule for non-federal lands. Under the proposed section 4(d) special rule, the Services would provide a safe harbor from ESA section 9 liability so long as forest management within specifically identified SEAs on non-federal lands in California and Washington did not reduce habitat below certain thresholds within existing 1.8-mile circles around owl site centers (USFWS 1993). The six SEAs in Washington (i.e., the Hoh/ Clearwater area on the Olympic Peninsula; the Columbia Gorge/ White Salmon area; the Sioux on Creek area; the Mineral Block area; the I-90 Corridor; and the Finney Block area) were selected in support of Federal owl conservation strategies outlined in Alternative 9 (i.e., Option 9) of the final Supplemental EIS on Management of Habitat for Late-Successional and Old Growth Forest Related Species within the Range of the Spotted Owl (USDA 1994).

Table 4. Acres of Designated Categories For All Ownerships Under the Northwest Forest Plan, Within Designated Conservation Areas (DCAs) Within the Planning Area

Designated Category/ Matrix	Western Washington Cascades Province		Eastern Washington Cascades Province		TOTALS
	WD-7	WD-8	WD-39	WD-40	
Congressional Reserve	955	101	541	0	**1,597**
Late-Successional Reserves	9,257	2,493	0	36,406	**48,156**
Adaptive Management Areas	139	7,021	70,642	0	**77,802**
Administratively Withdrawn	266	0	0	0	**266**
Matrix	17,927	97	0	2,837	**20,861**
Not Designated	50	562	0	383	**995**
TOTAL	**28,594**	**10,274**	**71,183**	**39,626**	**149,677**

It is important to point out that, throughout the evolution of spotted owl management, it has not been possible to directly and unequivocally define the habitat requirements of spotted owls on a site-by-site basis. The problem is, and has been, that over a broad landscape and over time, the requirements of different populations will necessarily be uncertain and unpredictable and they can be expected to differ within various geographic provinces or other designated habitat zones. Therefore, despite all of the evidence available, it is nearly impossible to apply the aggregated results of the historic evolution of owl management over the range of the species in any specific local context. This is where this HCP is particularly useful. Plum Creek's HCP is capable of providing guidance to protect spotted owls and other wildlife species based on site-specific data and requirements of local populations.

1.5 Federal Land Management Strategy

The on-going controversy concerning management of northern spotted owl habitat, late-successional forest species, late-successional ecosystems, and the economic implications in the Pacific Northwest led to President Clinton's Forest Conference held in Portland, Oregon on April 2, 1993. The purpose of the conference was to discuss concerns and explore options for the management of spotted owl habitat, late-successional forest species, and late-successional ecosystems on Federal and non-federal lands in northern California, Oregon, and Washington. Following the Forest Conference, the Forest Ecosystem Management Assessment Team (FEMAT) prepared an assessment of various ecosystem approaches to forest management (USDA 1993). The objective was to identify management alternatives that attain the greatest economic and social contribution from the forests and meet the requirements of the applicable laws and regulations of the ESA and the National Forest Management Act.

The FEMAT team evaluated 48 previously prepared options addressing the issues of conservation of threatened species (e.g., northern spotted owls and marbled murrelets), anadromous fish, and late-successional forest ecosystems. Using the principles developed in these previous options, the FEMAT team identified 10 options for ecosystem management on Federal lands, that would provide habitat to maintain the viability of: (1) northern spotted owls; (2) marbled murrelets; (3) at-risk fish species and stocks; (4) other species closely associated with late-successional forests; and (5) an interacting late-successional forest ecosystem.

The FEMAT team concluded that to ensure the viability of threatened and at-risk species, a system of Federal reserves was needed. Consequently, each of the 10 options contained reserve areas on Federal lands in which timber harvesting was either not allowed at all, or limited, and areas of Federal land outside of reserves, referred to as Matrix, where most timber harvesting was allowed. The reserves developed by the FEMAT team are of two types: Late-Successional Reserves, which encompass older forest stands, and Riparian Reserves, consisting of protected buffer strips along the banks of rivers, streams, lakes, and wetlands.

1.5.1 The Northwest Forest Plan

The Northwest Forest Plan consists of elements from the Scientific Panel on Late-Successional Forest Ecosystems (Johnson et al. 1991), the Scientific Analysis Team Report (Thomas et al. 1993), and the final draft Recovery Plan for the Spotted Owl (Lujan et al. 1992b). The Northwest Forest plan is an integration of these approaches. It incorporates Federal reserves, is based on protection of both species and old growth forests, and attempts to provide an integrated reserve system based on the protection of key watersheds that serve multiple purposes. The Northwest Forest Plan also incorporates the concept of Adaptive Management Areas, and includes ten large areas (84,000 to 400,000 acres) designated for the development and testing of technical and social objectives.

Under the Northwest Forest Plan, timber harvesting on Federal lands outside of reserve areas (i.e., Matrix) is allowed, subject to current Forest Service and Bureau of Land Management regulations and guidelines. One such guideline, applicable under various options developed by FEMAT, but not applicable under the Northwest Forest Plan, is the 50-11-40 rule, initially introduced to manage intervening forests between HCAs (Thomas et al. 1990). This rule is not part of the Northwest Forest Plan because of other features of the plan, primarily the size of the Late-Successional Reserves, the connectivity provided by Riparian Reserves, and the requirements for leaving trees in harvested areas.

Under the Northwest Forest Plan, all 24,455,300 acres of Federal lands within the range of the northern spotted owl are allocated into one of six designated categories, and the non-designated category referred to as Matrix.

Approximately 23% of the nonfederal lands in the HCP Planning Area are not intermingled with Federal lands. The remaining nonfederal lands are intermingled with one of the Federal land designations discussed below.

Table 5. Acres of Land Ownership in Each of the Designated Areas Under the Northwest Forest Plan Within the Planning Area Post-Land Exchange, Escrow and Option Sections PC

Designated Area	USFS	%	Plum Creek	%	Other	%	Water	%	TOTAL
Congressionally Reserved Area	9,424	4.3	84	0.1					**9,508**
Late-Successional Reserve	59,120	27.0	34,700	23.4	3,582	7.9			**97,402**
Adaptive Management Area	107,874	49.4	50,628	34.1	12,691	28.0	6,563	100	**177,756**
Managed Late-Successional Area	23	0.0							**23**
Administratively Withdrawn Area	4,628	2.1			5	0.0			**4,633**
Matrix	37,643	17.2	35,191	23.7	8,251	18.2			**81,085**
Not designated			27,690	18.7	20,773	45.9			**48,463**
TOTAL	**218,712**	**100**	**148,293**	**100**	**45,302**	**100**	**6,563**	**100**	**418,870**
Percent of Total HCP Area		52.2		35.4		10.8		1.6	100.0
NOTE: USFS – U.S. Forest Service Designated Areas and Matrix applicable to Federal lands only									

1.5.1.1 Congressionally Reserved Areas

These areas contain 7,320,600 acres, representing 30 percent of the Federal land within the range of the northern spotted owl, and include national parks, wild and scenic rivers, national refuges, and military installations. Within the Planning Area, 9,424 acres of Federal lands, representing about four percent of the total acreage of Federal lands within the HCP boundary are considered Congressionally Reserved Areas (Table 5 and Figure 10). 84 acres of non-federal lands, representing less than one percent of the total non-federal lands within the Planning Area are intermingled within this area.

1.5.1.2 Late-Successional Reserves (LSRs)

These reserves contain 7,430,800 acres, representing 30 percent of the Federal land within the range of the northern spotted owl. Late-Successional Reserves (LSRs) consist of old growth forests and extensive areas of younger forests on Federal lands that will be allowed or managed to grow into a late-successional condition. In addition, these areas will be managed to protect and enhance conditions of late-successional forest ecosystems, which serve as habitat for late-successional related species including the spotted owl and marbled murrelet. Reduced levels of silvicultural treatment (e.g., thinning young stands) are permitted in stands of certain ages to accelerate the development of late-successional habitat characteristics. It is possible that substantial forest management may occur in LSRs to control the risk of fire and insect infestation. Within the Plum Creek Planning Area, 59,120 acres of Federal lands, representing about 27 percent of the total Federal lands within the HCP boundary are designated as Late-Successional Reserves (Table 5 and Figure 10). 38,282 acres of non-federal lands, representing about 18 percent of the total non-federal lands within the Planning Area are intermingled within this area.

1.5.1.3 Adaptive Management Areas (AMAs)

AMAs contain 1,521,800 acres and represent six percent of the Federal land within the range of the spotted owl. These areas were designated to encourage the development and testing of technical and social approaches to achieve desired ecological, economic, and social objectives (USDA et al. 1993). The main objective of AMAs is to improve ecosystem-management strategies. This includes provisions of well distributed late-successional habitat outside of reserves (i.e., Matrix), retention of key structural elements of late-successional forests on lands subjected to regeneration harvest, and restoration and protection of riparian zones as well as provisions for a stable timber supply. Guidelines for management within the AMAs include a provision to retain 100 acres of habitat around known spotted owl activity centers. Ten AMAs, ranging in size from 84,000 to 400,000 acres, are located throughout the range of the northern spotted owl.

The Snoqualmie Pass Adaptive Management Area encompasses 231,300 acres and is intermingled with Plum Creek's ownership in the I-90 corridor in King and Kittitas Counties. The Snoqualmie AMA is unique in that it is the only AMA where an action plan is required prior to allowing forest-management activities. The objective of this AMA is to develop and implement a scientifically credible, comprehensive plan for providing late-successional forest on the "checkerboard" lands. The plan is also supposed to recognize the area as a critical connective link in north-south movement of organisms in the Cascade range. Within the Planning Area, 107,874 acres of Federal lands, representing about 49 percent of the total Federal lands within the HCP boundary are designated as Adaptive Management Areas (Table 5 and Figure 10). 69,882 acres of non-federal lands, representing about 35 percent of the total non-federal lands in the Planning Area are intermingled within this area.

1.5.1.4 Managed Late-Successional Areas

These areas contain 102,200 acres, representing approximately one percent of the Federal land within the range of the northern spotted owl. The objective of these areas is to produce and maintain an optimum of late-successional stands on a landscape scale. Certain silvicultural treatments and fire hazard reduction treatments are allowed in these areas to help prevent complete stand destruction from high intensity fires. These areas are identified only in ecosystems where regular and frequent fire is a natural part of the environment. Within the Planning Area, there are only about 23 acres of Managed Late-successional Areas on Federal lands, representing less than one percent of the total Federal lands within the HCP boundary (Table 5).

1.5.1.5 Administratively Withdrawn Areas

These areas include 1,477,100 acres, representing six percent of the Federal land within the range of the northern spotted owl. Lands within this designation are those not scheduled for timber harvest and include recreational areas, lands not suitable for timber production, visually significant areas, and areas removed from timber production for the protection of locally endemic species. Of Federal lands, 4,628 acres are designated as Administratively Withdrawn Areas, representing about three percent of the total Federal lands within the HCP boundary (Table 5 and Figure 10). Essentially none of the non-federal lands in the Planning Area are intermingled within Administratively Withdrawn Areas.

1.5.1.6 Matrix

The Matrix area comprises 3,975,300 acres, representing approximately 16 percent of the Federal land within the range of the northern spotted owl. This area includes all Federal lands outside of the six categories of designated areas discussed above. It is also the area in which most timber harvesting and other silvicultural activities will be conducted on Federal lands. However, there is a provision within the supplemental EIS (USDA 1994) to retain 100 acres of habitat around known spotted owl activity centers within the Matrix. Within the Planning Area, 37,643 acres of Federal lands, representing about 17 percent of the total Federal lands within the HCP boundary are identified as Matrix habitat (Table 5 and Figure 10). 43,442 acres of non-federal lands, representing about 22 percent of the total non-federal lands in the Planning Area are intermingled within this area.

1.5.1.7 Riparian Reserves

Initial estimates indicate that these reserves include 2,627,500 acres of Federal land. These areas represent approximately 11 percent of the Federal lands within the range of the northern spotted owl. The calculation of riparian reserve acreage is done after all other designated areas. As a result, the acreage shown above reflects only that portion of riparian reserves that is interspersed throughout the matrix. Estimates of reserve acreage may increase or decrease in the future depending upon results from upcoming Federal watershed analyses. The main purpose of these reserves is to help maintain and restore riparian structures and functions, benefit fish and riparian-dependent non-fish species, enhance habitat conservation for organisms dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for terrestrial animals and plants, and provide for greater connectivity of late-successional forest habitat. Riparian Reserves are also part of the Aquatic Conservation Strategy, and are discussed in more detail in Section 1.5.2.1.

1.5.2 Aquatic Conservation Strategy

The Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds. The strategy was designed to provide a scientific basis for protecting aquatic ecosystems and enabling planning for sustainable resource management. Late-Successional Reserves are also an important component of the Aquatic Conservation Strategy. The Standards and Guidelines, under which Late-Successional Reserves are managed, provide increased protection for all stream types. Streams, rivers, lakes, ponds, and wetlands within these reserves may be particularly important for endemic or locally distributed fish stocks. The following four sections describe the primary components of the Aquatic Conservation Strategy.

1.5.2.1 Riparian Reserves

These reserves are portions of watersheds, on Federal lands, where riparian-dependent resources receive emphasis. The reserves include those portions of a watershed directly coupled to streams and rivers (i.e., the portion of the watershed required for maintaining hydrologic, geomorphic, and ecological processes that directly affect standing and flowing water bodies). Riparian Reserves are intended to improve water quality by preventing sediments from reaching streams, maintaining stream temperatures by shading, and providing large woody debris to maintain invertebrate and vertebrate habitat within streams. The widths (in slope distance) of Riparian Reserves on Federal lands vary according to the type of stream (USDA 1994; pages C-30 and C-31):

1. **Fish-bearing streams —** Riparian Reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of the riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest.
2. **Permanently flowing nonfish-bearing streams —** Riparian Reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.

3. **Constructed ponds and reservoirs, and wetlands greater than 1 acre** — Riparian Reserves consist of the body of water or wetland and: the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of the wetland greater than 1 acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.

4. **Lakes and natural ponds —** Riparian Reserves consist of the body of water and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest.

5. **Seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas** — This category applies to features with high variability in size and site-specific characteristics.

   At a minimum, the Riparian Reserves must include:

   - The extent of unstable and potentially unstable areas (including earthflows);
   - The stream channel and area extending to the top of the inner gorge;
   - The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation; and
   - Extension from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest.

1.5.2.2 Key Watersheds

The network of 164 Key Watersheds, located throughout the range of the spotted owl, either provides, or is expected to provide, high quality habitat. Under the Aquatic Conservation Strategy, there are two designations for Key Watersheds. Tier 1 Key Watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species. They also have a high potential of being restored as part of a watershed restoration program. Tier 1 Key Watersheds consist of watersheds identified previously by the Scientific Panel on Late-Successional Forest Ecosystems (1991); and the Scientific Analysis Team Report (1993). The network of 143 Tier 1 Key Watersheds provides a refugia which may be crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. Although they may not contain at-risk fish stocks, the 21 widely distributed Tier 2 Key Watersheds are important sources of high water quality. Long-term management within Key Watersheds on Federal lands requires watershed analysis prior to resource management activity. For example, timber harvest, including salvage, cannot occur in Key Watersheds on Federal lands without a watershed analysis.

There are 8,119,400 acres, or about 33 percent of the total Federal land within the range of the spotted owl, included among the Tier 1 Key Watersheds and 1,001,700 acres, or about four percent of the total Federal land within the range of the spotted owl included among the Tier 2 Key Watersheds.

1.5.2.3 Federal Watershed Analysis

This analysis is a systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives on Federal lands. Federal watershed analysis is required in all Key and non-Key Watersheds containing roadless areas, and all Riparian Reserves prior to determining how proposed Federal land management activities meet Aquatic Conservation Strategy objectives.

Federal watershed analysis has a critical role in providing for aquatic and riparian habitat protection. Analysis of watershed condition includes more than just the state of the channel and riparian area. It also includes the condition of the uplands, distribution and type of seral classes of vegetation, land-use history, effects of previous natural and land-use related disturbances, and distribution and abundance of species and populations throughout the watershed.

Federal watershed analyses consist of technically rigorous and scientifically defensible procedures designed to identify: (1) hydrologic and biological processes that are active within a watershed; (2) how these processes are distributed through time and space; (3) current upland and riparian conditions of the watershed; and (4) how all of these factors influence riparian habitat and other beneficial uses.

1.5.2.4 Watershed Restoration

All restoration in watersheds on Federal lands throughout the range of the northern spotted owl is based on watershed analysis and planning. Watershed analysis is essential to identify areas of greatest benefit-to-cost relationships for restoration opportunities and greatest likelihood of success. Key Watersheds that currently contain poor quality habitat are thought to have the best opportunity for successful restoration and will receive priority in any Federal watershed-restoration program. The most important components of a watershed-restoration program are control and prevention of road-related runoff and sediment production, restoration of the condition of riparian vegetation, and restoration of in-stream habitat complexity.

Long-term systematic monitoring of watershed-restoration efforts is recommended to provide reference points for determining if best management practices have been implemented, the effectiveness of management practices, and validating whether ecosystem functions and processes have been maintained as predicted.

1.6 Consistency with Federal Programs

Because of the intermingled land ownership in the I-90 corridor, the HCP was designed to be consistent with the goals and objectives of applicable Federal forest-management efforts. For example, Plum Creek's HCP includes ecosystem-based strategies that are consistent with Federal objectives for the conservation and recovery of listed wildlife species (i.e., northern spotted owl; Lujan et al. 1992a and 1992b).

The objective of the final draft Recovery Plan is to remove the northern spotted owl from the list of threatened species (Lujan et al. 1992b). Although not formally adopted, the draft plan relies primarily on Federal lands for recovery of the spotted owl; it also recognizes the important role of non-federal lands in recovery. Among the key elements of the plan is a set of suggestions for contributions from non-federal forestlands to support spotted owl populations. Plum Creek has incorporated many of these suggestions into this HCP. For example, although the DCA management strategy outlined in the final draft Recovery Plan (Lujan et al. 1992b) has been superseded by the Northwest Forest Plan, the HCP will support opportunities for owls to disperse into and between the four DCAs in the Planning Area (i.e., WD-7, WD-8, WD-39, and WD-40), by providing adequate foraging and dispersal habitat in all riparian corridors in the Planning Area. Landscape-wide foraging and dispersal habitat amounts on Plum Creek lands are also expected to compliment habitat management goals for spotted owls. The HCP would also provide NRF habitat to supplement owl sites on Federal lands.

Under the Northwest Forest Plan, the Forest Service is mandated to take an ecosystem approach to forest management, with support from scientific evidence; meet the requirements of existing laws and regulations; maintain a healthy forest ecosystem with habitat that will support populations of native species (particularly those species associated with late-successional and old growth forests), including protection for riparian areas and waters; and maintain a sustainable supply of timber and other forest products that will help maintain the stability of local and regional economies on a predictable and long-term basis. This HCP includes many of the components recommended in the Northwest Forest Plan to protect forest habitat, develop riparian management options, and develop management options for the protection of stream corridors to enhance conditions for associated aquatic and terrestrial species and to provide "connectors" between patches of forest habitat. Individually and collectively, these components of the HCP help avoid, rectify, reduce, or eliminate potentially adverse environmental impacts resulting from Plum Creek's forest-management activities. For example, the HCP incorporates:

1. maintenance and protection of riparian habitat areas;
2. harvest deferral of NRF habitat for spotted owl and other wildlife nest sites;
3. selective harvests to FD habitat for spotted owl dispersal corridors;
4. watershed analysis;
5. green tree and snag retention;
6. habitat management for all known and unknown vertebrate species of wildlife in the Planning Area; and
7. monitoring.

The ESA directs the Secretary of the Interior, and the Secretary of Agriculture, with respect to National Forest System Lands, to establish and implement a program to conserve fish, wildlife, and plants, including those listed as threatened and endangered. Thus, Plum Creek's HCP, while different in some respects from the Standards and Guidelines recommended for Federal lands, is nevertheless firmly based on the best available science and designed to supplement the ecosystem-management responsibilities of the Forest Service.

At this point, it is important to note that Plum Creek assumes, that within the foreseeable future, the Northwest Forest Plan will continue as the management strategy for Federal old growth forests in the I-90 corridor. Because of the intermingled ownership pattern in the I-90 corridor, Plum Creek has used the Northwest Forest Plan as the framework to develop a creative conservation plan to protect and enhance forest-related species and to protect aquatic resources. Plum Creek's assumption regarding the Northwest Forest Plan is based on the recent approval of the plan and accompanying EIS by the Federal courts, and on implementation of the Standards and Guidelines which provide management direction for Federal lands within the range of the northern spotted owl, including actions that are prohibited and descriptions of the conditions that should occur on Federal lands. In the unlikely event that the Northwest Forest Plan is significantly modified or terminated during the Permit period, Plum Creek will continue to implement the HCP and follow the guidelines established in Section 8.0 (Unforeseen and Extraordinary Circumstances) of the Implementation Agreement (Appendix 10). In any event, it is Plum Creek's understanding that species in the Planning Area will remain adequately covered under the terms of Plum Creek's HCP, and the primary obligation for additional mitigation measures, if necessary, shall not rest with Plum Creek.

It was assumed that Plum Creek lands and held timber rights are, or will be, accessible by road. It was also assumed that access requests would be granted by the Forest Service where road access to Plum Creek lands currently do not exist.

1.7 Washington State Landscapes

The report of the Washington Forest Practices Board Spotted Owl Scientific Advisory Group (SAG)(Hanson et al. 1993), focused mainly on obtaining, interpreting, and synthesizing scientific information related to the conservation and management of the spotted owl on non-federal lands in Washington. The SAG Report recommended maintaining the descriptions of late successional and old growth forests. However, the report recommended combining several descriptions (such as DNR habitat Types A and B) under one inclusive term, Old Forest. Old Forest habitat consists of old growth or mature forest that provides all of the characteristics spotted owls require for nesting, roosting, foraging, and dispersal. Old Forest habitat is also synonymous with the "Superior" spotted owl habitat described by Thomas et al. (1990). The SAG Report also revised spotted owl habitat descriptions for younger forests based on the ecological functions they serve in spotted owl life history. Submature habitat consists of non-old growth habitat that provides all of the characteristics needed for roosting, foraging, and dispersal. Although spotted owls may occasionally nest in this habitat type, it usually does not serve this function. Submature habitat corresponds to the "high end" of the current DNR Type C habitat designation. Young Forest Marginal habitat consists of younger forests that provide some of the characteristics spotted owls need for roosting, foraging, and dispersal. This habitat type corresponds to the low- to mid-range of the current DNR Type C habitat designation. Dispersal habitat includes Old Forest, Submature, and Young Forest Marginal habitat. Non-habitat consists of forests that do not, at a minimum, provide characteristics necessary for successful spotted owl dispersal.

Major landscapes which encompass Plum Creek's ownership include I-90 West, I-90 West (Easton) and I-90 East/ Teanaway (Hanson et al. 1993). I-90 West is generally described as the Eastern portion of King County West of the Cascade Mountain crest, south of Highway I-90 to the Pierce County line, and East of Range 8 East. Federal and non-federal lands are intermingled in a checkerboard ownership, and spotted owls are found in moderate densities. This area includes Late-Successional Reserve, Adaptive Management, and Matrix areas (USDA 1993). The spotted owls in this area are considered important to provide interchange between owl populations in the north and south Cascades. The cluster of owl sites in the area presumably provides demographic support to the population. A large portion of the habitat in this area is comprised of young forests on private lands.

I-90 West (Easton) is generally described as lands in Township 20 North, Ranges 13 and 14 East in Kittitas County. Federal and non-federal lands are intermingled in a checkerboard ownership, and spotted owls are found in low- to moderate-densities. This area includes Late-Successional Reserve and Adaptive Management Areas. It also provides spotted owl habitat and is considered important to facilitate demographic interchange between owl populations in the north and south Cascades, and especially in the Eastern Cascades.

I-90 East/ Teanaway is generally described as lands in Kittitas County East of a boundary formed by Kachess Lake (Township 22N, Range 13E); north to the Alpine Lakes Wilderness Area (Township 23N, Range 13E); and including the East ½ of Township 23N, Range 14E; Township 22N, Range 14E; Township 2 N, Range 14, 15E; the north ½ of Township 20N, Range 15 and 16E; and the south half of Township 22N, Range 16E. Federal and non-federal lands are also intermingled in a checkerboard ownership; however there are contiguous blocks of non-federal lands. Spotted owls occur in high densities in the Eastern and Western portions of this area, and at low densities in the central portion. This landscape includes Adaptive Management Area (west area) and Late-Successional Reserve (east area) and provides spotted owl habitat. Maintaining spotted owls in this area is considered important to ensure demographic interchange between the north and south Cascades via the clusters of owls at the East and West ends of the landscape.

Subsequent to approval of the original Plum Creek Cascades HCP, the Washington Department of Natural Resources (DNR) received approval for a HCP covering 1.8 million acres in the State. The DNR HCP addressed northern spotted owls on DNR-managed lands East and West of the Cascade Crest. One section of DNR HCP land exists in the upper Green River and is designated for management providing nesting habitat. East of the Cascade crest, DNR ownership is scattered with management focus evenly divided between nesting and foraging objectives. The commitments in that HCP relative to nesting habitat include an assessment of the amount of Federal habitat on a Watershed Administrative Unit basis.

New State rules for the northern spotted owl, effective on July 1, 1996, were designed to compliment the Northwest Forest Plan and were based on stated conservation functions is specific areas of nonfederal lands. The State owl rule was developed concurrently with a proposed Federal rule. The new rules identified critical wildlife habitat (state), established 10 Spotted Owl Special Emphasis Areas (SOSEAs) where critical wildlife habitat (state) is designated within circles around owl site centers. Habitat goals (functions) are identified on maps for each SOSEA. The rule also contained seasonal provisions to reduce disturbance of nesting owls wherever they occur.

SOSEA lands were designated for all of the lands within the HCP Planning Area. Demographic support and Dispersal support were the two types of designated lands found on the West-side of the Planning Area. On the East-side of the Planning Area, designated lands included those with a demographic support role, a dispersal support role, as well as lands with a role in both Dispersal and Demographic support. Over half of the Plum Creek lands following the land exchange are in areas designated for demographic support. Less than 2 percent of Plum Creek lands are in areas designated for a combination of demographic and dispersal support.

1.8 Land Access

For the landscape and habitat analysis in the HCP, Plum Creek assumed that it had access to all Company lands and that all timber on those lands was available for harvest. This includes access through harvest deferral areas to non-deferral stands. It was assumed that all Plum Creek lands and held timber rights are, or will be, accessible by road and that access requests would be granted by the U.S. Forest Service where road access to Plum Creek lands do not currently exist. For all projects, the specific impacts of the action resulting from the access will be addressed on a site-specific basis.

FIGURE 1

Plum Creek's Habitat Conservation Planning Area in the Central Cascades Mountain Range, and Land Ownerships.

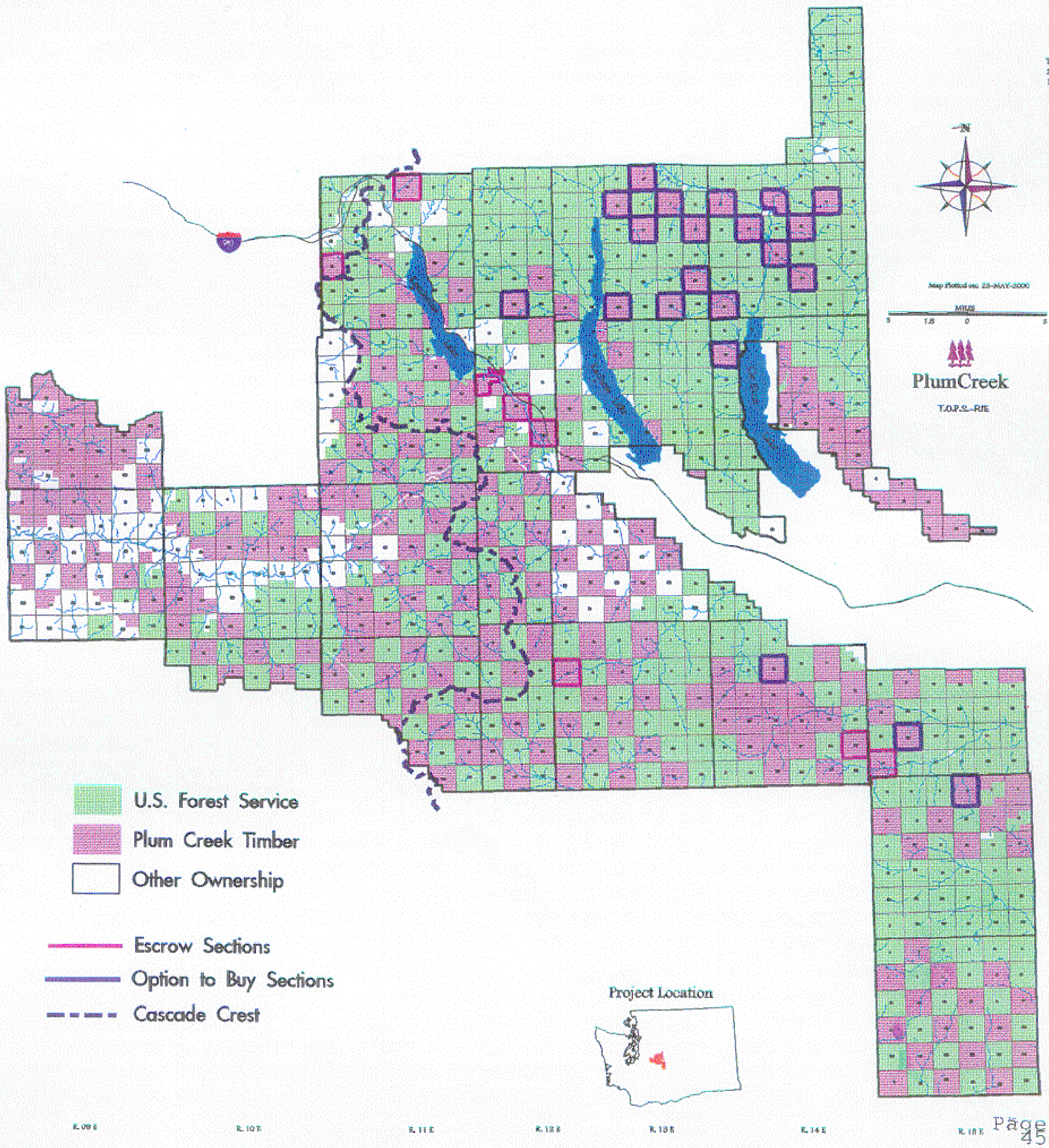
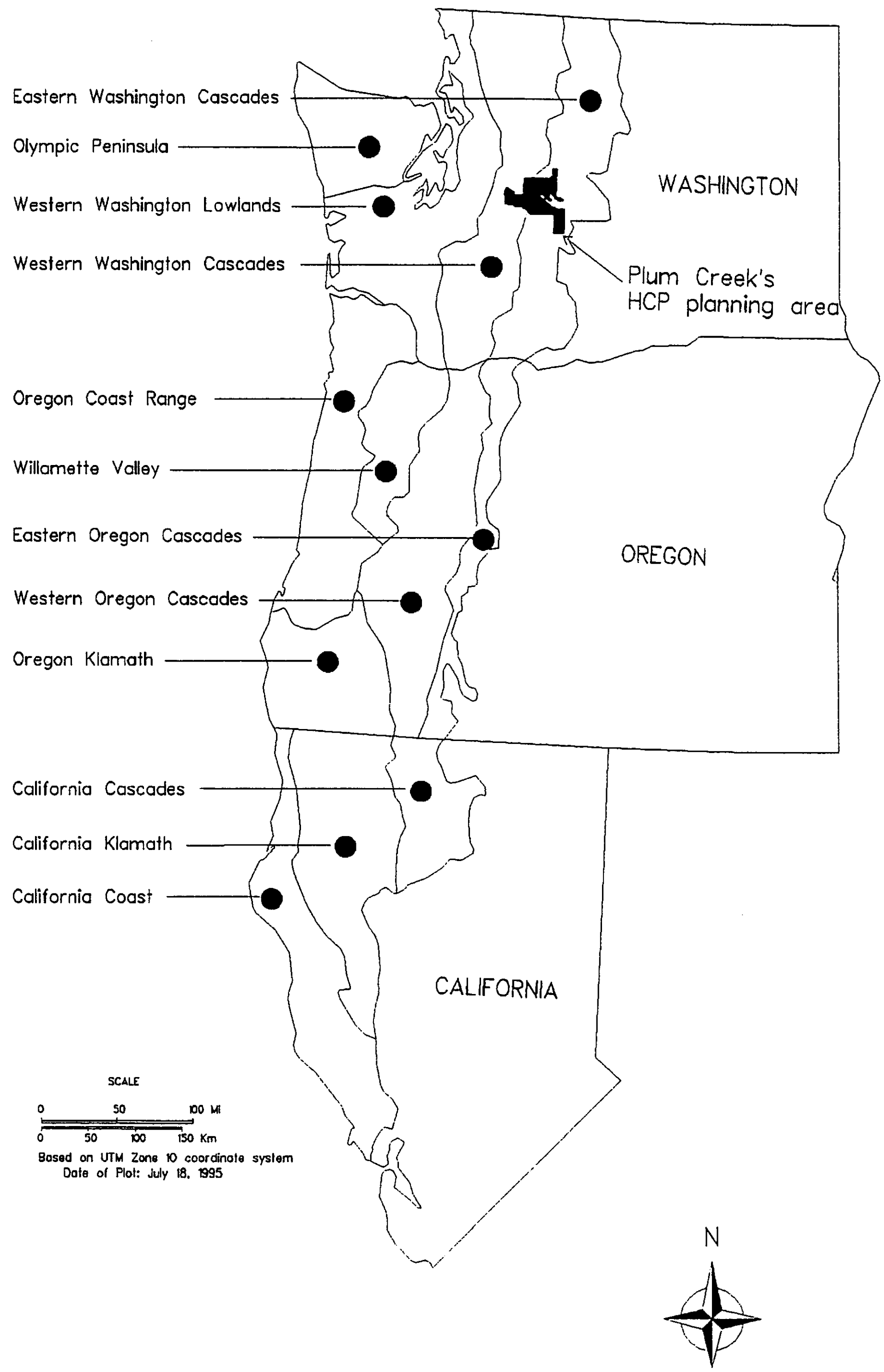


FIGURE 2

Physiographic provinces within the range of the northern spotted owl.



PlumCreek

FIGURE 3. Green River Drainage

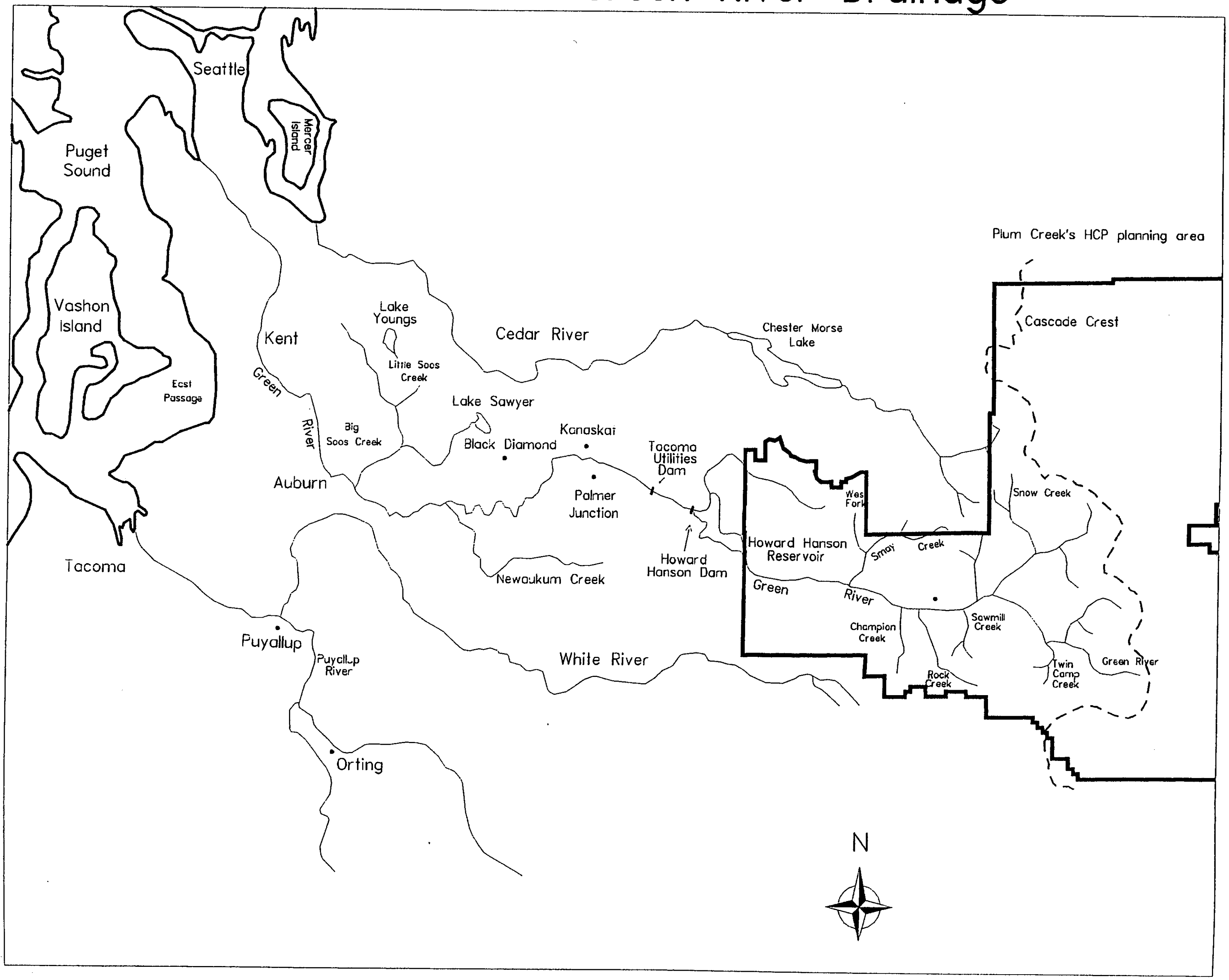


FIGURE 4

The Yakima River subbasin and tributaries (YIN et al. 1990).

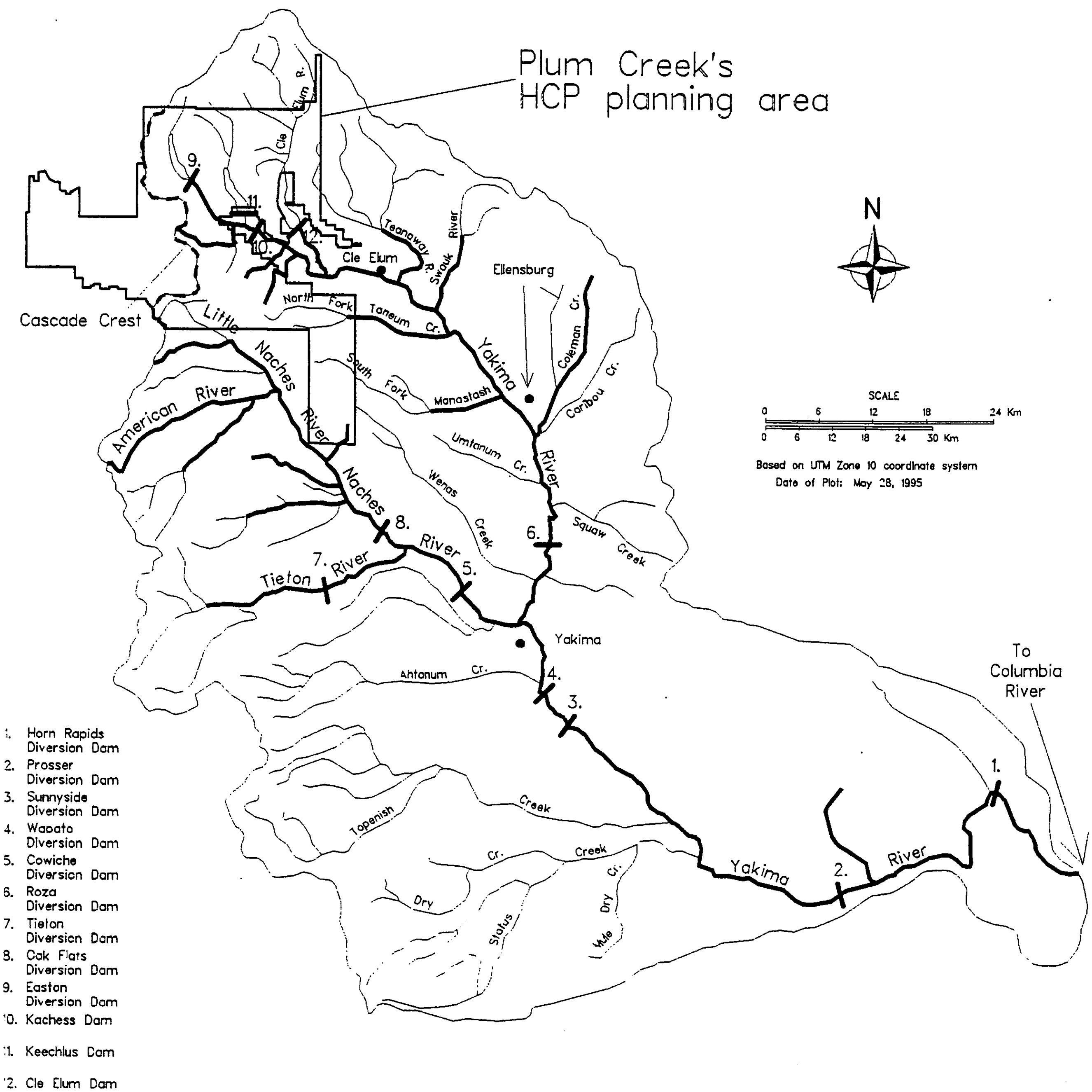
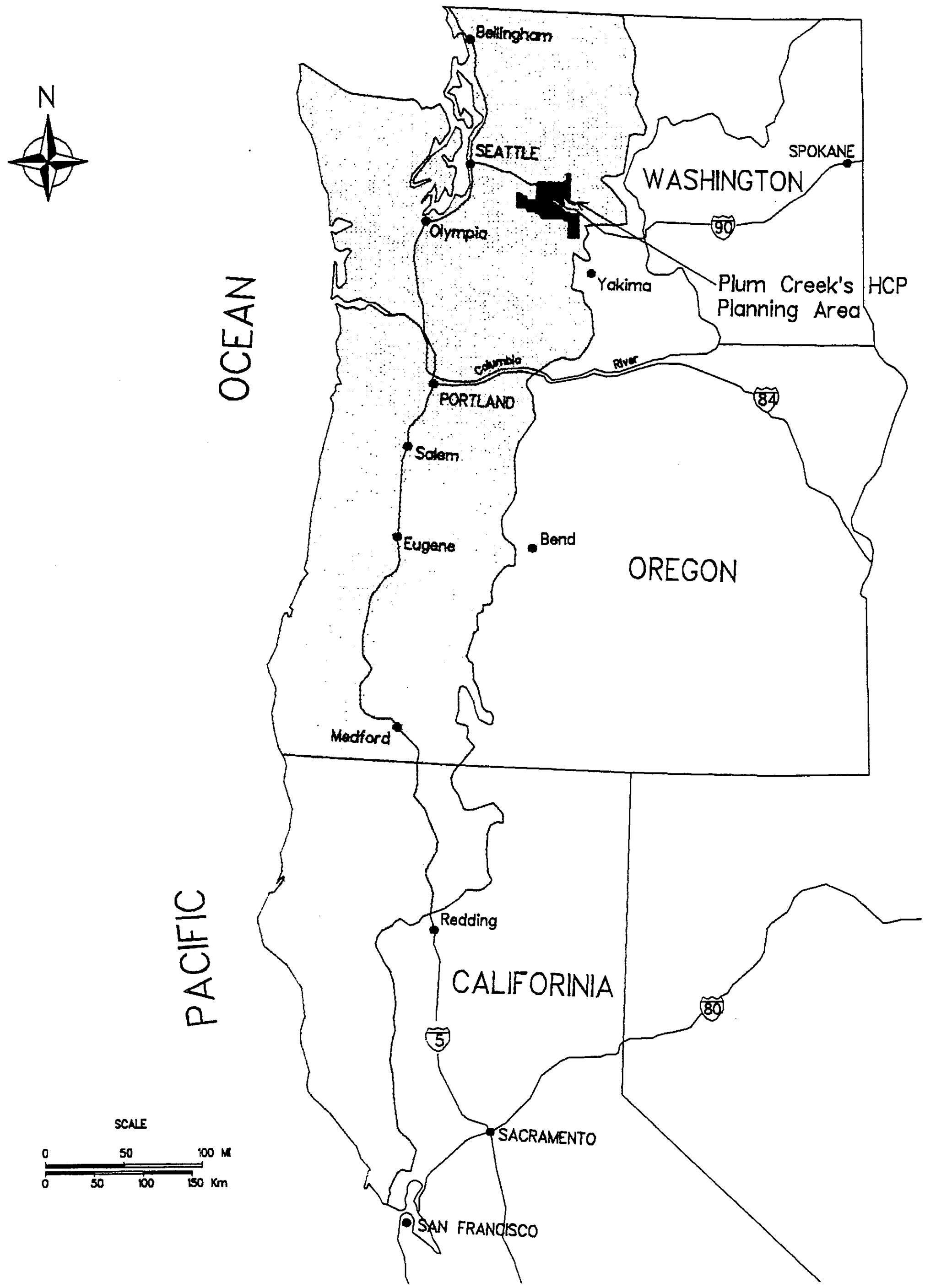


FIGURE 5

Range of the northern spotted owl within the United States (USDA 1994).



PlumCreek

FIGURE 6

Proposed Marbled Murrelet Critical Habitat in the Vicinity of Plum Creek's HCP Planning Area.

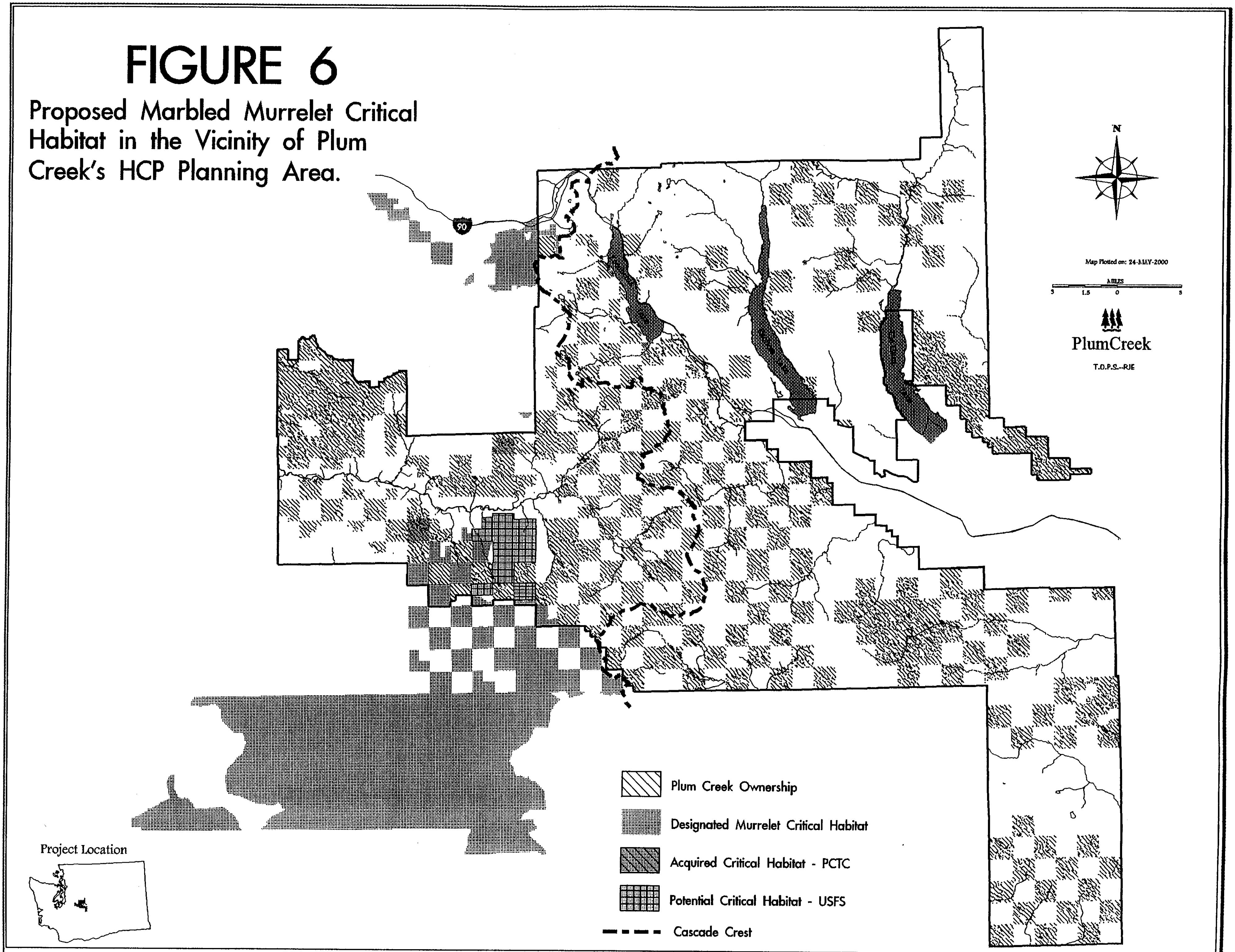


FIGURE 7 Grizzly Bear Range in the Conterminous United States

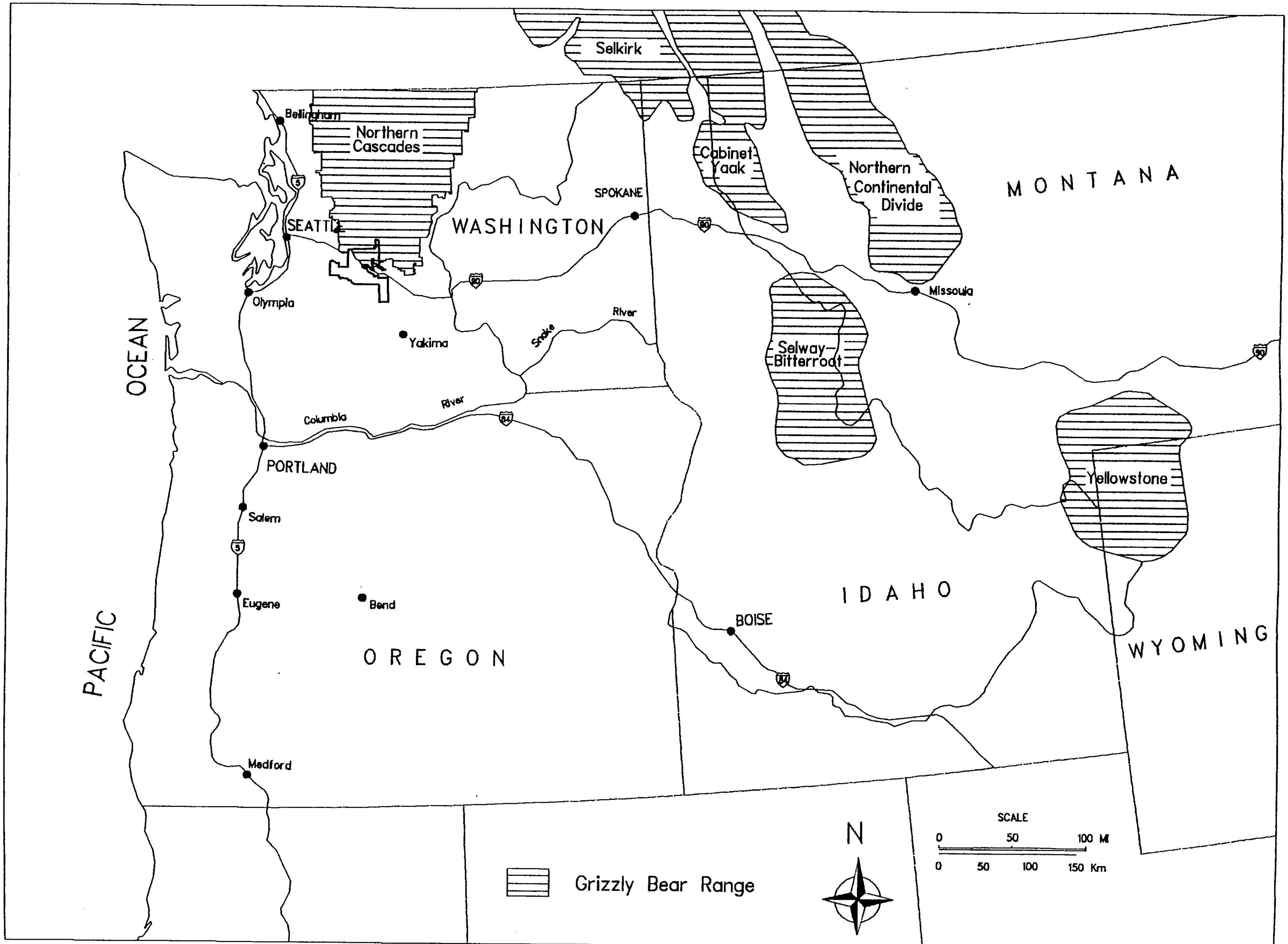


FIGURE 8
Proposed gray wolf recovery areas.

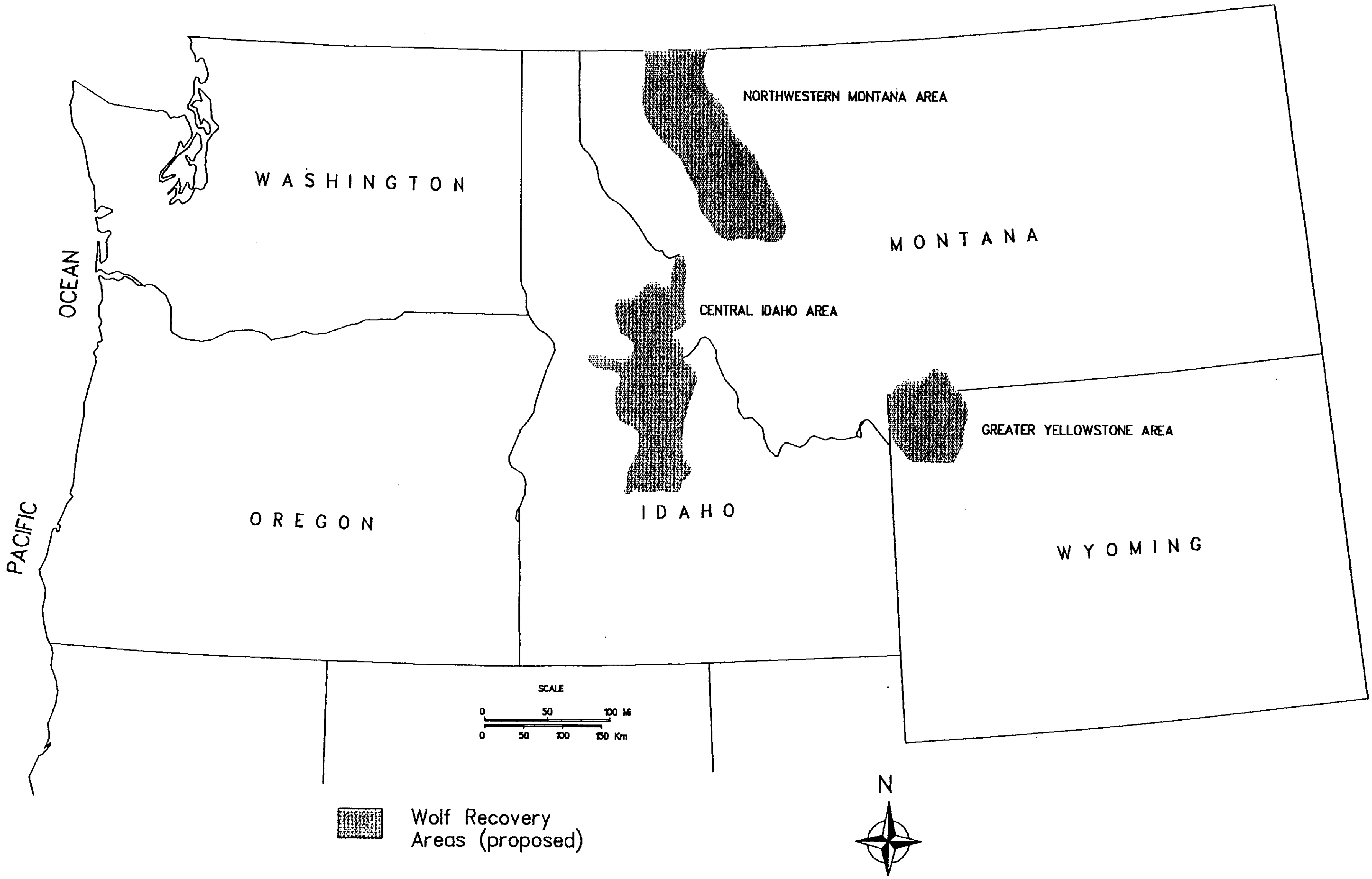


FIGURE 9

Designtated Conservation Areas (DCA's) in Proximity to Plum Creek's HCP Planning Area.

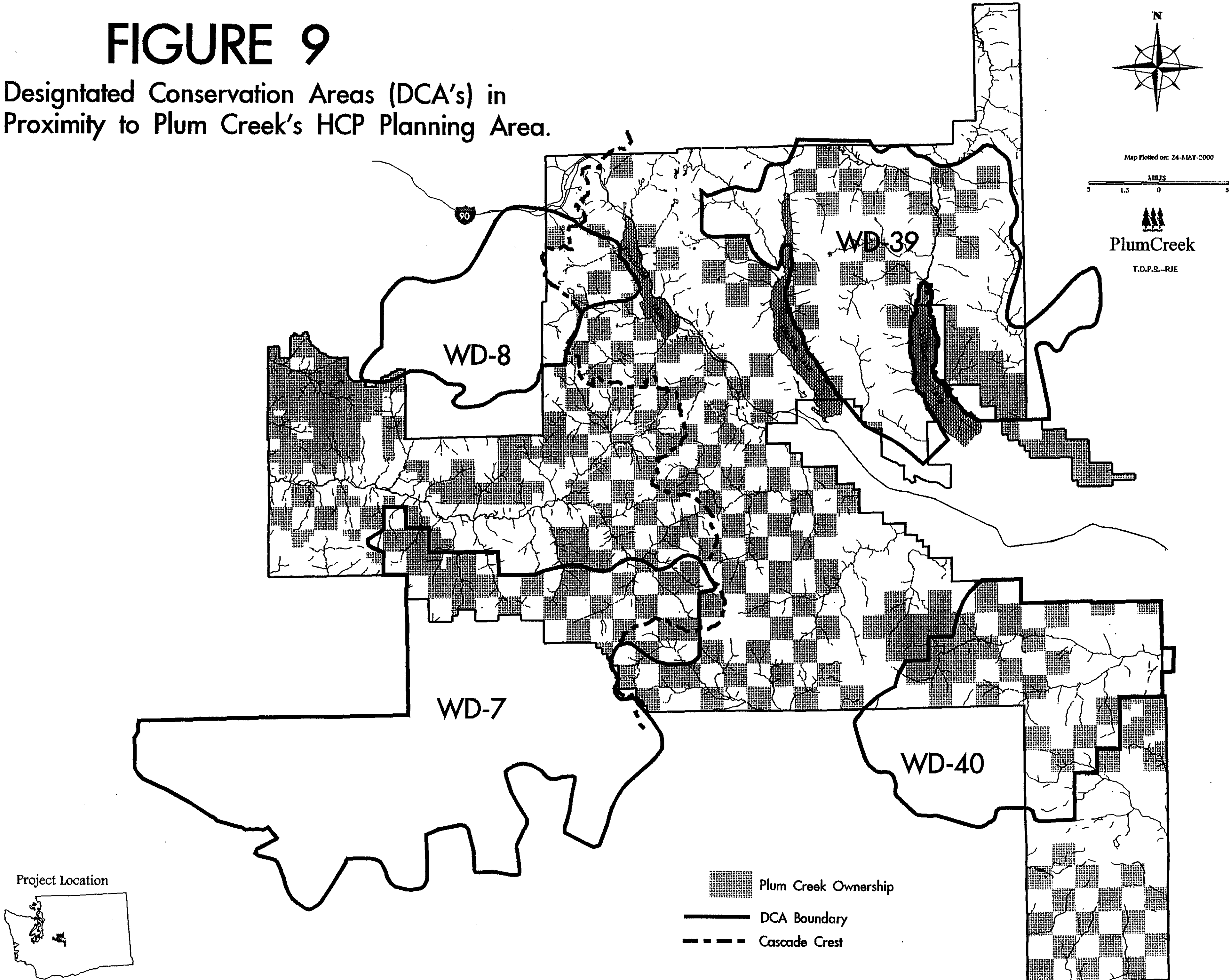
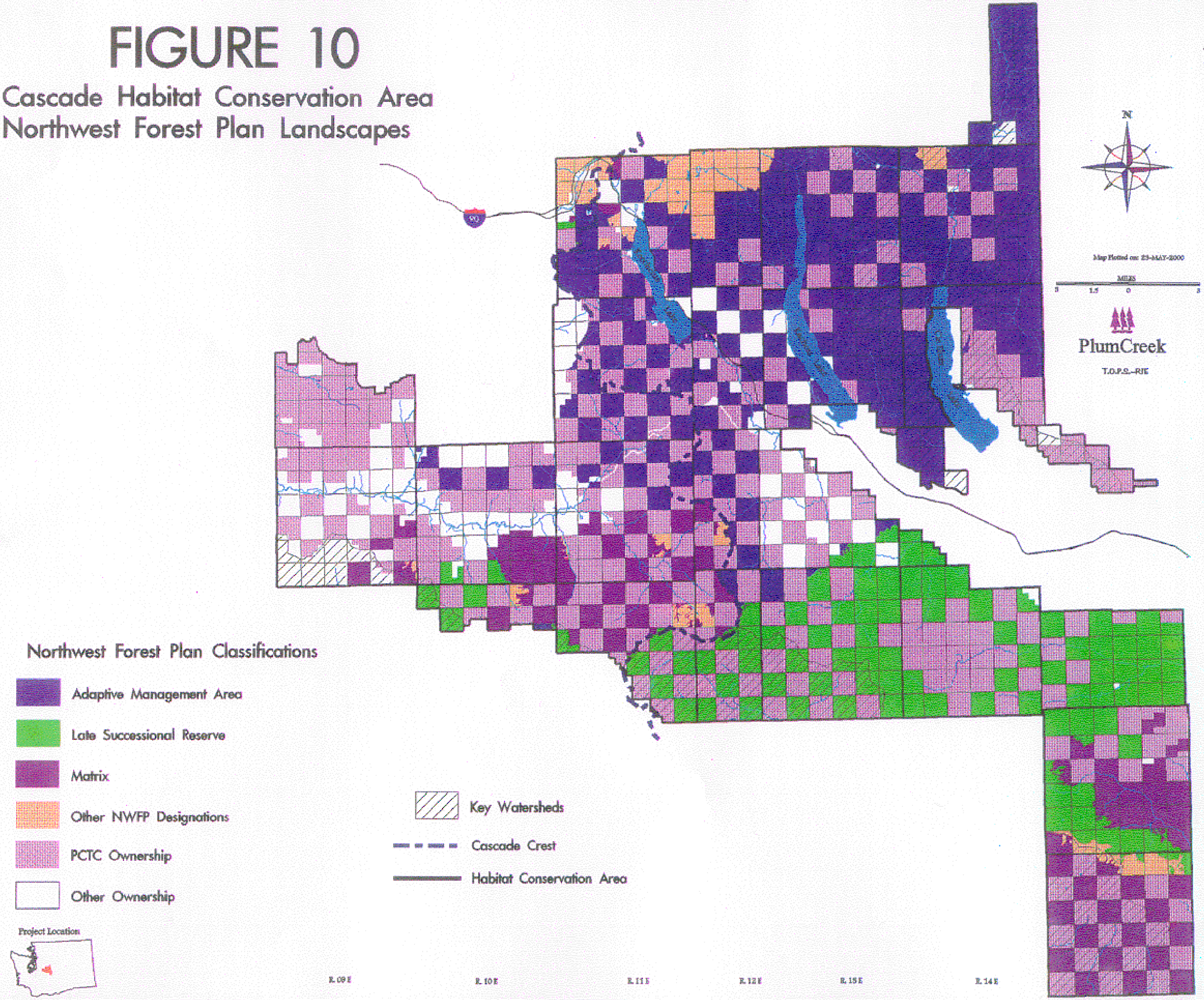


FIGURE 10

Cascade Habitat Conservation Area Northwest Forest Plan Landscapes



Section 2.0

Collection and Synthesis of Data

2.0 Collection and Synthesis of Data

2.1 HCP Planning Area

A summary of the large-scale characteristics of the Planning Area is provided in Jensen (1995). This report, entitled Ecological Habitat Classification, HCP Project Area, provides an ecological classification and evaluation of the Planning Area. In the report, the Planning Area is evaluated using geographical information systems (GIS), and classified using descriptive attributes of the area including elevation, slope, aspect, annual precipitation, soil-type, vegetation series, ownership, and seven hierarchical levels including, Ecoregion, Geologic District, Landtype Association, Landtype, Valley-Bottom Type, Landform, and Vegetation Type. The upper hierarchical levels (i.e., Ecoregion) consist mainly of large polygons that describe the Planning Area in terms of general criteria. At successively lower levels, the Planning Area is divided into smaller units that describe the area in terms of more refined criteria, from which increasingly more specific interpretations can be drawn.

2.2 Stand Structure/Habitat Relationship

Canopy Crown Closure is used extensively to relate wildlife needs to forest stand structure. Since typical forest mensuration does not include percentage Crown Closure, a relationship between Crown Closure and Relative Density was explored. After extensive testing, a correlation between these two variables was established. Testing within the Planning Area was conducted independently on both sides of the Cascade crest (Figure 11 and Figure 12).

Stand density is a function of crowding within a stand and is a major factor influencing the size of individual trees. Density can be expressed in terms of basal area per acre, stems per acre or stem volume per acre. For the HCP analysis, basal area per acre and Relative Density (Curtis 1982) were used because they are convenient, easily understood, and readily calculated using information in Plum Creek's inventory system (Oliver et al. 1995). Relative Density is defined as stand basal area divided by the square root of the quadratic mean diameter (i.e., diameter of trees of average basal area).

Following extensive sampling in a variety of stand conditions, including managed and unmanaged stands, Plum Creek developed a significant relationship between Crown Closure and Relative Density for forests East of the Cascade crest. For example, a Crown Closure of 70 percent on the East-side equates to a Relative Density index of 44 (Figure 12). Plum Creek is using the habitat and canopy closure relationship developed by Murray Pacific, Inc. (Beak Consultants, Inc. 1993) for the West-side of the Cascade crest. This relationship is further developed in Section 2.4.

2.3 Stand Structure Classification System

Prior to establishment of the forest stand structural classification system, Plum Creek identified three objectives for the Planning Area. These objectives were to: (1) link forest inventory and wildlife habitat databases; (2) provide a basis to predict habitat use for multiple species rather than just a single species such as the spotted owl; and (3) provide a viable classification system for ecosystem management across the intermingled land ownership.

A primary focus of Plum Creek's ecosystem-management approach in the Planning Area is to link the biological needs of forest wildlife to the physical and vegetative characteristics of the forest environment. Plum Creek recognized early in the planning process that in order for an ecosystem-management plan to be implemented successfully, three important prerequisites must be met: (1) a system to classify the diverse forest stands over the large HCP landscape must be developed; (2) the biological requirements of resident wildlife species must be oriented toward a series of structural classes used in the system; and (3) a modeling capability must be in place to predict accurately the amount and location of the forest structural classes in the future as a result of forest management. The developmental process that Plum Creek used to establish a forest stand structural classification system for wildlife in the Planning Area is outlined in Oliver et al. (1995).

Initial development of the structural classification system involved review of previously published classification systems (Thomas 1979; Brown 1985). These classification systems were useful as beginning points to describe stand-level structural stages, but Plum Creek modified these classifications to more closely reflect stand inventory and floristic conditions in the Planning Area.

To refine further the forest stand structural classification system, Plum Creek used the Stand Visualization Program developed by Dr. Chad Oliver at the University of Washington, College of Forest Resources. This program allows Plum Creek to construct a visual plot of a forest stand based on input from stand level inventory data such as tree densities, diameter, and species. The plots shown in Oliver et al. (1995) were constructed by the Stand Visualization Program and depict the eight structural stages developed by Plum Creek for the Planning Area. A short description of each of the structural stages is provided below. A complete description of each structural stage along with its corresponding visual plot is shown in Oliver et al. (1995).

Plum Creek recognizes that there are numerous structural stages across a forested landscape, and that these structural stands vary among physiographic provinces, vegetation types, disturbance regimes, elevation, climatic conditions, and soil conditions. The eight structural stand stages described in Oliver et al. (1995) were chosen for use in the HCP because they represent major structural attributes in forest types across the physiographic provinces (i.e., Eastern Washington Cascades and Western Washington Cascades) incorporating the Planning Area.

1. **Stand Initiation Stage** — This stage is characterized by trees less than 1 inch Quadratic Mean Diameter (QMD). It is similar to the grass/ forb stage described in Brown (1985) and Thomas (1979). This structural stage is commonly found after a recent disturbance such as timber harvesting or fire, and is comprised predominately of newly planted trees and resident herbs, as well as some residual green trees and standing snags. Wildlife support and usage of these initiation stages depends upon the amount and type of residual trees left standing. For example, cavity nesting species may benefit greatly by the retention of snags and cull green trees in a recent harvest unit.

2. **Shrub/Sapling Stage** — This stage is characterized by trees between 1 and 2 inches QMD. Shrubs often predominate in this stage, commonly providing habitat for a wide array of wildlife species different from those species occupying the stand initiation stage.

3. **Young Forest Stage** — This stage is characterized by trees between 3 and 5 inches QMD. This structural stage is often the result of growth in stand initiation or shrub/sapling stages, or it may be due to partial harvesting or removal of overstory trees which leaves a dense stocking of residual understory trees.

4. **Pole Timber Stage** — This stage is characterized in the West-side Cascades by trees between 6 and 9 inches QMD and in the East-side Cascades by trees between 6 and 8 inches QMD. On both sides of the Cascades trees in this stage exhibit a high degree of crown closure and relative density. These stands are typically densely stocked with little clearance between the shrub/sapling layer and the crown.

5. **Dispersal Forest Stage** — This stage was developed to encompass the stand conditions that are favorable to dispersal of spotted owls and that may be used regularly by a wide range of other wildlife species. On the West-side of the Cascades these stands are characterized by trees with quadratic mean diameters between 10 and 13 inches QMD with an average Relative Density of 48 and a minimum canopy closure of 70 percent. On the East-side of the Cascades, the dispersal forest stage is characterized by trees between 9 and 12 inches QMD and with an average Relative Density of 33 and a minimum canopy closure of 58 percent. Although these forest stands provide only minimal conditions for spotted owl roosting and foraging, they do provide adequate habitat for owls to move freely between more favorable nesting, roosting, and foraging habitat.
6. **Mature Forest Stage —** This stage is characterized on the West-side of the Cascades by trees between 14 and 20 inches in diameter, and on the East-side of the Cascades by trees between 13 and 15 inches QMD. Canopy closure in this stage is generally greater than 70 percent with a Relative Density in excess of 48 on the West-side of the Cascade crest and 44 on the East-side . This stage provides adequate nesting, roosting, and foraging habitat for spotted owls and habitat for a wide range of other wildlife species.
7. **Managed Old Growth Stage** — This stage is characterized on the West-side of the Cascades by average stands greater than 21 inches QMD, and on the East-side of the Cascades by trees greater than 16 inches in diameter. The age of these stands is less than 200 years and, although these stands can occur naturally as dense, large diameter trees, most of them have been selectively harvested. In most cases, 50 percent of the merchantable volume was removed, while up to 80 percent of the trees were retained. The management objective for these stands is to extract economically valuable trees while retaining sufficient forest structure to maintain nesting, roosting, and foraging habitat for spotted owls and other wildlife species.
8. **Old Growth Stage** — This stage is characterized more by age than by a distinct diameter range. The old growth stage is defined in the Planning Area using the same QMD as the managed old growth stage, but these forests are 200 or more years old. These forests are characterized by an abundance of decadent live trees, snags, down woody debris, and a general replacement of some of the long-lived pioneer species, such as Douglas fir, and by climax species such as Western hemlock. In addition, canopy closure in this stage typically approaches 100 percent and there are generally two or more distinct layers to the canopy.

2.4 Spotted Owl Habitat Types

At least three paradigms have been used previously to describe spotted owl habitat since the Federal listing of the species in 1990. One of the first descriptions of spotted owl habitat was the use of “suitable” and “non-habitat” as defined in the draft spotted owl Recovery Plan (Lujan et al. 1992a). Other descriptions used “A”, “B”, and “C” habitat types which equated to optimal, suitable, and marginal habitat for spotted owls (Washington Department Natural Resources “Owl Memo #3; March 5, 1991). More recently (Hanson et al. 1993) the spotted owl Scientific Analysis Group (SAG) developed a habitat nomenclature based on “Old”, “Submature”, and “Young Forest Marginal” definitions.

Among these three paradigms, the A/B/C habitat definition has been used most widely due to its adoption in State Forest Practices Rules and Regulations. As applied, the system has been modified to A/B (suitable) and C (marginal) habitat types. Over the past four years, a considerable portion of the spotted owl range in Washington, including all of Plum Creek’s HCP Planning Area, has been mapped using these habitat descriptions. However, despite the wide application of the A/B/C habitat nomenclature, there are three primary shortfalls limiting its usefulness. First, A/B and C habitat is viewed by many as being a variation of spotted owl nesting habitat. As such, the important elements of dispersal habitat are not derived easily under this system. Second, the stand level parameters used to identify A/B and C habitat have included canopy closure, "predominately larger trees", and other identifiers which are often difficult to derive from standard forest inventories. Lastly, the identification of Type C (marginal) habitat has been an ongoing challenge, resulting in a surprisingly diverse array of forest stands mapped under this category (ranging from very dense, overstocked Douglas fir/western hemlock stands on the West-side of the Cascades to relatively open stands comprised of grand fir and lodgepole pine on the East-side of the Cascades). Consequently, the Type C habitat designation has needlessly complicated efforts to model future stand development and to evaluate the importance of habitat quality and quantity in predicting future spotted owl occurrence.

Spotted owl habitat types used in the HCP include nesting, roosting, and foraging (NRF) habitat, and foraging and dispersal (FD) habitat. Plum Creek has defined FD and NRF habitat types, using data derived from site-specific spotted owl research, conducted by Plum Creek, in the Planning Area, and both NRF and FD habitat have been defined separately for forest conditions on the East-side and West-side of the Cascades (Hicks and Stabins 1995). Plum Creek made several basic assumptions prior to developing definitions for NRF and FD habitat. These assumptions include:

1. A/B "suitable" habitat is NRF habitat;
2. High quality Type C (marginal) habitat may serve as NRF habitat in the Eastern Cascades; whereas, mid- to low- quality Type C habitat generally provides at most, FD habitat at the stand level;
3. Some forest stands previously classified as "non-habitat" can be considered to be at least FD habitat, if radio telemetry and site center locations prove documented use; and
4. Vegetative plots of stand-level conditions surrounding spotted owl locations provide reliable data from which to describe owl habitat.

Several key parameters were used by Plum Creek to define spotted owl NRF and FD habitat. These include tree species, quadratic mean diameter (QMD), relative density (RD), and fire management analysis zone (FMAZ). Minimum standards for classifying NRF and FD spotted owl habitat in the Planning Area are summarized in Table 6 below:

Table 6. Key Parameters for Spotted Owl Nesting, Roosting and Foraging (NRF) and Foraging and Dispersal (FD) Habitat.

Habitat Type	HCP Subregion	FMAZ	Relative Density	Quad Mean Diameter	Dominant Tree Species
NRF	west	5	48	14	DF
NRF	east	2,3,4	44	13	DF, PP
FD (Upland)	west	5	30-48*	10	DF, TF, WH
FD (RHA)	west	5	48	10	DF, TF
FD	east	2,3,4	33	9	DF, PP, TF, WH

* The lower value of this range provides for a short-term reduction of stand density for thinning to promote more rapid growth and crown closure. At RD's less than 48 the canopy closure must be a minimum of 70 percent.

DF= Douglas fir; PP= Ponderosa Pine; TF= True fir; WH= Western Hemlock; RHA= Riparian Habitat Area

Dispersal habitat is defined as forested areas which provide at least roosting and foraging conditions for juvenile spotted owls while they move from the natal nest site to unoccupied habitat where they eventually may establish breeding territories. Although dispersal habitat is thought to be an essential ingredient to long-term productive use of landscapes by spotted owls, the types and amounts of forest needed to provide this function are poorly understood. Providing dispersal habitat for spotted owls in the Planning Area is an important component of Plum Creek's HCP for several reasons:

1. Maintenance of dispersal habitat is considered to be critical to reduce the potential for owl sites to become fragmented or isolated in the I-90 corridor, as recommended for non-federal lands in the spotted owl final draft Recovery Plan (Lujan et al. 1992b); the biological goals in the final draft Recovery Plan for spotted owls on non-federal lands in the I-90 corridor in the Western and Eastern Washington Cascades Provinces (Lujan et al. 1992b; pages 117 and 126, respectively) include provisions to provide dispersal habitat between Designated Conservation Areas (DCAs);
2. Incorporating a dispersal habitat strategy in the HCP will complement the success of the Northwest Forest Plan by providing opportunities for spotted owls and other wildlife species to disperse successfully across Plum Creek's lands to colonize the NRF habitat in Late-Successional Reserve and Adaptive Management Areas on adjacent Forest Service lands; and
3. Plum Creek will also, where practicable, set aside small (i.e., less than 5 acres) clumped, areas of older forest which would serve as "stepping stones within the FD habitat" to enhance juvenile dispersal across the Planning Area. These clumped areas may also serve to provide safe zones for juvenile owls for foraging and resting.

Because Plum Creek's Planning Area straddles the Cascade crest and encompasses ecologically diverse forests and environmental conditions, the Company developed two distinct definitions for dispersal habitat for the Planning Area. Plum Creek defined dispersal habitat as habitat that provides minimum stand conditions for foraging and cover for thermal and predator protection. Dispersal habitat is not ascribed any biological value as nesting habitat.

For the West-side of the Cascades and that portion of the East-side containing forests that are structurally similar to those on the West-side (i.e., FMAZ 5), Plum Creek is using a definition of dispersal habitat similar to that used by Murray Pacific Corporation (Beak Consultants, Inc. 1993), which states, "*A thorough review of the scientific literature shows that managed timberlands will provide roosting and foraging habitat when stands have a minimum of 130 coniferous trees per acre with a minimum diameter at breast (dbh) of 10 inches and a minimum canopy closure of 70 percent*."

Specifically, FD habitat (i.e., Douglas fir, Western hemlock, and true fir stands) in upland areas on the West-side of the Cascade crest includes stands with a minimum Quadratic Mean Diameter (QMD) of 10 inches, a minimum Relative Density (RD) of 30-48 (which is equivalent to approximately 175-280 trees of this size per acre), and a minimum canopy closure of 70 percent. The lower RD value in this definition is intended to provide for a short-term reduction in stand density due to periodic thinning to promote more rapid growth and crown closure. FD habitat within RHAs will be maintained at a higher Relative Density (i.e., RD=48) because periodic thinning is not anticipated for areas adjacent to streams.

Plum Creek developed a new definition of dispersal habitat for the East-side of the Cascades (i.e., FMAZ 2 through 4) based on forest characteristics measured on more than 944 plots taken at locations of radio-tagged, breeding adult spotted owls (Hicks and Stabins 1995; Section 2.4). Dispersal habitat in Plum Creek's HCP will include and may replace habitat currently classified by the WDFW as Type C (marginal habitat), and will also include some forest types that are currently not considered owl habitat, but have been documented by Plum Creek as being used by spotted owls, based on radio-telemetry locations taken in the Planning Area (Herter and Hicks 1995a).

Specifically, on the East-side of the Cascade crest, FD habitat (i.e., Douglas fir, Ponderosa pine, and true fir) includes stands with a minimum QMD of 9 inches and an average RD of 33, which is equivalent to approximately 225 trees of this size per acre.

2.5 Forest Health

The major natural occurrences or disturbances in Pacific Northwest forests that can affect forest health are fire, wind (storm events), insects, and disease (Lujan et al. 1992b). Whether these occurrences are minor or catastrophic, they can affect spotted owl and other wildlife population abundance by disturbing habitat and altering the physical environment.

Fire regimes in Pacific Northwest forests are variable (Agee 1981, 1991). Natural fire regimes range from infrequent (i.e., occurring every hundred years) stand replacement fires, to very frequent (i.e., occurring every few years) low-intensity surface fires that have only minor effects on canopy trees. The fire regime can also be described on the basis of fire effects or severity (Agee 1991). For the Pacific Northwest, three levels of fire severity are recognized (Lujan et al. 1992b): high, moderate, and low. Spotted owls occupy forests subjected to all three fire severity types. High severity fires top-kill most of the vegetation in a stand (70 to 80 percent of the basal area); a moderate severity fire top-kills 20 to 70 percent; and a low severity fire top-kills less than 20 percent of the basal area.

Within Pacific Northwest forests, species tolerance to wind is variable. Western hemlock and Pacific silver fir are generally prone to blowdown, Western red cedar and Sitka spruce may be wind-firm, and Douglas fir may be both wind-tolerant and wind-sensitive (Boe 1965; Moore and MacDonald 1974; Henderson et al. 1989). In general, dominant trees in a stand are often more wind-firm than intermediate crown-class trees (Boe 1965; Gordon 1973).

Only a few insect species have a major impact on Pacific Northwest forests. In general, insect species are categorized by their activity in the forest: defoliators, terminal miners, bark beetles, aphids and scale insects, and woodborers. Fewer insect species have a major impact on forests in the Western Cascade subregion than in the Eastern Cascade subregion. In the Western Cascades disturbances from insect infestations are smaller, but on occasion, large epidemics of defoliators occur, mainly in old growth hemlock stands (Furniss and Carolin 1977). Defoliators, such as the Douglas fir tussock moth, spruce budworm, and beetles, such as the mountain pine beetle, red turpentine beetle, and pine engraver beetle, are particularly important in the Eastern Cascade subregion, where infestations can cause tree mortality over thousands of acres (Furniss and Carolin 1977).

Forest diseases in the Pacific Northwest are caused mainly by fungi and dwarf mistletoe. Bacteria, viruses, and nematodes also cause diseases but their effect on forested areas is usually minor (Lujan et al. 1992b). The major diseases in Pacific Northwest forests are categorized as: foliage disease; heart rot or bole decay; stem and branch disease (i.e., canker, rust dwarf mistletoe); root rot; and cone and seed disease.

In Western Cascade subregion forests, root rot, stem decay, and dwarf mistletoe are more important in terms of disturbance to forested stands than insects; foliage disease, stem canker, and rust play only a minor role (Lujan et al. 1992b). In Eastern Cascade subregion forests, root disease, dwarf mistletoe infection, and foliage disease are occasionally important in all age stands. In older stands, butt rot and decay fungi increase in importance. These diseases have considerable influence on forest succession and biological diversity, and diseases can cause a change in species composition in an affected stand (Lujan et al. 1992b).

2.6 Database Development

Plum Creek has developed an inventory system which accumulates information at an individual stand or forest cover polygon level. The system classifies each stand or forest polygon by tree species, size class, and stocking level. In addition, Plum Creek's forest inventory and GIS also contain information on harvesting restrictions resulting from governmental regulations and self-imposed restrictions required by Plum Creek's Environmental Forestry Policies (Appendix 2).

2.6.1 Plum Creek's Forest Inventory and Management Units Pre-Land Exchange

The purpose of Plum Creek's Forest Inventory is to provide the Company with a system that will generate accurate, credible forest inventory information for the development and implementation of strategic and operational resource plans. This inventory has comprehensive databases that integrate existing cruise information with new inventory data to provide timber volume by species and size at all levels. Species, age, size, structure and location of every stand has become critical in forest planning and management. These stands are individually identified and consistently tracked from year to year. This is commonly referred to as an "in-place, stand-level inventory".

The creation of any forest inventory incorporates the collection of extensive detailed data, sophisticated tree models, and growth-and-yield equations. Areas of similar species, size, and stocking have been delineated into relatively homogeneous timber stands. Since it would be virtually impossible to gather information on an entire tree population within a stand, a statistically valid sample of stand characteristics is measured and that information is extrapolated to the entire stand. Sample intensity varies with stand size, stand homogeneity and standard error desired (i.e., variation in the means of plot basal area or volume). Since trees continue to grow, growth models are used to help predict stand parameters in the future. Periodic re-sampling of the same areas is necessary in order to capture major changes in stand structure caused by biotic, abiotic, or mechanical factors.

Plum Creek's January 1, 1994, inventory database was used as the foundation for the creation of operational management units and analysis for this HCP.

Based on Plum Creek's need to manage its properties in a logical, operational manner, Plum Creek subdivided its entire ownership within the Planning Area into "management units". Over 4,000 management units, averaging 42 acres in size, were created for the Plum Creek ownership within the Planning Area. Management unit size ranges from 2 to 110 acres. Each management unit was designed to meet State regulations for harvest prescriptions. Management units were then combined with the forest inventory data to create a new database. This new database was then used by FIBRPLAN (Section 2.7) to simulate harvest and growth.

By combining the forest inventory database into management units, Plum Creek was able to develop an accurate and useful depiction of silvicultural treatments and harvest schedules. By identifying management units, Plum Creek eliminated problems often associated with large inventory polygons, small and scattered inventory polygons, and unrealistic inventory management boundaries. Areas scheduled to be set aside, such as Riparian Management Zones (RMZs) and Upland Management Areas (UMAs), could be treated as unique polygons.

2.6.2 Plum Creek's Forest Inventory and Management Units Post-Land Exchange

The mitigation measures agreed to by Plum Creek to minimize and avoid impacts to species addressed in the HCP (Section 3.6), include actions by Plum Creek to revise and update its forest inventory to obtain more precise information on more acres of Plum Creek owned lands in the Planning Area (Section

3.6.10(35)). Further, the HCP contemplated the need to evaluate stand structure changes in quantity and distribution (Flexibility - Section 5.3.5) and anticipated that future habitat projections may need to be modified as a result of intensive forest inventories completed by Plum Creek during the first two years of the HCP (Section 5.3.3.2).

Plum Creek replaced the January 1, 1994 inventory database with the January 1, 1997 inventory database. The January 1, 1997 database was used as the foundation for the creation of forest inventory polygons and re-analysis of the HCP Planning Area. The new database was re-evaluated using the windows-based, forest estate planning model OPTIONS (Section 2.7). OPTIONS has more capabilities than FIBRPLAN and is used to simulate growth, silvicultural activities, ecological constraints, and harvesting for the large, complex, forest land base.

Based on the Plum Creek's need to manage its properties in a logical, operational manner, Plum Creek subdivided its entire ownership within the Planning Area into forest inventory polygons. Over 5,000 forest inventory polygons, averaging 32 acres in size, were identified for Plum Creek's ownership within the Planning Area. Forest inventory polygons range from 1 to 612 acres. Each polygon was defined by tree species, tree size and stocking information. By using forest inventory polygons, Plum Creek was able to more accurately model existing conditions in the Planning Area. This new database was then used by OPTIONS (Section 2.7) to simulate harvest and growth.

With the change to inventory polygons, the assessment of habitat for Lifeform 4 in talus slope areas had to change to accommodate the new database. For this analysis, the Department of Natural Resources soil type map was overlaid onto the Planning Area stand structure types. If a stand polygon contained at least 20 percent rock or rubble soil types, the stand was included in the search area for Lifeform 4 habitat analysis. Once the land exchange is finalized, a new layer will be developed to more precisely identify stand structures around talus slopes.

2.6.3 Other Landowners' Databases

Plum Creek's objective was to develop a spatially referenced database within the Planning Area for the land that is not managed by Plum Creek. Ownership within the Planning Area includes mainly the Forest Service (218,700 – 237,000 acres) and Plum Creek (130,000 – 148,300 acres). There are about 45,300 acres of other ownership within the Planning Area, including lands owned by the State of Washington, City of Tacoma, Weyerhaeuser Company, and other small private landowners. The Mt. Baker-Snoqualmie and the Wenatchee National Forests provided Plum Creek with information on Forest Service lands in the Planning Area including data provided by the Pacific Meridian Resource Company, vegetation classification data, and some stand examination data. In addition, the City of Tacoma allowed Plum Creek to use its timber inventory information which was compatible with Plum Creek's database. Because spotted owl habitat circles (i.e., 1.8-mile radius circles) in the Planning Area often extended beyond Plum Creek's HCP project boundary, additional polygon data was developed for a 1-mile "buffer area" surrounding the HCP boundary. Over 4,500 management units of other ownership in the Planning Area were created and more than 2,000 management units were created in the 1-mile buffer zone around the HCP boundary. Average stand size among these management units is 54 acres.

2.6.4 Other Landowner Coordination

It is well known that the majority of the species inhabiting the forests and streams in the Planning Area are not restricted to habitats on Plum Creek's lands. For this reason, Forest Service lands and other private ownerships are also integral parts of Plum Creek's strategy to address the overall Planning Area as an ecosystem.

Because of this interrelationship, and the intermingled pattern of ownership, cooperation between Plum Creek and the Forest Service is essential. A cooperative and coordinated effort between Plum Creek and the Forest Service offers unique opportunities to: (1) share information developed in the Planning Area; (2) reduce potential conflicts; and (3) test innovative management options, especially in the Adaptive Management Area, to address multiple species ecosystem-management strategies.

Initial coordination efforts between Plum Creek and the Forest Service have resulted in an exchange of timber inventory, GIS vegetation classification, and structural stand data. Information provided by the Mt. Baker-Snoqualmie and Wenatchee National Forests has provided Plum Creek with an opportunity to assess timber types on adjacent Federal ownership. Plum Creek has agreed to continue to exchange information gathered in the Planning Area with the Forest Service to better evaluate landscapes across ownerships.

2.6.5 Assumptions

Forest Service management of lands in the Planning Area is mandated by their respective Forest Management Plans as amended by the Northwest Forest Plan and the Snoqualmie Pass Adaptive Management Area (SPAMA) Plan. The applicable sections of both plans are as follows:

> Record of Decision for the Northwest Forest Plan, USFS, April 13, 1994, page 8:
>
> Late Successional Reserves: Late-successional reserves are to be managed to protect and enhance old-growth forest conditions. For each late-successional reserve (or group of small reserves) managers should prepare an assessment of existing conditions and appropriate activities. No programmed timber harvest is allowed inside the reserves. However, thinning or other silvicultural treatments inside these reserves may occur in stands up to 80 years of age if the treatments are beneficial to the creation and maintenance of late-successional forest conditions. In the reserves East of the Cascades and in Oregon and California Klamath Provinces, additional management activities are allowed to reduce risks of large-scale disturbance. Salvage guidelines are intended to prevent negative effects on late-successional habitat. Non-silvicultural activities within late-successional reserves are allowed where such activities are neutral or beneficial to the creation and maintenance of late-successional habitat.
>
> Record of Decision for Snoqualmie Pass Adaptive Management Area Plan, USFS, November 21, 1997, page 6:
>
> Silvicultural Treatments and Forest Commodities - At this time, the standards and guidelines of the Late-Successional Reserves (NWFP) apply to silvicultural treatments within the AMA. There will be no programmed harvest within the AMA; however, thinning and other silvicultural activities may occur, provided that the treatments are beneficial to the creation and maintenance of the late-successional forests. On the Western slopes of the Cascades Crest, the maximum stand age within which treatments can occur is 80 years of age. East of the Cascades Crest, there is no age limitation, but treatments will focus on younger stands. The types and locations of treatments to be carried out will be determined as a part of subsequent site-specific NEPA analysis. Since this area is allocated as an AMA, the results of monitoring and research will be used to adapt and change these standards and guidelines over time, while maintaining the focus on late-successional habitat and connectivity objectives.

The above guidelines preclude harvest in LSR and the SPAMA, to reduce impacts to late-successional habitat, but the guidelines allow silvicultural treatment to enhance habitat. Discussions with staff from both National Forests indicate that harvest in Matrix areas is likely to be low, but any harvest that does occur would emphasize habitat enhancement. Models for projections over time could not replicate habitat enhancement. Therefore, the growth and yield model runs conducted by Plum Creek for Forest Service lands assumed no harvest in LSR, AMA, and Matrix areas during the HCP Permit period. This approach understated the habitat, which would result from habitat enhancement activities.

2.7 Forest Estate Planning

FIBRPLAN is the forest estate planning model that was used in the Pre-Land Exchange HCP to project changes that will occur, over time in a forest as a result of various harvest levels and silvicultural applications (Figure 13). Specific forest inventory information used in FIBRPLAN was generated from Plum Creek's inventory system (described in Section 2.6.1; HCP) for each management unit. FIBRPLAN operates in an MS/DOS environment and was replaced by the OPTIONS forest estate planning model which is Windows-based.

OPTIONS performs basically the same functions as FIBRPLAN with some enhancements (Figure 13 also applies for OPTIONS). It is a forest estate simulation planning model with the capabilities of simulating growth, silvicultural activities, ecological constraints, and harvesting for large, complex forest landbases. By using OPTIONS, multiple combinations of forest-management and silvicultural applications (e.g., harvesting, planting, fertilization, and thinning) can be evaluated across the Planning Area and over any given time period for up to 999 years.

OPTIONS requires specific forest inventory information as well as growth and yield data in order to project changes that will occur over time in a forest as a result of various harvest levels and silvicultural applications. Specific forest inventory information used in OPTIONS is generated from Plum Creek's Inventory System described above for each forest inventory polygon. Inventory data obtained for other ownership's (i.e., Forest Service) in the Planning Area and used in OPTIONS is described in Oliver et al. (1995). OPTIONS uses inventory data to profile current forest landscapes in the Planning Area and to establish a basis for predicting the characteristics of future stands. The growth model, Stand Projection System (SPS), is used to create the growth and yield tables that OPTIONS uses to predict future stand characteristics. The growth and yield curves used by OPTIONS depict how a particular stand will grow and develop over time. OPTIONS uses yield tables for each defined tree species group and site index, allowing different tree species in different growing conditions to develop independently. The species and site-specific growth curves are then linked with current inventory stand data and exported into OPTIONS to profile forest landscapes in the Planning Area.

The landbase data, used in OPTIONS, is comprised of the forest inventory polygons described in Section 2.6.2 of the HCP. During the course of the simulation, each forest inventory polygon is updated yearly for growth, silvicultural treatments, insect infestations, diseases, blowdown, and other forest-related factors, according to user-defined rules. As each forest inventory polygon reaches the minimum age or criteria for thinning or harvesting, it is automatically placed into a harvest queue. After all records are updated, stands in the harvest queue are harvested according to a harvest schedule based on species and wood type priority, subject to availability due to ecological and habitat considerations. Wood types are defined as thinnings, second growth, and mature stands.

The model provides for accurate planning and is easily adapted when external factors such as forest health or market conditions necessitate changes in management plans. Consideration of other forest resources such as watersheds or wildlife may also necessitate altering timber management goals (e.g., harvest schedule, rotation length, and/or silvicultural treatment levels).

In addition to commercial thinning and even-aged timber harvesting, various types of selective harvesting can also be defined for each simulation run. In all simulation runs, selective harvests are treated as special types of thinning which can only be performed on forest inventory polygons that have either reached or exceeded the defined rotation age.

All common silvicultural treatments are available for inclusion in an OPTIONS scenario. For simplicity, all potential treatment methods are grouped into five general treatment types: (1) Regeneration; (2) Pre-commercial thinning (PCT); (3) Fertilization; (4) Commercial thinning; and (5) Genetics. Each individual treatment definition includes treatment specifications for each species group and site class. Thus, complex silvicultural and management regimes can be devised by using combinations of different treatments.

OPTIONS runs can be specified for any length of time up to 999 years. While running, the model produces “files” which are updated continuously, allowing reports and graphs to be produced on an annual basis.

Under the processing rules established for OPTIONS, the user can (1) specify yield tables for each management regime and for each model run, (2) specify threshold values (i.e., minimum recoverable commercial volumes) for commercial thinning and selection harvests, and (3) specify ecological rules/constraints that will be included in each scenario.

Ecological constraints can be complex under OPTIONS. For example, up to 25 categories of ecological constraints can be included within a single scenario. Constraints can be applied to individual stands, partial stands, or to many stands depending upon the type of constraint and its application. Rules of application can be applied to each constraint category, and its subsequent resultant effects on each individual treatment stand or neighboring stands can be evaluated. In addition, each constraint category can be specified with single- and multi-year disturbance rules. This capacity enables the model to effectively address issues at stand levels, watershed levels, and at landscape unit levels; while addressing effects on biodiversity and visual-quality objectives.

OPTIONS tracks all activities which occur on each individual forest inventory polygon. These activities are linked to a GIS database for visual display and further analysis. Management activities on each management unit can be controlled by a variety of factors including economic limitations, budget constraints, and ecological constraints.

A habitat evaluation model was developed to use output from OPTIONS to determine stand structure and corresponding habitat classifications for each management unit at any point in time. Output from each OPTIONS scenario is run through this model to summarize stand structure changes, and therefore habitat classification changes, over time. Stand structure parameters, output from OPTIONS, are linked to a stand structure classification model, which is linked to GIS for visual display of habitat classification changes.

2.8 Geographical Information Systems

Both ARC INFO and PAMAP GIS systems were used to integrate management unit databases and output data from OPTIONS to display graphically habitat information and provide spatial analysis. Much of the analysis was accomplished using the “overlay” capabilities of GIS to test a variety of hypotheses and perform sensitivity tests to a variety of assumptions and alternatives.

To help assess and display the habitat conditions for the section 10(a) Permit species, OPTIONS, linked to GIS, is being used to generate maps of future forest types. GIS is also being used to graphically depict future forest conditions at any point in time and assess habitat conditions for all Lifeforms (Section 2.10.7) included in the HCP.

Forest Service land and other ownership in the Planning Area has been similarly classified to allow landscape assessments across ownerships. Plum Creek will continue to evaluate the long-term availability of landscapes that provide adequate habitat for listed and unlisted species across ownerships in the Planning Area, and include a summary of each evaluation to the Services. Plum Creek will continue to provide this information to the Forest Service and Services to coordinate and assist the Services in their evaluation of Plum Creek's forest harvest schedules and silvicultural treatments (i.e., thinnings) that provide multi-layered habitat for multiple species in the Planning Area.

2.9 Resource Selection Probability Function Model

Using logistic regression analysis, Plum Creek estimated Resource Selection Probability Functions (RSPF) for an array of 0.7-mile concentric analytical circles or "moving windows" across the Planning Area (Irwin and Hicks 1995). Use of the 0.7-mile "moving window" does not imply that owls only require that amount of habitat to meet their life requirements. Rather, it was the analysis radius which provided the greatest level of discrimination between occupied and unoccupied sites. The process provides Plum Creek with an assessment of the size of landscape analytical unit that has the greatest statistical reliability for predicting the probability that any forest site is spotted owl habitat. Analysis of the RSPFs indicated that spotted owls are distributed non-randomly across the Planning Area landscape, and distributions vary with respect to available NRF habitat, topographic variation, and fire management analysis zone (FMAZ).

This RSPF model provides a data-driven mechanism for defining activities that may impact spotted owls via changes in vegetation, in association with data on physical environmental factors at a scale relevant to the biology of individual owls. The procedure also provides a means of estimating annual or decadal impacts to owls in all 418,900 acres in the Planning Area within the 50-year Permit period. This is possible through the use of GIS to integrate habitat for spotted owls with proposed timber harvest schedules for specified management areas and forest growth models such as OPTIONS (Section 2.7), that forecast the regrowth of NRF habitat from FD habitat. Thus, the process provides a means for not only tracking impacts of habitat losses, but it also accounts for habitat gains that result from forest growth. Similar types of analyses and habitat suitability techniques are being used to evaluate the suitability of habitat for all species covered in the HCP.

2.10 Species in the HCP

2.10.1 Northern Spotted Owl

2.10.1.1 Literature Review

Northern spotted owls are found primarily in northern California and the Pacific Northwest. They are medium sized owls, chocolate brown in color, with a round head and oval white spots on the head and body feathers, and white mottling on the breast and abdomen (Johnsgard 1988). Other common distinguishing features are dark eyes surrounded by tawny-colored facial disks. The northern spotted owl is one of three subspecies of spotted owls recognized by the American Ornithologists Union (AOU 1988). The other two subspecies are the California spotted owl (*S. o. occidentalis*) and the Mexican or Arizona spotted owl (*S. o. lucida*).

2.10.1.1.1 Age Characteristics

Spotted owls have an average life span of eight years in the wild (Thomas et al. 1990), but some may live as long as 15 to 20 years (Miller 1989). Plumage characteristics can be used to distinguish between several age classes of spotted owls. Newly hatched owlets are sparsely covered with white natal down feathers. After about 10 days, soft, buffy pale brown feathers with darker brown transverse barring begin to replace the natal down feathers (Forsman 1981). Birds with such plumage are referred to as juveniles (Franklin et al. 1990a). In about five months juveniles acquire plumage similar to that of adults except the tail feathers are white and sharp-tipped (Forsman 1981). Two subsequent age classes can be recognized. Subadults that are one year old have a downy tuft at the tip of the pointed tail feathers, which is lost during the bird's second year (Moen et al. 1991). Adults (i.e., more than 26 months old) exhibit rounded tips on the tail feathers, which are usually mottled in color.

2.10.1.1.2 Range and Distribution

The range of any species is that general geographic area within which the species may occur. The northern spotted owl is found from southern British Columbia, Canada, south to Marin County, California (Lujan et al. 1992b). They range East through this area to the edge of the Palouse prairie in Washington and the Great Basin shrub steppe in Oregon and California. Although spotted owls are found throughout this general range, their breeding distribution is restricted to forest communities. They occur from sea level to 7,500 feet in the southern portion of their range, and to approximately 4,000 feet in elevation in the northern part of their range. Densities of owls vary considerably across this broad range according to habitat type, quality, and quantity (Thomas et al. 1990). The current distribution of known spotted owl sites within Washington State is shown in Figure 14.

2.10.1.1.3 Home Range

Based on radio telemetry studies, summarized by Thomas et al. (1990), the home range of individual spotted owls is generally believed to exceed 2,000 acres and have widely variable habitat requirements within the boundaries. The minimum home range reported in the Western Cascades Physiographic Province in Washington (Thomas et al. 1990) is 2,969 acres; the maximum is 17,942 acres; and the median is 6,657 acres. The sample sizes used to estimate home ranges were small, however. In contrast, in the Olympic Peninsula Physiographic Province, the minimum reported home range is 4,497 acres; the maximum is 27,309 acres; and the median is 14,271 acres. It is unknown whether this variation is related to latitude, habitat, individuals, temporal, or prey-based variations, but the extremely wide variation in the reported size of the home range and the paucity of data leave a great deal of latitude for subjective interpretation. Several studies have reported correlations between home range size and total area of old growth (i.e., more than 200 years old) forest (Sisco and Gutierrez 1984; Gutierrez 1985) or mature/old growth forests (Solis 1983) within the home range. Forsman et al. (1984) suggested that owls may compensate for sparse coverage of old growth forests by increasing the size of the home range to include more old growth area. However, this research was conducted in areas with only limited amounts of intermediate-aged forests, which effectively forced the owls to select mainly between old growth or clear-cuts. Thomas et al. (1990) calculated the median amounts of old growth and mature forests in the home ranges of spotted owls. They found that the amounts of old growth and mature forests per home range vary between 615 to 4,579 acres.

From the information provided to date, some generalizations can be made about home range characteristics for the spotted owl: (1) all studies of home range support Forsman's (1980) original observation of a relatively large home range size. However, results of these studies need to be evaluated in terms of their low sample sizes; (2) there is a large degree of overlap in home range areas between members of the same pair (Forsman et al. 1984; Solis and Gutierrez 1990) and lesser overlap among adjacent pairs (Forsman et al. 1984); (3) there is considerable geographic variation in home range size with owls occupying the Olympic Peninsula exhibiting the largest home ranges (Thomas et al. 1990); (4) home range size increases as the amount of old growth forest within the home range decreases (Carey 1985; Forsman et al. 1984; Thrailkill and Meslow 1990).

2.10.1.1.4 Roosting

Roosting habitat for spotted owls has been described by Forsman (1976); Barrows and Barrows (1978); Forsman (1980); Solis (1983); Forsman et al. (1984); Chavez-Leon (1989); Sisco (1990); and Blakesley et al. (1990). Roost sites are typically areas of relatively dense vegetation, with high canopy closure dominated by large diameter trees. During the summer, roost sites are usually cool, shady spots near streams or are on the lower third of slopes (Forsman 1976; Solis 1983; and Blakesley et al. 1990). All studies that reported separate data for roosting habitat found strong selection by spotted owls for roosting in old growth forests. In the Oregon Cascades and Coast Range, Forsman (1980) and Forsman et al. (1984) described attributes of roost trees. They found that roost site location was influenced by weather, with owls using large trees (i.e., 20 to 70 inches DBH) in the forest overstory during cool or wet weather, and small trees in the forest understory during warm weather. Based on these observations, Forsman et al. (1984) suggested that spotted owls appear to prefer old forests in which a layered canopy structure provides a range of roosting microenvironments.

2.10.1.1.5 Foraging

Within a given geographical region, spotted owl foraging habitat is more extensive and variable than either nesting or roosting habitat. Spotted owl foraging habitat is characterized by high canopy closure and complex structure (Lujan et al. 1992a).

Spotted owls are primarily nocturnal predators (Bent 1938) and, like other nocturnal owls, they possess three primary adaptations for night life: (1) exceptional eyesight; (2) exceptional hearing; and (3) modified feathers to facilitate silent flight (Payne 1971; Konishi 1973; Clark et al. 1978; Martin 1986). Spotted owls are perch-and-pounce predators (Forsman 1976). Owls select a perch and attempt to locate prey by either sight or sound; once prey is detected, they try to capture it with their talons. Because of their capability for silent flight, spotted owls can fly close to prey without being detected. Spotted owls can capture arboreal (i.e., living in trees) or terrestrial (i.e., living on the ground) prey. In addition, spotted owls will on occasion exhibit “hawking” behavior (i.e., capturing flying prey).

Although spotted owls consume a broad range of prey types, they primarily take small mammals (Barrows 1980, 1985, 1987; Solis 1983; Forsman et al. 1984; Layman 1988; Richards 1989). Predominant prey species include northern flying squirrels (*Glaucomys sabrinus*) and woodrats (*Neotoma fuscipes* and *N. cinerea*). One of these species usually dominates the diet in an area, and this regional variation in diet is probably related to prey preference and the distribution of the prey species. In other words, prey preference can influence habitat selection. An example of this is owl use of young redwood stands in northern California because woodrats (preferred prey item of owls in northern California) prefer the low, dense cover of younger forest stands. In the Western Washington Cascade Region, spotted owls prey mainly on flying squirrels, but East of the Cascade crest, bushy tailed woodrats are also a common prey item.

Populations of spotted owls in the Plum Creek ownership, especially those found in the Eastern Cascade forests, may be related more to the periodic, recurrent, or sporadic fluctuations in prey abundance and availability than to a certain number of acres of habitat. Whatever stability there is in the prey population of the owls, it is not likely to be a static equilibrium, but rather a fluctuating or dynamic one, and perhaps a highly fluctuating one (Fretwell 1972). The interplay among predator/prey populations (i.e., spotted owl/ flying squirrel/ woodrat) is an important variable; however, the causal link between prey availability and habitat structure and composition needs to be addressed before a more accurate estimation of spotted owl population dynamics can be constructed.

2.10.1.1.6 Nesting and Breeding

The central unit of a spotted owl's life cycle is its functional territory. A functional territory is occupied by a pair of reproductively active birds (Lujan et al. 1992a) and is a defended territory. Both males and females defend the territory through vocalization and visual displays. These territories are thought to be smaller than the home range, but the exact relationship between the defended territory and home range is unknown and probably varies seasonally.

Spotted owls often form long-term pair bonds (Forsman et al. 1984). Pair bonds do occasionally break down, or death of a mate may occur resulting in unattached individuals called "floaters". Several behavioral patterns occur commonly among spotted owls which probably serve to reinforce pair bonds. For example, spotted owls exhibit relatively strong habitat territoriality during the breeding season. The role of territoriality during the breeding season may be behavioral, isolating mating adults to strengthen pair bonds. Similarly, "calling" serves to strengthen pair bonds especially during nest site selection and prey delivery to the female. Courtship feeding by the male is common during the early part of the nesting cycle (Forsman 1976). Finally, physical contact, as exemplified by mutual preening of feathers, also serves to strengthen pair bonds (Forsman and Wight 1979).

The nesting cycle begins in late winter or early spring (i.e., late February to early March). Spotted owls often breed as subadults, but subadults typically fledge fewer young than adults (Franklin et al. 1990a); and females are more likely to breed as subadults than are males (Miller 1989). Initially, pairs begin to communicate and roost together near the eventual nest site. Rather than build their own nest, spotted owls often modify existing structures. Five types of nest structures are used: broken treetop cavities, lateral tree cavities, abandoned raptor stick nests, large horizontal branches, and debris platforms including mistletoe clumps. Pairs have been observed reusing the same structure in subsequent years (Forsman et al. 1984). Initiation of laying is dependent upon the physical condition of the female, the availability and abundance of prey, and the ability of the male to capture sufficient prey (Lujan et al. 1992a). Once a pair is committed to nesting, the female lays her clutch of eggs (usually two eggs), and incubates and broods the young for about 30 days usually without assistance from the male. The male provides sufficient food to the female so that she need not forage (Forsman 1984).

Once the young have hatched, the juveniles remain for 3 to 5 weeks before leaving the nest. The young owls are fed and tended by one or both adults until they disperse in early fall (i.e., late September or early October). Following the dispersal of the young birds, adults roost together less frequently and begin to expand their range (Lujan et al. 1992a).

2.10.1.1.7 Reproductive Success

Recent studies suggest that reproductive success among spotted owls may vary between geographic areas (Carey 1985) and years (Forsman 1988; Franklin et al. 1990a). Furthermore, the number of pairs attempting to nest annually varies from 40 to 60 percent of the total potential breeding pairs (USDI 1990). However, in some years almost complete breeding failures have been noted (Barrows 1985), and the numbers of young fledged per pair also may vary substantially from one year to the next (Miller 1989).

Studies on survivorship of juveniles have shown that survival rates for this age class are low; the chance of a juvenile living through its first year have been reported to be between 5 and 29 percent relative to the adult survival rate (Thomas et al. 1990). The rigors of dispersal and inexperience (e.g., poor hunting skills, lack of familiarity with a territory) are most likely responsible for the higher mortality rate.

2.10.1.1.8 Dispersal

Dispersal, the process of leaving one area to establish a new home range in another area, is undertaken by both juvenile and adult spotted owls. A great deal more is known about the process and pattern of juvenile spotted owl dispersal than of adult dispersal (Gutierrez et al. 1985; Miller and Meslow 1985; Miller 1989).

Dispersal of juvenile spotted owls from their natal areas usually begins in September and October once the young birds have attained adult body size (Gutierrez et al. 1985; Miller 1989). Initial dispersal is usually rapid, in random directions (Gutierrez et al. 1985), and distances traveled vary between 9- and 30-miles (Gutierrez et al. 1985; Miller 1989). Studies have suggested that juveniles use a wide variety of habitat and forest types during dispersal (Gutierrez et al. 1985; Miller 1989). During the dispersal phase, juvenile survival rate is low (Gutierrez et al. 1985; Miller 1989). At this time, the young birds are particularly vulnerable to starvation (Miller 1989) and predators such as the great horned owl (*Bubo virginianus*) (Forsman et al. 1984; Miller 1989) and the goshawk (Miller 1989). Adult spotted owls are known to leave mates or move from established territories, but the causes for adult dispersal events are unknown.

2.10.1.2 Habitat Characteristics

The most controversial aspect of the life history of the spotted owl is habitat requirements. Most observations of spotted owl habitat use have been made in areas having a component of old growth and mature forests (Solis 1983; Forsman et al. 1984; LaHaye 1988; Sisco 1990; Ward 1990; Thomas et al. 1990). However, observations of spotted owl use of managed (i.e., previously harvested) stands have been reported (Diller 1989; Kerns 1989; Pious 1989); and spotted owls have been reported to occupy young managed stands (Forsman et al. 1977; Forsman 1988; and Hays et al. 1989). Results of most studies conducted on habitat use by spotted owls suggest that, in general, old growth forests are superior habitat for spotted owl nesting, roosting and foraging; mature stands are less suitable habitat than old growth; young stands provide marginal habitat; and clear-cuts and young plantations are unsuitable habitat.

Spotted owls are known to nest, roost, and forage in a wide variety of habitat types and forest stand conditions. For example, spotted owls use Western hemlock, mixed conifer, Douglas fir, redwood, Douglas fir/hardwood, evergreen/hardwood, Ponderosa pine, Western redcedar, and other forest types in different parts of their range. Spotted owls appear to prefer mature and/or old growth forest stands (Forsman 1980; Solis 1980; Carey et al. 1990), for nesting (LaHaye 1988; Blakesley et al. 1991), roosting (Solis 1983; Sisco and Gutierrez 1984; Blakesley et al. 1991), and foraging (Solis 1983; Sisco and Gutierrez 1984; Carey et al. 1990; Forsman 1988; Thomas et al. 1990). However, it is unclear how strong the causal link is between mature and/or old growth forest stands and nesting, roosting and foraging habitat, and spotted owl reproductive success. In fact, few studies have linked habitat suitability with reproductive success. This is an important issue since the causal link between habitat suitability and reproductive success may be central to determining if habitat modification will disrupt essential spotted owl behavior or result in a significant decline of the species' population.

Summaries by Forsman (1988), Thomas et al. (1990), and USDI (1990a) suggest that the structural characteristics of suitable habitat for spotted owls include:

1. A multi-layered, multi-species canopy cover open enough (60 to 80 percent canopy closure) to allow owls to fly within and beneath it;
2. An overstory dominated by conifers greater than 30 inches DBH and understory of shade-tolerant conifers or hardwoods;
3. Trees with features such as cavities, broken tops, or dwarf mistletoe growth;
4. Numerous large snags; and

5. Ground cover of logs and wood debris.

2.10.1.3 Factors Affecting Population Dynamics

2.10.1.3.1 Survivorship

Spotted owls die from a wide variety of causes. The most frequent cause of death is predation by other animals (Lujan et al. 1992a). Other causes of mortality include accidents (i.e., flying into objects) (Gutierrez et al. 1985) and starvation (Gutierrez et al. 1985; Miller 1989). Starvation occurs most frequently among juvenile spotted owls (Sisco 1990).

Juvenile and subadult survival rates are lower than those of adults. Annual survival rates of adults are relatively high. Overall, the probability of an adult spotted owl living from one year to the next is 81 to 96 percent (Barrowclough and Coats 1985; Lande 1985; Franklin et al. 1990a; Thomas et al. 1990).

2.10.1.3.2 Predation and Competition

Key predators of spotted owls include the great horned owl, northern goshawk, and red-tailed hawk (*Buteo jamaicensis*) (Lujan et al. 1992a). Among these predators, the great horned owl is the most common predator of the spotted owl (Miller 1989). Great horned owls have become more abundant throughout much of the range of the northern spotted owl; however, habitat differences between the two species make it difficult to measure the severity of this threat to the spotted owl. Although these two species commonly share similar habitat, the great horned owl tends to forage in more open habitats than those used by the spotted owl. Northern goshawks also prey on adult and juvenile spotted owls (Forsman et al. 1984; Gutierrez et al. 1985; Miller 1989). Nevertheless, spotted owls will nest within a goshawk territory, and will defend their young against attacks by goshawks (Forsman et al. 1984). For this reason, Lujan et al. (1992a) suggested that goshawks are probably not serious threats to spotted owl populations.

Competition can be a serious problem for any species when an “exotic” species of similar body size and ecological requirements invades its habitat. The recent invasion of the barred owl (*Strix varia)* into the range of the spotted owl is a potential example of interspecific competition. Barred owls are larger and more aggressive than spotted owls. They also feed on a broader array of prey items, occupy a wider range of habitat types, and have smaller annual home ranges than do the spotted owls (Hamer 1988). Furthermore, barred owls are known to have displaced spotted owls from some territories (Lujan et al. 1992a). Based on this information, Lujan et al. (1992a) concluded that barred owls are a serious competitive threat to spotted owls. In addition, hybridization between the two species has been documented. Vincent (1990) expressed concern about the recent invasion of barred owls and the potential effect of hybridization on the integrity of the spotted owl as a species.

2.10.1.3.3 Disease and Parasitism

Relatively little is known about the effects of diseases and parasites on spotted owls. Gutierrez (1989) conducted a survey of hematozoan parasites among all three subspecies of the spotted owl. He reported that five of the six hematozoan species were found in the northern spotted owl and the infection rate (100 percent) was one of the highest by these parasites recorded among birds (Greiner et al. 1975). Lujan et al. (1992a) suggested that spotted owls must be highly adapted to carry these high parasite loads because their survival rates are high despite high infection rates. In a study of infection levels by round worms, flat worms, and spiny-head worms in 20 spotted owls, Hoberg et al. (1989) found that more than 80 percent of the birds were infected with at least one worm species, and multiple infections were common. Infestation of nests and owlets by parasites may cause severe trauma to the young birds (Lujan et al. 1992a), but the overall effect of external and internal parasites and diseases on spotted owl survival, growth, and reproductive capacity is unknown.

2.10.1.3.4 Habitat Loss

By the early 1980's more than 80 percent of old growth forests in the Pacific Northwest had been removed (Booth 1991). Although not all old growth forests are suitable spotted owl habitat (e.g., high elevation forests), the 7.6 million acres of habitat that remain today are thought to represent only a small portion of the area formerly occupied by spotted owls (USDA 1991).

According to Thomas et al. (1990), remaining suitable spotted owl habitat is not distributed evenly over the range of the species. Habitat reduction has been greatest in low elevations in Oregon and Washington, and remaining populations of spotted owls are considered low in these areas. Remaining habitat at higher elevations may be of lower quality than that historically present at lower elevations (Thomas et al. 1990). Thus, the approximately 50 percent of remaining spotted owl habitat currently in federally reserved areas or in areas unsuited for timber harvest may not contribute proportionately to spotted owl productivity, because these lands are located at higher elevations.

2.10.1.4 Plum Creek's Spotted Owl Surveys

Plum Creek has supported surveys and research on the spotted owl since 1982. Most of the surveys and research projects were started in 1990, just prior to listing of the owl under the ESA in July 1990. Plum Creek has conducted geographically extensive surveys as a response to agency recommendations and as part of the Company's Environmental Forestry policies in an effort to protect potential spotted owl habitat. A comprehensive discussion of Plum Creek's spotted owl surveys and research projects, including typical survey methodologies, is provided in Herter and Hicks (1995a).

2.10.1.4.1 Spotted Owl Surveys in the Planning Area

Plum Creek conducted its first spotted owl survey in 1982 in connection with a land exchange between Plum Creek and the Forest Service in the Taneum and Manastash Creek drainages. Spotted owls were detected in both drainages. Following this initial effort, only occasional spotted owl surveys were conducted prior to 1990. In 1990, systematic project-level surveying for spotted owls began. A total of 30 project areas were surveyed in 1990 on Plum Creek's lands in the Planning Area, and spotted owls were detected at five of the 30 sites.

Following listing of the spotted owl in 1990, the DNR recommended that Plum Creek conduct more extensive surveys if harvest units or roads were proposed within 1.8-miles of a known spotted owl site center in the Washington Cascades (DNR spotted owl memo #3). Beginning in 1991, extensive surveys within the 1.8-miles circles around an owl site center were initiated by Plum Creek in the Planning Area. All surveys for spotted owls in the Planning Area were conducted in accordance with guidelines endorsed by the Services (USFWS 1991), as described in: *Protocols for Surveying Proposed Management Activities that May Impact Northern Spotted Owls*. The cumulative area that has been surveyed in the Planning Area, following FWS two-year protocols, by the end of the survey season in 1994 is shown in Figure 15. Approximately three-fourths of the HCP planning, which included about 90 percent of the current spotted owl habitat in the Planning Area has been intensively surveyed.

2.10.1.4.2 Spotted Owl Ecology in the Planning Area

Distribution — The spotted owl occurs throughout the Planning Area, spanning the East-west range of the species in the central Washington Cascades (Figure 14). Some owl site centers occur immediately West and East, and outside of the Planning Area. The region West of the Planning Area contains some potential spotted owl habitat, especially in the lower elevations along the Green River, but forests in this area have been harvested heavily during the past few decades and habitat is often fragmented. Farther to the north, in the Cedar River and Snoqualmie River drainages, there are moderately-sized forested areas containing adequate owl habitat. To the East of the Planning Area, in the lower elevation Ponderosa pine forests, there are areas of adequate spotted owl habitat. However, these forested areas have been harvested heavily in recent decades and remaining habitat is often patchy.

Connectivity of spotted owl populations north and south of the I-90 corridor has been raised as a major concern in the local area. Because of the relatively large amount of survey work conducted by Plum Creek, spotted owl densities in the area are known to be greater in this area than in regions north and south of the I-90 corridor (Figure 15). Overall, there does not appear to be a general constriction in the range of the spotted owl in the I-90 corridor, which suggests that the connectivity between spotted owl populations north and south of the I-90 corridor is being maintained. In fact, spotted owl planning circles (i.e., 1.8-mile radius) overlap in two areas that cross the I-90 corridor. The first is near Humpback Creek West of the Cascade crest, and the second is near Easton Ridge, East of the Cascade crest. The presence of high volcanoes to the south (e.g., Mt. Rainier, Mt. St. Helens, and Mt. Adams) may create greater natural breaks and separation among spotted owl populations than current conditions in the I-90 corridor. Similarly, the expanse of high, barren country in the North Cascades National Park and Glacier Peak Wilderness Area to the north of the I-90 corridor may create another region where owl habitat is naturally disjunct.

Within the Planning Area, spotted owls occur in varying densities, presumably in response to variable habitat availability and quality and prey availability (Figure 16). Site centers containing breeding pairs occur generally at higher densities in the Eastern portion of the Planning Area. Overall, the density of owls is lowest in the far southwest, far West, and north-central portions of the Planning Area, presumably due to insufficient habitat in these areas. Although 107 site centers have been identified in or near the Planning Area, only 67 site centers are on Plum Creek’s ownership in the Planning Area (Figure 17).

Demographics — From 1979 to 1989, spotted owl pairs and single owls located during a survey in the Planning Area were monitored irregularly for data on nesting and productivity. In fact, no owl sites were checked annually, on a regular basis, until the late 1980’s when Forest Service district biologists attempted to locate and monitor specific owl pairs yearly.

Beginning in 1989 in the Eastern Cascades, and 1991 in the Western Cascades, Plum Creek and the Forest Service initiated regular monitoring of known owl sites. Since the beginning of the monitoring program, most known owl site centers, with Status ratings of 1, 2, or 3 (Status 1 - owl pair; Status 2 - two owls, pair status unknown; Status 3 - resident single owl), have been surveyed and monitored in accordance with USFS-PNW demography monitoring protocols. The status of 104 of the known 107 spotted owl site centers, located in or near the Planning Area, that were monitored between 1990 and 1994, are summarized in Herter and Hicks (1995a).

More than 95 percent of the spotted owls encountered during surveying and monitoring in any one year were captured and banded with individual numbered leg bands and color bands. A summary of spotted owl sites containing banded birds, with the history of occupancy, nest status, number of young produced, and turnover of adults is shown in Herter and Hicks (1995a). Site centers that have contained at least one banded bird of the total 107 site centers are shown in Herter and Hicks (1995a). These data represent the core group of sites that have been active in the recent past and these are the sites used in the analysis of owl productivity.

Populations of spotted owls in the Cascade range can be placed into two groups based on geography and demographic variables. Owls on the West-side of the Cascade crest (and those owls just East of the crest in Douglas fir/western hemlock habitat) appear to have lower productivity levels (i.e., they nest usually every other year (Table 7), have higher nest failure rates, and raise at most one or two young), but adults may live longer than their counterparts in the East-side of the crest. Owls on the East-side of the crest (occupying Douglas fir/ grand fir and Douglas fir/ Ponderosa pine associations) tend to have higher productivity levels (i.e., they often nest every year, have lower nest failure rates, and may raise up to three young), but they appear to suffer higher mortality (juveniles and adults) (Table 7). Productivity of spotted owls, based on nesting data, from 1991 through 1994 is shown in Herter and Hicks (1995a).

Productivity of spotted owls in the Planning Area is comparable to neighboring study areas. Table 8 provides standard productivity estimates (based on females) for spotted owls in the Planning Area. For most measures, productivity in the Planning Area is slightly lower than that of the adjacent USFS-PNW Cle Elum study area. This difference is due primarily to lower productivity of the West-side owls. If West-side and East-side owls are measured separately, productivity measures for East-side owls are very similar to the productivity measures reported in the USFS-PNW Cle Elum study area, and productivity measures exhibited by West-side owls is similar to the productivity measures reported in the USFS-PNW study for owls on the Olympic Peninsula.

During three of the four years of intensive demographic study in the Planning Area, the percentage of adult spotted owls unaccounted for from one year to the next is variable, ranging from 8 to 31 percent (Table 9). Predation (most likely from larger raptors such as great horned owl and northern goshawk), disease, advanced age, and accidents are the most likely causes of death among adult owls. Low prey abundance and subsequent starvation may also be an important, although less frequent, cause of death among adult owls.

Table 7. Spotted Owl Productivity in the Planning Area from 1991 through 1994

Year — Area	Number of Sites	Number of Nests	Percentage Nesting	Number of Fledglings
1991 west	17	4	24	4
east	45	22	48	30
Total	**62**	**26**	**42**	**34**
1992 west	26	12	46	14
east	54	36	67	48
Total	**80**	**48**	**60**	**62**
1993 west	26	0	0	0
east	58	4	7	4
Total	**84**	**4**	**5**	**4**
1994 west	26	9	35	9
east	59	30	51	45
Total	**85**	**39**	**46**	**54**
Note: West = West of the Cascade Crest; East = East of the Cascade Crest				

Table 8. Standard Productivity Measures of Female Spotted Owls in the Planning Area from 1991 through 1994

Year	Proportion of Females Nesting[1]	Proportion of Females Fledging Young[2]	Proportion of Nesting Females Fledging Young[2]	Fecundity[3]	Mean Brood Size[2]
1991	0.606 (20/33)	0.511 (22/43)	0.700 (14/20)	0.430 (18.5/43)	1.682 (37/22)
1992	0.918 (45/49)	0.661 (37/56)	0.688 (31/45)	0.580 (32.5/56)	1.757 (65/37)
1993	0.068 (3/44)	0.059 (3/51)	0.666 (2/3)	0.039 (2/51)	1.330 (4/3)
1994	0.800 (36/45)	0.585 (31/53)	0.750 (27/36)	0.547 (29/53)	1.871 (58/31)

[1] Includes females at sites where nesting was determined by June 15.
[2] Includes females at sites where nesting was determined by June 15, and number of young fledged was determined by August 31.
[3] Includes females at sites where number of young fledged was determined by August 31.
Fecundity is defined as the number of female offspring produced per female owl, assuming a 50:50 sex ratio among offspring.
Mean productivity is defined as the number of young fledged per female that successfully fledged young.

Table 9. Movement and Replacement Rates among Color-Banded Adult Spotted Owls in the Planning Area from 1990 through 1994

No. Birds Monitored	Adults Missing		Adults Moved		New Adults		Unverified Adults	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
1990-91 49	5	10	2	4	7	14	2	4
1991-92 71	7	10	4	6	8	11	0	0
1992-93 88	27	31	0	0	8	9	5	6
1993-94 94	7	8	10	11	4	4	NA	NA

[1] Any age bird that becomes a member of a pair is considered as an adult for these analyses.
[2] This Figure could include some marked birds which may be reverified in 1995.
NA = No data available as data from 1995 is needed to complete this analysis.

The winter of 1992-1993 produced colder than normal temperatures for extended periods. The winter was particularly harsh for spotted owls in the Planning Area. For example, the harsh winter followed a record drought during the summer of 1992, which probably reduced the abundance, and availability of flying squirrel populations in the region. Twelve site centers formerly occupied by pairs of owls in 1992 were found to be unoccupied in 1993. In addition, 31 percent of the adult owls known to be alive in 1992 were missing in 1993. Very few females attempted to nest and lay eggs in 1993, indicating inadequate stores of body fat to prompt them to lay eggs. Several radio-tagged juveniles were found to have died of starvation during the same winter. The challenges of the winter of 1992-1993 may have caused a drop in prey abundance, coupled with lower than normal temperatures which would have required greater use of fat reserves by over-wintering owls. There is no evidence to suggest that the amount and availability of habitat determined which adults survived the winter, and there is no evidence to suggest that available habitat levels caused the low prey abundance observed during the winter of 1992-1993. Sites that became unoccupied in 1993 varied across all habitat levels. Experienced breeding pairs (normally experienced hunters) disappeared along with subadults (generally less experienced hunters) and adults of at least moderate age. It is likely, however, that a variety of factors including low-grade infectious diseases, poor body condition following the brood-rearing period, or chance predation, as well as inexperience at hunting, may have contributed to the observed starvation of owls in the Planning Area in 1993.

Home Range Analysis — Several recent reviews of spotted owl biology in the Pacific Northwest have reported median annual home ranges of adult spotted owls, based on radiotelemetry (Thomas et al. 1990; Lujan et al. 1992a; Hanson et al 1993; Holthausen et al. 1994). Analysis of owl home range size and habitat use within the estimated home range has formed the technical basis for State and Federal guidelines and plans to protect spotted owl site centers on Federal and non-federal lands (Lujan et al. 1992a; USFWS 1990).

As part of the ongoing research effort on spotted owls in the central Cascade Mountains, Plum Creek fitted a total of 26 different adult spotted owls with telemetry transmitters in the Planning Area. Adult spotted owls were fitted with radio transmitters primarily to define home ranges, to aid in identifying habitat preferences, and to evaluate use of forest stands subjected to different silvicultural methods designed to retain spotted owl habitat following timber-harvesting activities (Hicks et al. 1995).

Based on data collected to date, Plum Creek does not believe that radio tagging of adult spotted owls has affected their survival or behavior. All owls found dead in the Planning Area appeared to have died of natural causes unrelated to the presence of the transmitter. The proportion of radio-tagged birds producing young was similar to the unradio-tagged population.

Plum Creek has determined preliminary home range sizes for nine owl pairs in the Planning Area. All sites with home range calculations have telemetry data for both males and females, along with more than 100 telemetry data points collected over at least a 12-month period. Additional relocation information on five of the nine territories is continuing in order to obtain a multiple-year database and strengthen the estimation of home range size. All owls fitted with radio-tags to-date have been on the East slope of the Cascades. Recently, owls on the West-side of the Cascades were fitted with radio-tags to provide data to estimate owl home range size here.

Table 10. Total and Habitat Acreage (NRF and FD Habitat) within Spotted Owl Home Ranges as Measured in the Eastern Washington Cascades Portion of the Planning Area

Site Name	95% Adaptive Kernal		95% Minimum Convex Polygon	
	Habitat Acres	Total Acres	Habitat Acres	Total Acres
Branch Creek	3,295	6,356	1,659	**3,433**
Case Knife — East Fork	2,446	3,573	2,666	**3,374**
Case Knife — Lower	685	979	433	**534**
Case Knife — West Fork	7,900	10,238	4,690	**5,972**
French Cabin Creek	1,911	4,774	1,463	**3,538**
Frost Creek	2,342	3,253	1,775	**3,830**
Frost Meadows	3,352	4,767	1,668	**2,532**
Kachess Lake — East	2,894	7,124	2,074	**4,632**
Taneum — North Fork	3,909	5,066	3,344	**4,256**
Mean	2,894	4,774	1,775	**3,433**
Median	3,193	5,126	2,197	**3,438**
Standard Deviation	2,000	2,622	1,233	**1,516**

All home ranges were calculated at sites in which both members of a pair were radio-tagged and a total of greater than 100 relocations were obtained for more than 12 months.

NRF = Nesting, roosting, and foraging; FD = Foraging and dispersal

Table 10 indicates approximate spotted owl home range size based on Minimum Convex Polygon (MCP) and Adaptive Kernel (ADK) estimators. During the analysis of home range size, the outer 5 percent of data points were excluded from the calculations in both methods to allow for occasional forays by the owls out of the home range, which often occurs in wide ranging predatory animals (Stickel 1954). Consequently, the 95 percent level is considered to be the best estimate of the area needed by an owl pair to fulfill annual biological requirements. Size of home range varies substantially, even among adjacent pairs of owls inhabiting basically similar habitat. The amount of habitat within a home range also varies substantially. Within the Planning Area, the home range estimate of the nine owl pairs, based on a median 95 percent MCP, was 3,438 acres (Table 10). Data summarized in Irwin and Hicks (1995) suggests that a decrease in spotted owl productivity will occur if suitable (NRF) habitat decreases below the 30 to 39 percent category of total habitat available within the home range.

Habitat selection in relation to availability within the home range of 15 individual spotted owls in the Planning Area was evaluated by Plum Creek (Hicks et al. 1995), and results are summarized in Table 11. In 13 of the 15 home range estimates analyzed by Plum Creek, owls were found to use NRF habitat in greater proportion than its availability, which suggests that owls are selecting this habitat. In general, owls were neutral in their use of FD habitat; 7 of 15 owls used FD habitat in proportion to its availability, 2 of the 15 owls used FD habitat in greater proportion than its availability, and 6 of the 15 owls used FD habitat in lesser proportion than its availability. As expected, non-habitat was used infrequently, suggesting that owls avoid young forests and non-forested areas.

It seems appropriate to consider, as a working hypothesis, that spotted owls with more highly fragmented habitat would inhabit larger territories. However, the data have not consistently supported this argument. Habitat quality probably plays a role in determining the size of the home range, but the suitability of a given habitat may be difficult to define precisely. Higher quality habitat, even if fragmented by harvested areas, may allow an owl to remain in a smaller home range than would vast expanses of poorer quality habitat. Individual expertise in hunting, traditional use areas, or other behavior affecting selection of habitat may be important when an owl chooses to forage over greater distances than seems intuitively necessary.

Dispersal Studies — One of the most important components in any analysis of spotted owl demography is the dispersal and ultimate fate of juveniles (Hicks and Herter 1995). Dispersal among juveniles generally occurs immediately following the fledgling period, usually June to September. During this period, young spotted owls are fed regularly by their parents and the juveniles seldom move farther than 0.5-miles from the nest site. Data collected by Plum Creek indicates that the average movement of juveniles during the fledgling period is 0.22 miles. Once the parents stop feeding the fledglings, the juveniles begin to move away from the adults' territory. In 1991, Plum Creek radio-tagged four juvenile spotted owls and followed dispersal activity, and in 1992, eleven juveniles were radio-tagged and followed during dispersal. The known routes taken by the radio-tagged juveniles are shown in Herter and Hicks (1995a). Dispersal of juveniles away from the nest site during the fall (i.e., September and October) usually consisted of an initial long distance movement, followed by lesser distance movements throughout the late fall and winter. There is, however, substantial variation in distances traveled and patterns of movement among individuals. Some birds have been found to move at an almost continual rate during their first fall and winter, whereas other individuals moved relatively little following initial dispersal. Many of the juveniles that survive the winter show a resurgence of movement in early spring. This may be in response to territorial defense and subsequent displacement by resident owls, or depletion of prey resources.

Table 11. Habitat Availability and Selection by Spotted Owls in the Eastern Washington Cascades Portion of the Planning Area

Site Name	Sex	Use[1]	HABITAT PERCENTAGE			Sample Size
			NRF	FD	Non-Habitat	
Branch Creek	F	Expected	31.6	14.7	53.8	50
		Observed	72.0	20.0	8.0	
			+[2]	=	-	
	M	Expected	31.1	18.0	50.9	34
		Observed	76.5	11.8	11.8	
			+	=	-	
Case Knife — East Fork	F	Expected	71.4	12.7	15.9	62
		Observed	91.9	3.2	4.8	
			+	-	-	
	M	Expected	69.5	9.6	21.0	80
		Observed	83.8	8.8	7.5	
			+	=	-	
French Cabin Creek	F	Expected	35.8	5.2	59.0	46
		Observed	71.7	4.3	23.9	
			+	=	-	
	M	Expected	45.3	2.9	51.8	92
		Observed	82.6	2.2	15.2	
			+	=	-	
Frost Meadows	F	Expected	45.1	3.8	51.1	27
		Observed	74.1	0.0	25.9	
			+	-	-	
	M	Expected	55.3	11.3	33.5	70
		Observed	77.1	7.1	15.7	
			+	=	-	
Frost Creek	F	Expected	50.9	13.7	35.4	66
		Observed	93.9	1.5	4.5	
			+	-	-	
	M	Expected	70.7	7.2	22.1	70
		Observed	90.0	5.7	4.3	
			+	=	-	
Kachess Lake East[3]	M	Expected	30.7	19.4	49.9	74
		Observed	66.2	8.1	25.7	
			+	-	-	
Case Knife — Lower Fork	F	Expected	67.2	13.3	19.6	82
		Observed	87.8	6.1	6.1	
			+	-	-	
	M	Expected	65.6	15.1	19.3	69
		Observed	88.4	7.2	4.3	
			+	-	-	
Case Knife — West Fork	F	Expected	73.5	18.0	8.5	108
		Observed	40.7	56.5	2.8	
			-	+	-	

Site Name	Sex	Use[1]	HABITAT PERCENTAGE NRF	FD	Non-Habitat	Sample Size
	M	Expected	58.4	18.0	23.5	124
		Observed	39.5	53.2	7.3	
			-	+	-	
Site Summary	=		0	7	0	
	+		13	2	0	
	-		2	6	15	
All Sites Combined	Expected		52.2	12.2	35.7	1,068
	Observed		72.6	17.1	10.3	
			+	+	-	

[1] Expected values are based on the percentage of each habitat in the 95 percent MCP home range. Observed values are based on the percentage of relocations of each habitat in the home range. Chi-square tests were preformed on actual values and not on percentages as shown in this table.

Overall $X^2 = 384.7$.

[2] Simultaneous confidence intervals using the Bonferroni approach were used to determine if observed values were different from expected values at the alpha = 0.05 level. "+" indicates selection for, "-" indicates avoidance, "=" indicates neither selection nor avoidance for a particular habitat.

[3] Kachess Lake East female was not included in the use/availability analysis due to a low sample size (i.e., number of relocations = 14). Additional data is currently being collected and analysis will be conducted in the future.

Plum Creek's juvenile dispersal studies have been hampered due to the high mortality rates of juveniles that were tagged during the winter of 1992-1993. As mentioned earlier, the winter of 1992-1993 was particularly harsh and juvenile mortality throughout the Planning Area and region was high. The four juveniles radio-tagged in 1991 died during their first winter. The primary cause of death among the juveniles was starvation and predation (Table 12). The cold weather, combined with the juveniles' inexperience as hunters, probably increased the exposure of juveniles to larger predatory birds, such as the northern goshawk and great horned owl. Many juveniles in the Planning Area also died of starvation. Juveniles probably have enough fat reserves to sustain themselves from September (when adults discontinue feeding the young) to approximately mid-December or early January. It is of interest to note that most of the emaciated carcasses found in the area were retrieved during December, January, or February. If juvenile spotted owls are unable to find sufficient prey or if they do not learn to hunt efficiently, then they are likely to die of starvation during the mid-winter months. The 1992-1993 winter appeared to be a period of food stress even for adults owls in the central Cascades, as evidenced by three primary factors: (1) a higher percentage of adults were missing from territories in 1993 than any other year of study; (2) very few pairs of owls attempted to breed in 1993, suggesting that fat reserves of females were insufficient to initiate egg laying; and (3) one of the four adults followed during the winter of 1992-1993 died of starvation. The ultimate distance traversed by dispersing juvenile owls varied substantially among individuals, ranging from a minimum of approximately 3 miles, to a maximum distance of at least 54 miles (Table 13). Ultimate distances were estimated based on band recovery data taken from successful dispersing individuals. All juveniles fledged in the Planning Area that successfully dispersed, established a territory, and were eventually resighted are shown in Herter and Hicks (1995a). Table 14 also includes all territorial birds bearing juvenile bands from adjacent studies that were relocated in the Planning Area. Average dispersal distance was 15.3 miles for unsuccessful juveniles (i.e., those owls that did not survive the winter; n=15), and 18.8 miles for successful juveniles (i.e., those owls that survived into the spring; n=20).

Table 12. Cause of Death Among Radio-tagged Juvenile Spotted Owls in the Planning Area

Identification		Date*	Remains	Probable Cause of Death
1991-	BRL	26 Nov 91	scattered remains	predation
	BRR	20 Jan 92	scattered remains	predation
	CCL	23 Jan 92	carcass	starvation
	KEL	24 Jan 92	carcass	starvation
1992-	BRL	23 Nov 92	scattered remains	predation
	BXL	8 Feb 93	carcass	starvation
	BXR	4 Feb 93	carcass	starvation
	FML	(6 Oct 92)	(none)	(signal failure)
	FMR	2 Jan 93	carcass	starvation
	KEL	11 Dec 92	carcass	collision/starvation
	LKL	1 Feb 93	transmitter only	unknown
	SCL	29 Dec 92	carcass	starvation
	SCR	19 Oct 92	scattered remains	predation
	THR	1 Feb 92	carcass	Collision

*Date refers to either the date the remains were collected, or the date the bird was known to have stopped movement (if the bird stopped moving in a wilderness area, the remains were often not collected until the following summer after snowmelt occurred).

Table 13. Ultimate (Direct-line) Distances Moved by Dispersing Juvenile Spotted Owls in the Planning Area

UNSUCCESSFUL JUVENILES		SUCCESSFUL JUVENILES	
Location	Miles	Location	Miles
South Cle Elum River — Left (92)	2.9	Lower Case Knife — Male	3.6
Kachess Lake, East — Left (92)	5.1	Lower Case Knife — Female	3.6
Kachess Lake, East — Left (91)	7.3	Gooseberry Flat — Female	7.5
Branch Creek — Left (91)	8.3	Kachess Lake, East — Female	8.1
Branch Creek — Right (91)	10.0	Little Rattlesnake Creek — Female	11.7
Cabin Creek — Left (91)	10.0	South Cle Elum Ridge — Female	11.1
Box Canyon — Left (92)	10.4	Corral Creek — Male	12.1
Frost Meadows — Right (92)	14.7	Raven Roost — Female	13.3
Dry Meadow — Left (92)	14.7	Big Creek, Upper — Female	14.4
Little Kachess Lake — Left (92)	16.2	Deadhorse Hill — Male	15.4
Box Canyon — Right (92)	20.5	Little Naches, North Fork — Female	16.0
South Cle Elum Ridge — Right (92)	23.9	Greek Creek — Male	16.3
Thorp Creek — Right (92)	24.7	Mathew Creek, North — Male	19.0
Frost Meadow — Left (92)	33.0	Sawmill Ridge — Female	19.5
Branch Creek — Left (92)	37.2	Frosty Creek — Female	23.9
		Big Creek, Lower — Male	25.0
		Paris Creek — Female	25.6
		Lower Case Knife — Female	27.0
		Morrow Meadow — Female	47.5
		Chickmin Creek — Female	54.4

All successful dispersers were radio-tagged except one (Dry Meadow) which was found dead by USFS employees. Information for this group is primarily based on color-band resightings. Band resightings are likely to be biased toward nearer sites as birds dispersing far from known banding areas are less likely to be discovered than birds dispersing to nearby sites within adjacent demography study areas. Means of the two groups are not significantly different (p = 0.346).

Table 14. Ultimate Dispersal Distances of Juvenile Spotted Owls in the Planning Area

	Dispersal Distance (miles)	
	Unsuccessful Juveniles	Successful Juveniles
Minimum	2.9	3.6
Mean	15.3	18.8
Median	14.7	15.7
Maximum	37.2	54.4
(Sample Size)	(14)	(20)

Ultimate dispersal distances are not straight-line distances from the natal site to the final location of the juvenile owl and do not include known wanderings of telemetered birds before a final location was determined.

Unsuccessful birds are all birds that died of starvation or were predated during their first winter of life and are based completely on radio-telemetry. Successful birds are those that survived to the next summer and are based partly on telemetry and partly on band resightings. Band resightings are likely biased low because those birds dispersing far from known banding areas are less likely to be discovered than birds dispersing to nearby sites that are monitored regularly.

Means are not significantly different (p = 0.346).

Among the 20 juvenile spotted owls that are known to have dispersed successfully and became territorial adults in the Planning Area, 5 were males and 15 females. Although this data seems to suggest that males may be more susceptible than females to mortality early in life, other observations in the Planning Area have not consistently supported this argument. For example, among the 46 marked adults that are thought to have died in the Planning Area over the past four years (i.e., adults missing from previously occupied territories), 22 were males and 24 females. This data suggests that death rates among adult spotted owls are not skewed toward either sex. The skewed sex ratio observed among successful juveniles in the Planning Area is probably an artifact of low sample size.

Co-Occurrence with Barred Owls — In the Planning Area, spotted owls are slightly more common than barred owls, particularly on the East slope of the Cascades. Barred owls are commonly detected during spotted owl protocol surveys. The results of surveys conducted from 1991 through 1993, illustrating spotted owl site centers and barred owl site centers, are shown in Figure 18. Analysis of the amount of spotted owl habitat in 1.8- and 0.7-mile radius circles around spotted owl and barred owl site centers indicated no significant differences between these owls in terms of preference for amount of Type A and B, or all suitable habitat (Wilks' Lambda). However, spotted owls did tend to occupy sites with greater amounts of habitat at all radii analyzed than did barred owls (Table 15). For example, at the 0.5-mile radius, spotted owls showed a strong preference for greater amounts of suitable (NRF) habitat than did barred owls.

Table 15. Mean Amount of Suitable Spotted Owl Habitat at Various Radii Around Spotted Owl and Barred Owl Site Centers in the Planning Area

Radius (miles)	Spotted Owl		Barred Owl	
	Mean	Standard Deviation	Mean	Standard Deviation
0.5	212	108	167	123
0.7	370	184	325	208
1.0	698	340	660	393
1.5	1,469	674	1,397	769
1.8	2,059	907	1,956	1,058
2.0	2,478	1,078	2,374	1,258

2.10.2 Marbled Murrelet

2.10.2.1 Literature Review

The marbled murrelet was placed on the Federal threatened species list on October 1, 1992 (USDI 1992c). The marbled murrelet is a small seabird, ranging across the North Pacific from Japan to California; however, only the populations within Washington, Oregon, and California were listed.

The species is at least partially migratory and additional birds are known to move into Washington during the winter (Speich et al. 1992). The greatest number of birds occur in northern Puget Sound and the northern outer coast, and considerably fewer birds are found in southern Puget Sound and the southern outer coast (Speich et al. 1992). Although murrelets in Washington have been observed up to 50 miles inland, 98 percent of all detections have been recorded between 10 and 40 miles inland.

The current population of murrelets in Washington is estimated to be 5,500 birds (USFWS 1995). However, there is inadequate historical information on the abundance and distribution of murrelets in the Western Cascade Mountain Range to determine if a population decline has occurred or is occurring, but the current size of the population in Washington may reflect a region-wide population decline due to many factors including a reduction in old growth forests, oil spills in marine waters, and entanglement in gill nets (Marshall 1988; Leschner and Cummins 1990). The population size of murrelets within the Plum Creek HCP boundary is unknown, but it is believed to be small. Surveys are underway to evaluate the extent and quality of potential habitat, and to determine whether nesting murrelets are actually present within the Planning Area.

2.10.2.1.1 Habitat Characteristics

Murrelets have been found to be more commonly encountered in larger stands of older forests in California (greater than 500 acres) than in smaller, younger stands (less than 40 acres). In Washington, murrelet detections generally increase when the percentage of available old growth forests make up more than 30 percent of the landscape. Similarly, detections of murrelets decrease when the percentage of clear-cut/meadow on the landscape increases above 25 percent (Hamer and Cummins 1990).

At this time, there is no widely accepted definition of suitable murrelet habitat. In 1991, the Interagency Marbled Murrelet Committee (IMMC) recommended interim management guidelines for marbled murrelet conservation in Washington, Oregon, and California (IMMC 1991), and defined suitable habitat as old growth forests and mature forests with an old growth component, and trees greater than 32 inches in diameter with large moss covered branches. A general description of the important stand characteristics that have been associated with habitat used by murrelets was quoted by Cummins et al. (1993) from an unpublished manuscript by Hamer:

> *"...a site occupied by murrelets in Western Washington can be best characterized as being lower in elevation and having a large number of potential nest platforms, high percent cover of moss on tree limbs, low lichen cover on tree limbs, steeper slopes, medium canopy closure, larger stem density of low elevation tree species, and a larger mean DBH of low elevation tree species than an unoccupied site. In addition, many occupied sites have a higher number of trees infected with mistletoe than unoccupied sites."*

On August 10, 1995, the FWS published a proposal to designate critical habitat for the marbled murrelet (60 FR 40893-40954). With respect to critical habitat, the FWS considered forested areas with conditions that support nesting marbled murrelets as "suitable nesting habitat". The FWS noted that:

> *"Although marbled murrelet nesting habitat characteristics are somewhat variable throughout the range of the species, some general habitat attributes are characteristic throughout its range, including the presence of nesting platforms, adequate canopy cover over the nest, landscape condition, and distance to the marine environment. Individual tree attributes that provide conditions suitable for nesting include large branches (average of 32 centimeters (13 inches), range of 10 to 81 centimeters (4 to 32 inches) in Washington, Oregon, and California) or forked branches, deformities (e.g., broken tops), dwarf mistletoe infections, witches broom, or other structures large enough to provide a platform for a nesting adult murrelet. These structures are typically found in old-growth and mature forests, but may be found in a variety of forest types including younger forests containing remnant large trees."*

The total predicted amount of suitable murrelet habitat (i.e., habitat located below the silver fir zone), based on 1988 satellite imagery, is approximately 718,000 acres Statewide. However, disconnected stands less than 15 acres are not shown on the 1988 data. Therefore, this is a slight underestimate of potential available habitat. Approximately 85 percent of this habitat is located on Federal lands, 8 percent is on State owned lands, and 7 percent is on privately held lands (Cummins et al. 1993).

2.10.2.1.2 Nesting and Breeding

Murrelets appear to be semi-colonial in their nesting habitats and have been heard or seen at certain inland sites during most of the year (Paton et al., 1987). In spring, murrelet occurrence at inland sites increases and, as a result of breeding activities, reaches a peak level of activity in late-summer (Paton and Ralph 1988; Nelson 1989a). Breeding populations are not distributed continuously throughout the forested regions of their range.

During the past 20-years, 61 tree nests have been located in North America; within the range of the listed population, 8 have been found in Washington, 20 in Oregon, and 9 in California (Binford et al. 1975; Quinlan and Hughes 1990; Hamer and Cummins 1990, 1991; Kuletz 1991; Singer et al. 1991, 1992; Varoujean et al. 1989). All nests in Washington, Oregon, and northern California have been found in old growth trees that were greater than 32 inches in diameter. Current information suggests that 30 to 40 year-old second growth stands, regenerated after clear-cutting, do not provide the structural characteristics required for nesting by marbled murrelets (Quinlan and Hughes 1990). Most nests have been located on large or deformed branches with a moss covering; however, a few nests have been found on smaller branches and some nests were situated on conifer needles or sticks rather than moss. Nests typically are high above ground and usually have good overhead protection. Such locations allow easy access to the exterior of the forest and provide shelter from potential predators (Singer et al. 1991; Quinlan and Hughes 1990). Nests in Oregon and Washington have been found in stands dominated by Douglas fir.

Current FWS protocols require 2 years of survey data to ensure that no marbled murrelet nest sites exist in areas planned for timber harvest. According to the FWS, if behavior indicating occupation or nesting is documented during the surveys, all contiguous existing and recruitment habitat for marbled murrelets (i.e., stands that are capable of becoming marbled murrelet habitat within 25 years) within a 0.5-mile radius should be protected. According to the ROD requirements, the 0.5-mile radius circle should be centered on either the behavior indicating occupation, or within 0.5-miles of the location of the behavior, whichever maximizes interior old growth habitat to be protected. In addition, silviculture treatments in "non-habitat" areas within the 0.5-mile circle should protect or enhance suitable or replacement habitat. The 0.5-mile radius probably represents the area necessary to prevent wind penetration into the nest site.

Behavioral activities which indicate that marbled murrelets may be occupying a site include at least one of the following (Ralph and Nelson 1993):

1. discovery of an active nest or a recent nest site as evidenced by a fecal ring or egg shell fragments;
2. discovery of a chick or egg shell fragments on the forest floor;
3. birds flying below, through, into, or out of the forest canopy within or adjacent to a stand;
4. birds perching, landing, or attempting to land on branches;
5. birds calling from a stationary location within the stand; and/or
6. birds flying in small or large radius circles above the canopy.

2.10.2.2 Occurrence in the Planning Area

Marbled murrelet use of the Planning Area is likely to be at a low level based on a combination of: (1) relatively low murrelet populations in southern Puget Sound; (2) dearth of suitable habitat in the Planning Area West of the Cascade crest; and (3) low numbers of observed murrelets in the Planning Area, based on current site-specific surveys and strategic radar work. Reductions in the amount of mature forests in the Planning Area West of the Cascade crest may be one of the primary factors impeding greater murrelet use of the area. The Service designated portions of 10 sections (about 6,800 acres) as critical habitat within the Green River Basin (HCP Figure 6) (May 25, 1996, Federal register; 61 FR 26256-26320). Murrelets were subsequently discovered by Plum Creek and their contractors in two separate stands occurring on two of the sections designated as critical habitat.

2.10.2.3 Plum Creek's Marbled Murrelet Surveys

In 1994, Plum Creek initiated special surveys to detect marbled murrelets in the Planning Area West of the Cascade crest. These murrelet surveys followed standard guidelines established by the Pacific Seabird Group, Marbled Murrelet Technical Committee (Ralph et al. 1994) and endorsed by the FWS and WDFW. Detailed descriptions of survey protocols and an analysis of the findings of the surveys are presented in Herter and Hicks (1995).

During the surveys conducted by Plum Creek in the Planning Area West of the Cascade crest, murrelets were not detected. Similar findings have been reported by other survey crews in the Green River drainage. For example, surveys by Beak Consultants along the lower tributaries of the Green River in 1993 and 1994, using the same protocols used by Plum Creek, detected no murrelets. Although surveys conducted since 1992 by several agencies and private consultants in drainages adjacent to the Green River detected murrelets close to the Green River, none of these surveys actually detected murrelets in the Green River drainage. Surveys conducted in major river drainages to the north (i.e., Cedar River, South Fork Snoqualmie River) and south (i.e., Greenwater River, White River) of the Green River have either failed to detect or reported detecting few murrelets.

Reductions in the amount of old growth forests in the Planning Area West of the Cascade crest may be the primary factor precluding murrelets from using the area. Lower elevation Douglas fir/western hemlock forests of sufficient age and extent necessary to support murrelets within 40 miles of saltwater are uncommon in most of the Planning Area. Suitable murrelet forests are also uncommon in other drainages north and south of the Planning Area. In contrast, drainages containing extensive areas of old growth forests and at suitable elevations within 55 miles of marine waters (i.e., Carbon River, North and Middle Forks of the Snoqualmie River) appear to be able to support the nesting requirements of murrelets. Thus, the combination of low murrelet populations in southern Puget Sound and the availability of suitable nesting habitat in other river drainages along the Western slope of the Cascades suggests that marbled murrelet use of the Planning Area is unlikely.

In the spring of 1999, the Fish and Wildlife Service and Plum Creek cooperatively identified lands likely to be surveyed under the modified HCP. The lands to be surveyed under the modified HCP are identified in Figure 1 of the Record of Decision. The procedures and location of survey stations were coordinated with the Washington Department of Fish and Wildlife.

On June 11, 1999, a Plum Creek murrelet survey crew made visual and audial detections of murrelets in upper Champion Creek. Visual and audial detections were also made on the following days and verified by radar observations. Circling behavior was observed associated with several detections. In subsequent surveys of adjacent sections, murrelets were again detected. Following these results, the Fish and Wildlife Service and Plum Creek cooperatively identified stands which would have been protected according to HCP Section 3.2.1.2.3 Marbled Murrelet – Nest-Site Protection. As discussed in the HCP modification document and FSEIS, additional occupied stands may be identified as a result of surveys to be conducted under the HCP on remaining habitat. Subsequent surveys in 2000 determined that the remaining stands were not occupied.

Areas surveyed are shown in Figure 19.

2.10.3 Grizzly Bear

2.10.3.1 Literature Review

2.10.3.1.1 Characteristics and Behavior

The species, *Ursus arctos*, generally includes both the Eurasian and Alaskan brown bears and the grizzly bear. In the contiguous 48 States, grizzly bears occur in only five areas in mountainous regions, national parks, and wilderness areas in Washington, Idaho, Montana, and Wyoming (Hoak et al. 1981; Servheen 1989). They are large bears with long, curved claws, humped shoulders, and a dished face. Coloration varies from blonde to dark brown. Spring shedding, new growth, nutrition, and climate all affect coloration (USFWS 1993).

Male grizzly bears generally average between 400 to 600 pounds and females average between 250 to 350 pounds (USFWS 1993). Adult bears stand between 3.5 to 4.5 feet at the hump when on all fours, and may exceed 8 feet when reared up on their hind legs (USFWS 1993).

2.10.3.1.2 Age and Sex Characteristics

The age and sex structure of grizzly bear populations is variable, and influenced by many factors including habitat conditions, time of year, and hunting pressure (USFWS 1993). In a study of a hunted grizzly bear population in the Yukon, Pearson (1972) found 24 percent of the population was comprised of cubs and yearlings, 32 percent subadults (i.e., 2 to 6 years), and 44 percent adults. On Kodiak Island, Troyer and Hensel (1964) showed the population structure of grizzly bears was 26 percent cubs, 22 percent yearlings, 27 percent subadults, and 25 percent adults.

It is clear that examination of the age and sex structure of a grizzly bear population can be biased depending upon whether the range area is small or large. Small range areas may not reflect the true composition of the bear population because of home range size differences between the sexes and overlapping ranges. Conversely, larger ranges and mobility of males may bias samples toward males (Hornocker 1961; Troyer and Hensel 1964; Jonkel and Cowan 1971; Egbert and Stokes 1976). However, due to the greater vulnerability of males to mortality, sex ratios may favor females in older adult age classes (USFWS 1993).

2.10.3.1.3 Range and Distribution

Historically, the range of the grizzly bear in North America included nearly the entire coniferous and deciduous forest zone of the Western United States, Canada, and the mountains of northern Mexico (Rausch 1963; Herrero 1972; Hall 1981). The grizzly bear's range is now limited to relatively small populations in the northern Cascades and Selkirk Mountains in Washington (Figure 7), the northern Rocky Mountains in Idaho, Montana, and Wyoming to the San Juan Mountains in Colorado (USFWS 1993). Recent sightings of grizzly bears and their tracks have been recorded in the north Cascades. However, no individual grizzly bears have been captured or tagged by the WDFW despite more than 5 years effort. These sightings may indicate migration of individual bears from populations in southern British Columbia. Current estimates suggest that there are approximately 10 individuals in the north Cascades and perhaps as many as 18 individuals in the Selkirk Mountains in northeast Washington (Washington 2010 1992).

2.10.3.1.4 Home Range

The size of the home range of grizzly bears is generally believed to be extremely large (i.e., up to 1,500 square miles; USFWS 1993). Thus, space is essential for the survival of the grizzly bears. The home range is also variable depending upon food availability, weather conditions, and interactions with other bears. In addition, it has been shown that individual bears often expand their ranges seasonally or from one year to the next (Jonkel and Cowan 1971; Greer 1972; Craighead 1976; Rogers 1977; Russell et al. 1978). The mean density of grizzly bears in the Yellowstone ecosystem, which contains mainly dry habitat, was computed to be one bear per 34 square miles (Craighead et al. 1974), whereas, in Southeastern British Columbia, grizzly bear density was estimated to be approximately one bear per 6 square miles (McLellan 1989). In the Selkirk Mountain ecosystem in northeastern Washington, Knight et al. (1988) estimated a density of one bear per 16 square miles.

The home range of adult bears frequently overlap and there are substantial differences between the sexes in the size of home range. Adult male grizzly bears generally have home ranges two to four times larger than that of females (Pearson 1975; Craighead 1976; Herrero 1978; Servheen and Lee 1979). The home range of adult females is relatively small while they are attending to their cubs, but ranges expand when the young are yearlings in order to meet increased foraging demands (Pearson 1975; Herrero 1978; Russell et al. 1978).

As subadults, grizzly bears disperse, but their pattern of dispersal is not well documented. Young males are normally the first to leave their mother's home range (USFWS 1993). Their dispersal pattern is probably related to avoidance of previously established adult home ranges. Young females often establish a home range within the vicinity of their mothers' home range (Pearson 1975). Adult females often modify or reduce their home range to accommodate their offspring (USFWS 1993).

2.10.3.1.5 Breeding

The mating season for grizzly bears is generally between May and July, with a peak in mid-June (Craighead et al. 1969; Herrero and Hamer 1977). Cubs are born between 229 and 266 days after conception usually in late January to early March. Age at first reproduction and litter size in grizzly bears varies, depending upon nutritional state (Herrero 1978; Russell et al. 1978). Age at first reproduction averages 5.5 years for both males and females (range: 3.5 to 8.5 years); and litter size averages two cubs per female (range: 1 to 4 cubs). Reproductive intervals for females average 3 years.

The limited reproductive capacity of grizzly bears hinders a rapid increase in population size. These bears have one of the lowest reproductive rates among terrestrial mammals, due to the late age of first reproduction, small average litter size, and the long reproductive interval for females (USFWS 1993).

2.10.3.2 Habitat Characteristics

2.10.3.2.1 Foraging

Although their digestive system is essentially that of a carnivore, grizzly bears are successful omnivores, and in some areas they are primarily herbivores (USFWS 1993). Grizzly bears are mainly opportunistic feeders and they will consume a wide array of food items that are highly digestible and high in starch, sugars, protein, and stored fat (Stebler 1972; Mealy 1975; Hamer et al. 1977). Dietary items include fish, rodents, carrion, insect larvae, vegetable matter, and garbage (Stebler 1972; Hamer 1974; Hamer et al. 1977). Grizzly bears require foods that are rich in protein or carbohydrates in excess of maintenance requirements in order to survive denning and post-denning periods (USFWS 1993).

The search for food is a major influence of bear movement and home range size. Following emergence from the den, bears move to lower elevations where their immediate food requirements can be met. Throughout late spring and summer the bears normally migrate back to higher elevations. In late summer and fall the diet of bears consists mainly of fruits, nuts, and roots (USFWS 1993). Preferred foraging habitat includes areas with past disturbance (e.g., avalanche chutes, burned areas, floodplains, and clear-cuts) that support early successional plants and small mammals.

2.10.3.2.2 Cover

The relative importance of forest cover to grizzly bears has been well documented by Blanchard (1978). During the four-year study in the Yellowstone Grizzly Bear Ecosystem, Blanchard (1978) observed bears frequently in highly dense forested areas. However, he was unable to determine whether the occurrence of bears in the dense forests was related to an innate preference of bears or an avoidance response to humans. Forest cover has also been shown to be very important to grizzly bears for use as beds. Most grizzly bear beds are located less than a yard or two from a large tree (Servheen and Lee 1979; Blanchard 1978). Additionally, Blanchard (1978) noted that interspersion of semi-open and open areas as feeding sites associated with the dense forest was also important.

2.10.3.2.3 Denning

In the fall of each year, grizzly bears begin to search for a proper place to dig a den. Day length and the onset of inclement weather have been shown to influence pre-hibernation activities. Dens are usually dug on steep slopes where wind and topography cause an accumulation of deep snow and where the snow is unlikely to melt during warm periods (USFWS 1993). Dens are typically located at high elevations in remote areas. Grizzly bears may travel up to 30 miles to find a suitable isolated area that will provide a secure environment for a 6-month sleep. During hibernation, bears require no water or nourishment; normal fat reserves sustain the bear during the 6-month fast.

2.10.3.3 Occurrence in the Planning Area

A recent evaluation of grizzly bear habitat in the North Cascades cited nine sightings of grizzly bears in the Planning Area (Almack et al. 1993). All of the sightings were reported between 1974 and 1991. Among the nine sightings, three are rated “Class 1” by the WDFW. A Class 1 rating is a “confirmed” sighting, usually indicating an observation by a qualified biologist and/or photograph, carcass, track, hair, dig or food cache. Six of the sightings are rated “Class 2”. These sightings are considered “highly reliable” and are usually documented as an observation of a grizzly bear that was identified by two or more physical characteristics, but lacked the level of verification noted for Class 1 sightings.

Among the Class 1 sightings, one involved tracks, and two others involved observation of adult bears. Efforts to trap and radio collar grizzlies in the Planning Area have been unsuccessful (personal communication, WDFW). All reported sightings of grizzlies have been located in the I-90 Lakes Subunit (i.e., that portion of the HCP East and north of I-90, including the areas surrounding Kachess and Cle Elum Lakes) of the Planning Area within the zone corresponding to the North Cascades Recovery Area (Figure 7).

2.10.3.4 Grizzly Bear Habitat Analysis in the Planning Area

Recent research suggests that open roads with unrestrained public use can contribute to grizzly bear mortality, and females with cubs typically exhibit less preference for areas with high road density (Mace and Manley 1993; Interagency Grizzly Bear Committee 1993). Home range and habitat studies of grizzly bears suggest that optimal bear habitat includes a mixture of forested areas, used for hiding and thermal cover, as well as open meadows, avalanche chutes, and harvested sites where bears forage for plants and small mammals (LeFranc et al. 1987). Concerns regarding open road density and available preferred habitat are related in that excessive open road densities may displace grizzly bears from otherwise preferred habitat or expose bears to greater mortality risk should they become attracted to habitats with road networks used extensively by humans.

One of the objectives of the Grizzly Bear Recovery Plan (USFWS 1993 appended) is to manage grizzly bears and grizzly bear habitat within this clearly defined recovery zone. According to the Plan, "*the recovery of a sustainable grizzly bear population is expected to be a slow, gradual process requiring decades. Given the present, very small population of grizzly bears in the North Cascades Grizzly Bear Recovery Area the initial target for human-induced mortality is zero.*" To maintain consistency with the goals and objectives of the Federal recovery plan, Plum Creek will concentrate the Company's grizzly bear management efforts within the recovery zone in the I-90 Lakes Subunit within the Planning Area. The I-90 Lakes Subunit comprises 115,374 acres (28 percent of the Planning Area; Table 16 and Figure 20). The Forest Service is the largest landowner in the subunit (86,389 acres), followed by Plum Creek (22,911 acres), and other private landowners (6,013 acres).

To determine the "road influence zone," which includes the area within the subunit with an open road density exceeding one mile per square mile, Plum Creek used a GIS "moving window" analysis to estimate precisely the location and extent of open road densities (Mace and Manley 1993). A circular analysis area ("window") is superimposed on the landscape in sequential 30-meter increments. The radius of the window is 500 meters, which corresponds to the distance from an open road within which a grizzly bear will likely be displaced due to vehicular activity (Mace and Manley 1993). In essence, the "moving window" analysis simulates a circle with a 500-meter radius around an imaginary "bear" and calculates the road density within that road influence zone. Road density is calculated within each window sampling area and is summarized to produce "contours" of road density throughout the subunit (Figure 21). The results of the analysis indicated that open road density was exceptionally high in the I-90 Lakes Subunit, and identified areas where remedial road closures would be most effective in creating additional security habitat.

Table 16. Acreage, Road Density, and Security Area Estimates for the I-90 Lakes Subunit (Grizzly Bear Recovery Area) within the Planning Area Post Land Exchange, Escrow and Option Sections PC

	OWNERSHIP			
	Forest Service	Plum Creek	Other	Total
Total Acres	86,389	22,911	6,073	**115,374**
Total Square Miles	135	36	9	**180**
Total Road Miles	274	180	72	**526**
Total Road Density (miles/square mile)	2.0	5.0	7.6	**2.9**
Open Road Miles	206	106	69	**380**
Open Road Density	1.5	3.0	7.3	**2.1**
Road Influence Zone*	39,002	17,342	5,751	**62,095**
Security Area	47,387	5,569	322	**53,279**

* Road Influence Zone — area with greater than one mile/square mile open road density as determined by 500-meter radius moving window analysis.

To delineate security areas where habitat management for grizzly bears will be assessed and monitored, the results of the moving window analysis for road density was modified to identify polygons where open road density is 1.0 mile per square mile or less. The resultant polygons totaled 53,279 acres or 46 percent of the I-90 Lakes Subunit (Table 16 and Figure 22).

To assess habitat conditions within grizzly bear security areas, assumptions were made regarding the relationship between forest structural stages and grizzly bear foraging/prey habitat and hiding/thermal cover habitat. Grizzly bear foraging/prey habitat was assumed to include three forest structural stages (i.e., stand initiation, shrub/sapling and young forest stages; Section 2.3). Hiding/thermal cover for grizzly bears was assumed to include five forest structural stages (i.e., pole timber, dispersal forest, mature forest, managed old growth, and old growth). Habitat conditions for grizzly bears were assessed only within the security areas as a conservative estimate of potential grizzly bear habitat use should the bears “recolonize” the subunit. Although grizzlies might use habitat near open roads and recreational facilities, conservation and recovery of the bear depends on minimizing the likelihood of grizzlies interacting with humans.

Currently, 22 percent of the security area in the I-90 Lakes Subunit serves the function of foraging habitat, while 58 percent provide hiding/thermal cover. Although 20 percent of the security area is considered “non-forested,” this area includes meadows and alpine areas that will serve as foraging areas for bears and these areas will remain unaffected following implementation of the HCP.

2.10.4 Gray Wolf

2.10.4.1 Literature Review

On June 4, 1973, the gray wolf, *Canis lupus*, was federally listed as endangered throughout the lower 48 States except in Minnesota, where it was listed as threatened on March 9, 1978. In compliance with the ESA, the FWS released a Northern Rocky Mountain Wolf Recovery Plan in 1987 (USFWS 1987).

Historically, gray wolves ranged widely in temperate forests throughout North America (Paradiso and Nowak 1982; Bangs 1991). However, by the late 1930's, few, if any, wolves remained in the Northern Rocky Mountain region (USFWS 1987), and as of 1988, wolf populations were scattered throughout Alaska, Minnesota, Michigan, Wisconsin, Montana, Idaho, and Washington. The 1987 Recovery Plan specifies three recovery areas in the northern Rocky Mountains: the Yellowstone Recovery Area, including and surrounding Yellowstone National Park; the Northwestern Montana Recovery Area, including and surrounding Glacier National Park; and the Central Idaho Recovery Area. The criteria for selecting these three recovery areas includes the presence of a prey base sufficient to support ten breeding pairs of wolves, and a minimum of 3,000 square miles, of which less than ten percent is private ownership, except "railroad land grants" (USFWS 1987). According to the recovery plan, maintaining at least ten breeding pairs in an area for at least three years will result in reclassifying wolves in the area as threatened rather than endangered. When at least ten breeding pairs have been maintained for at least three years in all three recovery areas, the species will be delisted (USFWS 1987). There are currently no recovery areas located in the Washington Cascade Mountains; however, the Washington State Department of Fish and Wildlife is conducting a survey to determine the number and distribution of gray wolves in the Cascades.

2.10.4.1.1 Characteristics and Behavior

The species, *Canis lupus*, includes 32 subspecies or geographic races occurring around the world, 24 of which are in North America (Mech 1970). As of 1988, populations were scattered throughout Alaska, Minnesota, Michigan, Wisconsin, Montana, Idaho, and Washington. The gray wolf is a large canid with longer legs and proportionally larger feet than coyotes or domestic dogs. Colors range from white, cream, and tawny shades, or gray to black. The belly and legs are often lighter and the back and top of the tail is darker than the rest of the body (Ream and Matson 1979). Adult male wolves generally weigh between 80 to 100 pounds; females are slightly smaller. Adults range between 4.5 to 6.5 feet from the tip of the nose to end of the tail, and they stand 26 to 32 inches in height at the shoulders.

2.10.4.1.2 Age and Sex Characteristics

Sex ratios in wolf populations from several areas in the Northern Hemisphere are biased towards males (Mech 1970). Wolves held in captivity have showed a slightly larger (53:47) number of male pups. High-density wolf packs in Northeastern Minnesota had a significantly higher number of males (66:34) in the population. In contrast, wolf packs from other areas of Minnesota with lower population densities had approximately equal sex ratios. Thus, the percentage of male wolf pups appeared to be proportional to population density and perhaps inversely related to estimated levels of nutrition (Mech 1975).

Ratios of pups to adults in wolf populations are strongly influenced by the degree of human exploitation. For example, pup to adult ratios in exploited (i.e., hunted) wolf populations range between 55:45 to 73:27. In unexploited populations, pup to adult ratios of 13:87 to 31:69 have been reported (USFWS 1984). This suggests that exploited wolf populations are characterized by a relatively high proportion of pups.

2.10.4.1.3 Range and Distribution

At one time, the gray wolf had an extensive range, occurring throughout North America, Europe, Asia, and Japan, with the exception of vast deserts and high mountaintops in these regions. In North America, the wolf's range extended southward to the southern end of the Mexican Plateau (Mech 1970). Currently, the wolf's range is more restricted. Outside of Alaska, large populations exist in northern Minnesota and Isle Royale, Michigan, and small populations are scattered throughout Wisconsin, Montana, Idaho, and Washington (Figure 8).

Factors that seem to be responsible for wolf population declines within the United States include: (1) intensive human settlement; (2) direct conflict with domestic livestock; (3) a lack of understanding of the animal's ecology and habits; (4) fears and superstitions about wolves; and (5) the extreme control programs designed to eradicate the wolf (USFWS 1987).

2.10.4.1.4 Home Range

Wolves are highly social animals, occurring in packs that number from 2 to more than 25 individuals (Mech 1970). The pack consists of a breeding male and female, often called the alpha pair, and their offspring from one or more generations. While most wolves live in packs, young or subordinate wolves often leave existing packs in search of a mate and new territory. These lone wolves may find another lone wolf of the opposite sex, establish a territory, and begin a new pack. Packs establish and defend territories that vary in size from 48 square miles to over 981 square miles depending on pack size and prey density (Ballard et al. 1987; Mech 1987). Reproductively successful packs normally occupy exclusive territories, whereas nonbreeding loners live in the buffer zones between territories, avoiding the packs. The amount of available prey relative to numbers of pack members is important in determining the size of territories (USFWS 1984).

2.10.4.1.5 Dispersal

Wolves disperse at ages ranging from 9 to 28 months. Dispersal usually occurs in the fall by juveniles ranging in age from 17 to 20 months. In low-density populations, juveniles of both sexes disperse into unoccupied areas on the periphery of the pack's territory. Following movement away from the pack, juveniles seek out another lone wolf of the opposite sex and form a new pack. In high-density populations, young animals may stay with the pack and wait for changes in the rank order and opportunities to mate. It is not unusual for subordinate wolves to disperse hundreds of miles to find a mate or unoccupied territory (Fritts and Mech 1981).

2.10.4.1.6 Breeding

Most wolves do not reach sexual maturity until at least 22 months (Wise et al. 1991). Alpha wolves are responsible for most of the successful matings, suggesting that reproduction after sexual maturity depends on social status (Peterson 1986). Wolves usually mate in February and produce young 63 days later in litters of 1 to 11 pups (Mech 1970). The alpha pair, as well as other members of the pack, helps gather food for the young-of-the-year. Wolves have high potential rates of population increase given favorable conditions. Summer population increases of 60 percent from the pre-breeding winter population have been recorded in Alberta (Fuller and Keith 1980).

2.10.4.2 Habitat Characteristics

The wolf has flexible habitat requirements. Wolves require an adequate food supply, suitable denning and rendezvous sites, travel corridors, and regulation of disturbances caused by humans (USFWS 1987). Many endangered species face extinction because certain characteristics leave them vulnerable to disruptions caused by humans. This is not the case with wolves, which have high reproductive rates and flexible habitat needs (Wise et al. 1991), and they appear to be relatively unaffected by forest-management activities. The major causes of the decline in wolf populations in the lower 48 States have been trapping, poisoning, and shooting, as well as reduction in prey abundance (Mech 1970).

Wolves are found only where conditions will support an adequate prey base, comprised primarily of ungulates. In northern Montana, wolves prey mostly on white-tailed deer, elk, moose, and occasionally, on mule deer (Ream et al. 1986). Elk remains accounted for 59 percent of the total weight of wolf scats collected near Glacier National Park (Giddings 1980). Remains of beaver, snowshoe hare, and other small mammals appear in wolf droppings and may be seasonally important. Prey species vary depending on their availability and abundance. Both the abundance and vulnerability of prey to wolf attacks helps to determine the content of wolves' diet (Wise et al. 1991). For gray wolf populations in the central Cascades, required resources are undoubtedly patchily distributed in time and space, and resource availability may be patchy despite widespread resource production, because most of the resources are preferentially consumed by a wide array of competitors. In any event, wolf populations will be maintained only if the area is capable of providing a year-round food supply.

2.10.4.2.1 Foraging

As stated above, wolves have extremely flexible habitat requirements, especially for foraging. Historically, wolves use various habitats across a rather broad spectrum of types. However, these habitats have two specific features in common: (1) an abundance of natural prey; and (2) minimal encounters and conflicts with human interests, such as livestock (USFWS 1987). Habitat for wolves consists primarily of an adequate supply of vulnerable prey (ideally in an area with minimal opportunity for exploitation of wolves by humans) (USFWS 1984).

2.10.4.2.2 Denning and Rendezvous Sites

Pups are born in early spring, usually in an underground den, abandoned beaver lodge, or hollow log (Peterson 1986). Typically, dens are located on south or southwest aspects of moderately steep slopes in well drained soils (or rock caves), at elevations less than 200 meters above the surrounding low-lying area, and usually within 200 meters of surface water (Mech 1970). Some den sites may receive traditional use by a wolf pack from year to year. Most wolf packs appear particularly sensitive to human disturbance near den sites and may, depending upon the extent of the disturbance, abandon the den (USFWS 1984). After 6 to 10 weeks pups are moved from the dens to rendezvous or post-denning sites. Rendezvous sites are best described as resting, feeding, or activity sites occupied by wolves during summer and early fall months (Kaminski and Boss 1981). These sites usually include small (i.e., one acre or less), secluded bogs or complexes of meadows and adjacent hillside forests, in proximity to surface water (Weaver 1978). Rendezvous sites are also characterized by matted vegetation in the meadow, a system of well used trails through the adjacent forest and resting beds adjacent to trees in the forest (USFWS 1984). At this time, pups are unable to hunt and must remain at rendezvous sites where adults return with food. Wolves typically use two to three rendezvous sites while raising the young.

2.10.4.3 Occurrence in the Planning Area

Gray wolves have only recently been reported to occur in the Planning Area. According to WDFW records (WDFW database August 11, 1994), a total of nine wolf sightings have been reported inside or within two miles of the HCP boundary. These sightings date back to 1984, but seven of the sightings occurred between 1992 and 1994. Seven of the reports were of single adults, and based on sightings, tracks and responses to howling calls. Wolf reports have not been assigned a "reliability rating", as have grizzly bear reports. All nine wolf reports have been located on the East-side of the Cascades in and adjacent to the Planning Area. Eight of the nine reports have been from the southeastern corner of the Planning Area near Taneum Creek, which is within a federally designated Late-Successional Reserve.

2.10.5 Special Emphasis Species

A complete discussion of each of the Special Emphasis Species including information on range, occurrence in the Planning Area, habitat requirements, and management considerations is provided in Lundquist et al. (1995).

2.10.5.1 Amphibians

2.10.5.1.1 Tailed Frog (Ascaphus truei)

Tailed frogs occur commonly from sea level to 6,500 feet throughout the coastal mountains from British Columbia to northern California and Western Montana (Nussbaum et al. 1983). Tailed frogs have been reported throughout Western Washington in Chelan County, in mid-elevation Douglas fir/western hemlock (*Pseudotsuga menzeisii/ Tsuga heterophylla*) forests of the southeastern corner of the State (Beak Consultants 1993).

These frogs are usually found in or near permanent streams or in steep-walled valleys with dense vegetation (Bury 1968). Perhaps the most important factor limiting the distribution of tailed frogs is their requirement for permanent, fast-flowing streams with low water temperatures (Nussbaum et al. 1983). Unlike most other frogs, the tailed frog tends to avoid wetlands, marshes, ponds, lakes, and slow sandy bottom streams (Daugherty and Sheldon 1982). Streams supporting tailed frogs primarily occur in mature and old growth coniferous forests (Bury and Corn 1988; Welsh 1990; Bury 1983). Population densities of tailed frogs have been reported to be lower in clear-cut areas (Bury and Corn 1988) or managed young forests (Welsh 1990), although they have been observed in young, naturally regenerated forests. This suggests that forest structure rather than age may be the most important habitat attribute (Welsh 1990).

Although no comprehensive studies have been conducted to determine the occurrence of tailed frogs on the Plum Creek ownership, these frogs may occur within the permanent streams throughout the Planning Area. Highest population densities are expected in permanent streams draining old growth stands.

2.10.5.1.2 Northern Red-Legged Frog (Rana aurora aurora)

The northern red-legged frog is found in California, Oregon, Washington, and Canada (Nussbaum et al. 1983; Leonard et al. 1993). In Western Washington and Oregon, this frog occurs from sea level to 2,800 feet near Longmire, on Mt. Rainier.

These frogs are found in moist forests and riparian habitats West of the Cascades, below about 2,800 feet in elevation (Nussbaum et al. 1983). Critical habitat of northern red-legged frogs is not precisely known; however, suitable habitat is probably very similar to that of the closely related California red-legged frog (*Rana aurora draytoni*), which includes dense vegetation close to water level (Hayes and Jennings 1986) that provides surfaces for egg attachment (Nussbaum et al. 1983) and shading of the water (Hayes and Jennings 1986). The adults are highly terrestrial and little or no water flow may be required for reproduction (Nussbaum et al. 1983). They are often observed at some distance from aquatic habitat during the non-breeding season (Leonard et al. 1993). Studies in the southern Washington Cascades have indicated higher abundances of these frogs in mature stands than in younger or old growth stands, and abundance was correlated with high levels of woody debris, which may be used as hiding cover (Aubry and Hall 1991).

2.10.5.1.3 Cascades Frog (Rana cascadae)

Cascades frogs occur throughout the Cascade Mountains of Washington, Oregon, and northern California, and in the Olympic Mountains of Washington. They are rarely found at elevations below 2,000 feet and have been found at elevations as high as 6,190 feet near Mt. Rainier in Washington, and to 6,550 feet at Three Creek Lake in Oregon (Leonard et al. 1993).

Cascades frogs are most commonly found in pools adjacent to streams flowing through subalpine meadows. They also are found around marshy edges of streams and ponds, seasonally flooded swamps, small lakes, and sphagnum bogs and fens (Leonard et al. 1993). These frogs have been observed during the non-breeding seasons in upland forests. In the southwestern Cascades, adult frog abundance increased with forest stand age, favoring stands with moderate moisture (Aubry and Hall 1991).

2.10.5.1.4 Spotted Frog (Rana pretiosa)

Spotted frogs are commonly found in the Cascade Mountains and in areas of Eastern and central Washington and Oregon. These frogs have been found at elevations ranging from near sea level to 6,400 feet near Hart's Pass in Whatcom County, Washington (Leonard et al. 1993). The only known population of spotted frogs in Western Washington is in a tributary stream to the Black River in Thurston County.

Spotted frogs are the most aquatic native frog and are nearly always found in or near perennial water bodies such as ponds, springs, streams, and lakes (Nussbaum et al. 1983; Leonard et al. 1993). In addition, they are often associated with non-woody plant communities (i.e., sedges, rushes, and grasses) (Leonard et al. 1993). Habitat requirements are not precisely known, however, suitable oviposition and tadpole rearing sites, and refuges for post-metamorphic frogs, especially hibernating adults, are thought to be critical (Nussbaum et al. 1983; Hayes and Jennings 1986). There are no records which indicate sightings of spotted frogs within the Planning Area. In recent years, the Oregon spotted frog has been recognized as a distinct species from the Columbia spotted frog (*Rana lutiventris*). The Oregon spotted frog (*Rana pretiosa*) is a Federal candidate species and is currently only known to still reside at two sites in Thurston County and two sites in Klickitat County.

2.10.5.1.5 Larch Mountain Salamander (Plethodon larselli)

The Larch Mountain salamander is one of the rarest species of amphibians in the Pacific Northwest (Leonard et al. 1993). Until recently, it was thought that these salamanders were restricted to the vicinity of the lower Columbia River Gorge, between Hood River and Troutdale, Oregon, and from the Washougal River to near the Klickitat River, Washington (Nussbaum et al. 1983). However, disjunct populations of Larch Mountain salamanders have been found north of the Gorge in the central Cascade range of Washington near Mt. St. Helens and just south of Mt. Rainier (Aubry et al. 1987; Leonard et al. 1993). In addition, Larch Mountain salamanders have recently been reported by Forest Service biologists as occurring further north along the Cascade crest in the Plum Creek Planning Area. This salamander has been reported to occur at elevations near 3,400 feet (Leonard et al. 1993).

Most populations of Larch Mountain salamanders are found on steep talus slopes of the Columbia Gorge, where talus is kept moist by a covering of mosses and a dense overstory of coniferous and/or deciduous trees (i.e., Douglas fir or big leaf maple). The Larch Mountain salamander is primarily a terrestrial species and is almost never associated with open or flowing water (Rodrick and Milner 1991; Leonard et al. 1993).

2.10.5.2 Fish

All species of salmonids require a freshwater environment for spawning and embryonic development, but the species differ in the extent to which they reside and rear in freshwater after emerging from the gravel as fry. On the basis of duration of stream residence, three major life history patterns can be distinguished among salmonids: (1) stream residence throughout life (e.g., brook trout, brown trout, and some bull trout stocks); (2) stream spawning and residence of young for a period ranging from weeks (e.g., chinook salmon) to one to three years (e.g., coho salmon, steelhead trout) followed by emigration of the newly emerged fry to lakes or the ocean; (3) stream spawning followed by emigration of the newly emerged fry to lakes (e.g., kokanee) or ocean (e.g., pink and chum salmon)(MacFadden 1968). Patterns intermediate among these three also exist, and populations within the Planning Area may follow different patterns of freshwater residence. Rainbow trout, for example, may follow any of the three major patterns. Thus, within this wide range of environmental requirements the Fish Habitat Protection Plan (Section 3.3.3) will incorporate most, if not all, of the life history patterns and spawning and rearing requirements of the most sensitive species in the Planning Area, and will provide the opportunity for successful spawning, embryonic development, and juvenile rearing for other species of fish as well.

2.10.5.2.1 Bull Trout (Salvelinus confluentis)

Bull trout are native to North America (Morton 1970) and are distributed from 41 to 60 degrees North latitude along the Cascade and Rocky Mountain ranges (Meehan and Bjornn 1991). Bull trout also occur in the headwaters of North and South Saskatchewan Rivers of the Hudson Bay drainage in Alberta, and in the headwaters of the Athabaska, Peace, and Laird Rivers tributary to the Mackenzie River system in Alberta and British Columbia (Cavender 1978; Haas and McPhail 1991). South of the 49th parallel, bull trout occur mainly West of the continental divide in river systems that drain the Columbia River basin, except in Montana and Oregon (Platts et al. 1993).

The historical distribution of bull trout in Washington includes most of the State except that portion south and East of the Columbia River, but north of the Snake River; and in the southwest region of the State, that portion West of the Lewis River to Grays Harbor, but south of the Nisqually River basin (Mongillo 1992). Reductions in the historical distribution of bull trout have occurred mainly in Eastern Washington. As an example, bull trout populations are currently absent from the Chelan, lower Yakima, and Okanogan basins (Brown 1992). Although it is presumed that bull trout were once widely distributed throughout the Columbia basin, presently they are only occasionally observed in the Columbia and Snake Rivers (Brown 1992).

Life history forms of bull trout include: resident, fluvial, adfluvial (i.e., lacustrine), and anadromous (Goetz 1989; Brown 1992). Stream resident bull trout occupy small, high elevation streams. They rarely move and are seldom larger than 30 centimeters (Goetz 1989). Adult fluvial and adfluvial bull trout are known to migrate extensively (up to 225 kilometers) to spawning areas (Shepard et al. 1984). Adfluvial bull trout mature in lakes or reservoirs and spawn in tributary streams. Fluvial forms have a similar life history as adfluvial forms, except they move frequently between mainstem rivers and smaller tributary streams. Juveniles remain between one to six years in nursery streams before migrating downstream to either rivers (i.e., fluvial forms) or lakes (i.e., adfluvial forms) (Fraley and Shepard 1989; Brown 1992). Anadromous bull trout spawn and rear initially in streams, and migrate to saltwater where they grow and mature (Brown 1992).

2.10.5.2.2 Rainbow/Steelhead Trout (*Oncorhynchus mykiss*)

The rainbow/steelhead trout originally ranged from the Eastern Pacific Ocean and inland, mainly West of the Rocky Mountains, from northwest Mexico to the Kuskokwim River, Alaska (Rodrick and Milner 1991). In Washington, resident and anadromous (i.e., steelhead) rainbow trout occur throughout most of the drainages of Puget Sound, coastal streams, and the lower Columbia River. East of the Cascade Mountains, rainbow trout are commonly found in tributaries of the Columbia basin and tributaries of the Snake River (Scott and Crossman 1973; Wydoski and Whitney 1979; Rodrick and Milner 1991).

Rainbow trout and steelhead (i.e., freshwater phase) inhabit moderate gradient streams and rivers, preferring riffles and pools in summer and primarily pools with adequate cover during other seasons of the year (Scott and Crossman 1973). Primary factors limiting rainbow and steelhead populations in streams and rivers in Washington are stream temperatures that exceed the normal spawning and rearing range, lack of spawning and rearing habitat, high sedimentation and silt input at spawning and rearing areas, and reductions in productivity of preferred food items.

2.10.5.2.3 Coho Salmon (Oncorhynchus kisutch)

The coho salmon is native to the northern Pacific Ocean. Coho spawn and rear in streams from Monterey Bay, California, to Point Hope, Alaska, and southward along the Asiatic coast to Japan (McMahon 1983). The primary area of abundance is North America from Oregon to Alaska (Briggs 1953; Godfrey 1965; Hart 1973; Scott and Crossman 1973). In Washington, coho salmon spawn and rear throughout most of the drainages of Puget sound, coastal streams, and the lower Columbia River.

Although little is known of the historic distribution of coho salmon in the Yakima Subbasin, many fisheries managers believe that virtually all of the major upper Yakima River tributaries (i.e., the Teanaway River and Taneum, Manastash, Swauk, Big and Umtanum Creeks) supported coho (YIN et al. 1990). The Naches River and all accessible tributaries above the Tieton are also considered to have supported substantial numbers of coho.

Coho salmon use a wide variety of habitats in freshwater. Optimal rearing habitat for coho consists of a mixture of pools and riffles, abundant in-stream and bank cover, water temperatures that average between 10 to 15 degrees Centigrade © in summer, dissolved oxygen levels near saturation, and riffles with minimum concentrations of fine sediment (Reiser and Bjornn 1979). Side-stream vegetation is a particularly important component of coho habitat because it provides food, cover, temperature control, and helps maintain stream bank integrity (Narver 1978). Spawning occurs mainly in moderate-sized coastal streams and tributaries of larger rivers. As a general rule, coho do not use main channels of large rivers for spawning (Scott and Crossman 1973).

2.10.5.2.4 Chinook Salmon (Oncorhynchus tshawytscha)

Chinook salmon are known to be distributed from northern Hokkaido to the Anadyr River on the Asian Coast, and from the Sacramento-San Joaquin River system in central California, to Kotzebue Sound, Alaska (McPhail and Lindsey 1970; Major et al. 1978). In the Yakima Subbasin, natural production of spring chinook occurred historically in the Yakima River above the City of Ellensberg, the Naches River, the Cle Elum River below Lake Cle Elum, the Tieton River, Rattlesnake Creek, Bumping River, Little Naches, and American Rivers. Historical records also indicate that most of the large tributaries were also used by spawning adults (YIN et al. 1990).

Spawning stocks of chinook salmon prefer large rivers with deep pools (i.e., 3 to 6 feet) and abundant cover in the form of underwater ledges, large rocks, debris accumulations, and tree roots. Spawning occurs from near tidewater to over 3,000 kilometers upstream in the headwaters of the Yukon River (Majors et al. 1978). Spawning areas chosen by chinook vary considerably in a number of characteristics. Suitable spawning areas usually include gravel beds with an optimum mixture of gravel and large rocks, and minimal fine sediment, good subgravel flow, and oxygen concentrations near saturation. Chinook spawn in water depths ranging from a few centimeters (Burner 1951; Vronskiy 1972) to several meters (Chapman 1943; Chapman et al. 1986). Chinook are known to spawn in small tributaries (Vronskiy 1972) and in mainstems of large rivers like the Columbia and Yakima River systems (Chapman 1943; YIN et al. 1990). Adequate water percolation through the gravel comprising the nest site is extremely essential for egg and alevin survival. Chinook salmon have the largest eggs among the Pacific salmon (Rounsefell 1957), and thus, their eggs have a smaller surface-to-volume ratio than other Pacific salmon. Chinook eggs should, therefore, be the most sensitive to reduced oxygen concentrations and require greater rates of irrigation around the eggs. The chinook's greater need for strong subsurface flow may indicate that suitable spawning habitat is limiting production, and in many areas of the Columbia and Yakima River systems, many populations of chinook may be spawning in areas of low suitability, and their eggs consequently may be suffering high mortality.

Smaller chinook fry normally inhabit marginal areas of a river, particularly back eddies, behind and under fallen trees, undercut tree roots, or other areas of bank cover. As fry increase in size, they tend to venture into mainstream and higher velocity areas. Chinook juveniles rarely occur in "still" water or where velocity is greater than 30-centimeters per second (Chapman and Bjornn 1969), and chinook juveniles prefer finer substrates than steelhead of comparable size, but both species show a strong preference for rubble type habitat. Murphy et al. (1989) found that chinook were located mainly in riverine habitats, and infrequently in beaver ponds or off-channel sloughs. Velocity and turbidity are the primary factors associated with chinook distribution in rivers and streams (Chapman and Bjornn 1969).

2.10.5.3 Birds

2.10.5.3.1 Harlequin Duck (Histrionicus histrionicus)

The harlequin duck occurs in northeast Asia, Alaska, Canada, the Western United States, Greenland, and Iceland (Peterson 1961). In the Western United States, it breeds in mountainous areas from the Aleutian Islands to northern California, and along the northern Rocky Mountains to Yellowstone National Park (Rodrick and Milner 1991). In Washington, harlequins breed in the Olympic Mountains, the Cascades, Blue, and Selkirk Mountains. Wintering areas include northern Puget Sound, northern Hood Canal, Strait of Juan de Fuca, San Juan Islands, and the outer coast.

Harlequin ducks are generally found in mountainous areas alongside fast-moving mountain streams, where they nest on the ground or in holes in cliffs or trees (Rodrick and Milner 1991), with nearby loafing sites and dense shrubs or timber/shrub mosaic vegetation on the stream banks (Cassirer and Groves 1989).

2.10.5.3.2 Northern Goshawk (Accipter gentilis)

The northern goshawk is widely distributed throughout North America and Eurasia (Peterson 1961). In North America, goshawks breed in Western Alaska, most of Canada, the Pacific coast of the United States, south to California, along the Eastern States south to West Virginia, on the Eastern foothills of the Rocky Mountains and Black Hills, and in southern Arizona and New Mexico south to Western Mexico (AOU 1983). In Washington, the northern goshawk is an uncommon migrant and permanent resident throughout highly forested areas in the State. Goshawks are most common East of the Cascade range (Larrison and Sonnenberg 1968).

In general, goshawks are forest generalists, occurring in all major forest types (i.e., coniferous, deciduous, and mixed), forest ages, structural conditions, and successional stages (Reynolds et al. 1991). However, because of its relatively large body size and wing span, the goshawk seldom uses young, dense forests (Fischer 1986). In younger forest stands there are few trees in which goshawks can construct its large nest, and there is insufficient space in and below the canopy to facilitate hunting flight and capture of prey (Reynolds et al. 1991). The wide variation in habitat occupancy suggests that the choice of foraging habitat by goshawks may be more closely related to prey availability than to habitat structure or composition (Kenward and Widen 1989; Reynolds 1989).

In a study of the northern goshawk in the southwestern United States, Reynolds et al. (1991) identified three components of a goshawk's nesting home range, which is believed to encompass about 6,400 acres: nesting area includes approximately 30 acres; post-fledgling-family area includes about 420 acres; and foraging area encompasses about 5,400 acres.

In Eastern Washington the northern goshawk breeds most commonly in stands of Douglas fir, lodgepole pine (*Pinus contora*) and aspen (*Populus* species.), frequently along the edges of clearings (Reynolds et al. 1991). Approximately 80 nest sites are known in Washington at the present time (Washington

Environment 2010 1992). Nests commonly occurred in mature and old growth coniferous forest stands with a closed canopy near the bottom of north-facing moderate slopes.

2.10.5.3.3 Little Willow Flycatcher (Empidonx traillii brewsteri)

The little willow flycatcher is likely to breed in the Western portions of the Planning Area (west of the Cascade crest), probably along streams in willow or alder thickets and in adjoining plantations in the shrub/sapling stage, particularly those with a deciduous component, below 3,000 feet elevation. Thus, this subspecies would most likely occur in the lower portions of the Green River drainage. Another subspecies (*E. t. adastus*), which is not included on the Federal candidate list, likely occurs in similar situations in the Eastern portions of the Planning Area.

Throughout their range, willow flycatchers use a variety of open, brushy habitats that contain small tree or shrub thickets, such as wooded stream bottoms, deciduous thickets, or wet meadows with shrubs (Sharp 1992). They are commonly associated with willow thickets, and often with the presence of surface water, as in riparian or wetland habitats with woody cover (see McCabe 1991 and Sedwick and Knopf 1992). In Western Washington lowlands (western hemlock zone), they may be found in regenerating clear-cuts and brushfields with a component of deciduous shrubs, such as willow, alder, or vine maple (Sharp 1992). They commonly nest in shrub species such as dogwood, hawthorn, willow, elderberry, blackberry, and viburnum (USDA no date). Females select nest sites, accompanied by the males. They feed primarily on flying insects by sallying from a perch for short distances (Erlich et al. 1988). They often utilize exposed perches for singing and foraging (Sharp 1992).

2.10.5.3.4 Olive-sided Flycatcher (Contopus borealis)

Olive-sided flycatchers are known to occur within the Planning Area (D. Herter, personal communication, Raedeke Associates). They probably occur throughout the forests of the Planning Area, from lower elevations to the subalpine fir zones (Sharp 1992) on both sides of the Cascade crest.

This species generally inhabits open, mature montane and boreal coniferous forest and woodland of various types, up to spruce and true fir zones, especially in areas with abundant snags (Erlich et al. 1988; USDA no date; Sharp 1992; Dobkin 1994). Olive-sided flycatchers also occupy mixed woodlands near edges and clearings (USDA no date). They typically use prominent, high hunting perches (live trees or snags) with a view of openings. Apparently, the broken canopy and openings provide foraging areas (Marshall 1988; Sharp 1992).

From studies in unmanaged forests, Olive-sided flycatchers have been found to be most abundant in old growth stands in specific areas of the Pacific Northwest (i.e., Oregon Coast Range and Cascades), but of relatively similar abundance (no trend) among young, mature, and old growth stands in the southern Washington Cascades (Carey et al. 1991; Gilbert and Allwine 1991; Manuwal 1991; Ruggiero et al. 1991). Olive-sided flycatchers typically forage by sallying for insects in flight from prominent perches (Erlich et al. 1988).

2.10.5.4 Mammals

2.10.5.4.1 Townsend's Big-Eared Bat (Plecotus townsendii)

Townsend's big-eared bats occur in the Western United States, central Appalachian Mountains, and northern Mexico. Breeding sites in Washington are confirmed near Bellingham, Mt. St. Helens, and near the Columbia Gorge (Rodrick and Milner 1991). Additional sites have been recorded along the West-side of the Cascade crest in talus adjacent to old growth forests (Patty Garvey Darda, personal communication, Forest Service).

These bats are found in caves, lava tubes, and abandoned buildings. Temperature is a critical factor in selection of breeding, roosting, and hibernation sites for this species. Hibernation occurs in caves at temperatures near freezing [i.e., 32 degrees Fahrenheit (F)], whereas nursery colonies require warmer temperatures, generally above 50 degree F (Perkins and Levesque 1987). These bats are extremely sensitive to disturbance, and if a disturbance is severe enough, adult bats will abandon nursery colonies (Pearson et al. 1952; Graham 1966; Humphrey and Kunz 1976).

2.10.5.4.2 Myotis Bats (Myotis species.)

Five species of the genus *Myotis* may occur within the Planning Area. These species include the Long-legged Myotis *(Myotis volans)*; Long-eared Myotis *(M. evotis)*; Fringed Myotis *(M. thysanoides)*; Small-footed Myotis *(M. ciliolabrum)* and; Yuma Myotis *(M. yumanensis*). All of these myotis species share some aspects of their ranges and habitat requirements; therefore, discussions of the ecological requirements of each species have been combined into one review.

As a group, little is known about the precise ranges of each of the myotis species listed above and records from the Pacific Northwest are limited (Barbour and Davis 1969). These species of myotids are generally distributed throughout the Western United States, from the Rocky Mountains to the Pacific Coast and from Mexico north through the Pacific Northwest. All of the species occur in Washington, with the long-eared, long-legged, and Yuma myotids found throughout the State, and the small-footed and fringed myotids found primarily in the Eastern portions. The fringed myotis, however, has been infrequently observed and may be relatively uncommon in Washington (Perkins et al. 1990).

The long-legged, long-eared, and Yuma myotids have been frequently observed hibernating in Oregon and Western Washington (Senger 1974; Perkins et al. 1990) with most of the hibernacula found in caves and mines. The long-legged bat was the most common hibernating bat observed by Perkins et al. (1990). In addition, the long-legged, long-eared, and Yuma myotis are commonly encountered during the summer in Oregon which may indicate moderate population levels (Perkins et al. 1990). In addition, on-going research indicates the long-legged myotis is probably common throughout the forests of Western Washington (Thomas and West 1991).

Most temperate bat species migrate relatively short distances (10 to 500 km) from their summer ranges to winter hibernacula, and most bats in the northwest also exhibit short migrations (Christy and West 1993). Myotis species normally begin their migrations in October and November, and emerge from hibernacula sometime in March and April (Dalquest 1948 and Maser et al. 1981).

Current distributions of the long-legged, fringed, long-eared, Yuma, and small-footed myotis within the Planning Area are not known. Surveys for these species have not been conducted within the Planning Area or in the adjacent region; although, these species could occur in the area where suitable habitat is available for roosting (rockslides, caves/mines, buildings, bridges, and crevices) and foraging (open areas within forests and open water).

Three of the bats (long-legged, long-eared, and Yuma) inhabit coastal and montane forest and could be found in the Western portion of the Planning Area, particularly in the lower elevations where Douglas fir/western hemlock forests are located. The long-eared and Yuma myotis also occur in more arid forest (e.g., Ponderosa pine), as does the fringed myotis. Ponderosa pine/ lodgepole pine habitats are located in the Eastern and southeastern portion of the Planning Area and could support populations of myotids. The small-footed myotis is primarily associated with rock cliffs and slides, and may inhabit some of the talus slopes within the Planning Area.

Caves and mines play an important role in bat ecology by providing a safe place for hibernacula and maternity roosts; however, few caves occur in the immediate area. The nearest known caves are a series of caves located on Cave Ridge north of Snoqualmie Pass, north of the Planning Area; and a single cave West of the Naches River along Highway 410 in Yakima County, outside the southeastern portion of the Planning Area. However, abandoned mines and tunnels in the area may provide suitable sites for hibernacula and maternity roosts.

Studies of habitat requirements for myotis species are limited. Long-eared and Yuma myotis are known to occur in a wide variety of habitats including coastal and montane forests, arid forest (Ponderosa pine/Douglas fir), as well as arid grasslands. The long-legged myotis also occurs in coastal and montane forest, but does not normally inhabit more arid forests. Conversely, the fringed-myotis is thought to be common in arid forests such as Ponderosa pine and Douglas fir habitat, but may not inhabit more mesic forests, such as those found in Western Washington. The small-footed myotis normally inhabits rocky areas (e.g., rock cliffs) and is not thought to be a forest dweller; although, the species has been observed in old growth forests (Christy and West 1993).

Based on research on bat activity in mid-elevation, unmanaged forests of Western Oregon and Washington, bat activity has been found to be greater in old growth stands than in young or mature stands (Thomas and West 1991). These studies suggested that bats apparently utilize old growth forest for roosting rather than foraging, with foraging activities occurring over nearby water, along roads, and forest edges. In Western Washington, few of the bats captured in mist nets were female, and none showed evidence of reproduction. In addition, juveniles were only captured after the dissolution of maternity colonies (Thomas and West 1991). These data were in contrast to the results of surveys in Eastern Washington and Oregon where pregnant and lactating females were present at similar elevations (Fenton et. al. 1980; Perkins 1983). Thomas and West (1991) found no pregnant females in Western Washington at study sites between 300 and 600 meters, whereas pregnant females were common on the East-side of the Cascade range in Washington and in the Oregon Coast range (Christy and West 1993). In the Washington and Oregon Cascade Mountain ranges, climatic factors apparently affect the spatial distribution of reproductive individuals (Christy and West 1993).

The availability of suitable roost sites is a critical factor in determining population density and distribution of various bat species (Kunz 1982). Key requirements of roost sites include proximity to water and foraging habitat, protection from predators, and favorable temperature and moisture regimes. Variables such as sex, age, and breeding condition may also influence roost selection; for example, breeding females and young generally require different kinds of roosts than males and nonbreeding females (Christy and West 1993).

Several types of roosts are used by bats. Hibernacula are roosts in which bats hibernate during winter. Maternity roosts are structures used colonially by females and their young during the spring and summer months; males often join them in autumn after young are weaned. Day roosts are used to sleep or rest in during the day, either colonially or by small groups or individuals. Night roosts are structures used briefly (several minutes to several hours) at night by bats to rest between feeding periods or to feed on large insects that cannot be eaten while in flight; they are usually in different locations than day roosts (Christy and West 1993; Kunz 1982).

All of the aforementioned myotids utilize caves and mines for roosting (hibernacula or maternity roosts); however, some species (e.g., long-legged and fringed) also roost under the bark of live trees and snags and in rock crevices, as well as human-made structures such as bridges over streams (or old buildings, where available) for such purposes. These latter habitat elements are typically used by many species for colonial or solitary roosts.

Suitable foraging habitat is critical for the survivability of all bat species in the Pacific Northwest. Bats are most often observed foraging over water, although some also forage to some degree in forests, as well as in parks and street lamps in lowland areas with some level of development. Thomas and West (1991) documented detection rates of foraging myotids in Douglas fir forests in Western Oregon and Washington to be 10 times greater over water than in the forest interior; other studies have shown even greater differences in activity levels (e.g., Lunde and Harestad 1986). In upland forests, most foraging appears to occur over clearings and roads, but recently harvested areas do not seem to provide suitable foraging habitat; detections of little brown myotis were substantially reduced after clear-cutting in a study in British Columbia (Lunde and Harestad 1986).

The fringed myotis feeds on beetles and moths along forest edges, roads, open areas within forest, and along thickets near streams, whereas the small-footed myotis typically forages along cliffs and slopes (Christy and West 1993). The Yuma myotis is particularly unique among North American bats since the species forages almost exclusively over open water areas on aquatic insects (USDA 1995), and normally roosts relatively close to water (Verner and Boss 1980). The long-legged myotis utilizes riparian areas and forest clearings for foraging where it preys primarily on moths and beetles (USDA 1995). The long-eared myotis also feeds on airborne insects, but also gleans insects (e.g., beetles) from vegetation or off the ground (USDA 1995).

2.10.5.4.3 California Wolverine (Gulo gulo luteus)

The California wolverine has a circumboreal distribution, it occupies remote habitats, and populations are naturally low (Whitman et al. 1986). They are uncommon in Oregon, Washington, California, Idaho, and Wyoming (Groves 1988). Records of wolverines in Washington may represent dispersal or wandering of individuals from Canada. Although a number of observations have been recently recorded, the current distribution of wolverines in Washington is unknown.

Generally, wolverines are restricted to boreal forests, tundra, and Western mountains (Banci 1994). They occupy a variety of habitats, but wolverine habitat is often characterized by remoteness. Wolverine habitat has often been defined as large, sparsely inhabited (by humans) wilderness areas with adequate year-round food supplies, but the attributes of such "wilderness" has not been precisely defined. Wolverines are primarily nocturnal, non-migratory, and they do not hibernate (Wilson 1982; Krott 1960). The home range of wolverines ranges from less than 40 to more than 350 square miles, with male home ranges being larger than those of females, especially females with young (Bianci 1994).

2.10.5.4.4 Pacific Fisher (Martes pennanti)

The Pacific fisher is found through North America, and as far north as northern British Columbia (Strickland et al. 1982). They occur in portions of the Appalachian Mountains from New England south to West Virginia, northern Wisconsin, Minnesota, and Michigan, northern Idaho, Western Montana, and as far south as northern California along the West coast (Allen 1983; Rodrick and Milner 1991). Historic records show that the fisher was concentrated primarily in remote portions of the Olympic Mountains, along the Cascades, and as far East as the Okanogan Valley (Scheffer 1938). The fisher is apparently absent from the southern and Eastern portions of the State (Yocom and McCollum 1973; Aubry and Houston 1992). Fishers still occur on the Olympic Peninsula (Houston and Seaman 1985), and in other parts of its historic range in Washington (Rodrick and Milner 1991), but in very low numbers and in a patchy distribution (Aubry and Houston 1992; Powell and Zielinski 1994).

Fishers are normally solitary except for a brief period during the breeding season (deVos 1952; Coulter 1966; Powell 1982). This species is always found in or near forests with continuous overhead cover (Powell 1982), comprised primarily of dense coniferous and mixed coniferous/deciduous forests (Allen 1983). Although second growth forests with adequate cover may be used occasionally, mature to old growth stands are generally preferred due to the greater availability of cover and den sites, as well as habitat for prey species (deVos 1952; Ingram 1973; Aubry and Houston 1992; Powell and Zielinski 1994).

Fishers are opportunistic, feeding on a variety of small to medium-sized mammals and birds, and carrion (Strickland et al. 1982). Snowshoe hares are the most common prey and have been reported in fisher diets in virtually all food habitat studies (Powell and Zielinski 1994). Although few diet studies have been conducted in the Pacific States, Ingram (1973) found that northern flying squirrels, snowshoe hares, and Douglas squirrels were important food items in a study in Oregon, and Strickland et al. (1982) described the specialized ability of the fisher in hunting and capturing porcupine. Although porcupines are important prey of fishers in many places, they are seldom as common in fisher diets as hares (Powell and Zielinski 1994).

In Washington, records of fisher occurrence indicate that West of the Cascade crest, fishers occur below 3,300 feet elevation in the Western hemlock and Sitka spruce zones, however, most records of fishers East of the Cascade crest occur above the 3,300 feet elevation level in subalpine fir and grand fir/Douglas fir zones (Aubry and Houston 1992). The difference in elevation preference East and West of the Cascade crest is thought to be related to an aversion of fishers to the deep snow commonly found West of the Cascade crest which may hamper movement and foraging success (Aubry and Houston 1992; Powell and Zielinski 1994). Although fishers are known to occur in a wide variety of forest types, they are most often associated with wetland forests and riparian zones (Powell 1982; Strickland et al. 1982; Aubry and Houston 1992). Home range size estimates vary greatly across the range of the fisher and differs between the sexes. Mean home range size for males is about 16 square miles (range 7 to 31 square miles), and about 6 square miles for females (range 2 to 12 square miles). Because of their large home ranges, one to several hundred square miles of contiguous, interconnected suitable habitat may be needed to maintain a viable population in a given area (Powell and Zielinski 1994).

In Western mountains, fishers prefer late-successional forests (particularly for resting and denning) and occur most frequently where forests include fewer large, nonforested openings (Powell and Zielinski 1994). Ideally, large tracts of late-successional forest stands with at least 80 percent canopy closure should be maintained where fishers are present. Large physical structures (e.g., live trees, snags, logs) are the most frequent resting sites. Snags, defective live trees, especially those with “hollows”, and downed woody material should be maintained to provide den sites for fishers.

2.10.6 Species of Concern

A discussion of the Species of Concern including information on range, occurrence in the Planning Area, habitat requirements, and management considerations for each species is provided in Lundquist et al. (1995).

2.10.6.1 Reptiles

The northwestern pond turtle (*Clemmys marmorata marmorata*) is the only reptile among the Species of Concern. This species is found along the Pacific Coast of North America from southwestern British Columbia to northwestern Baja California. In Washington, populations of the Western pond turtle are confirmed only in Klickitat and Skamania Counties, with individual sightings from Thurston, Pierce, and King Counties. Within King County, the closest Western pond turtle sighting to the Planning Area is probably the Ravensdale turtle collected in 1992 and later added to the Woodland Park Zoo captive breeding project (personal communication, WDFW).

The turtle usually inhabits marshes, ponds, sloughs, and small lakes in Washington (Slater 1939). These turtles prefer waters with abundant aquatic vegetation and protected shallow areas where juveniles may rest and feed under cover. Adults commonly require logs, banks, or floating vegetation for basking. In winter, adult turtles hibernate either on land or on pond bottom. Those adults overwintering on land often move several hundred meters from water, usually burying themselves under several inches of leaves, soil, or sticks (personal communication, WDFW). Those turtles overwintering on pond bottoms, bury themselves in soft mud or sand (Rodrick and Milner 1991).

2.10.6.2 Birds

2.10.6.2.1 Black Tern (Chlidonias niger)

In North America, the black tern nests in prairie sloughs and marshes across the northern plains of the United States and Canada. These terns winter in South America (Peterson 1961). According to Jewett et al. (1953), black terns are casual visitors on Puget Sound and the Columbia River. Black terns are common and doubtless nest on all suitable bodies of water in Eastern Washington (Jewett et al. 1953).

Black terns are summer residents of the sloughs, marshes, and wet meadows of the plains (Bent 1921). Peterson noted that they nest on floating marsh vegetation, in loose colonies. The black tern is a rare migrant on the West-side of the Cascades, and primarily a summer visitor on the East-side where it is commonly associated with freshwater habitats (Wahl and Paulson 1981).

2.10.6.2.2 Bald Eagle (Haliaeetus leucocephalus)

The bald eagle is found throughout North America. It breeds primarily in Alaska, Canada, the Pacific Northwest States, the Rocky Mountain States, the Great Lakes States, and Chesapeake Bay (USFWS 1986; American Ornithologists' Union 1983). In Washington it is most common along saltwater, lakes, and rivers in the Western portion of the State and along the Columbia River East to the Cascade Mountains (Larrison and Sonnenberg 1968). The bald eagle's primary wintering range in Washington is Puget Sound and its major river systems.

In Washington, breeding territories are located in predominantly coniferous, uneven-aged stands with old growth components (Anthony et al. 1982). Bald eagles typically build large stick nests in mature or old growth trees, and these nests are generally used over successive years. Bald eagles use perches near feeding areas which are typically isolated areas in old growth stands that have trees larger than the surrounding trees. Roost trees are chosen according to their diameter, and growth form, and for the protection (i.e., canopy) they offer from inclement weather and disturbances (USFWS 1986). Sufficient, consistent, accessible, and non-contaminated food resources may be the most critical component of winter and breeding habitat for bald eagles (USFWS 1986; Stalmaster 1987)

2.10.6.2.3 Golden Eagle (Aquila chrysaetos)

The golden eagle is an extremely widespread species, occurring throughout the northern hemisphere in both Arctic and temperate zones (Rodrick and Milner 1991). These eagles breed throughout Western North America from Western Alaska to northern Mexico (American Ornithologists' Union 1983). In Washington, the golden eagle occurs mainly in the upper Columbia Basin, and it breeds in all counties except for those in the lower Columbia Basin and parts of the Puget Trough (Rodrick and Milner 1991). The eagle is considered an uncommon resident of open alpine areas of the Cascades; a fairly common, but scattered resident in Eastern Washington; and uncommon in Western Washington, except in the San Juan Islands where it occurs regularly (Larrison and Sonnenberg 1968).

In general, the golden eagle requires large, open areas for feeding, and nests are usually on cliffs or in large trees (Anderson and Bruce 1980; Snow 1973). East of the Cascades, these eagles are commonly associated with open, arid sagebrush, Ponderosa pine, and grassland habitats near cliff and plateau topography (Rodrick and Milner 1991). In Western Washington, nest sites are normally in large trees in mature to old growth forests near the edge of clear-cuts (Anderson and Bruce 1980). Bruce et al. (1982), in a survey of golden eagle nesting territories in Western Washington, found four territories on the Western slopes of the north Cascades, four in southwestern Washington, three on the Olympic Peninsula, and two in the San Juan Islands. Twelve of the 13 territories contained nests in large Douglas fir trees in mature to old growth forests.

2.10.6.2.4 Peregrine Falcon (Falco peregrinus)

The peregrine falcon was once one of the most widely distributed birds in the world (Terres 1980). They nested from the northern edges of North America, south to southern South America, and from northern Europe, northern Asia, south to southern Africa, Madagascar, Australia, and other Islands of Western Oceania. Within Washington, these falcons may nest in all but the driest portions of the State (WDW 1993).

Peregrines usually prefer open country such as marshes, coastal and river shorelines, estuaries, wide meadows, and farmlands, which enhances their style of hunting. A specific hunting territory may extend to a radius of 12 to 15 miles from a nest site (Hoover and Willis 1987; WDW 1993). Nests are found on cliff faces, typically 150 feet or more in height, in undisturbed areas.

2.10.6.2.5 Flammulated Owl (Otus flammeolus)

The flammulated owl ranges within mountainous regions of Western America from Guatemala to Canada. They are relatively uncommon in Washington, usually occurring only at elevations above 3,000 feet on the East-side of the Cascade Mountains. These owls occur in Ponderosa pine and grand fir/Douglas fir forests in Kittitas and Yakima Counties in proximity to the Planning Area. They also occur in Franklin, Benton, Okanogan, Lincoln, Klickitat, Adams, Spokane, Douglas, Walla Walla, and Whitman Counties (Rodrick and Milner 1991).

This owl is found primarily in open, mature to old growth Ponderosa pine and grand fir/Douglas fir forests (Guenther and Kucera 1978; Jones and Stokes Associates 1980; Bull and Anderson 1978; Goggans 1986; Reynolds and Linkhart 1987). In Oregon, individual home ranges of this owl averages about 25 acres in size, with core areas located in mature timber stands with two canopy layers (Goggans 1986). The uppermost canopy layer usually includes trees at least 200 years old, and the core areas are often adjacent to or near clearings of 10 to 80 percent brush cover (Marcot and Hill 1980; Bull and Anderson 1978). Daytime roosts are usually located in mature, mixed conifer stands with dense, multi-layered canopies (Goggans 1986; Bull and Anderson 1980; Rodrick and Milner 1991). Grasslands in or adjacent to forest stands are important foraging areas for this owl (Rodrick and Milner 1991).

2.10.6.2.6 Lewis' Woodpecker (Melanerpes lewis)

Lewis' woodpecker breeds from British Columbia and southern Alberta to New Mexico, and from South Dakota West to the Pacific. It winters from Oregon south to Baja, California East to Western Texas and southern Nebraska (Jackman and Scott 1975; Rodrick and Milner 1991). Lewis' woodpecker has been noted in Western Whatcom and Skagit Counties, Olympic Peninsula and southwestern Washington, through the Columbia Gorge, on the East slopes of the Cascade Mountains to the Okanogan Highlands, northeast Washington, and the Blue Mountains.

This woodpecker is principally a resident of the Transition Zone associated with Ponderosa pine and cottonwood riparian areas, and it is locally distributed, often in colonies, and frequently in burned forests (Jewett et al. 1953; Larrison and Sonnenberg 1968; Rodrick and Milner 1991). They normally nest in conifers and hardwoods, with a preference for dead snags rather than live trees (Bock 1970; Rodrick and Milner 1991). Open and/or park-like Ponderosa pine forests are probably the major breeding habitat of this woodpecker, although they are known to nest in burned-over stands of Douglas fir, mixed conifer, riparian and oak woodlands (Bock 1970). An open canopy is the common characteristic in all breeding habitats used by these woodpeckers, and is related to their foraging methods of hawking (i.e., catching insects on the wing) and gleaning. An important component of their preferred breeding habitat is brushy undergrowth which supports insects. Another desirable habitat feature is selectively logged or burned coniferous forests, with a shrub understory in which insects are prevalent (Bock 1970; Jackman and Scott 1975; Rodrick and Milner 1991).

2.10.6.2.7 Pileated Woodpecker (Dryocopus pileatus)

Pileated woodpeckers are residents from northern British Columbia, and southern Canada East to Nova Scotia, south to northern California, Idaho, Montana, Eastern Kansas and south to the Gulf Coast and Florida. They also occur in forested areas of Washington State.

These woodpeckers are most common in mature and old growth forests, and second growth forests with substantial numbers of large snags and fallen trees. The most suitable habitats are probably conifer stands with two or more canopy layers. This woodpecker excavates large nest holes in snags or living trees with dead wood. The preferred tree species for nest sites East of the Cascades are Western larch (*Larix occidentalis*), black cottonwood (*Populus trichocarpa*), Ponderosa pine, and Douglas fir and grand fir West of the Cascades (Mellen 1987; Nelson 1988; Bull 1987; Madsen 1985). These woodpeckers forage primarily within forests 40 years old or older, on large snags, logs, and stumps. They seldom forage in clear-cuts, but they are known to feed readily in logging debris in shelterwood cuts.

2.10.6.2.8 White-Headed Woodpecker (Picoides albolarvatus)

Although ranging from southern British Columbia and Idaho, to southern California, this woodpecker is uncommon throughout its range. Within Washington, this woodpecker is found in Ponderosa pine forests on the East slope of the Cascade Mountains and throughout Eastern Washington (Rodrick and Milner 1991).

The white-headed woodpecker requires large, decayed snags and forages mainly on large Ponderosa pine trees over 24 inches DBH (Jackman and Scott 1975; Thomas 1979; Lang et al. 1980). It forages on insects inhabiting the scales of trees and during winter, this woodpecker feeds heavily on seeds from unopened pine cones. The estimated home range for this species in northeastern Oregon averages 20 acres (Thomas 1979), although the size may vary depending upon habitat quality.

2.10.6.2.9 Vaux's Swift (Chaetura vauxi)

Vaux's swift occurs from southeast Alaska, northeast British Columbia and Western Montana, south to central California, and Central America. This swift is a summer resident throughout the wooded areas of Washington (Rodrick and Milner 1991). Terres (1980) noted that Vaux's swift are regarded as a more or less common summer resident in the greater Seattle area.

Vaux's swift nest in mature and old growth coniferous forests and require cavities in large hollow snags or broken tops of trees for nesting and night roosting (Rodrick and Milner 1991). Lundquist and Mariani (1991) found high swift counts associated with high density of old growth trees and with snags abundant in the old growth stands. Occurrence of this swift was also found to be strongly correlated with live trees greater than 39 inches DBH. According to Meslow et al. (1981) Vaux's swift finds optimum habitat, and thus attains greatest densities, in old growth forests in the Douglas fir region.

2.10.6.2.10 Western Bluebird (Sialia mexicana)

The Western bluebird breeds in southern British Columbia and central Montana, and south to northern Baja, California and Mexico (Terres 1980). Within Washington, this species is found throughout the lowlands and foothills of the State, but is most common in Eastern Washington (Rodrick and Milner 1991).

This bluebird is most common in open oak and open coniferous woodlands, with snags, and in other open areas with scattered trees. This species forages commonly on the ground. Nests are constructed in natural cavities of oaks, yellow pines, and in abandoned nest holes of woodpeckers.

2.10.7 Associated Species

One of the primary objectives of Plum Creek's HCP is to provide a variety of habitat conditions that will benefit a diversity of wildlife species. In keeping with that goal, Plum Creek developed a matrix of wildlife species occurrences across the array of forest types, stages of forest stand structural development, and special habitats that occur in the Planning Area. The matrix allows Plum Creek to assess various forest stand structural stages across the landscape for its wildlife habitat value. The matrix also aids in comparing HCP management alternatives and their impacts on the wildlife species that are either known or expected to occur in the Planning Area.

The wildlife habitat matrix includes 280 vertebrate species that may use suitable habitats in the Planning Area (Lundquist and Hicks 1995). This associated species complex includes: 68 mammals, 162 birds, 8 amphibians, 12 reptiles, and 30 fish. In order to evaluate adequately responses of this large group of species to changes in habitat conditions predicted under various forest-management options, Plum Creek assigned each of the 280 species into one of the 16 Lifeforms originally developed by Thomas (1979) and also used by Brown (1985) that best describes their breeding and feeding strategies (Table 17). In addition, for the purposes of the wildlife habitat matrix, a list of structural stages of stand development was derived within each forest type. In other words, the eight structural stages used by Plum Creek to identify spotted owl habitats in the Planning Area (Oliver et al. 1995) were re-grouped into six categories (Table 18) in order to correspond generally to the stand conditions or stages of forest development used by Brown (1985) and Thomas (1979). Similarly, a list of special habitats, including wetland, riparian, and other (forest and non-forest) habitats were adapted from Brown (1985) and Thomas (1979) for use in the wildlife habitat matrix.

Table 17. Lifeform Descriptions Used in Plum Creek's HCP

No.	LIFEFORM TYPE	SEARCH AREA	No. Spp	REPRODUCES	FEEDS	HABITAT
1	Fish	RHAs	34	in water	in water	Primary: Water
2	Frogs, salamanders	RHAs	10	in water	on the ground, in bushes, and/or in trees	Primary: DF/MF/MOG/OG Secondary: SI/SS/YF/PT
3	Turtles, ducks	RHAs	36	on the ground around water	on the ground, and in bushes, trees, and water	Primary: DF/MF/MOG/OG Secondary: SI/SS/YF/PT
4	Falcons, goats	Rocks & Talus	17	in cliffs, caves, rimrock, and/or talus	on the ground or in the air	Primary: PT/DF/MF/MOG/OG Secondary: SI/SS/YF
5	Grouse, hares, elk/deer (gray wolf)	0.5 mile window	33	on the ground without specific water, cliff, rimrock or talus association	on the ground	Forage: SI/SS/YF Cover: PT/DF/MF/MOG/OG
6	Warblers, porcupines	RHAs	8	on the ground	in bushes, trees, or in the air	Primary: SI/SS/YF Secondary: PT/DF/MF/MOG/OG
7	Sparrows, blackbirds, thrushes	RHAs	19	in bushes	on the ground, in water, or in the air	Primary: SS/YF/PT/DF Secondary: SI/MF/MOG/OG
8	Warblers, flycatchers	HCP	7	in bushes	in trees, bushes, or in the air	Primary: SS/YF/PT Secondary: DF/MF/MOG/OG
9	Waxwings, grosbeaks	RHAs	5	primarily in deciduous trees	in trees, bushes, or in the air	Primary: YF/PT/DF Secondary: MF/MOG/OG
10	Squirrels, tanagers, warblers	HCP	12	primarily in conifers	in trees, bushes, or in the air	Primary: PT/DF/MF/MOG/OG Secondary: SS/YF
11	Vireos, hawks	HCP	28	in conifers or deciduous trees	in trees, in bushes, on the ground, or in the air	Primary: PT/DF/MF/MOG/OG Secondary: SI/SS/YF
12	Herons, osprey, great horned owl	RHAs	6	on very thick branches	on the ground or in water	Primary: DF/MF/MOG/OG Secondary: PT
13 13a	Woodpeckers Lewis' woodpecker, whiteheaded woodpecker, pileated woodpecker	HCP HCP	14	in own holes excavated in trees	in trees, in bushes, on the ground, or in the air	Primary: DF/MF/MOG/OG Secondary: YF/PT Primary: MF/MOG/OG Secondary: SI\SS after 10 yrs. YF/PT after 20 yrs. DF every year
14 14a	Bats, owls, bluebirds flammulated owl, Vaux's swift, fisher	HCP HCP	43	in a hole made by another species or in a natural hole	on the ground, in water, or in the air	Primary: DF/MF/MOG/OG Secondary: SI /SS/YF/PT Primary: MF/MOG/OG Secondary: DF
15	Shrews, bears, voles	HCP	36	in a burrow underground	on the ground or underground	Young-Aged: SI/SS/YF Mid-Aged: PT/DF Late-Aged: MF/MOG/OG
16	Kingfishers, otters, beavers	RHAs	7	in a burrow underground	in the air or in the water	Primary: DF/MF/MOG/OG Secondary: SI/SS/YF/PT
Total			**315**			

DF - Dispersal Forest; MF - Mature Forest; MOG - Managed Old-Growth; OG - Old-Growth; SI - Stand Initiation; SS - Shrub/Sapling; YF - Young Forest; PT - Pole Timber

Search Area:

RHA — Riparian Habitat Areas; HCP — Habitat Conservation Plan Planning Area; 0.5 mile window — Scanning radius which provides a basis for sampling edge (i.e., the area between forage and cover habitats) in the HCP Planning Area.

Table 18. Comparison of Proposed Stand Structural Stages Used in Plum Creek's HCP with Stages of Forest Ecosystem Development from Published Sources Used as a Basis for the Wildlife Habitat Matrix

Proposed Spotted Owl Structural Stages	Brown (1985) Stand Conditions	Thomas (1979) and Hanley & Taber (1979) Stand Conditions
(1) Stand Initiation	Grass-Forb	Grass-Forb
(2) Shrub-sapling	Shrub	Shrub-Seedling
(3) Young Forest	Open Sapling-Pole	Pole-Sapling
(4) Pole Timber	Closed Sapling, Pole, Sawtimber	Young
(5) Dispersal Forest	Closed Sapling, Pole, Sawtimber	Young
(6) Mature	Large Sawtimber	Mature
(7) Managed Old-Forest	N/A	N/A
(8) Old-Growth	Old-Growth (over 200 years old)	Old-Growth

When compiling the wildlife habitat matrix for the Planning Area, Plum Creek assumed that habitat conditions are the primary determinants of the number of wildlife species and numbers of individuals in a given area. Thus, the first step in developing the wildlife habitat matrix for the Planning Area was consideration of important habitat conditions such as vegetation structure, plant species composition, presence and abundance of special habitats (including vegetative and non-vegetative), as well as environmental factors such as climate (i.e., moisture, temperature regimes), elevation, slope aspect, landscape position, disturbance history and frequency, soils, and geologic history.

Forest-management practices can have an effect on habitat conditions, vegetation structure and presence of special habitat elements. In addition, timber harvest activities can produce conditions similar to natural stages of forest development following a natural disturbance such as a fire. Therefore, an understanding of the relationships between wildlife and natural stages of development can be useful in predicting the effects of forest management on wildlife diversity and abundance. The versatility of wildlife species and their adaptations to the array of habitat conditions across the landscape varies, and as a result, their vulnerability to forest-management activities varies greatly.

Fish and wildlife habitat management will occur under the HCP in coordination with forest management, which will be the predominant land use activity in the Planning Area. It is reasonable to assume that the occurrence and distribution of fish and wildlife populations in the Planning Area will be influenced by forest-management activities proposed by Plum Creek, and by activities on Federal and other lands within the Planning Area. For widely ranging and migrant species, populations will also be influenced by activities on lands outside the Planning Area, and outside the central Cascade Mountain Range.

2.10.8 Plants

Numerous references were consulted to determine if any plant species observed or likely to occur in the Planning Area were listed as endangered, threatened, sensitive, or species of special status by State or Federal agencies (Washington Natural Heritage Program 1981, 1994; Hitchcock and Cronquist 1990; Hitchcock et al. 1990; Potash 1991; Smith-Kuebel and Lillybridge 1993). The Washington Natural Heritage Program was contacted in November 1994, for specific information on the occurrence of endangered, threatened, or sensitive plant species in the Planning Area (Washington Department of Natural Resources 1994; Appendix 6).

2.10.8.1 Federal Listing

No federally listed endangered or threatened plant species are likely to occur in Plum Creek's Planning Area.

2.10.8.1.1 Federal Endangered Species

Two plant species within Washington State are listed as endangered by FWS: swamp sandwort (*Arenaria paludicola*), and Bradshaw's desert parsley (*Lomatium bradshawii*). Marsh sandwort, listed as occurring historically in King and Pierce Counties, has been found in swamps, mostly in Pierce County. It ranges from the "prairies" near Tacoma and coastal southwestern Washington to Los Angeles County, California. It is unlikely that suitable habitat occurs within the higher elevations of the Planning Area. Bradshaw's desert parsley has been found in moist, low ground in the Willamette Valley of Oregon, from Salem to Eugene, and is also not expected to be present within the Planning Area (Washington Natural Heritage Program 1981; Hitchcock et al. 1990).

2.10.8.1.2 Federal Threatened Species

Those plants listed as federally threatened within Washington State are: Nelson's checker-mallow (*Sidalcea nelsoniana*), a regional endemic found in Cowlitz County, and Howellia *(Howellia aquatilis*), a federally threatened species and regional endemic which has been found in Clark, Pierce, and Spokane Counties, and historically in Mason and Thurston Counties. A regional endemic is a taxon inhabiting a relatively large geographical area ranging from a mountain range to the entire Pacific Northwest. Neither Nelson's checker-mallow or Howellia has historically occurred or is expected to occur in King or Kittitas Counties nor in the Planning Area (Hitchcock et al. 1990; Washington Natural Heritage Program 1994) (Tables 19 and 20).

Golden Indian paintbrush (*Castilleja levisecta*) is listed as a proposed threatened species by the FWS (59 FR 3811). It was historically and presently is found in the Puget Sound region in prairies. Golden Indian paintbrush is suspected to occur at low elevations West of the Cascades and is not expected to be found in the Planning Area (Washington Natural Heritage Program 1981; Hitchcock et al. 1990).

2.10.8.1.3 Federal Candidate Species

Clustered lady's-tresses (*Cypripedium fasciculatum*) is a Federal candidate species, and a Washington State threatened species. This plant has been found East of the Cascade Mountains, in moist to rather dry, rocky, open coniferous forest. It is often associated with Douglas fir (*Pseudotsuga menziesii*) and Ponderosa pine (*Pinus Ponderosa*) (Smith-Kuebel and Lillybridge 1993).

2.10.8.2 State Listing

The State of Washington Natural Heritage Program (1994) maintains a list of plant species considered to be endangered, threatened, or sensitive within the State (Tables 19 and 20).

2.10.8.2.1 Washington State Endangered Species

Swamp sandwort (*Arenaria paludicola*) is listed as possibly extinct in King County where it was found historically. As described above, swamp sandwort grows along the Western portion of Puget Sound and along the Washington coast (Section 2.10.8.1); thus, primary suitable habitat is unlikely to occur in the Planning Area.

The State endangered plant species known or expected to occur in Kittitas County are Wenatchee larkspur (*Delphinium viridescens*), and Oregon checker-mallow (*Sidalcea oregana* var. *calva*). Both may occur in the northern portions of the Planning Area. Wenatchee larkspur populations are reported to be very local (i.e., small areas provide habitat) in the Wenatchee Mountains. This species grows in moist, micro-sites in open coniferous forests, in springs, seeps, and riparian areas, where there is surface water or saturated upper soil layers during spring through early summer, and drying in late summer. Wenatchee larkspur has been found at elevations between 1,800 to 4,200 feet. Oregon checker-mallow also grows in the Wenatchee Mountains generally within dry, Ponderosa pine forests. However, it also has been found growing with quaking aspen and Wenatchee larkspur in moist sites, in boggy meadowlands, and near streams (Washington Natural Heritage Program 1981; Hitchcock et al. 1990; Smith-Kuebel and Lillybridge 1993).

The only State endangered plant species known or expected to occur in King County is golden Indian paintbrush, described above (Section 2.10.8.1), however, it is not expected to occur in the Planning Area (Hitchcock et al. 1990; Potash 1991).

2.10.8.2.2 Washington State Threatened Species

The Columbia milk-vetch (*Astragalus columbianus*), tall bugbane *(Cimicifuga elata*), White eatonella (*Eatonella nivea*), Basalt daisy (*Erigeron basalticus*), Hoover's desert-parsley (*Lomatium tuberosum*), Hoover's tauschia (*Tauschia hooveri*), adder's-tongue (*Ophioglossum pusillum*), clustered lady's-slipper (*Cypripedium fasciculatum*), water lobelia (*Lobelia dortmanna*), Choriso bog-orchid (*Plantanthera chorisiana*), and Seely's silene (*Silene seelyi*), are the State-listed threatened plant species known or expected to occur in King or Kittitas Counties (Tables 19 and 20).

Table 19. Endangered, Threatened, and Sensitive Vascular Plants of King County, Washington, as of January, 1994 (Source: Washington Natural Heritage Program 1994; Updated February 1995; Federal Register 1994; Reed 1988, 1993)

Scientific Name	Common Name	Status		Historic Record	WIS
		State	Federal		
Arenaria paludicola	Swamp sandwort	PE	LE	H	OBL
Castilleja levisecta	Golden Indian- paintbrush	E	PT	H	UPL*
Cimicifuga elata	Tall bugbane	T	C	H	UPL*
Lobelia dortmanna	Water lobelia	T	-	-	OBL
Plantanthera chorisiana	Choris' bog-orchid	T	-	-	OBL
Aster curtus	White-top aster	S	C	-	UPL*
Botrychium lanceolatum	Lance-leaved grape-fern	S	-	-	FACW
Botrychium pinnatum	St. John's moonwort	S	-	-	FACW
Campanula lasiocarpa	Alaska harebell	S	-	-	FACU
Carex comosa	Bristly sedge	S	-	H	OBL
Carex pauciflora	Few-flowered sedge	S	-	-	OBL
Carex saxatilis var. major	Russet sedge	S	-	-	FACW
Carex stylosa	Long-styled sedge	S	-	-	FACW
Cassiope lycopodioides	Clubmoss cassiope	S	-	-	UPL*
Galium kamtschaticum	Boreal bedstaw	S	-	-	UPL*
Lycopodiella inundata	Bog clubmoss	S	-	H	OBL
Lycopodium dendroidium	Treelike clubmoss	S	-	-	FACU
Orobanche pinorum	Pine broomrape	S	-	-	UPL*
Plantanthera obtusata	Small northern bog-orchid	S	-	H	FACW
Pleuricospora fimbriolata	Fringed pinesap	S	-	-	UPL*

Status Codes:

State: E = Endangered; T = Threatened; S = Sensitive; PE = Possibly Extinct

Federal: C = Candidate for listing on the November 15, 1994 Federal Register; LE = Listed Endangered; PT = Proposed Threatened; — = No Federal Status

Historic Record: H = Known only from historic records

Wetland Indicator Status (WIS) Ratings (Reed 1988, 1993): OBL = Obligate wetland; FACW = Facultative wetland; FAC = Facultative; FACU = Facultative upland; UPL* = Upland; UPL = Plant species not mentioned on the WIS list, were rated upland by default

Table 20. Endangered, Threatened, and Sensitive Vascular Plants of Kittitas County, Washington, as of January 1994 (Source: Washington Natural Heritage Program 1994; Updated February 1995; Federal Register 1994; Kartesz 1994; Reed 1988, 1993

Scientific Name	Common Name	Status		Historic Record	WIS
		State	Federal		
Delphinium viridescens	Wenatchee larkspur	E	C	-	UPL*
Sidalcea oregana	Oregon checker-mallow	E	C	H	FACW-
Astragalus columbianus	Columbia milk-vetch	T	C	-	UPL*
Cypripedium fasciculatum	Clustered lady's slipper	T	C	-	FACU
Eatonella nivea	White eatonella	T	-	-	UPL*
Erigeron basalticus	Basal daisy	T	C	-	UPL*
Lomatium tuberosum	Hoover's desert-parsley	T	C	-	UPL*
Ophilglossum pusillum	Adder's-tongue	T	-	-	UPL*
Silene seelyi	Seely's silene	T	C	-	UPL*
Tauschia hooveri	Hoover's tauschia	T	C	-	UPL*
Agoseris elata	Tall agoseris	S	-	-	FAC
Anemone nuttalliana	Pasqueflower	S	-	-	UPL*
Astragalus arrectus	Palouse milk-vetch	S	-	H	UPL*
Astragalus misellus var. pauper	Pauper milk-vetch	S	-	-	UPL*
Carex buxbaumii	Buxbaum's sedge	S	-	-	OBL
Carex comosa	Bristly sedge	S	-	H	OBL
Chaenactis thompsonii	Thompson's chaenactis	S	-	-	UPL*
Cryptantha leucophaea	Gray cryptantha	S	-	-	UPL*
Cyperus bipartitus	Shining flatsedge	S	-	-	UPL*
Erigeron piperianus	Piper's daisy	S	-	-	UPL*
Erigeron salishii	Salish fleabane	S	-	-	UPL*
Galium kamtschaticum	Boreal bedstraw	S	-	-	UPL*
Gentiana douglasiana	Swamp gentian	S	-	H	OBL
Hackelia hispida	Sagebrush stickseed	S	-	H	UPL*
Iliamna longisepala	Longsepal globemallow	S	-	-	UPL*
Limosella acaulis	Southern mudwort	S	-	-	OBL
Mimulus suksdorfii	Suksdorf's monkey-flower	S	-	H	FACU
Montia diffusa	Branching montia	S	-	H	UPL*
Nicotiana attenuata	Coyote tobacco	S	-	H	FACU
Oenothera cespitosa	Desert evening-primrose	S	-	-	UPL*
Orobanche pinorum	Pine broomrape	S	-	-	UPL*
Oryzopsis hendersonii	Henderson's ricegrass	S	-	-	UPL*
Pellaea breweri	Brewer's cliff-brake	S	-	-	UPL*
Spiranthes porrifolia	western ladies-tresses	S	-	H	FACW
Status Codes, Historic Record, and Wetland Indicator Status Ratings: (see key for Table 17)					

Six of the eleven State threatened species are unlikely to find suitable habitat in the Planning Area. For example, the Columbia milk vetch is found on dry hillsides and valley floors in sandy or gravelly alkaline soils; locally plentiful in Western Nevada and adjacent California, it was collected historically in Walla Walla, Washington. Tall bugbane is suspected to grow in moist, shady woods at lower elevations West of the Cascades. White eatonella is found on dry, sandy or volcanic desert areas along the Salmon River in Idaho, and in southeast Oregon. Basalt daisy has been found in Yakima County along Selah Creek in cliff crevices in basaltic canyons at low elevations. Hoover's desert-parsley has been found historically on rocky hillsides near Fort Simcoe and White Swan in Yakima County. Hoover's tauschia is a small plant of sagebrush scablands in Yakima County (Washington Natural Heritage Program 1981; Hitchcock et al. 1990; Potash 1991; Smith-Kuebel and Lillybridge 1993).

The remaining five State threatened species are likely to find suitable habitat within the Planning Area. Clustered lady's-slipper has been documented within the Planning Area (Appendix 5) and can be expected at elevations between 460 to 4,500 feet, in moist to rather dry, rocky, open coniferous forests. Water lobelia is suspected to grow in shallow water at the margins of lakes and ponds at unspecified elevations. Adder's tongue is circumboreal. Although not found at higher latitudes, it grows in meadows and forests, and in boggy areas with Douglas' spirea (*Spiraea douglasii*), Western crabapple (*Malus fusca*), and grape fern (*Botrychium multifidum*). Adder's tongue is likely found in wetlands at lower elevations of the Planning Area. Choriso bog-orchid has been found on the Mount Baker Snoqualmie National Forest in very wet meadows, rocky seeps, and lakeshores between 1,000 to 6,000 feet elevation. Seely's silene has been found on cliffs and talus slopes in the Wenatchee Mountains in Chelan and Kittitas Counties at 2,000 to 7,000 feet elevation (Washington Natural Heritage Program 1981; Hitchcock et al. 1990; Potash 1991; Smith-Kuebel and Lillybridge 1993).

2.10.8.2.3 Washington State Sensitive and Monitor Species

Thirty-eight of the State-listed sensitive species may occur in both King and Kittitas Counties. Suitable habitat for many of these species is expected within the Planning Area. Habitats, which occur within the Planning Area, and the associated plant species of concern are shown in Table 21. Although the table shows various habitats and lists the plant species that may occur in each habitat type, it is important to note that some species occur in more than one habitat in areas of Kittitas and King Counties. Two State Sensitive species, Thompson's chaenactis and branching montia, have been documented in the Planning Area, but the latter only from historic records (Appendix 6).

Species on the State of Washington Monitor List are taxa of potential concern. The Monitor List is divided into three groups: (1) Taxa in need of additional field work before a status can be assigned; (2) Taxa with unresolved taxonomic questions; and (3) Taxa more abundant and/or less threatened in Washington than previously assumed. One monitor plant, *Carex scopulorum* var. *prionophylla*, a Group 3 monitor species, has been documented within the Planning Area (Appendix 6).

Table 21. Plant Species Listed as Endangered, Threatened or Sensitive by the State of Washington (WNHP 1994), and Likely to be Found in King and Kittitas Counties Above the 1,500 Foot Elevation Level. *Note: Most Species are not Confined Strictly to the Habitat Listed Below* (Washington Natural Heritage Program 1981; Hitchcock Et al. 1990; Potash 1991; Smith-Kuebel and Lillybridge 1993).

1 Mixed deciduous and coniferous forests
Botrychium lanceolatum (east and west-side Cascades)
Botrychium pinnatum (east)
Cimicifuga elata (Below 2,000 feet elevation on west-side of Cascade Range)
Galium kamtschaticum (east and west-side)
Monitia diffusa (east)
Agoseris elata (eastside, suspected in meadows, open woods, and exposed rocky ridge tops on various slope aspects from low elevations to timberline)
2 Moist to dry coniferous forests
Botrychium lanceolatum (east and west)
Botrychium pinnatum (east)
Cimicifuga elata (at elevations below 2,000 feet on West-side of Cascades)
Cypripedium fasciculatum (east)
Iliamna longisepala (east, open Ponderosa pine or mixed conifer)
Galium kamtschaticum (east and west-side Cascades)
Montia diffusa (east)
Orobanche pinorum (west and east, as parasite on ocean spray)
Plantanthera obtusata (west)
Pleuricospora fimbriolata (east, emerging from duff in dense forest, and west-side Cascades)
Sidalcea oregana var. calva (moist areas, sometimes in open Ponderosa pine forest on dry sites; and with quaking aspen and *Delphinium viridescens* on moist sites in boggy meadowlands and near streams)
3 Gravel/Scree/Talus
Botrychium lanceolatum (east and west)
Hackelia hispida var. disjuncta (east)
4 Rocky areas and boulder fields
Botrychium lanceolatum (west)
Lycopodium dendroidium (west)
5 Rock outcrops
Campanula lasiocarpa (west-side)
Plantanthera choisiana (west-side, in seeps)
Cassiope lycopodioides (west-side, northern exposure mountain cliff in deep ravine)
Agoseris elata (eastside, suspected in meadows, open woods, and exposed rocky ridge tops on various slope aspects from low elevations to timberline)
6 Riparian areas (in or adjacent to streams or rivers)
Botrychium pinnatum (east)
Carex stylosa (east, marshes, streambanks)
Galium kamtschaticum (east and west-side Cascades)

Iliamna longisepala (east, gravelly streambanks)
Sidalcea oregana var. calva (east, streambanks, boggy meadows in association with quaking aspen)
Spiranthes porrifolia (east)
7 Bogs
Carex buxbaumii (east, bogs, marshes, wet meadows)
Carex pauciflora (east and west-side Cascades)
Carex saxatilis var. *major* (west, bogs; east, shallow water, bogs, and sedge meadows)
Carex stylosa (west, bogs; east, marshes and streambanks)
Gentiana douglasiana (Bogs and lake margins, Lake Ozette area, and in Snoqualmie Pass bog at approximately 3,000 feet)
Lycopodiella inundata (Below 2,000 feet elevation on east and west-side Cascades)
8 Other wet areas
Carex buxbaumii (east, bogs, marshes, wet meadows)
Carex comosa (at elevations below 2,000 feet, on the east and west-side Cascades)
Carex saxatilis var. *major* (east, shallow water, bogs, sedge meadows)
Carex stylosa (west)
Delphinium viridescens (east, wet meadows drying in summer)
Galium kamtschaticum (east and west-side Cascades)
Gentiana douglasiana (Bogs and lake margins, Lake Ozette area, and in Snoqualmie Pass bog at approximately 3,000 feet)
Lobelia dortmanna (lakes and ponds) (west)
Lycopodiella inundata (Below 2,000 feet elevation on east and west-side Cascades)
Plantanthera chorisiana (west)
Sidalcea oregana var. *calva* (moist areas, sometimes in open Ponderosa pine forest on dry sites; and with quaking aspen and *Delphinium viridescens* on moist sites in boggy meadowlands and near streams)
9 Insufficient data
Chaenactis thompsonii (east and west-side Cascades, often associated with serpentine soils on the East-side)

2.10.8.2.4 Washington Natural Heritage Database

Consultation with the Washington Natural Heritage Information System revealed the known occurrence of several species of concern (Washington Natural Heritage Program 1994). Clustered lady's-slipper (*Cypripedium fasciculatum*; State Threatened), was noted near Hex Creek and the Teanaway River in the Eastern portion of the Planning Area (T21N; R14E; S11; NE of SE). Thompson's chaenactis (*Chaenactis thompsonii*; State sensitive) was found near Hex Mountain in the same section (T21N; R14E; S11; SW of SW). Saw-leaved sedge (*Carex scopulorum* var. *prionophylla*; State Monitor) was found on Sasse Ridge, and branching montia (*Montia diffusa*) was found near the Cle Elum River (T23N; R14E; S26).

2.11 Fisheries Limiting Factor Analysis

In order to predict the relative benefits and impacts of Plum Creek's HCP on fish stocks of concern, a Limiting Factors Analysis (LFA) was conducted for bull trout, spring chinook salmon, coho salmon, and steelhead trout in the Green River and Yakima River Subbasins. Limiting factors for each of the species of concern were identified by having fisheries agencies, tribes, and others with pertinent experience and expertise in this area participate jointly in the development of the estimates. The LFA Teams ensured that all appropriate methods or approaches to limiting factors were considered, that the assumptions required in evaluating the significance of the limiting factors on each species were widely accepted, and that all experience and data were evaluated from the widest possible perspective. Table 22 presents a listing of the factors that potentially affect fish populations in the Green River and Yakima River Subbasins. Analysis of these factors provides the basis for evaluation of the factors thought to be critical to the fish populations in the Planning Area. A complete description of the Assessment Teams' evaluation of the potential risk factors for each species of fish and river basin is presented in Watson and Toth (1995). Briefly, the findings of the Assessment Teams indicate that the primary factors contributing to the decline of anadromous salmonid stocks in both the Green River and Yakima River Subbasins include:

1. degradation and loss of spawning and rearing habitat resulting from many activities including agriculture, timber harvesting, road construction, urban development, water withdrawals and diversions, and dams;
2. over-exploitation in open-ocean and in-river fisheries; and
3. migratory impediments such as dams and water diversions.

The primary factors limiting coho salmon, chinook salmon and steelhead trout populations in the Green River Subbasin are urban development, agricultural activities, dam operations, timber harvesting, and flood control structures. Although numerous factors limit each of the species of concern to a greater or lesser degree, the two most significant factors limiting all of the fish species of concern in the Yakima River Subbasin are agricultural activities (especially irrigation withdrawals) and dam operations. All of the potential risk factors evaluated certainly have had significant effects in specific locations, but they often act so complexly that it is impossible to identify cause and effect.

The Assessment Teams concluded that the primary causes of reductions in salmonid populations in the Green River and Yakima River Subbasins are dams, agricultural practices, habitat modification, and over-fishing.

Table 22. Limiting Factors Analysis Checklist for Spring Chinook Salmon, Coho Salmon, Steelhead Trout, and Bull Trout in the Green River and Yakima River

Potential Risk Factor		Historic Recovery
Population:	Life History Distribution Abundance/Trend	(This section is meant to identify life history requirements and current status of populations; see Watson and Toth 1995)
Angling:	Legal Harvest Illegal Harvest Biological Sampling	
Habitat:	Development Agriculture Recreation Facilities Dam Operations Mining Grazing Forestry Transportation Flood Control Structures	
Migration Barriers:	Dams Irrigation Diversions Culverts Thermal/Chemical Natural	
Other Species:	Predation Competition Hybridization	
Environmental:	Drought Landslide/Geology Flood/Rain-on-Snow Fire	

2.12 Fish Resources in the Green River Subbasin

Major fish-bearing streams in the upper Green River Subbasin include Sunday Creek, Snow Creek, Tacoma Creek, Pioneer Creek, East Creek, West Creek, Intake Creek, and Twin Camp Creek (Figure 23).

Historically, the upper Green River supported coho (*Oncorhynchus kisutch*) and chinook salmon (*O. tshawytscha*), and steelhead trout (*O. mykiss*), with an estimated total of 107 miles of accessible salmonid habitat above the two dams with a productive capacity of 3,500 steelhead trout, 37,240 coho, and 8,060 chinook adult salmon (Muckleshoot Tribe Fisheries Department 1993). Although chinook salmon no longer occur naturally in the upper basin, coho salmon and steelhead trout remain widely distributed throughout the upper Green River (Figures 24 and 25).

Currently fish habitat in the upper basin is degraded. Recent stream surveys have indicated low number of pools, poor pool quality, lack of adequate cover, lack of riparian vegetation, and a low number of stable side channels. In addition, sediment scour-chain studies, conducted by the Muckleshoot Tribes, indicate that extensive scouring of redds is occurring during moderate flow events.

The Tacoma Diversion Dam currently blocks all upstream migration of adult fish. However, hatchery produced coho and chinook fry are released in the upper basin for overwinter rearing. The U.S. Army Corps of Engineers is currently conducting a feasibility study to redesign and reconstruct the existing dam outlets to improve downstream fish passage. Wild steelhead are trapped at the diversion dam and released upstream of Howard Hanson Dam. These steelhead have successfully spawned in the upper basin.

Stream surveys conducted in the subbasin by an interagency team of resource scientists from the Forest Service, Muckleshoot Tribe, Washington Department of Fish and Wildlife, City of Tacoma, and DNR, indicate that the limiting factors for salmonids in streams in the upper Green River Subbasin appear to be scouring of steelhead redds, lack of pools for holding adult steelhead trout, and lack of rearing and over-winter habitat for all species.

2.13 Fish Resources in the Yakima River Subbasin

Historically, the Yakima River Subbasin supported large populations of spring, summer, and fall chinook salmon (*Oncorhynchus tshawytscha*); sockeye salmon (*O. nerka*); coho salmon (*O. kisutch*); and summer steelhead (*O. mykiss*) (Table 23). Natural runs of sockeye and coho are extinct in the Yakima River Subbasin, and efforts are underway currently to determine if summer chinook still exist in the subbasin. Spring and fall chinook are known to still exist in the subbasin, but their respective population levels are far below historical run sizes (YIN et al. 1990).

Table 23. Estimated Historic Run Sizes of Anadromous Fish in the Yakima River Subbasin (YIN et al. 1990)

Species/Race	Estimated Run Size
Spring Chinook Salmon	200,000
Summer/Fall Chinook Salmon	200,000
Sockeye Salmon	200,000
Coho Salmon	110,000
Summer Steelhead Trout	80,000
TOTAL	**790,000**

Native stocks of rainbow and cutthroat trout, in addition to introduced brook and brown trout, are known to occur in the Yakima River Subbasin. There are also abundant populations of mountain whitefish in the subbasin. Among the resident trout species, rainbows are the most important because of their significance to the recreational fishery above Roza Dam.

The following fisheries summary is derived largely from the Yakima River Subbasin Plan, Salmon and Steelhead Plan (YIN et al. 1990). Based on historical accounts, between 600,000 and 960,000 salmon and steelhead returned to the Yakima River at the turn of the century. According to the Yakima River Subbasin Plan (YIN et al. 1990), the decline of anadromous fish in the subbasin occurred during four relatively distinct phases. During the first phase, from 1850 to about 1900, there was large-scale destruction of anadromous fish resources due to uncontrolled lower Columbia River and ocean fisheries.

At the same time, factors within the subbasin were operating together to maintain anadromous fish populations below their full potential. The most important factors included:

1. construction of unladdered dams (e.g., Pomona Dam, 1880 and Sunnyside Dam, 1893) that completely blocked spawning adults during parts of their run;
2. entrainment of fry and smolts in newly constructed diversion canals;
3. movement of logs downstream and subsequent release of large volumes of water from upstream dams;
4. indiscriminate and intensive local fishery;
5. diking and channelization projects; and
6. reduction in beaver populations which resulted in the loss of natural water storage areas and juvenile rearing habitat.

The second phase, from 1900 to 1941, includes construction of the major irrigation systems in the Subbasin and modification of natural summer flows. Continued uncontrolled ocean fishing, construction of major dams on the mainstem Columbia River, and dewatering of extensive areas of spawning and rearing habitat, as well as construction of barriers to spawning adults in the Subbasin, resulted in the further decline of anadromous fish.

Although the period between 1941 and 1980 was relatively stable in terms of large scale environmental degradation, runs of spring chinook and other anadromous fish continued to decline.

Escapement into the Subbasin was extremely low (estimated mean escapement during the 1970's was 384 fish) while at the same time, smolt mortality increased due to the increased number of dams on the mainstem Columbia River (e.g., Bonneville, The Dalles, John Day, and McNary). During this period, the spring chinook sport fishery was eliminated, as were the spring and summer chinook commercial fisheries.

In response to the dangerously low levels of anadromous fish in the Subbasin, three legislative and judicial developments in 1979 and 1980 introduced the framework for initiating a major recovery effort. The first development, the Yakima River Basin Water Enhancement Project, occurred in 1979 with the passage of Public Law 96-162. The second and third developments, the Kittitas ("Quackenbush") decision and the passage of the Northwest Electric Power Planning and Conservation Act (Northwest Power Act), occurred in 1980. The Kittitas decision ordered that spring chinook redds must be protected in the Yakima River. This action led to the immediate improvement in reproductive success of the upper Yakima River chinook. The Northwest Power Act created the Northwest Power Planning Council (NWPPC) which was given the responsibility of protecting and enhancing fisheries resources in the Columbia River Basin. Under its authority, the NWPPC established the Columbia River Basin Fish and Wildlife Program. This program developed specific tasks and goals to determine the extent of unmitigated losses of salmon and steelhead attributable to development and operation of hydroelectric projects in the Columbia River Basin, and at the same time, identified options for protection, enhancement and mitigation in the basin (YIN et al. 1990).

During the fourth phase, between 1980 and the present, spring chinook stocks recovered relatively rapidly in the Yakima River Subbasin. In the early 1980's, scientists determined that in addition to uncontrolled ocean harvesting, the most significant factor limiting production of anadromous fish in the Subbasin was inadequate, obsolete and deteriorating fish passage facilities. Furthermore, the problems associated with the mainstem Yakima River were the most severe. Reconstruction efforts at all passage facilities at all Yakima River mainstem dams, and some dams on tributary streams were completed between 1984 and

1989. The resulting reduction in losses of outmigrating smolts attributable to dams in the Subbasin is believed to be to have been a major first step in re-establishing anadromous fish runs in the Subbasin (YIN et al. 1990).

Two additional factors may have had a significant role in the continued improvement of anadromous fish runs in the Yakima River Subbasin. The first is implementation of the United States-Canada Pacific Salmon Treaty of 1985, and the second is the adoption of the Columbia River Management Plan in 1988 by the United States, the States of Washington and Oregon, and the Warm Springs, Nez Perce, Umatilla, and Yakama tribes (United States vs Oregon, No. 68-513).

Due to the nature of the data available and the multiplicity of factors affecting fish runs in the Yakima River Subbasin, estimates of fish losses due directly or indirectly to timber-harvesting operations will require a set of assumptions. It is not possible to directly and unequivocally isolate and estimate the numerical reduction in salmon or trout populations caused by timber harvesting in the Yakima River Subbasin. The reasons are that: (1) numerous other factors are operating together to depress the fish runs; (2) hatcheries and other measures have been put in place to counterbalance to an unknown degree those effects; (3) there has not been enough information available to account for all fish in the catch, specifically the ocean catch where it has not been possible to enumerate the part of the catch made up of stocks from the segments of the rivers affected by the HCP, nor until recently, the hatchery from which the fish came; and (4) there has not been adequate information on numbers of spawners.

Effects of hydroelectric development and operation are known to have depressed all anadromous fish stocks in the Columbia River Basin. In addition, as mentioned above, numerous other factors including road building, livestock effects on riparian habitats, channelization, mining, urbanization, water diversions, and increased water intakes, have adversely affected stocks of fish in the Columbia River. However, Chapman et al. (1982) concluded that the two primary causes of reductions in salmon populations in the Columbia River Basin are dams and overfishing. All of the other factors may have had significant effects in specific locations, but they act together so complexly that it is frequently impossible to identify cause and effect.

2.13.1 Spring Chinook Salmon

The historic spawning areas of the spring chinook in the Yakima River Subbasin were extensive and included the mainstem Yakima River above Ellensberg, the Naches River, Cle Elum River below Lake Cle Elum, the Tieton River (both North and South forks), Rattlesnake Creek and Bumping, Little Naches and American Rivers. Spring chinook still spawn in most of these areas, especially in the Yakima River above Ellensberg, the upper Naches and American Rivers (Figure 26). Spring chinook distribution in the upper Yakima River Subbasin in the Planning Area (Figure 27), is limited primarily to the mainstem Yakima River, Cabin Creek, and the upper portion of the Little Naches River (Figure 28).

Spring chinook historically comprised one of the largest anadromous fish runs in the Yakima River Subbasin. According to Smoker (1956) production of spring chinook in the Subbasin accounted for nearly 14 per cent of the total Columbia River spring chinook runs in the 1950’s. Although historical spring chinook run sizes in the Yakima River Subbasin have been estimated to be approximately 200,000 fish (Table 23), since the late 1950’s, annual returns of spring chinook have ranged from 166 to 9,442 fish (Fast et al. 1987).

2.13.2 Coho Salmon

Historic distribution of coho salmon in the Yakima River Subbasin is not well known; however, fisheries managers in the region believe that production areas were widely scattered throughout streams and rivers in the Subbasin. Pre-dam coho production areas in the upper Yakima River mainstem were mainly above the mouth of the Teanaway River and it is believed that most, if not all, Yakima River tributaries (i.e., the Teanaway River, and Taneum, Manastash, Swank, Big, and Umtanum Creeks) produced coho. The Naches River and tributaries above the Tieton River are also thought to have supported large populations of coho, but the upper Tieton (above Rimrock), upper Cle Elum, Ahtanum, and Logy Creeks probably supported fewer numbers of coho (Bryant and Parkhurst 1950). The present and potential distribution of coho salmon in the Yakima River Subbasin is shown in Figure 29.

Coho have been planted in the upper Yakima River since at least the 1940's, with the intention of creating a terminal fishery. Some plantings were extremely large (e.g., 750,000 smolts were released in 1979); however, the return rate has been less than 0.1 percent (YIN et al. 1990). Inadequate passage for adult spawners at old fish ladders and extremely heavy harvest rates in the ocean and lower Columbia River fisheries are thought to be the major factors limiting the fish runs (YIN et al. 1990).

The United States vs. Oregon Columbia River Fish Management Plan required the transport and release of 700,000 coho smolts in the Yakima River Subbasin each year for 5 years to enhance fishing opportunities for a Yakama Indian Nation terminal fishery. An interesting aspect of this plan is that there were no escapement requirements. Currently, most if not all returning adult coho are from releases in the Yakima River below the Naches River confluence.

At present, there are no coho salmon hatcheries in the Yakima River Subbasin; however, between 1986 and 1988, the Yakama Indian Nation used Nile Pond (RM 29.4 Naches River) for juvenile coho salmon rearing for experimental volitional release (YIN et al. 1990).

2.13.3 Summer Steelhead Trout

Historically, steelhead were distributed throughout the entire Yakima River Subbasin. Steelhead spawners prefer smaller, steeper gradient streams than spring chinook or coho. Thus, essentially all permanent and accessible streams in the Yakima River Subbasin are potentially capable of supporting steelhead. At present, steelhead numbers in the Subbasin are far below historic levels, and production areas are concentrated mainly in the lower Naches River and tributaries, the Yakima River from the Naches confluence to Union Gap, and Satus Creek, Toppenish Creek and the Marion Drain (Figure 30) (YIN et al. 1990). Passage problems at Roza Dam have limited steelhead production in the upper Yakima River. Since 1983, fewer than 80 (and usually fewer than 20) steelhead spawners annually have been counted over Roza Dam (YIN et al. 1990). The current distribution of summer steelhead in the upper Yakima River Subbasin in the Planning Area (Figure 27) is shown in Figure 25.

Based on habitat models, annual steelhead adult returns in the Yakima River Subbasin have been estimated at 80,000 fish (Table 23). However, Smoker (1956) estimated that summer steelhead populations in the Yakima River Subbasin may have been as high as 100,000 fish. Mean annual adult steelhead returns to the Yakima River (hatchery and wild fish) from 1981 through 1987 was 1,547 fish (range 255 to 2,693 fish) (YIN et al. 1990).

2.13.4 Bull Trout

Bull trout generally occur in all parts of the State except in the area East of the Columbia River and north of the Snake River in Eastern Washington, and the extreme southwest portion of the State (Figure 31) (Mongillo 1993).

According to Mongillo (1993), there are at least 77 distinct bull trout subpopulations in the streams and rivers in Washington. Within the Mid-Columbia Basin there are 15 subpopulations, and among these, seven are within the Yakima River Subbasin. These include subpopulations in the Naches River, Bumping Lake and Rimrock Lake, Kachess Lake, Keechelus Lake, North Fork of the Teanaway, and

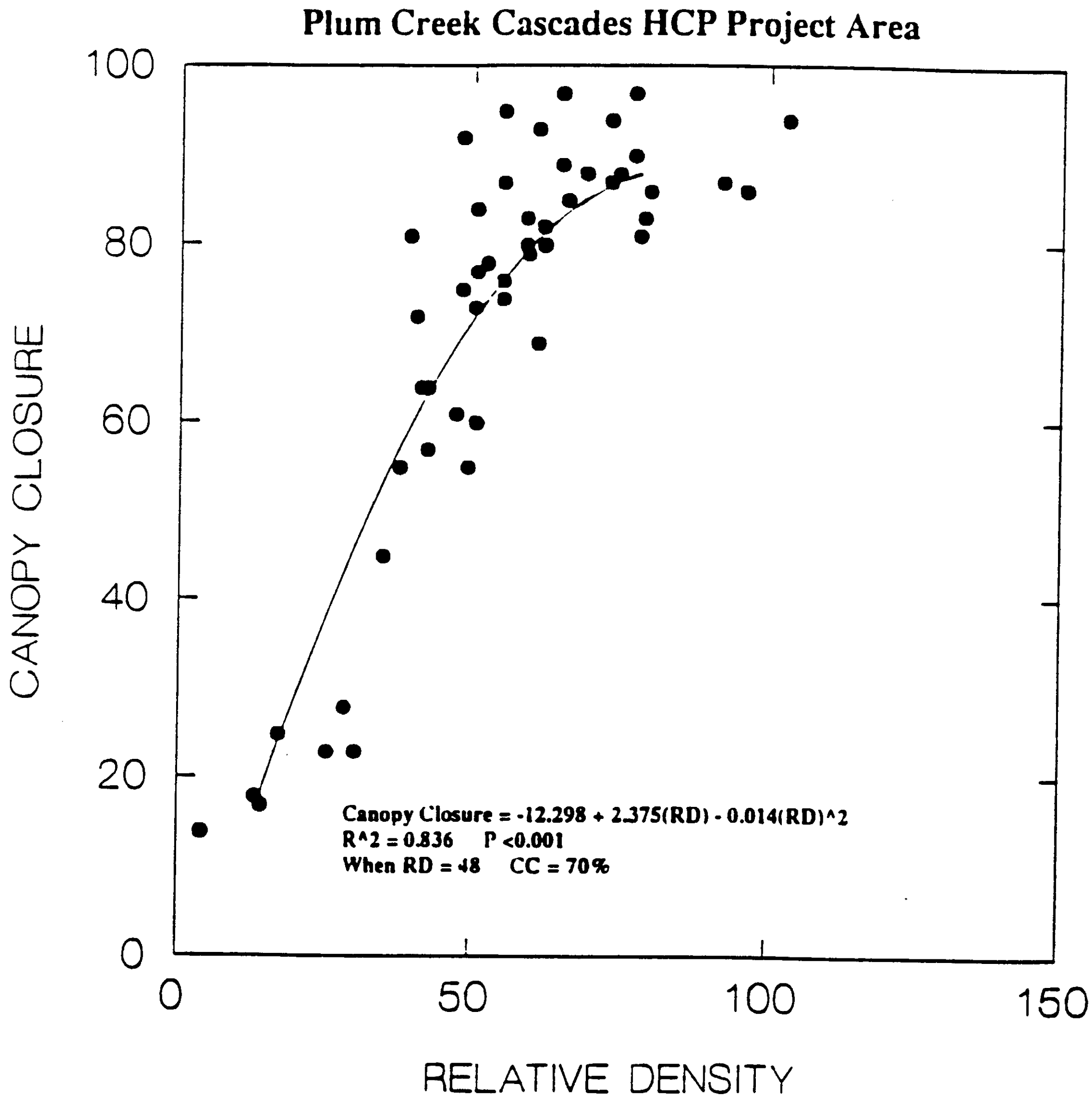
Waptus/Cle Elum Lakes. The status of each of these subpopulations is generally unknown; however, there is evidence to suggest that the subpopulation of bull trout in Rimrock Lake is stable, whereas the subpopulations in Kachess and Keechelus Lakes are thought to be declining (Mongillo 1993). The distribution of bull trout in the upper Yakima River Subbasin in the Planning Area (Figure 27), occurs mainly in the mainstem Yakima River, and in the I-90 Lakes Subunit area and tributary streams north of the lakes (Figure 32).

Factors limiting bull trout populations are complex and in some cases dependent upon the activities occurring within a particular watershed or Subbasin. For example, within the Mid-Columbia Basin, agriculture, accessibility, predation and competition by non-native fish, poaching, streamflow, forest management, and physical habitat limit bull trout populations. In contrast, in the Puget Sound Basin (e.g., Green River Subbasin) bull trout populations are limited primarily by alterations in physical habitat, grazing, hydropower development and operation, and flood control reservoirs (Mongillo 1993). Throughout all subbasins State-wide, it appears that habitat destruction or modification is the most common factor affecting bull trout populations, followed by inadequate streamflow and water quality.

Because of the complexities involved in the life history characteristics of bull trout, and the considerable variation among subpopulations, it may be difficult to isolate and estimate how and the extent to which particular activities in a watershed may impact bull trout spawning and rearing in the Yakima River Subbasin. For example, although a large portion of bull trout subpopulations can be considered resident (i.e., spend their entire life cycle in smaller or low order streams with little or no seasonal migration), other relatively large subpopulations exhibit fluvial (i.e., reside mainly in large streams, but migrate into smaller streams to spawn, with juveniles remaining in the smaller streams for up to two years), or adfluvial (i.e., reside in lakes but migrate into streams to spawn, with juveniles rearing in the small streams for up to two years) life history patterns (Mongillo 1993). However, it is unclear what factors influence the structure of the stream fish assemblages or how strong the causal link is between habitat type and availability and population size/viability.

FIGURE 11

Relative Density vs. Canopy Closure
Westside Cascades



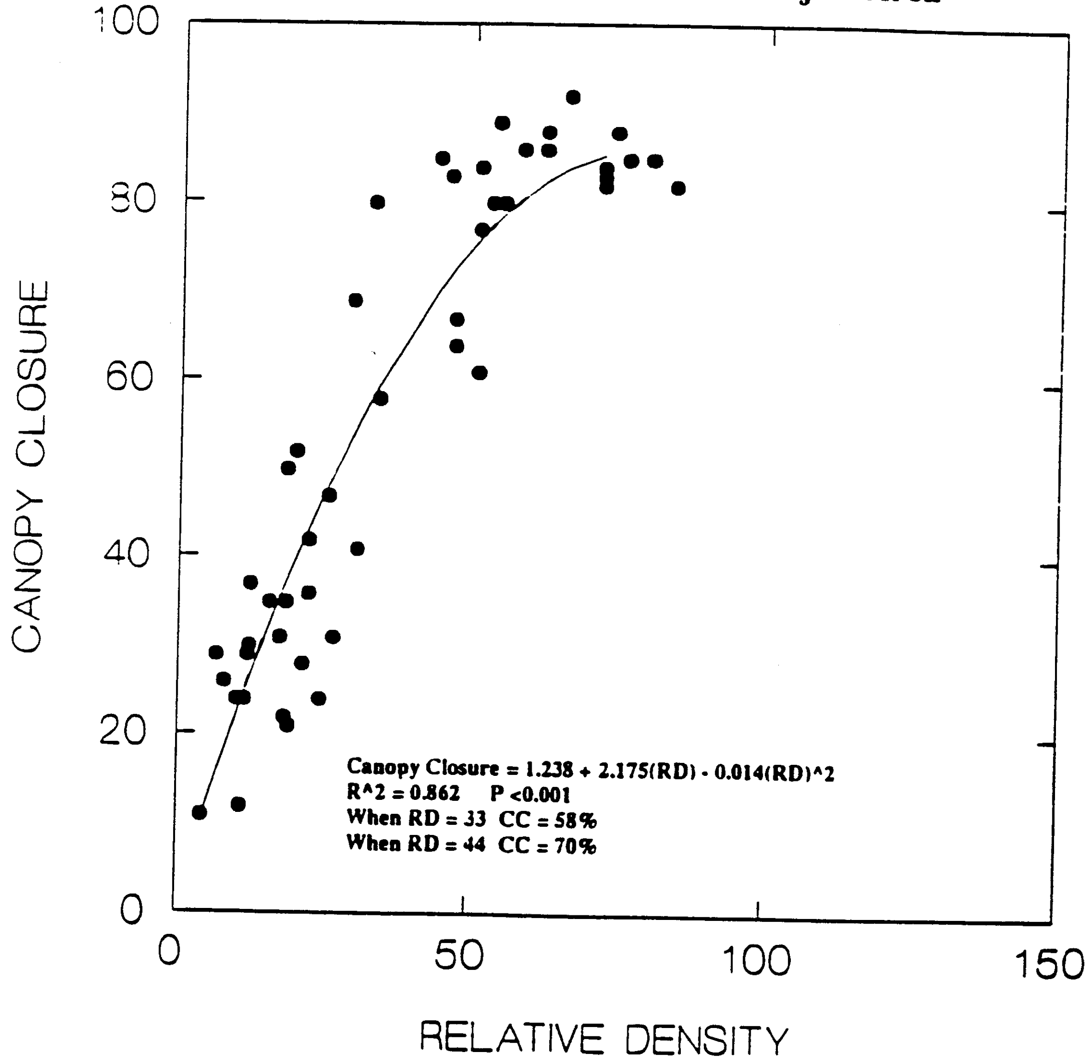
Relative Density = Basal Area/Quad Mean DBH^0.5

Quad Mean DBH = 13.54((ΣX^2(0.005451/n)^0.5) Where X = DBH and n = number of trees

FIGURE 12

Relative Density vs. Canopy Closure
Eastside Cascades

Plum Creek Cascades HCP Project Area



Relative Density = Basal Area/Quad Mean DBH^0.5

Quad Mean DBH = 13.54((ΣX^2(0.00545)/n)^0.5) Where X = DBH and n = number of trees

Figure 13. Diagrammatic Flowchart of the FIBRPLAN forest landscape simulator.

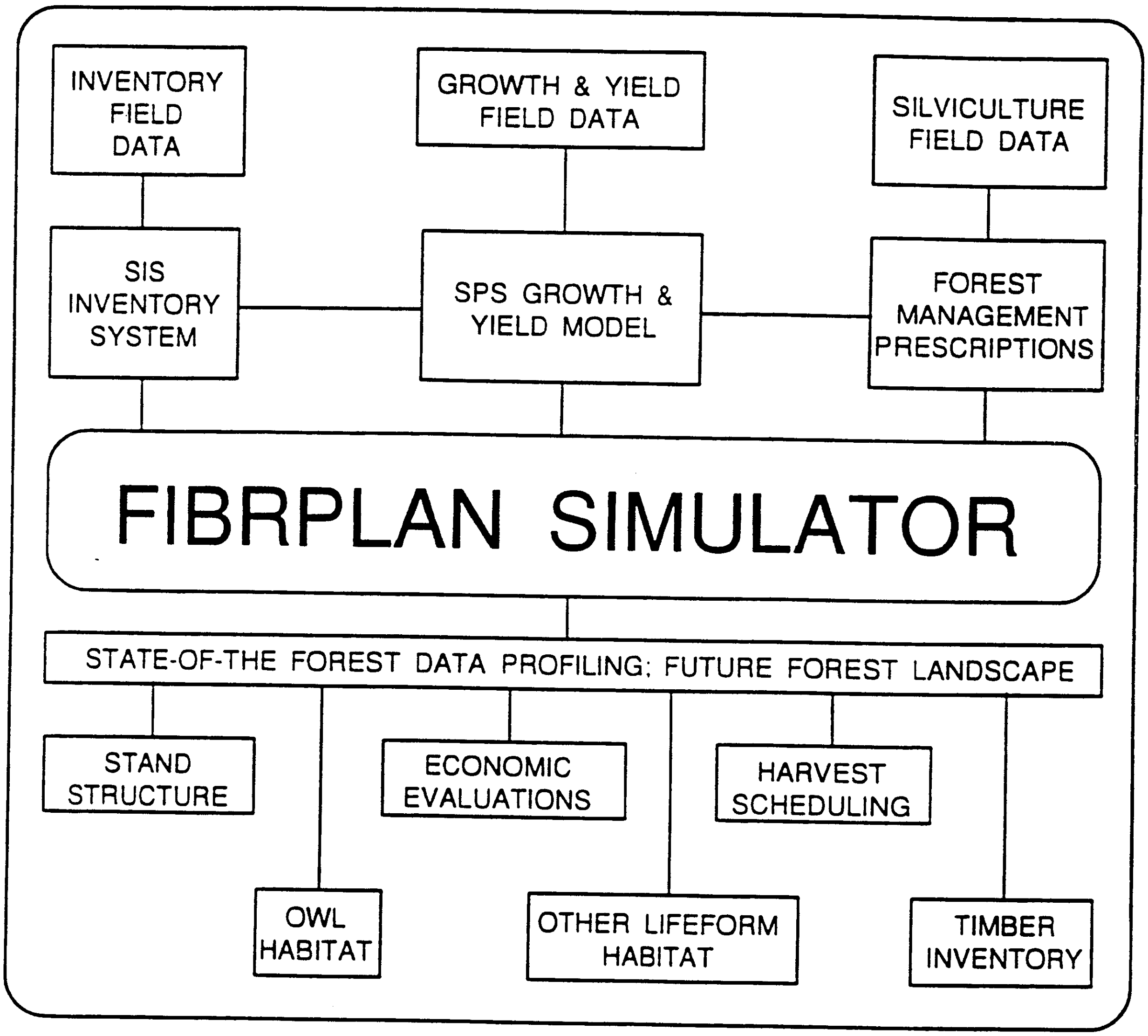
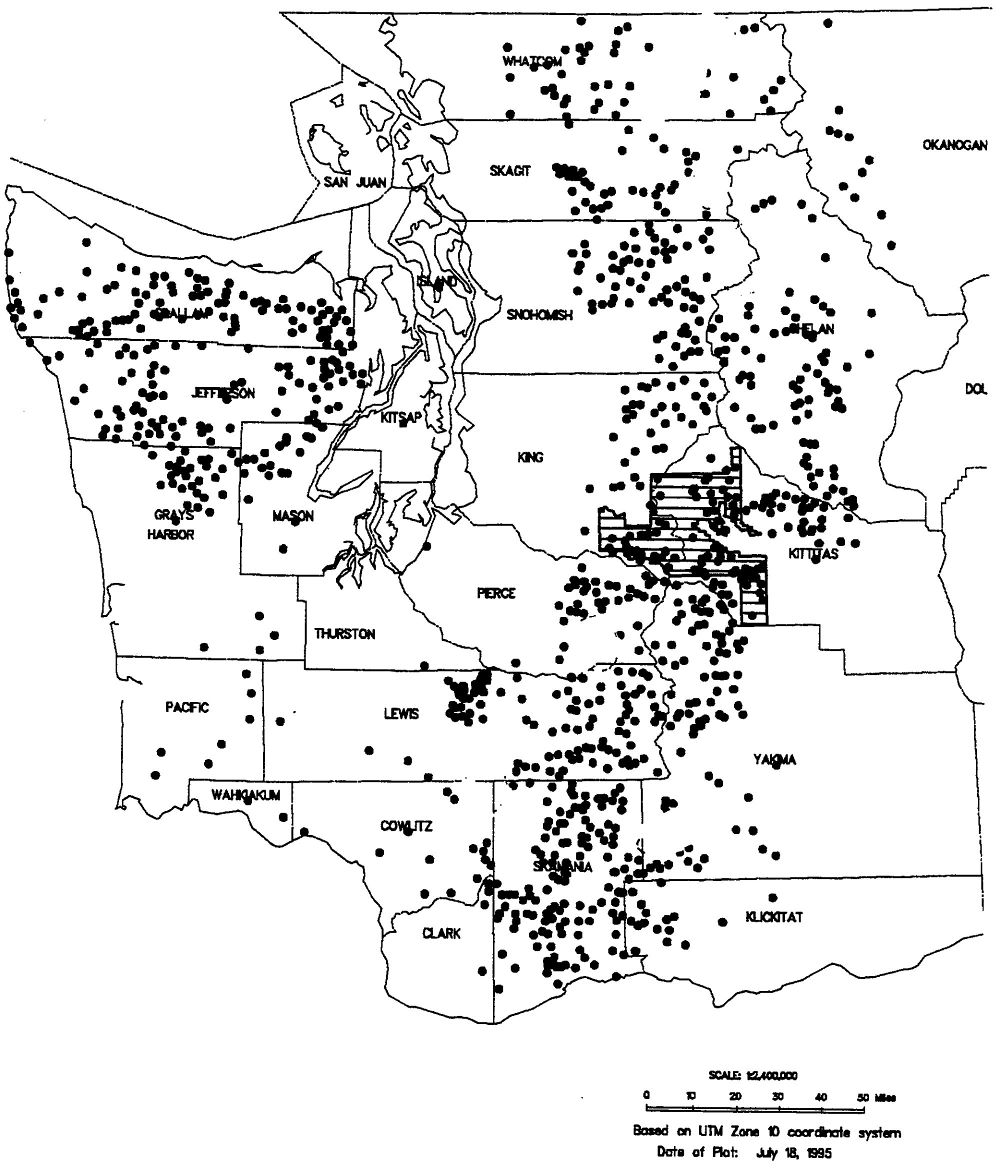


FIGURE 14

State wide distribution of spotted owl site centers and location of the Plum Creek's Cascade HCP planning area.



● Northern spotted owl site center

HCP Area

N

PlumCreek

FIGURE 15
1991–94 Spotted Owl survey coverage in Plum Creek's HCP Planning Area.

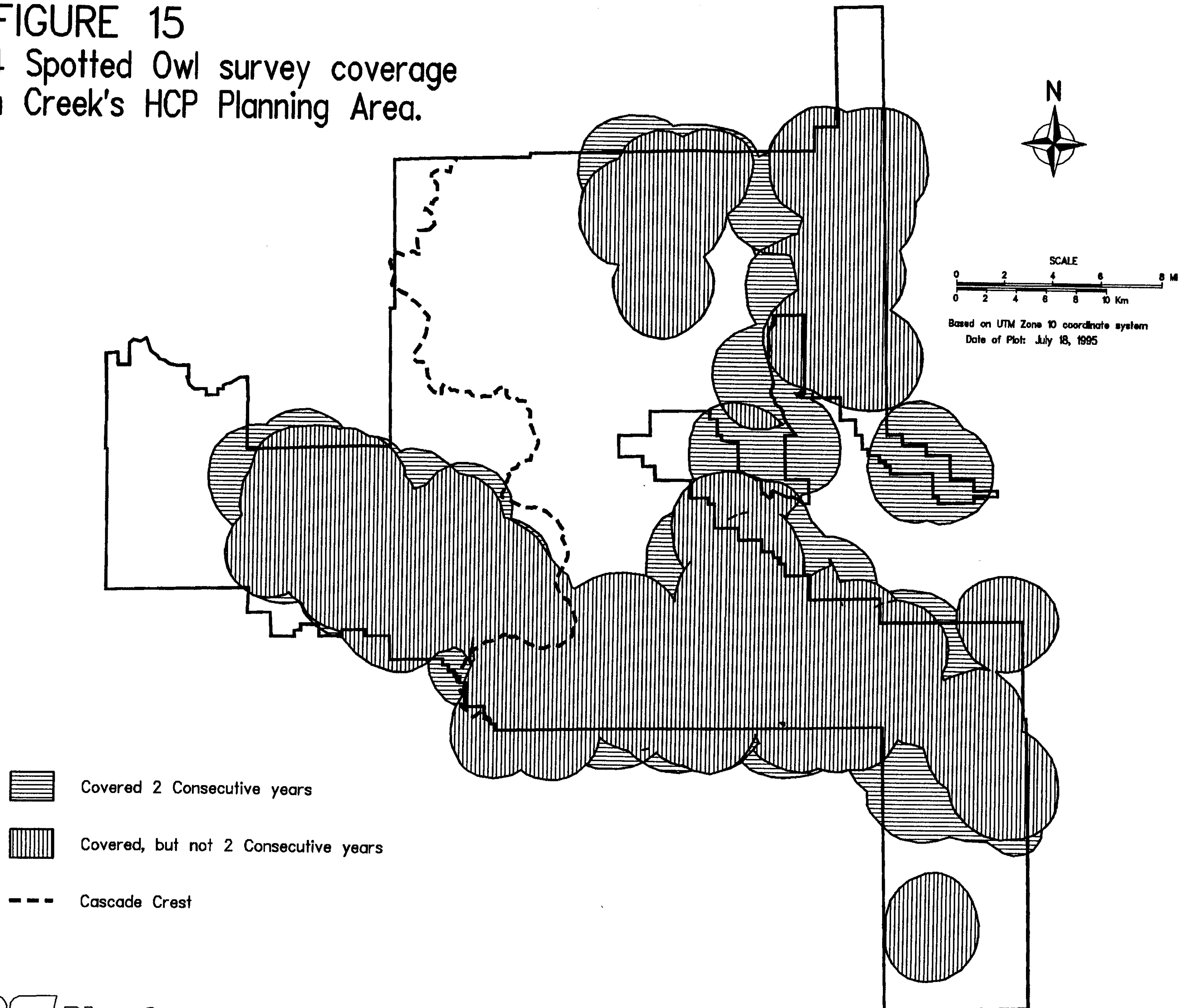


FIGURE 16

Location of 109 Northern Spotted Owl Site Centers Within and Adjacent to Plum Creek's HCP Planning Area

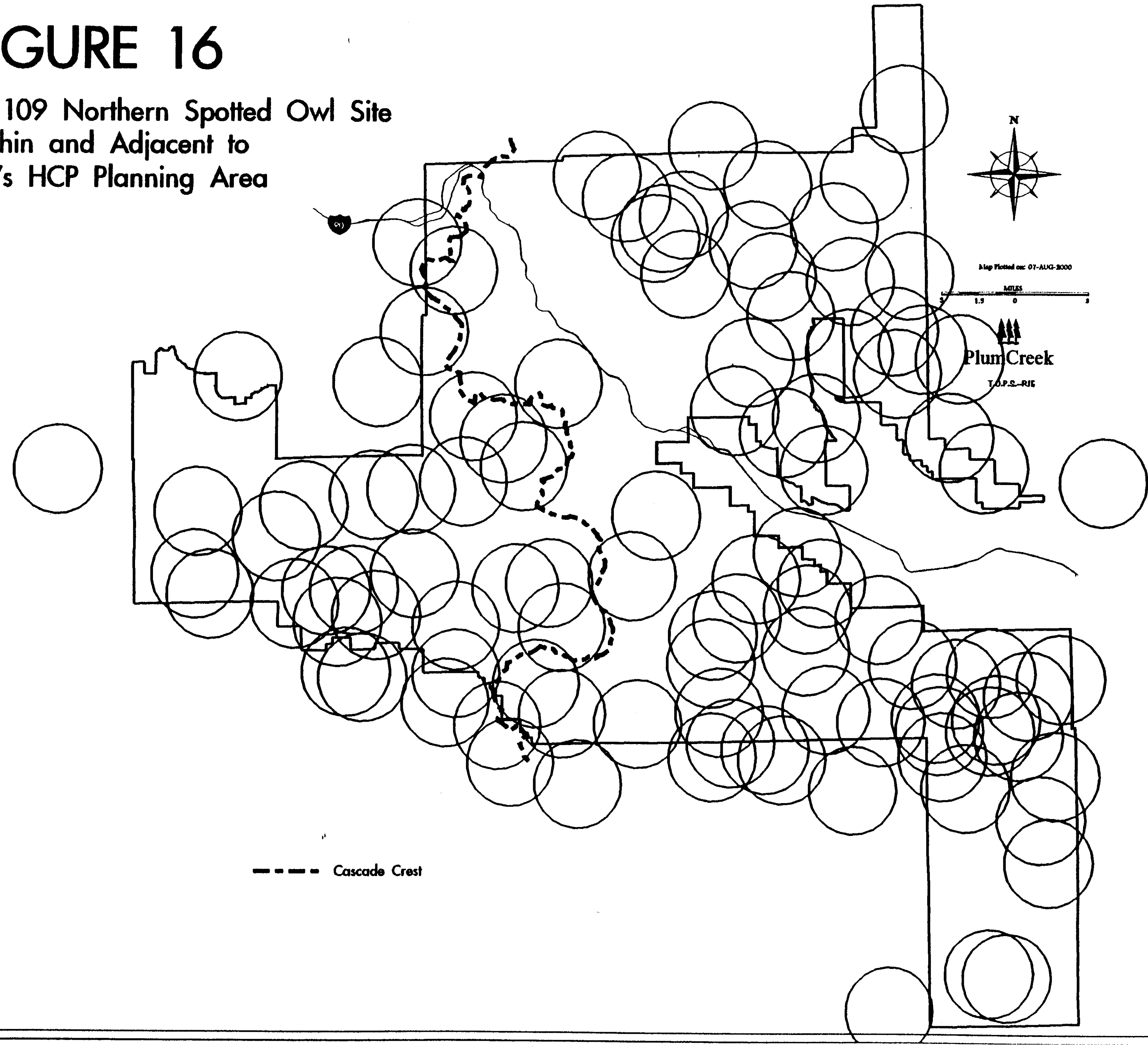


FIGURE 17.
Spotted Owl site centers with more than 100 acres on Plum Creek ownership

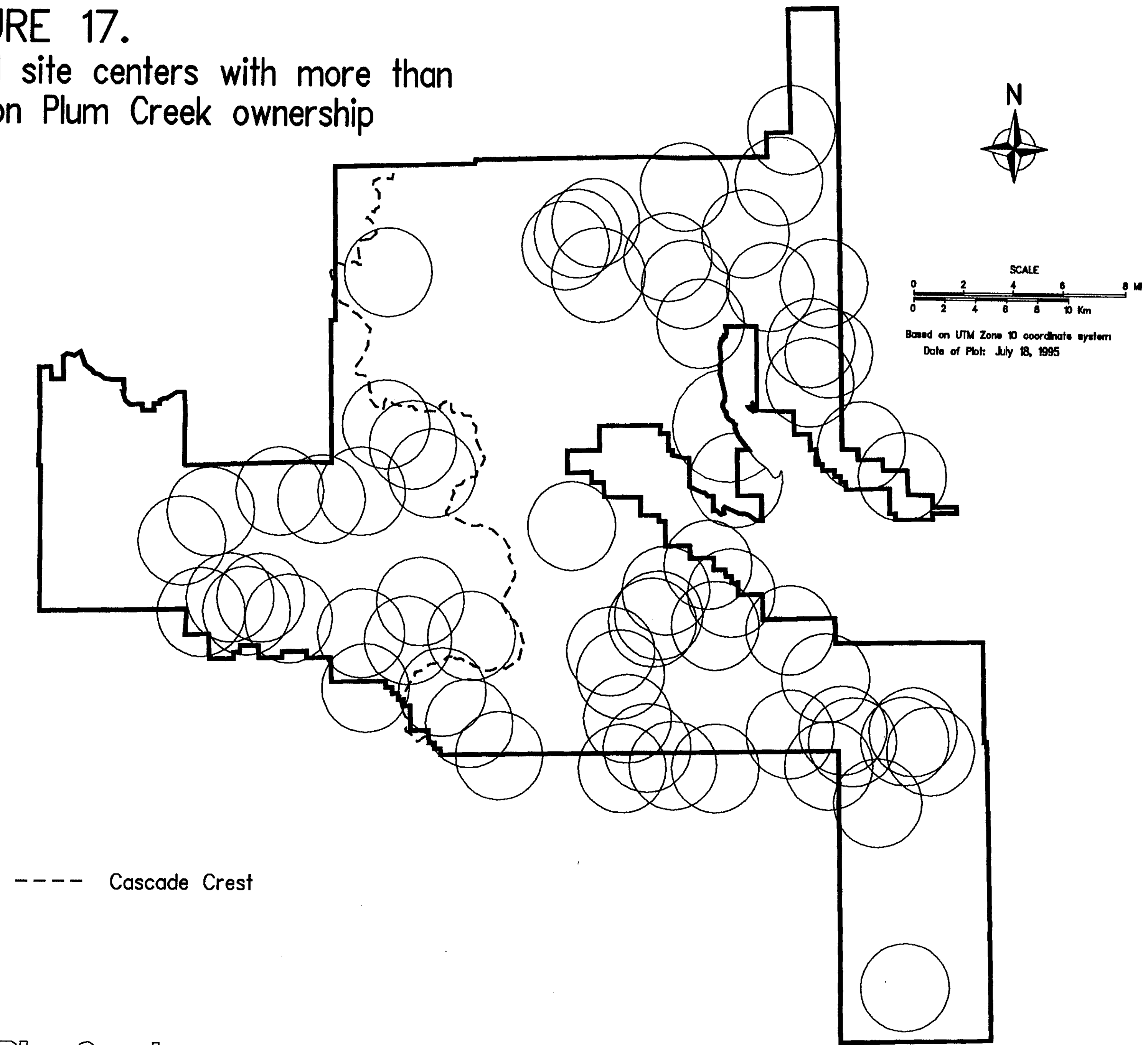


FIGURE 18

Location of barred and spotted owl site centers in Plum Creek's HCP planning area during 1991 through 1993.

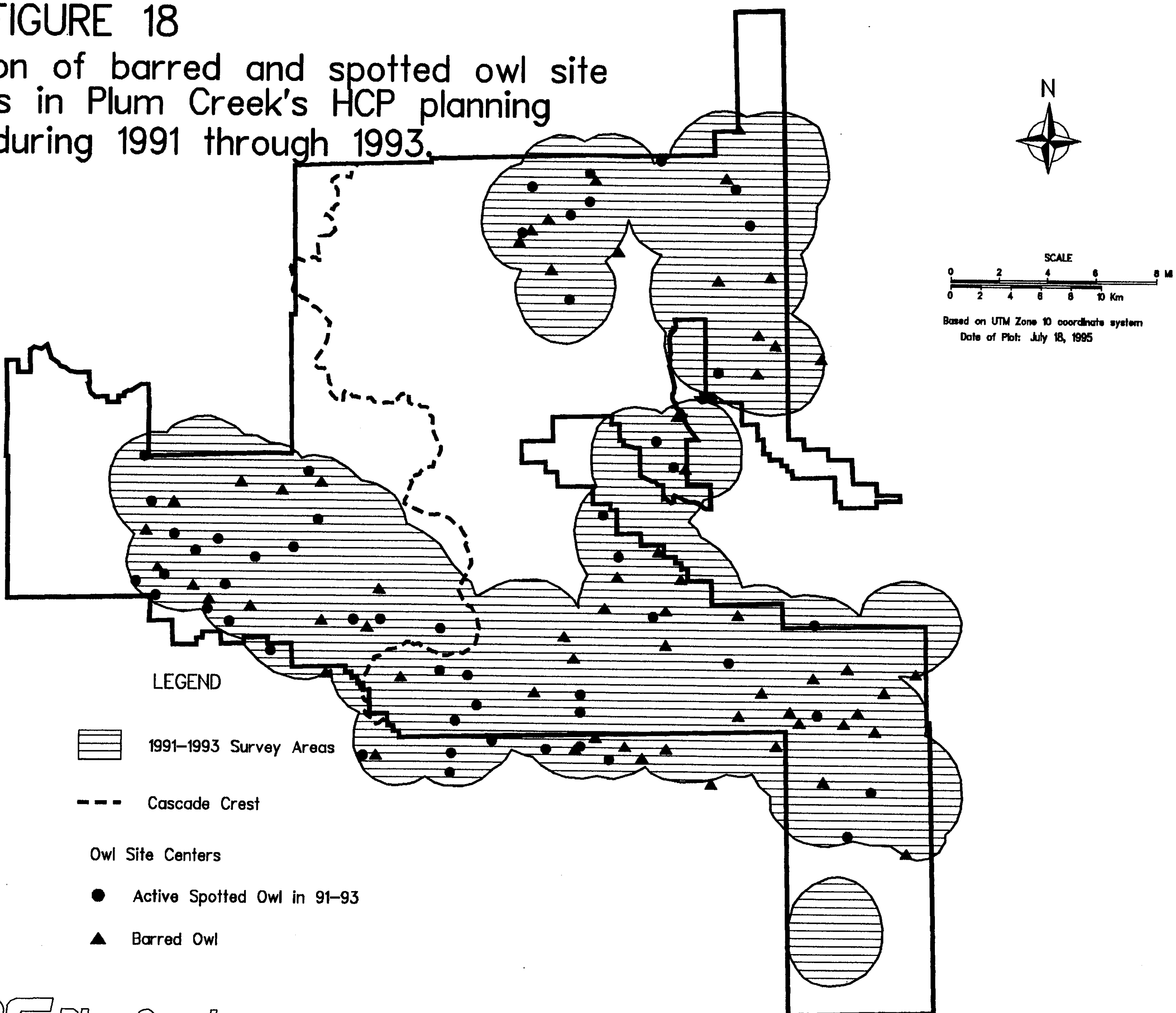


FIGURE 19

Marbled Murrelet Surveys
Plum Creek Timber Company
Habitat Conservation Plan

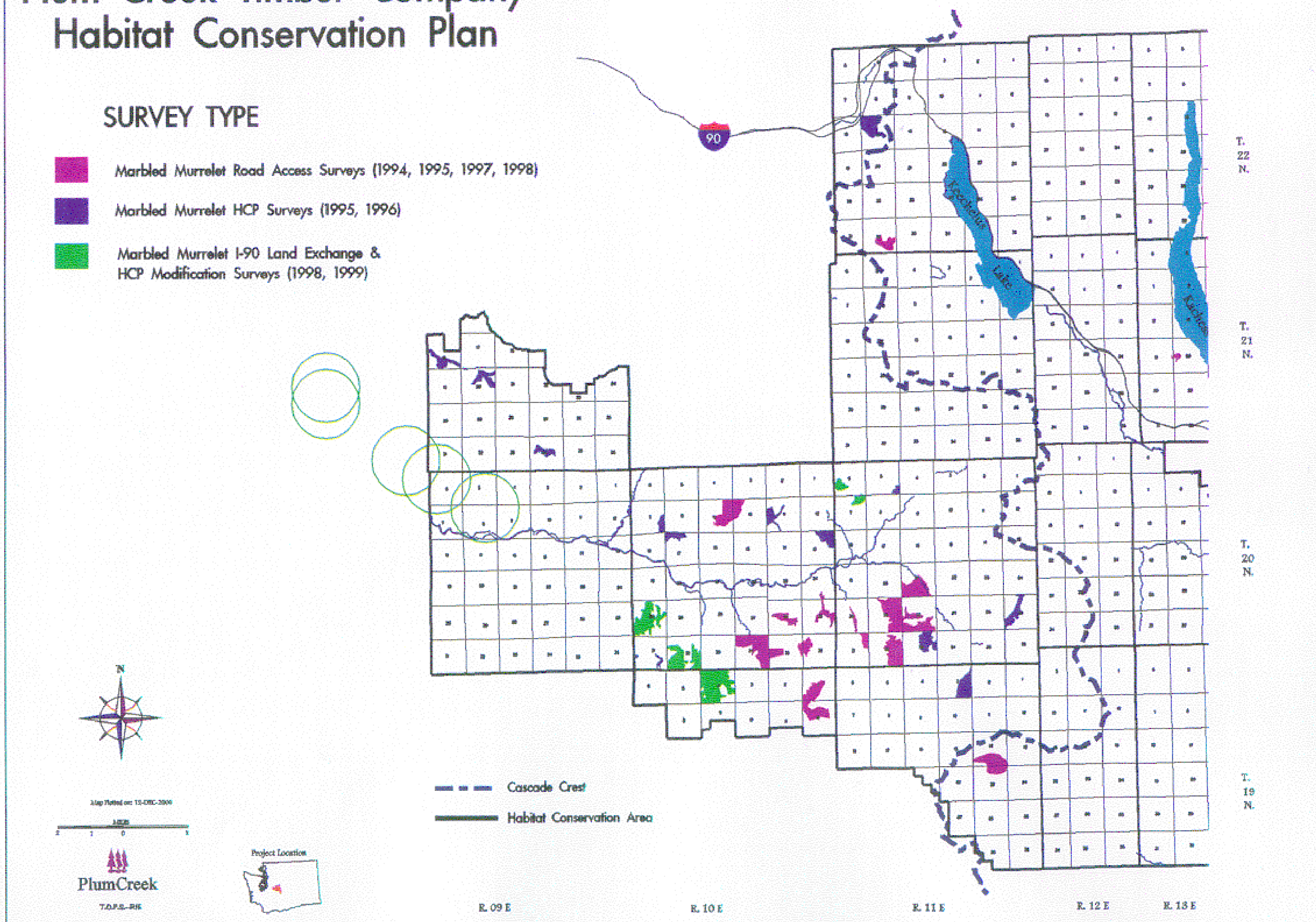
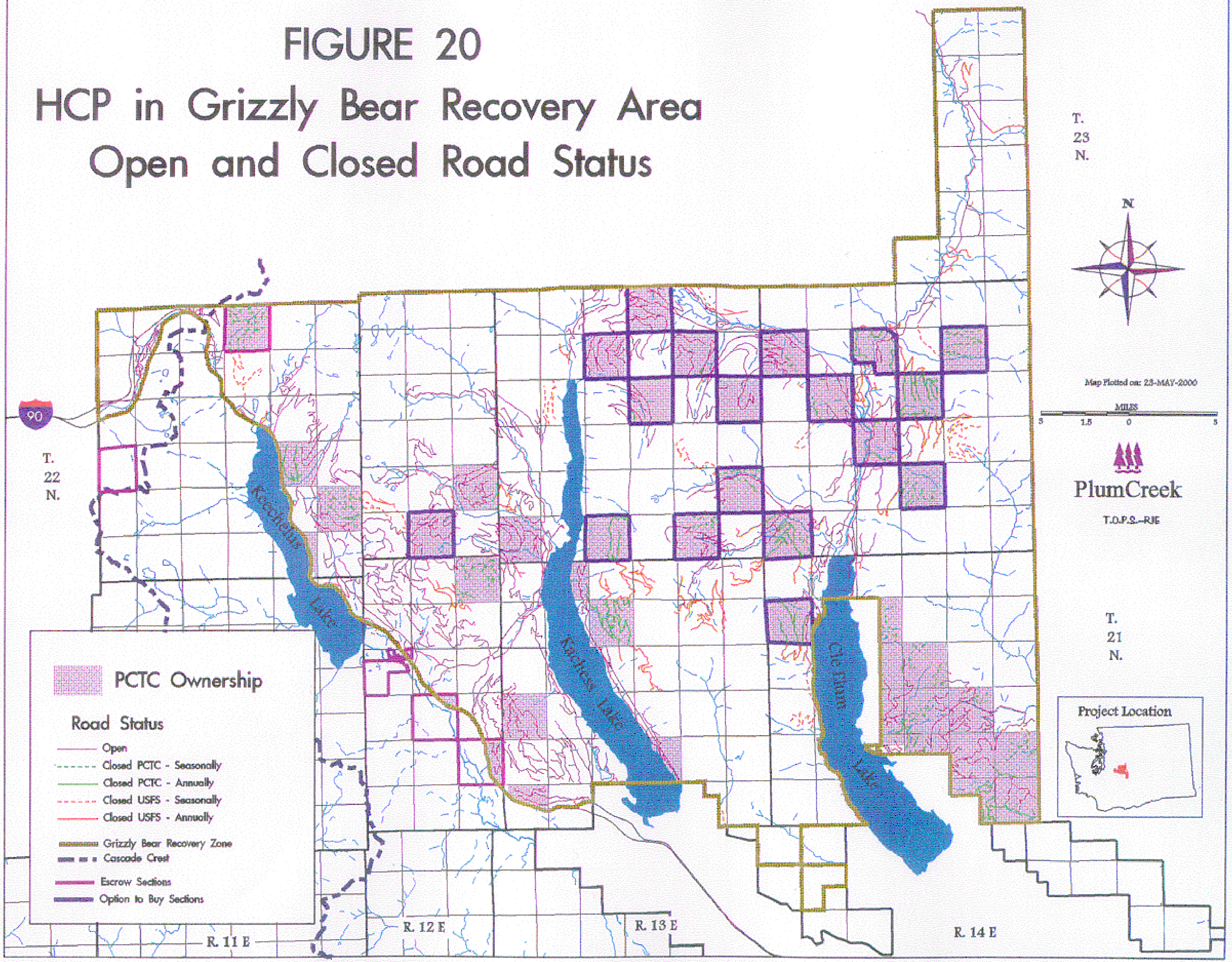
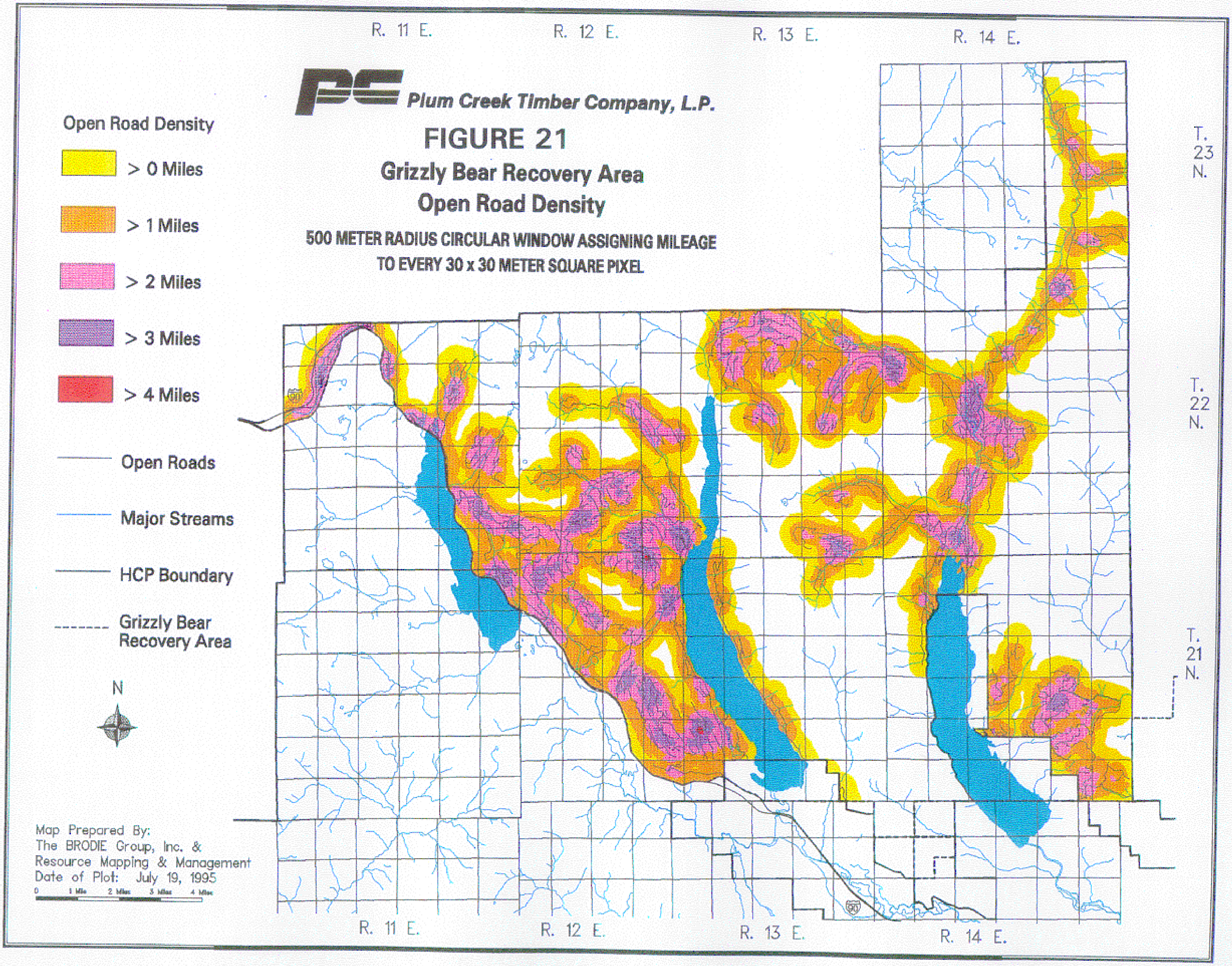


FIGURE 20
HCP in Grizzly Bear Recovery Area
Open and Closed Road Status




Plum Creek Timber Company, L.P.
FIGURE 21
Grizzly Bear Recovery Area
Open Road Density
500 METER RADIUS CIRCULAR WINDOW ASSIGNING MILEAGE
TO EVERY 30 x 30 METER SQUARE PIXEL
Open Road Density
> 0 Miles
> 1 Miles
> 2 Miles
> 3 Miles
> 4 Miles
Open Roads
Major Streams
HCP Boundary
Grizzly Bear Recovery Area
N
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
T. 23 N.
T. 22 N.
T. 21 N.
90
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
Date of Plot: July 19, 1995
0
1 Mile
2 Miles
3 Miles
4 Miles

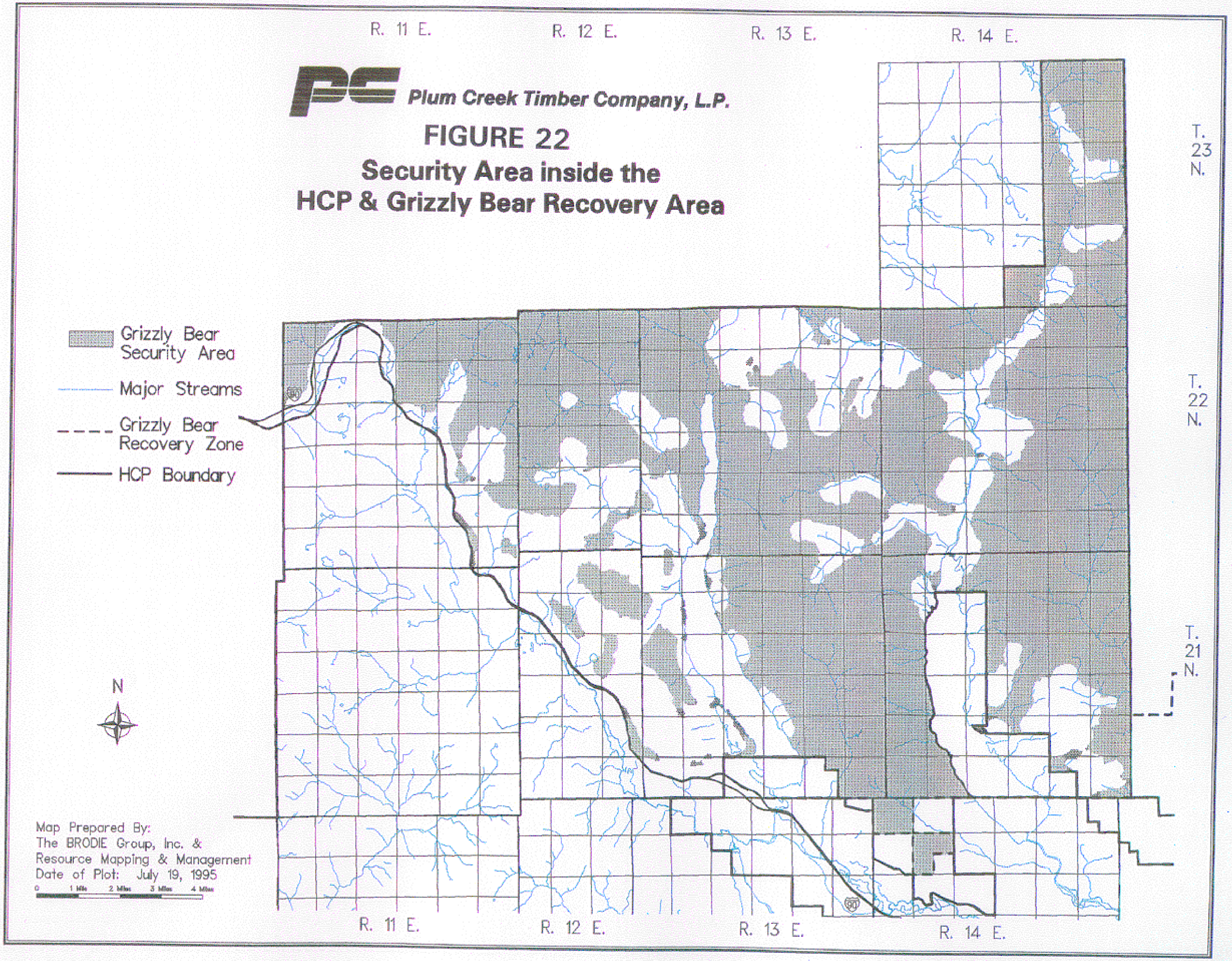

Plum Creek Timber Company, L.P.
FIGURE 22
Security Area inside the HCP & Grizzly Bear Recovery Area
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
T. 23 N.
T. 22 N.
T. 21 N.
Grizzly Bear Security Area
Major Streams
Grizzly Bear Recovery Zone
HCP Boundary
N
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
Date of Plot: July 19, 1995
0
1 Mile
2 Miles
3 Miles
4 Miles
90

FIGURE 23
Green River Drainage Basin within the Planning Area

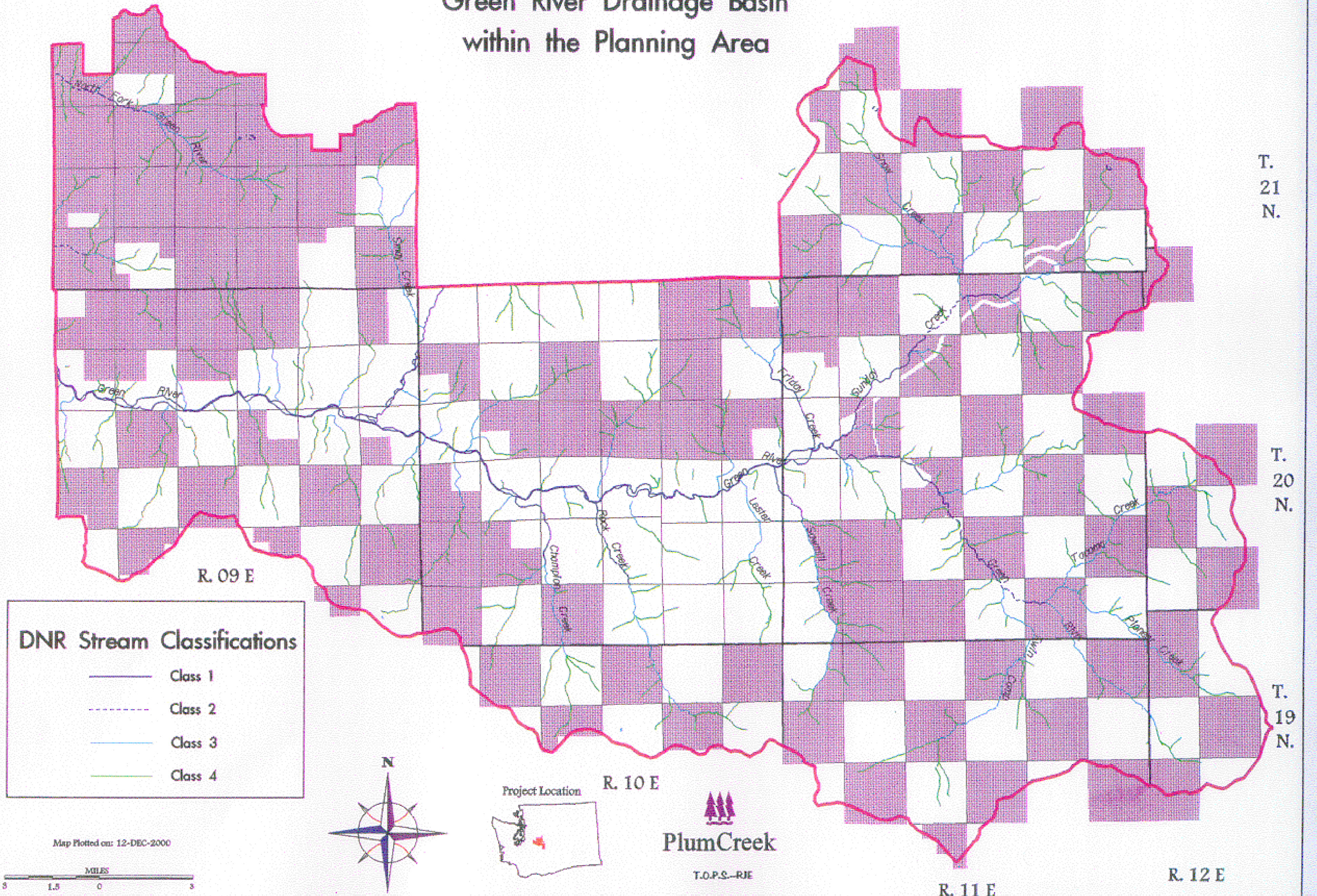


FIGURE 24

COHO SALMON RANGE WITHIN THE PLANNING AREA

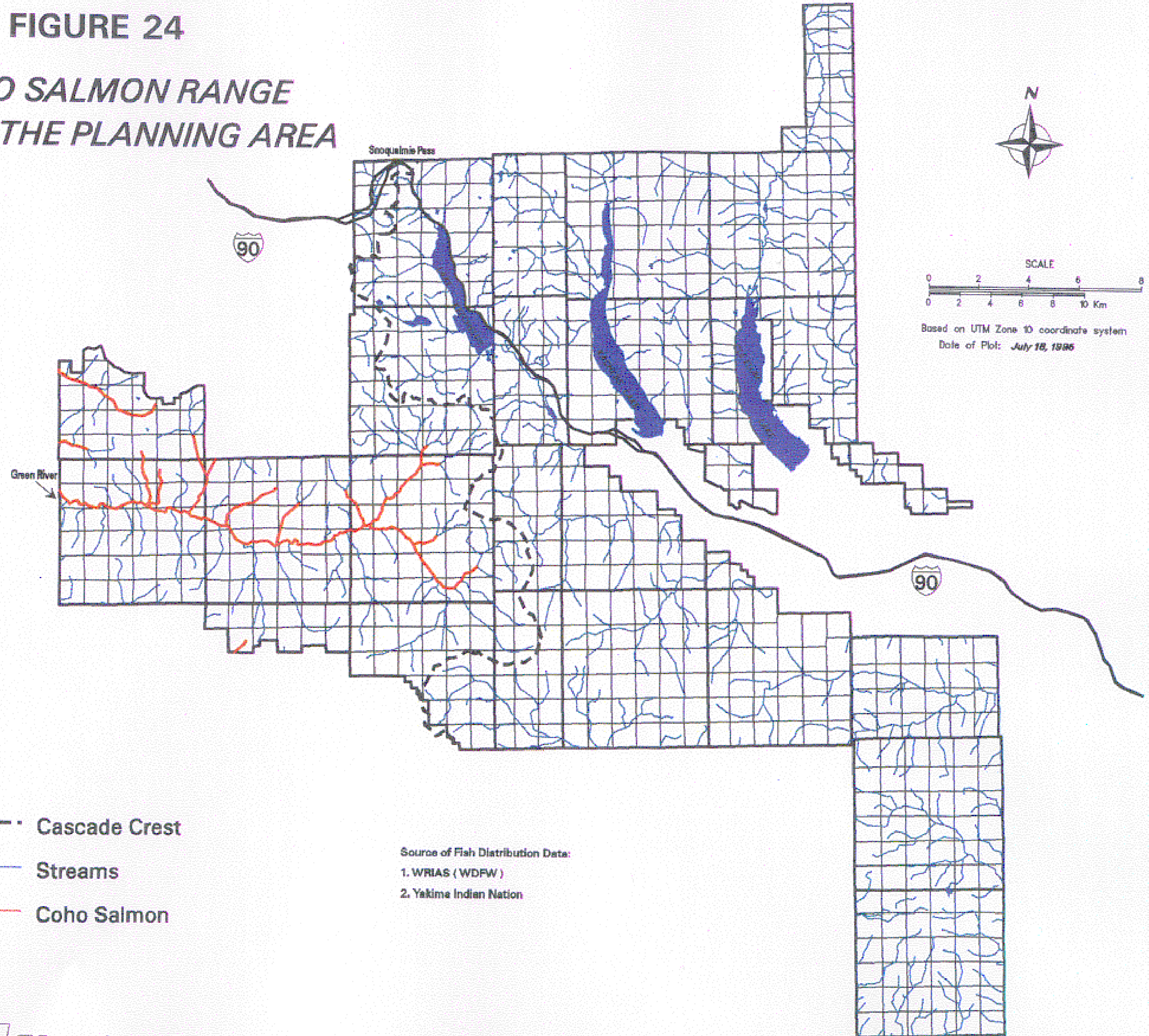


FIGURE 25

STEELHEAD TROUT RANGE WITHIN THE PLANNING AREA

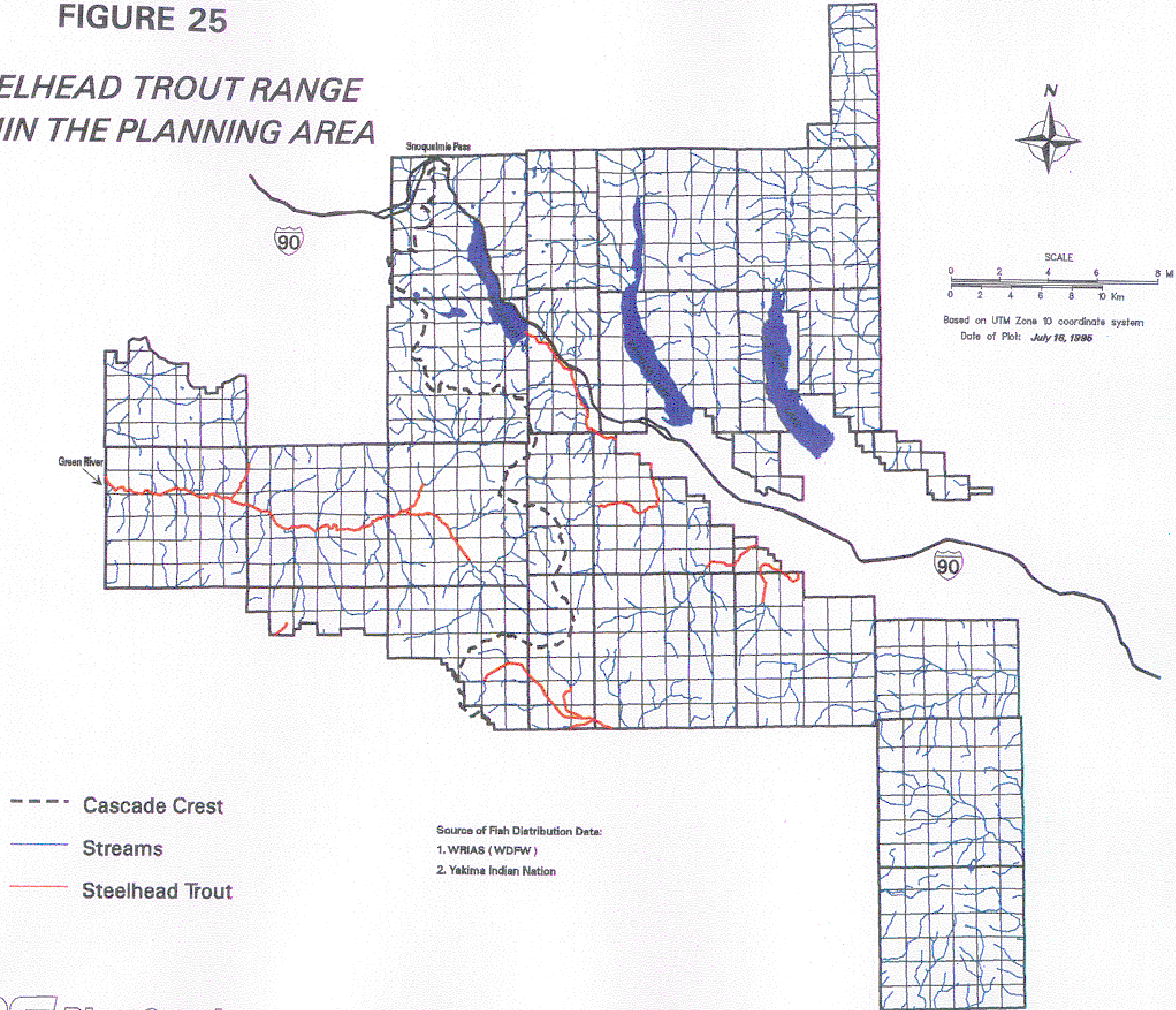


FIGURE 26

Present and potential distribution of spring chinook salmon in the Yakima River subbasin (YIN et al. 1990).

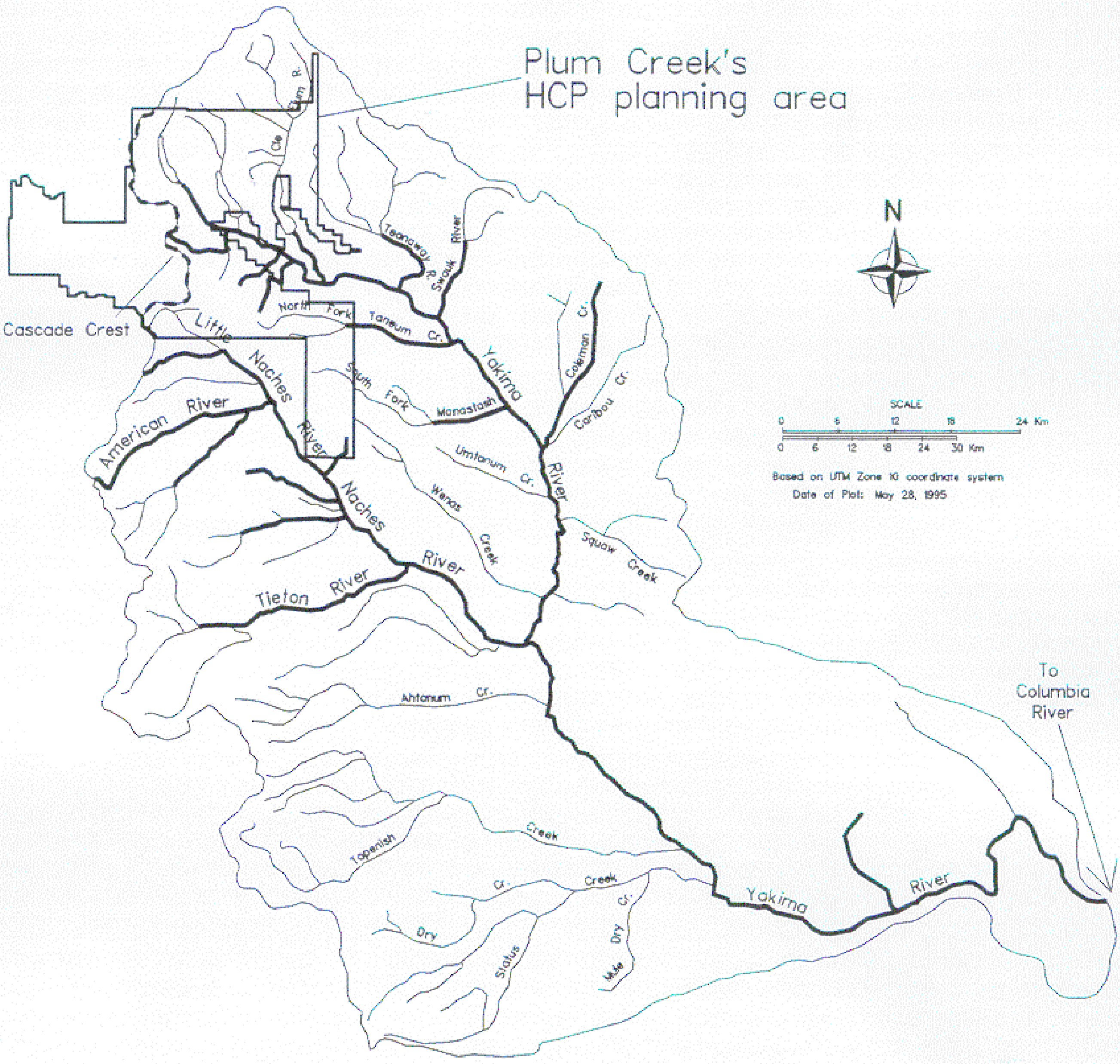


FIGURE 27

Yakima River Drainage Basin within the Planning Area

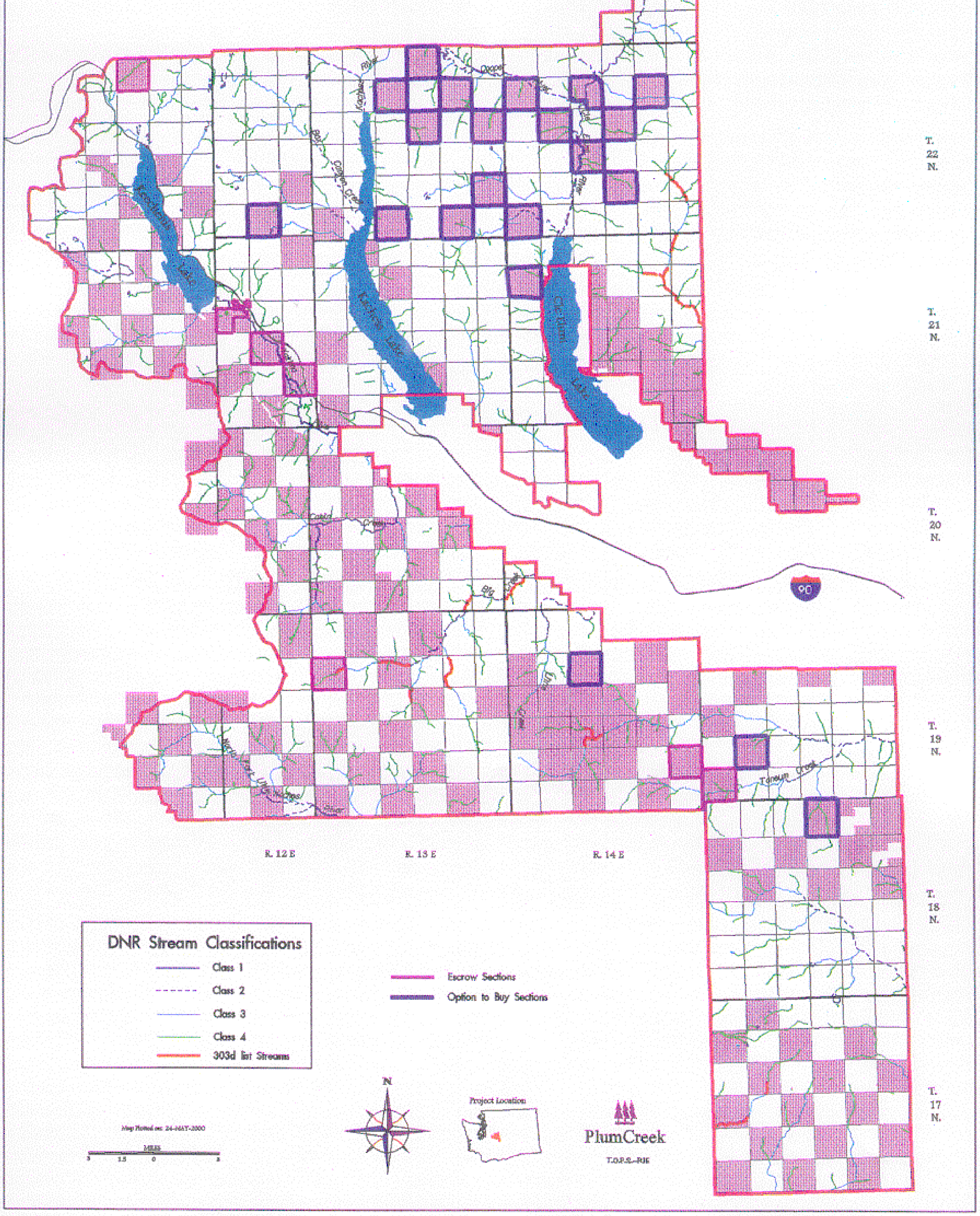


FIGURE 28

SPRING CHINOOK SALMON RANGE WITHIN THE PLANNING AREA

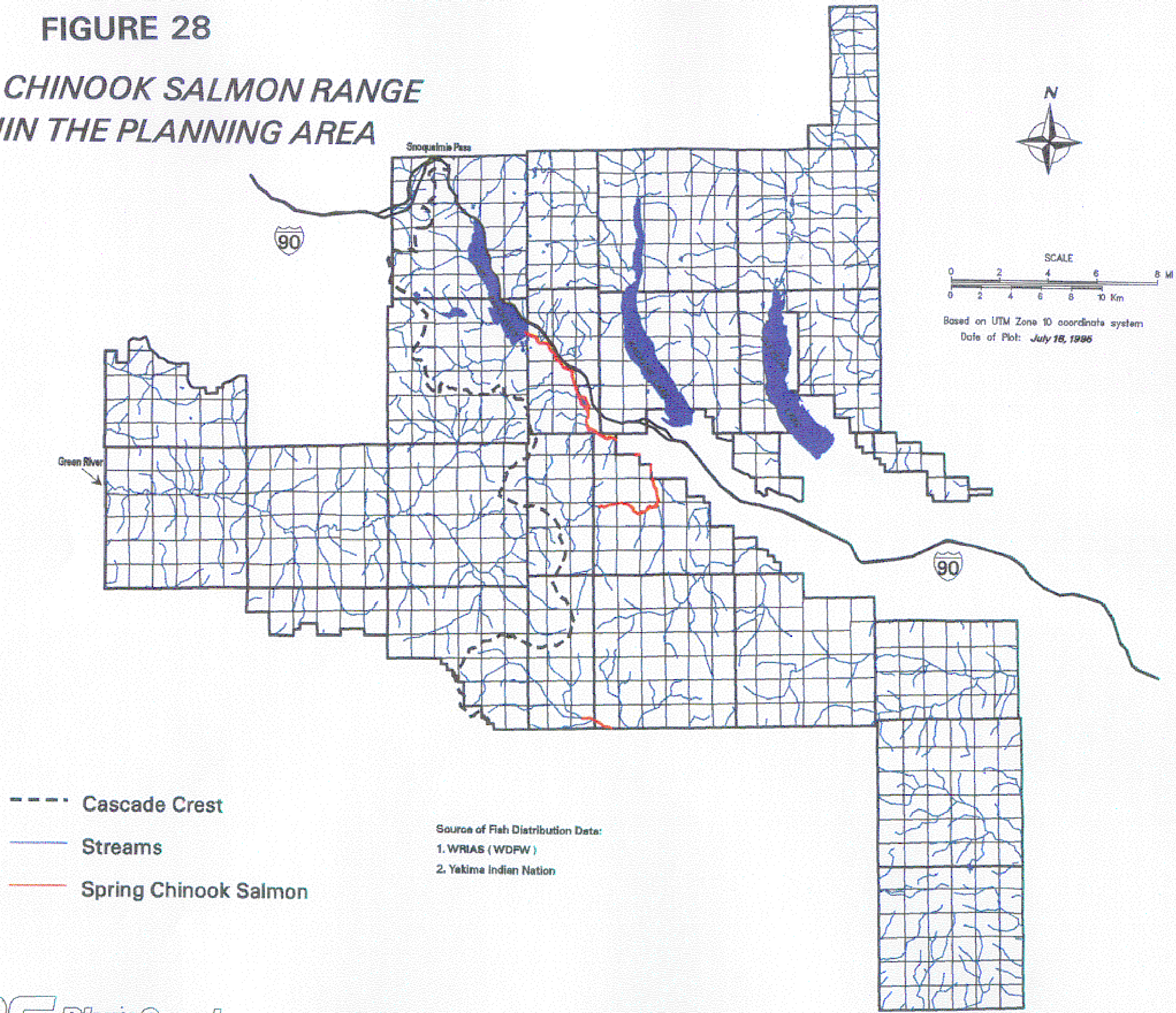


FIGURE 29

Present and potential distribution of coho salmon in the Yakima River subbasin (YIN et al. 1990).

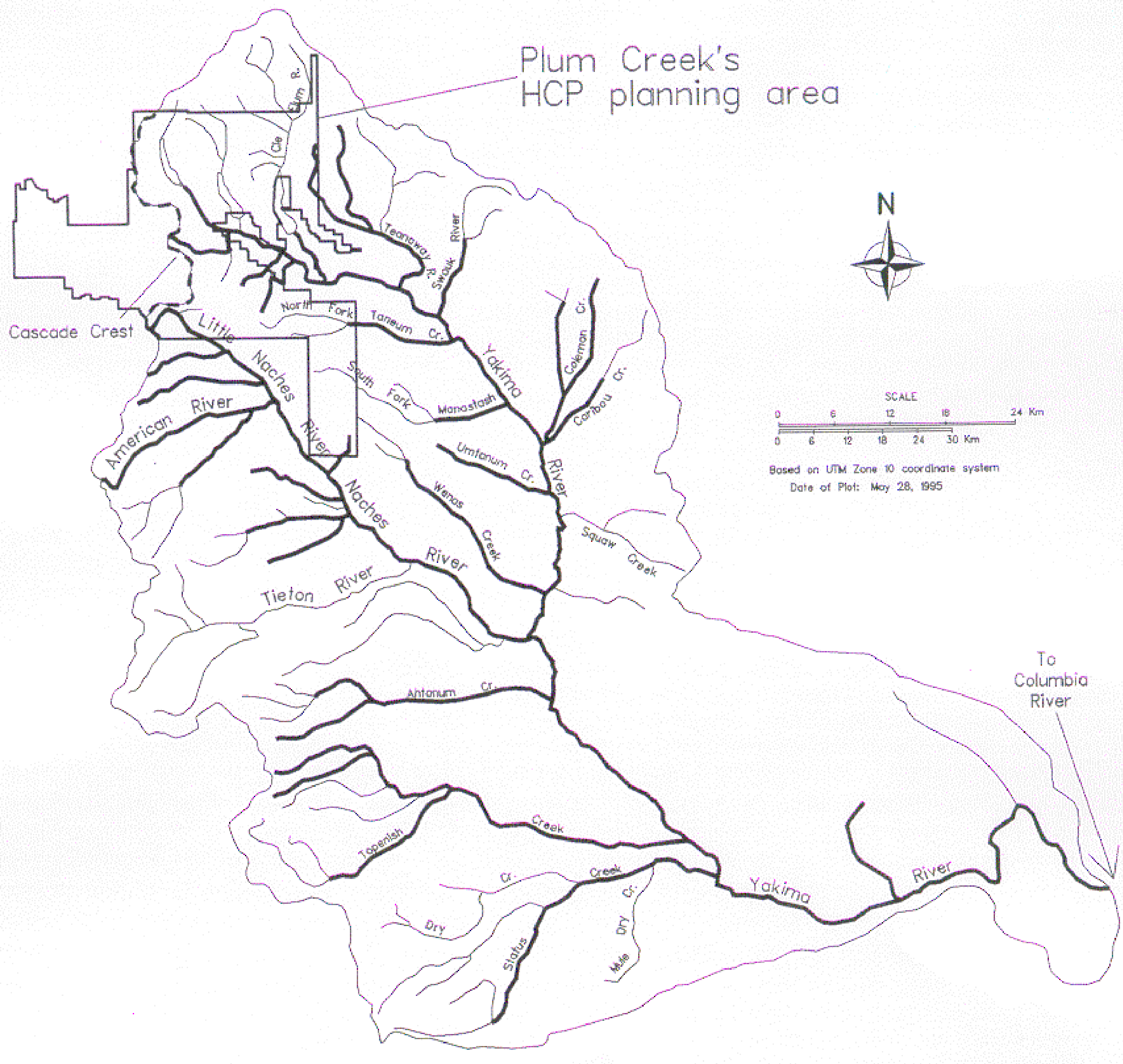


FIGURE 30

Present and potential distribution of summer steelhead trout in the Yakima River subbasin (YIN et al. 1990).

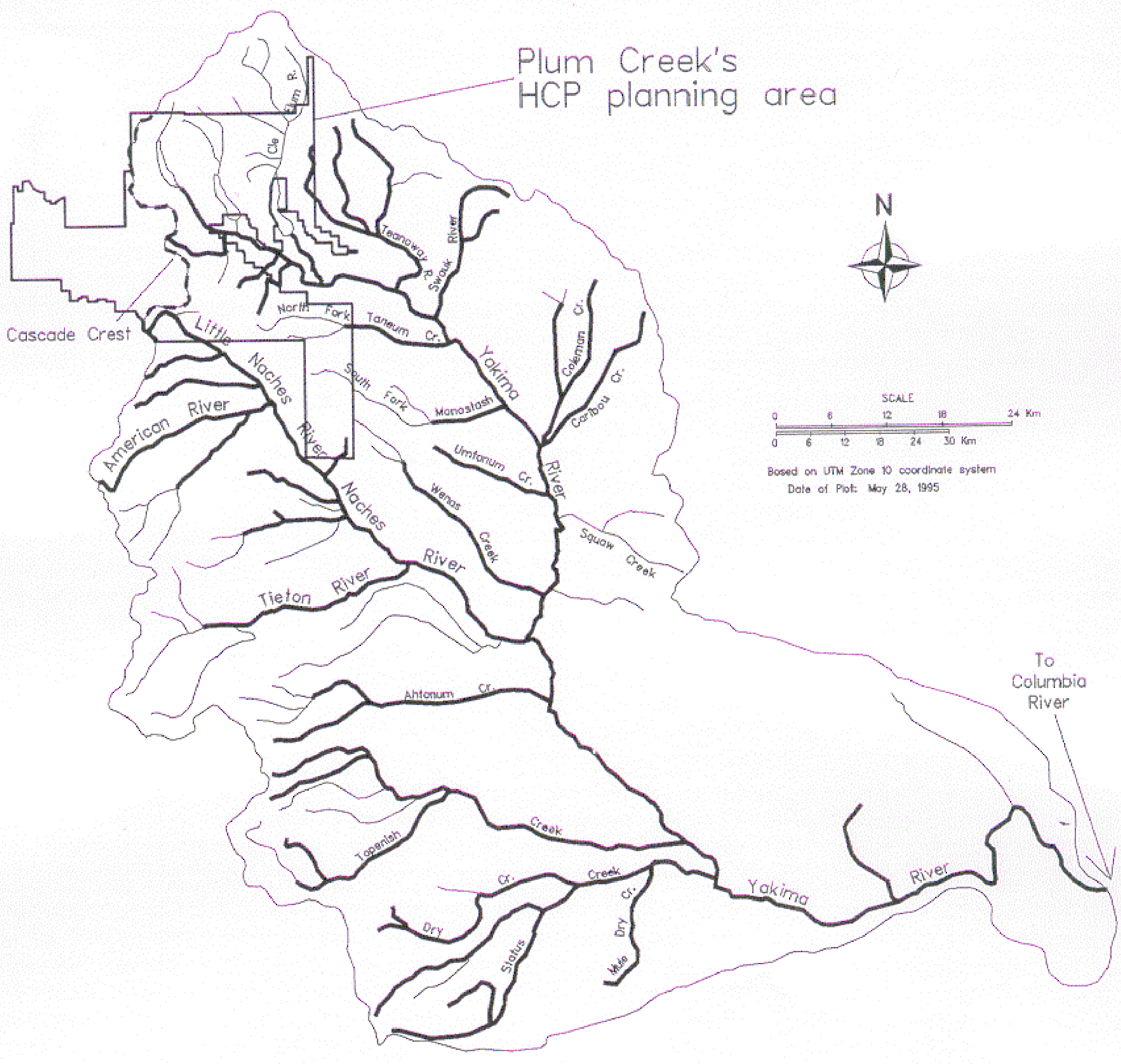
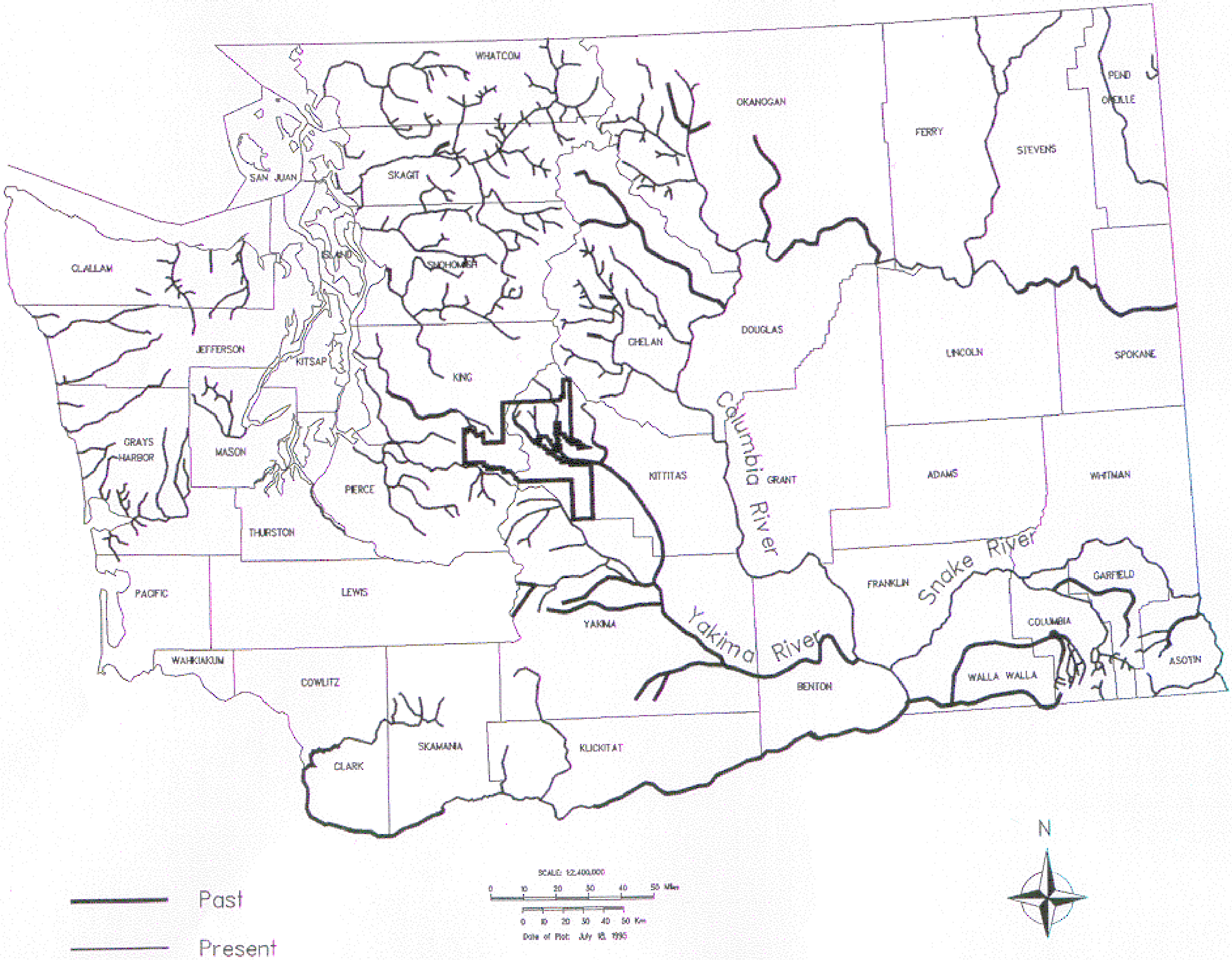


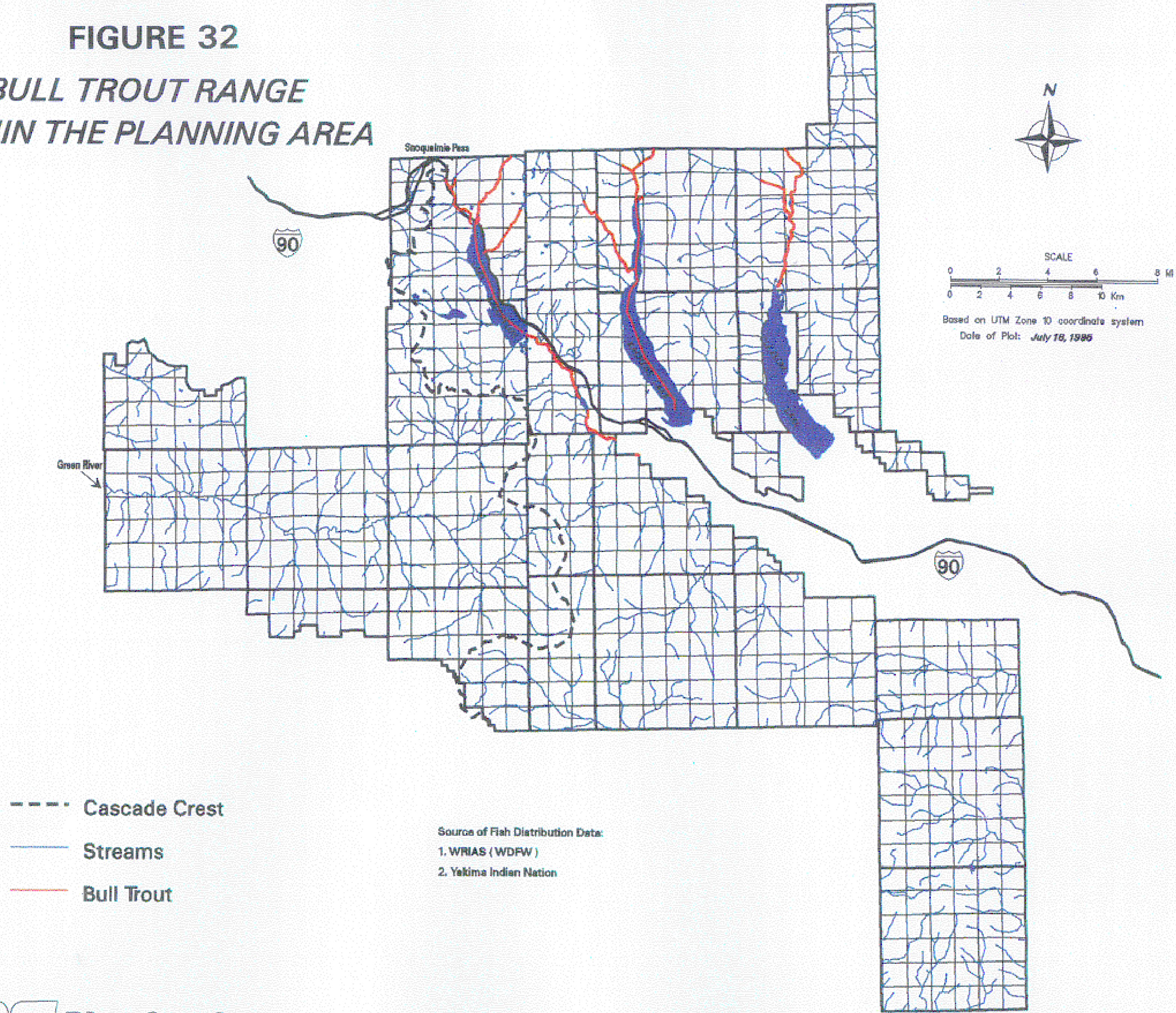
FIGURE 31 Historical and current distribution of bulltrout/Dolly Varden in Washington (Mongillo 1993).



PlumCreek

FIGURE 32

BULL TROUT RANGE WITHIN THE PLANNING AREA



Section 3.0

Habitat Conservation Plan

3.0 Habitat Conservation Plan

3.1 Introduction

As mentioned in Section 1.1, the primary goals of this HCP are: (1) to comply with the requirements of section 10(a)(2)(A) of the ESA; (2) to provide Plum Creek with predictability and flexibility to manage its timberlands economically while contributing in a meaningful way to the conservation of the spotted owl, marbled murrelet, grizzly bear, and gray wolf, and numerous other species; (3) to provide adequate habitat conditions in the Planning Area so that additional species may not need to be listed in the future; and (4) to provide protection from the uncertainties of future listings under the ESA.

Plum Creek's HCP is a forest ecosystem-management plan that will avoid or minimize potential impacts to the forest resources and associated wildlife species in the Planning Area in the I-90 corridor in the central Washington Cascades Mountain Range. However, no HCP can be constructed to avoid or minimize every potential ecological problem, or benefit every species of wildlife residing in a Planning Area. In this context, Plum Creek's HCP presents a reasonable and workable process where potential forest-management problems can be identified and resolved before they become major conflicts. In addition, this HCP assumes implementation of the Northwest Forest Plan on Federal lands in the Planning Area. In this way, the HCP augments the protection extended to listed and unlisted species on Federal lands and provides a framework for future coordination between Plum Creek, Forest Service, and other landowners within the checkerboard ownership in the Planning Area.

During the preparation of this HCP, Plum Creek conducted an in-depth analysis of the potential impacts of various harvest prescriptions and silvicultural treatments on spotted owls, marbled murrelets, grizzly bears, gray wolves, and other wildlife species in the Planning Area. The time period for the analyses covered the Permit period of the HCP.

The objectives of the analyses were to:

1. Estimate the impact of differing forest-management regimes on wildlife habitat in the Planning Area;
2. Identify and quantify the areas where existing habitat will be impacted and the mitigation measures that will be implemented; and
3. Identify management units in riparian habitat areas where special prescriptions can be used to protect and maintain fish and wildlife habitat.

The following sections of the HCP describe the details of the conservation plan required under section 10(a) for application of an incidental take permit from the Services. Section 3.2 identifies the multiple species addressed in the HCP; Section 3.3 outlines the riparian management strategy, including protection measures for riparian forests, and fish and wildlife habitat; Section 3.4 outlines the strategies and plans of the HCP to address special habitats in the Planning Area; Section 3.5 identifies the potential impacts that implementation of the HCP may have on the spotted owl, marbled murrelet, grizzly bear, gray wolf, Special Emphasis Species, Species of Concern, and Associated Species (Lifeforms) in the Planning Area; Section 3.6 identifies mitigation measures in the HCP and discusses measurable criteria for determining the biological success of the HCP; Section 3.7 discusses funding for implementation of the HCP; and Section 3.8 details how the HCP satisfies the issuance criteria described in section 10(a)(2)(b) of the ESA.

3.2 Multi-Species Approach

This HCP takes a multi-species, ecosystem approach to managing for all species found in the Planning Area. The biological needs of vertebrate species (listed and unlisted, named and unnamed) are addressed by the HCP and are covered by the Implementation Agreement with the Services. Plum Creek includes multiple species in the HCP in anticipation of future demands for landscape planning to address all general forest wildlife concerns. Plum Creek is evaluating the potential impact of the HCP on these species and providing a mitigation strategy for each species with the expectation that the incidental take permit will be amended, should any or all of these species become listed during the Permit period. This procedure provides a strategy to manage species prior to actual listing, and regulatory predictability for Plum Creek subsequent to listing.

To achieve this objective, Plum Creek is using two commonly accepted wildlife analysis techniques: (1) species prioritization and (2) guilding. All 315 vertebrate wildlife species either known or suspected to reside in the Planning Area have been prioritized, for convenience of discussion, by their respective legal and biological status into four groups (Table 2). These groups include:

1. **Section 10(a) Permit Species —** This group includes the four incidental take permit species: spotted owl, marbled murrelet, grizzly bear, and gray wolf.

2. **Special Emphasis Species —** This group includes 21 species, all of which were Federal candidate species at the time of the June 1996 HCP. Only the bull trout and the Oregon spotted frog were retained as candidates following the restructuring of the Federal candidate-tracking system (61 FR 7596).

   These include species with the highest likelihood of becoming federally listed during the Permit period. This group includes eight mammals, four birds, four fish, and five amphibians. Subsequent to June, 1996, several listings have occurred: Columbia River population and the Puget Coastal population of bull trout were listed as threatened effective July 10, 1998; Puget Sound chinook salmon were listed as endangered on March 24, 1999; Middle Columbia River steelhead were listed as threatened on March 25, 1999; and Canada lynx was listed as threatened effective April 24, 2000.

3. **Species of Concern —** This group includes 11 species, one of which is federally listed but proposed for delisting, one species which has been delisted, two species which were Federal candidate species, and seven State species of concern. This group (10 birds and one reptile) includes species that occur in the Planning Area but are not inhabitants of forest types that will be effected by the HCP or they are protected by other regulatory processes outside of the HCP (e.g., bald eagle site management plans).

4. **Associated Species —** Plum Creek has grouped the remaining 280 vertebrate species of wildlife (i.e., 68 mammals, 162 birds, 12 reptiles, 8 amphibians, and at least 30 species of fish) that potentially inhabit the Planning Area, into this general forest wildlife category. This category generally includes big game, small game, and other familiar forest wildlife species (Appendix 3).

Guilding was also used by Plum Creek to develop this multi-species HCP. Guilding is a commonly used technique for building assemblages of species based on similarities in breeding and feeding habitat preferences. Guilds are also known as “Lifeforms”. Lifeforms have been used to group species for analysis in several forest wildlife compendia (Brown 1985; Thomas 1979). A total of 16 Lifeforms represent the vertebrate species included in the HCP (Lundquist and Hicks 1995). For each Lifeform, forest structural classes were assigned as primary and secondary habitat preferences, or as nonhabitat.

The eight forest structural classes developed for use in the HCP are based on standard forest inventory parameters and wildlife components. The forest structural classification system ranges from stand initiation to old growth forests (Section 2.3 and Oliver et al. 1995). Orientation of Lifeform habitat preferences to inventory-based forest structural classes allows Plum Creek to model and evaluate present and future habitat conditions for multiple wildlife species across the Planning Area.

3.2.1 Section 10(a) Species Management

3.2.1.1 Northern Spotted Owl

3.2.1.1.1 Features of the Management Plan

A primary focus of the HCP is to target conservation measures to address the predicted reduction of spotted owl habitat and thereby avoid a significant reduction of NRF habitat for owl population recovery.

To address the biological requirements of northern spotted owls in the Planning Area, the following actions will be taken:

1. Identify and classify NRF, FD, and non-habitat in the 418,900 acres within the Planning Area throughout the Permit period (Section 2.4).
2. Provide spotted owl NRF habitat throughout the Permit period. Plum Creek will maintain those amounts of NRF habitat identified for each decade in Tables 25b and 25c. At a minimum, six-eight percent of its ownership in the Planning Area, at the lowest point in time, will be spotted owl NRF habitat. Significant amounts of foraging and dispersal habitat will also be present.
3. Prioritize owl nest sites to protect NRF habitat and develop dispersal habitat corridors for the most productive and strategically located (i.e., high density “cluster areas”) owl nest sites on Plum Creek’s lands in the Planning Area. Prioritization of owl nest sites following the land exchange with the Forest Service is shown in Table 24.
4. Defer harvest activities on approximately 1,100 - 1,900 acres of NRF habitat. These acres also provide dispersal habitat within the Planning Area.
5. Use only selective or partial harvest on approximately 1,300 - 2,300 acres to create and retain FD corridors. These corridors are currently NRF and/or FD habitat.
6. Provide NRF and dispersal habitat between and within the Designated Conservation Areas (i.e., WD-7, WD-8; WD-39, WD-40; Figure 9) in the Planning Area in support of the biological goals for non-federal lands (Section 1.4) outlined in the final draft recovery plan (Lujan et al. 1992b) for the spotted owl in the I-90 corridor. This will enable spotted owls to disperse successfully across Plum Creek’s ownership to occupy habitat on interspersed Federal lands.
7. Provide NRF and FD habitat between upland deferrals on Plum Creek’s lands and habitat on Federal lands by protecting and maintaining 7,200 - 8,500 acres in riparian habitat areas (Section 3.3.3). This includes 3,100 - 3,700 acres in riparian habitat areas that currently function as NRF or FD. Upland NRF deferrals or FD corridors were purposely located adjacent to riparian habitat areas to augment habitat conservation for the spotted owl, and to serve as refuge for species that disperse only short distances, and to provide greater connectivity of late-successional forests for owl movement, especially where telemetry studies suggested current use by owls.
8. Demographic and verification surveys in the Planning Area will be conducted to evaluate the effectiveness of Plum Creek’s harvest deferrals and dispersal corridors in maintaining the

viability of spotted owl nest sites identified in the prioritization process for deferrals, and to verify the assumptions of the RSPF model (Section 2.9; Irwin and Hicks 1995).

9. Small mammal surveys will be conducted to verify that populations of spotted owl prey species, such as flying squirrels, are adequate within the dispersal forest and managed old growth structural stand classifications to provide a prey base sufficient to sustain resident spotted owls.
10. When entering owl sites to conduct harvesting operations, Plum Creek will consider prioritizing owl sites by first entering those stands with less biological value (i.e., unoccupied sites), and secondly, those stands furthest from an owl site center.
11. Known owl sites with active spotted owl nests in the Planning Area will receive protection within a 0.25-mile radius from March 1 through August 31.

3.2.1.1.2 Rationale for Designating NRF Deferrals and FD Corridors

OPTION modeling of spotted owl habitat in the Planning Area over the Permit period indicated that total habitat for spotted owls (i.e., NRF and FD) will be greater in the Planning Area, at the end of the Permit period (i.e., 2045). The increase in total owl habitat is due to two major factors: (1) forest in-growth following historical harvest on all ownerships which will develop into FD habitat; and (2) a substantial reduction in harvesting of NRF and FD habitat on Federal lands. However, the modeling also suggested that habitat levels would decline slightly and potentially affect owl populations during the first 20 years of the Permit period (i.e., until about 2016). This slight decline in owl habitat is the result of continuous harvesting of owl habitat on non-federal ownerships, and insufficient time for regrowth in old harvest units to replace previously harvested habitat. This situation is similar to conditions predicted in both the Interagency Spotted Owl Committee Report (Thomas et al. 1990) and the final draft Recovery Plan (Lujan et al. 1992b) regarding trends of future habitat throughout the range of the spotted owl. Section 3.5.1.1 provides an analysis of spotted owl habitat trends in the Planning Area.

To address this short-term reduction in owl habitat at a reasonable economic cost to Plum Creek, a network of 40 NRF harvest deferrals and FD corridors were designated in the Planning Area. The specific objectives of the NRF deferrals and FD corridors are to:

1. Support productive pair sites in the Planning Area;
2. Link Federal NRF and FD habitat in spotted owl high density “cluster” areas;
3. Augment and connect riparian habitat areas where NRF and FD habitat currently exist; and
4. Provide dispersal opportunities for spotted owls between high-density “cluster” areas.

Forty-five to sixty-eight forest inventory polygons totaling 1,100 – 1,900 acres were designated as NRF deferrals. The forest inventory polygons designated for NRF deferral will remain unharvested for at least 20 years. All 45 - 68 polygons are currently NRF habitat. Thirty-nine to seventy-eight forest inventory polygons totaling 1,300-2,300 acres were designated as FD corridors. In these polygons, selective or partial harvest prescriptions will be employed to harvest some merchantable timber while retaining FD habitat. A description of spotted owl habitat types is provided in Section 2.4. The FD corridor polygons will remain as FD habitat throughout the Permit period. All 39 - 78 FD corridor forest inventory polygons are currently NRF or FD habitat.

To maximize the biological value of the NRF deferrals and FD corridors, Plum Creek prioritized the 106 spotted owl sites in the Planning Area (Herter et al. 1995) and identified 11 sites where deferrals and corridors would be beneficial to maintaining spotted owl productivity through the first 20 years of the Permit period. Of the 109 known spotted owl site centers, only 40 within the Planning Area contain 100 acres or more of habitat on Plum Creek's ownership within a 1.8-mile radius and have been recently occupied, based on demographic surveys (Table 24). Among these, 14 are considered unlikely to be affected by Plum Creek's forest-management activities because either, (1) habitat on Plum Creek's land was present only at the outer edges of the 1.8-mile management circle and this habitat was often isolated from the site center by prominent ridges that lack habitat or by lakes, or (2) the site centers were located on Forest Service ownership which contained sufficient habitat, based on the RSPF model (Section 2.9; Irwin and Hicks 1995).

Of the 26 remaining sites, 11 sites, where habitat on Plum Creek's land is beneficial to maintaining occupancy and productivity, were selected for NRF deferral and FD corridor designation. These sites are generally located in high-density cluster areas and in either Adaptive Management Areas or Late-Successional Reserves where the deferrals and corridors will augment and link habitat retained on Federal lands. Some of these sites are located in Federally designated Matrix and were selected for NRF deferrals and FD corridors based on their long-term reproductive histories and geographic locations. Ten of the 11 sites selected for NRF deferrals and FD corridors were occupied in the last five years.

Table 24. Prioritization of Spotted Owl Sites.

Prioritization Criteria	Number of Owl Sites	Owl Sites Remaining
Total spotted owl sites in and around the Planning Area	109	109
Site centers decertified by WDFW	3	106
Site centers more than 1.8-miles from the Planning Area boundary	3	103
Sites with no habitat on Plum Creek's land in a 1.8-mile circle	14	89
"Single status unknown" sites where recent surveys show no owls	8	81
Verified pair or single sites occupied only one year or two years, breeding never documented	3	78
Resident single sites verified as unoccupied	6	72
Adequate Federal habitat and no Plum Creek habitat within 0.7-miles	22	50
Pair sites with no daytime sightings for 4 years	2	48
Sites with less than 100 acres of Plum Creek habitat between the 0.7- and 1.8-mile radius	8	40
Plum Creek harvest likely will not affect owl sites due to Federal core habitat[2]	14	26
Plum Creek deferrals of NRF habitat for 20 years will ensure owl site viability[3,4]	11	15
Sites on or adjacent to Plum Creek's lands that will be impacted within 20 years of Permit issuance [5,6]	15	0

NOTE: Factors influencing the last three prioritization criteria
[1] Adequate NRF habitat existed on Federal land per the RSPF model (Irwin and Hicks 1995).
[2] Priority for 20-year deferral sites was given to high density clusters in AMA and LSR.
[3] 28 of 30 deferral sites were occupied in 1994.
[4] 13 of 20 "impact" sites were vacant in 1994.
[5] Some "impact" site centers were converted to FD habitat only to maintain connectivity between and within clusters.

Specific criteria used to select the forest inventory polygons for NRF deferrals and FD corridors include the following:

1. proximity to known nest sites;

2. areas of known spotted owl use based on radio-telemetry;
3. habitat quality;
4. proximity to Federal habitat and riparian areas; and
5. likelihood of the deferrals and corridors being used by multiple spotted owl pairs.

Figure 33 illustrates the rationale used to designate NRF deferrals and FD corridors in the Planning Area. The remaining 15 sites were not considered for NRF deferrals because they lacked consistent occupancy or productivity (i.e., only four of the 15 sites had nests in the last five years). Additionally, many of these sites were distant from high-density cluster areas or were located primarily in habitat on non-federal lands.

3.2.1.2 Marbled Murrelet

The likelihood of marbled murrelets currently using the Planning Area is very low. In fact, based on results of Plum Creek's surveys and other surveys (Section 2.10.2), marbled murrelets have not been detected in the Planning Area, except for a single bird sighting near Gold Creek in 1993 (Herter and Hicks 1995). Subsequent surveys in 1994 failed to yield any further detections in this area. However, implementation of the HCP on Plum Creek's lands and the Northwest Forest Plan on Federal lands may increase the future potential for murrelet use. These conclusions were reached based on the findings of several databases and information sources: (1) the FWS proposal for designation of marbled murrelet critical habitat (USFWS 1994) includes 6,800 acres within the Planning Area; (2) the DNR proposal for marbled murrelet rules identified the WAUs within the Planning Area as having a "low potential" for murrelet presence, and would not require surveys prior to authorizing forest practices permits in the area (DNR 1994); (3) analysis of potential habitat for murrelets in the Planning Area indicates that habitat is minimal and highly fragmented West of the Cascade crest and located primarily at higher elevations near the crest (Section 2.10.2.2); and (4) surveys completed in the Planning Area to-date, by several organizations including Plum Creek, have failed to detect any murrelet nest sites or occupied stands (Herter and Hicks 1995b).

Despite the extremely low potential for murrelet use of the Planning Area, murrelets may eventually use the Planning Area for nesting and breeding during the Permit period. The murrelet management plan was developed in conjunction with the Services, and will include the following four actions:

1. **Harvest** Deferrals — harvest was deferred through 1996 on 257 acres of potential murrelet nesting habitat while surveys were completed to identify possible murrelet nesting activity in the Planning Area. Habitat stands selected for deferral met the following criteria:
    - Plum Creek's lands West of the Cascade crest in the Planning Area;
    - spotted owl NRF habitat (i.e., A/B habitat);
    - less than 3,500 feet in elevation;
    - less then 60 percent composition of true firs;
    - greater than five acres;
    - stands contain 8 trees per acre greater than 32 inches DBH and these large trees are clumped or contiguous across a patch rather than scattered, isolated remnants above a second growth canopy (The above criteria regarding the number of large trees per acre was used to determine potential murrelet habitat in lieu of the number of suitable murrelet nesting

platforms because of differences in platform measuring methodology between Plum Creek and Washington Department of Fish and Wildlife (Hamer 1995) surveys. Two stands were considered unsuitable murrelet habitat without being field surveyed based on prior knowledge of a professional wildlife biologist experienced in murrelet biology. These stands were considered unsuitable because they either were mistyped and contained small, densely-packed trees or were bisected by railroad and power lines and remaining large trees were scattered, isolated remnants above the existing canopy); and

- confirmation of parameters

2. **Murrelet Surveys** – Plum Creek conducted murrelet surveys on 853 acres in the Planning Area between 1994 and 1995. Of the 853 acres surveyed, approximately 224 acres were on Plum Creek land and 629 were on Forest Service ownership. These surveys were conducted to fulfill environmental requirements for access requests from the Forest Service. Additional surveys were completed during 1995 and 1996 on the 257 acres identified in step 1. Thus, by the end of 1996, Plum Creek had completed surveys for murrelets on a total of 1,110 acres. Subsequent to the implementation of the HCP, additional access surveys were conducted during 1997 and 1998 on 362 acres. Another 1,082 acres were surveyed in 1999 and 2000 as a result of the I-90 Land Exchange. Since presence was detected on two of the Land Exchange parcels, not all the acres will have a second year of surveys. In total, 2,554 acres have been surveyed with varying levels of intensity and methods (Figure 19). Survey methodology for the surveys related to the HCP included six visits (i.e., three visits per year for 2 years) for each deferral stand between May 1 and August 5 of each year. Some of the surveys related to the Land Exchange used a modified protocol developed with the U.S. Fish & Wildlife Service and the Washington Department of Fish and Wildlife which used radar techniques to supplement ground surveys. This methodology detected presence on U.S. Forest Service lands during the I-90 Land Exchange. Subsequent surveys completed in 2000 determined the stands were not occupied.

3. **Nest Site Protection —** Occupied stands found during HCP required surveys will be protected by deferring a specific block of habitat surrounding the site. Criteria that will be used to designate the habitat block are as follows:

   - Suitable habitat will be protected in all directions from an occupied stand until a 300 foot break in suitable habitat is encountered. Narrow (i.e., less than 300 foot) areas of suitable habitat will not be considered as "habitat" or as links between larger habitat patches greater than 300 feet apart; or

   - An upper limit of 500 acres will be established per nest site. Plum Creek and FWS will cooperatively determine "the best 500 acres", regardless of ownership. Plum Creek will protect their portion of the identified "best 500 acres".

   - The protection period for all nesting stands will be the period of occupancy plus 5 years. Verification of absence will be determined by full applicable protocols in effect at the time, or as mutually agreed upon with the Services.

4. **Seasonal Protection —** Future surveys for murrelets in the Planning Area by other individuals or organizations may detect murrelet activity on Plum Creek's lands. It is possible that these sites may be located in areas not identified and deferred during Plum Creek's surveys. Plum Creek would, however, protect these "future" murrelet sites in the Planning Area by deferring harvest within a 0.25-mile radius from March 1 to August 31. Additionally, maintenance of old growth forests in nondeclining amounts on Plum Creek's lands combined with designated critical habitat

and riparian conservation areas set aside on Forest Service lands under the Northwest Forest Plan, will provide late-successional habitat along all major West flowing river systems, which murrelets would be expected to use in the future.

3.2.1.3 Grizzly Bear

State and Federal agencies agree that grizzly bears occur, at least occasionally, within the Planning Area. Historical and recent observations in the north and central Cascades also indicate that grizzly bears may be slowly extending their southern range. However, at present there is insufficient information to confirm the extent to which grizzly bears use the Planning Area. Plum Creek's strategy for addressing grizzly bears focuses on analysis of two major habitat-related concerns: (1) open road density; and (2) habitat diversity (i.e., hiding/thermal cover and forage/prey habitat). To address habitat concerns and increase the potential for grizzly bears to occupy and successfully reside in the I-90 Lakes Subunit (Figure 22), Plum Creek will implement a series of Best Management Practices (BMPs) to maintain habitat in a condition that allows bears to meet their essential biological needs. Plum Creek will implement the BMPs in two phases. Phase I will be implemented upon issuance of the Permit. The objective of this phase will be to create conditions in the I-90 Lakes Subunit that are conducive to grizzly bear re-occupancy of the area. Phase II will be implemented following verification that grizzly bears are residing in the subunit. This phase will include more aggressive actions and measures to ensure protection and survival of resident bears.

Phase I BMPs will include:

1. **Restrict Public Use —** Restricting public use and minimizing the potential for grizzly bear disturbance and displacement by installing gates on roads which Plum Creek has total administrative control. Administrative use of roads by Plum Creek to manage its lands is allowed and consistent with the intent of these road closures;
2. **Open Road Density —** Reducing open road density to 1.0 mile per square mile on Plum Creek's lands in the I-90 Lakes Subunit within the first decade of the Permit period (i.e., 2006). "Open" is defined as roads open to the public. Roads which Plum Creek does not have total control (e.g., paved roads or roads to private residences) are excluded from the road-density requirement. Permanent (i.e., year-long) road closures and seasonal closures that coincide with likely use of the subunit by grizzly bears are considered to meet this requirement;
3. **Visual Screening —** Plum Creek will retain visual screening along open roads on Company property to minimize disturbance and potential illegal killing of grizzly bears. Visual screening is defined as trees and vegetation that can effectively obscure up to 90 percent of a grizzly at a distance of 100 feet. To the extent possible, this requirement will be achieved by retaining submerchantable trees and shrubs rather than commercially valuable trees. Roads, (including gated roads) closed to the public are excluded from visual screening requirements; and
4. **Prohibit Firearms —** Within the recovery zone in the I-90 Lakes Subunit, Plum Creek will prohibit firearms in all Company and contractor vehicles, except where firearms are a necessary part of the duties of Company personnel (e.g., law enforcement/security).

Phase II BMPs will be implemented by Plum Creek once the Services verify that grizzly bears have successfully recolonized and reside in the I-90 Lakes Subunit. Verification will consist of successful denning by grizzly bears in the subunit and/or multiple sightings of adult grizzly bears with cubs. Phase II BMPs will be implemented within 1 year of FWS verification and include the following actions.

Phase II BMPs will include:

1. **Road Closures —** Plum Creek will provide additional road closures and barriers on roads managed jointly by Plum Creek and the Forest Service in the I-90 Lakes Subunit.

2. **Road Location and Construction —** In the event that grizzlies are confirmed in the Planning Area, new roads where necessary, will be constructed to avoid preferred bear habitat types. Where possible, Plum Creek will avoid aligning main haul or other roads that will remain open, through the center of clear-cuts and seedtree harvest units. Road-management criteria will include: (1) minimizing the number of miles of road needed to achieve the objectives of each timber sale; and (2) maximizing the use of local roads, and minimizing the use of arterials and collectors. In addition to the standards and guidelines outlined in Section 1.2.3.4, Plum Creek's road management will include the following:

   - construct roads to minimum specifications to discourage high use, but to maintain safety and protect environmental conditions;
   - locate roads where practical, to avoid wetlands, ridgetops, saddles, or creek bottoms since these areas often are used by grizzly bears as feeding and travel corridors;
   - reduce sight distances using "doglegs" or "crooks";
   - minimize construction of "loop" roads since they encourage recreational usage;
   - schedule construction to avoid seasonal use by bears; and
   - identify temporary roads and landings that will be closed and replanted with conifers following harvest operations.

     Some of the provisions of this BMP may be implemented in Phase I. Watershed analysis and the riparian and wetland strategies, together with the Environmental Principles would likely influence the locations of new roads, and removal of some old roads, so that there would be fewer miles of roads in many sensitive areas in the future. Some habitat categories (e.g., wet meadows and avalanche chutes) would be avoided specifically for grizzly bears beginning Phase I. Berry fields which are likely to be important for grizzlies would also be avoided whenever practicable. Similarly, saddles are often the most environmentally sound alternative for crossing a ridge with a road. Crossing in other locations might have severe impacts for species relying on talus slopes or other important special habitat type, or might increase the cost of roads to avoid steep slopes and mass-wasting sites. Plum Creek may consider establishing priority areas should come Federal designation effort be initiated. In the meantime, Plum Creek will use its own discretion regarding road location relative to most grizzly bear habitat.

3. **Cover —** Cover is an important habitat consideration for grizzly bears especially in areas of recreational and/or administrative use. Effective cover: (1) allows bears to move between foraging areas and seasonal ranges; (2) reduces mortality risk; and (3) provides for thermal regulation. In all watersheds in the Planning Area, Plum Creek will maintain riparian habitat areas and other vegetative corridors, which should effectively conceal bears. Particular attention will be given to maintaining vegetative cover areas adjacent to openings in order to facilitate bear movement around clear-cuts and feeding areas within openings. Vegetative cover will also be provided in and adjacent to preferred habitats (such as low-elevation riparian areas, wetlands, avalanche chutes, and wet meadows) and adjacent to open roads. In addition, suitable vegetative cover will be distributed throughout the watersheds in the Planning Area, and estimates of total cover available to bears will be calculated based on all ownerships within the Planning Area.

4. **Size of Openings —** Research on grizzly bears has shown that bears select edge or cover/no-cover interfaces. This preference is attributed to high forage values and proximity to escape cover. However, use of open areas by bears has been found to decrease as distance to vegetative cover increases. For this reason, Plum Creek will design all even-aged and seed-tree harvest units within the I-90 Lakes Subunit (Grizzly Bear Recovery Zone) so that no point in the unit is more than 600 feet from effective hiding cover for bears. Areas suitable for application of this BMP include harvest units near preferred habitat and stands with understory conifers and shrub vegetation appropriate for overstory removal or other partial harvest treatments. Areas unsuitable for application would include stands near human habitation (e.g., cabins, campgrounds) where bear use is not prudent or where forest stands lack understory development and only highly valuable, merchantable timber would otherwise be retained. By following this strategy, Plum Creek will increase forest edge opportunities for bears and other wildlife, maintain bear habitat effectiveness, and allow bears to take maximum advantage of adjacent vegetative cover. Although configuration of harvest units to provide cover is a Phase II BMP, in certain critical areas and on an experimental basis, Plum Creek may decide to con Figure some harvest units similarly in Phase I to develop an understanding of how to provide this level of security.

5. **Timing of Operations —** Seasonal timing of timber-harvesting operations is an effective means for Plum Creek to minimize bear/human confrontations and to maximize the effectiveness of important bear habitat (e.g., riparian corridors, avalanche chutes), Plum Creek will coordinate timber-harvesting operations in time and space so that activities will occur in areas and at times that have the least biological importance to the bears. For example, activities will be scheduled to reduce the possibility of disturbance to bears in denning habitat and areas identified as important foraging areas. Important foraging areas include low-elevation riparian areas and ungulate winter ranges in the spring (i.e., April through May) and areas where shrubfields and fruit/nut sources exist at higher elevations in the late summer and fall. If portions of the I-90 Lakes Subunit area are identified as spring foraging habitat, Plum Creek will schedule harvest activities to commence after June 1. If areas of the subunit are identified as late-summer/fall grizzly bear habitat, forest activities will be scheduled to commence in winter or early spring, where practical.

6. **Riparian Habitats —** Riparian areas are among the most important habitat types for grizzlies for foraging opportunities and cover/movement corridors. Maintenance and protection of RHAs is part of Plum Creek's Riparian Management Strategy (Section 3.3), and the Company will institute silvicultural prescriptions that provide habitat for a wide variety of wildlife species including grizzly bears. Management prescriptions for RHAs (Section 3.3.3) specify selective uneven-aged harvest techniques in or near riparian zones that will maintain forage habitat for bears while retaining vegetative cover values.

Even though the I-90 Lakes Subunit is the only area included in Plum Creek's grizzly bear management strategy, the recovery zone boundary does not impose an obstacle to grizzly bear movement into other areas of the Planning Area. In the event that grizzly bears are detected (by either Plum Creek or the Services) inside or outside of the I-90 Lakes Subunit recovery zone, but within the Planning Area, Plum Creek will, to the extent practical and within the Company's forest-management plans, implement temporary road closures or other temporary measures to minimize the potential for human/bear conflicts.

3.2.1.4 Gray Wolf

As with the grizzly bear, State and Federal agencies believe that gray wolves occur, at least occasionally, within the Planning Area. Although available information on the distribution of gray wolves in the north and central Cascades is not as extensive as for other wildlife species, Plum Creek believes it is reasonable to assume that gray wolves would eventually reside in the Planning Area during the Permit period. Biologically, the fate of the gray wolf in the Planning Area is linked primarily to that of its prey, which includes large herbivores, such as elk and deer, and smaller mammals, such as snowshoe hares. Because Federal "recovery areas" in the central Cascade Mountains have not yet been established for the gray wolf, Plum Creek will evaluate the amount of habitat for preferred wolf prey species throughout the entire Planning Area. However, some areas within the Planning Area will be given higher priority, because they may have a higher likelihood of providing adequate habitat for preferred prey species. For example, road-management activities will be implemented in the Taneum Creek watershed and the I-90 Lakes Subunit in conjunction with similar road-management practices being implemented for the grizzly bear.

As with the grizzly bear, Plum Creek will avoid or minimize potential impacts to gray wolves by maintaining habitat in a condition that allows wolves and their important prey species to meet their essential biological needs while residing in the Planning Area.

The three features of the gray wolf management plan are:

1. **Den Site Protection —** In the event that wolves den on Plum Creek's land in the Planning Area during the Permit period, Plum Creek will restrict forest-management activities within a 0.25-mile radius of an active den site during the denning period (i.e., April 1 through June 15). The purpose of this restriction is to minimize disturbance near a den site which might contribute to den site abandonment. Plum Creek will coordinate all activities planned for the area within 0.5-miles of active dens with the Services to determine if potential adverse impacts would occur. Additional road closures will be considered near dens to further protect the site. Known rendezvous sites will be protected. Management activities in a management unit containing a den site will be deferred for a period of 2 years following the last known denning. Deferrals will be limited to a maximum of three den sites at any one time during the Permit period. If greater than three active den sites occur at any one time, Plum Creek will consult with the FWS to determine priorities for protection in the least burdensome, but most effective manner. These requirements are considered to be interim for the Planning Area and will be re-evaluated and reduced when six wolf packs are documented in Washington.

2. **Provisions for Prey Habitat Conditions —** Habitat management for wolves is primarily directed at habitat for its prey species (USFWS 1980). The most important prey species for wolves in the Planning Area are deer, elk, and snowshoe hares. These prey species are grouped under Lifeform 5, as species which use edges between forage (i.e., stand initiation; shrub/sapling; and young forest) and cover habitats (i.e., older forest types). The creation and maintenance of edge habitat through forest-management activities (e.g., harvest units) will provide adequate habitat for wolf prey species, although, as discussed in Section 3.2.2.5, primary habitat for Lifeform 5 species will likely decline from current levels during the Permit period.

3. **Road Management —** Plum Creek will increase road management to provide more secure conditions for both prey species and wolves that use the available habitat. Minimal contact with humans has been cited as the second most important biological necessity for wolf recovery (USFWS 1980). Plum Creek has been involved in many cooperative road closures with the Forest Service, WDFW, and DNR, to restrict vehicular traffic to maintain or increase big game security and manage hunting pressure. An important area for cooperative road management is the Taneum Creek watershed where Plum Creek has established hunting season road closures on major roads controlled by the Company. The Taneum Creek watershed is also the area where most of the historical and recent sightings of wolves in the Planning Area have been recorded. Plum Creek will maintain these closures and increase road-management efforts in the future. Ungulate fawning/calving and wintering areas are areas where wolves are most likely to occur.

To the extent possible, Plum Creek will schedule forest-management activities to occur at times of the year when wolves are least likely to be present. These actions should also provide additional protection against displacement and death of wolves due to poaching and malicious shooting. Road management for grizzly bears in the I-90 Lakes Subunit will provide similar protection benefits for wolves.

In addition, implementation of the riparian management strategy (Section 3.3) will provide structural diversity and potential travel corridors for wolves to move unimpeded across Plum Creek's lands to adjacent Federal lands. Company directives to contractors restricting firearm possession in road closure areas and grizzly bear security areas will provide additional protection for wolves in the Planning Area.

3.2.2 Lifeform Management

A fundamental objective of this HCP is to address the biological needs of wildlife species known to occur in the Planning Area. This multi-species approach is required to achieve both ecosystem management and regulatory predictability for Plum Creek. To achieve this objective, Plum Creek consolidated the breeding and feeding habitat preferences of all 315 vertebrate species in the Planning Area into 16 "Lifeforms" ranging from very specialized groups to habitat generalists (Lundquist and Hicks 1995; Appendix 3). This "guilding" approach includes (1) Section 10(a) Permit Species (4 spp.); (2) Special Emphasis Species (21 spp.); (3) Species of Concern (11 spp.); and (4) Associated Species (280 spp.). Section 3.4 discusses management of special habitats important to each of the Lifeforms. This section summarizes the Lifeform approach used in the HCP and the assessment of habitat conditions resulting from implementation of the HCP.

For each Lifeform, forest structural stages (Section 2.3) were assigned as habitat preferences. These assignments were based on extensive literature review and consultation with local biologists. Although the Lifeform approach has been used in other large-scale wildlife habitat analyses and compendia (e.g., Thomas 1979; Brown 1985), the approach was modified based on site-specific information and suggestions by professional biologists. First, some Lifeforms were partitioned into subgroups, based on specialized habitat preferences. For instance, some primary cavity excavators (Lifeform 13) prefer older, more complex forest structural stages where larger snags are available. Consequently, these species were separated from the other species in Lifeform 13 and placed into a subgroup (13a) to facilitate habitat evaluation for these species.

Second, although forest structural stages were grouped into primary and secondary habitats for each Lifeform, primary habitat was emphasized in evaluations to ensure that the most important habitats would not be reduced to undesirable levels (Lundquist et al. 1995). During the evaluations of suitable habitat, secondary habitat was allotted only half the "weight" or importance of primary habitat. Primary and secondary habitat combined was considered "suitable" habitat for each Lifeform. Suitable habitat thresholds for each Lifeform were used to evaluate alternatives considered in the plan.

Third, a "delayed implementation" feature was built into the modeling to incorporate habitat for some Lifeforms. This modification was added to the plan to address concerns that even-aged harvest units harvested under previous regulations in the Planning Area do not contain the residual snags and wildlife reserve trees now routinely provided in harvest units. Inclusion of these units as habitat for some Lifeforms (such as cavity excavators) could overestimate the amount of habitat present for these species. Consequently, even-aged harvest units where not considered as secondary habitat for Lifeform 13a, for 10 years (stand initiation, shrub sapling) to 20 years (young forest, and pole timber stages) into the Permit period, when recently harvested stands with increased structural retention would be more dominant in the Planning Area.

Fourth, the GIS scanning area used to evaluate current and future habitat conditions for some Lifeforms was constrained to fit their specific biology. These modifications were added to ensure that habitat evaluation were as accurate as possible for each Lifeform and that mitigation efforts required for some Lifeforms were accurately allocated. For example, Lifeforms 2 and 3 contain species that only occur adjacent to wetlands and streams. Consequently, current and future habitat conditions for these Lifeforms were evaluated in terms of changes in primary and secondary habitat in Plum Creek's RHAs, Forest Service riparian conservation areas (RCAs), and wetlands in the Planning Area. Similarly, habitat conditions for Lifeform 4 (i.e., goats and peregrine falcons) were evaluated only in management units containing significant rock and talus components, since this is an important habitat prerequisite for these species. The method of analysis for talus slopes utilized the State of Washington Department of Natural Resources Soil Type Map. Categories of the "Rubble Land" and "Rock Outcrops" were identified in the Planning Area on a GIS layer for all ownerships. This GIS layer was overlayed on a stand structure layer for all ownerships. If 20 percent of an inventory polygon or management unit (collectively "polygons") included these DNR Soil Categories, the stand structures on the polygons were included in the analysis. As more site-specific information becomes available, the analysis method may be changed and will be addressed with a revision of the field manual (see 3.6.10 (40)).

Projected percentages of spotted owl habitat and the structural stages occurring on Plum Creek's land for the current regulations alternative and during the HCP are shown in Tables 25a, 25b and 25c, respectively. The projected percentage of primary and suitable habitat available for each Lifeform is summarized by decade in the Planning Area for the current regulations alternative and the HCP in Tables 26a, 26b and 26c, respectively. Extracting from these tables, the following trend in primary and suitable habitat for each Lifeform is discussed below.

Table 25a. Estimated Percentages of Plum Creek (PC) and All Ownership's (HCP) in the Planning Area, Providing Spotted Owl Habitat and Forest Structural Stages Under the *Current Regulations Alternative* Before the Land Exchange. Percentages are Estimated and Displayed by Decade for the 50 Year Permit Period.

Category	YEAR											
	1996		2006		2016		2026		2036		2045	
	PC	HCP	PC	HCP	PC	HCP	PC	HCP	PC	HCP	PC	HCP
SPOTTED OWL HABITAT												
NRF	20	29	18	26	13	25	13	25	14	25	17	29
FD	20	18	17	18	17	17	25	22	37	31	46	35
Total (Percent)	**40**	**47**	**32**	**44**	**30**	**42**	**38**	**47**	**51**	**56**	**63**	**64**
STRUCTURAL STAGES												
SI/SS/YF	41	30	41	31	36	26	34	15	15	11	16	11
Pole Timber	8	5	15	9	26	17	30	22	26	17	13	9
Dispersal Forest	19	13	16	15	16	14	24	20	36	28	43	32
MF/MOG/OG	24	39	17	33	14	32	14	31	15	32	20	36
Non-Forested	8	13	8	12	8	12	8	12	8	12	8	12
Total (Percent)	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
NRF — Nesting/Roosting/Foraging; MOG — Managed Old Growth; SS — Shrub/Sapling; MF — Mature Forest; SI — Stand Initiation; YF — Young Forest; FD — Foraging/Dispersal; OG — Old Growth												

Table 25b. Estimated Percentages of Plum Creek (PC) and All Ownerships (HCP) in the Planning Area Providing Spotted Owl Habitat and Forest Structural Stages as a Result of *Modification of the HCP*. Percentages are Estimated and Displayed by Decade for the 50-Year Permit Period. Post-Land Exchange. Escrow and Option Sections PC.

Category	YEAR											
	1996		2006		2016		2026		2036		2045	
	PC	HCP	PC	HCP	PC	HCP	PC	HCP	PC	HCP	PC	HCP
Spotted Owl Habitat												
NRF	19	29	10	27	8	26	8	27	8	28	8	28
F/D	15	18	11	15	9	15	18	19	28	23	34	26
Total (Percent)	**34**	**47**	**21**	**42**	**17**	**41**	**26**	**46**	**36**	**51**	**42**	**54**
Structural Stages												
SI/SS/YF	51	30	61	32	45	22	30	15	24	11	24	10
Pole Timber	8	5	8	6	27	15	31	15	27	14	20	10
Dispersal Forest	13	13	11	10	10	11	21	16	30	19	35	22
MF/MOG/OG	23	39	15	39	13	39	13	41	14	43	16	45
Non-Forested	5	13	5	13	5	13	5	13	5	13	5	13
Total (Percent)	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

*NOTES: Goals for spotted owl habitat and structural stages will be achieved if measurements are within 10 to 20 percent of the values estimated in the table.

NRF – Nesting/Roosting/Foraging; FD – Foraging/Dispersal; SI – Stand Initiation; SS – Shrub/Sapling; YF – Young Forest; MF – Mature Forest; MOG – Managed Old Growth; OG – Old Growth

Table 25c. Estimated Percentages of Plum Creek (PC) and All Ownerships (HCP) in the Planning Area Providing Spotted Owl Habitat and Forest Structural Stages as a Result of *Modification of the HCP*. Percentages are Estimated and Displayed by Decade for the 50-Year Permit Period. Post-Land Exchange. Escrow and Option Sections USFS.

Category	YEAR											
	1996		2006		2016		2026		2036		2045	
	PC	HCP	PC	HCP	PC	HCP	PC	HCP	PC	HCP	PC	HCP
Spotted Owl Habitat												
NRF	18	29	8	27	6	26	6	27	6	28	7	28
F/D	14	18	9	15	7	15	15	19	26	23	32	26
Total (Percent)	**32**	**47**	**17**	**42**	**13**	**41**	**21**	**46**	**32**	**51**	**39**	**54**
Structural Stages												
SI/SS/YF	52	30	64	32	48	23	32	15	24	11	26	10
Pole Timber	8	5	8	6	27	14	31	15	30	14	22	10
Dispersal Forest	13	13	10	10	9	11	20	16	29	19	32	22
MF/MOG/OG	22	39	13	39	11	39	12	41	12	43	15	45
Non-Forested	5	13	5	13	5	13	5	13	5	13	5	13
Total (Percent)	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

*NOTES: Goals for spotted owl habitat and structural stages will be achieved if measurements are within 10 to 20 percent of the values estimated in the table.

NRF - Nesting/Roosting/Foraging; FD - Foraging/Dispersal; SI - Stand Initiation; SS - Shrub/Sapling; YF - Young Forest; MF - Mature Forest; MOG - Managed Old Growth; OG - Old Growth

Table 26a. Estimated Percentages of all Ownerships in the Planning Area Providing Primary (P) and Total Suitable Habitat (SH) for Each Lifeform Under the *Current Regulations Alternative* Before the Land Exchange. Percentages are Estimates and Displayed by Decade for the 50 Year Permit Period.

Lifeform	YEAR											
	1996		2006		2016		2026		2036		2045	
	P[1]	SH[2]	P	SH	P	SH	P	SH	P	SH	P	SH
2	57	64	57	65	58	65	61	67	66	69	69	71
3	57	64	57	65	58	65	61	67	66	69	69	71
4	32	34	29	33	26	31	25	31	28	32	29	33
5	94[3]		96		96		88		73		74	
6	12	42	11	42	8	40	1	37	1	36	1	37
7	22	48	24	48	28	50	26	49	24	48	21	47
8	25	51	26	50	35	57	31	56	22	52	14	48
9	23	44	22	44	26	48	26	49	24	48	21	48
10	59	69	57	66	62	71	72	77	77	79	76	79
11	59	73	57	72	62	75	72	80	77	82	76	82
12	57	59	57	59	58	61	61	66	66	69	69	70
13	53	64	48	59	46	61	51	66	60	70	67	74
13A	36	45	33	49	31	59	31	59	31	59	36	61
14	53	70	48	68	46	66	51	69	60	73	67	77
14A	36	45	33	40	31	38	31	41	31	46	36	51
15 (early)	28[4]		30		25		15		11		11	
15 (middle)	23		24		31		41		45		41	
15 (late)	36		33		31		31		31		36	
16	57	64	57	65	58	65	61	67	66	69	69	71

[1] – Percentage of the HCP search area containing Primary Habitat

[2] - Percentage of the HCP search area containing Suitable Habitat = Primary Habitat + (Secondary Habitat/2)

[3] - Percentage of the HCP Planning Area within 0.5-miles of an “edge” between forage and cover habitats

[4] – Expresses the percentage of habitat in the HCP Planning Area containing early, middle, and late-aged forests.

Search Area: RHAs only (Lifeforms 1, 2, 3, 6, 7, 9, 12, 16); Rocks and Talus (Lifeform 4); Entire Planning Area (Lifeforms 8, 10, 11, 13, 13a, 14, 14a, 15)

Table 26b. Estimated Percentages of all Ownerships in the Planning Area Providing Primary (P) and Total Suitable Habitat (SH) for Each Lifeform Resulting from *Modification of the HCP*. Percentages are Estimates and Displayed by Decade for the 50 Year Permit Period. Post-Land Exchange. Escrow and Option Sections PC.

Life-form	YEAR											
	1996		2006		2016		2026		2036		2045	
	P[1]	SH[2]	P	SH	P	SH	P	SH	P	SH	P	SH
2	66	76	67	77	69	78	73	80	77	82	76	81
3	66	76	67	77	69	78	73	80	77	82	76	81
4	32	35	31	34	30	34	31	34	34	36	36	37
5	88		89		86		81		72		64	
6	17	52	13	50	10	48	8	47	2	44	1	44
7	26	56	28	57	27	57	24	55	21	54	20	53
8	26	53	34	59	34	59	28	57	23	54	17	51
9	25	52	23	52	27	57	24	55	21	54	20	53
10	58	69	55	69	65	75	72	79	76	80	77	81
11	58	73	55	71	65	76	72	80	76	82	77	82
12	66	68	67	70	69	73	73	76	77	81	76	81
13	53	65	49	62	50	66	57	70	61	72	67	75
13a	40	47	39	51	39	63	41	64	42	65	46	67
14	53	70	49	68	50	69	57	72	61	74	67	77
14a	40	47	39	44	39	45	41	49	42	52	46	57
15 (early)	29		32		22		15		11		10	
15 (middle)	18		16		26		31		34		31	
15 (late)	40		39		39		41		42		46	
16	66	76	67	77	69	78	73	80	77	82	76	81

[1] – Percentage of the HCP search area containing Primary Habitat

[2] - Percentage of the HCP search area containing Suitable Habitat = Primary Habitat + (Secondary Habitat/2)

[3] - Percentage of the HCP Planning Area within 0.5-miles of an "edge" between forage and cover habitats

[4] – Expresses the percentage of habitat in the HCP Planning Area containing early, middle, and late-aged forests.

Search Area: RHAs only (Lifeforms 1, 2, 3, 6, 7, 9, 12, 16); Rocks and Talus (Lifeform 4); Entire Planning Area (Lifeforms 8, 10, 11, 13, 13a, 14, 14a, 15)

Table 26c. Estimated Percentages of all Ownerships in the Planning Area Providing Primary (P) and Total Suitable Habitat (SH) for Each Lifeform Resulting From *Modification of the HCP*. Percentages are Estimates and Displayed by Decade for the 50 Year Permit Period. Post-Land Exchange. Escrow and Option Sections USFS.

Life-form	YEAR											
	1996		2006		2016		2026		2036		2045	
	P[1]	SH[2]	P	SH	P	SH	P	SH	P	SH	P	SH
2	66	76	64	75	68	77	72	79	75	81	76	81
3	66	76	64	75	68	77	72	79	75	81	76	81
4	32	35	31	34	30	34	31	34	34	36	36	37
5	88		89		86		81		72		64	
6	17	52	16	51	10	48	8	47	3	45	1	44
7	26	56	31	59	29	58	26	56	24	55	22	54
8	26	53	35	59	35	60	28	57	23	54	18	51
9	25	52	26	53	29	58	26	56	24	55	22	54
10	58	69	54	69	64	74	72	79	76	80	77	81
11	58	73	54	71	64	76	72	80	76	82	77	82
12	66	68	64	67	68	72	72	75	75	79	76	81
13	53	65	48	61	49	65	57	70	61	72	66	74
13a	40	47	38	50	38	63	41	64	42	65	45	66
14	53	70	48	68	49	68	57	72	61	74	66	77
14a	40	47	39	43	39	44	41	49	42	52	45	56
15 (early)	29		33		23		15		11		10	
15 (middle)	18		16		26		31		34		32	
15 (late)	40		38		38		41		42		45	
16	66	76	64	75	68	77	72	79	75	81	76	81

[1] – Percentage of the HCP search area containing Primary Habitat
[2] - Percentage of the HCP search area containing Suitable Habitat = Primary Habitat + (Secondary Habitat/2)
[3] - Percentage of the HCP Planning Area within 0.5-miles of an "edge" between forage and cover habitats
[4] – Expresses the percentage of habitat in the HCP Planning Area containing early, middle, and late-aged forests.
Search Area: RHAs only (Lifeforms 1, 2, 3, 6, 7, 9, 12, 16); Rocks and Talus (Lifeform 4); Entire Planning Area (Lifeforms 8, 10, 11, 13, 13a, 14, 14a, 15)

3.2.2.1 Lifeform 1 (fish)

Lifeform 1 includes four Special Emphasis Species: bull trout, rainbow/steelhead trout, coho salmon and chinook salmon (Section 2.10.5.2 and Toth et al. 1995). In addition to these four species, other fish species within the Planning Area include: brook trout, cutthroat trout, lake trout, brown trout, whitefish, kokanee, and sculpins. With implementation of the HCP, the amount of aquatic habitat will not change; but, quality habitat and, therefore, amount of usable habitat should increase. Plum Creek will continue to participate in cooperative enhancement and restoration projects in the Planning Area.

3.2.2.2 Lifeform 2 (frogs and salamanders)

Species in this group breed in water and feed on the ground, in shrubs, or in trees. Lifeform 2 includes four special emphasis species: the tailed frog, northern red-legged frog, Cascades frog, and spotted frog. With implementation of the HCP, primary habitat for this Lifeform **(**Dispersal Forest and older forest**)** within Plum Creek's RHAs, Forest Service RCAs, and wetlands will increase from 66 percent in 1996 to 76 percent in 2045. Suitable habitat will increase from 76 percent in 1996 to 81 percent in 2045. The increase in habitat for these species is primarily due to the planned reduction in harvest activities near streams on both Plum Creek and Forest Service lands during the Permit period.

3.2.2.3 Lifeform 3 (turtles and ducks)

Species in this group breed on the ground around water and feed on the ground, in shrubs, trees or water. Lifeform 3 includes one special emphasis species (e.g., harlequin duck) and two species of concern (e.g., Western pond turtle and black tern). Primary habitat for this Lifeform **(**Dispersal Forest and older forest**)**, within Plum Creek's RHAs, Forest Service RCAs, and wetlands increases from 66 percent in 1996 to 76 percent in 2045. Suitable habitat increases from 76 percent in 1996 to 81 percent in 2045. As was shown for Lifeform 2, habitat conditions for Lifeform 3 will increase as forest structural classes along streams and wetlands advance to more complex conditions.

3.2.2.4 Lifeform 4 (falcons and goats)

Members of this Lifeform are associated with cliffs, rims, and talus. Lifeform 4 includes two special emphasis species (e.g., Larch Mountain salamander and Townsend's big-eared bat) and two species of concern (e.g., golden eagles and peregrine falcon). Primary habitat for this Lifeform **(**Pole Timber and older forest surrounding rock and talus areas**)**, will increase slightly, from 32 percent in 1996 to 37 percent in 2045, with the lowest percentage estimated at 30 percent in 2016. Suitable habitat also will increase slightly, from 35 percent in 1996 to 37 percent in 2045 with a reduction to 34 percent estimated at 2006, 10 years into the Permit period.

3.2.2.5 Lifeform 5 (grouse, hares, deer, elk, lynx)

Species in Lifeform 5 breed and feed on the ground and include one special emphasis species (e.g., California wolverine). This Lifeform contains many species that tend to use edges between cover and forage habitats. Since many of these species are primary prey for the gray wolf, habitat trends for Lifeform 5 are indicative of habitat conditions for the wolf. For purposes of analysis, a 0.5-mile radius "moving window" analysis was performed across the entire Planning Area using the stand structural stages to quantify the number of analysis units containing two group of stages: (1) "forage" made up of recently harvested areas (i.e., stand initiation; shrub/sapling; and young forest), and (2) "cover" made up of areas with more developed forest conditions. Analysis areas with both forage and cover groups present within the 0.5-mile radius circle were presumed to have significant "edge" and therefore were capable of supporting Lifeform 5 species. The 0.5-mile radius selected for the moving window analysis was derived from elk telemetry data from the Taneum Creek watershed which suggested that elk concentrate their use of openings within 0.5-miles of cover. Results of each "moving window" analysis was summarized to provide a composite display of the percentage of the Planning Area that would be predicted to have "edge" habitat available for Lifeform 5 species. Results of the analysis indicate that "edge" habitat for Lifeform 5 decreases from 88 percent of the Planning Area in 1996 to 64 percent in 2045 (Figure 34). This reduction is caused primarily by landscape management objectives to address spotted owl habitat concerns by increasing contiguous dispersal habitat (therefore decreasing "edge") across ownerships in the Planning Area.

3.2.2.6 Lifeform 6 (warblers, porcupines)

Species in Lifeform 6 breed on the ground and feed in the shrubs, trees, or in the air. There are no species in this Lifeform currently considered as Special Emphasis Species or Species of Concern. The eight species in this Lifeform tend to use edge habitats and wet sites, with a high degree of use of younger structural stages. With implementation of the HCP, total potential suitable habitat for this Lifeform in the Planning Area will decrease from 52 percent in 1996 to 44 percent in 2045. Primary habitat for Lifeform 6 **(**Stand Initiation to Young Forest in RHAs**)**, decreases from 17 percent in 1996 to 1 percent in 2045. The sharp reduction in primary habitat for Lifeform 6 is due to the reduction in timber harvest activity predicted in the Planning Area across all ownerships. Although only timber harvest was modeled, many other factors such as fire and natural disturbances, are responsible for creating stand initiation, shrub sapling, and young forest structural stages considered to be primary habitat for this Lifeform.

3.2.2.7 Lifeform 7 (sparrow, blackbirds, thrushes)

Members of Lifeform 7 breed in shrubs and feed on the ground, in the water, or the air. There are no species in this Lifeform currently considered as special emphasis species or species of concern. The 19 species in Lifeform 7 use a variety of structural stages that include shrubs, with a high degree of use around wet sites and riparian settings. Primary habitat for Lifeform 7 **(**Stand Initiation to Dispersal Forest in RHAs) in Plum Creek's RHAs, Forest Service Riparian Reserves, and wetlands decreases slightly from 26 percent in 1996 to 20 - 22 percent in 2045. Suitable habitat for this Lifeform along streams and wetlands also decreases slightly from 56 percent in 1996 to 53 **-** 54 percent in 2045.

3.2.2.8 Lifeform 8 (warblers, flycatchers)

Species in Lifeform 8 breed in shrubs, and feed in trees, shrubs, or in the air. These species tend to concentrate in shrub communities in mid-aged forest structural types. However, they are not as dependent on riparian and wetland areas as Lifeform 7. There are no species in Lifeform 8 currently considered as special emphasis species or species of concern. Primary habitat for Lifeform 8 **(**Shrub Sapling stage to Pole Timber**)**, will decrease from 26 percent in 1996 to 17 - 18 percent in 2045. Suitable habitat for this Lifeform will decrease slightly from 53 percent in 1996 to 51 percent in 2045.

3.2.2.9 Lifeform 9 (waxwings, grosbeaks)

Species in Lifeform 9 breed primarily in deciduous trees and feed in trees, shrubs, or the air in areas adjacent to riparian areas and wet sites. There are no species in Lifeform 9 currently considered as special emphasis species or species of concern. Primary habitat for Lifeform 9 **(**Young Forest, Pole Timber, and Dispersal Forest**)**, in Plum Creek's RHAs, Forest Service Riparian Reserves, and wetlands decreases slightly from 25 percent in 1996 to 20 - 22 percent in 2045. Suitable habitat for Lifeform 9 remains virtually unchanged during the Permit period from 52 percent in 1996 to 53 **-** 54 percent in 2045.

3.2.2.10 Lifeform 10 (squirrels, tanagers, warblers)

Members of Lifeform 10 breed in conifers and feed in trees, shrubs, or the air. There are no species in Lifeform 10 currently considered as special emphasis species or species or concern. Primary habitat for Lifeform 10 **(**Pole Timber and older forest**)** increases in the Planning Area from 58 percent in 1996 to 77 percent in 2045. Suitable habitat for this Lifeform increases from 69 percent in 1996 to 81 percent in 2045.

3.2.2.11 Lifeform 11 (vireos, hawks, flycatchers)

Species in Lifeform 11 breed in conifers and deciduous trees while feeding in trees, shrubs, on the ground, or in the air. These species are oriented toward structural stages with larger trees but can use younger forests if residual large trees are present. Lifeform 11 includes one special emphasis species (e.g., northern goshawk). There are no species in Lifeform 11 currently considered as species of concern. Primary habitat for Lifeform 11, **(**Pole Timber and older forest**)**, increases in the Planning Area from 58 percent in 1996 to 77 percent in 2045. Suitable habitat for this Lifeform also increases from 73 percent in 1996 to 82 percent in 2045. Habitat trends for this Lifeform closely parallel habitat trends for the spotted owl.

3.2.2.12 Lifeform 12 (herons, ospreys, great horned owls)

Species in Lifeform 12 breed on very thick branches and feed on the ground or in the water. Most primary breeding use by these species occurs in mature and old growth forests near water, although they may forage in a wide range of structural stages. Primary habitat for Lifeform 12 **(**Dispersal Forest and older forest**)** in Plum Creek's RHAs, Forest Service Riparian Reserves, and wetlands will increase from 66 percent in 1996 to 76 percent in 2045. Suitable habitat (which adds only pole timber to primary habitat) shows a similar trend, increasing from 68 percent in 1996 to 81 percent in 2045. Habitat trends for this Lifeform reflect the protection extended to riparian areas and wetlands by the Federal government and Plum Creek.

3.2.2.13 Lifeform 13 and 13a (woodpeckers and nuthatches)

Species in Lifeform 13 and 13a are primary cavity excavators that nest in snags and defective trees. There are no special emphasis species in this Lifeform, but three species of concern (i.e., Lewis' woodpecker, white-headed woodpecker, and pileated woodpecker) are included in this Lifeform. Because of differing needs among the species for snags of suitable size, this Lifeform was partitioned into two subgroups, "13" and "13a." Primary habitat for 13a includes only mature, managed old growth, and old growth which have larger snags in desirable densities to support these species. Secondary habitat for Lifeform 13a includes pole timber and recently harvested areas, but only after 10 to 20 years to allow time for new forest practices to provide necessary snags and residual wildlife trees in harvest units. Primary habitat for Lifeform 13 **(**Dispersal Forest and older forest**)**, will increase in the Planning Area from 53 percent in 1996 to 66 - 67 percent in 2045. Suitable habitat for Lifeform 13 also will increase from 65 percent in 1996 to 74 - 75 percent in 2045. Primary habitat for Lifeform 13a **(**Mature Forest and older forest**)**, will increase in the Planning Area, ranging from 40 percent in 1996 to 45-46 percent in 2045. Suitable habitat for Lifeform 13a will increase more dramatically, from 47 percent in 1996 to 66-67 percent in 2045.

3.2.2.14 Lifeform 14 and 14a (bats, owls, bluebirds)

Species in Lifeform 14 and 14a use cavities or hollows created by defects or by the actions of other species; they tend to breed primarily in more developed structural stages, but use a somewhat wider variety of special habitats or features than primary cavity excavators (e.g., Lifeform 13 and 13a). Species in Lifeform 14a are considered to have primary habitat in mature, managed old growth, and old growth and include one special emphasis species (i.e., fisher) and three species of concern (e.g., flammulated owl, Vaux's swift, and Western bluebird). Primary habitat for Lifeform 14 **(**Dispersal Forest and older forest**)** will increase in the Planning Area, from 53 percent in 1996 to 66 - 67 percent in 2045. Suitable habitat for Lifeform 14 will increase from 70 percent in 1996 to 77 percent in 2045. Primary habitat for Lifeform 14a **(**Mature forest and older forest**)**, will increase from 40 percent in 1996 to 45-46 percent in 2045. Suitable habitat for Lifeform 14a will increase from 47 percent in 1996 to 56 - 57 percent in 2045.

3.2.2.15 Lifeform 15 (shrews, bears, voles)

Species in Lifeform 15 breed in underground burrows and feed on or under the ground. Species in this Lifeform use a wide variety of structural stages and special habitats or elements as primary breeding habitat. Therefore any of the structural stages could be considered primary habitat, depending on the species. For purposes of analysis, the structural stages were grouped into early-, mid-, and late-aged forests to display the diverse conditions used by these species. There are no special emphasis species or species of concern included in Lifeform 15. With implementation of the HCP, early-aged habitat (e.g., stand initiation, shrub/sapling, and young forest) for Lifeform 15 will decrease from 29 percent in 1996 to 10 percent in 2045, while middle-aged (e.g., pole timber and dispersal forest) and late-aged (e.g., mature forest, managed old growth, and old growth) habitat will change from 18 percent and 40 percent in 1996 to 31-32 percent and 45-46 percent in 2045, respectively.

3.2.2.16 Lifeform 16 (kingfishers, otters and beavers)

Members of Lifeform 16 breed in underground burrows and feed in the air or in the water. These species are all associated with aquatic habitats for breeding or feeding. There are no special emphasis species or species of concern included in Lifeform 16. These species have no particular affinity for forest structural stages around water. Consequently, Plum Creek used criteria similar to Lifeform 2 to analyze primary and secondary habitat. Primary habitat for Lifeform 16 **(**Dispersal Forest and older forest**)** in Plum Creek's RHAs, Forest Service Riparian Reserves, and wetlands will increase from 66 percent in 1996 to 76 percent in 2045. Suitable habitat for this Lifeform also will increase from 76 percent in 1996 to 81 percent in 2045.

3.3 Riparian Management Strategy

In addition to the multi-species approach, the HCP is also built upon a Riparian Management Strategy which identifies riparian forests as priority areas for fish and wildlife habitat protection. Diverse riparian habitat in the Planning Area will be the result of management regimes whereby entries (i.e., timber harvest) into the upland and riparian forest stands will create a mosaic of large (i.e., greater than 1.0 acre) and small openings as well as areas of multi-layered, dense cover. The Riparian Management Strategy is designed to protect instream habitat for resident and anadromous fish and maintain streamside habitat for wildlife species in Riparian Habitat Areas (RHAs). The strategy is based upon Plum Creek's experience and experimentation with New Forestry techniques (Appendix 7), fish limiting factors analysis (Section 2.11; Watson and Toth 1995); and an ecological classification analysis of the Planning Area (Section 2.1; Jensen 1995). The Riparian Management Strategy incorporates five major components:

1. Forest Practices Rules and Regulations (Section 3.3.1 and Appendix 5);
2. Watershed Analysis (Section 3.3.2 and Toth 1995);
3. Riparian Habitat Protection (Section 3.3.3);
4. Harvest Deferrals for Section 303(d) Stream Segments and Wetland Management Zones (Section 3.3.4); and
5. Aquatic Resources Monitoring (Section 3.3.5).

Specific objectives of the Riparian Management Strategy are to:

1. Maintain the distribution, diversity, and complexity of various components of watersheds to ensure protection of the aquatic and riparian systems which support large numbers of fish and wildlife species;
2. Maintain the connectivity within and between watersheds through lateral, longitudinal, and drainage network connections, and unobstructed routes and corridors to critical areas for aquatic and riparian-dependent wildlife;

3. Maintain the physical and biological integrity of the aquatic and riparian zone to ensure water quality necessary to support survival, growth, reproduction, and migration of individual species comprising aquatic and riparian-dependent communities;
4. Manage road densities to minimize disturbance to fish and wildlife species, and maintain a natural sediment regime (i.e., road network BMPs) to protect the aquatic system;
5. Maintain a mosaic of forest stand structures within RHAs, including a large tree component in the forest stand structures (i.e., snags, downed logs, and mature or live trees in clumps) to provide opportunities to maximize prey densities for forest carnivores such as spotted owls, grizzly bears, and gray wolves; and
6. Maintain habitat within RHAs to support well-distributed upland and riparian-dependent wildlife species, including forested and non-forested special habitats (i.e., ponds, bogs, springs, seeps, wetlands, caves, talus slopes, meadows).

Plum Creek recognizes that some wildlife species are strongly tied to watersheds and associated stream channel networks (e.g., fish and riparian-dependent species), whereas other species are not as dependent on a single watershed (e.g., spotted owls, northern goshawk). These latter species frequently use trans-watershed habitats that cross ownership boundaries. Thus the HCP combines a landscape (terrestrial) element with the riparian habitat strategy, allowing Plum Creek flexibility in developing management options that consider listed and unlisted species.

3.3.1 Washington Forest Practices Rules and Regulations

The Washington Forest Practices Act (RCW 76.09) and implementing Forest Practices Rules and Regulations (WAC 222) are the principal means of State regulation of activities on private forestlands in Washington. Administered and enforced by the DNR, the Forest Practices Rules and Regulations set standards to address many issues of concern on State and private lands, including clear-cut size/green-up regulations, culvert sizing, watershed analysis procedures, road design standards, chemical applications rules, and wetland protection (Appendix 5). All harvest activities on private forestlands require a Forest Practices Notification or Approval from the DNR, the issuance of which is contingent upon compliance with provisions of the Act and regulations. Most or all provisions within the Forest Practices Rules and Regulations ultimately influence fish and wildlife habitat by regulating how and when certain activities may take place on private forestlands. The intent of this HCP is that compliance with State Forest Practices Rules and Regulations would continue throughout the Permit period. However, it should be noted that WAC 222-16-080-7(a) exempts activities covered under an HCP from the provisions of 222-16-080. State Forest Practices Rules and Regulations, such as road construction standards and minimum leave tree requirements are not intended to be supplanted as a result of implementation of the HCP.

3.3.2 Watershed Analysis

Watershed analysis for State and private lands in Washington is a systematic procedure that assesses physical and biological processes within a watershed. This procedure also generates information for developing management guidelines that protect and restore aquatic habitat.

Washington State watershed analysis has seven modules that assess various watershed elements important to fish habitat and water quality (Table 27). A water-quality module is expected to be added in 1996. The assessment identifies areas sensitive to land management. A prescription team then develops options for operating in and adjacent to sensitive areas to prevent or minimize impacts to aquatic resources. For each prescription team assembled by Plum Creek in the Planning Area, Plum Creek will invite at least one representative from either the FWS, NMFS, WDFW, or local Tribe to participate on the team. In the event such representatives cannot participate, a biologist with expertise in fisheries and watershed analysis will be required.

To illustrate situations that are addressed in watershed analysis, a number of common prescriptions from on-going or completed analyses are described below. For areas prone to landslides (e.g., such as inner gorges), road construction and timber harvest are generally prohibited. Intermittent/ ephemeral streams on steep slopes with a high potential for erosion are thus protected by riparian buffers that range in size from 30 to greater than 200 feet. Road drainage must be diverted away from steep convergent slopes and landings adjacent to sensitive areas pulled back. Road systems will be evaluated for sediment production and mass wasting potential. Road maintenance and abandonment plans will then be developed to reduce erosion below specified target levels. Management in riparian areas will be customized to site-specific conditions and consider the potential for streams: (1) to migrate; (2) to be subjected to debris torrents; (3) to be affected by large woody debris; and (4) to be impacted by future timber harvesting. The objective will be generally to provide late-seral stand conditions (i.e., large diameter conifers) within a half of a site-potential tree height. Harvesting will be typically prohibited in channel migration zones and within the first 30 feet of the riparian management zone to maintain bank stability and a high level of shade and large woody debris recruitment. In areas where harvesting has the potential to significantly affect peak streamflows, limits will be placed on harvesting until trees reach hydrologic maturity. Landowners are also encouraged to retain canopy cover through partial harvesting.

Watershed analysis will be the primary procedure for developing and documenting scientifically-based information of the ecological structure, functions, processes, and interactions affecting aquatic resources within each watershed.

Watershed analysis will provide the basis for implementing the ecosystem-management objectives of the HCP related to aquatic resources. Management objectives related to wildlife resources are addressed in Section 3.2. Evaluation of watershed condition involves completion of watershed analysis in 17 Watershed Administrative Units (WAUs) within the Planning Area. These watershed analyses will include the following analyses:

1. stream channel and adjacent riparian habitat areas;
2. condition of adjacent uplands;
3. effects of previous natural disturbances and forest-management actions; and
4. landscape-level factors including percentage of area in rain-on-snow zones, percentage of this zone which supports hydrologically mature vegetation, and percentage of slopes which are at risk of mass wasting.

The results of watershed analysis will allow Plum Creek to evaluate the processes and functions operating within each WAU in the Planning Area, and to establish appropriate timber harvest practices. A more detailed description of the watershed analysis procedures is shown in Toth (1995).

By the end of 1999, Plum Creek will have submitted or be in the process of submitting watershed analysis evaluations for 13 WAUs in the Planning Area. Watershed analyses completed and submitted by Plum Creek are still subject to public review and comment through the State Environmental Policy Act (SEPA) prior to approval. Under the HCP, implementation of prescriptions developed for a particular watershed begins as soon as the prescriptions are completed and is not delayed until completion of SEPA as was the case under State regulations. Plum Creek will accelerate watershed analysis in the WAUs in the Planning Area, and submit all watershed analyses completed in the Planning Area within 10 years following issuance of the Permit (i.e., 2006).

Table 27. Summary of Watershed Processes and Resources Addressed by the Washington State Watershed Analysis Modules

Watershed Analysis Module	Watershed Processes and Resources Addressed
Mass Wasting	• Debris Torrents • Landslides • Earthflows
Surface Erosion	• Hillslope Surface Erosion - Gullying - Dry Ravel - Sheetwash • Road Erosion
Hydrology	• Peak Streamflows • Summer Low Flows
Riparian Function	• Large Woody Debris Recruitment • Shade / Water Temperature • Bank Stability
Channel Condition	• Historic Channel Disturbance • Current Channel Condition • Spatial Distribution of Channel Response Types • Dominant Habitat Forming/Geomorphic Processes
Fish Habitat	• Distribution and Relative Abundance of Salmonoid Fish • Existing Habitat Condition • Fish Habitat Utlization and Preferences
Water Supply / Public Works	• Location and Sensitivity of Water Supplies/Public Works - Public State Roads and Bridges - Reservoir, Irrigation Surfaces - Municipal, Domestic, Hatchery Water Supplies

3.3.3 Riparian Habitat Protection

The Riparian Management Strategy also includes the maintenance and protection of riparian habitat areas (RHAs). RHAs are important for both watershed and wildlife habitat protection. RHAs and wetlands total more than 12,000 acres on Plum Creek's lands in the Planning Area. These riparian areas are among the most ecologically significant components of the forested landscape, and management focused on maintenance and protection of RHAs is extremely important because of the extensive number of species that use these areas. They form boundaries between different ecosystems and provide connectivity for interchange and dispersal for plants and animals. Furthermore, the vegetative productivity and favorable physical conditions along streams provides the basis for the high biological diversity found in RHAs. Not only are RHAs integral to watershed analysis, but research on Plum Creek's land indicates that extensive numbers of species use these areas, and spotted owls concentrate their home range in habitats in proximity to streams (Herter and Hicks 1995).

3.3.3.1 Interim and Minimum Guidelines for RHAs

Plum Creek will use the Company's scientific experience and experiments similar to the Frost Meadows New Forestry Unit (Appendix 7) and watershed analysis to establish prescriptions for RHAs along streams that support a wide array of wildlife species including bull trout and anadromous fish. Plum Creek will implement the following interim (i.e., these guidelines will be considered interim until completion of watershed analysis) and minimum guidelines in RHAs:

1. **Fish-bearing streams** — Establish 200-foot RHAs (measured as horizontal distance from the edge of the stream) as determined by the normal high water mark or, if applicable, channel disturbance zone, on each side of all fish-bearing streams. In terms of stream systems in the Planning Area, Plum Creek's major consideration is whether a particular stream is fish-bearing or nonfish-bearing and then if nonfish-bearing, whether it is perennial or seasonally intermittent.

   Two hundred-foot RHAs will provide at least one tree height of protection for fish-bearing streams because the average tree height for late-seral riparian vegetation within the Planning Area typically ranges between 80 and 140 feet for East-side conditions and between 140 and 200 feet for West-side conditions.

   One of the primary management objectives within RHAs for aquatic resources is to provide an adequate number of large-diameter conifers to maintain natural functioning of the stream ecosystem. The entire RHA will be retained as spotted owl habitat, or if not currently functioning as spotted owl habitat, the area will be managed to provide forest conditions equal to or greater than FD habitat for spotted owls (see Section 2.4). A 30-foot (horizontal distance), "no-harvest" area will be situated in RHAs adjacent to fish-bearing streams to maintain bank integrity, provide nutrients, and contribute large woody debris to the stream. (No-harvest is intended to mean no commercial harvest of conifer trees. Limited silvicultural prescriptions for conifers and harvest of deciduous trees will be allowed to address watershed and wildlife concerns (e.g., excessively high tree density or undesirable course woody debris species). Beyond the 30-foot, no-harvest zone, management objectives will be to meet large woody debris goals, maintain a late-successional forest structure, accommodate channel migration, slope stability, and/or additional wildlife considerations, and to implement a "feathering treatment" whereby more "large trees" will be left at the inner portion (i.e., the area closest to the stream) of the RHA. Structural features within RHAs will be tracked to determine the extent and distribution of structural stand stages. One-time (i.e., one harvest during the Permit period) selective or partial harvests will be allowed in RHAs, if Plum Creek can ensure that post-harvest conditions in the RHAs will provide, at a minimum, the equivalent of spotted owl habitat (i.e., FD habitat or greater). Where it is possible to harvest tress from the RHAs and still maintain the required FD habitat conditions, these harvests will incorporate removal of up to 50 percent of the merchantable (i.e., commercial) timber volume available for harvest in the 200-foot RHA. More often than not, the FD requirement will result in much less than 50 % removal. Seasonally intermittent streams found to be fish-bearing would receive special consideration under watershed analysis.

   Nonfish-bearing perennial streams with a high likelihood of fish presence or near the confluence of a fish-bearing stream will be tested prior to harvest to verify presence or absence of fish to ensure the proper buffers are utilized. Additionally, if a fish-bearing stream has a blockage and the source of the blockage is removed, the stream up to the nearest natural blockage will be treated as a fish-bearing stream.

2. **Nonfish-bearing, perennial streams** — Along nonfish-bearing, perennial streams within Federal Late-Successional Reserves, Adaptive Management Areas, and where elevation (up to 5,000 feet)

and topography are suitable for owl dispersal, Plum Creek will provide 100-foot RHAs on each side of these streams with a 30-foot, no ground-based equipment zone. In addition, watersheds East of the Cascade crest containing 303(d) streams and/or bull trout or anadromous fish would receive 100-foot RHAs along perennial streams above 5,000-foot elevation and outside of Late-Successional Reserves and Adaptive Management Areas. Also, ground-based equipment is prohibited in the 30-foot zone nearest the stream for all RHAs. No-harvest zones will not be maintained on nonfish-bearing streams. The primary purpose of the RHAs along nonfish-bearing streams will be to protect downstream fish habitat, water quality, and habitat for other aquatic and riparian-dependent wildlife species, such as frogs and salamanders (i.e., Lifeform 2). These RHAs will also be managed to maintain NRF or FD habitat through harvest deferral or partial harvesting.

Along perennial, nonfish-bearing streams outside Late-Successional Reserves, Adaptive Management Areas, or in drainages where owl habitat maintenance is not feasible, Plum Creek will provide 25-foot wide Riparian Leave Tree Areas (RLTAs) on each side of the streams. Plum Creek will retain a minimum of 25 live conifer trees, greater than 12 inches DBH, per 1,000 feet of stream (i.e., about 44 conifer trees per acre). Plum Creek will also retain all snags, culls, and "leaners" that do not present a safety hazard. The RLTAs will be designated for a distance of at least 2,000 feet upstream from the junction of a nonfish-bearing perennial stream with a fish-bearing stream. RLTA requirements may be met alternatively through "clumping" the required number of leave trees into Upland Management Area (UMA)-like patches adjacent to the streams. Shrubs, small trees, and other streamside vegetation within the areas between the clumps will be retained. The width of each patch will not exceed 150 feet from the stream. Ground-based equipment will be excluded from the 25-foot RLTAs. Because of the Environmental Principles, Plum Creek will cluster some leave trees in areas adjacent to many smaller streams, which otherwise would receive no specific protection under State Forest Practices Rules and Regulations

In perennial, nonfish-bearing streams that may be susceptible to landslides or debris flows (e.g., inner gorge topography), appropriately sized riparian buffers will be determined through watershed analysis. In the interim, State Forest Practices Rules and Regulations preclude harvest and road construction on slopes at risk of failure.

3. **Yarding Corridors** — Yarding corridors may be necessary in RHAs to accommodate full-suspension or, if necessary, partial suspension cable yarding systems. All yarding corridors will be placed at the discretion of Plum Creek. Plum Creek will minimize the removal of trees. During yarding operations, normal breakage of trees will occur and provide snags and downed material which will provide habitat for many wildlife species. In addition, the post-harvest yarding corridors will be comprised of young forest and residual trees which will provide multi-structural forests and habitats and enhance wildlife diversity in the RHAs. As an overall objective, Plum Creek will attempt to disturb no more than 15 percent of the stream corridor in or adjacent to each 1,000-foot reach of stream. If site-specific conditions or safety considerations require larger yarding corridors, Plum Creek can, at its discretion, expand the yarding corridors, but will disturb no more than 20 percent of the stream corridor in or adjacent to each 1,000-foot reach of stream. Plum Creek will also avoid, where possible, placing yarding corridors across fish-bearing streams. Plum Creek will attempt to minimize the necessity of yarding corridors. However, in some areas, yarding corridors would be preferable if the only alternative is construction of additional roads or landing areas.

4. **Road Management** — Plum Creek's management objective for roads will be to minimize disturbance of RHAs and to prevent sediment delivery to streams. If a road is required to be built through an RHA, Plum Creek will implement the Company's road building practices (Section 1.2.3.4) and implement specific measures to reduce the potential effects of road construction and use on streams and riparian habitat areas by:
   - minimizing road building activity;
   - minimizing disruption of natural hydrologic flow patterns;
   - restricting sidecasting during construction to prevent the introduction of sediment into streams and riparian habitat areas;
   - minimizing erosion at road sites using advanced techniques;
   - identifying roads and associated drainage features that pose a potential risk;
   - closing or stabilizing roads based on short-term and long-term transportation needs in each watershed;
   - the smallest possible right-of-way clearing that allows for safe construction and passage on roads will be used; and
   - roads will cross all streams at right angles.

3.3.3.2 RHA Design and Fish Habitat Protection

The primary objective of the riparian management strategy is to provide watershed protection and implement specific prescriptions identified during watershed analysis to minimize impacts to resident and anadromous fish resources in streams within the Planning Area. The design of RHAs, based on sound ecological principles, is vital to fisheries protection in the Planning Area (Toth 1995).

All species of fish are sensitive to thermal fluctuations, suspended sediment, and alterations in streamflow regime, and salmonids are especially sensitive to any changes in the freshwater environment. For this reason, Plum Creek assumes that by addressing the biological needs of the most sensitive fish species (i.e., salmonids), the environmental requirements for successful spawning and rearing of all other fish species in the Planning Area would be adequately protected as well.

Vegetation in the RHAs will provide a number of functions for maintaining stream processes including bank stability from root strength; large woody debris input for pool formation, sediment storage and habitat complexity; nutrient input for aquatic organisms; and shade for moderation of stream temperatures. Most effects of riparian vegetation on streams decreases with increasing distance from the streambank (VanSickle and Gregory 1990; McDade et al. 1990). As a general rule, the riparian width that can affect fish habitat is approximately one tree height in length (Figure 35) (Beschta et al. 1987; Robison and Beschta 1990; USDA 1993).

There are a total of 1,233 miles of streams on Plum Creek's lands in the Planning Area (Table 29). Approximately 412 miles (33 percent of the total stream miles) occur within the AMA, 296 miles (24 percent) occur within the LSR, and 266 miles (24 percent) occur in the Matrix (Table 28). There are 100 miles of fish-bearing streams, and approximately 196 nonfish-bearing perennial streams on Plum Creek's lands in the Planning Area. However, 937 miles of streams on Plum Creek's lands are seasonal or unclassified streams of unknown status (Table 28).

Table 28. Miles of Stream Types Within Each Northwest Forest Plan Designated Category on Plum Creek's Land in the Planning Area Post-Land Exchange, Escrow and Options Sections PC.

Stream Type	Northwest Forest Plan Category				
	AMA	LSR	Matrix	None	TOTAL
Fish-bearing	34	24	22	20	**100**
Nonfish-bearing	73	37	45	41	**196**
Seasonal	168	186	135	107	**596**
Unclassified	137	49	64	91	**341**
TOTAL	**412**	**296**	**266**	**259**	**1,233**
NOTE: AMA – Adaptive Management Areas ; LSR - Late Successional Reserves					

In summary, until watershed analysis is completed, Plum Creek will implement the interim guidelines described above. The 30-foot, no-harvest zone provided adjacent to fish-bearing streams will maintain root strength and stream bank integrity. Plum Creek will also maintain forest conditions equal to or greater than FD habitat (Section 2.4) for spotted owls in RHAs along all fish-bearing streams, and address aquatic resource protection using 200-foot RHAs on all fish-bearing streams and 100-foot RHAs on perennial, nonfish-bearing streams occurring within Northwest Forest Plan designated areas such as Late-Successional Reserve (LSR) or Adaptive Management Areas (AMAs). By providing the equivalent of at least one tree height of protection for fish-bearing streams, litter fall and stream shading will be fully maintained, and the RHAs are expected to provide, at a minimum, 85 percent, and in most instances, up to 100 percent of the large woody debris inputs that occurred under natural conditions. In nonfish-bearing streams outside of LSRs and AMAs, Plum Creek will provide 25-foot wide RLTAs on each side of the stream to protect water quality and to provide supplemental habitat for riparian-dependent wildlife species, such as salamanders. While the RLTAs may provide less shading and woody debris input than under natural conditions, they will provide enough leave trees to minimize or prevent impacts to stream functions (e.g., sediment storage, temperature control) for these small, nonfish-bearing streams. Watershed analysis may identify additional prescriptions that may be implemented to protect nonfish-bearing streams.

The approximate number of miles stream types within each riparian management strategy in the Planning Area is shown in Table 29.

Table 29. Approximate Miles and Percentage of Stream Types Within Each Riparian Protection Strategy by Ownership in the Planning. Post-Land Exchange, Escrow and Option Sections PC

Stream Type	U.S. Forest Service			Plum Creek Timber Company					Other Private			Total
	300' RCA	150' RCA	*Sub-Total*	200' RHA	100' RHA	25' RLTA	No Buffer	*Sub-Total*	Std. RMZ	No Buffer	*Sub-Total*	
Fish-bearing	180 (51%)		*180*	100 (29%)				*100*	70 (20%)		*70*	**350**
Nonfish-bearing		249 (49%)	*249*		151 (30%)	45 (9%)		*196*	64 (12%)		*64*	**509**
Seasonal		794 (52%)	*794*				596 (39%)	*596*		137 (9%)	*137*	**1,527**
Unclassified		393 (47%)	*393*				341 (41%)	*341*		104 (12%)	*104*	**838**
TOTAL	**180**	**1,436**	**1,616**	**100**	**151**	**45**	**937**	**1,233**	**134**	**241**	**375**	**3,224**

[a] Watershed analysis will require buffers on streams prone to landslides/debris flows.

Std. – Standard; RMZ – Riparian Management Zone; RCA – Riparian Conservation Area; RLTA – Riparian Leave Tree Area; RHA – Riparian Habitat Area

3.3.4 Harvest Deferrals for 303(d) Stream Segments and Wetland Management Zones

To address specific water quality concerns, special consideration will be given to fish-bearing streams and adjacent habitat areas that have been listed by the Washington State Department of Ecology as water quality limited. Within the Planning Area, stream segments in four drainages (i.e., Big Creek, West Fork Teanaway, Lookout Creek, and Gold Creek) are considered as water quality limited under section 303(d) of the Clean Water Act. All stream segments were listed because stream temperatures exceeded State water quality standards. In order to improve environmental conditions in these streams in support of beneficial uses such as fisheries habitat, Plum Creek will defer harvest within 667 acres in RHAs adjacent to the 303(d) listed stream segments until watershed analysis is completed in each watershed (Figures 23 and 27), and within 1,320 acres in wetland management zones (WMZs) surrounding wetlands (Section 3.3.4). Currently listed 303(d) streams are being provided with a 100-foot RHA on nonfish-bearing, perennial streams. Watershed analysis will address the water quality parameters typically impacted by forest practices such as stream temperature, turbidity, and sediment input.

3.3.5 Aquatic Resources Monitoring

Habitat monitoring will ensure that appropriate prescriptions have been implemented to protect fish and water quality. Where appropriate, monitoring methods used by Plum Creek will conform to the Timber/Fish/Wildlife (TFW) survey methodology protocol (Shuett-Hames et al. 1993). Fish habitat monitoring methods will include some combination of inventory assessment (baseline monitoring) and measurements over time (trend monitoring). Baseline monitoring is useful for characterizing existing conditions and establishing a database for future comparisons. Trend monitoring evaluates long-term changes in a particular parameter. Trend monitoring may include water quality parameters such as water temperature and turbidity.

As described in Section 5.1.6, all aquatic resources monitoring will be directed at specific technical questions and concerns addressed by the riparian management strategy. The Aquatic Resources Monitoring Program was designed to achieve four main objectives. These objectives include the following.

1. Provide landscape-wide monitoring of habitat conditions over the Permit period. This will involve analysis of permanent channel cross-sections in the Green River and Yakima River Subbasins, and re-examination of conditions in 17 Watershed Administrative Units (WAUs) in the Planning Area every 5 years for the first 10 years, and every 10 years thereafter throughout the Permit period to determine the effectiveness of prescriptions implemented for resource protection and recovery.
2. Analyze the effects of the various riparian habitat areas (RHAs) management strategies on stream temperatures. This will involve measurements of the potential differences in stream temperatures for the four RHA strategies described in Section 3.3.3.1. The strategies include: (1) 200-foot RHA on fish-bearing streams; (2) 100-foot RHA on nonfish-bearing streams on Federal LSR and/or AMAs; (3) 25-foot riparian zone with leave tree requirements on nonfish-bearing streams outside of Federal LSRs and/or AMAs; and (4) 30-foot, no-harvest riparian buffer on fish-bearing streams on Forest Service lands. In addition, Plum Creek will monitor stream temperatures on four streams on the 303(d) list and/or two streams that have verified populations of bull trout to determine reasons for the elevated temperatures, and to evaluate the effectiveness of prescriptions identified during watershed analysis.
3. Assess fish populations in the context of habitat association.
4. Assess the biological integrity of streams in the Planning Area over the Permit period. Long-term monitoring of aquatic insect species composition and abundance in the Little Naches River will provide information on watershed health that physical habitat measurements alone may not reflect.

3.4 Special Habitat Management

The Planning Area contains a number of special habitats that may be important to a wide range of wildlife species. Most of the species that use special habitats in the Planning Area, including wetlands, talus slopes, and caves, will not be affected by Plum Creek's forest-management activities. However, other species, particularly sensitive species, or those that migrate regularly between the special habitats and the coniferous forests, may be affected by activities in the adjacent forest.

3.4.1 Wetlands

The riparian wetlands will be identified during watershed analysis and appropriate prescriptions to protect the functions and values of these wetlands will be developed. Most of the wetlands within the Planning Area are spatially and functionally associated with rivers and streams. Other wetlands may occur more or less in isolation. These isolated wetlands are generally small, but may have unique characteristics and provide habitat for numerous wildlife species. Plum Creek will implement, as minimum and interim guidelines, standard State Forest Practices Rules and Regulations and the Riparian Management Strategy to protect all wetlands.

Forest Practices Rules and Regulations and watershed analysis may provide adequate protection of wetland features such as water quality, temperature, and some associated wildlife species (e.g., amphibians), however, they may not be adequate to protect all wetland-dependent species. Species such as cavity-nesting ducks would benefit from larger buffers as would be provided by the Proposed Action for nonforested wetlands and bogs greater than 5 acres in size (see below).

The Forest Practices Rules and Regulations recognize two major categories of wetlands, forested or nonforested. The nonforested wetlands are divided further into two classes: Type A (i.e., generally larger than 0.5 acres, with open water), and Type B (i.e., other nonforested wetlands).

The Forest Practices Rules and Regulations require buffers, termed wetland management zones (WMZs), on all Type A wetlands and on most Type B wetlands. For Type A wetlands greater than 5 acres in size, Plum Creek will retain a minimum WMZ width of 100 feet and an average of 200 feet. For wetlands between 0.5 and 5 acres, Plum Creek will retain a 50-foot average WMZ. For Type B wetlands greater than 5 acres, Plum Creek will retain an average WMZ of 50 feet, and for wetlands between 0.5 and 5 acres the WMZ retained will be a minimum of 25 feet.

3.4.1.1 Buffer Size and Shape

The Forest Practices Rules and Regulations require buffers, termed wetland management zones (WMZs), on all Type A wetlands and on most Type B wetlands. These regulations will be followed for wetlands less than 5 acres in size. For Type A wetlands between 0.5 and 5 acres, Plum Creek will retain a 50-foot average WMZ, and for Type B wetlands between 0.5 and 5 acres, the WMZ retained will be a minimum of 25 feet.

Nonforested wetlands and bogs greater than 5 acres will receive a 100-foot minimum and 200-foot average buffer width because of the greater seasonal persistence of open water, seasonal and spatial variation, and year-to-year variation.

In addition to leaving WMZs, there are several other harvest restrictions around nonforested wetlands required by the State Forest Practices Rules and Regulations. For example, individual trees and small (i.e., less than 0.5 acres) patches of forested wetlands cannot be harvested if surrounded by a Type A or Type B wetland, although these trees can contribute to the leave tree requirement in the WMZ. Harvest of upland areas or larger forested wetlands, if they are surrounded by Type A or Type B wetlands, require a plan approved by DNR. Timber cannot be felled into or cable yarded across a Type A or Type B wetland without prior approval by DNR. In addition, tractors or wheeled skidders cannot be used in Type A or Type B wetlands without prior approval of DNR. Slash disposal is not allowed in Type A or Type B wetlands or in WMZs, scarification is not allowed in any wetland, and machine piling is discouraged.

3.4.1.2 Additional Wetland Treatments

Although forested wetlands have fewer restrictions on timber harvest than nonforested wetlands, they have special rules designed to protect wetland soils. Cable systems are allowed in forested wetlands, but tractors, wheeled skidders, and other ground-based logging systems may be used only when soil moisture is low or the ground is frozen. At all times equipment use must minimize compaction or disturbance of the soils. Where possible, forested wetlands will be left in a forested condition (i.e., retain a canopy closure of 30 percent).

Plum Creek will allow only one entry every 50 years to each wetland buffer. Where wetlands are located outside of, but associated with, riparian areas, such as off-channel habitats or where they are located in association with unstable slopes, the minimum buffer width may be waived, after consultation with the Services, in favor of a redirected effort to more appropriately distribute the buffer trees to link these critical habitats. All wetlands which are an integral part of the stream system will receive the appropriate RHA, RLTA, or other treatment as directed by the Riparian Management Strategy. The Services have recommended that harvest unit leave trees be clumped in proximity to all small wetlands when such options exist and do not conflict with higher-priority ecological objectives.

> **Residual Trees**. The size and number of leave trees for wetland buffers are specified in the State Forest Practices Rules and Regulations. In addition to these specifications, the leave trees will be representative of pre-harvest tree sizes and species.

Road Building and Equipment Exclusion. In planning roads and landings, Plum Creek will comply with State Forest Practices Rules and Regulations and attempt to avoid wetlands. If wetlands cannot be avoided, Plum Creek will maintain natural drainage and reduce impacts by minimizing subgrade width and spoil areas. If Plum Creek is unable to minimize impacts, the Company will restore affected areas, reduce impacts, or replace affected wetlands as specified by State Forest Practices Rules and Regulations. Also, if a particular road segment necessitates filling or draining more than 0.5 acres of wetland, the Company will compensate for that fill (or drainage) by creating new wetlands or by enhancing existing wetlands.

The area adjacent to the edge of a wetland will be maintained free from ground-based equipment. This will avoid direct impact to amphibians and other wetland edge-dependent species and prevent compaction of soil and interstitial spaces in the substrate. In addition, ground-based equipment will not be allowed in the following areas:

1. Within a nonforested wetland;
2. Within 25 feet of a nonforested wetland edge, where the wetland exceeds 0.5 acres; and
3. Within 25 feet of an open water area associated with a forested wetland, where the wetland exceeds 0.5 acres.

3.4.2 Talus Slopes

Talus slopes are defined as areas at the base of steep slopes and cliffs where broken and dislodged fragments accumulate adjacent to forests. Rock crevices and associated vegetation provide a unique and relatively stable breeding and feeding environment for a variety of amphibians (e.g., Western redbacked salamander), small mammals (e.g., pikas, marmots), birds (e.g., swallows, wrens), and predators (e.g., bobcats). Although these areas represent a relatively small portion of the landbase in the Planning Area, they are an important special habitat which may be adversely affected by road construction and timber harvest activities. Biological objectives are to maintain the integrity of these sites while retaining trees adjacent to talus slopes which provide shade and down logs for foraging and shelter. On talus slopes greater than 1.0 acre in size, Plum Creek will avoid road construction and rock extraction, where possible. Where there are existing operations, the Service will be consulted prior to expansion of such operation. Skidding and yarding activities will be avoided on talus slopes. Residual large green trees and snags will be left within 100 feet of the sites. Where possible the objectives of maintaining shade and providing a source of course woody debris would be met.

Talus conditions can be quite diverse. In some areas East of the Cascade crest, it becomes difficult to distinguish talus slopes from rocky slopes. The field manual provides guidance on the level of protection warranted for these areas. West-side talus slopes have moisture and mossy conditions which met the need of a wide range of species. On the East-side, talus fields (or rock outcroppings) are often dominated by rock substrate of varying sizes and can be solid or have crevices and spaces. These areas generally have limited surrounding natural tree cover and moist conditions typically are not present beyond the rain and snow seasons. However, these areas are also important to some species. The objectives in these areas would be to maintain some tree and understory vegetation cover to provide natural inputs of coarse woody debris and structural diversity to this habitat type, especially since these rocky, dry areas are typically slow to regenerate. Where possible, Wildlife Reserve Trees (WRTs) and Green Recruitment Trees (GRTs) should be left with a focus on Ponderosa pine. To maintain biological integrity when avoidance of these areas is not practicable, management activities should include minimizing disturbance from road building and yarding in or through the talus areas.

3.4.3 Caves

The Services' definition of a cave includes naturally occurring cavities or recesses large enough to contain a human (interpreted as a 2 foot by 2 foot opening with at least 4 feet of depth), with attributes of high humidity, stable temperature (interpreted such that the opening-passage relationships are either cylindrical or the opening is restricted, or depth of the cave is significantly deep so that air does not flow freely to and from the outside causing desiccation and rapid temperature changes in the cave), and has a zone characterized by darkness and silence (dripping or running water is an exception). Caves with known maternal colonies or hibernacula for significant numbers of bats would meet minimum size and shape requirements. If cave passages are sufficiently below the ground surface, road building may be permissible directly above the passages. If passages are shallow, recommendations for road building and equipment may be warranted in areas above and immediately adjacent to those passages.

There are currently no known caves in the Planning Area. If a cave is discovered in the Planning Area, Plum Creek will notify the Services. It would be the responsibility of the Services, in conjunction with the State Department of Fish and Wildlife, to map the cave and recommend prescriptions to avoid compromising the integrity of the cave passages. Plum Creek will reduce the potential for impacts by establishing a buffer around the entrance to caves. This buffer will be designed around site-specific conditions, but would not be less than 100 feet from the entrance of the cave. The 100-foot buffer will be managed, if adequate trees and size classes are available, to approximate FD habitat similar to that prescribed for the 100-foot riparian buffers.

Many species of wildlife including Townsend's big-eared bats roost almost exclusively in cavities and caves, both man-made and natural. Potential impacts to bats and other species may include disturbance of caves used for hibernation, denning, or other activities. Additional steps to protect known hibernation or denning caves includes prohibition of human disturbance near the entrance of caves, and elimination of the spraying of herbicides or fertilizers within 100 feet of caves. A managed buffer of this size was developed in conjunction with the Services and is considered adequate to maintain stable temperature and relative humidity in adjacent caves and to address the biological needs for most, if not all, cave-dependent species. It is important to note that it is not the intention of Plum Creek to buffer every depression, hole, or fissure found in rock outcrops. Rather, Plum Creek will protect all caves discovered which are sufficiently deep and narrow of opening that provide a stable environment for cave-dependent species.

3.4.4 Snags and Snag Recruitment Trees

Variable amounts of green leave trees and snags will remain after harvest. Plum Creek will strive, under the direction of the Environmental Principles, to leave as many large, quality snags as practicable.

During all operations, including even-aged harvests, the Environmental Principles will result in post-harvest conditions that exceed State Forest Practices Rules and Regulations. This will occur in several ways:

1. Where snags are lacking, additional green recruitment trees will be left instead.
2. The number of snags left will exceed State Forest Practices Rules and Regulations. Although not every harvest unit will have sufficient snags prior to harvest to meet these objectives, when considered in total, Plum Creek's even-aged harvest units will average three snags retained per acre harvested.
3. Larger snags will be given priority for retention, and Plum Creek will leave three green recruitment trees that are either dominants or codominants.

4. Snags and recruitment trees will be either clumped or scattered across harvest units depending on operational feasibility. Clumping and scattering offer differing benefits to different species. Over time and the landscape, the use of both distribution strategies will result in benefits to many species. A common strategy may be to clump leave trees along intermittent streams or adjacent to existing riparian protection areas. Under unusual situations, leave trees for a harvest unit may be left in adjacent riparian protection areas after consultation with the Services. These leave trees will be over and above the number required by the combination of the Riparian Management Strategy and watershed analysis.

Hollow snags have been identified by the Services as important habitat for swifts, fisher, and marten. Although hollow snags are relatively rare in comparison with similarly sized solid snags, they will be given high priority for retention at all sites. However, if these or any other standing snags present a safety hazard, they will be felled and either left in place or removed.

3.4.5 Seeps and Springs

Seeps and springs represent areas transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered periodically, by shallow water. Although these special habitats may be small and difficult to locate, they may have unique characteristics and provide habitat for specialized plants and animals not provided elsewhere in riparian areas. Foremost among the wildlife species that depend upon these special habitats (e.g., mineral springs) is the band-tailed pigeon (*Columbia fasciata*). During the breeding season (i.e., April through September) the main population of these birds occurs below 1,000 feet elevation in Western Washington forests exhibiting good interspersion of seral stages and openings, abundant food resources, and mineral springs (Sanderson 1977). Band-tails are known to seek sources of mineral salts necessary for the production of “crop milk” for feeding young birds (Sanderson 1977). The most common sources of these minerals are from mineral springs and brackish water in estuary tide channels (Sanderson 1977). In late summer, these birds move into higher elevations in response to the increasing availability of fruits and berries. By late September most band-tails depart for southern wintering areas (Jeffrey 1989).

To prevent or reduce impact to these habitats and wildlife species that depend upon them, such as the band-tailed pigeon, Plum Creek will implement, as minimum and interim guidelines, the Riparian Management Strategy and standard State Forest Practices and Regulations. The biological objectives are to protect and maintain the integrity of known seeps and mineral springs, while retaining trees adjacent to these habitats to maintain water quality, provide shade, and provide downed logs for forage and shelter. Activities within 200 feet of mineral springs will be coordinated with the Services and designed to retain adequate trees for perching, and to maintain berry, fruit, and mast-producing shrubs and trees which provide food sources, particularly in openings in proximity to the mineral springs (Roderick and Milner 1991). Trees designated for harvest in proximity to seeps and springs will be felled directionally away from these habitats. Skidding and yarding activities will be avoided and all ground-based logging equipment will be prohibited from entering these habitats. Residual large green trees and snags within 25 feet of these sites will be left, and either clumped or scattered depending upon operational feasibility. In addition, under corporate Environmental Principles, Plum Creek voluntarily minimizes its use of herbicides, and the Company exceeds State Forest Practices Rules and Regulations by prohibiting spraying in riparian areas, and by not allowing spraying within 100 feet of water bodies.

3.4.6 Ponderosa Pine Stands

Plum Creek utilizes selective harvesting in Ponderosa pine stands where such techniques are operationally and silviculturally appropriate. Continued use of selective harvesting would result in multi-aged stands over the Permit period. Tables 32a and 32b (added to HCP Section 3.5.3, see FEIS Appendix 4) present an analysis of stand structural stages within the Ponderosa pine/ Lodgepole pine forest class (Jensen 1995) for the HCP during the Permit period. Where development of a multi-aged forest is not possible, Plum Creek will enhance opportunities for biological diversity by leaving trees of various size classes, as well as existing snags and snag recruitment trees.

3.5 Impacts of the HCP

3.5.1 Section 10(a) Permit Species

Plum Creek is seeking a Permit for all aspects of management activities that may be associated with timber harvest and forest management in the Planning Area that will allow impacts to spotted owls, marbled murrelets, grizzly bears, and gray wolves, and other vertebrate species. Plum Creek does not anticipate that actual death or injuries to these species will result as a consequence of its management, and all reasonable precautions will be taken to avoid such impacts; however, instances of incidental take will be covered by the Permit. The HCP will allow removal of some spotted owl foraging, roosting, nesting, and dispersal habitat, but no significant net loss of habitat is anticipated because harvested habitat will be replaced through growth of younger forest stands. In addition, the measures described in this HCP are designed to protect habitat and minimize or avoid the likelihood of injury to listed and unlisted species.

3.5.1.1 Northern Spotted Owl

The principal form of impact for which Plum Creek is seeking this Permit is displacement of spotted owls due to modification of owl habitat, including areas with nest sites. Direct injury to owls as a result of forest management is not anticipated. Nesting, roosting, foraging, and dispersal habitat may be harvested annually in the Planning Area. Some net loss of suitable habitat is anticipated, measured over the Permit period, however, a portion of that habitat will be replaced through growth of younger forest stands on both Plum Creek and Forest Service lands. In addition, the mitigation measures described in this HCP are designed to: (1) avoid injury to spotted owls; (2) protect habitat; and (3) facilitate dispersal of adult and juvenile owls. Given the population monitoring efforts in the Planning Area, seasonal protection of specific owl site centers from disturbance, maintenance of adequate habitat acreage at 30 selected nest sites, and incorporation of a dispersal strategy to reduce the likelihood of isolating owls across the I-90 corridor, Plum Creek anticipates minimal impact to local and regional populations of spotted owls over the Permit period.

For the purposes of this HCP, Plum Creek has considered both direct and indirect impacts to spotted owls as a result of forest-management activities. Indirect impacts will occur when spotted owl nest sites are harvested (outside the breeding season), causing either death or displacing the owl pair that once occupied those sites during the nesting and fledging seasons, and when forest-management activities in forest stands close to owl nest sites either precludes the use of the stand for foraging and/or reduces habitat within a home range to a threshold below that which would normally support a pair or single owl.

Of the 106 spotted owl site centers in the vicinity of the Planning Area, only 40 site centers contain significant amounts (i.e., 100 acres or more) of habitat, within a 1.8-miles radius, on Plum Creek’s lands, and are known to have been occupied recently by pairs or singles (Table 24). Among the 40 sites, 14 are unlikely to be affected by Plum Creek’s forest-management activities because they contain adequate habitat on Federal lands (Section 3.2.1.1).

Among the remaining 26 sites, Plum Creek will defer harvest, for at least 20 years, in selected core nesting areas and use selective harvesting in the surrounding foraging areas at 11 of the 26 sites. Based on the forest-management strategy outlined in this HCP, Plum Creek evaluated the amount of potential habitat that may be available in the Planning Area over the Permit period. The analysis indicated that past timber-harvesting operations on both private and Federal lands in the I-90 corridor, have reduced the amount of mature and late-successional forests, which subsequently, in conjunction with planned harvest on Plum Creek's land and other ownerships, will create a moderate reduction in available habitat approximately 20 years after Permit issuance. After 20 years, these sites may become available for harvest. However, anticipated land exchanges, regrowth of habitat on Plum Creek and Federal lands, and movement of owl pairs are expected to reduce the likelihood of impact.

Habitat areas, also known as "conservation areas" or "Late-Successional Reserves" have been the key components of most spotted owl and late-successional, forest-management strategies developed in the Pacific Northwest in the last decade. Although habitat areas from different plans are variously defined, the objective of each plan has been to provide areas where habitat would occur in amounts and arrangements capable of supporting multiple, reproductive pairs of spotted owls and other species of wildlife associated with late-successional forests.

In that regard, Plum Creek's HCP is designed to minimize impacts to spotted owls by supplementing the Federal objective. Plum Creek is accomplishing this by allowing natural successional processes to continue in areas currently suitable as spotted owl habitat, focusing silvicultural activities on developing suitable dispersal habitat in areas where such habitat may be currently unavailable or unsuitable, and providing dispersal corridors to encourage North/South and East/west movement of owls into the Federal DCAs. Plum Creek is also considering the long-term impacts that forest management in the Planning Area may impose on spotted owl populations by providing prescriptions to reduce the risk of large-scale disturbances, such as insect infestation and wildfire.

To evaluate the change in amount of habitat, rate of change, distribution, type, and capability of the habitat to support spotted owls, Plum Creek examined NRF habitat, and FD habitat at six intervals (i.e., 1996, 2006, 2016, 2026, 2036, and 2045) spanning the Permit period using OPTION linked to GIS. These time periods were considered relevant in evaluating spotted owl habitat because the owl is a relatively long-lived species with an average generation time of about 10 years. Thus, Plum Creek's estimate of habitat availability through the Permit period will consider multiple spotted owl generations (i.e., about five generations).

Analyses used to determine the impact that Plum Creek's HCP may have on spotted owls considered generally six criteria. Because of the inter-relationship among the criteria, none were used independently to assess potential impacts to owl populations. The criteria used, along with an assessment of the potential impact to owl populations in the Planning Area, are discussed below:

1. **Trends in amount and type of owl Habitat** — As displayed in Tables 25b and 25c and discussed in Section 3.2.1.1, total spotted owl habitat in the HCP will increase on Plum Creek's lands. Total habitat for spotted owls in the Planning Area will decrease slightly during the first 20 years of the plan, from 47 percent in 1996 to 41 percent in 2016. For the following 30 years (i.e., 2016 through 2045) total habitat for spotted owls in the Planning Area will increase from 41 percent to 53 percent.

   The type of spotted owl habitat provided by the HCP and the Northwest Forest Plan is also important to evaluate potential impacts to spotted owls. NRF habitat will decrease slightly in the Planning Area during the first 20 years, from 29 percent in 1996 to 26 percent in 2016, and increase slightly during the final 30 years of the plan to 28 percent in 2045, for a net decrease of 1 percent anticipated over the Permit period. Similarly, FD habitat will decrease slightly in the first two decades, from 18 percent in 1996 to 15 percent in 2016, but will increase significantly to 25 percent by 2045.

The combined efforts of the Northwest Forest Plan and the HCP are directed at reducing the anticipated shortfall of habitat mid-way through the Permit period and providing adequate spotted owl habitat on the landscape at the end of the Permit period, thereby reducing impacts to spotted owls by reversing a trend of habitat loss and facilitating recovery of the species over time. Estimates of habitat provided in the Planning Area may be conservative because Plum Creek's analyses include a minimal contribution of spotted owl habitat on State and private lands, which, it was assumed, would be managed consistent with existing State Forest Practices Rules and Regulations. Table 25a displays the amounts of the Planning Area providing spotted owl habitat under current regulations. The differences between the HCP and current regulations in providing spotted owl habitat across all ownerships in the Planning Area through the Permit period are minimal. Current and future habitat conservation planning efforts on State and private lands in the Planning Area will augment habitat protection anticipated for Plum Creek's land and Federal land.

2. **Distribution of spotted owl habitat through the Permit period** — Equally as important as the amount and type of habitat, is the distribution of habitat provided to spotted owls as a result of the HCP. The distribution of habitat in the Planning Area is visually depicted in Figures 36 through 38. As seen from these figures, areas with high concentrations of habitat today continue to provide habitat throughout the Permit period, especially in the Northwest Forest Plan LSRs and AMAs where the combined retention efforts of the Forest Service and Plum Creek are concentrated. Outside these concentration areas, spotted owl NRF and FD habitat are widely distributed and intermingled to provide maximum probabilities for persistence through the Planning Area. For example, the retention of NRF habitat is greatest on Plum Creek's lands and other ownerships within LSR and AMA than in other areas. In the LSR, Plum Creek estimates that 12 percent of Company lands and 39 percent of all lands in the Planning Area will support NRF habitat at year 50. For the AMA, these values are 9 and 25 percent, respectively, and for the Matrix, 6 and 14 percent, respectively. The distribution of NRF habitat should also be consistent with the objectives of the final draft spotted owl Recovery Plan (Lujan et al. 1992b). It is estimated that at year 50, DCAs will contain greater amounts of NRF habitat than areas outside of DCAs. For example, WD-40 (Figure 9) is expected to contain more NRF (i.e., 48 percent) than the other DCAs, whereas, WD-7 is expected to contain the least NRF (i.e., 20 percent). Overall, at year 50, DCAs are estimated to contain more NRF habitat (i.e., 38 percent) than the Planning Area as a whole (i.e., 26 percent). In 1996, 11 percent of the NRF habitat on Plum Creek's land in the Planning Area is in RHAs, and the remainder (i.e., 89 percent) is distributed throughout upland areas. At the end of the Permit period (i.e., 2045), 18 percent of NRF habitat would occur in RHAs, and 82 percent would be distributed throughout upland areas. The distribution of habitat created by implementation of the HCP will reduce impacts by reducing current barriers to spotted owl movement. Barriers to spotted owl movement and distribution has been cited as a major impediment to recovery (Lujan et al. 1992b) and a major objective of the Snoqualmie Pass Adaptive Management Area (USDA 1995).

3. **Carrying capacity for spotted owls** — Application of the Resource Selection Probability Function (RSPF) model to the future landscapes created by the HCP and the Northwest Forest Plan suggest that impacts of the HCP on the area's capability to support spotted owls will be minimal (Irwin and Hicks 1995). To provide a "high end" and "low end" estimate of the effects of the HCP on carrying capacity, the RSPF model was applied to the Planning Area in two different ways.

The model was first applied to the Planning Area and surrounding habitat buffer to evaluate the probability for owl sites adjacent to the Planning Area that might depend on habitat within the Planning Area. The pair site occupancy rate was also relaxed to provide an estimate of the total number of sites (pairs and singles) that may occur during the Permit period. The result (Figure 39) suggests that as many as 130 sites could occur in and adjacent to the Planning Area. With implementation of the HCP and the Northwest Forest Plan, the number of potential sites could decrease 15 percent to 110 mid-way through the Permit period, and increase to 120 sites by the end of the Permit period.

The model was then applied to habitat only within the HCP boundary and calibrated to estimate the number of sites that would likely support pairs (Figures 40 through 42). This application yielded an estimate of 88 pairs in 1996, decreasing 5 percent to 84 mid-way through the planning period and subsequently increasing to 89 pair sites by 2045. Based on these conservative estimates, implementation of the HCP will have some impacts on the long-term capacity of the landscape to support spotted owls.

4. **Dispersal habitat** — An important contribution of the HCP to recovery of the spotted owl is the definition and provision for dispersal habitat to improve demographic interchange of spotted owls in the I-90 Special Emphasis Area. As discussed above, dispersal habitat is projected to increase from 18 to 25 percent in the Planning Area over the Permit period. As shown in Figures 36 through 38, the "filling in" of dispersal habitat between NRF habitat areas will occur as a result of HCP and Northwest Forest Plan implementation. Although dispersal habitat is structurally deficient to support nesting, dispersal habitat will provide "stopover" and "resting" places where adults and juveniles can find suitable cover and foraging opportunities. Provision for dispersal habitat on Plum Creek's lands between Federal DCAs will facilitate the movement and distribution of spotted owls among and between cluster areas, thereby further reducing impacts to spotted owls as a result of the HCP.

   FD habitat is defined on the basis of average stand conditions and dominant tree species. Due to the variability of growing sites and retention of snags and residual green trees, some FD habitat patches will contain some characteristics of NRF habitat. For example, high quality FD habitat is expected in RHAs which currently contain a diversity of diameters and tree species, and which will be managed conservatively to protect watershed conditions and enhance wildlife habitat. Although the distribution of some FD habitat will be placed strategically through deferrals, forest growth across the entire Planning Area will guarantee that FD habitat will be widespread across the landscape.

5. **NRF habitat patch sizes** — Plum Creek will strive to manage patches in such a way as to maximize patch size. Plum Creek has not committed to large minimum patch sizes; however, the Company's intent is to manage in such a way that harvest-units might be located near recently harvested areas to the extent allowed by State Forest Practices Rules and Regulations. This would facilitate periods of activity in subbasins, followed by periods of inactivity during which time roads could be closed or abandoned. Another benefit of this management is that these harvested areas would be of similar age and, after a number of years, would start to represent larger blocks of older forest.

   The HCP has been constructed to provide biologically relevant patch sizes for retention and eventual regrowth of NRF habitat. Although it is impossible to specify the exact size and location of every patch of NRF habitat on the landscape for 50 years, the provision for management units to be designated on Plum Creek's land establishes a framework for assessing current and future NRF patch sizes. Management units on Plum Creek's ownership range between 2 to 120 acres and average 42 acres. All NRF patches however, will not be 42 acres in size. Some of the patches will be adjacent to other management units and some will be adjacent to Forest Service lands. These represent a biological and operational compromise, facilitating both logical management activities and relevant habitat units. Using management units as a basis for future planning reduces impacts on spotted owls by providing viable blocks of habitat for current and future owl use.

6. **Maintenance of spotted owl nest site clusters** — The HCP was designed to provide short and long-term support for existing spotted owl cluster sites in the Planning Area. NRF habitat deferrals were prioritized for existing nest sites in cluster areas. The dispersal corridors are instrumental in linking habitat found on adjacent Federal lands, as well as RHAs, and areas between cluster sites across the I-90 corridor (Section 3.2.1.1). Prioritization efforts in the HCP for habitat retention and restoration in existing cluster areas further reduces impacts of the HCP on spotted owls and achieves expectations for conservation contributions of non-federal lands established in the final draft Recovery Plan (see Table 2; and Lujan et al. 1992b).

3.5.1.2 Marbled Murrelet

For reasons stated in Section 3.2.1.2, the current potential for murrelet activity in the Planning Area is very low. However, as part of the HCP, Plum Creek will identify potential habitat remaining in the Western portion of the Planning Area, defer harvest on that potential habitat, and survey the habitat for murrelet use. Should occupancy by murrelets be detected, Plum Creek will protect an adequate amount of habitat to maintain the nesting capabilities of the site or sites detected in the surveys. The Services will be consulted in the selection of potential habitat, completion of surveys, and identification of habitat blocks to protect occupied stands. The removal of unoccupied suitable murrelet habitat may decrease the likelihood of future pioneering by murrelets. Plum Creek’s overall strategy for murrelets will be avoidance and minimization of take.

3.5.1.3 Grizzly Bear

Plum Creek recognizes that although grizzly bears may not currently occur in the Planning Area, they may eventually emigrate and reside in the Planning Area during the Permit period. Plum Creek used the best information available to assess habitat and analyze impacts that could impede recovery of grizzly bears in the I-90 Lakes Subunit, which is included in the North Cascades Recovery Zone. Implementation of the HCP will result in a series of BMPs initiated by Plum Creek in the I-90 Lakes Subunit to restrict access and reduce excessive open road densities, implement seasonal restrictions on operations in preferred habitat areas where bears are likely to occur, and restrict firearm use by Company employees and contractors which could contribute to malicious killing of bears.

In addition, implementation of the HCP will focus on retention of cover in riparian areas and wetlands, which are important areas for grizzly bears. An important aspect of the HCP is that some mitigation efforts will be implemented immediately to provide security habitat for bears and other mitigation efforts will be implemented upon confirmation of actual use by resident bears to further minimize and mitigate incidental “take.” Improper timber management may affect grizzly bears by: (1) removing thermal, resting, and security cover; (2) displacing bears during timber-harvesting operations; and (3) increasing human/grizzly bear confrontation potential or disturbance factors as a result of road building and management. However, by implementation of Environmental Principles and grizzly bear BMPs, such as road closures, Plum Creek can have a net positive effect on grizzly bears. Properly managed harvesting operations can result in an increase in bear foods (e.g., forbs, berries, and grasses) through silvicultural manipulation (e.g., tree removal, riparian management, prescribed burning) (USFWS 1993). Consequently, implementation of the HCP will have minimal adverse impact on grizzly bears

Table 30. Grizzly Bear Habitat Conditions Estimated for Security Areas Within the I-90 Lakes Subunit During the Permit Period. Estimates Shown are Percentages of the Security Area in the Entire Subunit and on Plum Creek's Land, by Decade.

AREA	YEAR					
	1996	2006	2016	2026	2036	2045
ENTIRE SUBUNIT						
For/Prey	22	21	13	8	5	5
Hid/Therm	58	59	67	72	75	75
PLUM CREEK						
For/Prey	51	55	35	22	20	22
Hid/Term	44	40	60	73	75	73
For/Prey — Foraging/Prey Habitat; Hid/Therm — Hiding/Thermal Habitat						

Implementation of the HCP and the Northwest Forest Plan will reduce the percentage of foraging/prey habitat in forested stands within security areas to 4 percent by 2045 (Table 30; Figures 43 through 45). On Plum Creek's lands alone, the percentage of security areas in foraging/prey habitat will decrease from 21 percent to 11 percent, whereas, hiding/thermal cover will increase from 60 percent to 71 percent by 2045. The reduction in foraging/prey habitat over time in the subunit is due to the anticipated reduction in harvest activity as well as regrowth of previously harvested areas into more densely timbered conditions. Estimates for reduction in foraging/prey habitat may be conservative however, because analyses did not include 12 percent of the Planning Area which is non-forested (e.g., alpine meadows) but which could potentially support some grizzly bear foraging and did not consider that the total amount of security cover may increase due to road closures. These areas would not be impacted by forest-management activities described in the HCP, and therefore they would continue to provide habitat for grizzly bears.

3.5.1.4 Gray Wolf

Gray wolves are currently not known to reside in the Planning Area, although several sightings suggest that transient wolves may have used the area in recent times. Despite the fact that no Federal recovery area has been designated for the gray wolf in the Planning Area, Plum Creek recognizes the likelihood that wolves may establish residency in the Planning Area during the Permit period. Plum Creek's HCP strategy is to manage potential wolf habitat for prey species such as deer and elk, prioritize road-management efforts in areas where possible wolf sightings have occurred to protect big game prey, and restrict seasonal operations within 0.25-miles of an active den site during the denning period (i.e., April through June 15), should a den site be detected during the Permit period. Therefore, implementation of the HCP should have minimal impact on the gray wolf if it occurs in the Planning Area.

3.5.2 Special Emphasis Species and Species of Concern

This portion of the HCP considers the impact of implementation of the HCP on 21 Special Emphasis Species and 11 Species of Concern (Table 2) for which an amendment to the Permit will be sought should they become federally listed. Additional detail on life history requirements, distribution in the Planning Area and management considerations can be found in Lundquist et al. (1995) and Section 2.0.

3.5.2.1 Reptiles (Northwestern Pond Turtle)

Northwestern pond turtles are unlikely to be present in the Planning Area because of their limited distribution in the State, and preference for low-elevation wetlands, ponds, and sloughs. In the unlikely event that the species should occur in the Planning Area, provisions in the HCP to maintain and protect riparian and wetland habitats and retention of structural and vegetation diversity will adequately address the biological needs of this species. Specifically, habitat for this species will be addressed through 30-foot, no-harvest zones along all fish-bearing streams with 30-foot, no-equipment zones along permanent, nonfish-bearing streams and larger wetlands. RHAs along all fish-bearing streams and most perennial streams will provide additional habitat.

3.5.2.2 Amphibians

Most amphibians require riparian habitat for foraging, breeding and cover. The importance of riparian habitats to amphibians varies with life history characteristics and species. For example, some amphibians breed only in high gradient mountain streams (e.g., tailed frog), whereas other species (e.g., northern red-legged frog) use lowland streams and ponds. The effects of forest management may alter or impact amphibian habitat by changing the basic hydrology of the area (e.g., water temperature, stream substrate) or adjacent riparian characteristics such as large woody debris.

3.5.2.2.1 Tailed Frog

Tailed frogs are known to occur in cold, fast-flowing permanent streams in the Planning Area. Designation of RHA’s on Plum Creek’s ownership and RCAs on Federal lands within the Planning Area will provide adequate consideration for this species. More specifically, retention of 30-foot, no-harvest buffers within the 200-foot RHAs along fish-bearing streams and LWD guidelines and 30-foot, no-equipment zones within 100-foot RHAs on each side of perennial, nonfish-bearing streams will meet the biological needs of this species.

3.5.2.2.2 Northern Red-Legged Frog

Northern red-legged frogs are thought to occur in the Planning Area but have not been confirmed. The species prefers open-water wetlands, temporary ponds and intermittent streams at relatively low elevations where they inhabit dense vegetation near the waters edge. Designation of 30-foot, no-harvest buffers along fish-bearing streams and 30-foot, no-equipment buffers on nonfish-bearing perennial streams on Plum Creek’s lands and RCAs on Federal lands, and retention of LWD adjacent to streams will adequately address habitat concerns for this species.

3.5.2.2.3 Cascades Frog

Cascades frogs are known to occur in the Planning Area, particularly in small pools and adjacent to streams flowing through subalpine meadows. Much of the habitat potentially supporting this species is in areas not economically feasible for timber management and therefore will not be impacted by the HCP. Additional habitat for this species that may occur in commercial harvest areas will be addressed through 30-foot, no-harvest buffers within the 200-foot RHAs along fish-bearing streams and and 30-foot, no-equipment zones within the 100-foot RHAs on perennial, nonfish-bearing streams on Plum Creek’s lands and RCAs on Federal lands, and retention of LWD adjacent to streams will adequately address habitat concerns for this species. Additional protection of wetlands afforded by Forest Practices Rules and Regulations and watershed analysis will further address the habitat requirements of this species. Consequently, the biological needs of this species are adequately addressed in the HCP.

3.5.2.2.4 Spotted Frog

The spotted frog may be present in the Planning Area, though no records of its occurrence currently exist. Spotted frogs are nearly always found in or near perennial water bodies such as springs, streams and lakes. They are often associated with non-woody plant communities (e.g., sedges, rushes and grasses) and are not known to rely upon forested areas as habitat. Implementation of the HCP will provide RHAs with 30-foot, no-harvest buffers with additional partial harvest zones along fish-bearing streams and additional LWD retention areas (RLTAs) and 30-foot, no-equipment zones on perennial nonfish-bearing streams. The wetlands strategy also provides additional retention in buffers, no-equipment zones around certain nonforested wetlands, and wider buffers on larger wetlands. Lakes will be protected by establishing buffers as specified by standard Forest Practice Rules and Regulations. Therefore, the HCP adequately addresses the biological needs of this species.

3.5.2.2.5 Larch Mountain Salamander

Larch Mountain salamanders have been documented on shaded talus slopes in the Planning Area, but they are also known to occur in late-successional forest stands associated with piles of bark slabs around large trees. The species is terrestrial and has almost never been associated with open water. With implementation of the HCP, timbered stands (e.g., pole timber to old growth) around talus slopes on Plum Creek's land will decrease initially from 44 percent in 1996 to 20 percent in 2016 but increasing back to 44 percent 2045. Retention of patches of trees and residual larger trees within 100 feet of talus areas and restrictions on site disturbance from log skidding and heavy equipment will retain habitat components near areas of known or suspected use. Plum Creek will also reduce the impact to potential habitat near caves by establishing a 100-foot buffer around the entrance to caves. Additionally, retention of NRF and FD habitat in RHAs on Plum Creek's lands to address needs for spotted owls and other wildlife species will also benefit the Larch Mountain salamander. Consequently, the HCP adequately addresses the needs of this species. Subsequent to the implementation of the HCP larch mountain salamanders have been documented at 7 sites in the Planning Area.

3.5.2.3 Fish

Protection and enhancement of RHAs, watershed analysis, and resultant improved water quality will ensure that the necessary habitat conditions for bull trout, rainbow/steelhead trout, coho salmon, and chinook salmon are maintained and, in many cases, improved. This should maintain or improve habitat for other species of fish as well. Proposed measures will maintain and enhance instream habitat by minimizing the introduction of fine sediment into streams. The protected RHAs will provide shade to address stream temperature concerns, retain standing and down trees for recruitment of large woody debris, and filter fine sediment. Road closures and abandonment, combined with improved crossings and drainage, will ensure passage of bedload material downstream and unobstructed movement of fish both upstream and downstream. Monitoring programs will evaluate the need for periodic road maintenance and effectiveness of remedial prescriptions and corrective actions. Overall, the HCP will increase protection of stream corridors through measures outlined in the Riparian Management Strategy (Section 3.3). Fish habitat will be improved above baseline conditions, and Plum Creek will monitor and continue to implement the Company's adaptive approach to RHA and fish habitat protection. Implementation of these measures will adequately address the biological needs of fish species by minimizing siltation entering spawning and rearing areas, maintaining suitable stream temperatures, protecting habitat and stream bank integrity, and providing a continuous source of LWD. Salmonids, especially bull trout, may be the most habitat-limited species due to their water quality, and passage requirements; therefore, provisions to address the needs of salmonids should ensure adequate habitat quality and quantity for other fish and aquatic species.

3.5.2.4 Birds

The structural components of riparian and adjacent upland habitats may be the most important features for meeting forest-dwelling bird life history requirements (e.g., feeding, roosting, nesting areas) and minimizing impacts as a result of the HCP. Maintaining a wide array of forest structural classes at the landscape level and increasing structural diversity within harvested areas by retention of snags, downed logs and residual green trees is a primary objective of the HCP and will enhance or maintain avian habitat diversity compared to current conditions.

3.5.2.4.1 Harlequin Duck

Harlequin ducks may occur in the Planning Area, although no records of their occurrence are available. The species is generally found along fast-moving mountain streams where they nest on the ground or in holes in cliffs or trees, often using LWD or dense undergrowth for nesting cover. This species migrates to saltwater habitats in the winter. Provision for 100- to 200-foot RHAs (with 30-foot, no-harvest zones on fish-bearing streams, and 30-foot, no-equipment zones on nonfish-bearing streams) along perennial streams on Plum Creek's lands in the Planning Areas with retention of snags and large, old trees adjacent to streams will provide adequate loafing and nesting sites for these ducks. In addition, reduced harvesting in riparian areas and reductions in siltation, to protect prey items such as macroinvertebrates, will adequately address the biological requirements of this species.

3.5.2.4.2 Northern Goshawk

A total of 18 goshawk site centers are known in the Planning Area, based on historical observations and recent survey data, applying similar criteria for persistence and behavior used to designate spotted owl site centers. Two to four of these site centers are on Plum Creek's land in the Planning Area. The strategy employed in the HCP to protect goshawks and avoid impacts includes the following three components:

1. **Harvest Deferrals —** Harvest in these management units which currently contain goshawk sites will be deferred for at least 20 years. These management units are located on the East-side of the Cascades. The harvest deferral~~s~~ will protect all known goshawk sites on Plum Creek's land in the Planning Area. The purpose of the 20-year deferral period is to maintain habitat around the known sites until structural classes that can support goshawk sites (e.g., dispersal, mature, managed old growth, old growth) are more abundant in the Planning Area.

2. **Habitat Management —** Goshawks use all spotted owl habitat types (i.e., NRF and FD), with some nesting occurring in both habitat types. As a result of implementation of the HCP, goshawk nesting habitat (i.e., primary habitat approximates NRF and secondary habitat approximates FD; therefore, "suitable" habitat is roughly equivalent to NRF habitat plus one-half FD habitat) is projected to increase from 37 percent of Planning Area in 1996 to 41 percent in 2045. Thus, goshawks will benefit from the fundamental HCP strategy to increase the amount and distribution of spotted owl habitat.

3. **Seasonal Restrictions –** Known sites with active goshawk nests in the Planning Area will receive protection within a 0 – 25 mile radius from March 1 until August 31. Harvest activities within the nest site would be allowed should that stand become available for harvest, although experimental silvicultural treatments may be used.

3.5.2.4.3 Little Willow Flycatcher

The habitat requirements of willow flycatchers will be addressed through the management of RHAs within the Planning Area. Retention of deciduous shrubs and small trees within 200-foot or 100-foot RHAs, and RLTAs along perennial streams in the Planning Area will provide appropriate habitat.

The willow flycatcher is included in Life Form 8, for which primary habitat includes the management units in riparian and wet sites in the early to mid-stages (shrub/sapling, young forest, pole timber, dispersal forest). Secondary habitat includes those units in the other stages (stand initiation, mature, managed old forest, and old growth).

Based on the analysis, the amount of primary habitat (shrub/sapling through dispersal forest) in RHAs for species in this life form is expected to decrease substantially on Plum Creek's lands (from about 53 percent to about 32 percent; see Figure 21 in Lundquist and Hicks 1995) as stands mature and develop through the Permit period. This pattern is similar but less pronounced when other ownerships are added across the HCP Planning Area (net decrease in primary habitat from 27 percent to 17 percent). Total potentially suitable habitat would decrease slightly on Plum Creek lands, as well as across all ownerships (Tables 26b and 26c). Thus, species such as the willow flycatcher, which utilize early stages of forest development, could be affected temporarily under the proposed plan. However, retention of existing deciduous components of riparian areas (which are currently limited within the Planning Area) or within partial harvest areas in the RHAs would help mitigate potential adverse effects. In addition forest edges created through partial harvests in RHAs may provide willow flycatcher habitat as the woody cover develops, particularly if some deciduous components (e.g., vine maple, elderberry) are retained.

3.5.2.4.4 Olive-sided Flycatcher

Components of the HCP will protect streamside corridors, certain spotted owl nesting locations, and forests on unstable slopes. Maintenance of streamside corridors with large trees and snags, retention of snags and "green" leave-trees in the harvest units, protection of stream-side corridors with large trees and snags, and measures to maintain spotted owl habitat within the HCP will help provide forest habitat elements to benefit the olive-sided flycatcher as nesting and foraging habitat. Trees retained within the above management areas will provide perching and nesting sites, and forest edges and openings within the RHAs will result in structural variety for foraging.

The olive-sided flycatcher is included in Life Form 10, for which primary habitat is defined as the percentage of management units occurring in the middle to later stages (i.e., pole timber through old growth), and with secondary habitat as the percentage of units occurring as shrub/sapling and young forest stages (Table 15).

The combination of middle to later structural stages considered primary habitat for species in this life form is expected to increase over the course of the Permit period, while secondary habitat (shrub/sapling and young forest) is expected to decrease (Tables 26b and 26c; see also Figure 27 in Lundquist and Hicks 1995). Overall the total potentially suitable habitat for these species is expected to increase, both on Plum Creek's lands and across the entire Planning Area. The expected decrease in edge habitat across the Planning Area (Tables 26b and 26c) may temporarily affect edge-dependent species such as the olive-sided flycatcher. Development of even-aged stands over time with less structural diversity in the canopy than unmanaged or older forests may be less suitable for this species. However, management and retention of habitat elements within the RHAs, as well as management for spotted owl habitat, will result in open and varied structure conducive to olive-sided flycatcher nesting and foraging. Thus, the needs of olive-sided flycatchers should be well accommodated under the HCP.

3.5.2.4.5 Black Tern

The black tern is a summer resident of the plains region. The species is unlikely to be found in the Planning Area, except perhaps at the lowest elevations on the Eastern edge of the Cascades in sloughs, marshes or lakes. There are no State records of the species in the Planning Area. Strategies in the HCP to address wetlands (Section 3.4.1) and riparian areas (see Section 3.3.3) by limiting operations and retaining habitat structure will address the biological needs of this species.

3.5.2.4.6 Bald Eagle

Bald eagles are known to nest on Forest Service land and winter in the Planning Area. Breeding habitat consists of predominately coniferous, uneven-aged stands of trees located on the shorelines of lakes and streams. These stands often have residual components of old growth forests (e.g., scattered large trees, snags, and defect). With implementation of the HCP, habitat for bald eagles will be maintained, due to the proximity of these sites to spotted owl sites, management of RHAs, and the protection afforded such sites by current Forest Practices Rules and Regulations. Management actions taken under the HCP will not adversely affect current or future bald eagle nests in the Planning Area. Plum Creek is not seeking to "take" any bald eagle sites incidental to its operations.

As required under the Washington State Bald Eagle Protection Rules (WAC-232-12-292) a cooperative Site Management Plan will be developed whenever Plum Creek's forest-management activities are proposed near a verified bald eagle nest territory. Each Site Management Plan will be designed using the flexible, territory zoning concept developed by WDFW (Stalmaster 1987), to avoid disturbing eagles, particularly during the critical nesting (January 1 through August 15) and wintering periods (November 1 through April 1). Bald eagle site-protection plans will not only include nest sites, but associated foraging areas and pilot trees. Winter concentration areas and communal roost sites will be protected from disturbances during the season of use.

3.5.2.4.7 Golden Eagle

One golden eagle nest site has been observed in the Planning Area. However, the current status of the site is not known. Golden eagles nest primarily in large trees in mature or old growth forests near the edge of clear-cuts or large openings. Provisions in the HCP for retention of habitat in RHAs, harvest deferrals of spotted owl NRF habitat, and retention of residual large trees in harvest units to accelerate the development of future habitat (e.g., managed old growth) will address nesting habitat concerns for this species. Provisions for addressing the habitat concerns of potential prey species (e.g., Lifeform 5) which use "edge habitats" will also benefit golden eagles.

3.5.2.4.8 Peregrine Falcon

Peregrine falcons have not been confirmed as residents of the Planning Area, but habitat to support the species is present. Although the peregrine falcon is not associated closely with late-successional forests, it often nests on inaccessible ledges on cliffs, or rock outcrops that are situated among coniferous forests. The peregrine forages in and around coniferous forests, and wetlands, marshes, and riparian zones are also important foraging habitat since these areas serve to attract and concentrate a diverse prey base.

To protect the nesting/breeding and foraging habitat of the peregrine falcon, Plum Creek will implement the State Forest Practices Rules and Regulations which regulate activities in areas for nesting or breeding by threatened or endangered species listed by the Federal government. In addition, where appropriate for site-specific management, Plum Creek will implement the recommendations outlined in the Pacific States Peregrine Falcon Recovery Plan (USFWS 1982). This recovery plan addresses populations and habitat and includes recommendations for management of the species.

Protocol surveys will be performed prior to harvest or road building within 400 meters of a potential eryie (i.e., a rock cliff vertical face greater than 150 feet). Near verified peregrine falcon nesting/breeding sites, Plum Creek will restrict all forest-management activities within 0.5-miles of the site. During the nesting/breeding season (i.e., March 1 through July 30), Plum Creek will restrict all forest-management activities within 0.5-miles of an active peregrine nest site. During the rest of the year, Plum Creek will restrict forest-management activities within 0.25-miles of an active nest site. Protection afforded RHAs, wetlands, and other riparian areas will maintain suitable foraging habitat for peregrines. Consequently, forest-management activities proposed in the HCP will not adversely affect the peregrine falcon.

3.5.2.4.9 Flammulated Owl

Flammulated owls occur in timber stands dominated by Ponderosa pine within the Planning Area. The Planning Area does not include large acreages of the Ponderosa pine timber type and it is only located East of the Cascade crest. Flammulated owls nest in large pines in mid- to late-seral stages. The HCP includes maintenance of streamside corridors with large trees and snags, and retention of snags and green leave trees in East-side harvest units to maintain a supply of suitably-sized trees for potential nesting cavities. In addition, shrub (and tree) cover will be in proximity. The mix of structural classes within the Planning Area will provide foraging areas for the owls. In addition, Plum Creek's lands are interspersed within a matrix of Forest Service lands, much of which will be maintained as mature or old growth forest. The HCP will maintain a wide variety of structural stages that would potentially benefit flammulated owls. Potential nesting habitat would be made available through the provision of at least three snags per acre (on average) on Plum Creek's lands in the Planning Area. Together with those retained on Forest Service lands, snags (of suitable size) should continue to be available for use by flammulated owls.

3.5.2.4.10 Pileated Woodpecker

Pileated woodpeckers occur regularly in the Planning Area. This species is a primary cavity excavator with the most stringent habitat requirements of the woodpecker group. To accommodate this concern, Lifeform 13a was developed to evaluate habitat trends for this species. As a result of implementation of the HCP, primary habitat for pileated woodpeckers on Plum Creek's land in the Planning Area will increase (from 39 percent in 1996 to 46 percent in 2045). Additionally, the HCP includes retention of large standing snags and residual green trees and logs in harvest areas in excess of requirements in State Forest Practices Rules and Regulations, as well as the maintenance of RHAs with large trees and snags, and downed woody debris to maintain nesting and foraging habitat for these woodpeckers. Set asides to maintain spotted owl habitat within the Planning Area will also provide foraging and nesting habitat for pileated woodpeckers. Consequently, actions taken under the HCP will adequately address the biological needs of this species.

3.5.2.4.11 Lewis' Woodpecker

Lewis' woodpeckers are common to park-like Ponderosa pine forests in the Eastern Cascades. Consequently, the species is unlikely to be a resident in the Planning Area. However, should Lewis woodpeckers appear in the area, they are likely to occur in limited locations, such as riparian areas with shrub understories where Lewis' woodpeckers engage in "hawking" behavior in search of flying insects. Recently harvested or burned coniferous forest is an important part of the Lewis' woodpecker habitat, but only during the shrub stage. Protection of RHAs, together with retention of snags and provision for a mixture of stands in various stages of regeneration will adequately address habitat needs for this species. Adaptive management provisions as described in Section 5.4 may also be used to adequately address habitat requirements of this species.

3.5.2.4.12 White-headed Woodpecker

White-headed woodpeckers are unlikely to occur in the Planning Area, due to the dependence of this species on extensive Ponderosa pine forests and the limited occurrence of this timber type in the Planning Area. In addition to large dead and dying pine, white headed woodpeckers use broken-topped snags, leaning logs, and even high cut stumps as nesting sites. White-headed woodpeckers will benefit from actions taken in the HCP to address other cavity-excavators (e.g., Lifeform 13a) such as maintenance of older, more complex structural stages and retention of broken-topped snags, leaning logs, and high-cut stumps in harvest units and riparian areas. These efforts would be particularly effective in open areas dominated by Ponderosa pine, where partial or selective harvesting techniques retained tall (e.g., up to eight feet) and large (e.g., over 20 inches DBH) Ponderosa pine and Douglas fir stumps.

3.5.2.4.13 Vaux's Swift

Vaux's swifts reside in the Planning Area, especially within Western hemlock/Douglas fir stands. The species nests and roosts within mature and old growth forests where large broken-topped trees or hollow snags are present. As discussed for Lifeform 14 (Section 3.5.3.14), habitat trends for Vaux's swifts are similar to spotted owls in the Planning Area. Implementation of the HCP, combined with the Northwest Forest Plan on Forest Service lands will provide primary and secondary habitat for the species. Maintenance of streamside corridors with large trees and snags, and the retention of snags and "green" leave-trees in the harvest units, the protection of streamside corridors with large trees and snags, along with measures to maintain spotted owl habitat within the Planning Area will help provide adequate foraging and nesting habitat for swifts. Across all ownerships, primary habitat for Vaux's swifts will increase slightly while secondary habitat (i.e., dispersal forest) will increase significantly. The leave tree retention strategy places special emphasis on large hollow snags.

Consequently, impacts on the species will be minimal and the biological needs of the species will be adequately addressed.

3.5.2.4.14 Western Bluebird

Since Western bluebirds most often occur in open oak and/or open coniferous woodlands, occurrence of this species in the Planning Area is questionable; potentially limited to the lower elevation, drier East-side Cascades portion. Western bluebirds use cavities created by other birds (e.g., Lifeform 14), especially in snags located next to openings. Maintenance of riparian corridors with large trees and snags, and the retention of snags and "green" leave trees in harvest units and younger stands will maintain a supply of suitably sized trees for potential nesting cavities. Potential nesting habitat will be made available through the provision of at least three snags per acre (on average) on Plum Creek's lands in the Planning Area. Together with snags retained on Forest Service lands, sufficient numbers of snags will be available for use by bluebirds. Continued timber harvesting across the Planning Area will provide some forest openings, which, together with other structural stages, will result in a mixture of stands in various stages of regeneration.

3.5.2.5 Mammals

Historically, mammals have been viewed primarily as causing negative impacts on commercial forestry, contributing to significant damage and delay in forest regeneration. Currently, the importance of small mammals to ecological functions such as microbial soil building and as a prey base for forest predators (e.g., spotted owl, gray wolf) is becoming better understood. Impacts to mammals from forest management occur from changes in forest structure and damage to den or burrow systems from ongoing operations. Actions taken in the HCP to address these impacts include additional protection for riparian areas where mammal densities are usually greatest, and retention of important structural components such as large down logs and snags which provide micro-sites for den sites and feeding areas.

3.5.2.5.1 Townsend's Big-eared Bat

Townsend's big-eared bats roost almost exclusively in cavities and caves, both man-made and natural. Occurrence of the species has not been verified in the Planning Area, though sightings have been recorded in caves near the Planning Area. These bats occur most frequently in old growth or mature Douglas fir forests, where they prey on a wide variety of insect species. Potential impacts to the species are limited to disturbance of bat colonies using caves for hibernation. Disturbance of the colony can cause bats to warm themselves and become active. Such activity may require an expenditure of energy from their limited winter energy reserves. If repeated, the energy losses could result in reproductive failure, abandonment of the site, or death due to starvation. Disturbance will be reduced by establishing a buffer around the entrance to hibernation caves (see Section 3.4.3). This buffer will be designed around site-specific conditions, but will not be less than 100 feet from the entrance. Steps taken in the HCP to protect cave security, provide a balance of habitat types, and restricting public access should adequately address the biological needs for this species (Lundquist et al. 1995).

3.5.2.5.2 Myotis Species

If timber harvest is proposed near caves, abandoned mines, tunnels, and buildings with known or likely use by bats, steps will be taken to protect these features by restricting human access through visual or physical barriers, and by establishing a site-specific buffer around the entrances. Barriers at the entrances of caves and mines will be designed in such a manner as to restrict human access, but not impede use by bats. Maintenance of streamside corridors with large trees and snags (through management of RHAs) and retention of snags within the harvest units for the benefit of snag-dependent species, as well as for protection of certain spotted owl nesting sites, will also help provide foraging and roosting habitats for bats.

Myotis bats utilize a wide variety of habitats for roosting, but for purposes of analysis, they are designated as belonging to Life Form 14 (these species use cavities or hollows created by defect or the actions of other species) and are included in subgroup 14a. For purposes of evaluating this group of myotids, the group is considered to have primary habitat affinity among the later structural stages (i.e., mature through old growth), similar to Vaux's swift. Primary habitats are the stages thought to be most conducive to providing cavities and hollow trees suitable as roosting areas.

Potential impacts to these *Myotis* species can involve disturbance of hibernating bats and roost sites in the area (e.g., caves, abandoned mines, buildings, and large trees/snags). Impacts to the myotids will most likely be similar to those expected for Vaux's swift and northern spotted owl, with reduction in roosting habitat occurring during the course of the Permit period. Primary habitat will be reduced within Plum Creek's lands in the Planning Area during the first 10 years and will then increase later in the Permit period, for a net increase overall (Table 26b).

Management options which will maintain older forests, retain structural elements (e.g., large snags and large green trees) throughout the various successional stages, and maintenance of riparian corridors will provide suitable roosting and foraging habitat for bats. Avoiding activities near talus slopes and developing buffers around caves and abandoned mines, and restricting human access to cave and mine entrances will minimize human impacts, and will also help preserve existing bat habitats. Bat species in the Planning Area would also benefit from management of Federal lands for the northern spotted owl, including retention of late-successional forests, riparian corridors, and buffering of caves and mines used by bats (USDA 1993).

3.5.2.5.3 California Wolverine

The last recorded sighting of California wolverine in the Planning Area was in 1983, although suitable habitat for this species is present. Wolverines exhibit a preference for edges between cover and forage areas similar to other species in Lifeform 5; although they den in areas similar to grizzly bears. Consequently, steps taken in the HCP to accommodate other wildlife groups will also benefit the wolverine. Also, regardless of the forest-management regime implemented, some edge will exist, providing foraging opportunities for wolverines. Moreover, the impact of the expected reduction in edge habitat on wolverines will be lessened to the extent that wolverines use high-elevation alpine (i.e., non-forested) habitat in the Planning Area, including open, park-like "subalpine" forests. The edge habitat and open areas will be affected less by implementation of the HCP than would lower and mid-elevation forests. Road-management efforts to provide secure habitat for grizzly bears will also meet the most important limiting factors for wolverines in the Planning Area, which are remoteness and protection from human disturbance and poaching.

3.5.2.5.4 Pacific Fisher

The current distribution of Pacific fishers is not known, but they may occur within the Planning Area. Recent sightings have been reported just outside the Planning Area. The species is always found in or near dense coniferous forests and mixed coniferous/deciduous forests with a continuous canopy cover, especially near wetlands and riparian zones. The primary limiting factor appears to be availability of denning sites in older, more complex, forest structural types. Den sites consist of "hollows" in live trees, snags, and logs. Habitat measures taken in the HCP to increase or maintain more advanced, forest structural classes (e.g., dispersal, mature forest, managed old growth, old growth) for spotted owls will benefit the fisher. Management practices proposed in the HCP to retain representative green trees, snags and downed logs in harvest units and to retain similar structural components in RHAs and wetlands will reduce impacts and adequately address the biological needs of this species by providing travel corridors, denning sites, canopy cover, and a prey base.

3.5.3 Associated Species (Lifeforms)

As a means of quantifying the habitat conditions used by species grouped into each of the Lifeforms, wildlife use patterns among the eight forest stand structural stages (Figures 46 through 48) and special habitats were tallied and summarized by decade in the Planning Area with current regulations (Table 31a) and implementation of the HCP (Tables 31b and 31c) (see Lundquist and Hicks 1995; Lundquist et al. 1995). An analysis of the stand structural stages within the forest classes (Jensen 1995) for the HCP is presented in Tables 32a and b. Plum Creek then determined the combination of forest stand structural stages that incorporate primary and secondary habitats for each of the species within each Lifeform. The effects of the HCP on wildlife species, named and unnamed, in the Planning Area were then evaluated in terms of primary and secondary habitats for each Lifeform for the Permit period.

The precision of Lifeform analysis is dependent upon the knowledge of biological requirements of each species, the flexibility of each species in its use of habitat types, and the level of detail available regarding habitat conditions in the Planning Area. Consequently, analyses can be expected to be precise for some species and Lifeforms (e.g., spotted owls and other late-successional species) but "coarse-grained" for other species or Lifeforms (e.g., Lifeform 6 and early-successional species or Lifeform 5 and talus-associated species).

Table 31a. Estimated Percentage of Each Structural Stage for the Entire Planning Area, Riparian Habitat Areas (RHAs), and Rocks and Talus Slopes, Under the No-Action Alternative Before the Land Exchange.

Habitat Area	1996		2006		2016		2026		2036		2045	
	PC[1]	HCP[2]	PC	HCP	PC	HCP	PC	HCP	PC	HCP	PC	HCP
HCP[3]												
Non Habitat	**8**	13	**8**	12	**8**	12	**8**	12	**8**	12	**8**	12
Stand Initiation	**6**	8	**17**	13	**10**	7	**8**	6	**8**	6	**8**	6
Shrub/Sapling	**5**	3	**3**	4	**4**	3	**1**	1	**2**	1	**1**	1
Young Forest	**29**	18	**24**	14	**21**	15	**14**	8	**5**	4	**6**	4
Pole Timber	**9**	5	**15**	9	**26**	17	**30**	21	**26**	17	**13**	9
Dispersal Forest	**19**	13	**16**	15	**17**	14	**25**	20	**36**	28	**44**	32
Mature Forest	**19**	26	**14**	21	**11**	19	**11**	19	**12**	19	**17**	22
Managed Old Growth	**4**	8	**2**	6	**2**	6	**2**	4	**2**	4	**1**	5
Old Growth	**1**	6	**1**	6	**1**	7	**1**	9	**1**	9	**2**	9
TOTAL	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100
RHAs[4]												
Non Habitat	**7**	14	**7**	24	**7**	24	**7**	24	**7**	24	**7**	24
Stand Initiation	**3**	6	**7**	5	**14**	3	**12**	3	**6**	2	**8**	2
Shrub/Sapling	**5**	1	**2**	2	**1**	2	**2**	0	**2**	0	**1**	0
Young Forest	**26**	10	**26**	8	**15**	7	**7**	2	**11**	2	**9**	2
Pole Timber	**9**	3	**12**	5	**21**	9	**30**	13	**28**	10	**23**	6
Dispersal Forest	**13**	12	**18**	14	**18**	14	**19**	16	**21**	18	**25**	20
Mature Forest	**29**	32	**22**	25	**18**	23	**18**	24	**19**	24	**21**	26
Managed Old Growth	**5**	12	**4**	8	**4**	8	**3**	6	**3**	7	**3**	7
Old Growth	**3**	10	**2**	9	**2**	10	**2**	12	**3**	13	**3**	13
TOTAL	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100
TALUS[5]												
Non Habitat	**53**	63	**53**	64	**53**	64	**53**	64	**53**	64	**53**	64
Stand Initiation	**3**	1	**9**	5	**12**	6	**12**	6	**9**	4	**4**	2
Shrub/Sapling	**1**	1	**0**	0	**1**	1	**1**	1	**4**	2	**3**	1
Young Forest	**3**	3	**3**	2	**7**	3	**10**	5	**4**	2	**7**	4
Pole Timber	**8**	3	**7**	5	**6**	5	**8**	6	**12**	7	**10**	6
Dispersal Forest	**23**	12	**21**	13	**15**	11	**10**	9	**11**	10	**15**	11
Mature Forest	**9**	12	**6**	7	**6**	6	**6**	6	**7**	7	**8**	8
Managed Old Growth	**0**	2	**1**	2	**0**	2	**0**	1	**0**	1	**0**	1
Old Growth	**0**	3	**0**	2	**0**	2	**0**	2	**0**	3	**0**	3
TOTAL	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100

NOTES:
[1] Percentage of ownership, Plum Creek Planning Area.
[2] Percentage of all ownerships in the HCP and wetlands.
[3] Search area within entire HCP Planning Area and wetlands.
[4] Search area within Riparian Habitat Areas and wetlands.
[5] Search area within Plum Creek's management units containing rock and talus slope areas.

Table 31b. Estimated Percentage of Each Structural Stage for the Entire Planning Area, Riparian Habitat Areas (RHAs), and Rocks and Talus Slopes. Post-Land Exchange. Escrow and Option Sections PC.

Habitat Area	1996		2006		2016		2026		2036		2045	
	PC[1]	HCP[2]	PC	HCP	PC	HCP	PC	HCP	PC	HCP	PC	HCP
HCP[3]												
Non Habitat	**5**	13	**5**	13	**5**	13	**5**	13	**5**	13	**5**	13
Stand Initiation	**3**	8	**9**	4	**9**	3	**8**	2	**8**	3	**9**	3
Shrub/Sapling	**8**	3	**14**	9	**9**	3	**5**	2	**4**	1	**5**	2
Young Forest	**40**	18	**38**	19	**27**	16	**17**	11	**12**	7	**10**	5
Pole Timber	**8**	5	**8**	6	**27**	15	**31**	15	**27**	14	**20**	10
Dispersal Forest	**13**	13	**11**	10	**10**	11	**21**	16	**30**	19	**35**	22
Mature Forest	**18**	26	**12**	21	**10**	20	**10**	20	**11**	21	**13**	21
Managed Old Growth	**3**	8	**2**	11	**2**	12	**2**	12	**2**	13	**2**	14
Old Growth	**2**	6	**1**	7	**1**	7	**1**	9	**1**	9	**1**	10
TOTAL	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100
RHAs[4]												
Non Habitat	**6**	14	**6**	14	**6**	14	**6**	14	**6**	14	**6**	14
Stand Initiation	**2**	6	**0**	1	**0**	0	**0**	0	**0**	0	**0**	0
Shrub/Sapling	**5**	1	**2**	5	**1**	0	**0**	0	**0**	0	**0**	0
Young Forest	**30**	10	**33**	7	**20**	10	**8**	8	**3**	3	**2**	1
Pole Timber	**11**	3	**9**	6	**21**	7	**26**	5	**21**	7	**15**	9
Dispersal Forest	**14**	12	**17**	10	**18**	10	**21**	11	**30**	12	**32**	10
Mature Forest	**25**	32	**26**	29	**27**	27	**31**	27	**31**	27	**36**	28
Managed Old Growth	**5**	12	**5**	17	**5**	19	**5**	19	**6**	21	**5**	22
Old Growth	**2**	10	**2**	11	**2**	13	**3**	16	**3**	16	**4**	16
TOTAL	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100
TALUS[5]												
Non Habitat	**48**	63	**48**	63	**48**	63	**48**	63	**48**	63	**48**	63
Stand Initiation	**0**	1	**4**	1	**8**	1	**1**	0	**2**	0	**1**	0
Shrub/Sapling	**1**	1	**12**	2	**11**	2	**7**	1	**1**	0	**2**	0
Young Forest	**7**	3	**6**	3	**13**	4	**18**	5	**12**	3	**5**	1
Pole Timber	**4**	3	**4**	3	**4**	3	**8**	3	**19**	5	**24**	5
Dispersal Forest	**24**	12	**17**	8	**9**	7	**9**	6	**9**	6	**11**	7
Mature Forest	**13**	12	**8**	15	**6**	15	**8**	16	**8**	15	**8**	15
Managed Old Growth	**0**	2	**0**	2	**0**	2	**0**	2	**0**	4	**0**	5
Old Growth	**3**	3	**1**	3	**1**	3	**1**	4	**1**	4	**1**	4
TOTAL	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100

NOTES:
[1] Percentage of ownership, Plum Creek Planning Area.
[2] Percentage of all ownerships in the HCP and wetlands.
[3] Search area within entire HCP Planning Area and wetlands.
[4] Search area within Riparian Habitat Areas and wetlands.
[5] Search area within Plum Creek's management units containing rock and talus slope areas.

Table 31c. Estimated Percentage of Each Structural Stage for the Entire Planning Area , Riparian Habitat Areas (RHAs), and Rocks and Talus Slopes. Post-Land Exchange. Escrow and Option Sections USFS.

Habitat Area	1996		2006		2016		2026		2036		2045	
	PC[1]	HCP[2]	PC	HCP	PC	HCP	PC	HCP	PC	HCP	PC	HCP
HCP[3]												
Non Habitat	**5**	13	**5**	13	**5**	13	**5**	13	**5**	13	**5**	13
Stand Initiation	**3**	8	**9**	4	**9**	3	**7**	2	**8**	3	**11**	3
Shrub/Sapling	**9**	3	**17**	9	**10**	3	**6**	2	**4**	1	**8**	3
Young Forest	**40**	18	**38**	20	**29**	17	**20**	11	**12**	7	**8**	4
Pole Timber	**8**	5	**8**	6	**27**	14	**31**	15	**30**	14	**22**	10
Dispersal Forest	**13**	13	**10**	10	**9**	11	**20**	16	**29**	19	**32**	22
Mature Forest	**17**	26	**10**	20	**8**	20	**8**	20	**9**	21	**11**	21
Managed Old Growth	**3**	8	**2**	11	**2**	12	**2**	12	**2**	13	**2**	14
Old Growth	**2**	6	**1**	7	**1**	7	**1**	9	**1**	9	**1**	10
TOTAL	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100
RHAs[4]												
Non Habitat	**6**	14	**6**	14	**6**	14	**6**	14	**6**	14	**6**	14
Stand Initiation	**3**	6	**0**	1	**0**	0	**0**	0	**0**	0	**0**	0
Shrub/Sapling	**7**	1	**2**	5	**1**	0	**0**	0	**0**	0	**0**	0
Young Forest	**33**	10	**37**	10	**21**	10	**8**	8	**3**	3	**3**	1
Pole Timber	**9**	3	**9**	6	**23**	8	**28**	6	**23**	8	**14**	9
Dispersal Forest	**12**	12	**15**	10	**16**	11	**21**	12	**30**	13	**34**	12
Mature Forest	**23**	32	**24**	28	**26**	27	**30**	28	**30**	27	**35**	28
Managed Old Growth	**5**	12	**5**	16	**5**	18	**5**	18	**5**	20	**4**	21
Old Growth	**2**	10	**2**	10	**2**	12	**2**	14	**3**	15	**4**	15
TOTAL	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100
TALUS[5]												
Non Habitat	**49**	63	**49**	63	**49**	63	**49**	63	**49**	63	**49**	63
Stand Initiation	**0**	1	**4**	1	**9**	1	**1**	0	**1**	0	**3**	0
Shrub/Sapling	**2**	1	**15**	3	**13**	2	**8**	1	**1**	0	**1**	0
Young Forest	**7**	3	**6**	3	**14**	4	**21**	5	**12**	3	**3**	1
Pole Timber	**4**	3	**3**	3	**3**	3	**8**	3	**24**	5	**28**	6
Dispersal Forest	**24**	12	**16**	7	**8**	6	**6**	6	**7**	6	**9**	6
Mature Forest	**11**	12	**6**	14	**3**	15	**6**	16	**5**	15	**6**	15
Managed Old Growth	**0**	2	**0**	3	**0**	3	**0**	2	**0**	4	**0**	5
Old Growth	**3**	3	**1**	3	**1**	3	**1**	4	**1**	4	**1**	4
TOTAL	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100	**100**	100

NOTES:
[1] Percentage of ownership, Plum Creek Planning Area.
[2] Percentage of all ownerships in the HCP and wetlands.
[3] Search area within entire HCP Planning Area and wetlands.
[4] Search area within Riparian Habitat Areas and wetlands.
[5] Search area within Plum Creek's management units containing rock and talus slope areas.

Table 32a. Projected Structural Stages of Major Forest Classes in the Planning Area by Stand Structural Changes for Years 1996, 2016, and 2045. Post-Land Exchange. Escrow and Options Sections PC.

HCP	
Forest Class	**Acreage**
DF-WH	93,092
NF-SF	66,720
NF/SF/SA	38,479
DF-GF	148,044
PP-LP	18,093
DECID	1,572
Non-forested	52,600
Total	**418,871**

HCP – Forest Classes

Structural Stage	DF-WH			NF-SF		
	1996	**2016**	**2045**	**1996**	**2016**	**2045**
Stand Initiation	13%	1%	1%	9%	11%	11%
Shrub/Sapling	0%	9%	4%	15%	1%	1%
Young Forest	23%	22%	7%	29%	27%	9%
Pole Timber	5%	22%	20%	5%	20%	16%
Dispersal Forest	22%	10%	26%	10%	8%	24%
Mature Forest	26%	26%	30%	19%	20%	25%
Managed Old Growth	1%	1%	2%	3%	3%	1%
Old Growth	10%	9%	9%	10%	10%	12%
Structural Stage	**NF/SF/SA**			**DF-GF**		
	1996	**2016**	**2045**	**1996**	**2016**	**2045**
Stand Initiation	7%	11%	11%	7%	0%	1%
Shrub/Sapling	7%	0%	1%	0%	3%	3%
Young Forest	22%	19%	4%	19%	14%	4%
Pole Timber	5%	10%	9%	4%	15%	6%
Dispersal Forest	12%	12%	19%	13%	14%	27%
Mature Forest	28%	18%	17%	36%	22%	22%
Managed Old Growth	13%	24%	23%	15%	24%	26%
Old Growth	6%	8%	16%	5%	8%	11%
Structural Stage	**PP-LP**			**DECID**		
	1996	**2016**	**2045**	**1996**	**2016**	**2045**
Stand Initiation	0%	2%	2%	8%	0%	0%
Shrub/Sapling	1%	0%	0%	0%	2%	1%
Young Forest	13%	7%	2%	6%	13%	2%
Pole Timber	19%	8%	5%	27%	13%	12%
Dispersal Forest	10%	24%	18%	25%	27%	21%
Mature Forest	41%	27%	29%	30%	43%	52%
Managed Old Growth	13%	27%	36%	3%	1%	12%
Old Growth	4%	5%	9%	0%	1%	1%

* Structural stage percentages are based on the total acreage with each forest class

Table 32b. Projected Structural Stages of Major Forest Classes in the Planning Area by Stand Structural Changes for Years 1996, 2016, and 2045. Post-Land Exchange. Escrow and Options Sections USFS.

HCP	
Forest Class	**Acreage**
DF-WH	93,074
NF-SF	66,734
NF/SF/SA	38,722
DF-GF	148,054
PP-LP	18,085
DECID	1,576
Non-forested	52,616
Total	**418,862**

HCP – Forest Classes						
Structural Stage	**DF-WH**			**NF-SF**		
	1996	**2016**	**2045**	**1996**	**2016**	**2045**
Stand Initiation	13%	1%	1%	9%	10%	11%
Shrub/Sapling	0%	9%	6%	15%	1%	1%
Young Forest	23%	22%	6%	29%	29%	8%
Pole Timber	5%	21%	21%	5%	19%	17%
Dispersal Forest	22%	10%	23%	10%	8%	24%
Mature Forest	26%	26%	30%	19%	20%	26%
Managed Old Growth	1%	1%	2%	3%	3%	1%
Old Growth	10%	9%	9%	10%	10%	12%
Structural Stage	**NF/SF/SA**			**DF-GF**		
	1996	**2016**	**2045**	**1996**	**2016**	**2045**
Stand Initiation	7%	9%	12%	7%	0%	1%
Shrub/Sapling	7%	0%	1%	0%	3%	2%
Young Forest	22%	19%	4%	19%	14%	4%
Pole Timber	5%	11%	8%	4%	15%	7%
Dispersal Forest	12%	12%	19%	13%	14%	27%
Mature Forest	28%	18%	17%	36%	22%	23%
Managed Old Growth	13%	24%	23%	15%	24%	27%
Old Growth	6%	8%	16%	5%	8%	11%
Structural Stage	**PP-LP**			**DECID**		
	1996	**2016**	**2045**	**1996**	**2016**	**2045**
Stand Initiation	0%	2%	2%	8%	0%	0%
Shrub/Sapling	1%	0%	1%	0%	2%	1%
Young Forest	13%	7%	2%	7%	12%	3%
Pole Timber	19%	9%	5%	27%	15%	11%
Dispersal Forest	10%	24%	18%	25%	28%	22%
Mature Forest	41%	27%	29%	28%	41%	50%
Managed Old Growth	13%	27%	36%	3%	1%	12%
Old Growth	4%	5%	9%	0%	1%	1%

* Structural stage percentages are based on the total acreage with each forest class

Descriptions of the Forest Classes (see Jensen 1995):

- **Douglas fir – Western Hemlock**: Forest stand of Douglas fir or Western hemlock that occurs on the West-side of the Cascades. Other species such as Grand fir, Engleman spruce, Western larch, Sitka spruce, Red cedar, Western white pine are minor components in Douglas fir stands. Mountain hemlock is included here but normally inhabits elevation higher that is typical of this Forest Class.
- **Noble Fir – Silver Fir**: Natural stands of dense Silver fir and Planted stands of Noble fir that occur at higher elevations on the West-side of the Cascades. Subalpine fir occurs as a minor component of this Forest Class.
- **Noble Fir – Silver Fir – Subalpine Fir**: Natural stands of dense silver fir and planted stands of noble fir that occur at higher elevations on the East-side of the Cascades. Subalpine fir occurs as a minor component.
- **Douglas fir – Grand Fir**: Areas dominated by Douglas fir but with grand fir as a secondary species on the East-side of the Cascades. This drier Forest Class is more susceptible to insect attack and fire. Western hemlock, Engleman spruce, Sitka spruce, Western larch, Red cedar, Mountain hemlock, and Western white pine may be included as minor components of stands or may be dominant in some stands. Soils and microclimate influence the distribution of tree species within this Forest Class.
- **Ponderosa Pine – Lodgepole Pine**: Arid transition zone dominated by Ponderosa pine. Fire frequency is high but usually of low intensity.
- **Deciduous**: Hardwood dominated stands that occur primarily in moist sites on the West-side of the Cascades and in isolated pockets on the East side.
- **Non-forested**: Areas that do not support commercial forests. They may be void of trees or unable to support a sustainable commercial forest crop (e.g., lakes, rock areas).

It is important to point out that a variety of wildlife species in the Planning Area use early successional forests as primary habitat for breeding and feeding (see Lundquist et al. 1995). In general, these species are opportunistic and mobile, are good dispersers, have high reproductive rates, and are able to persist in small patches of habitat that may occur naturally or as a result of a small-scale disturbance (Hunter 1990; Smith 1966). These small patches, which, for example, may occur only on the East-side of the Cascade crest, only in Ponderosa pine forests, or only at high elevations, are often difficult to identify across a broad landscape and may be underestimated. In addition, since these habitat patches are wide spread and represent only a very small portion of the Planning Area, it will be difficult to evaluate precisely, the potential impacts and trends for many wildlife species as a result of forest management throughout the Permit period. However, species in the "coarse-grained" group do not include threatened or endangered species or priority species.

3.5.3.1 Lifeform 1

Fish occupy Lifeform 1. Salmonids in the Planning Area are discussed in detail in Section 3.5.2.3. As mentioned in this section, meeting the habitat conditions for bull trout, rainbow/steelhead trout, coho salmon, and chinook salmon increases the quality and amount of usable habitat for all fish species.

3.5.3.2 Lifeform 2

Species in Lifeform 2 includes mostly amphibians. These species occupy wetland, pond, and stream habitats as primary breeding areas, and thus the use of a particular structural stage for breeding is generally conditional upon the presence of aquatic habitat. They also feed in a wide variety of structural stages.

The combined percentage of structural stages in RHAs considered as primary habitat is expected to increase over the Permit period, both on Plum Creek's land and on other ownerships. This increase in habitat is primarily due to the planned reduction in harvest activities near streams. Moreover, RHA protection of riparian corridors, as well as other stream protection measures identified from Watershed Analysis would minimize adverse impacts resulting from siltation, increased temperature, or other water quality effects. The forested cover within the riparian corridors would continue to act as a source of downed woody debris.

3.5.3.3 Lifeform 3

Species in Lifeform 3 include turtles, some reptiles, waterfowl, shorebirds, and some passerines. These species use aquatic and riparian habitats without particular association with a given structural stage. Only three species (out of 33 species included within this Lifeform) were considered to be associated with the surrounding forest (e.g., Western skink, common garter snake, and Pacific jumping mouse), and these tended to use secondary habitat more than primary habitat. However, all species in Lifeform 3 are dependent on riparian areas for feeding and breeding.

As was shown for Lifeform 2, the acreage of structural stages considered primary habitat (i.e., dispersal forest, mature forest, managed old growth, and old growth) for some species in Lifeform 3 is expected to increase over the Permit period, whereas, secondary habitat (i.e., stand initiation, shrub/sapling, young forest, and pole timber) is expected to decrease. Assignment of primary habitat was done to provide a conservative estimate of forest conditions that would provide the most stable aquatic environment upon which species in this Lifeform depend. Moreover, protection measures for the riparian zones and aquatic habitats would help provide for the needs of these species, regardless of the surrounding forest characteristics. Primary habitat for the species in the group associated with early structural stages (e.g., Pacific jumping mouse) is expected to decrease over the Permit period. These species may, therefore, be impacted as a result of the HCP.

3.5.3.4 Lifeform 4

Species of Lifeform 4 are those typically associated with cliffs, rims, and talus slopes, and include falcons and goats. These species use a variety of structural stages for breeding and feeding.

The total acreage of middle to late structural stages considered primary habitat within management units that include rock and talus slopes over the Permit period is expected to decrease slightly from about 32 percent to about 30 percent during the first 20 years, followed by an increase during the latter 30 years of the Permit period to about 36 percent in 2045. "Potentially suitable" habitat (i.e., the sum of primary and one-half of secondary habitat) remains relatively the same over the Permit period starting at 35 percent in 1996 and ending at 37 percent at 2045. Furthermore, the total acreage of rock and talus in the Planning Area would remain constant throughout the Permit period. Because a number of the species use a variety of structural stages as primary habitat, whereas, other species use mainly non-forested rock and cliff areas, the potential impacts of the HCP on these species is highly variable. However, guidelines for restricting operations and retaining forest habitat around talus slopes (Section 3.4.2) will reduce impacts on species in this Lifeform.

3.5.3.5 Lifeform 5

Lifeform 5 species breed and feed on the ground and include, for example, several reptiles, a variety of birds, big game, and hares. This Lifeform contains species that find primary breeding habitat in edges, logs, and some wetland or riparian areas. These species exhibit slightly greater primary use of early structural stages (i.e., from stand initiation to young forest), than later structural stages.

Based on "moving window" habitat analysis, the "suitable" habitat (e.g., edges) for species in Lifeform 5 is expected to increase slightly during the first 10 years of the Permit period from 88 percent to 89 percent, then decrease rather sharply during the last 40 years to about 64 percent (Figure 34). The reduction in edge habitat would reduce the potential suitability of the area for a number of species, such as deer and elk. However, there are species within this Lifeform that do not use edges as readily as others. The species that occupy earlier structural stages would be more likely to undergo a reduction in suitable habitat than those species that use primarily the middle or later stages.

Although there is a decrease in the amount of edge habitat expected by year 2045, it is expected that 64 percent of the area would be within a 0.5-mile radius of a distinct edge. This remains a substantial amount of habitat for Lifeform 5 species in the Planning Area. Road closures in selected areas will increase habitat availability for some Lifeform 5 species such as elk and deer, thereby decreasing their vulnerability to legal and illegal harvest.

3.5.3.6 Lifeform 6

Lifeform 6 includes species such as nighthawks, poorwills, Townsend's solitaire, several warblers, Lincoln's sparrow, and the porcupine. The species within this Lifeform tend to use edge habitats, wetlands, and other aquatic habitats, with a propensity to use younger structural stages.

For the purposes of analysis, primary habitat was considered to include the percentage of management units in riparian and wet sites, occurring in the earlier structural stages (i.e., stand initiation, shrub/sapling, and young forest), whereas secondary habitat was the percentage of those units occurring in the later structural stages (i.e., pole timber through old growth).

Additional emphasis was placed upon the discussion of the impacts to this Lifeform to ensure that species within Lifeform 6 would be adequately addressed. The overall emphasis of the HCP is in many ways counter to the generalized habitat needs of Lifeform 6. The HCP strives to provide more mature forest adjacent to riparian and wetland areas to address species other than those in Lifeform 6. Because the projected amounts of primary habitat (i.e., SI, SS, YF within riparian and wetland areas) appears to decrease to low levels, the Services believed that a closer examination of the habitat needs of Lifeform 6 species was warranted.

Primary habitat (including stand initiation, shrub/sapling, and young forest) in RHAs for species in this Lifeform is expected to decrease sharply over the Permit period (Lundquist and Hicks 1995). The expected decrease is due to the modeled reduction in timber harvest activity anticipated within RHAs across all ownerships in the Planning Area, as a result of management focused on other species (e.g., northern spotted owl), which requires retention of later structural stages of forest development. Although natural disturbance such as fire, blowdown, disease, flooding, and insect infestations could produce substantial acreage of Stand Initiation, Shrub/Sapling, and Young Forest stages, these stochastic events and the occurrence of yarding corridors were not modeled in the habitat analyses. Non-timbered areas (e.g., wet meadows) also were not considered in the modeling, although these areas may be used by many Lifeform 6 species. Consequently, estimated levels of primary habitat for Lifeform 6 species may have been underestimated in the analysis.

As might be expected, different species in this Lifeform may be affected differently over the Permit period. For example, species that find primary breeding habitat in early structural stages within riparian areas, such as common nighthawk and common poorwill would also use open forests (e.g., open Ponderosa pine forests) as well as talus slopes, and therefore, maybe less effected than predicted by the models. . Similarly, Wilson's warbler can use well-developed shrub layers in older structural stages and wet habitats, and should, therefore, continue to find suitable habitat during the Permit period. Other species, such as Lincoln's sparrow, are typically associated more with aquatic habitats than with specific structural stages, and protection of these areas would provide suitable habitat. The lone mammal in this group, the porcupine, occupies a wide variety of structural stages and can utilize rocks, talus, and wetlands to some degree; thus, this species would likely find a reasonable amount of suitable habitat throughout the Permit period.

Some species, such as Townsend's solitaire and Nashville warbler, are not necessarily associated with wetlands or other aquatic habitats and they will likely continue to use early structural stages outside of the riparian areas. Orange crowned warblers are commonly associated with young stands of most forest types, dense shrubby thickets, forest openings, and forest edges, and will likely continue to use early structural stages outside of the riparian areas. Townsend's solitaire may also be affected due to the anticipated reduction in edge habitat during the Permit period. During the Permit period, early-structural stages are expected to decrease throughout the Planning Area, though not as sharply as within the RHAs (Tables 31b and 31c). During the Permit period, early-structural stages are expected to decrease throughout the Planning Area, though not as sharply within the RHAs (Tables 31b and 31c). It should be noted that breeding bird populations will be monitored to evaluate actual habitat associations and trends in the Planning Area. Should any species associated with these stages appear to be affected from the cumulative effects of forest management by Plum Creek and the Forest Service, appropriate management options (e.g., controlled burns) for these species will be evaluated. Porcupines use older stands with younger trees as well.

3.5.3.7 Lifeform 7

Species in Lifeform 7 include hummingbirds, flycatchers, magpies, thrushes, some sparrows, blackbirds, cowbirds, and others. These species typically nest in bushes and feed on the ground, in the air, or in water. Lifeform 7 species use a variety of structural stages that include shrubs. These species are also associated commonly with wetlands and riparian areas.

Throughout the Permit period, the amount of primary habitat (shrub/sapling through dispersal forest) in RHAs for species in this Lifeform is expected to decrease on Plum Creek's land (i.e., from about 64 percent to about 50 percent; Lundquist and Hicks 1995). This pattern is similar but less pronounced throughout the entire Planning Area (i.e., a net decrease in primary habitat from 26 percent to 20 - 22 percent). Total potentially suitable habitat will decrease slightly on Plum Creek's lands, as well as across all ownerships. Therefore, species, such as calliope hummingbird, that find primary breeding habitat in the early to middle structural stages will likely be adversely affected to some degree under the HCP, but nevertheless, should remain adequately addressed. Those species typically associated with aquatic habitats, such as the green heron, will likely be less affected, because of the protection afforded to aquatic habitats. Invasive species, such as the brown-headed cowbird, which can make use of small openings, also will not likely be affected adversely by the HCP.

3.5.3.8 Lifeform 8

Lifeform 8 includes cuckoos, dusky flycatcher, bushtit, several warblers, and goldfinches. These species are similar to Lifeform 7 with respect to structural stage use, with greatest use of the shrub/sapling and young forest stages (none are known to breed in stand initiation stages). These also tend to be edge species.

The amount of primary habitat (shrub/sapling through pole timber stages) is expected to decrease throughout the Permit period, on both Plum Creek's land and throughout the Planning Area. The structural stages grouped as secondary habitat (mainly dispersal forest, mature forest, managed old growth, and old growth) is expected to increase over the Permit period. Therefore, availability of primary habitat for species such as the bushtit or American goldfinch, that breed mainly in early structural stages will decrease over the Permit period. Those species that can use a wider range of structural stages as primary habitat or are more typically associated with riparian or other aquatic habitats, such as dusky flycatcher, yellow warbler, and yellow-breasted chat, will not be as affected under the HCP. As a group, the species in Lifeform 8 occupy a wide range of structural stages, and riparian and aquatic areas as primary habitat. The total amount of potentially suitable habitat will decrease slightly across all ownerships in the Planning Area.

3.5.3.9 Lifeform 9

Species in Lifeform 9 include waxwings, American redstart, black-headed grosbeak, northern oriole, and house finch. These species collectively use a variety of structural stages for primary breeding habitat, with slightly greater use of the middle structural stages and no primary breeding use of stand initiation stages. In addition, four of the five species use edges for breeding (Lundquist and Hicks 1995).

The amount of primary habitat (i.e., the combined total of young forest, pole timber, and dispersal forest in riparian zones) is expected to decrease throughout the Permit period on Plum Creek's land, but across all ownerships in the Planning Area, primary habitat for these species will increase slightly in the middle of the Permit period, then decrease slightly to the end of the Permit period, resulting in an overall net decrease. Secondary habitat (i.e., mature forest through the later structural stages) will increase over the Permit period across all ownerships. Species that can use these stages as primary habitat, such as black-headed grosbeak and northern oriole, may benefit from increases in the later structural stages. On the other hand, habitat generalists, such as the house finch, to the extent that they occur in the Planning Area, will probably be relatively unaffected by shifts in primary or secondary habitat. To the extent that deciduous trees (where present) are retained in riparian zones, the collective needs of the species in this Lifeform, which nest primarily in deciduous trees, can be accommodated in the RHAs.

3.5.3.10 Lifeform 10

Species in Lifeform 10 include olive-sided flycatcher, Clark's nutcracker, kinglets, several warblers, Western tanager, crossbills, and Douglas's squirrel. These species tend to find primary breeding habitat in later structural stages of forest development and in later stages associated with forested wetlands, although these species may forage in a wider variety of stages.

The combination of middle to late structural stages considered primary habitat for species in this Lifeform is expected to increase over the Permit period, whereas secondary habitat (i.e., shrub/sapling and young forest) is expected to decrease. Overall, the total potentially suitable habitat for these species is expected to increase across all ownerships in the Planning Area. Thus, the needs of most of these species, which nest primarily in coniferous trees, will be accommodated under the HCP. Some species, such as the olive-sided flycatcher, which tends to occupy edge habitats, may be affected by the decrease in edge habitat expected throughout the Planning Area. However, as stated earlier, regardless of the forest-management strategy implemented, some edge habitat will always exist and provide foraging opportunities for the species in this Lifeform.

3.5.3.11 Lifeform 11

Species in Lifeform 11 include hawks, pigeons, doves, several flycatchers, jays, crows, ravens, robins, vireos, finches, and others. These species tend to find primary nesting habitat in the middle and later structural stages, although they may forage in a variety of stages.

As was shown for Lifeform 10, the total amount of structural stages considered primary habitat (i.e., pole timber through old growth) for species in Lifeform 11, which also nest in trees, is expected to increase across the Planning Area throughout the Permit period. Therefore, collectively, the needs of these species will be provided for under the HCP. This Lifeform includes a greater number of species than Lifeform 10, and the expected reduction in the total acreage of early structural stages may reduce at least a portion of the primary habitat (either nesting or foraging) for some species, such as the chipping sparrow or American robin.

3.5.3.12 Lifeform 12

Lifeform 12 includes bald eagle, osprey, great blue heron, red-tailed hawk, and two owl species. Most primary breeding use by these species occur in mature and old growth forests, although they may forage in a wide range of structural stages. Some species (e.g., great blue heron and osprey) are associated with aquatic habitats, particularly for foraging.

The total amount of primary habitat, which includes the later structural stages (i.e., from dispersal stages to old growth) in management units that include riparian areas, is expected to increase across the Planning Area throughout the Permit period. The total potentially suitable habitat also will increase throughout the Permit period. Thus, the RHAs will retain sufficient forest structure to serve as a source of large nest trees for species in this Lifeform. Primary foraging habitats in the earlier structural stages (e.g., stand initiation) for some species, such as great horned owls and red-tailed hawks, will decrease in the Planning Area. Nevertheless, because these species forage in a variety of structural stages, as well as special habitats, substantial foraging habitat will remain available throughout the Planning Area.

3.5.3.13 Lifeform 13

Species in Lifeform 13 excavate cavities in snags and defective live trees for nesting and are termed primary cavity nesters or cavity excavators. These species, primarily woodpeckers and nuthatches, find primary habitat in structural stages from pole stands to old growth, presumably where the primary forest elements used for breeding (i.e., snags) are most abundant or suitable. Although some may forage in earlier structural stages, nesting will not occur without snags of appropriate size and condition; some species are more adaptable than others in regard to snag attributes required for nesting.

Because of differing needs among the species for snags of suitable size, this Lifeform was partitioned into two subgroups, "13", and "13a". Primary habitat for Lifeform 13 was considered to be the later structural stages (i.e., dispersal forest through old growth). Secondary habitat includes young forest and pole timber and recently harvested areas.

Several species, including the pileated, white-headed, and Lewis" woodpeckers, were included in subgroup 13a. For purposes of evaluating habitat conditions through the Permit period, primary habitat for this group includes only mature forests, managed old growth, and old growth which have larger snags in densities sufficient to support these species. Secondary habitat includes young forest and pole timber (after 20 years), and stand initiation and shrub/sapling (after 10 years when stands with greater structural diversity (e.g., live and dead tress) are more dominant in the Planning Area (Table 15). These species are discussed in detail among those species with special State or Federal status in Lundquist et al. (1995). Plum Creek recognizes that the number and distribution of suitable snags and downed logs in forested stands across the landscape through time is a more important predictor of woodpecker habitat than is the amount and distribution of structural stages. Nevertheless, the primary habitats were thought to be those structural stages most conducive to providing snags of suitable size.

In terms of the structural stages most likely to provide habitat elements (i.e., snags for nesting and foraging) for woodpeckers and nuthatches, primary habitat is predicted to increase across all ownerships the Planning Area, throughout the Permit period, with a decrease during the first 20 years and a gradual recovery during the last 30 years. The stages comprising primary habitat for species in group 13a are expected to show a slight net decrease across all ownerships, throughout the Permit period (Lundquist et al. 1995). However, the number and distribution of suitable snags and downed logs in the forested stands throughout the Planning Area is a more important predictor of woodpecker habitat than is the amount and distribution of particular structural stages (Lundquist and Hicks 1995).

State Forest Practice Rules and Regulations in Western Washington (without benefit of the HCP) require retention of an average of at least three standing dead or defective live trees (greater than 12 inches DBH and greater than 10 feet tall), two live recruitment trees (greater than 10 inches DBH and greater than 30 feet tall), and two downed logs (greater than 12 inches at the smaller end, and greater than 20 feet long) per acre of harvest. In Eastern Washington only two standing dead or defective live trees are required. These retention levels could support woodpecker populations across the harvested areas at approximately 60 percent of the potential maximum population sizes (based on tables presented in Nietro et al. 1985), provided the snags are of suitable size (i.e., DBH and height) and decay stage for the species likely to occur in the Planning Area, and provided sufficient numbers of snags are recruited through the Permit period. A proportion of the snags retained would have to be substantially larger, and taller, than the minimum requirements to provide for the larger species, and the majority should be relatively "Hard" (i.e., earlier decay stages). Overall, the degree to which species' needs for snags are met would vary by the excavator species, structural stage, and forest type (Ohmann et al. 1994). These snag retention levels do not, however, account for the snags that may be needed by nuthatches, which excavate their own cavities at least part of the time, nor do they account for patchy species distributions that may occur among the forest vegetation types. For example, some species occur widely in East-side forests, whereas others may be restricted to a single forest type in the Planning Area, such as Ponderosa pine.

Recent analysis of snag levels on non-federal forested lands in Washington and Oregon (Ohmann et al. 1994) suggests that the required number of suitable snags for several species are not being met in all structural stages at or near maximum population levels under current and past Forest Practices Rules and Regulations. Moreover, this varies by forest type. For example, stands in the early structural stages (e.g., stand initiation, shrub/sapling and young forest) tend to provide relatively fewer snags for some woodpecker species than later stages, and Ponderosa pine was the least capable of providing required snag densities among the types analyzed (Ohmann et al. 1994). This largely reflected the relative lack of retention of snags and live trees using traditional silvicultural practices. Differences in the use of structural stages and requirements for specific habitat elements, underscores the importance of retaining large snags and live trees during harvesting operations, as provided for in the HCP, which exceeds those required under State Forest Practices Rules and Regulations, to provide current nesting habitat in early structural stages and to provide a source of future nesting habitat.

The RHAs and set-asides for the spotted owl on Plum Creek's lands, and in particular the retention of later structural stages on Forest Service lands, will continue to provide existing and potential future snags across the Planning Area. In addition, Plum Creek's intention to emphasize uneven-aged and partial harvest methods where feasible, leaving dominant and co-dominant trees following harvest operations (see Section 3.4.4), removal of the tops of live trees to create green snags, clumping leave trees along nonfish-bearing streams (DNR Type 5), and conducting experiments, where possible, to retain more snags while still meeting operational objectives, will enhance the capability of the Planning Area to provide nesting and foraging habitat for cavity excavators.

3.5.3.14 Lifeform 14

Species in Lifeform 14 includes bats, owls, bluebirds, and others. These species use cavities or hollows created by defect or the actions of other species. They tend to breed primarily in later structural stages of forest development, but utilize a somewhat wider variety of special habitat or features than the primary cavity nesters.

Based on the analysis of structural stages considered most likely to provide a source of snags and other forest elements for nesting and foraging for these species, "primary" habitat exhibits a similar trend as was shown for Lifeform 13 (Lundquist and Hicks 1995). Primary habitat is predicted to show a net increase in acreage on Plum Creek's lands, and across the entire Planning Area, with a decrease during the first 10 years of the Permit period, followed by an increase during the last 40 years. The trend in primary habitat for species in group "14a" was similar to that for group "13a" (Lundquist et al. 1995). If Plum Creek assumes that the snags provided for primary cavity nesters in the Planning Area will also provide for secondary nesters (see Raphael and White 1984), then the effects on those species in Lifeform 14 will be similar to effects discussed for species in Lifeform 13a. Although Plum Creek cannot assume that the snags retained would meet the needs of species that require large natural cavities, appropriate snags and defective live trees with natural cavities can be targeted in identifying trees to retain in each harvest unit. As mentioned previously, RHAs and set-asides for spotted owls on Plum Creek's lands, and RCAs retained on Forest Service lands, will enhance the capability of the Planning Area to provide nesting and foraging habitat for cavity-dwelling species, including secondary cavity-nesters.

3.5.3.15 Lifeform 15

Species in Lifeform 15 include shrews, moles, rodents, and some carnivores. They may use a wide variety of structural stages and special habitats or elements as primary breeding habitat.

Habitat analysis for Lifeform 15 involved evaluation of relative amounts of young, middle, and late structural stages throughout the Permit period. Young structural stages (i.e., stand initiation through young forest) are expected to become less prevalent through the Permit period, as a result of current stands in early stages developing into canopied stands, as well as the relatively low level of harvest assumed on Forest Service lands. The acreage of middle structural stages (i.e., pole timber and dispersal forest) is expected to increase during the Permit period. Late structural stages (i.e., mature stages through old growth stage) are expected to decrease slightly during the first 20 years of the Permit period on Plum Creek's lands, then gradually increase during the last 20 years, for a slight net decrease at the end of the Permit period (i.e., 2045). However, within the entire Planning Area, the acreage of late structural stages are expected to decrease during the first 10 years, then gradually increase during the remainder of the Permit period, for a slight net increase by the end of the Permit period.

Given the diversity of wildlife species in this Lifeform, it is reasonable to expect widely different responses among the species to changes in structural stages throughout the Permit period. For example, for species that find primary habitat in the early structural stages, such as the broad-footed and least moles, vagrant shrew, creeping and Townsend's vole, and the northern pocket gopher, primary habitat will become less prevalent, making the Planning Area generally less suitable for populations of these species. Species finding primary habitat mainly in the later structural stages, such as the shrew-mole, will be adversely impacted by reductions in these stages early in the Permit period, but may be relatively unaffected overall as more stands develop into the later structural stages, particularly on Federal lands. Species adapted to a wider range of structural stages, or whose primary habitat includes the middle stages, such as the masked and Trowbridge's shrews, ermine, and Townsend's chipmunk, will likewise be relatively unaffected (or perhaps, benefit) under the HCP, in terms of the available structural stages.

Lifeform 15 early habitat (Table 17) decreases from 29 percent of the Planning Area in 1996 to 10 percent in 2045 (Table 25). Although this represents a decrease from current amounts, it may still be substantially more than would occur under natural conditions. Some of the species in this category may experience population fluctuations or decreases from current levels. These species should be adequately addressed due to the continued provision of early-successional and nonforested habitat in the Planning Area. Other species in this category may have requirements which further limits their available habitat. For example, a species requiring early-successional habitat in the Douglas fir/Grand Fir zone (Tables 32a and 32b) may have much less habitat available than if it could use early-successional habitat in any forest type. Stand structures projected for the five coniferous forest types and for deciduous forest types indicate that early-successional habitat will continue to be available in all forest types, but may be decrease slightly through time.

3.5.3.16 Lifeform 16

Species in Lifeform 16 include the kingfisher, water shrews, river otter, beaver, and muskrat. These species are typically associated with aquatic habitats for breeding and/or feeding.

The maintenance of riparian and other aquatic habitats should provide for the needs of species in this Lifeform that are likely to occur in the Planning Area. The structural stages analyzed as “primary” habitat in riparian areas for species in this Lifeform are expected to increase across the Planning Area and throughout the Permit period. This will help maintain optimum conditions in the aquatic habitats. Actual occurrence and distribution of these species in the Planning Area is presumably more a function of the distribution of aquatic habitats with suitable characteristics, rather than the stand conditions in surrounding upland forests.

3.5.4 Forest Health

Forest health refers to the capability of forest stands to sustain productivity and withstand the destructive influences of fire, insects and disease. For Plum Creek and other forest resource managers in the Western United States, forest health is an important issue of economic and biological significance. In the Planning Area, fire disturbance and subsequent fire suppression and mistletoe infestations have created some of the current spotted owl habitat (Buchanan et al. 1993). These processes also pose the greatest future threat to wildlife habitat by increasing the probability of catastrophic fire (Oliver et al. 1995). A recent Forest Service ecosystem health assessment for East-side forests concluded that most future fires will be large-scale damaging events, and that outbreaks of conifer defoliating insects are currently more threatening to resources than in pre-settlement times (Everett et al. 1993). Additionally, forest health conditions can affect the vigor and merchantability of timber stands which potentially impact the economic value of the assets managed by Plum Creek. Consequently, forest health was considered in the selection and evaluation of the alternatives considered in the HCP. Silvicultural strategies used to address forest health may also affect the availability of habitat for listed and unlisted species on Plum Creek and Forest Service land in the Planning Area.

Plum Creek developed two models to evaluate and quantify the risks to forest health posed by the forest-management strategy. These models addressed the two most significant forest health issues affecting spotted owl habitat in the I-90 corridor: (1) fire risk and (2) spruce budworm (*Choristoneura occidentalis)* outbreaks. The models relate fire risk factors and insect infestation to forest inventory characteristics such as stand age, species composition and fuel loading. These risk factors are linked to the eight stand structural classes described in Section 2.3, thereby permitting Plum Creek to simultaneously evaluate wildlife habitat and forest health conditions under various alternatives at the stand and landscape level at various intervals during the Permit period.

3.5.4.1 Fire Susceptibility

The fire susceptibility model was based on "dead" fuel accumulation, fire potential, and other factors described in Oliver et al. (1995). An initial fuel loading estimate was generated for each tree species group, structural stage, and Fire Management Analysis Zone (FMAZ). Additional calculations were made to account for accumulations due to ingrowth over time and natural decomposition of fuel over the same time period. Implementation of the HCP, in conjunction with the Northwest Forest Plan, may substantially increase fuel loading in the Planning Area. Based on results obtained from the fire susceptibility model, Plum Creek estimated that in 1996, 15 percent of the Planning Area will contain 30 tons of fuel per acre, and by 2045 more than 34 percent of the Planning Area will be in this higher fuel loading condition (Figures 49 through 51).

3.5.4.2 Insect Susceptibility

A spruce budworm susceptibility model was adapted from an algorithm developed by Oliver et al. (1995). The model is driven primarily by the density of grand fir, Douglas fir and Engelmann spruce. Spruce budworm is primarily an East-side forest problem. For this reason, the model was applied to forest stands in FMAZ 2, 3 and 4. Implementation of the HCP will increase the percentage of the Planning Area, on the East-side of the Cascades, with a high susceptibility rating (index greater than 100) for spruce budworm outbreaks; increasing from 22 percent in 1996 to 31 percent in 2045 (Figures 52 through 54).

In summary, the diminishing role of prescribed and natural fire, combined with forest succession and retention of wildlife habitat components (e.g., snags and downed woody debris) will result in an increase in the susceptibility of future forest fires and spruce budworm infestations. The trend in fuel loading and insect risk can be expected to increase over the Permit period as a result of implementation of the HCP. Plum Creek intends to mitigate this trend by employing silvicultural practices such as pre-commercial and commercial thinning where practical. Thinning operations will maintain healthy, vigorous stands; reduce fuel loading; and increase the resistance of the forests to spruce budworm epidemics. Spotted owl FD habitat will be thinned in upland stands to enhance growth and increase resistance to forest health risks. Thinning regimes for spotted owl FD habitat are described in Section 2.4.

3.6 Mitigation Measures and Measurable Criteria for Determining Biological Success

Mitigation measures are actions taken by Plum Creek to minimize and avoid impacts to species addressed in the HCP. These actions include steps taken to develop the plan as well as actions proposed to monitor and address impacts after implementation of the plan. Mitigation in a multi-species, habitat-based plan is inextricably woven into the plan itself. The following constitute some basic elements of mitigation for issuance of a Permit for Plum Creek's Planning Area. A majority of these actions contribute directly to the biological success of the HCP and are quantifiable. They also constitute the measurable criteria (designated MC below) that Plum Creek will use to evaluate the biological success of the HCP.

3.6.1 Spotted Owl

1. **Habitat Mapping (MC) —** Development of a habitat classification system to identify and map nesting/roosting/foraging (NRF), foraging/dispersal (FD) habitat, and non-habitat in the 418,690 acre Planning Area; and continued mapping of habitat conditions throughout the Permit period.
2. **NRF Maintenance (MC) —**Plum Creek will maintain target percentages for NRF habitat for each decade of the Permit period (Tables 25b and 25c), and at a minimum, maintain 6 - 8 percent of its ownership in the Planning Area as NRF habitat.

3. **NRF Deferrals (MC) —** 1,100 - 1,900 acres of current NRF habitat will be deferred from harvest for at least 20 years near key spotted owl sites in the Planning Area (Section 3.2.1.1).
4. **FD Corridors (MC) —** 1,300 - 2,300 acres of current NRF and FD habitat will be retained as FD corridors to facilitate dispersal and linkage to additional habitat on PC and Federal lands (Section 3.2.1.1)
5. **Riparian Habitat Areas (MC) —** 3,100 – 3,700 acres of forestland adjacent to perennial streams will be maintained as spotted owl habitat (NRF or FD) during the Permit period.
6. **Model and Deferral Validation Surveys** — Plum Creek will conduct surveys in portions of the Planning Area to validate the RSPF model predictions of spotted owl habitat suitability during the Permit period and the effectiveness of deferrals at selected spotted owl sites. Survey methodology will be determined with the FWS.
7. **Prey Surveys —** Plum Creek will conduct surveys for spotted owl prey species in the dispersal forest and managed old growth structural stages which are designed to function as spotted owl habitat.
8. **Harvest Timing —** When entering owl sites to conduct harvesting operations, Plum Creek will consider prioritizing owl sites by first entering those stands with less biological value (i.e., unoccupied sites), and secondly, those stands furthest from an owl site center.
9. **Seasonal Protection** — Known sites with active spotted owl nests in the Planning Area will receive protection within a 0.25-mile radius from March 1 through August 31. (See U.S. Fish and Wildlife Service letter dated June 6, 1998; Appendix 1.)

3.6.2 Marbled Murrelet

10. **Murrelet Surveys (MC)** — Plum Creek conducted murrelet surveys on 853 acres in the Planning Area between 1994 and 1995. Additional surveys were completed during 1995 and 1996 on 257 acres identified in the original HCP. Thus, by the end of 1996, Plum Creek had completed surveys for murrelets on a total of 1,110 acres. Subsequent to the implementation of the HCP, additional access surveys were conducted during 1997 and 1998 on 362 acres. Another 1,082 acres were surveyed in 1999 and 2000 as a result of the I-90 Land Exchange. Since presence was detected on two of the Land Exchange parcels, not all the acres will have a second year of surveys. In total, 2,554 acres have been surveyed with varying levels of intensity and methods
11. **Murrelet Habitat Harvest Deferrals (MC) —** Timber harvest was deferred on the 257 acres in the Planning Area being surveyed in 1995 and 1996 until the surveys were completed. Harvest on lands to be surveyed after the land exchange were also deferred until the surveys were completed.
12. **Murrelet Nest Site Protection (MC) —** A portion of the best 500 acres surrounding stands occupied during Plum Creek's HCP-required surveys will be maintained for the duration of occupancy and a minimum of 5 years after abandonment, as determined by protocol surveys. Additional murrelet sites discovered by qualified surveyors during the Permit period in the Planning Area would be protected by deferring harvest in the stands within a 0.25-mile radius during the nesting season from March 1 to August 31.

3.6.3 Grizzly Bear

13. **Habitat Mapping/Assessment (MC) —** Road densities, hiding/thermal cover and forage/prey habitat were mapped to evaluate the quantity and quality of grizzly bear habitat on 115,462 acres

in the Planning Area; habitat will continue to be assessed and displayed throughout the Permit period.

14. **Phase I BMPs (MC) —** Upon approval of the HCP, Plum Creek will implement a series of Best Management Practices (BMPs) within the recovery zone in the I-90 Lakes Subunit to facilitate grizzly bear "recolonization" of the Planning Area. Phase I BMPs include road closures, road-density targets, visual screening, and firearm prohibitions for Company personnel and contractors.

15. **Phase II BMPs (MC) —** Upon confirmation of grizzly bear residency in the Planning Area, Phase II will be implemented to reduce potential for death and displacement of resident bears. Phase II BMPs include additional road closures, retention of cover in harvest units, and seasonal timing restrictions on forest-management operations.

3.6.4 Gray Wolf

16. **Den Site Protection (MC) —** Guidelines will be implemented to reduce operations which may disturb wolves and Plum Creek will defer harvest which may alter habitat around den sites in the Planning Area.

3.6.5 Other Species

17. **Goshawk Nest Protection (MC) —** Plum Creek will defer harvest of 101 - 262 acres of habitat currently supporting goshawk sites on Plum Creek's land, for at least 20 years (Section 3.5.2.4). Known sites with active goshawk nests in the Planning Area will receive protection within a 0.25-mile radius from March 1 through August 31.

18. **Bald Eagle Management Plans —** Plum Creek will develop cooperative site management plans with the Washington Department of Fish and Wildlife for bald eagle nest sites which may occur in the Planning Area and in proximity to Plum Creek's ownership during the Permit period.

19. **Peregrine Falcon Protection Plans —** Plum Creek will implement steps outlined in the Pacific States Peregrine Falcon Recovery Plan to address forest-management activities near peregrine falcon nests which may occur on or near Plum Creek's lands during the Permit period.

3.6.6 Lifeform Management

20. **Forest Stand Structure Classification —** Plum Creek developed a stand level classification system which integrates timber inventory parameters with wildlife habitat components for 8 structural classes, ranging from stand initiation to old growth forests.

21. **Structural Stage Diversity (MC) —** Plum Creek will maintain a diversity of forest structural stages on its lands in the Planning Area through the Permit period to provide primary and secondary habitat for 16 Lifeforms (Tables 26b and 26c).

22. **Breeding Bird Surveys —** Plum Creek will conduct breeding bird surveys at designated intervals during the Permit period to verify associations of various Lifeforms to stand structural classes developed for the HCP.

23. **Amphibian Surveys —** Plum Creek will conduct amphibian surveys at designated intervals during the Permit period to evaluate the success of riparian management practices in providing habitat and protecting conditions for amphibians.

3.6.7 Riparian Management

24. **Ecological Classification —** Plum Creek has completed a hierarchical ecological classification of the Planning Area which incorporates geomorphology and hydrologic data necessary for watershed analysis (Jensen 1995; Section 2.1).

25. **Watershed Analysis (MC) —** Watershed analysis will be accelerated in 17 watersheds in the Planning Area and evaluations, subject to SEPA review, will be submitted up to 10 years following issuance of the Permit. In the Green River subbasin, watershed analysis has been completed for all units except the North Fork of the Green. Until the analysis is completed for that area, and when it is appropriate, existing watershed analysis prescriptions will be used in locations comparable to locations already analyzed.

26. **Riparian Habitat Areas (MC) —** 4,900 - 6,200 acres of forest adjacent to perennial streams have been placed in RHAs on Plum Creek's lands in the Planning Area. The minimum and interim widths and restrictions are as follows:

    (a) **In Federal LSRs and AMAs:** 200-foot RHA on fish-bearing streams with 30-foot, no-harvest zone; 100-foot RHAs on perennial, nonfish-bearing streams up to 5,000 feet elevation; a 30-foot, no-equipment zone and an additional 100-feet RHA for "sensitive reaches"; and 25-foot RLTAs on nonfish-bearing streams above 5,000 feet elevation.

    (b) **Outside of Federal LSRs and AMAs:** 200-foot RHAs on fish-bearing streams with 30-foot no-harvest zone; and 25-foot RLTAs on perennial, nonfish-bearing streams for at least 2,000 feet from the junction with a fish-bearing stream.

    (c) **All RHAs:** Harvest in RHAs will be limited to 50 percent volume removal with the remaining volume managed as spotted owl habitat.

27. **303 (d) Harvest Deferrals (MC) —** Harvest will be deferred on 667 acres of riparian forest adjacent to stream segments listed as water quality limited until completion of watershed analysis. Subsequent additions to listed streams since approval of the HCP have been in areas where watershed analysis has been completed.

28. **Aquatic Resources Monitoring —** Stream reaches in key watersheds on Plum Creek land have been identified to evaluate aquatic habitat conditions and fish populations at periodic intervals over the Permit period.

3.6.8 Special Habitats

29. **Wetlands —** Wetland management zones and operational restrictions have been specified for 1,320 acres of forestlands adjacent to wetlands on Plum Creek ownership in the Planning Area.

30. **Snags/Snag Recruitment Trees —** State requirements for snag and green tree retention on Westside forests will be extended to the entire Planning Area to support Lifeforms dependent upon dead and defective trees for breeding and feeding habitat. The requirements are three snags and three green trees per acre harvested.

31. **Talus Slopes —** Large green trees and snags will be retained within 100 feet of talus slopes to maintain shade and habitat for wildlife species associated with talus slopes. Operational restrictions around talus slopes will also be implemented.

32. **Caves —** Forested buffers will be left for a minimum of 100 feet from cave entrances to protect bats and other species of wildlife. Site-specific analysis would follow in cooperation with the Services.

3.6.9 Road Management

33. **Minimizing Road Building —** Plum Creek will reduce road construction where economically and operationally possible by using other harvesting systems (e.g., cable yarding, helicopters).

34. **Closures/Abandonment —** Plum Creek will close or abandon ("decommission") roads where feasible to address watershed concerns and habitat requirements for grizzly bears, wolves and other species included in the HCP.

3.6.10 Other Measures

35. **Forest Inventory —** Plum Creek will revise its inventory procedures to incorporate measurement of wildlife habitat characteristics (e.g., snags, structural class) necessary to evaluate and monitor success of the HCP. The inventory schedule will be accelerated in the Planning Area to obtain more precise information on more acres of company ownership.

36. **Environmental Principles —** Plum Creek will continue to employ its Environmental Principles (Appendix 2) as amended from time to time to address aesthetic and environmental issues in the Planning Area. Implementation of the Environmental Principles typically involves implementing practices in excess of State Forest Practices Rules and Regulations.

37. **Employee/Contractor Training —** To facilitate implementation of the HCP, Plum Creek will conduct training programs for all professional foresters, engineers, scientists, and contractors. The program will train all employees and contractors involved in forest management in state-of-the-art techniques to integrate the management of all forest resources, and familiarize them with the details of the HCP along with the Company's plans, policies, and programs to implement the HCP. A "field manual" will be distributed which will summarize the mitigation implemented in the field and will provide specific instruction or directions on measurement criteria. The manual will be updated as necessary as changes in methodology are made in response to the need for clarification or improvements.

38. **Monitoring and Reporting —** Plum Creek will monitor key criteria annually for the Permit period and provide reports to the Services at years: 2, 5, 10, 15, 20, 30, 40, and 50. Reports also will be provided at 10-year intervals during Phase II.

3.7 Issuance Criteria

When deciding whether to issue a section 10(a) permit for the incidental taking of federally listed species, the FWS must consider six issuance criteria provided for under section 10(a)(2)(B) of the ESA and under Federal regulation [50 CFR 17.22(b)(2) and 17.32(b)(2)]. If Plum Creek submits a conservation plan that meets the criteria in section 10(a)(2)(A) of the ESA, together with other supporting documents required by the ESA or by regulation, the FWS must issue the permit if it finds that the following criteria are satisfied:

1. **The taking will be incidental —** All timber harvests conducted by Plum Creek under the HCP will be in compliance with local, State, and Federal laws and regulations governing the management of forested lands, and therefore, will constitute "otherwise lawful activities" as required by section 10(a)(1)(B) of the ESA. If any impacts occur to the spotted owl, marbled murrelet, grizzly bear, gray wolf, or other wildlife species included in the HCP, such impacts will be incidental to the otherwise lawful activity of timber harvesting and will not be the purpose of the harvesting.

2. **The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking —** Plum Creek's HCP includes detailed prescriptive measures that will adequately address, minimize, and mitigate the impacts from incidental take of spotted owls, marbled murrelets, grizzly bears, gray wolves, and other wildlife species in the Planning Area. Significant impacts to the local, regional, and rangewide populations of listed and unlisted species, as well as other wildlife species are not anticipated, and the beneficial effects of the proposed conservation program will contribute significantly to forest health and provide a dynamic mosaic of habitat types for a wide range of wildlife species. As discussed in Section 3.0, impacts will be minimized by: Plum Creek's Riparian Management Strategy, and species protection plans; by protecting habitat and deferring harvesting activities adjacent to productive spotted owl nest sites; by maintaining NRF and dispersal habitat in RHAs; and by incorporating a dispersal habitat management strategy to allow spotted owls and other wildlife species to disperse across Plum Creek's lands to the habitat available in LSRs and AMAs on Forest Service lands.

3. **The applicant will ensure that adequate funding for the HCP and procedures to deal with unforeseen circumstances will be provided** — As required under the ESA, Plum Creek will fund implementation of the HCP and monitoring and implementation of the proposed mitigation program. The Implementation Agreement (IA) sets forth Plum Creek's financial responsibility and commitment to meet funding obligations during the 50-year Permit period. Plum Creek Timber Company and its subsidiaries own, manage, and operate more than 7.9 million acres of timberlands in 19 states and 9 wood product conversion facilities in Montana and Idaho. Due to its history and stable financial condition, Plum Creek has the resources to adequately fund implementation of the HCP. The Company's net income in 1998 exceeded $75 million on net revenues of $699 million, and in 1999, net income exceeded $125 million on net revenues of $759 million (Plum Creek Timber Company, L.P., Annual Report, 1993 and 1994). The operating costs associated with implementation of the HCP are expected not to exceed $1 million annually, which is less than 1 percent of current annual operating income. Measures necessary to adequately address unforeseen circumstances are set forth in Section 8.0 in the IA (Appendix 10).

4. **The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild —** Prior to issuance of an incidental take permit, the Services must determine, through a section 7 consultation, that the incidental take will not "jeopardize" the continued existence of any of the listed species in the Planning Area. Plum Creek's HCP has been specifically designed to be consistent with the goals and objectives outlined in the final draft Recovery Plan for the Northern Spotted Owl (Lujan et al. 1992b), and the Northwest Forest Plan. A major consideration of both plans is to maintain and protect suitable habitat for spotted owls and other wildlife species, and to supplement NRF and dispersal habitat to ensure the unimpeded movement of spotted owls throughout the I-90 corridor.

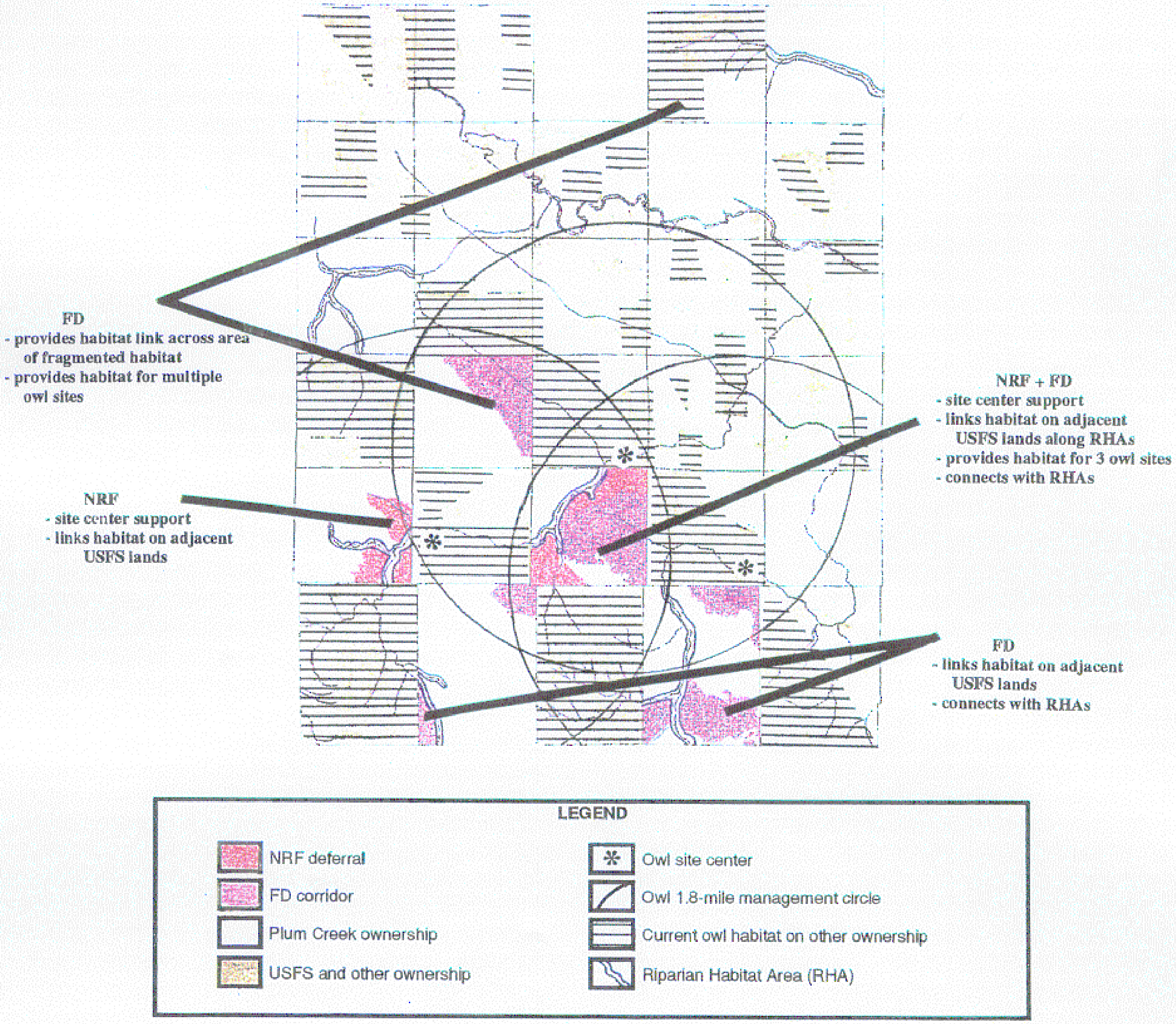
5. By providing harvest modification strategies and habitat deferrals, maintenance and protection of RHAs, and dispersal habitat, the HCP will protect fish habitat, facilitate connectivity among and between DCAs, and provide opportunities for spotted owls and other wildlife species to disperse successfully across Plum Creek's lands to habitat on adjacent Forest Service lands, thereby contributing to the survival and recovery of the section 10(a) Permit Species, and other fish and wildlife species in the Planning Area.

6. **The applicant will ensure that other measures that the Services may require as being necessary or appropriate will be provided** — In addition to the HCP, Plum Creek and the Services will sign the accompanying IA, which defines the roles and responsibilities of each party and provides a common understanding of the actions that will be undertaken for the conservation

of the subject listed and unlisted species and their habitats during the Permit period. No additional measures have identified by the Services as being necessary or appropriate.

7. **The Services have received such other assurances as may be required that the HCP will be implemented** — None beyond those previously listed in the HCP.

FIGURE 33. Schematic diagram illustrating the placement and function of NRF deferrals and FD corridors for spotted owls in the HCP Planning Area.



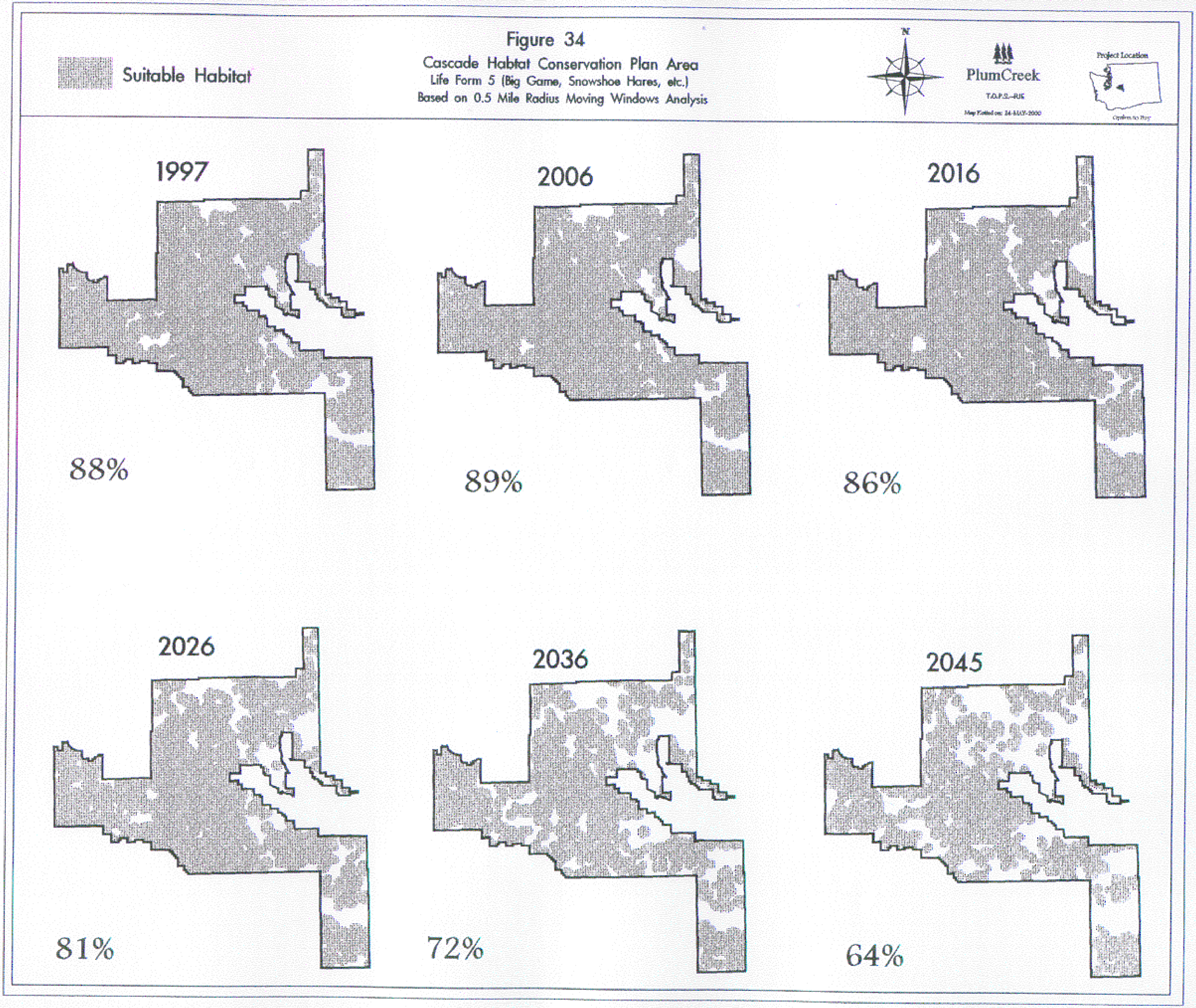


Figure 34
Cascade Habitat Conservation Plan Area
Life Form 5 (Big Game, Snowshoe Hares, etc.)
Based on 0.5 Mile Radius Moving Windows Analysis

FIGURE 35

Generalized curves indicating percent of riparian ecological functions and processes occurring within varying distances from the edge of a forest stand (USDA 1993).

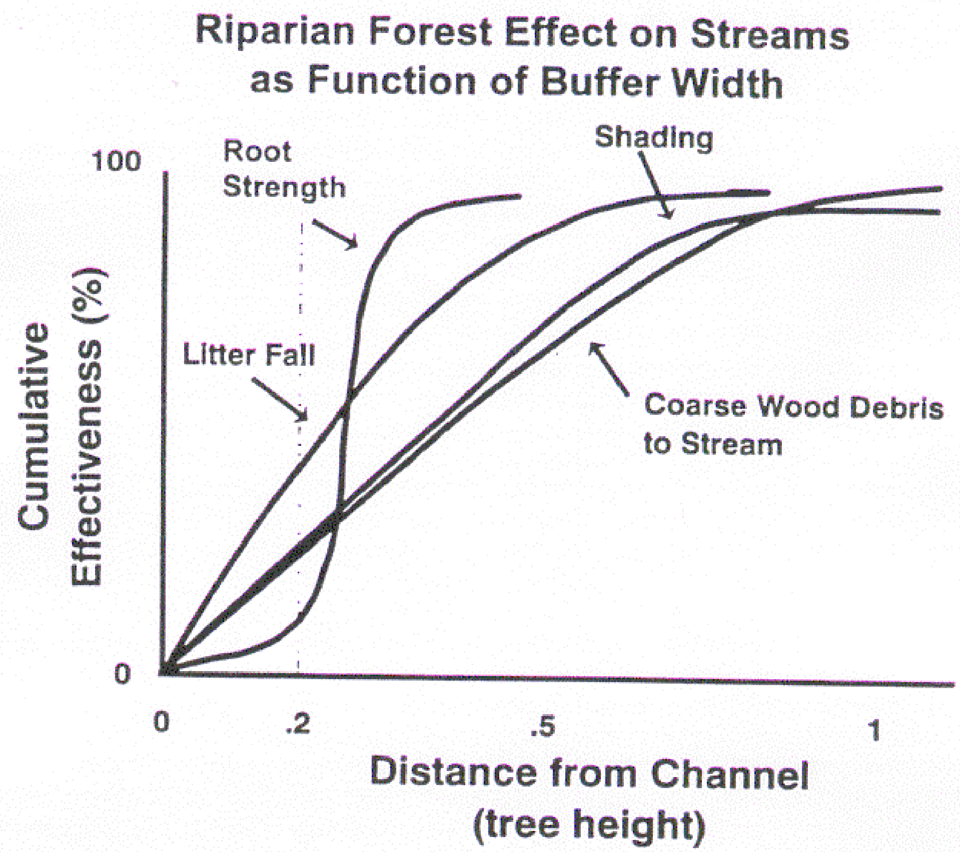


FIGURE 36

Cascade Habitat Conservation Area
Spotted Owl Habitat
1996

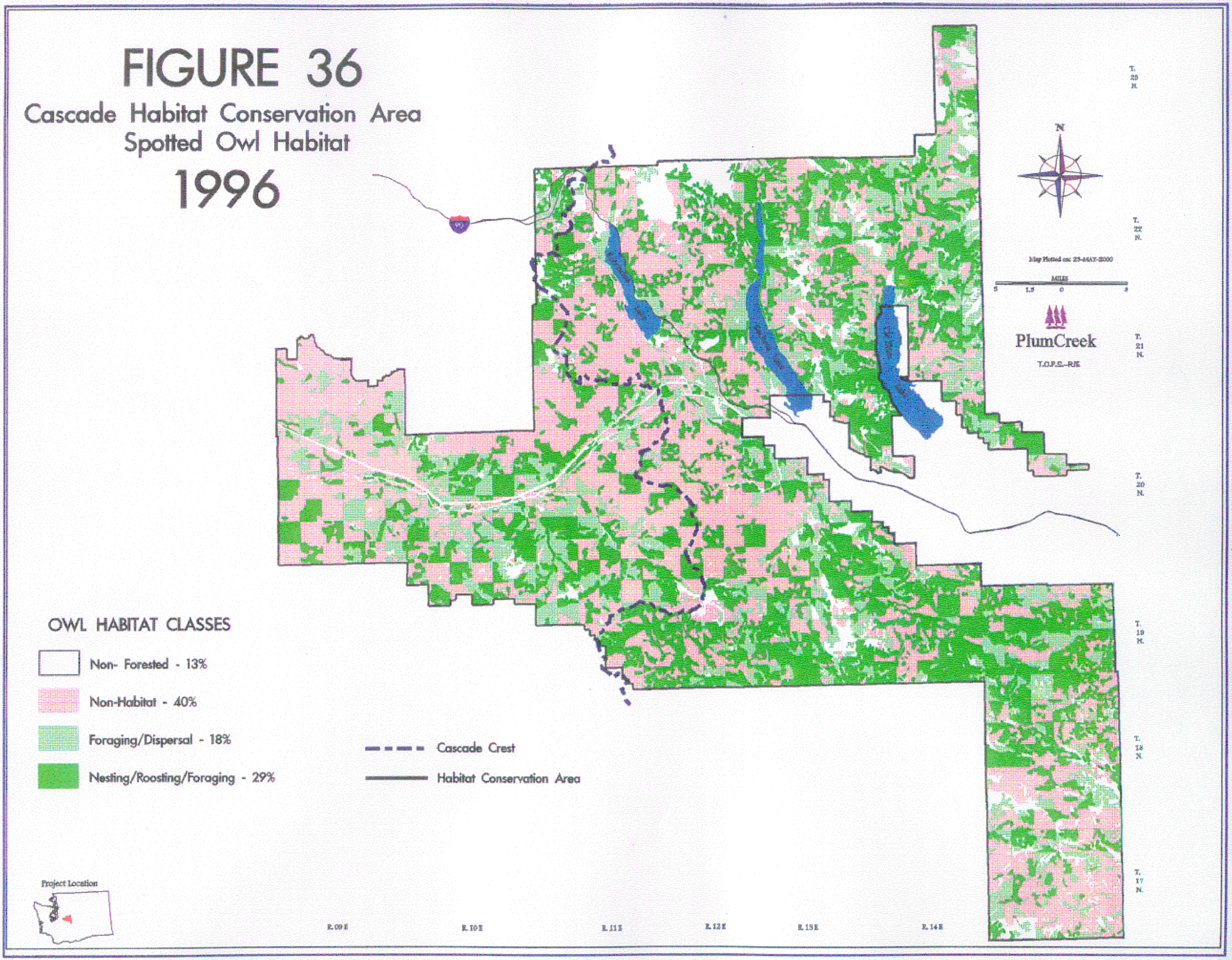


FIGURE 37

Cascade Habitat Conservation Area
Spotted Owl Habitat
2016

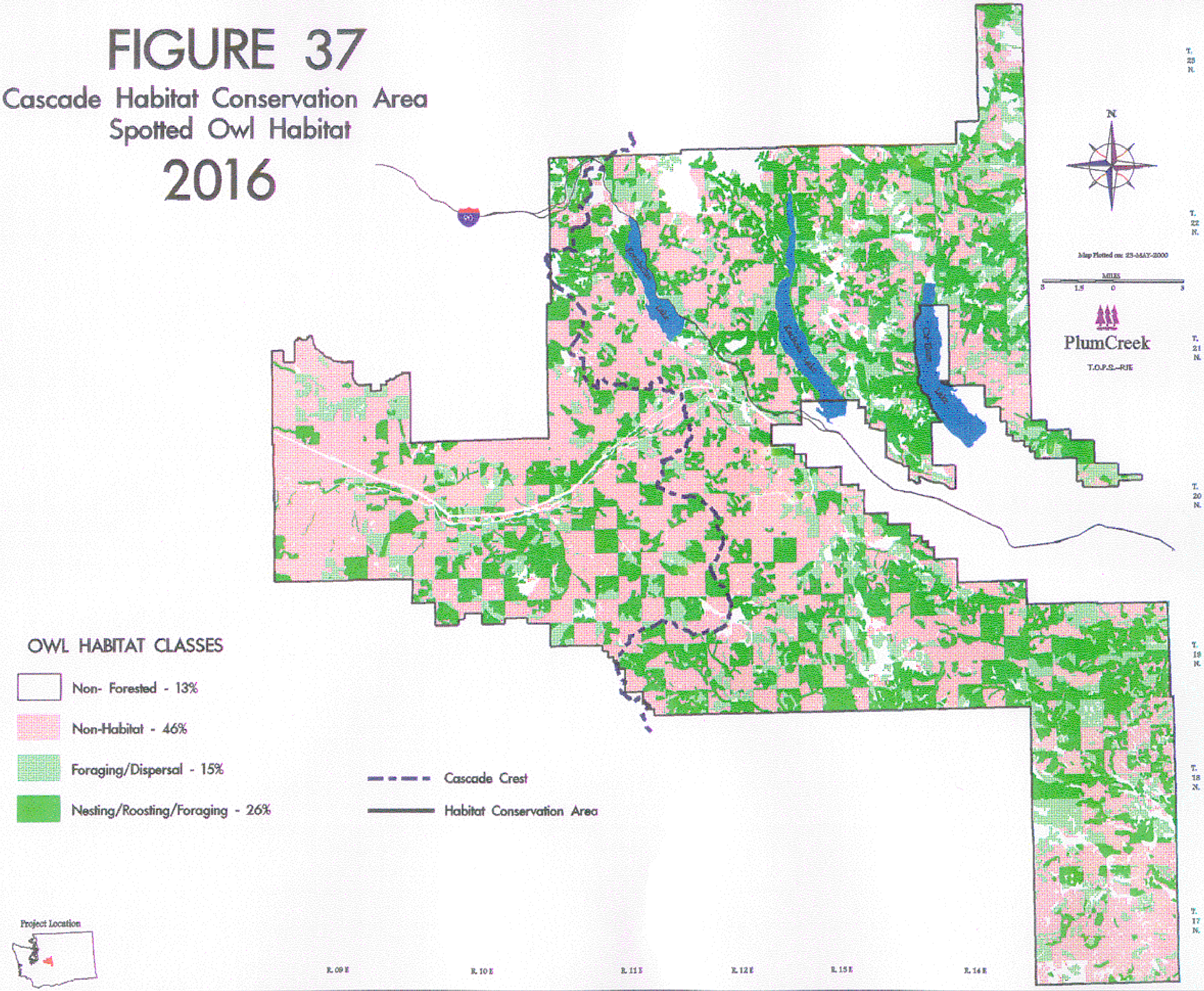


FIGURE 38
Cascade Habitat Conservation Area
Spotted Owl Habitat
2045

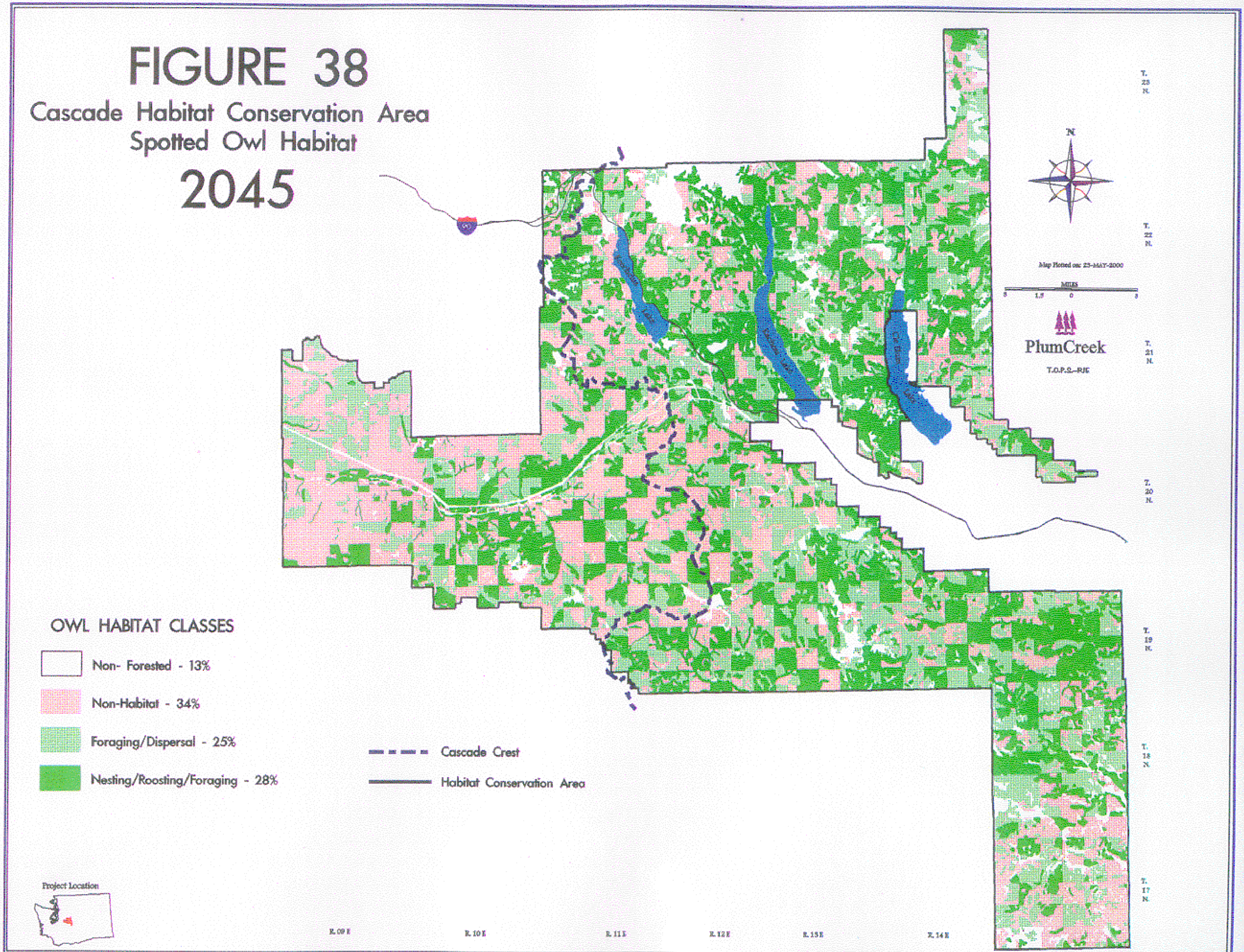
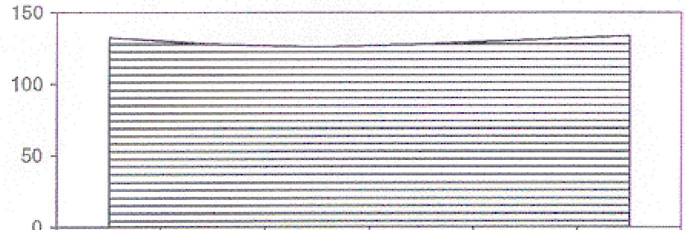


FIGURE 39

Carrying Capacity for Spotted Owls in the Cascades HCP Planning Area

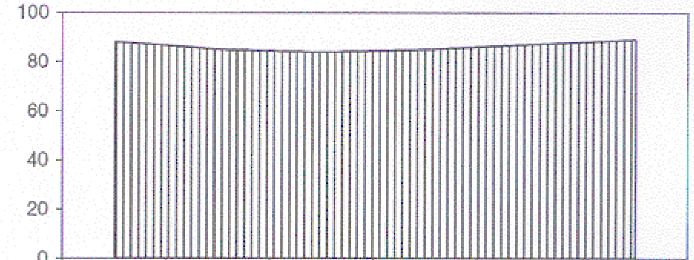
HABITAT CONSERVATION PLAN

Owl Sites in the Planning Area and Surrounding 2 Mile Buffer



	1996	2006	2016	2026	2036	2045
# of Owls	132	128	126	128	131	134

Owl Pair Sites in the Planning Area Only



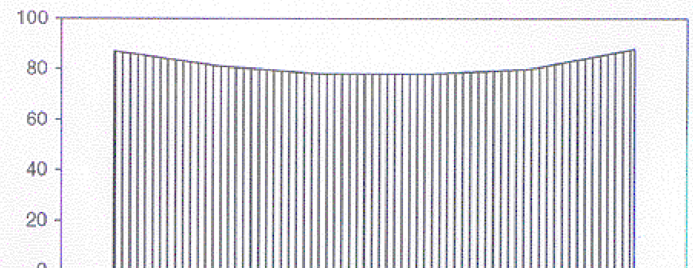
	1996	2006	2016	2026	2036	2045
# of Owls	88	85	84	85	87	89

CURRENT REGULATIONS ALTERNATIVE

Owl Sites in the Planning Area and Surrounding 2 Mile Buffer

	1996	2006	2016	2026	2036	2045
# of Owls	130	122	117	117	120	132

Owl Pair Sites in the Planning Area Only



	1996	2006	2016	2026	2036	2045
# of Owls	87	81	78	78	80	88

FIGURE 40

Cascade Habitat Conservation Area
Spotted Owl Pair Nest Site Probability
1996

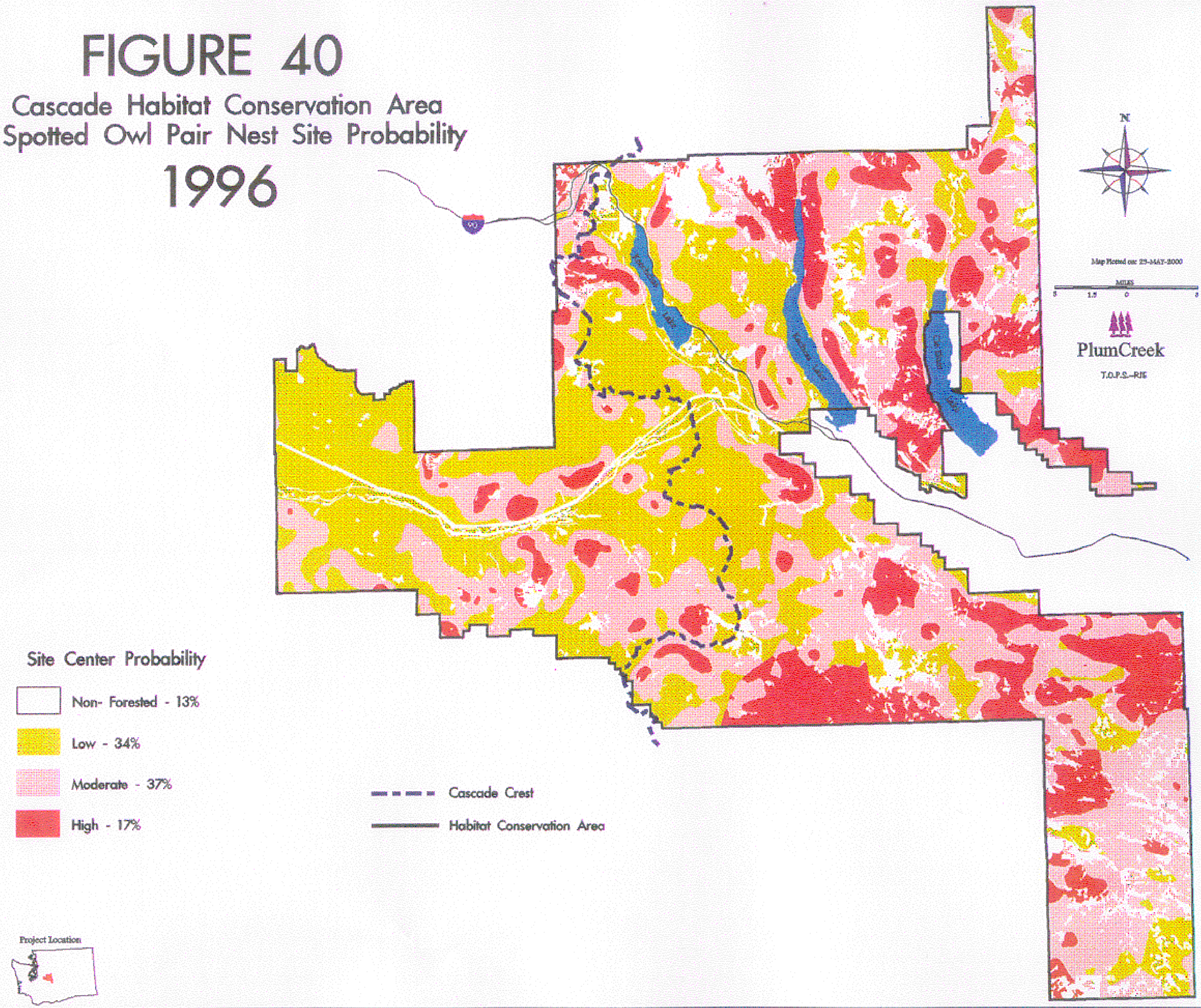
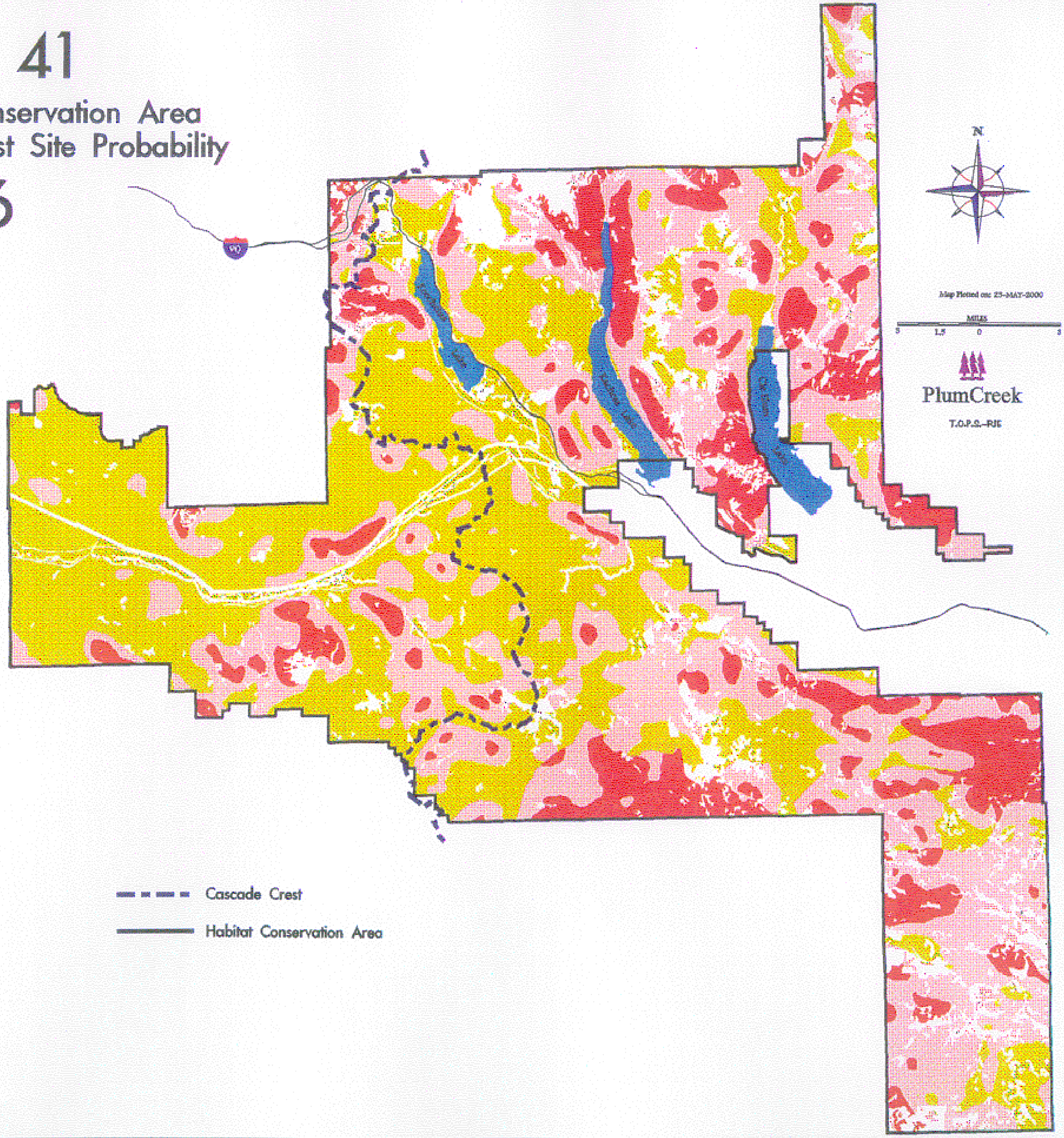


FIGURE 41

Cascade Habitat Conservation Area
Spotted Owl Pair Nest Site Probability
2016



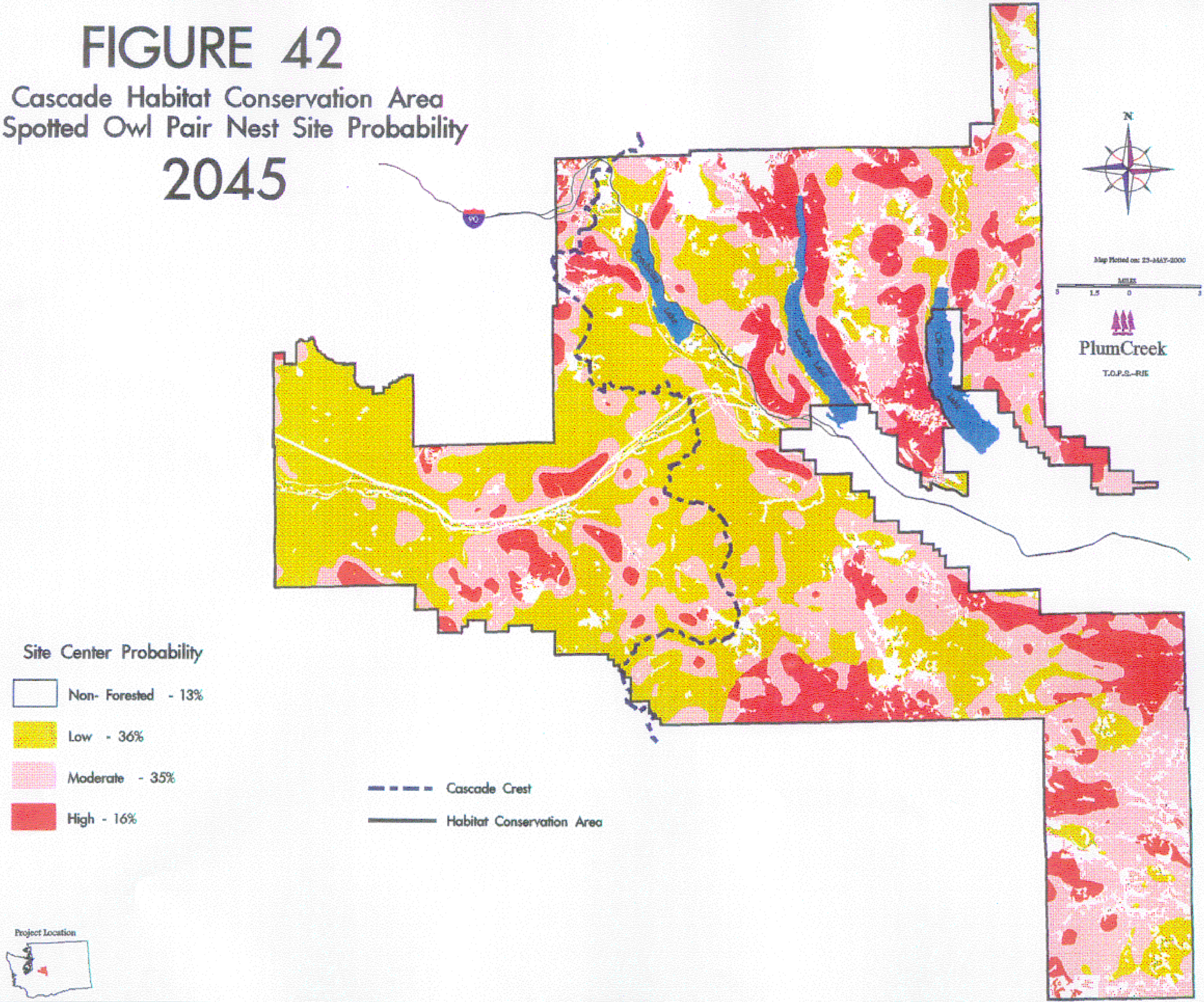
Site Center Probability

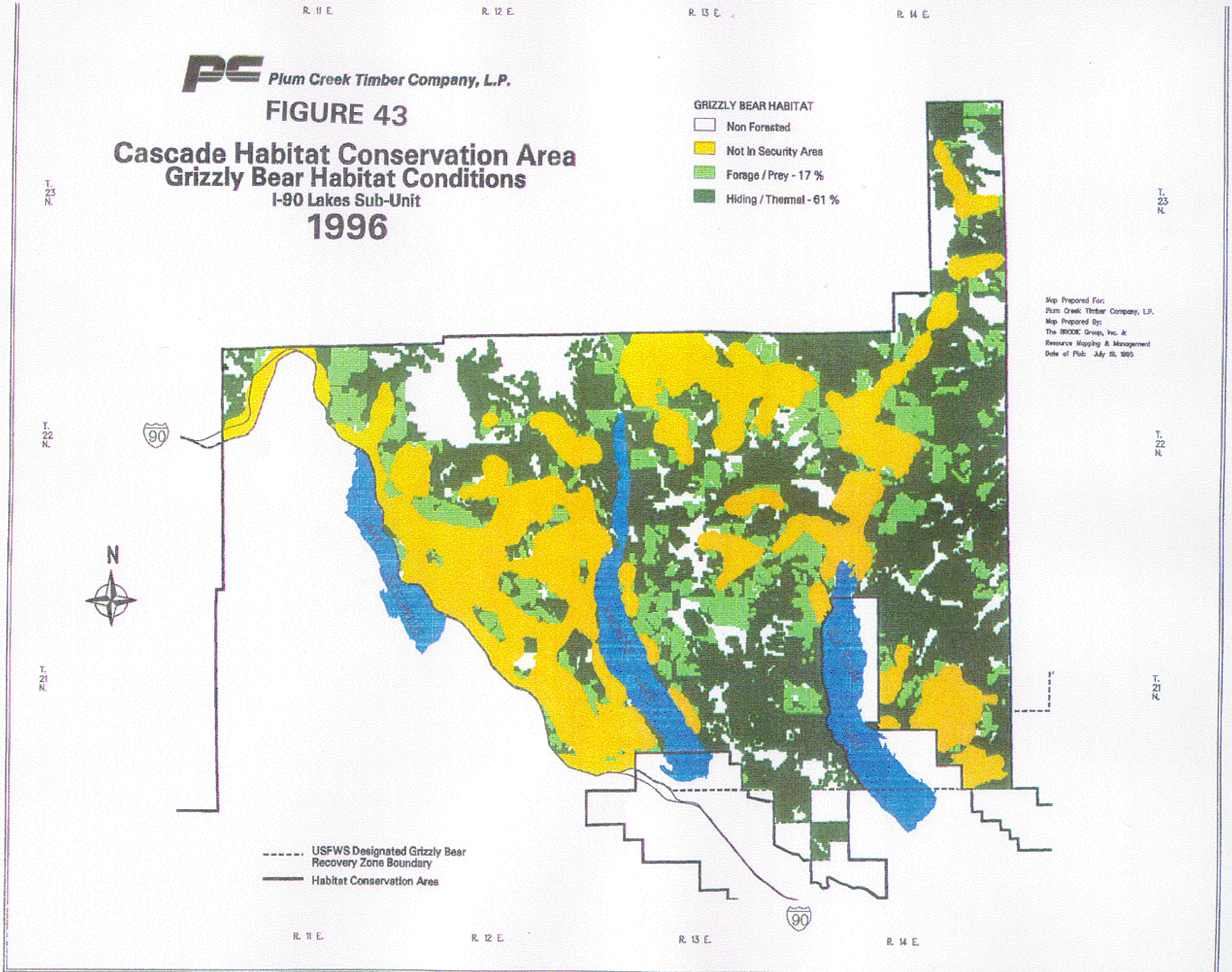
- Non- Forested - 13%
- Low - 38%
- Moderate - 35%
- High - 14%

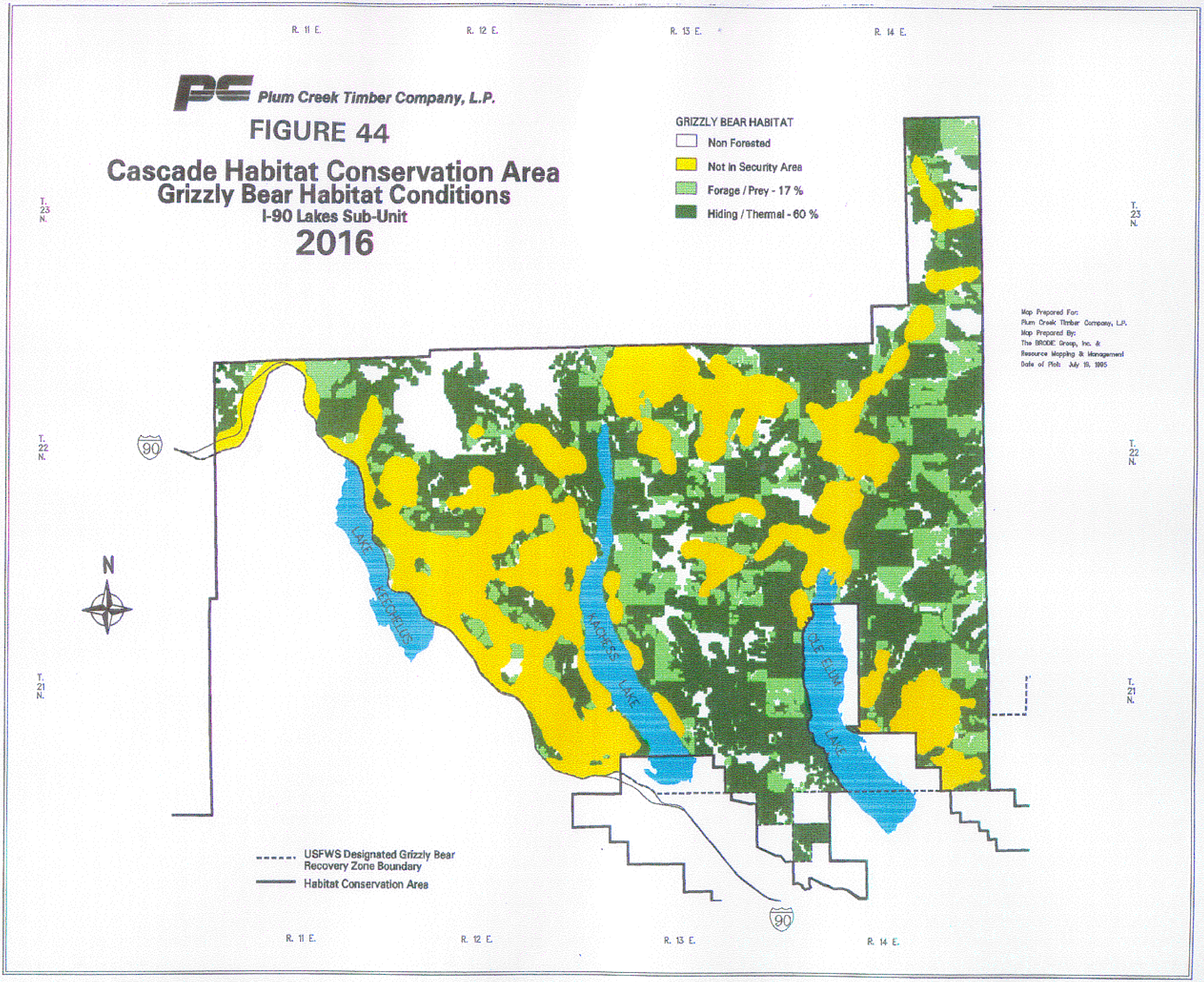
- Cascade Crest
- Habitat Conservation Area

FIGURE 42

Cascade Habitat Conservation Area
Spotted Owl Pair Nest Site Probability
2045




Plum Creek Timber Company, L.P.
FIGURE 43
Cascade Habitat Conservation Area
Grizzly Bear Habitat Conditions
I-90 Lakes Sub-Unit
1996
GRIZZLY BEAR HABITAT
Non Forested
Not In Security Area
Forage / Prey - 17 %
Hiding / Thermal - 61 %
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
T. 23 N.
T. 22 N.
T. 21 N.
90
N
Map Prepared For:
Plum Creek Timber Company, L.P.
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
USFWS Designated Grizzly Bear Recovery Zone Boundary
Habitat Conservation Area



R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
Plum Creek Timber Company, L.P.
FIGURE 44
Cascade Habitat Conservation Area
Grizzly Bear Habitat Conditions
I-90 Lakes Sub-Unit
2016
GRIZZLY BEAR HABITAT
Non Forested
Not In Security Area
Forage / Prey - 17 %
Hiding / Thermal - 60 %
T. 23 N.
T. 22 N.
T. 21 N.
Map Prepared For:
Plum Creek Timber Company, L.P.
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
Date of Plot: July 19, 1995
90
N
LAKE KEECHELUS
KACHESS LAKE
CLE ELUM LAKE
USFWS Designated Grizzly Bear Recovery Zone Boundary
Habitat Conservation Area

Plum Creek Timber Company, L.P.

FIGURE 45

Cascade Habitat Conservation Area
Grizzly Bear Habitat Conditions
I-90 Lakes Sub-Unit
2045

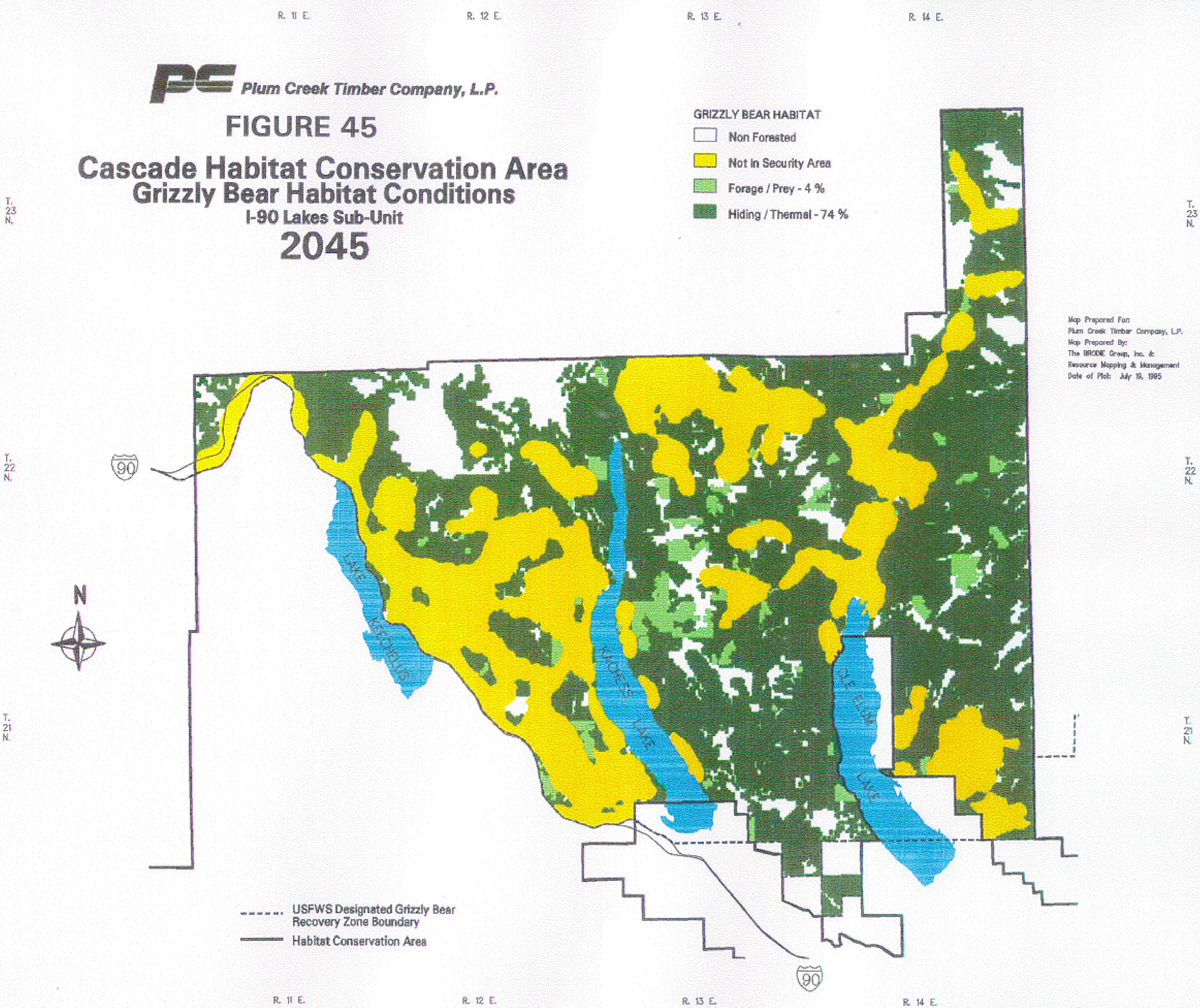
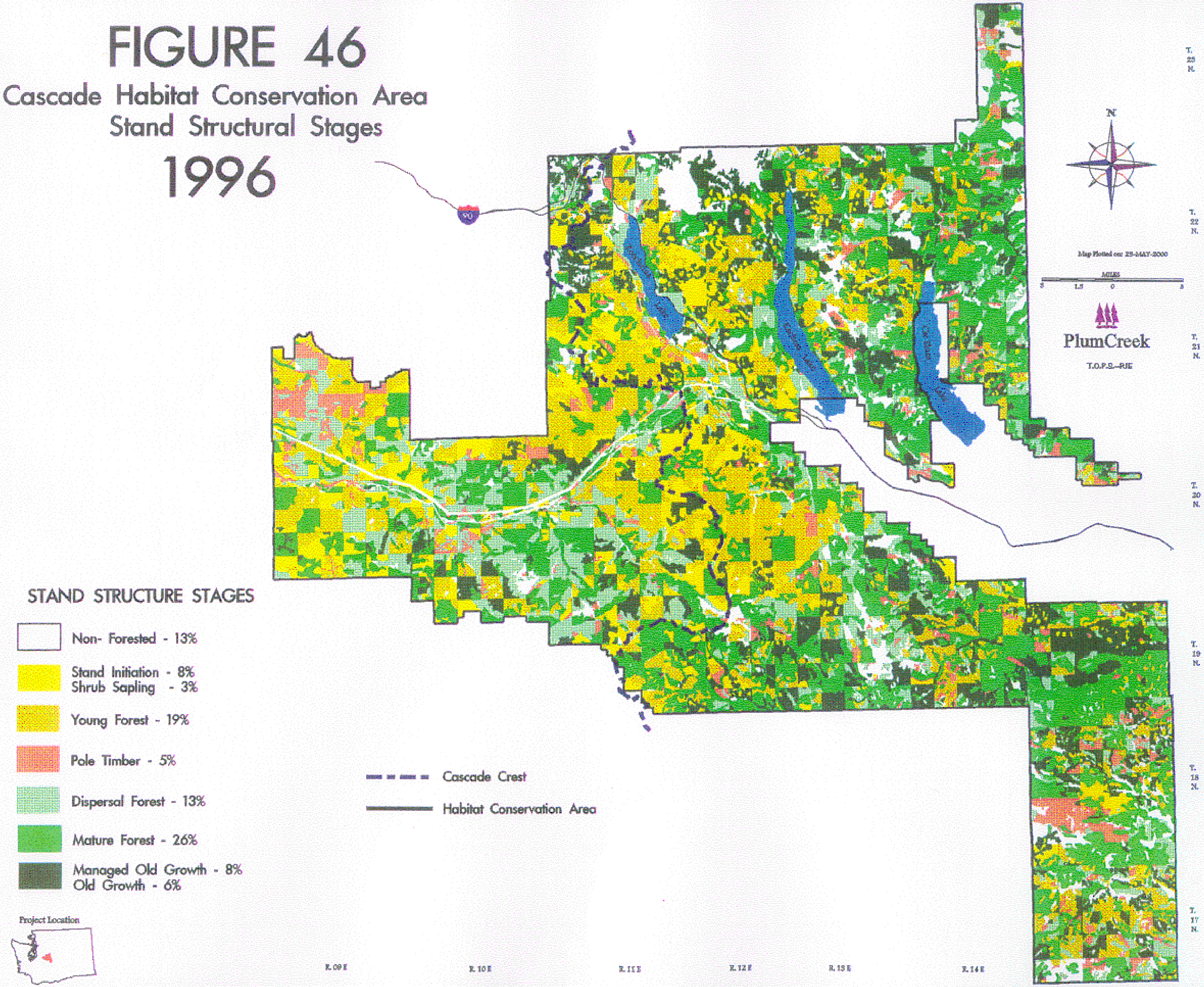


FIGURE 46
Cascade Habitat Conservation Area
Stand Structural Stages
1996



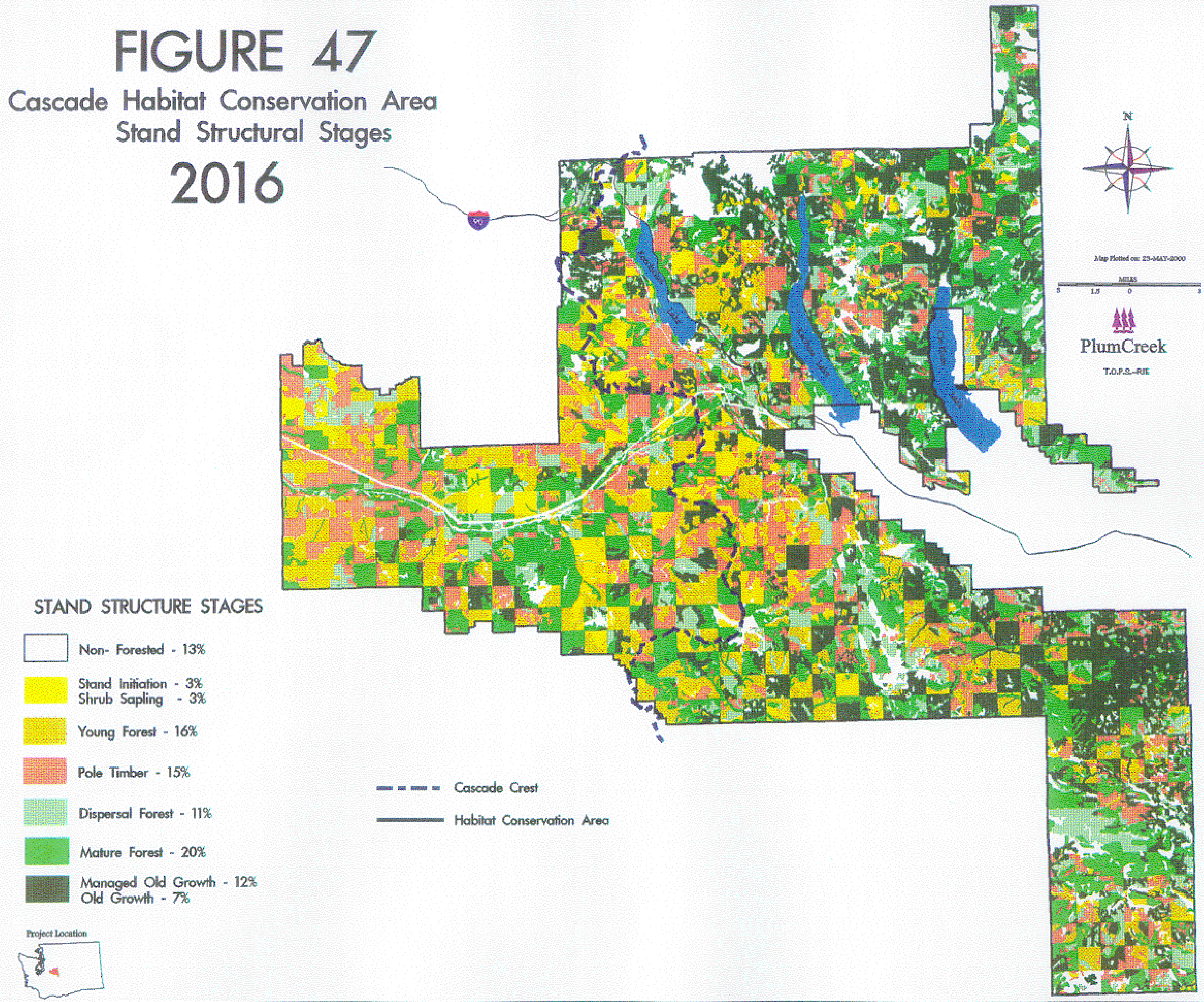
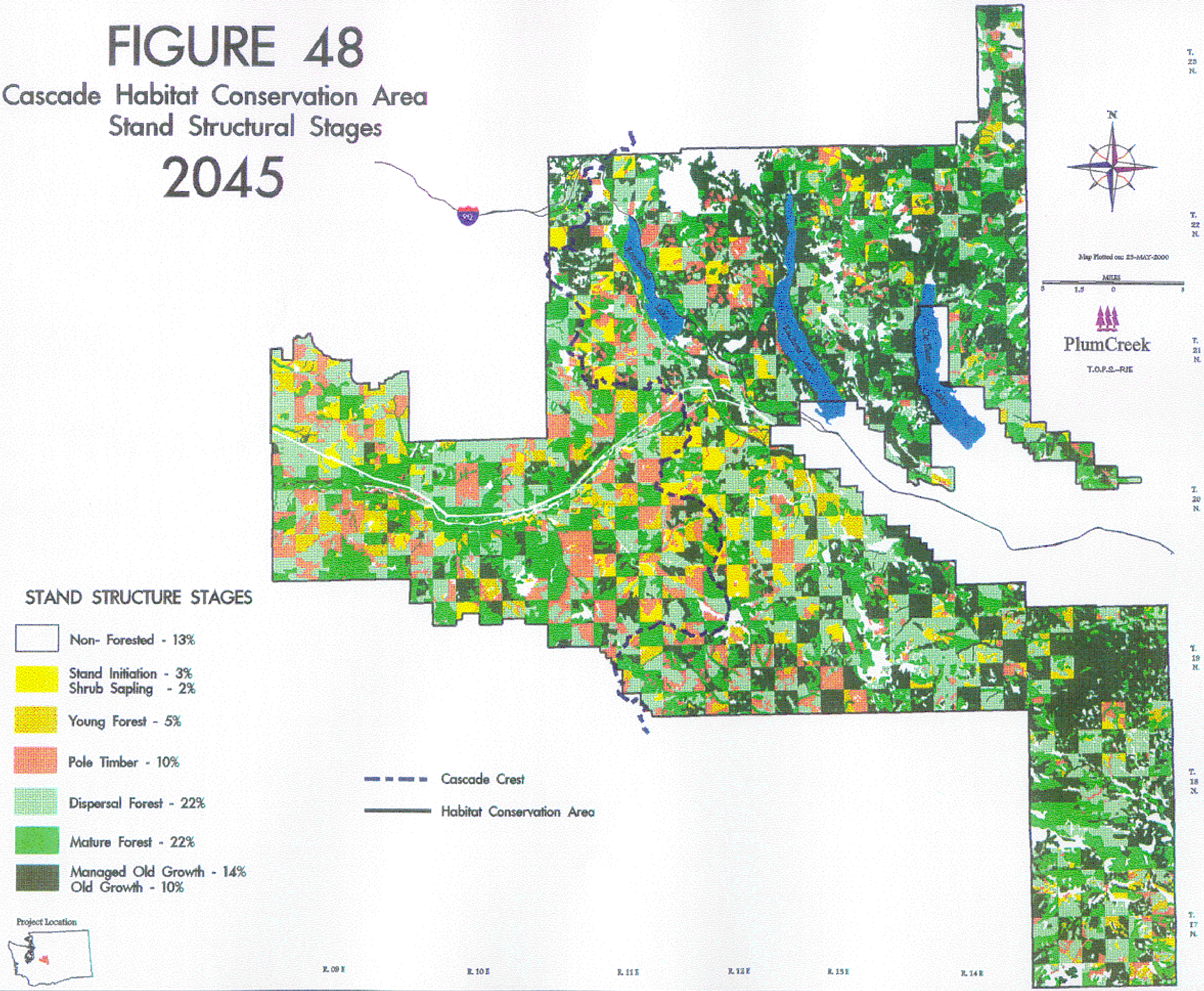
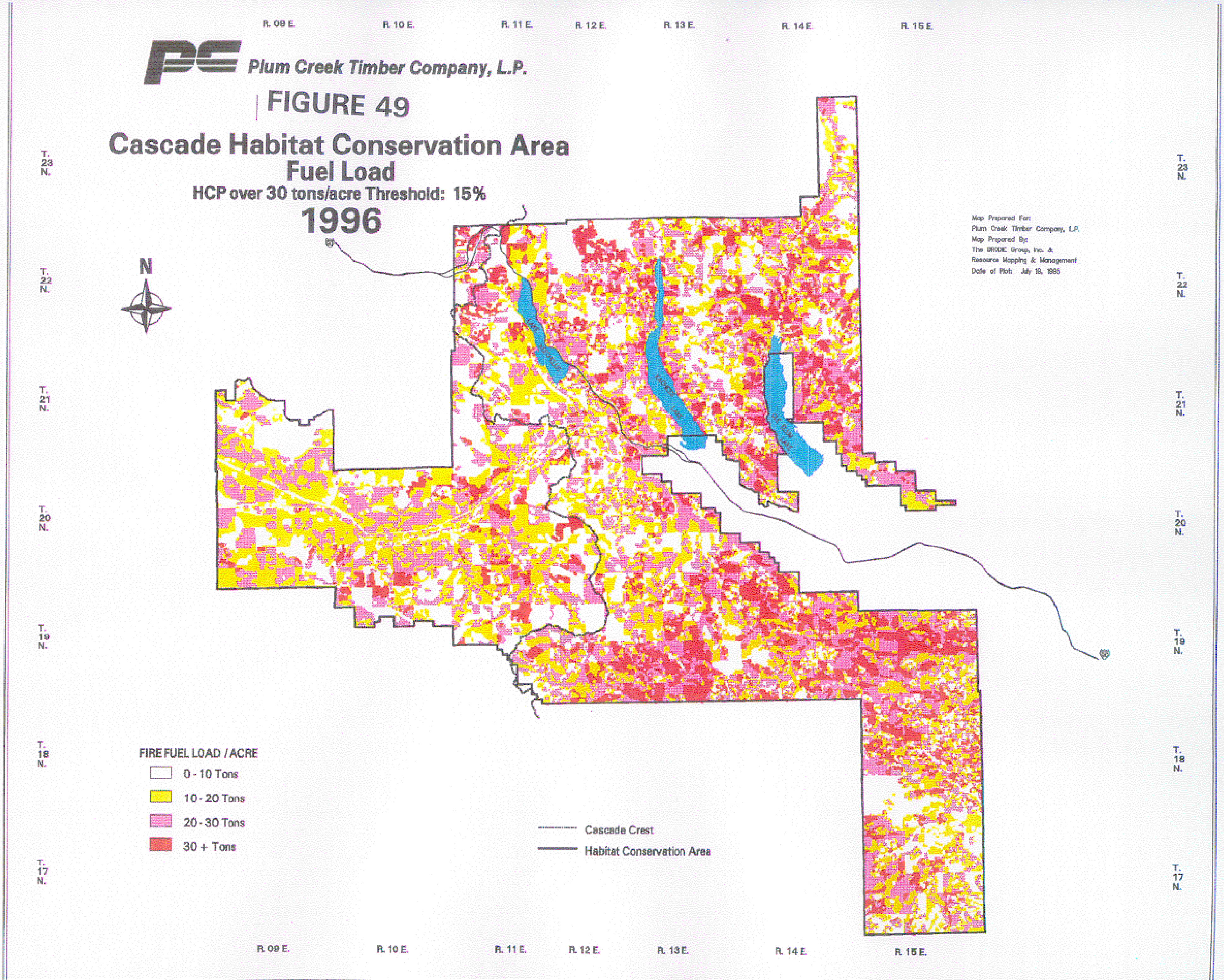


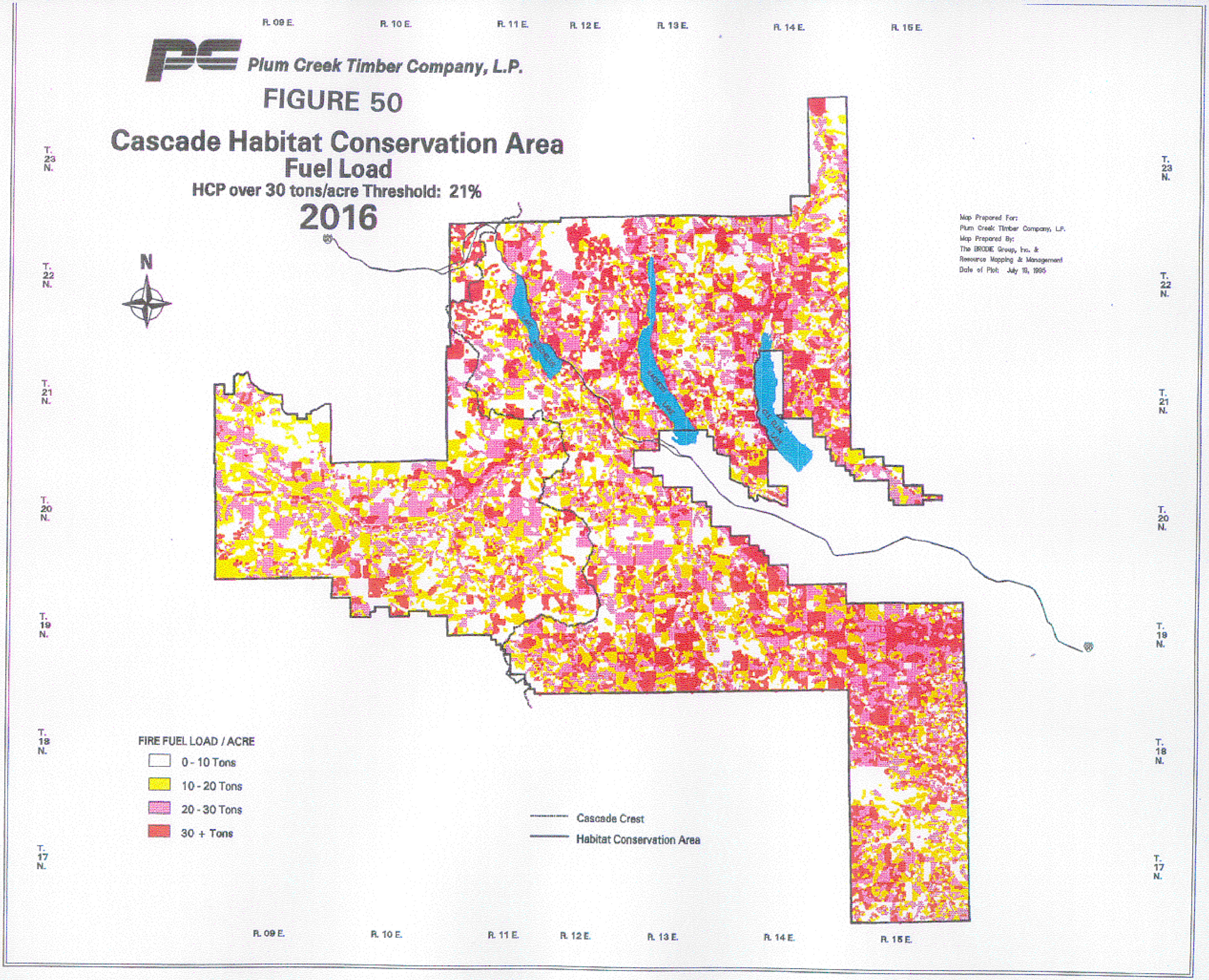
FIGURE 47
Cascade Habitat Conservation Area
Stand Structural Stages
2016
N
Map Plotted on: 25-MAY-2000
MILES
PlumCreek
T.O.P.S.-RIE
STAND STRUCTURE STAGES
Non- Forested - 13%
Stand Initiation - 3%
Shrub Sapling - 3%
Young Forest - 16%
Pole Timber - 15%
Dispersal Forest - 11%
Mature Forest - 20%
Managed Old Growth - 12%
Old Growth - 7%
Cascade Crest
Habitat Conservation Area
Project Location

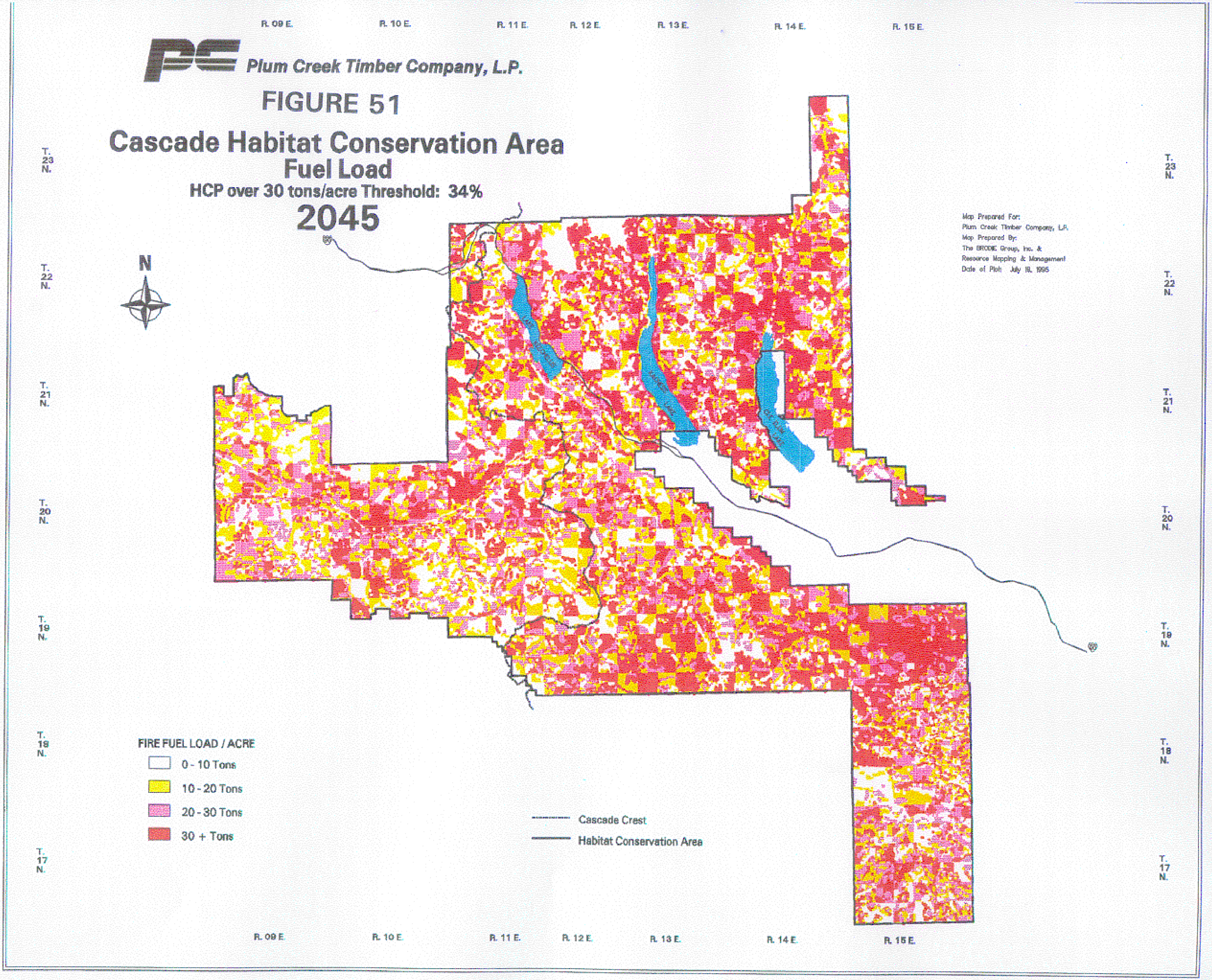
FIGURE 48

Cascade Habitat Conservation Area
Stand Structural Stages
2045

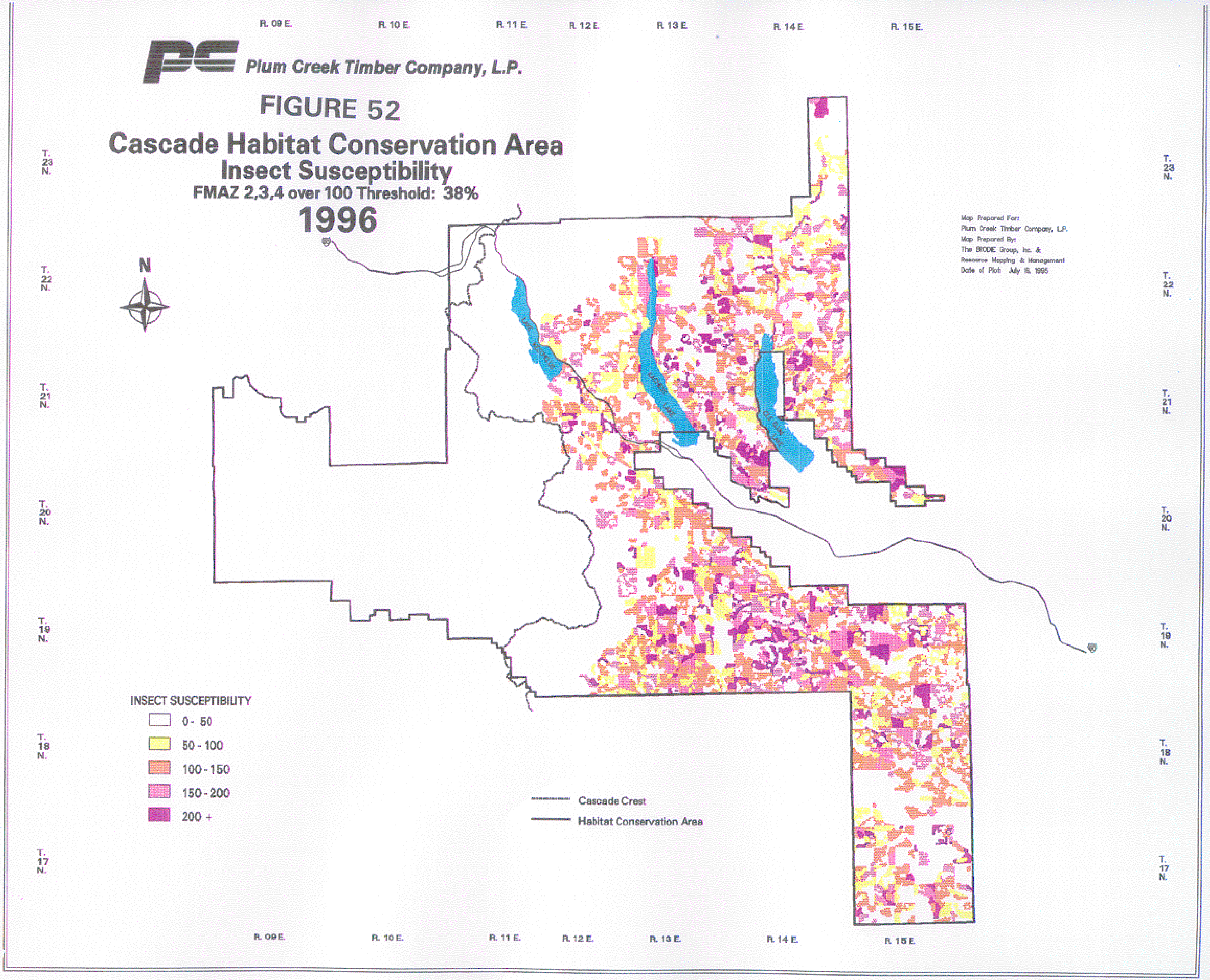



Plum Creek Timber Company, L.P.
FIGURE 49
Cascade Habitat Conservation Area
Fuel Load
HCP over 30 tons/acre Threshold: 15%
1996
N
R. 09 E.
R. 10 E.
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
T. 23 N.
T. 22 N.
T. 21 N.
T. 20 N.
T. 19 N.
T. 18 N.
T. 17 N.
Map Prepared For:
Plum Creek Timber Company, L.P.
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
Date of Plot: July 19, 1995
FIRE FUEL LOAD / ACRE
0 - 10 Tons
10 - 20 Tons
20 - 30 Tons
30 + Tons
Cascade Crest
Habitat Conservation Area

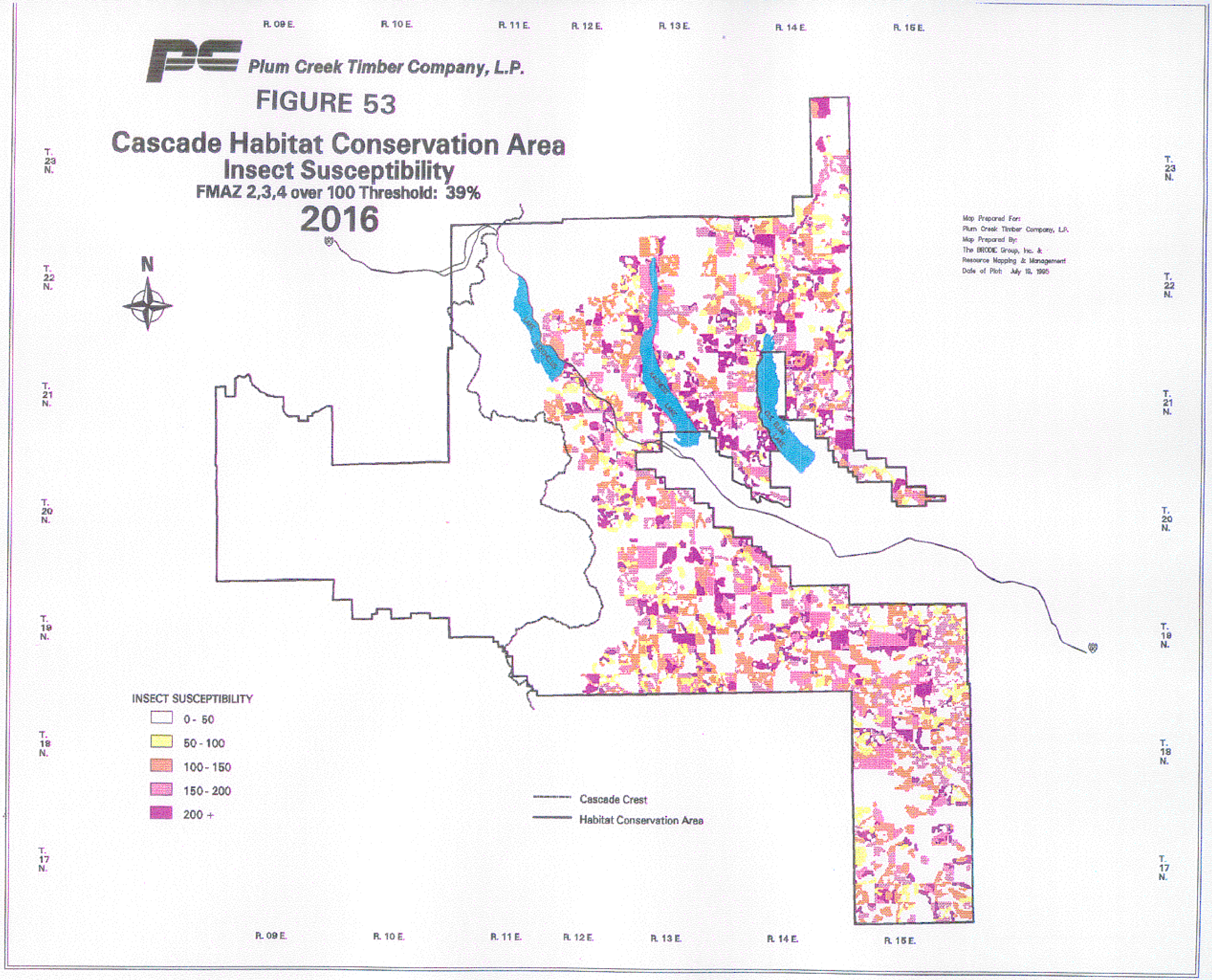

Plum Creek Timber Company, L.P.
FIGURE 50
Cascade Habitat Conservation Area
Fuel Load
HCP over 30 tons/acre Threshold: 21%
2016
N
R. 09 E.
R. 10 E.
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
T. 23 N.
T. 22 N.
T. 21 N.
T. 20 N.
T. 19 N.
T. 18 N.
T. 17 N.
Map Prepared For:
Plum Creek Timber Company, L.P.
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
Date of Plot: July 19, 1995
FIRE FUEL LOAD / ACRE
0 - 10 Tons
10 - 20 Tons
20 - 30 Tons
30 + Tons
Cascade Crest
Habitat Conservation Area

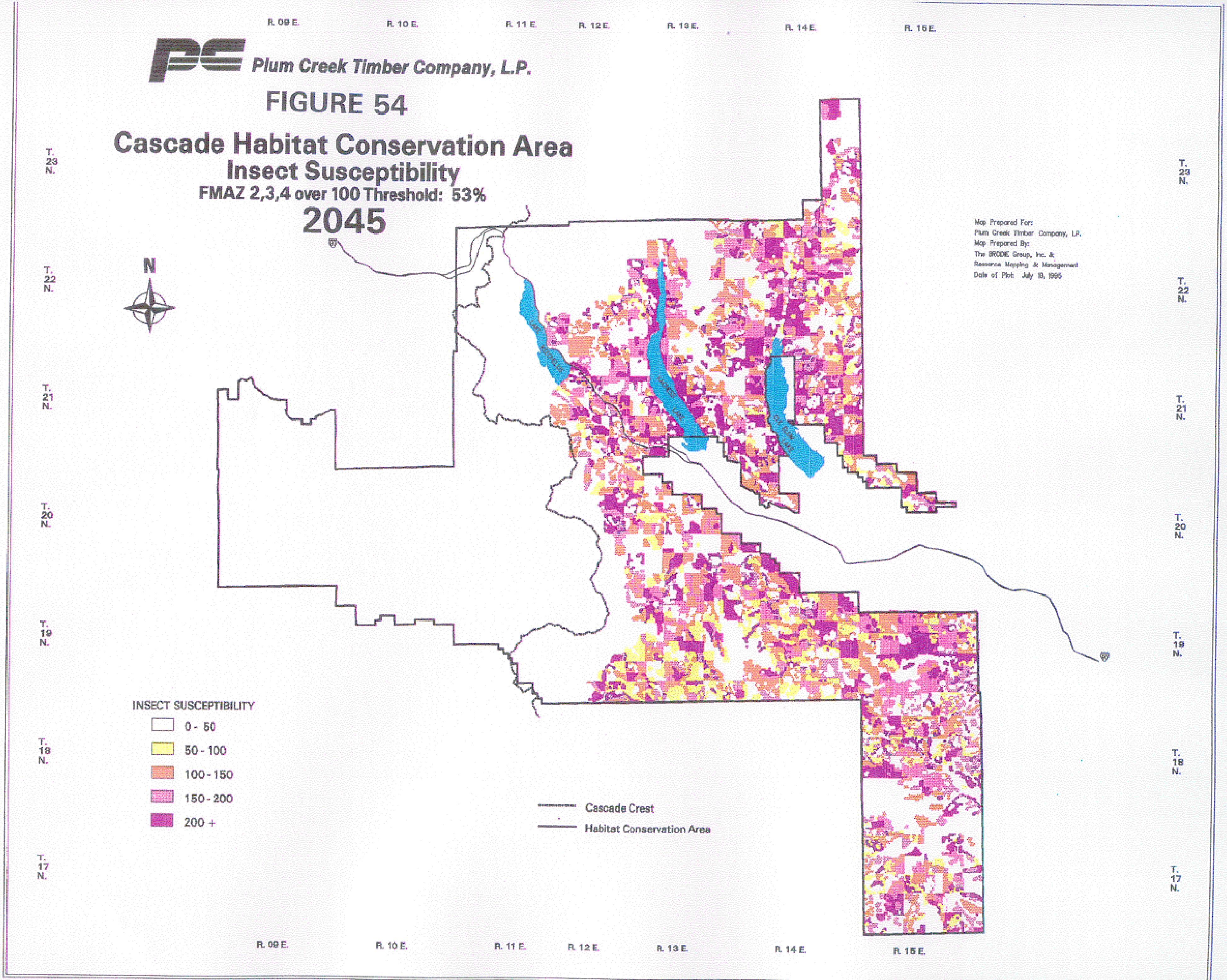


Plum Creek Timber Company, L.P.
FIGURE 51
Cascade Habitat Conservation Area
Fuel Load
HCP over 30 tons/acre Threshold: 34%
2045
N
R. 09 E.
R. 10 E.
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
T. 23 N.
T. 22 N.
T. 21 N.
T. 20 N.
T. 19 N.
T. 18 N.
T. 17 N.
Map Prepared For:
Plum Creek Timber Company, L.P.
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
Date of Plot: July 19, 1995
FIRE FUEL LOAD / ACRE
0 - 10 Tons
10 - 20 Tons
20 - 30 Tons
30 + Tons
Cascade Crest
Habitat Conservation Area



R. 09 E.
R. 10 E.
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
Plum Creek Timber Company, L.P.
FIGURE 52
Cascade Habitat Conservation Area
Insect Susceptibility
FMAZ 2,3,4 over 100 Threshold: 38%
1996
N
T. 23 N.
T. 22 N.
T. 21 N.
T. 20 N.
T. 19 N.
T. 18 N.
T. 17 N.
Map Prepared For:
Plum Creek Timber Company, L.P.
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
Date of Plot: July 18, 1995
INSECT SUSCEPTIBILITY
0 - 50
50 - 100
100 - 150
150 - 200
200 +
Cascade Crest
Habitat Conservation Area


Plum Creek Timber Company, L.P.
FIGURE 53
Cascade Habitat Conservation Area
Insect Susceptibility
FMAZ 2,3,4 over 100 Threshold: 39%
2016
N
R. 09 E.
R. 10 E.
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
T. 23 N.
T. 22 N.
T. 21 N.
T. 20 N.
T. 19 N.
T. 18 N.
T. 17 N.
Map Prepared For:
Plum Creek Timber Company, L.P.
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
Date of Plot: July 19, 1995
INSECT SUSCEPTIBILITY
0 - 50
50 - 100
100 - 150
150 - 200
200 +
Cascade Crest
Habitat Conservation Area


Plum Creek Timber Company, L.P.
FIGURE 54
Cascade Habitat Conservation Area
Insect Susceptibility
FMAZ 2,3,4 over 100 Threshold: 53%
2045
N
R. 09 E.
R. 10 E.
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
T. 23 N.
T. 22 N.
T. 21 N.
T. 20 N.
T. 19 N.
T. 18 N.
T. 17 N.
Map Prepared For:
Plum Creek Timber Company, L.P.
Map Prepared By:
The BRODIE Group, Inc. &
Resource Mapping & Management
Date of Plot: July 18, 1996
INSECT SUSCEPTIBILITY
0 - 50
50 - 100
100 - 150
150 - 200
200 +
Cascade Crest
Habitat Conservation Area

Section 4.0

Alternatives Analyzed

4.0 Alternatives Analyzed

Sections 4.1 through 4.3 discuss the alternatives considered during the development of this HCP, along with an explanation of why each alternative was not adopted. During development of alternatives, Plum Creek made numerous assumptions regarding management plans and options on Federal lands. These assumptions are detailed in Section 2.6.5.

4.1 Alternative 1 (No Action)

4.1.1 Biological Implications

The No Action Alternative quantifies the economic and biological impacts of operating under current State and Federal regulations, without implementation of Plum Creek's Environmental Principles. This alternative could also be considered as the landscape-level implementation of the FWS's current recommendation for protecting spotted owls from "take" by restricting harvest within a 1.8-mile circle around an owl site on private lands in the I-90 corridor.

Under the No Action Alternative, Plum Creek would leave all economically valuable timber, within 1.8-mile radius circles, below habitat thresholds around all spotted owl pairs and resident single sites. To avoid inadvertent "take" of an unknown owl site, Plum Creek would continue to survey areas in the central Cascade region, following Federal survey protocols (i.e., six visits to a site), to document "absence" of owls prior to road construction and timber harvest. Plum Creek would limit retention of timber in riparian areas to only that required by current Forest Practices Rules and Regulations. Douglas fir, true firs, and Ponderosa pine would be the priority species scheduled for harvest first in late-successional, second growth, and then thinned stands. Intensive silvicultural practices including genetics, plantings, fertilization, pre-commercial, and commercial thinning would be part of the forest-management plan. Watershed analysis would be conducted only in priority watersheds where access to Plum Creek's inholdings require crossing Federal lands.

4.1.2 Rationale for Not Selecting This Alternative

The No Action Alternative would maintain owl habitat within the current 1.8-mile radius circles and cluster areas of multiple site centers. However, maintaining owl circles would neither resolve the dilemma of providing suitable habitat for other wildlife species nor increase the connectivity and distribution of diverse forest habitats. Further, habitat outside of the regulatory circles would become zones of non-habitat or fragmented habitat that may attract, but would not successfully support, dispersing juvenile owls. However, this alternative may provide opportunities for wildlife species that prefer early- and mid-successional habitat. A true mosaic of forest stand structures that would offer habitat for many wildlife species and provide opportunity for maximum prey densities is unlikely under this Alternative.

Many desirable features which could support ecosystem management would be missing from this alternative. For example, features such as riparian habitat areas along streams on Plum Creek's lands, and enhanced structural retention on each harvest unit (i.e., partial harvesting) would not be a component of the No Action Alternative. As a result, the existing contrast between landscape conditions on Plum Creek's and Forest Service lands would become even more severe; thereby limiting the biological potential of the overall landscape to provide wildlife habitat for species that prefer mature and old growth habitat except within the relatively isolated owl sanctuaries created by retention of the 1.8-mile radius circles. Forest health implications would also be a critical issue, since few, if any, corrective management practices would be allowed within the owl circles on both private and public lands. By prohibiting all timber-harvesting activities within existing owl habitat and not recognizing the dynamics of habitat growth, significant volumes of high value timber would be deferred indefinitely resulting in reductions in cash flow. Moreover, current restrictions on harvesting of suitable habitat provide disincentives for private landowners to manage future spotted owl habitat. Under this alternative, Plum Creek could harvest forest stands prior to these stands achieving characteristics of spotted owl habitat, rather than risk regulatory restraints. This could reduce future suitable habitat for owls on non-federal lands, which could adversely affect habitat for other wildlife species throughout the Planning Area.

4.2 Alternative 2 (Riparian Management)

4.2.1 Biological Implications

The Riparian Management Alternative would implement and evaluate a riparian habitat strategy on Plum Creek's lands and develop Riparian Habitat Areas (RHAs) along all perennial streams draining Plum Creek's ownership in the Planning Area. This alternative would focus on providing supplemental stream protection to address resident and anadromous fish habitat concerns, complementing the Federal Aquatic Conservation Strategy, and retaining a mosaic of forest structures along streams to benefit riparian-dependent and other wildlife species that use these areas. Suitable habitat for many species is extremely specific and would be essentially protected by provisions for maintenance of RHAs. This alternative also represents an aggressive forest-management strategy. Plum Creek management units outside of RHAs would be prioritized by economic value and harvested using even-aged harvesting techniques, with minimal green tree retention. This alternative would provide habitat types for a wide variety of wildlife, including species that prefer RHAs and early- and mid-successional forest stands.

As mentioned above, this alternative represents the most aggressive timber-harvesting plan among the alternatives, but it also provides a reasonable landscape-level planning program for the intermingled ownerships within the Planning Area. The economic aspects under this alternative would be maximized because circle-based owl restrictions would be eliminated and only minimal, if any, special habitat considerations would be made for spotted owls outside of designated RHAs. In addition, management units would be prioritized to select the highest value stands across Plum Creek's ownership for even-aged harvesting, with subsequent planting and thinning to maximize re-growth and return-on-investment.

Under this alternative, RHAs would be maintained. Timber harvesting in RHAs would be restricted to partial cutting within 100 to 200 feet of streams (depending upon stream size), with a 30-foot, no-harvest zone adjacent to the stream. Essentially, this alternative would achieve many of the objectives of the Pack Forest Agreement (Appendix 8). In that agreement, the role of private lands in an ecosystem-management strategy was to provide enhanced riparian protection, rather than to retain Late-Successional Reserves. Under this alternative, habitat for riparian-dependent wildlife species would be protected, and species that prefer open or early- or mid-successional forest stands would also benefit.

4.2.2 Rationale for Not Selecting This Alternative

The Riparian Management Alternative is the most basic plan among the alternatives for establishing an HCP-based ecosystem-management program for the I-90 corridor. This alternative represents the minimum level of protection of late-successional forest habitat, but it includes many desirable ecosystem-management concepts such as RHAs, and maintenance and evaluation of forest structural stages.

Based on **OPTIONS** simulations of implementation of this alternative for the Permit period, a reduction in habitat within current spotted owl circles, without specific protection extended to these nest sites on Plum Creek's lands, would cause a continuous decrease in owl numbers until about midway through the Permit period, when owl numbers would stabilize. Spotted owls in the Planning Area would persist, but at lower levels until the forest stands on Forest Service lands recover sufficiently to support more site centers. An owl population reduction of this magnitude (i.e., perhaps as high as one-third of the 1994 population estimate) may be considered unacceptable by the FWS for ensuring the persistence and viability of the spotted owl in the I-90 corridor. From an agency perspective, this alternative presents a formidable challenge; that is, how much are we willing to compromise the population size of a single species in the short-term in order to achieve ecosystem management, and maintenance and/or restoration of habitat conditions for a multitude of species in the long-term? This alternative also provided substantially fewer benefits for other species of concern and special habitats than the HCP.

4.3 Alternative 3 (Dispersal Habitat)

4.3.1 Biological Implications

The Dispersal Habitat Alternative includes the Riparian Habitat Strategy of the Riparian Management Alternative (i.e., Alternative No. 2), along with protection of spotted owl dispersal habitat. The objective of this strategy would be to ensure the success of the Northwest Forest Plan by providing opportunities for spotted owls, as well as other wildlife species to successfully disperse across Plum Creek lands to colonize nesting, roosting, and foraging (NRF) habitat in Late-Successional Reserves and Adaptive Management Areas on adjacent Forest Service lands. Retention of RHAs would provide additional protection for riparian-dependent and other wildlife species in the Planning Area. Provisions to protect spotted owl dispersal habitat on Plum Creek's lands would provide more opportunities for wildlife species than currently exists in intensively managed stands where structural components (i.e., snags, residual green trees) may be lacking. This alternative also achieves the "common goals but, different roles" vision for ecosystem management that Plum Creek presented at the 1992 Forest Conference in Portland, Oregon. The common goal under this alternative is ecosystem management. The different role is preservation of late-successional forests and NRF habitat on Federal lands and dispersal habitat characterized by "structurally diverse" young forests on private lands. Basically, this alternative is similar to the strategy behind the Murray Pacific HCP, but applied to a larger area and more species.

Plum Creek would employ a selective harvest strategy in RHAs and in areas where owl habitat currently exists. The objective would be to maintain the capability of these forested stands to meet minimal spotted owl requirements for foraging and dispersal, and maintain suitable habitat for other wildlife species. Implementation of this harvest strategy would provide minimal nesting opportunities, but maintenance, restoration, and/or protection of NRF habitat for wildlife species would not be a specific objective under this alternative. In combination with mitigation provisions for RHA protection, watershed analysis, landscape and stand-level mapping and monitoring, this alternative provides riparian habitat protection and fills an important biological need for spotted owl, murrelet, goshawk, and other wildlife dispersal habitat with minimal risk to forest health, but at an unacceptable economic cost.

4.3.2 Rationale for Not Selecting This Alternative

A common perception of the I-90 corridor is that the fragmented habitat imposed by topography and past even-aged harvesting restricts the North/South movement of spotted owl populations in the central Cascades. A long-term strategy devised to link late-successional forests with structurally diverse dispersal habitat would encourage the movement of spotted owls, provide refuge habitat for wildlife species that disperse any short distance, and alleviate many of the problems currently thought to restrict spotted owl and other wildlife dispersal in the I-90 corridor.

A key issue that remains unresolved is the acceptability of short-term reductions in owl, murrelet, goshawk, and other wildlife habitat and sites supported by that habitat as a result of timber harvesting, in exchange for a long-term strategy of growing forested stands to a stage that will accommodate wildlife dispersal. The watershed and fisheries objectives outlined in the HCP would be fully achieved under this alternative, and early- and mid-successional habitat would be available throughout the Planning Area. Implementation of this alternative may limit the recovery goals for spotted owls in the area because some areas may contain less NRF habitat due to harvesting operations. However, the many small to medium sized openings and younger forest stands across the landscape would benefit a broad array of vertebrates, invertebrates, and vascular plants that thrive under these conditions. By implementing a selective harvesting strategy in RHAs and existing owl habitat, harvesting costs are higher and access to significantly larger areas would be required to remove economically equivalent volumes of timber. Operationally, this greater volume of timber removed and the greater number of acres needed to be harvested significantly increases the cost of timber harvesting and makes this alternative considerably less attractive economically. As in the Riparian Alternative, the benefits provided to the other species of concern and special habitats would be substantially less than under the HCP.

Section 5.0

Plan Implementation

5.0 Plan Implementation

Implementation of this HCP will be governed by an agreement between Plum Creek and the Services, and funded by Plum Creek as part of the Company's ongoing operations in the Cascades Region. The Implementation Agreement (IA) defines the roles and responsibilities of the parties and provides a common understanding of actions that will be taken for the conservation of the listed and unlisted species and their habitats during implementation of the HCP.

Pursuant to the provisions of section 10(a)(1)(B) of the ESA, Plum Creek has prepared this HCP, submitted it to the Services, and is requesting the issuance of an incidental take permit (Permit) for the listed species described in Sections 1.2.4 and 1.2.5 of the HCP, within the Planning Area as depicted in Figure 1 of the HCP. The HCP proposes a comprehensive program of conservation for listed and unlisted species and their habitat through several strategies that will address crucial habitat needs.

In the event of any direct contradiction between the terms of the IA and the HCP, the terms of the IA shall control. In all cases, the terms of the IA and the terms of the HCP shall be interpreted to be supplementary to each other.

To fulfill the requirements that will allow the Services to issue the Permit, the HCP provides measures that are intended to ensure that any "take" occurring within the Planning Area will be incidental to the carrying out of otherwise lawful activities; that the impacts of the incidental take will, to the maximum extent practicable, be minimized and mitigated; that adequate funding for the HCP will be provided; and that the take will not appreciably reduce the likelihood of the survival or recovery of the listed species in the Planning Area.

5.1 Monitoring

The section 10 regulations of the ESA [50 CFR 17.22 (b)(1)(iii)(B)] require that an HCP specify the measures that will be taken to "monitor" the impacts of the taking resulting from implementation of the conservation plan. This section describes briefly the monitoring program for the HCP as outlined in Table 34. Shaded columns represent mandatory reviews (presentations) to the Services.

5.1.1 Habitat Verification

An important focus of the HCP is to link the biological requirements of resident wildlife species to a series of eight structural classes described in Section 2.3 of the HCP, and to predict accurately the amount and distribution of these structural classes in the future as a result of plan implementation.

Plum Creek's inventory system, which accumulates information by tree species, size class, and stocking level, for individual stand or polygons, will be expanded to include snags and LWD, and will be tracked from year-to-year. Plum Creek will monitor periodically and re-sample specific areas in the Planning Area to capture major changes in stand structure caused by biotic, abiotic, or mechanical factors. This information will also be used to verify the reliability of OPTIONS and other modeling components.

Table 33. Plum Creek HCP Monitoring/Reporting Schedule.

Report Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Calendar Year	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
ANNUALLY																																																			
Habitat Verification																																																			
Stand Structures		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lifeform (Except Lifeform 5)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spotted Owl Habitat		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OTHER TERRESTRIAL																																																			
Sp. Owl Carrying Capacity						X					X					X					X										X										X										X
Lifeform 5						X					X					X					X										X										X										X
Spotted Owl Monitoring		X	X							X	X				X	X				X	X																			X	X										
Marbled Murrelet	X			X	X																																														
Grizzly – Habitat & Roads			X			X					X					X					X										X										X										X
Gray Wolf – Habitat			X			X					X					X					X										X										X										X
Breeding Bird Surveys				X	X	X								X	X	X																																			
Amphibian Surveys						X	X	X									X	X	X																																
Small Mammal/Prey Surveys									X	X	X																																								
AQUATIC RESOURCES																																																			
Fish Habitat Conditions																																																			
Monitor Permanent Stream Monitoring Sites					X		X		X		X		X			X					X					X					X					X					X					X					X
Watershed Analysis 5-Year Reviews						X	X	X	X	X	X	X	X	X	X						X	X	X	X	X						X	X	X	X	X						X	X	X	X	X						
Stream Temperatures																																																		
4 riparian scenarios					X	X	X	X	X																																										
303(d) listed & Bull Trout		X	X			X					X																																								
Fish Population and Aquatic Insect Community Assessments																																																			
Fish Population 75-meter survey reaches					X	X	X		X		X					X					X					X					X					X					X					X					X
Aquatic Insect collection					X		X		X		X		X			X					X					X					X					X					X					X					X

In addition, Plum Creek will use OPTIONS (Section 2.6) to evaluate multiple combinations of forest management across the Planning Area over the Permit period. A habitat evaluation model will use output from OPTIONS to determine stand structure and the distribution and abundance of habitat types for any point in time. Output from the stand structure classification model will be linked to GIS for visual display of habitat changes.

5.1.2 Spotted Owl Monitoring

5.1.2.1 Purpose

Spotted owl monitoring will be conducted to verify the assumptions of the Resource Selection Probability Function (RSPF) model (Irwin and Hicks 1995) and verify the effectiveness of selected harvest deferrals in maintaining site occupancy.

5.1.2.2 Scope

Model and deferral validation surveys will be conducted in 10 to 15 percent of the Planning Area to reestablish contact and locate all spotted owl nest sites in areas sampled. Survey areas will be distributed in LSR, AMA, and Matrix landscapes within the North Green River, Twin Camp, Teanaway, and Taneum subunits of the Planning Area (Figure 55). Note that although the I-90 Lakes spotted owl monitoring area may be dropped, should additional lands in this area be transferred to the US Forest Service, the other spotted owl monitoring areas are being expanded resulting in approximately the same total area being surveyed. Survey methodology was determined with the FWS and incorporates a 2-visit survey sequence each season (i.e., about May 1 to June 30), surveying of likely habitat, and use of appropriately distanced calling stations (i.e., 0.25- to 0.5-mile distance between calling stations). Spotted owl sites within the survey areas that were targeted with deferrals are monitored for occupancy for the duration of the deferral period. Ten of the 11 NRF deferral or FD corridors sites are included in the survey areas. Sites discovered during surveys are checked later in the season to determine nesting success/productivity. As additional owls are located, they are banded, at the discretion of Plum Creek, to facilitate identification upon later sightings.

Spotted owl habitat suitability will be monitored over time using the RSPF model. By combining the RSPF model with results of the spotted owl monitoring and GIS information, Plum Creek will be able to determine the “carrying capacity” or the number of owls the forest habitat is capable of supporting at any time through the 50-year term of the HCP, or such shorter term if terminated sooner, pursuant to the IA (i.e., the “Phase I”). These efforts will include monitoring to verify that NRF and FD habitat for owls exists as projected, and that the estimated number of owls remain within predicted ranges.

5.1.2.3 Frequency

The demographic data will be gathered for two seasons prior to reporting years 2, 10, 15, 20, and 40 (Table 34). “Carrying Capacity” projection using the RSAF model and GIS will be made at years 5, 10, 15, 20, 30, and 40.

5.1.3 Marbled Murrelet Monitoring

Surveys of potential murrelet habitat in the Planning Area, West of the Cascade crest, will be completed prior to harvest. Active nest sites discovered during these surveys will be deferred from harvest as long as murrelets occupy the sites. If abandonment of the site is suspected, then Plum Creek will initiate monitoring, for 5 years, to verify absence of murrelets. Survey protocols in place at the time will be used to verify absence, or an alternative methodology will be negotiated with the Services prior to initiating these surveys. Following completion of these surveys and verification of abandonment by murrelets, the stand will be available for harvest at the discretion of Plum Creek.

5.1.4 Grizzly Bear Monitoring

State and Federal agencies agree that grizzly bears occur, at least occasionally, within the Planning Area. Historical and recent observations in the north and central Cascades also indicate that grizzly bears may be slowly extending their southern range. However, at present there is insufficient information to confirm the extent to which grizzly bears use the Planning Area. To minimize impacts and increase the potential for grizzly bears to occupy and successfully reside in the I-90 Lakes Subunit, Plum Creek will implement a series of Best Management Practices (BMPs) to maintain and monitor habitat that allows bears to meet their essential biological needs. Plum Creek will implement the BMPs in two phases. Phase I will be implemented upon issuance of the Permit. This phase will include aggressive actions and measures to ensure protection and survival of resident bears including installation of gates and barriers on roads and spurs, and maintaining an open road-density goal of 1.0 mile per square mile or less on Plum Creek's lands in the I-90 Lakes Subunit (see Section 3.2.1.3). The objective of Phase I will be to monitor and maintain habitat conditions in the I-90 Lakes Subunit that are conducive to grizzly bear re-occupancy of the area. Phase II will be implemented following verification, by the FWS, that grizzly bears are residing in the Planning Area. This phase will include habitat monitoring and measures to ensure protection and survival of resident bears.

5.1.5 Gray Wolf Monitoring

As with the grizzly bear, State and Federal agencies believe that gray wolves occur, at least occasionally, within the Planning Area. Although available information on the distribution of gray wolves in the north and central Cascades is not as extensive as for other wildlife species, Plum Creek believes it is reasonable to assume that gray wolves will eventually reside in the Planning Area during the Permit period. Biologically, the fate of the gray wolf in the Planning Area is linked primarily to that of its prey, which includes large herbivores, such as elk and deer, and smaller mammals, such as snowshoe hares. Because Federal "recovery areas" in the central Cascade Mountains have not yet been established for the gray wolf, Plum Creek will evaluate and monitor the amount of suitable habitat for preferred wolf prey species throughout the entire Planning Area. However, some areas within the Planning Area will be given higher priority, because they may have a higher likelihood of providing suitable habitat for preferred prey species. For example, road-management activities will be monitored in the Taneum watershed and the I-90 Lakes Subunit in conjunction with similar road-management practices being monitored for grizzly bears.

As with grizzly bears, Plum Creek will address gray wolves by monitoring habitat conditions that allow wolves and their important prey species to meet their essential biological needs while residing in the Planning Area. The three features of the gray wolf plan include:

1. Monitoring prey habitat conditions using forest stand structures throughout the Planning Area over the Permit period;
2. Monitoring road-management actions to provide suitable habitat for both prey species and wolves; and
3. Den site protection monitoring to evaluate the effectiveness of restricting forest-management activities.

5.1.6 Aquatic Resources Monitoring

The Aquatic Resources Monitoring program was designed to evaluate the effectiveness of the HCP as a "management experiment" that may be modified as necessary to meet objectives. Modifications will be addressed through implementation of an adaptive management approach (Section 5.4). The three main objectives of the Aquatic Resources Monitoring program, along with the methodology, location, and frequency of monitoring for each of the objectives is described below.

5.1.6.1 Objective 1: Provide landscape-wide monitoring of habitat conditions over the Permit period.

5.1.6.1.1 Method 1. Establish permanent stream monitoring sites in the Green River and Yakima River subbasins.

Plum Creek will conduct integrated monitoring of riparian, stream channel, and fish habitat conditions in stream segments in the Green River and Yakima River subbasins. Stream segments are defined as stream reaches with similar gradients per Montgomery and Buffington (1997). Fish populations and aquatic insect communities will also be monitored (see Objective 3). All parameters will be measured in at least two 75-meter sites within each segment. The following parameters will be measured at each site:

1. General
    - Drainage area, elevation, aspect, geology, stream channel gradient and confinement, valley form, ownership and disturbance history (floods, fire, landslides, timber harvest, etc.)
2. Riparian (measured within one site potential tree height's distance from the stream)
    - Tree density, diameter, age, growth, and species composition;
    - Forest vegetation series, understory vegetative composition, and stand damage/disease ratings
3. Stream Channel
    - Bankfull width and depth;
    - Substrate size composition (Wolman pebble counts);
    - LWD abundance, size, and volume (minimum dimensions of 10-cm diameter and 2-m length);
    - LWD input and depletion;
    - Bank erosion
    - Canopy closure
4. Fish Habitat
    - Pool frequency, area, residual depth, and formative factors;
    - Stream temperatures (hourly intervals, continuous during summer months)

All sites will be monumented to facilitate repeat measurements. Permanent photo points will be established to document changes in channel morphology and substrate composition. All channel and habitat measurements will be made during summer/fall low flow conditions.

Plum Creek will establish stream segment monitoring locations in the following streams in the Green River and Yakima River subbasins (Figure 56).

Green River Subbasin	Yakima River Subbasin
Sawmill Creek	West Fork Bear Creek
Green Canyon Creek	Little Creek
Rock Creek	Taneum Creek
North Fork Green River	Davis Creek

The above list of streams may be adjusted upon final designation of stream segments. The intent of such designation is to place the stream segments in different watersheds and subbasins, while at the same time maximizing the information that can be learned from such monitoring.

Within each drainage, stream segments will be selected using the following criteria:

- Plum Creek ownership;
- Riparian harvest opportunity (near-term);
- Channel responsiveness to LWD and sediment (i.e., pool-riffle to step-pool channel classes, Montgomery and Buffington 1993);
- Moderate stream size (focus on tributaries, not mainstems);
- Unmanaged riparian areas (controls) nearby, preferably within the same drainage or channel segment;
- Fish-bearing streams;
- Representative of the full HCP geography

Survey sites will be randomly selected in each segment. Stream monitoring sites will be surveyed in years 4, 6, 8, 10, 12, 15, and every 5 years thereafter until the end of the HCP term.

The permanent sites will provide information on the conditions in each watershed. Key habitat components that are controlled by the influx of sediment, water, and wood will be evaluated during the HCP term.

5.1.6.1.2 Method 2. Watershed Analysis 5-year reviews

A total of 17 Watershed Administrative Units (WAUs), as described in Toth (1995) will be re-examined every five years. If after ten years of monitoring (i.e., two re-examinations), aquatic resource conditions are stable or improving, the frequency of watershed analysis reviews will be reduced to every ten years.

Level 2 watershed analyses will provide the context for Plum Creek to interpret results from the overall monitoring program. Re-evaluation of watershed analyses will provide updated information on hillslope conditions, stream channel conditions, and the effectiveness of prescriptions for resource protection and recovery.

Monitoring and research is a vital component of watershed analysis and is consistent with an adaptive management strategy. Watershed analyses are revisited every five years to make appropriate changes in prescriptions based on monitoring data or advances in scientific understanding. Examples of monitoring and research done as a result of watershed analysis include: (1) a road sediment production study; (2) McNeil sampling of streams to assess fine sediment levels; (3) installation of two stream gages; (4) testing of digital elevation hydrologic models; (5) stream temperature monitoring; and (6) stream surveys to evaluate channel changes and large woody debris levels. If data indicate that prescriptions are ineffective or inadequate, changes in the prescriptions will be made.

5.1.6.2 Objective 2: Analyze the effects of the various riparian habitat area (RHA) management strategies on stream temperature

5.1.6.2 Objective 2: Analyze the effects of the various riparian habitat area (RHA) management strategies on stream temperature { }

5.1.6.2.1 Method 1. Pre- and Post-harvest canopy closure and temperature measurements.

Plum Creek will initiate a study to measure potential stream temperature effects of four riparian habitat area harvest strategies described in the HCP (Sections 3.3.4 and 3.3.5). In addition, one common stream-associated mass wasting prescription described in Watershed Analysis will be studied:

1. 200-foot RHA on fish-bearing streams
2. 100-foot RHA on nonfish-bearing streams in Federal LSRs and/or AMAs
3. 25-foot RLTAs on nonfish-bearing streams outside of Federal LSRs and/or AMAs
4. 300-foot, no-harvest riparian buffer on fish-bearing streams on Forest Service lands
5. 50-ft, no-harvest buffer in inner gorges (a landslide-prone area).

For each strategy, Plum Creek will select at least three sites on the West and East-sides of the Cascades crest, for a total of 30 sites within the Planning Area. Selection of study sites will be largely opportunistic (as opposed to random), owing to the need for riparian harvest opportunities.

At each site a thermograph will be installed at the upstream and downstream ends of a harvest unit. The ratio of upstream to downstream temperatures will be established during the pre-treatment period. Assuming no change in conditions of the thermal reach upstream of the upper (control) thermograph, if a statistically significant change is detected in the temperature relationship between the upper and lower thermographs, then the change will be attributed to the effect of the RHA. Statistical significance will be defined as a reach-scale temperature increase of 1^{o}C or more (MWAT) following streamside timber harvesting. The allowable Type 1 error will be 0.1 (alpha=0.1), or a confidence interval of 90%. During monitoring, stream temperatures will be recorded hourly.

Temperatures will be monitored for at least four years, from mid-July through mid-September, so as to capture the period of annual peak temperatures. Monitoring will occur at least one year prior to riparian treatments and for three years post-treatment. Where operationally feasible, pre-treatment monitoring will be extended to two years. In the event that post-harvest summer temperatures are unusually low, post-harvest monitoring will be extended over additional summers. If only one side of a stream is harvested in a given year, monitoring will continue at that site until at least one year after the second side is harvested. If the time between harvests is greater than four years, monitoring of the site may be temporarily interrupted to make use of equipment on other sites.

Temperature monitoring will provide valuable information on the effectiveness of the design of RHAs to maintain stream temperatures for both Western and Eastern Cascades conditions. Temperature regimes for these streams will be established during the pre-harvest monitoring period. This study would focus on potential changes in annual weekly average temperatures (MWAT: the mean of daily average water temperatures measured over the warmest consecutive seven-day period during a given year).

5.1.6.2.2 Method 2

Streams that are on the 1994 303(d) list will be monitored for stream temperature at a minimum of two locations per stream. The 303(d) listed streams in the Planning Area have in the past exceeded State water temperature standards. Plum Creek will monitor these streams to measure temperature trends, the effectiveness of prescriptions, and the rapidity with which temperatures achieve natural background conditions. Both daily diurnal fluctuations in temperature and maximum annual temperatures will be evaluated.

Temperature monitoring for 303(d) streams will be conducted by Plum Creek on four streams (i.e., Big Creek, Lookout Creek, Gold Creek (Naches River tributary), and Dingbat Creek). The locations of stream temperature monitoring sites are shown in Figure 56. Stream temperatures will be monitored for Years 1, 2, 5, and 10 from early July through mid September.

5.1.6.2.3 Method 3

Additional temperature monitoring will be conducted at various locations throughout the planning area during the HCP term. This monitoring will occur as part of Watershed Analysis preparation and monitoring, and as part of other research projects aimed to better understand the temperature regimes of planning area streams. The location and duration of these monitoring sites will vary.

5.1.6.3 Objective 3: Assess fish populations and aquatic insect communities to assess the biological integrity of streams in the Planning Area over the Permit period

Resident fish populations and many species of aquatic macroinvertebrates can spend all or a majority of their life cycle within segments of streams. Certain aquatic insect species are especially sensitive to disturbance and changes in water quality, and changes in species composition, population abundance and/or distribution often accompanies modifications in watershed conditions. Long-term monitoring of resident fish populations and aquatic insect species composition and abundance in the integrated monitoring study reaches will provide information on watershed conditions that physical habitat measurements alone may not reflect.

Fish population and aquatic insect community surveys will be conducted in the permanent integrated monitoring study reaches described under Objective 1 (section 5.1.6.1.1). These surveys will help assess the biological integrity of streams in the planning area over the permit period, and will help evaluate the effectiveness of the HCP's aquatic resource management system.

Fish populations will be estimated at a minimum of two ~75-meter sections of each integrated monitoring response reach identified under Objective 1. Sites used for fish surveys will be selected randomly. The survey sections will be bounded by hydrologic controls (e.g., riffle crests). Surveys will be conducted using standard multiple-pass removal electrofishing techniques, with block nets. Electrofishing effort (seconds) will be recorded. Areal and lineal densities for each species will be reported in addition to population estimates. Habitat surveys will be conducted concurrently using the elements of the cross-sectional surveys described under Objective 1. Plum Creek will conduct fish population surveys during years 4, 5, 6, 8, 10, 15, and every 5 years thereafter until the end of the HCP term.

Aquatic insects will be collected from the stream substrate, in riffles, using a modified Surber square-foot sampler (Plotnikoff 1995). Insects in each sample will be sorted, counted, and identified, where practicable, to species. The more difficult groups to identify, such as the Chironomidae, may be reported at the family or subfamily level. Various metrics will be evaluated (e.g., Benthic Index of Biotic Integrity, total insect abundance, EPT index, Shannon Diversity Index) to evaluate trends in aquatic insect community structure. Three samples will be collected from a single riffle in each survey reach during September. Sampling once a year with multiple samples per riffle is an effective sampling strategy if conducted in a consistent manner (Jim Karr, pers. comm., Univ. of Washington). Samples will be collected in years 4, 6, 8, 10, 12, 15, and every five years thereafter until the end of the HCP term.

The adaptive management approach (Section 5.4.2) will provide a feedback mechanism to evaluate monitoring data and a basis for determining if corrective actions are necessary.

5.1.7 Lifeform Habitat Monitoring

As described in Section 5.1.1.1, the distribution of the eight stand structural stages will be evaluated annually. At the same time, suitable habitat for all 16 Lifeforms except for Lifeform 5 will be described and projected over time to ensure that habitat availability, habitat growth, and stand structures are meeting the target goals projected in the HCP. Since Lifeform 5 utilizes a "moving window" GIS technique and is more complicated to run, projections will be made at years 5, 10, 15, 20, 30, and 40. If a "moving window" method is employed for any other Lifeforms (such as Lifeform 4), projections will be made at the same time as Lifeform 5.

5.1.8 Reporting

The reporting schedule for the HCP Phase is shown in Table 34. For year 2, the report was submitted November 23, 1999. Subsequent reports will be submitted to the Services within 180 days following the end of HCP calendar Years 5, 10, 15, 20, 30, 40, and 50. For example, HCP year 5 will be 2001. The second mandatory report will be submitted to the Services no later than 180 days after December 31, 2001, or not later than June 30, 2002.

The reports will reflect the current status of habitat and stand structures compared to the projections made in the HCP for that point in time, and will provide forecasts into the future which will also be compared to the HCP projections for the same time period. Each report will reflect the status of the monitoring programs established in Section 5.1.1. Additional information such as harvest activity, will be provided as agreed upon between Plum Creek and the Services.

The first report following Year 2 addressed the progress made in implementation of the plan encompassing data base development, examples of mitigation measures, and the status of terrestrial and aquatic monitoring. It was not as detailed as subsequent mandatory reports scheduled for Years 5 and 10.

Section 11 of the IA allows for termination of the HCP Phase prior to the full 50-year term by either party. This section states that if Plum Creek elects to terminate the HCP Phase, a "termination report" must be submitted to the Services at the time of termination. The report will provide information on the status of the HCP in detail comparable to that required for reports scheduled for Years 5 and 10.

5.2 Surveys

5.2.1 Breeding Bird Surveys

5.2.1.1 Purpose

Breeding bird surveys will be used to verify the Lifeform strategy used in the HCP to orient assemblages of wildlife species to forest structural stages. Most of the species occurring in the Planning Area are avian and some Lifeforms are comprised entirely of birds. Surveys of birds will provide data to evaluate and calibrate the forest structural stage descriptions used to assign primary and secondary habitat for

Lifeforms. Breeding bird surveys are the most accepted and efficient way to evaluate presence/absence data. Data obtained in this effort can be used to supplement current national efforts to assess population trends of neotropical migrant forest-dwelling birds.

5.2.1.2 Scope

The survey design will be structured to sample the variety of forest types and structural stages in the Planning Area. There are five forest types within the Planning Area (Douglas fir/western hemlock; noble fir/Pacific silver fir [western Cascades]; noble fir/Pacific silver fir/subalpine fir [eastern Cascades]; Douglas fir/grand fir; and Ponderosa pine) and eight structural types within each forest type (Section 2.3). One possible survey design includes surveying five stands within each forest structural type at least three times during the survey season (May 1 through June 30). The sample size would total 600 samples per year (5 types x 8 stages x 5 stands x 3 surveys). The sampling methods would follow national neotropical migrant survey protocols using fixed 50-meter radius point counts spaced 150 meters apart and surveyed for five minutes per station.

5.2.1.3 Frequency

Annual breeding bird surveys will be conducted over two periods of 3 to 5 years each, with data provided for the second (2001) and fourth (2011) reports (Table 34).

5.2.2 Amphibian Surveys

5.2.2.1 Purpose

Amphibian surveys are required to evaluate the success of RHA and RLTA prescriptions in providing habitat and protecting favorable conditions for amphibians. The surveys will provide information on amphibian use in perennial streams and in adjacent uplands identified as primary habitat for amphibians.

5.2.2.2 Scope

The Service is assessing the amphibian work currently ongoing and being prepared within the Pacific Northwest and Washington State. It is their intent to ensure that various studies and investigations compliment each other and, where possible, use comparable methods allowing for potential pooling of data or at least comparison of results. The Service requested that the amphibian monitoring in the Plum Creek HCP be delayed so that adaptive monitoring could be employed. The Service expects guidance to be available to help development of study design and sampling protocols.

Amphibian surveys may employ two techniques: stream-reach surveys and time-constraint surveys. During stream-reach surveys, segments of streams (of pre-determined lengths) are generally sampled intensively. Time constraint surveys may be used to identify an upland plot and specific time period (i.e., hours) during which all possible amphibian habitats (e.g., down logs) are searched. The overall study design may incorporate stream sampling from a variety of forest structural stages and tree-species composition both East and West of the Cascade Crest. Sampling site selection may be coordinated with the RHA stream temperature study, as described in Section 5.1.6; Objective No. 2. Samples will be taken both before and after harvest treatments. Amphibian surveys are thought to be most effective when scheduled for spring or fall sampling, when field conditions are wet and cool. However, depending on the species or life-stage, sampling may be most effective at low flow or other times of the year. The Service and Plum Creek will work together to craft a sampling design which answers the most urgent questions with respect to management under the HCP and potential effects / benefits, while at the same time ensuring that the HCP monitoring compliments the information already available and information being collected in association with other efforts. This might mean focusing on only a few species or focusing on a limited set of circumstances.

5.2.2.3 Frequency

Amphibian surveys will be conducted over two periods of three to five years each, with data provided for the second and fourth reports (Table 34). The first period of survey work is expected to begin in 2001 pending finalization of a collaborative effort with several study groups. The second period of surveys will follow the second series of Breeding Bird surveys.

5.2.3 Small Mammal/Prey Surveys

5.2.3.1 Purpose

In the HCP, Plum Creek proposes two new stand structural classifications stages for spotted owl habitat: dispersal forest and managed old growth. Both of these forest types are presumed to provide habitat for spotted owls because they consist of key structural features necessary for spotted owl nesting and prey species. The purpose of the small mammal surveys is to verify that populations of spotted owl prey species, such as flying squirrels, are adequate within these forest structural types (i.e., managed old growth and Dispersal Forest) to provide a prey base sufficient to sustain resident spotted owls.

5.2.3.2 Scope

Small mammal surveys will be targeted for dispersal and managed old growth structural stages only. Since Murray Pacific Corporation is currently conducting small mammal studies as part of their HCP (Beak Consultants, Inc. 1993) in the Mineral Block area (i.e., West-side of the Cascades), Plum Creek may use the findings of those studies to evaluate dispersal forest conditions on the West-side of the Cascade crest. Consequently, Plum Creek's small mammal surveys will focus on East-side foraging/dispersal and managed old growth habitats. Small mammal surveys will be limited to East-side Douglas fir/grand fir stands, which comprise the majority of NRF and FD habitat on the East-side . FD habitat will be compared with NRF habitat controls. Managed old growth (MOG) habitat will be compared with unmanaged NRF habitat controls. The primary survey method will be standard 8 foot x 8-foot trapping grids with both Sherman and Tomahawk live-traps placed at each station to capture squirrels and mice. Captured mammals will be tagged and recaptured to provide a statistical estimate of density. There will be three replications of the treatment and control in dispersal stands, and three replications of the treatment and control in managed old growth stands, yielding a total of 12 trap-grids at six study sites. A minimum of nine nights of trapping at each grid will yield over 1,000 trap-nights per grid (9 nights x 64 stations x 2 traps/station). The study will be designed to sample sites that had been harvested at least 2 years prior to initiation of the surveys. Managed old growth stands may be surveyed in the spring/early summer and dispersal stands may be sampled in the late summer/fall. These periods correspond to estimated seasons of use by owls and allows for economy of scale for manpower demands. Sampling periods may be expanded from 3 years to 5 years to provide for cooperative research, whereby, subject stands and controls would be sampled for 2 years prior to treatment as well as after treatment.

5.2.3.3 Frequency

Small mammal trapping will be conducted for three consecutive years, beginning in 2004 (i.e., 2004, 2005, 2006). This time frame was selected for three reasons. First, 3 years of sampling should be sufficient to document annual fluctuations in small mammal populations imposed by weather. Second, initiating the project 7 years after HCP implementation allows time for these treatments to be designed, completed, and "rested" prior to sampling. Finally, by timing the sampling effort to allow for early data evaluation, Plum Creek and the Services will be able to evaluate the efficacy of the forest structural stages and to modify the plan accordingly if the surveys suggest that these forest stages do not provide acceptable prey densities.

5.3 Implementation Agreement

5.3.1 Unforeseen Circumstances

Congress recognized in the section 10 amendments that "circumstances and information may change over time and that the original plan might need to be revised" (H.R. Rep. No. 97-835, 97th Congress, Second Session). Accordingly the section 10 regulations (50 FR 39681-39691) require that all HCPs detail the "procedures to be used to deal with Unforeseen Circumstances".

As defined in the Implementation Agreement (Appendix 11; Section 2.10), the term "Unforeseen Circumstances" means a change in circumstances or information that might give rise to the need to revise a habitat conservation plan prepared under Section 10(a) of the ESA. The listing of any Plan species or the designation of critical habitat are not Unforeseen Circumstances.

The "Unforeseen Circumstances" section of this HCP and Implementation Agreement (Appendix 11) discuss specific measures, as appropriate, that were developed by Plum Creek in conjunction with the Services to meet the changing circumstances in the Planning Area.

The policy of the Services regarding Unforeseen Circumstances is reflected in the "No Surprises" guidance document published by the Secretary of Interior and Secretary of Commerce titled "Assuring Certainty for private landowners in

Endangered Species Act Habitat Conservation Planning," which is shown in Appendix 4 of the HCP and Exhibit 3 of the IA. This HCP and IA expressly incorporate the "No Surprises" policy by reference, but the IA governs in the event of any inconsistencies.

Because Plum Creek has adequately covered the conservation needs of the listed and unlisted species in the Planning Area, consistent with the No Surprises policy, the Services shall not seek further mitigation from Plum Creek to address Unforeseen Circumstances related to one or more of the species so long as Plum Creek is in compliance with the terms and conditions of the IA, the Permit, and the HCP. It is the intent of Plum Creek that the adaptive management and amendment process described in Section 5.3.5 of this HCP will minimize the likelihood that there will be Unforeseen Circumstances.

In the event of Unforeseen Circumstances, the Services and Plum Creek would discuss the situation and possible remedies. A number of possible remedies would be explored in succession. Remedies first explored would be those which could be accomplished through the use of flexibility or adaptive management. In the event that those actions are not practicable or are not acceptable to either party, the Services or Plum Creek may suggest an amendment. An amendment is possible at any time under this agreement if it is mutually agreeable to both parties. If an amendment is not possible, the Services may seek to obtain additional conservation or mitigation from Federal lands. The Services would also be permitted to pursue any other avenues within their means. However, the Services would be unable to impose additional mitigation upon Plum Creek except under Extraordinary Circumstances, as defined in the Implementation Agreement and discussed in the following section.

5.3.2 Extraordinary Circumstances

As defined in the Implementation Agreement (Appendix 11; Section 2.11), the term "Extraordinary Circumstances" means a substantial and material adverse change in the status of the species.

Only in the case of Extraordinary Circumstances may the Services seek additional mitigation from Plum Creek. The Services, however, have the burden of demonstrating that Extraordinary Circumstances actually exist using the best scientific and commercial data available. The Services findings of Extraordinary Circumstances must be clearly documented and based upon reliable, peer reviewed, technical information regarding the status and habitat requirements of the affected species covered by the Permit.

Additional mitigation shall be limited to the original terms of the HCP to the maximum extent possible. Mitigation shall take place first on public lands to the maximum extent possible and only as a last resort on Plum Creek lands within the Planning Area. Additional mitigation requirements shall not involve the payment of additional compensation or apply to parcels of land available for harvest or other forest-management activity or development under the original terms of the HCP without the consent of Plum Creek.

It is the intent of Plum Creek that the adaptive management and amendment procedures described in Section 5.3.5 of the HCP will minimize the likelihood that there will be Extraordinary Circumstances. If Plum Creek does not agree with the terms of the additional mitigation proposed by the Services, the Company may terminate the agreement under the terms and conditions set forth in Section 11 in the IA.

The Services may need to recommend an amendment to reallocate the level of conservation among species and habitats to avoid jeopardizing a species while avoiding imposing additional financial constraints on Plum Creek. If Plum Creek does not agree with the terms of the additional mitigation proposed by the Services, Plum Creek may terminate the Permit with respect to one or more species under the terms and conditions set forth in Section 11 of the Implementation Agreement.

5.3.3 Safe Harbor (Phase II)

5.3.3.1 Background

Plum Creek believes that implementation of the HCP may result in increases in populations of listed species on its lands, particularly if more or better habitat for listed and unlisted species is voluntarily provided in the Planning Area than was projected at the outset. If so, the incentive for any landowner, absent any special provisions, would be to reduce habitat to levels projected for the end of Phase I of the Permit, particularly if Federal law at that time provides that habitat modification or disturbance may be a form of incidental take of listed species. Plum Creek believes that it is in the best interest of the Company and listed species to have a positive incentive to attract and maintain species and to improve wildlife habitat during and beyond Phase I of the HCP. To address these concerns, Section 12 of the IA (Appendix 10), provides for a second phase.

This second phase of the HCP is modeled after the “Safe Harbor” concept. It is designed to provide an incentive to maintain habitat. It is undesirable for landowners to manage their lands to avoid providing wildlife benefits out of fear for additional regulatory requirements. Similar to the “Sandhills Agreement” (FWS 1995), the landowner would continue to avoid or minimize “direct take” and reproductive-season impacts. So long as the Baseline (defined below) is met or exceeded, any subsequent incidental taking will be authorized by the section 10(a) permit.

Unlike the “Sandhills Agreement”, the voluntary contribution of habitat under this HCP is not measured against the current Baseline. This is related to the delayed implementation of the “Safe Harbor” concept in this case. Also, in the event of early termination of this HCP, the Baseline would be more restrictive than provided in the “Sandhills Agreement”. For these reasons, the term Phase II is used to describe the “Safe Harbor” concept provided in this HCP.

To the extent that habitat conditions exceed the Baseline described below for a species, the Permit would continue after Phase I to authorize incidental take of certain Permit wildlife species and other wildlife species that become listed and are associated with that habitat for up to an additional 50 years (hereinafter "Phase II"), or until the habitat defined as the voluntary contribution is reduced to the Baseline.

Phase II is subject to the requirements for minimization and mitigation presented below under the heading **Baseline**. During Phase II, Plum Creek will report the status of the subject habitat parameters (e.g., stand structures) every 10 years to the Services.

Incidental take authorization under Phase II does not take effect until confirmed by the Services or, in the event of any disagreement, until all parties complete the dispute resolution process as described under Section 14 of the IA. Furthermore, Phase II would not take effect until the dispute resolution process is completed under Section 14.2 of the IA to determine whether additional mitigation is necessary upon early termination. Nothing in this section precludes Plum Creek from conducting forest-management activities while Phase II availability is being determined or so long as such activities are otherwise in accordance with existing law. If at any time during Phase II, the Services determine, based on reliable, peer reviewed, technical information, that Plum Creek's continued use of a Phase II incidental take authorization for a species will appreciably reduce the likelihood of the continued survival and recovery of such species, the Services may terminate the Phase II incidental take authorization for such species. Pending any dispute resolution under Section 14 of the IA, the Services may suspend such incidental take authorization.

5.3.3.2 Baseline

5.3.3.2.1 Selection of Baseline Year

As described above, and except as specifically recorded below, if the 50-year Phase I is completed, the Baseline will be the amount of habitat projected to exist at year 50 (i.e., 2045 if the Permit is issued in 1996) as described in this document, as the same may be amended from time to time. In the event that Phase I is terminated early, the Baseline would be either the amount of habitat projected to exist at year 2045 (expected Phase I termination year) or the amount of habitat existing in year 1996 (time of Permit issuance), whichever is greater and provides the most habitat for that species or Lifeform. Baselines will be calculated for each species affected, and habitat will be defined separately for each species, or groups of species pursuant to the Lifeform groupings.

Primary habitat, where such is differentiated for a given species or Lifeform, is the driving factor when comparing the amount of habitat in 1996 and 2045. In the event of early termination of Phase I, the amount of primary habitat will be used to determine whether the 1996 or 2045 Baseline applies.

For example, Lifeforms 9, 13a, and 14a have more suitable habitat projected for year 2045 than currently exists, but lesser amounts of primary habitat are projected for 2045 than currently exists. In the event of early termination, because primary habitat amounts determine the selection of Baseline year, the amounts of primary and suitable habitat available in 1996 would form the Baseline.

However, the determination of habitats available for harvest in Phase II will utilize both primary and suitable habitats as described below. In other words, both primary and suitable habitats must exceed the Phase II Baseline before Phase II would apply to a species.

5.3.3.2.2 Baseline Habitat Amounts

For the northern spotted owl, primary habitat is defined as NRF habitat, while "suitable" owl habitat is NRF and FD. In the event of early termination of Phase I, the amounts of primary habitat available for management and harvest during Phase II and under this provision would be those amounts of primary habitat that exceed the amount in 1996 (i.e., 20 percent). This is because primary habitat is the driving factor when comparing habitat amounts in 1996 and 2045. Therefore, the amount of suitable habitat comprising the Baseline is equivalent to the 1996 amount as well (i.e., 40 percent). The use of primary and suitable habitats would allow Plum Creek to substitute excess NRF habitat for deficiencies, if any, in FD. In the case of normal termination of Phase I at year 50, the amount of primary and suitable habitat comprising the Baseline is equivalent to such habitat amounts projected for 2045.

For marbled murrelets, habitat is defined by the criteria delineated in Section 3.2.1.2.

For Grizzly bears, habitat is, for the purposes of this section, the amount of security habitat as defined in Section 2.10.3.2. This is the combined total of foraging/prey, hiding/thermal, and non-forested habitats occurring in low road-density areas. This calculation of habitat would be completed for the portion of the I-90 Lakes Subunit which includes the Recovery Zone. Avoidance of prime habitats and provision of cover and escape opportunities as described in the applicable BMPs would continue during Phase II.

For gray wolves, habitat is defined as the amount of security habitat found throughout the Planning Area. Other than the geographic area, wolf security habitat is defined in a similar manner to grizzly bear habitat. Wolf habitat is that amount of habitat which remains usable due to an absence of excessive road densities. Unless the most current scientific data indicate otherwise, useable habitat will be defined using the same road densities as were applied for grizzly bears in Phase I.

For all other species, whether listed now or listed within the next 100 years, habitat will be defined using the appropriate mix of stand structures which comprise the primary and suitable habitats for the appropriate Lifeform. Stand structure amounts to be considered for these purposes are the minimum amounts (those amounts required during Phase I) that will occur on Plum Creek's lands only. These minimums reflect the flexibility provided Plum Creek to operate within a range for all of the stands structures. These minimums as they apply to Phase II, can be calculated by multiplying the values depicted for Plum Creek ownerships in Table 31b by 90 percent. The reasoning for this calculation can be found in the explanation for stand-structure flexibility found in Section 5.3.5 **Amendments and Flexibility**. However, it should be recognized that Table 31b depicts current projections for 1996 and 2045. It is expected that these values may be changed pursuant to the amendment provisions set forth in the IA. Current estimates and 1996 projections, as well as future projections, may be modified as a result of the intensive inventories to be conducted during the first 2 years of the HCP. Phase II calculations would utilize the best estimates available and the most current projections. Criteria to be met in comparison to the baseline include suitable as well as primary habitats.

Several exceptions to these methods exist. For Lifeform 5, habitat is defined based on edge habitat and requires GIS to calculate the amount of edge available. For the majority of species in Lifeform 5, road densities may play as important a role as amount of edge habitat, because high road densities sometime preclude the use of what otherwise would be usable habitat. Baselines for Lifeform 5 species will include road densities as a determining factor and will be determined prior to implementation of Phase II with regard to any such species.

With respect to fish species, the Baseline includes those riparian habitat elements necessary for properly functioning fish habitat. Fish habitat will be determined as properly functioning based on the results of both watershed analysis and monitoring. The habitat benefits appropriate for reduction during Phase II, are those habitats that if removed, do not diminish the proper function of riparian and fish habitats. Like all aquatic, riparian, and wetland species; certain habitat treatments would continue throughout all portions of Phase II:

1. Most minimum and interim treatments would continue. Buffer widths for wetlands and riparian areas would remain as prescribed in Phase I. The amount of commercial timber removed during

harvest would be no more than 50 percent from managed riparian areas provided the resulting stand would still provide FD habitat for owls. Other riparian and wetland buffers would only be harvested in accordance with the prescriptions found in Phase I. No-harvest and no-equipment zones would be maintained.

2. Watershed analysis prescriptions developed during Phase I would be followed during Phase II.
3. Stand structure projections for riparian and wetland search areas, as presented in Table 30, would form the baseline.

With respect to species which may be listed in the future, and which are inextricably linked to a particular special habitat or habitats (e.g., caves, talus, cliffs, wetlands) would not receive Phase II coverage unless the special habitat treatments specified in the HCP were continued through Phase II.

5.3.3.2.3 Baseline Minimization Efforts

In addition to the habitat provisions discussed above, steps will be taken to minimize the direct take and reproductive-season impacts upon listed species. For instance, harvesting or road building would not occur within a 0.25-mile radius of an active owl nest, goshawk nest, or occupied murrelet stand between March 1 and August 30. Wolf den sites would be protected as specified during Phase I. Eagle and peregrine falcon plans and protection measures specified in Phase I would continue in Phase II. Limited operations immediately adjacent to nesting and breeding sites which are necessary to avoid precluding successful nesting and breeding of listed species will be implemented during the breeding/rearing season. For most species, the time when young are less mobile and are limited to a given structure or geographic location is when they are most susceptible to direct impacts or abandonment.

This type of protection would be afforded other species should they become listed. For example, should wolverines be listed, restrictions for wolverines would involve the type of seasonal protections provided gray wolves under Phase I but would not include the entire home range area that might otherwise need protection to ensure that incidental take would not occur. The Services would not preclude the modification of suitable habitat having only indirect effects outside the breeding season so long as required habitat levels are maintained. If an area is subject to two or more restrictions or take-minimization methods simultaneously, and if these restrictions would otherwise preclude economic operations in the Planning Area, Plum Creek may develop site-specific plans in conjunction with the Services which would minimize the risk of death or injury to a known member of a listed species to the maximum extent practicable while at the same time, allow economic operations to continue.

5.3.3.3 Impacts

Since no take of listed species would be authorized under Phase II, except to the extent habitat conditions exceeds the baseline for a specific species, it is expected that the biological and physical conditions during Phase II should at a minimum mirror the conditions described for year 50. To invoke Phase II, Plum Creek would maintain habitats above the Baseline for the affected species. The worst-case scenario is that the voluntary contribution would be negligible; i.e., habitat amounts would be equal to those projected for year 50. Habitat conditions are expected to improve over the long-term for Federal lands in the Planning Area. However, for the purposes of this analysis, it is assumed that all such improvement would cease at year 50. Habitat amounts calculated by using the 90 percent factor across the board is also a worst-case scenario. With the exclusion of catastrophic events, the total amount of potential forested habitat should remain constant. Current levels of nonforested habitat (e.g., lakes, rock, and ice) comprise approximately **5** percent of the subject properties. Harvesting of mature stands would result in conversion to an earlier seral stage, but would not reduce the total acreage of habitats available. Therefore, actions taken by Plum Creek cannot reduce the habitats to 90 percent of projected levels for all forested stand structures simultaneously. However, Table 34 presents the amounts of habitat available to most Lifeforms, assuming a reduction to 90 percent was possible “across the board”.

Should early termination occur, conditions must exceed year 1996 or 2045, which ever is greater, in order to utilize Phase II. Therefore, conditions depicted at year 2045 for each Phase II species would always be exceeded. The analyses presented in the HCP for Phase I as they pertain to years 1996 and 2045 are therefore incorporated herein by reference.

Phase II impacts are minimized and mitigated in several ways. First, actions conducted during Phase I would benefit a host of species. These benefits will be realized by unlisted as well as listed species and many currently unlisted species are expected to benefit from the actions occurring in Phase I. Second, the level of “take” expected is variable and dependent on the amounts of habitat voluntarily provided over time. Management decisions made by Plum Creek may result in habitat amounts which exceed the Baseline. The value derived from these habitats would depend on the amount by which they exceed the Baseline and the length of time those habitats are present. Maintenance of habitat above the Baseline is considered mitigation. The level of mitigation would depend on the amounts of habitat and the length of time over which they are provided. In the case of Phase II, the mitigation must, by its very nature, occur in advance of the take. Lastly, “direct take” and reproductive-season impacts would be avoided. Avoidance of these impacts should help substantially reduce the level of impact associated with Phase II.

Should additional habitat be present during the later stages of the Permit period, the incentive for Plum Creek, absent any special provisions, would be to reduce habitat to levels projected for the end of Phase I, particularly if Federal law at that time provides that habitat modification or disturbance may be a form of incidental take of listed species. Plum Creek believes that it is in the best interest of the Company and listed species to have a positive incentive to attract and maintain species and to improve wildlife habitat during and beyond Phase I of the HCP. For example, if Plum Creek exceeded the projections for NRF habitat prior to completion of Phase I, it would be allowed to maintain that habitat for some period of time without fear of additional Federal restrictions. In the absence of Phase II, Plum Creek would have to decide whether to harvest that habitat prior to the end of Phase I or risk foregoing those profits. It is in the best interest of the resources and the Company to provide the flexibility that Phase II offers. For these reasons, Phase II offers advantages beyond those of a 50-year Phase I.

As a further assurance that impacts would be minimal, several provisions exist. In the event of early termination, a comparative standard would be used to determine the baseline. This would result in a very high Baseline for most species. In the event of completion of Phase I, the Services are provided an opportunity at year 40 for further analysis as to whether Phase II is warranted for the requested species. In addition, the Services retain the ability to invoke extraordinary circumstances at any time. Together, these provisions afford the Services assurance that impacts would be minimal and would be exceeded by the benefits accrued.

Table 34. Estimated Percentages of all Ownerships in the Planning Area Providing Primary (P) and Total Suitable Habitat (SH) for Each Lifeform at 90 Percent of the Levels Projected for Implementation of the HCP (Table 26b). Percentages are Estimates and Displayed by Decade for the 50 Year Permit Period.

Lifeform	YEAR											
	1996		2006		2016		2026		2036		2045	
	P[1]	SH[2]	P	SH	P	SH	P	SH	P	SH	P	SH
2	59	68	60	69	62	70	66	72	68	73	68	73
3	59	68	60	69	62	70	66	72	68	73	68	73
4	29	31	28	31	27	30	28	31	31	32	32	33
5	not estimated		not estimated		not estimated		not estimated		not estimated		not estimated	
6	15	46	12	45	9	43	7	42	3	40	1	39
7	23	50	25	51	24	51	22	50	20	49	18	48
8	23	47	31	53	31	53	25	51	21	48	15	45
9	23	47	21	46	24	51	22	50	20	49	18	48
10	52	62	50	62	59	67	65	71	68	72	69	72
11	52	65	50	64	59	68	65	72	68	73	69	74
12	59	61	60	63	62	65	66	68	68	72	68	72
13	48	58	44	55	45	59	51	63	55	65	60	67
13a	36	42	35	45	35	57	37	58	38	58	41	60
14	48	63	44	61	45	62	51	65	55	67	60	69
14a	36	42	35	40	35	40	37	44	38	46	41	51
15 (early)	26		29		20		14		10		9	
15 (middle)	16		14		23		28		31		28	
15 (late)	36		35		35		37		38		41	
16	59	68	60	69	62	70	66	72	68	73	68	73

[1] – Percentage of the HCP search area containing Primary Habitat

[2] - Percentage of the HCP search area containing Suitable Habitat = Primary Habitat + (Secondary Habitat/2)

[3] - Percentage of the HCP Planning Area within 0.5-miles of an "edge" between forage and cover habitats

[4] – Expresses the percentage of habitat in the HCP Planning Area containing early, middle, and late-aged forests.

Search Area: RHAs only (Lifeforms 1, 2, 3, 6, 7, 9, 12, 16); Rocks and Talus (Lifeform 4); Entire Planning Area (Lifeforms 8, 10, 11, 13, 13a, 14, 14a, 15)

5.3.3.4 Alternatives

Plum Creek considered several alternatives to the "Safe Harbor" concept presented herein. A No-Action scenario would mean that Plum Creek would be encouraged to harvest habitats which exceed the HCP projections as the end of Phase I was approached to minimize regulatory restrictions. Plum Creek wishes to avoid this type of disincentive to proper management and would prefer to have the option of providing additional habitat instead of liquidating habitat in fear of regulatory constraints. For this reason, Plum Creek did not choose the No-Action Alternative. Other alternatives considered were a 100-year Phase I, periodic renewal of the Permit, and consensual or unilateral Phase I extensions. The end result of these alternatives would likely be similar biologically; however, the Proposed Plan offers greater certainty to Plum Creek than alternatives involving review and revisions. The 100-year Phase I alternative was not chosen by Plum Creek because it believed 100 years was an excessive period of time for Phase I due to uncertainties of economic projections and operations (i.e., rotation ages).

5.3.4 Land Sales or Exchanges

5.3.4.1 Land Acquisition within the Planning Area

Either through land exchange or purchase, Plum Creek may acquire ownership of lands within the Planning Area. Because this HCP has considered the effect of covered activities on listed species within the Planning Area, and has adequately addressed the needs of unlisted species, Plum Creek may acquire lands within the Planning Area and add them to the HCP. Activities conducted on these acquired lands within the Planning Area would also be covered by the Permit unless there would be an increase in the level of incidental take for any listed species above the amount analyzed in connection with this HCP. Lands added to the HCP under this section would become part of Plum Creek's ownership (i.e., Project Area in the IA) in the Planning Area and would be managed in accordance with the mitigation and implementation plan in the HCP.

The Services may require a formal amendment of the Permit to cover acquired lands if there would be an increase in the level of incidental take for any listed species above the amount analyzed in connection with this HCP or Plum Creek may choose not to add the acquired lands to the HCP.

5.3.4.2 Land Sales or Exchanges with the Federal Government

The HCP contemplates that Plum Creek may sell or exchange certain Company lands within the Planning Area to the Federal Government. Upon completion of the sale or exchange, lands acquired by the Federal Government would be managed in accordance with the Northwest Forest Plan, which would maintain healthy riparian corridors, and provide functional, interactive, late-successional and old growth forest ecosystems for a multitude of wildlife species. Activities conducted on the lands acquired by the Federal Government would NOT be covered by Plum Creek's Permit. Lands sold or exchanged by Plum Creek would no longer be part of Plum Creek's ownership or be managed in accordance with the mitigation and implementation plan in the HCP.

There are generally three scenarios under which land sales or exchanges with the Federal government could occur in the Planning Area. Under the first two scenarios described below, the biological integrity of the HCP would be either maintained or improved. Although not contemplated by Plum Creek, the effects of the third scenario on the biological integrity of the HCP is unclear, but such an exchange would likely require implementation of the formal amendment process.

The first, and perhaps the most favorable in terms of the long-term goals of the Northwest Forest Plan, would involve exchanging Plum Creek owned lands in the Planning Area for government owned lands outside of the Planning Area. Such an exchange would increase the total acres of land within the Planning Area covered by the Northwest Forest Plan.

Such an exchange may also:

1. reduce the total amount of harvest activity in the Planning Area;
2. maximize the amount of late-successional forest, creating more NRF habitat for spotted owls; and
3. increase the size of riparian reserves along streams, wetlands, ponds, lakes, and unstable or potentially unstable areas where the conservation of aquatic and riparian-dependent terrestrial resources receive primary emphasis.

Reductions in harvest activity combined with the components of the Aquatic Conservation Strategy would be expected to enhance the capability of riparian reserves to maintain and restore riparian structures and functions, benefit fish and riparian-dependent non-fish species, enhance habitat conservation for organisms dependent upon the transition zone between upslope and riparian areas, improve travel and dispersal corridors for terrestrial animals and plants, and provide greater connectivity of late-successional forest habitat.

Under a second scenario, Plum Creek would exchange Company lands owned in the Planning Area that are intermingled between federally designated LSR/AMA and Matrix areas. Such an exchange would increase the acreage of Federal ownership in late-successional and old growth forest habitat in LSRs and AMAs in the Planning Area, and would reduce Federal ownership in Matrix. Since the Forest Service would likely harvest less aggressively in LSRs and AMAs than in Matrix, this could result in an overall reduction in available harvestable area for the Forest Service in the Planning Area. However, the Forest Service has been directed (USDA 1994) to consider land exchanges involving LSRs and AMAs. For LSRs;

> *Land exchanges involving Late-Successional Reserves will be considered if they provide benefits equal to or better than current conditions. Consider land exchanges especially to improve area, distribution, and quality (e.g., connectivity, shape, contribution to biodiversity) of Late-Successional Reserves, especially where public and private lands are intermingled (e.g., checkerboard ownership) (USDA 1994; page C-17).*

For the Snoqualmie Pass Adaptive Management Area (SPAMA) the primary emphasis of the Forest Service is the "Development and implementation, with the participation of the U.S. Fish and Wildlife Service, of a scientifically credible, comprehensive plan for providing late-successional forest on the checkerboard lands" (USDA 1994; page D-16).

A third scenario involves Plum Creek exchanging Company lands owned intermingled between Federal lands in Matrix, for Federal lands in LSRs and/or AMAs, in the Planning Area. Such an exchange would decrease the total acreage of Federal ownership in LSRs and AMAs, and increase Federal ownership in the Matrix, in the Planning Area. This could result in an overall increase in available harvestable area for the Forest Service in the Planning Area. However, an exchange as described is not contemplated by Plum Creek and furthermore, it would likely require a formal amendment to the HCP to ensure the continued biological integrity of the HCP and to support the objectives for LSRs as outlined in the Standards and Guidelines in the Record of Decision (USDA 1994). The Record of Decision specifically states that, *"Late-Successional Reserves are to be managed to protect and enhance conditions of late-successional and old growth forest ecosystems, which serve as habitat for late-successional and old growth related species, including the spotted owl"* (USDA 1994; page C-11). Furthermore, all silvicultural treatments inside LSRs must ensure that the treatments are beneficial to the creation of late-successional forest conditions, or in the case of younger stands in LSRs, silvicultural treatments must accelerate development of late-successional conditions while making the future stands less susceptible to natural disturbances (USDA 1994). If Plum Creek obtained more land in LSRs in the Planning Area, the Company's harvest plan and silvicultural activities would not be aimed at creating late-successional and old growth forest conditions.

The Services may require a formal amendment of the Permit to cover the sale or exchange of Plum Creek's lands if there would be an increase in the level of incidental take for any listed species above the amount analyzed in connection with the HCP, or where the integrity of the HCP may be compromised.

5.3.4.3 Land Sales or Exchanges with Non-Federal Government Parties

Historically, Plum Creek has participated in very few small land transactions in this area with non-governmental parties, and none are currently anticipated. However, to ensure flexibility without compromising the effectiveness of the HCP, Plum Creek may sell or exchange Company lands within the Planning Area to non-government parties subject to the following limitations: (1) any lands may be sold or exchanged to a nonprofit organization or other private entity, provided appropriate covenants or assurances are given by the acquiring party to the Services that such lands will be managed consistent with the goals and objectives of the HCP or at least in a way beneficial to the species in the Planning Area; and (2) parcels of land, not in excess of 640 acres other than those lands subject to harvest deferrals for up to 20 years during the deferral period only, may be sold to any private party without restriction so long as the cumulative total of all such transactions does not exceed 5 percent of the acreage covered by the Permit and the cumulative total of all such transactions in any one township does not exceed 1,920 acres. The Services will review any proposed sale or exchange to ensure that the mitigation requirements of the HCP will still be met with respect to Plum Creek's remaining lands. In addition to the limitation placed on the total acreage eligible to be transferred to other ownerships and review of each transaction by the Services to ensure HCP mitigation compliance, additional factors contribute to ensuring deminimus impacts on HCP objectives: (1) it is unlikely that spotted owl NRF habitat would be selectively transferred and thus, only a small percentage of any sale would consist of such habitat; (2) it is unlikely that riparian and instream habitat along fish-bearing streams would be selectively transferred and thus, only a small percentage of any sale would consist of such habitat; and (3) after 5 years, watershed prescriptions, developed through watershed analysis conducted by Plum Creek in the Planning Area, will replace State Forest Practices Rules and Regulations regardless of future ownership.

5.3.5 Amendments and Flexibility

At a minimum, Plum Creek's forest-management strategy will follow State Forest Practices Rules and Regulations, including watershed analysis, as the same may be amended from time to time. Similarly, Plum Creek expects that adjustments to its forestry operations throughout its ownership in the Planning Area, while maintaining consistency with the Company's Environmental Principles, may be necessary from time to time during the Permit period. Plum Creek also expects to achieve continuous improvements in learning through experience and experimentation during implementation of the HCP. Changes in the conduct and flexibility of Plum Creek's operations such as harvest timing, harvest location, and application of silvicultural techniques such as commercial thinning, pruning, or fertilizing may be incremental and extended over time, but will not require amendment of the HCP or Permit. Similarly, certain aspects of the HCP (e.g., protection strategy for wolf dens) provide for variances upon discussions with the Services. These will, likewise, not require amendment of the HCP or Permit.

Another operational issue, which could be addressed as a minor modification under Section 7.3.2 of the IA, involves seasonal closures. The HCP provides for seasonal closures to protect habitat for certain species when predetermined conditions exist. If an area is subject to two or more seasonal closures simultaneously, and if these closures prohibit effective operations on Company lands, then Plum Creek would develop site-specific plans which would establish closures to create effective protection for the species while at the same time, allow operations to continue.

Amendments to the HCP and Permit are addressed in the IA under Section 7.0. Material changes to the HCP or Permit will be effected under the process identified in Section 7.1 of the IA, which outlines a formal process that will be used for major amendments. However, situations may arise that require changes, but the changes will not warrant application of the formal amendment process. Section 7.3.2 of the IA addresses minor modifications, which can be made by consensual agreement between Plum Creek and the Services without the need to activate the formal amendment process. Modifications anticipated through Adaptive Management are addressed in Section 5.4 of the HCP and Section 7.3.3 of the IA.

Plum Creek and the Services cannot anticipate all circumstances that might arise in the future. The situations described in the remainder of this section represent only examples of circumstances that may warrant flexibility and administration as minor amendments. Future situations, that may arise from time to time, can be compared to the examples to determine the necessary level of flexibility and the process needed to amend the HCP. Plum Creek expects that new information concerning the efficacy of the mitigation program will emerge that warrant changes in the HCP. Most changes should be able to be accomplished through the minor modification provisions of Section 7.3.2 of the Implementation Agreement (IA) so long as the net effect on the species resulting from the change is not significantly different from that anticipated under the original Permit and expected incidental take remains within the level (the relationship between the impact and severity of the take and the associated minimization / mitigation measures remains equivocal) authorized under the Permit.

In another example, new information may disclose that dispersal habitat definitions for the northern spotted owl require less or greater canopy cover than previously allotted. To better tie mitigation to the needs of the species, minor modifications to the HCP might be allowed to incorporate new canopy-cover objectives.

Another example might be minor modification or alteration of stand structure/Lifeform habitat projections that are based on the results of monitoring over time or new information from the increasing body of scientific literature. The data and models used to prepare the HCP will be updated from time to time to increase the accuracy and amount of information available. In addition, management units developed for the analysis may be restructured to better reflect operational constraints. More accurate information on forest stand structures will improve Plum Creek's ability to evaluate the availability of habitat for the various Lifeforms. Projections of stand structures and Lifeform habitat could be impacted during the Permit period, with no discernable physical change to the landscape or harm to the species. The stand structure classifications used in the HCP will be projected annually as new information becomes available. If an individual class varies by more than 10 percent from the original projection, then that stand structure and all stand structures in older categories will be evaluated as a composite group. If a group is within 10 percent of the projected values, then no further action will be required. If an individual class varies by more than 20 percent or a group of classes varies by more than 10 percent from the original projections, then Plum Creek will initiate discussions with the Services to determine the cause and potential impact of the stand structure variance on Lifeforms in the Planning Area. If both parties agree that the stand projections have not been achieved despite Plum Creek's good faith efforts, and there is no significant impact on Lifeforms, minor modifications to the mitigation program in the HCP may result in the establishment of a new projection or time frame or the targets in the HCP may be amended.

The frequency and scope of monitoring may be changed if the objectives of the survey can be achieved by a different frequency of surveys or by a different intensity. For example, in some instances, it may be appropriate to increase the frequency of particular surveys from five consecutive years, to two separate 3-year periods conducted a decade apart to better evaluate potential impacts over time.

As discussed in this section, minor modifications may be made upon mutual consent of the parties from time-to-time. These modifications are generally documented by the exchange of letters between the Services and Plum Creek. Such minor modifications have and should generally address the current provision being modified, the modification provision, the rationale for the change, the effect on the species, and the conclusion regarding whether the modification is minor. Explicit statements shall be used as to whether the responding party agrees or disagrees. Responses indicating agreement with certain stipulations should be viewed as a proposal in and of itself and warranting a response. These letters will document the modification.

Modifications (modified text) will be incorporated into the field manual. The most-recent version of the field manual will be made available to the Services following the revisions.

Future minor modifications will not require printing the entire HCP document, as was done for this December 2000 revision. Much of the information in this document was changed as a result of changing ownership and not directly as a result of a minor modification. Future changes will result in a revision of the applicable sections of this document (Sections 3 and 5), not a revision of the document in its entirety. Most changes are expected to be reflected through updates to the field manual.

5.3.6 Funding

As set forth under Section 3.7 of the HCP and Section 5 in the IA, Plum Creek has sufficient financial resources to, and by the IA does commit to, fund its affirmative obligations under the HCP.

5.4 Adaptive Management

5.4.1 Introduction

Although a significant body of scientific information and expertise was used to develop Plum Creek's Cascades HCP, not all of the questions about the long-term effects of HCP implementation on fish and wildlife species and their habitats can be answered with total certainty today. However, uncertainty can be addressed by implementation of an adaptive management approach, which incorporates research, and monitoring into a responsive program to evaluate the HCP as a "management experiment" that may be modified as necessary to meet objectives.

The purpose of this section is to identify components of the HCP where concepts of adaptive management can be applied. This section also establishes the process and conditions upon which modification of the plan would be deemed necessary. It is important to note that incorporation of an adaptive management strategy into the HCP is compatible with the Northwest Forest Plan for adjacent Federal lands, which includes a large Adaptive Management Area where the concept of adaptive management will also be included and addressed (USDA 1993). Consequently, Plum Creek views the coordination of research and monitoring activities relative to adaptive management with the Forest Service as being both desirable and essential to the success of land management strategies in the Planning Area.

Adaptive management is a process that can improve management practices incrementally by implementing plans in ways that maximize opportunities to learn from experience. Adaptive management (Thomas et al. 1990; Eberhardt 1988; Holling 1978; MacNab 1983, 1985; Romesburg 1981; Walters 1986) can provide a reliable means for assessing the HCP, producing better ecological knowledge, and developing appropriate modifications to improve forest management. The primary challenge for using an adaptive management approach is to demonstrate simply and clearly why a change in management would be worthwhile.

If, through a change in circumstances or new information, changes to the HCP are warranted that would increase the level of mitigation required under the HCP, the Unforeseen/Extraordinary Circumstances provisions in Section 8.0 of the IA shall govern. However, Section 5.4.2 discusses adaptive management practices that may involve, within prescribed limits, additional mitigation beyond that specifically addressed in the HCP.

5.4.2 Elements of Adaptive Management for the HCP

Described below are the important elements that define the process for incorporating adaptive management into the HCP. The process is linked to the research and monitoring program and the designated reporting intervals for Plum Creek and the Services to evaluate the HCP.

5.4.2.1 Research and Monitoring

In adaptive management, research blends with monitoring. Whereas the function of monitoring is to test hypotheses specific to the HCP, research will compare predictions and assumptions of hypotheses stemming from the HCP and alternative landscape options and stand treatments. Therefore, it is important that research projects are designed to make use of data collected in monitoring. Monitoring is particularly important in detecting trends in key areas such as watershed health and spotted owl demography which, if negative, will trigger corrective action in the HCP before long-term habitat damage has occurred. Research will be designed to provide alternatives for management if necessary, such as alternative management practices for water quality or revised criteria for spotted owl habitat types and location in the Planning Area.

5.4.2.2 Thresholds for Triggering Corrective Action

A key element of adaptive management is the establishment of testable hypotheses tied to management objectives. Should resultant monitoring determine that biological conditions are outside the “bounds” estimated in the HCP, Plum Creek and the Services will review assumptions, refine models and modify management to protect public resources. These “thresholds” for triggering corrective action must be linked to key elements of the HCP by being related to statistically significant, biologically relevant elements and obtainable through monitoring data collected during the Permit period.

5.4.2.3 Analysis of Causative Actions

Should biological conditions be determined to have deviated from those predicted or estimated in the HCP, additional analysis would be conducted and discussed with the Services to determine if the deviation is caused by management actions taken in the HCP or by external factors independent of the HCP. Examples of external factors are changes in predicted habitat conditions as a result of activities on Federal land, or naturally occurring events such as catastrophic fires. Another example may be changes in spotted owl demographics due to competition with barred owls or predation by goshawks. Adaptive management will be used to evaluate the success of Plum Creek’s HCP in achieving stated ecological objectives. Corrective actions taken by Plum Creek to modify mitigation and management under the HCP will be based on “nonachievement” of specific HCP objectives rather than on conditions created by external causes.

5.4.2.4 Modification of Management and Mitigation Elements

If biological conditions have deviated from desired levels estimated in the HCP, and the deviations are due to actions instigated by implementation of the HCP, then appropriate “mid-course corrections” will be taken to effect desired outcomes. Adjustments in management strategies will result in changes in the levels of mitigation provided in the HCP. Changes in management and mitigation will be determined by monitoring data, guided by research results, and consistent with limits specified under Section 10 of the IA. For instance, harvest deferrals to maintain NRF habitat around selected sites may be moved, extended or increased if predicted levels of use are not achieved. Adaptive management feedback “loops” to evaluate monitoring data and determine necessary corrective actions would be synchronized with 5- and 10-year HCP review periods currently specified in Section 5.1.2 and Table 34.

5.4.3 Opportunities For Adaptive Management

Several aspects of the HCP, including watershed analysis, spotted owl management, and RHAs, are particularly amenable to adaptive management. These aspects are examined below in relation to the elements of adaptive management discussed earlier.

5.4.3.1 Watershed Analysis

Watershed analysis is a systematic procedure to assess physical and biological processes within a watershed and provide information necessary for developing management prescriptions to protect or restore aquatic habitat and riparian functions while allowing for compatible commercial forestry. An important component of watershed analysis is monitoring to assess the effectiveness of remedial prescriptions in addressing and correcting causative factors for watershed deterioration and damage. Thresholds for determining when revision of remedial prescriptions is necessary are built into the process and reviewed every 5 years. The aquatic monitoring section of the HCP (Section 3.3.5) was designed to support watershed analysis and would be incorporated into the development and reevaluation of management prescriptions for watersheds that are reviewed. HCP standards and guidelines would be modified for individual watersheds as a result of scheduled watershed analysis reviews. This would be accomplished through adaptive management. Modifications prescribed by watershed analysis would be implemented by Plum Creek.

5.4.3.2 Spotted Owl Management Strategy

The spotted owl management strategy is a management experiment based upon empirical data and a predictive RSPF model (Irwin and Hicks 1995) for estimating the amount and juxtaposition of habitat needed to avoid impacts. Spotted owl monitoring will be directed at verifying the assumptions of the RSPF model and effectiveness of spotted owl deferrals at selected owl sites. The RSPF model would also be tested in other landscapes supporting owls outside the Planning Area. Additionally, the model would evaluate the Planning Area using current habitat conditions to generate a revised estimate of spotted owl carrying capacity, and compared against current occupancy of designated survey areas. Should the revised estimates be found to be lower than those predicted currently, concern would exist about the viability of the owl strategy and may require a modification of some elements of the strategy. Action would be necessary if the revised estimate of spotted owl carrying capacity was less than 80 percent of the predicted level, based on monitoring data, and a peer-reviewed opinion by the Services that the problem is due to conditions caused by the HCP or miscalculation of owl response to the habitat provided. Peer review of the scientific data on which the opinion is based will be conducted consistent with Section (B)(1) of the interagency cooperative policy for peer review in the ESA (59 FR 34,270).

The opinion should also show conclusively that modifications of the HCP would remedy conditions in a substantive way. Corrective actions could include the redesign of NRF deferrals and FD corridors to change location, deferral period, or number stands to be deferred. However, redesign of NRF blocks and FD corridors based upon monitoring data and research results are consistent with the principles of adaptive management. The total amount of owl habitat to be maintained on Plum Creek's land will not be increased from levels specified in the HCP, except as provided under Section 8 in the IA (Extraordinary Circumstances).

5.4.3.3 Riparian Management Strategy

The riparian management strategy is directed at three primary objectives: fish habitat protection, Lifeform support (particularly amphibians), and spotted owl habitat. The strategy specifies different practices for fish-bearing and nonfish-bearing streams. The design for riparian protection zones around these streams can be viewed as a "management experiment" and should be reviewed in light of adaptive management principles. Monitoring will be directed at pre-and post-harvest comparisons of structural components in the riparian zone as well as sampling for amphibian use. Thresholds for triggering corrective action will be developed from two monitoring projects: (1) amphibian surveys linked to RHA monitoring (Section 5.2.2) and (2) breeding bird surveys to verify Lifeform composition and orientation to forest structural stages (Section 5.2.1). Corrective actions could include changing the riparian buffer design to include larger or smaller zones, more or less (or different) structural retention guidelines, or extending protection to additional stream areas and types. Direct management action to create or to maintain early successional habitat in RHAs (through timber harvest, prescribed burning, or a combination thereof) to support some Lifeforms (e.g., Lifeform 6) may be warranted as a result of this analysis.

5.4.3.4 Cooperative Experimental Areas

For adaptive management to be beneficial for ecosystem management, monitoring and research must be "multi-scale," that is, designed and completed at several levels beginning with the individual stand-or stream-level to the landscape and watershed level. As stated earlier, the Forest Service has both a large ownership and vested interest in research and monitoring to support adaptive management in the Planning Area. The HCP does not require the Forest Service and Plum Creek to cooperate on research and monitoring efforts. However, cooperation and coordination on research and monitoring to support adaptive management is desired in order to address issues of common concern, conserve costs by combining efforts, and investigate biological relationships at a meaningful scale. Adjustments to prescriptions and operations may be necessary to accommodate these efforts. Such adjustments would be made only with the mutual consent of Plum Creek and the Services.

5.4.4 Research Program

Adaptive management is based on the premise of treating resource management activities as management experiments while formulating testable hypotheses to reliably evaluate success in achieving desired objectives. The research and monitoring program described in the HCP has been designed to address key aspects of the HCP where assumptions and modeling were used to bridge a lack of empirical data or experience. Listed below are potential research questions which could become the basis for hypothesis testing within the Planning Area.

5.4.4.1 Stand Scale

5.4.4.1.1 Watershed Analysis

- Are extended buffers around migrating channels effective?
- Are LWD recruitment rates from RHAs being met?
- Are pool habitat frequencies increasing, decreasing, or remaining static?

5.4.4.1.2 Spotted Owl Strategy

- Are prey densities in dispersal forest and managed old growth stands adequate?
- Is spotted owl use of contoured patch retention units as FD comparable to dispersed tree retention units?

5.4.4.1.3 Riparian Management Strategy

- Are there significant differences in structural characteristics between "no-harvest" and partial cut portions of RHAs?
- Are "clumped" RLTA prescriptions more effective than "linear" pattern RLTAs?

- Do burned areas that are naturally regenerated support more Lifeforms than managed second growth stands?

5.4.4.2 Landscape Scale

5.4.4.2.1 Watershed Analysis

- Are sediment budgets to reduce fine sediment from roads effective?
- Are RHAs and RLTAs effective in ameliorating stream temperature?

5.4.4.2.2 Spotted Owl Strategy

- Are FD corridors functioning to provide connectivity between cluster sites?
- Do habitat use patterns for spotted owl vary between FMAZ or Landtype Associations?

5.4.4.2.3 Riparian Management Strategy

- Are early successional habitats created and maintained in riparian areas alleviating predicted declines in Lifeform 6 species?
- Are there significant differences in species richness or species density between RHAs on Plum Creek land and RCAs on Forest Service land?

Figure 55
Northern Spotted Owl Monitoring Demographic Study Areas
Post I-90 Land Exchange

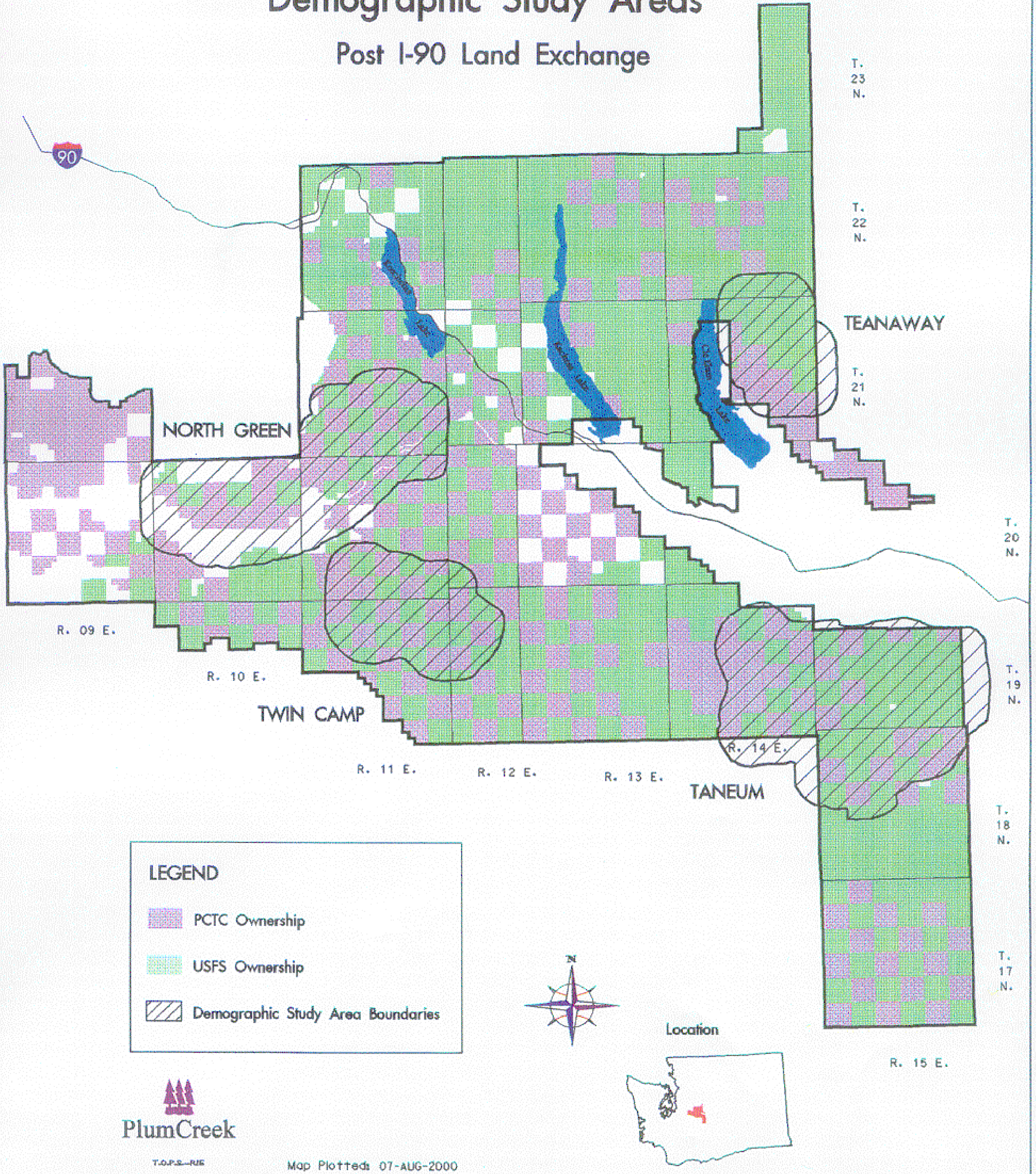
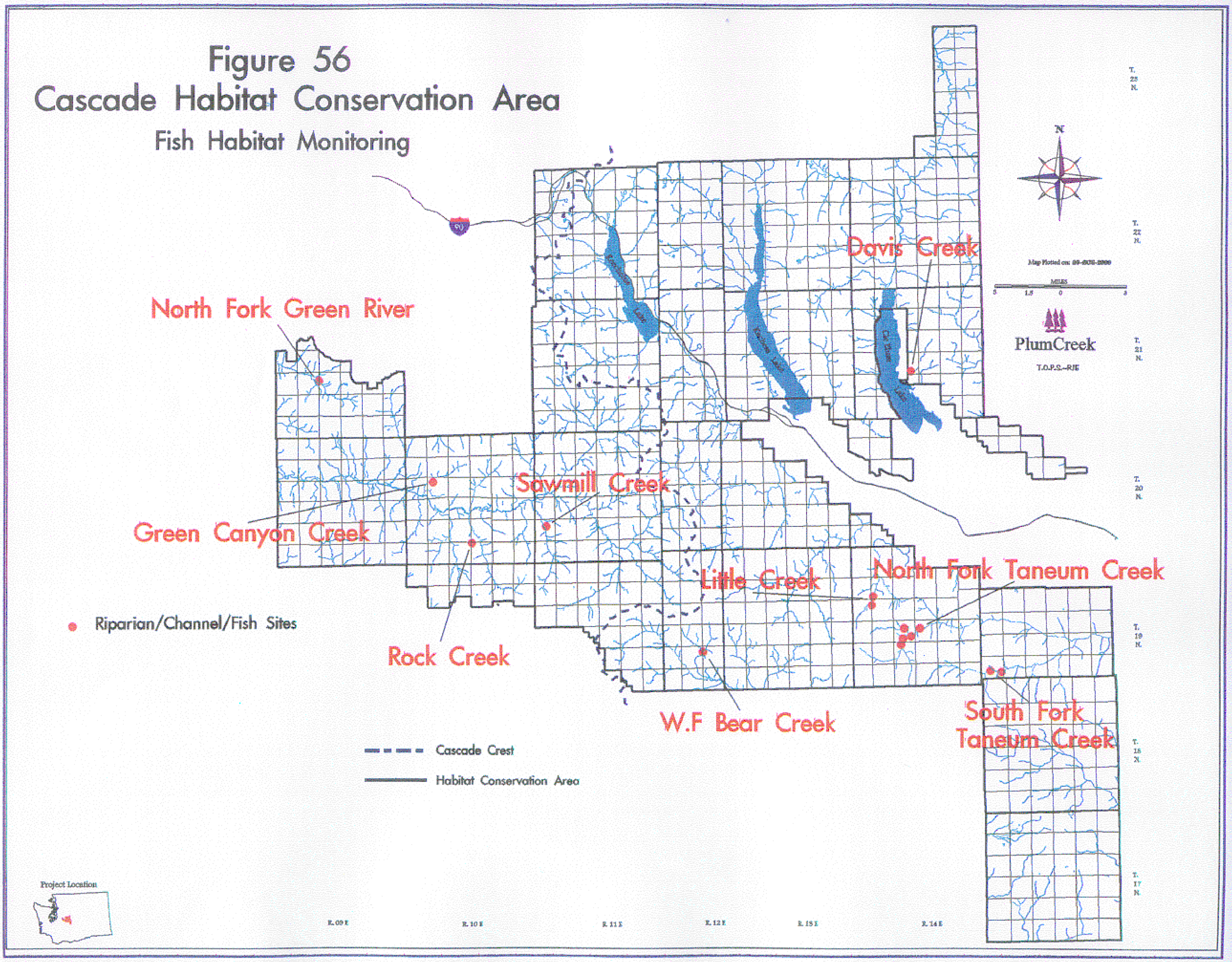


Figure 56
Cascade Habitat Conservation Area
Fish Habitat Monitoring



Section 6.0

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Section 7.0

Glossary

7.0 Glossary

7.1 Abbreviations and Acronyms

A	
ADK	Adaptive Kernal Estimator
AMA	Adaptive Management Area
B	
BMP	Best Management Practices
C	
CFS	Cubic Feet per Second
CFR	Code of Federal Regulations
D	
DBH	Diameter at Breast Height
DCA	Designated Conservation Area
DF	Dispersal Forest
DNR	Washington State Department of Natural Resources
DOE	Washington State Department of Ecology
E	
ESA	Endangered Species Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
F	
FD	Foraging and Dispersal
FEMAT	Forest Ecosystem Management Assessment Team
FWS	U.S. Fish and Wildlife Service
G	
GIS	Geographical Information Systems
H	
HCA	Habitat Conservation Area
HCP	Habitat Conservation Plan

I	
IA	Implementation Agreement
IMMC	Interagency Marbled Murrelet Committee
IFIM	Instream Flow Incremental Methodology
IRPP	Instream Resource Protection Program
ISC	Interagency Scientific Committee
L	
LFA	Limiting Factor Analysis
LSR	Late-Successional Reserve
LWD	Large Woody Debris
M	
MCP	Minimum Convex Polygon Estimator
MBF	Thousand Board Feet
MMBF	Million Board Feet
MF	Mature Forest
MOG	Managed Old Growth
N	
NEPA	National Environmental Policy Act
NRF	Nesting, Roosting, and Foraging
NWPPC	Northwest Power Planning Council
NWTIC	Northwest Tree Improvement Cooperative
O	
OG	Old Growth
ORD	Open Road Density
P	
PACFISH	FWS Pacific Salmon and Steelhead Strategy
PHS	Priority Habitat and Species
PT	Pole Timber
Q	
QMD	Quadratic Mean Diameter
R	
RCA	Resource Conservation Area

RHA	Riparian Habitat Area
RLTA	Riparian Leave Tree Area
RM	River Mile
RMZ	Riparian Management Zones
ROD	Record of Decision
RSPF	Resource Selection Probability Functions
S	
SAG	Scientific Advisory Group
SEA	Special Emphasis Area
SI	Stand Initiation
SOHA	Spotted Owl Habitat Areas
SPAMA	Snoqualmie Pass Adaptive Management Area
SS	Shrub/Sapling
U	
UMA	Upland Management Areas
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USDI	U.S. Department of the Interior
W	
WAU	Watershed Administrative Unit
WDFW	Washington Department of Fish and Wildlife
WMZ	Wetland Management Zone
Y	
YF	Young Forest
YIN	Yakama Indian Nation

7.2 Definitions

A	
Activity Center	A nest site or primary roost area, synonymous with “spotted owl site.”
Age Class	A management classification using tree stand age.
Alluvial	Originated through the transport by and deposition from running water.
Anadromous Fish	Fish that are born and reared in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce.

Aquatic Ecosystem	Any body of water, such as a stream or lake, and all organisms and non-living components within it, functioning as a natural system.
At-risk Fish Stocks	Stocks of anadromous salmon and trout that have been identified by professional societies, fish management agencies, and in the scientific literature as being in need of special management consideration because of low or declining populations.
B	
Basal Area	The cross-sectional area of trees including bark per unit area, measured at breast height, or approximately 4.5 feet above ground, and read as: square feet per unit area.
Best Management Practices	Methods, measures, or practices designed to prevent or reduce water pollution. Not limited to structural and nonstructural controls, and procedures for operations and maintenance. Usually, BMPs are applied as a system of practices rather than a single practice.
Biological Diversity	The variety of lifeforms and processes, including a complexity of species, communities, gene pools, and ecological functions.
Biological Legacies	Large trees, down logs, snags, and other components of the forest stand left after harvesting for the purpose of maintaining site productivity and providing structures and ecological functions in subsequent stands.
Blowdown	Trees felled by high winds.
Breast Height	Approximately 4.5 feet above ground level, at which trees are measured for diameter, girth, or basal area.
Buffer Zone	An area of vegetation left or managed to reduce the impact of a treatment or action of one area on another.
C	
Candidate Species	Those plants and animals included in Federal Register “Notices of Review” that are being considered by the U.S. Fish and Wildlife Service for listing as threatened or endangered. There are two categories of primary concern Category 1. Taxa for which there is substantial information to support proposing the species for listing as threatened or endangered. Listing proposals are either being prepared or have been delayed by higher priority listing work. Category 2. Taxa information indicates that listing is possibly appropriate. Additional information is being collected.
Canopy	A layer of foliage in a forest stand. This most often refers to the upper most layer of foliage, but it can be used to describe lower-layers in a multi-storied stand.
Canopy Closure	The degree to which the canopy blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken directly under the canopy.
Carrying Capacity	The maximum number of organisms that can be supported in a given area of habitat at a given time.
Catastrophic Event	A large-scale, high intensity natural disturbance that occurs infrequently.
Cavity Nester	Wildlife species, most frequently birds, that require cavities (i.e., holes) in trees for nesting and reproduction.
Center of Activity	The nest site of a breeding pair of owls or primary roost area of a territorial individual owl.
Channel Disturbance Zone	Includes the stream, channel migration zone (i.e., 100-year flood-plain), and areas which may be prone to channelized debris flows.

Checkerboard Ownership	Land ownership pattern in which alternate sections (i.e., square mile) are in private ownership as a result of Federal land grants to early Western railroad companies.
Clear-cut	Common harvest/regeneration practice which removes all or nearly all trees from an area in a single cutting in order to regenerate a new even-aged stand, fully exposed to sunlight.
Clear-cut Harvest	A timber harvest method in which all trees are removed in a single entry from a designated area, with the exception of wildlife trees or snags, to create an even-aged stand.
Closely Associated Species	A species is designated as “closely associated” with a forest successional stage if the species is found to be significantly more abundant in that forest successional stage compared to the other successional stages, if it is known to occur almost exclusively in that successional stage, or if it uses habitat components that are usually produced at that stage.
Cluster	An area that contains habitat capable of supporting three or more breeding pairs of spotted owls with overlapping or nearly overlapping home ranges.
Coarse Woody Debris	Portion of a tree that has fallen or been cut and left on the forest floor. Usually refers to pieces of wood at least 20 inches in diameter.
Colonization	The establishment of a species in an area not currently occupied by that species. Colonization often involves dispersal across an area of unsuitable habitat.
Commercial Thinning	The removal of merchantable trees through thinning to assure adequate growing space and crown area for the remaining trees, to increase volume growth and prevent stagnation, to remove poor quality trees, to recover anticipated mortality, to obtain wood products and positive cash flow, to receive an early return on investment, and to decrease final harvest costs.
Community	Plant and animal species living in close association and interacting as a unit.
Connectivity	A measure of the extent to which conditions among old growth forest areas provide habitat for breeding, foraging, dispersal, and movement of old growth-associated wildlife species.
Conservation	The process or means of achieving well-distributed plant and animal populations throughout the planning area.
Conservation (Planning) Area	Designated land where conservation strategies are applied for the purpose of attaining well-distributed plant and animal populations.
Conservation Strategy	A management plan for a species, group of species, or ecosystem that prescribes measures that if implemented provide a high likelihood that the species, group of species, or ecosystem, with its full complement of species and processes, will continue to exist throughout the conservation (planning) area.
Contiguous Habitat	Habitat suitable to support the life needs of a species that is distributed continuously or nearly continuously across the landscape.
Core Area	That area of habitat essential in the breeding, nesting, and rearing of young, up to the point of dispersal of the young.
Corridor	A defined tract of land, often linear, through which a species must travel to reach habitat suitable for reproduction and other life-sustaining needs.
Cover	Vegetation used by wildlife for protection from predators, to migrate, or to reproduce.
Critical Habitat	Under the Endangered Species Act, critical habitat is defined as: (1) the specific areas within the geographic area occupied by a federally listed species on which are found physical and biological features essential to the conservation of the species, and that may require special management considerations or protection; and (2) specific areas outside the geographic area occupied by a listed species, when it is determined that such areas are essential for the conservation of the species.

Crown	The upper part of a tree or woody plant bearing live branches and foliage.
Crown Cover	The ground area covered by the crowns of trees or woody vegetation as delimited by the vertical projection of crown perimeters and commonly expressed as a percentage of total ground area.
Cull	A tree or log that does not meet merchantable specifications.
D	
Decommission	To remove those elements of a road that reroute hillslope drainage and present slope stability hazards.
Demography	The quantitative analysis of population structure and trends. Also known as population dynamics.
Designated Conservation Areas (DCAs)	A continuous area of habitat on Federal lands to be managed and conserved for spotted owls under the Final Draft Recovery Plan for the Northern Spotted Owl. This general description can be applied to two DCA categories:
	DCA 1 - Category intended to support at least 20 pairs of spotted owls.
	DCA 2 - category intended to support one to 19 pairs of spotted owls.
Diameter at Breast Height (DBH)	The diameter of a tree 4.5 feet above the ground on the uphill side of the tree.
Dispersal	The movement, usually one way and on any time scale, of plants and animals from their point of origin to another location.
Dispersal Capability	The ability of members of a species to move from their area of birth to another suitable location and subsequently breed.
Dispersal Distance	A straight-line distance that an individual ravels from its birth place until it stops dispersing or dies.
Dispersal Habitat	Habitat that supports the life needs of an individual animal during dispersal. This habitat generally satisfies needs for foraging, roosting, and protection from predators.
Distribution (of a species)	The spatial arrangement of a species within its range.
Disturbance	Significant change in structure and/or composition through natural (i.e., fire, flood, wind, earthquake, or disease), or human-caused events (i.e., forest management).
Down Log	Portion of a tree that has fallen or been cut and left on the forest floor. Particularly important as habitat for some old growth-associated species.
Draft Environmental Impact Statement	The draft statement of environmental effects that is required for major Federal action under section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review.
E	
Ecosystem	A unit comprising interacting organisms considered together with their environment (i.e., lake, stream, watershed).
Ecosystem Management	A strategy or plan to manage ecosystems to provide for all associated organisms, as opposed to a strategy or plan for managing individual species.
Edge	An area where plant communities meet or where successional stages or vegetative conditions within plant communities come together.
Edge Effects	The modified environmental conditions along the margins, or “edges,” of forest patches surrounded partially or entirely by harvested lands.

Emigration	Permanent movement of individuals of a species from a population.
Endangered Species	Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the Federal Register.
Environmental Assessment (EA)	A systematic analysis of site-specific activities used to determine whether such activities have a significant effect on the quality of the human environment and whether a formal environmental impact statement is required; and to aid an agency's compliance with the National Environmental Policy Act (NEPA) when no environmental impact statement is necessary.
Environmental Impact	The positive or negative effect of any action upon a given area or resource.
Environmental Impact Statement (EIS)	A formal document to be filed with the Environmental Protection Agency that considers significant environmental impacts expected from implementation of a major Federal action.
Even-aged Forest	A forest stand containing a single age class in which the range of tree ages is usually less than 20 percent of rotation length.
Even-aged Harvest	A planned sequence of treatments designed to maintain and regenerate a stand with one age class with the range of tree ages usually less than 20 percent of the rotation age. Clear-cut, shelterwood, or seed tree harvesting methods produce even-aged stands.
Extended Rotation	A period of years that is longer than the time necessary to grow timber crops to a specified condition of maturity.
Extended Rotation Age	A point in time when trees are harvested or planned to be harvested beyond the age necessary to grow a timber crop to a specified condition of maturity.
F	
FIBRPLAN	A forest estate simulation planning model with the capabilities of simulating growth, silvicultural activities, and harvesting for large, complex forest landbases.
50-11-40 Rule	One of the standard and guidelines of the Interagency Scientific Committee strategy designed to provide dispersal habitat for northern spotted owls on Federal lands outside Federal reserves. The formula calls for maintaining 50 percent of forested land within each quarter township (i.e., 9 square miles) to remain forested with stands averaging at least 11 inches in diameter at breast height and with a stand canopy closure of at least 40 percent.
Final Draft Recovery Plan for the Northern Spotted Owl	A management plan developed under the authority of the Endangered Species Act that sets forth management standards and population or other biological objectives for listed species. Implementation of such plans has a high likelihood that the species population and/or distribution will improve to the point listing is no longer required.
Fire Regime	The characteristic frequency, extent, intensity, severity, and seasonality of fires in an ecosystem.
Fire Severity	The degree to which a site has been altered or disrupted by fire. Severity reflects fire intensity and residence time.
Fire Suppression	The practice of controlling and extinguishing wild fires.
Fish-bearing	All fish-bearing streams are considered by the DNR as Type 1-3 streams. Type 1 waters are those inventoried as "shorelines of the State" under Chapter 90.58 RCW and includes the large rivers of the State. Type 2 waters are those waters not designated as Type 1 and have a high level of fish, wildlife, or human use. Type 2 waters typically have a defined channel width at the ordinary high water mark of at least 20 feet and have a gradient of less than 4 percent. Type 3 waters are those not designated as Type 1 or 2 and have moderate fish, wildlife, or human use. Type

	3 waters typically have a defined channel at least 5 feet wide and a gradient of less than 12 percent.
Fledgling	A young, pre-dispersal bird which has left the nest.
Floaters	Nonbreeding adult and subadult spotted owls that move and live within a breeding population, often replacing breeding adults that die; non-territorial individuals.
Forest Canopy	The collective cover of branches and foliage formed by the crowns of trees and other woody growth.
Forest Fragmentation	The change in the forest landscape, from extensive and continuous forests of old growth to a mosaic of younger stand conditions.
Forest Watershed	The forested drainage area contributing water, organic matter, dissolved nutrients, and sediment to a lake or stream.
Fuel	Slash and other forest residue that can represent a fire hazard.
Fuel Loading	The amount of combustible material present per unit area, usually expressed in tons per acre.
G	
Geographic Information System (GIS)	A computer system capable of storing and manipulating spatial data.
Green Tree	A living and growing tree.
Green Tree Retention	A stand management practice in which live trees as well as snags and large down wood are left as biological legacies within harvest units to provide habitat components over the next management cycle.
H	
Habitat	The place where a plant or animal naturally or normally grows.
Habitat Capability	The estimated number of pairs of spotted owls that can be supported by the kind, amount, and distribution of suitable habitat in the area. As used in the Final Draft Recovery Plan for the Northern Spotted Owl, this means the same as capability to support spotted owls.
Habitat Conservation Area (HCA)	As proposed by the Interagency Scientific Committee, a contiguous block of federally owned habitat to be managed and conserved for breeding pairs of spotted owls, connectivity, and distribution of owls.
Habitat Conservation Plan (HCP)	An agreement between the Secretary of the Interior and either a private entity or a state that specifies conservation measures that will be implemented in exchange for a permit that would allow “taking” of a threatened or endangered species.
Habitat Fragmentation	The breaking up of habitat into discrete islands through modification or conversion of habitat by management activities.
Hiding Cover	Generally any vegetation used by wildlife for security or to escape from danger. More specifically, any vegetation capable of providing concealment (i.e., hiding 90 percent of an animal) from human view at a distance of 200 feet or less.
Home Range	The area that an animal traverses in the scope of normal activities. This is not equivalent with territory, which is the area an animal defends.
Home Range of a Pair	The sum of the home ranges of each member of a spotted owl pair minus the area of home range overlap.

I	
Immigration	Movement of individuals into a population.
Impact	A spatial or temporal change (i.e., either positive or negative) in the environment caused by human activity.
Incidental Take	"Take" of a threatened or endangered species that is incidental to, and not the purpose of, the carrying out of otherwise lawful activities.
Intermittent Stream	Any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This definition includes what are often referred to as ephemeral streams.
J	
Jeopardy	A finding made through consultation under the Endangered Species Act that the action of a Federal agency is likely to jeopardize the continued existence of a threatened or endangered species.
Juvenile (Spotted Owl)	A juvenile is normally considered to be any bird that is less than 1 year old.
L	
Large Woody Debris (LWD)	Pieces of wood, in a stream channel, larger than 10 feet long and 6 inches in diameter
Large Woody Material	Logs on the forest floor in pieces at least 24 inches in diameter at the largest end.
M	
Managed Forest	Any forestland that is treated with silvicultural practices. Generally applied to land that is harvested on a scheduled basis and intensively managed.
Management Activity	An activity undertaken for the purpose of harvesting, traversing, transporting, protecting, changing, replenishing, or otherwise using resources.
Management Prescriptions	The use of management activities to attain goals and objectives.
Management Units	Subdivision polygons within Plum Creek's ownership in the HCP planning area. More than 4,000 management units, averaging 42 acres in size (ranging in size between 2 to 110 acres), were created on Plum Creek ownership.
Merchantable Timber	Harvested timber with commercial value.
Mitigation Measures	Modifications of actions that: (1) avoid impacts by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (3) rectify impacts by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or (5) compensate for impacts by replacing or providing substitute resources or environments.
Monitoring	The process of collecting information to evaluate if objectives and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned.
Movement	Shifts in locations of animals, which may be two-way such as seasonal movements, or one-way as in a shift to a new breeding territory.
Multilayered Canopy	Forest stands with two or more distinct canopy layers.

N	
Natal Area	The nest tree and proximity of birth or hatching.
National Environmental Policy Act (NEPA)	An act passed in 1969 to declare a national policy that encourages productive and enjoyable harmony between humans and the environment, promotes efforts that will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and establishes a Council on Environmental Quality.
National Forest Management Act (NFMA)	A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of forest plans and the preparation of regulations to guide that development.
Nesting, Roosting, and Foraging Habitat (NRF)	The forest vegetation with the age class, species of trees, structure, sufficient area, and adequate food sources to meet some or all of the life needs of the northern spotted owl.
Nocturnal	Referring to organisms that are active at night.
Nonfish-bearing	All nonfish-bearing streams are considered by the DNR as either Type 4 or Type 5 streams. Type 4 waters are those not designated as Type 1-3 and are at least 2 feet in width. Type 4 waters are considered significant for maintaining downstream water quality and may be perennial or intermittent. Type 5 waters are all waters not classified as Type 1-4 and include streams with or without well-defined channels, areas of perennial or intermittent seepage, ponds, natural sinks, and drainage having short periods of spring or storm runoff.
O	
Old growth Dependent Species	An animal species so adapted that it can exist only in old growth forests.
Old Growth Forest	A forest stand usually at least 180 to 200 years old with moderate to high canopy closure; a multilayered, multispecies canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (i.e., decadence); numerous large snags; and heavy accumulations of wood, including large logs on the forest floor.
Owl Site	Any site where there has been a recent or historic observation of a single spotted owl or a pair of owls.
P	
Partial Harvesting	Harvesting of individual trees or clumps for the creation or maintenance of uneven-aged stands
Perennial Stream	A stream that typically has running water on a year-round basis.
Physiographic Province	A geographic area having a similar set of biophysical characteristics and processes due to effects of climate and geology which result in patterns of soils and broad-scale plant communities. Habitat patterns, wildlife distributions, and historical land use patterns may differ significantly from those of adjacent provinces.
Plan Amendment	A change in the terms, conditions, or decisions of the Habitat Conservation Plan.
Planning Area	All of the lands within Plum Creek's management boundary addressed in the Habitat Conservation Plan.
Population	A collection of individual organisms of the same species that potentially interbreed and share a common gene pool. Population density refers to the number of individuals of a species per unit area, population persistence to the capacity of the

	population to maintain sufficient density to persist, well distributed, over time.
Population Density	The numbers of individuals of a species per unit area.
Population Structure	The numbers of males and females in various age classes.
Population Viability	Probability that a population will persist for a specified period across its range despite normal fluctuations in population and environmental conditions.
Potential Habitat	A stand of trees of a vegetation type used by spotted owls, or other wildlife species, that is not currently suitable but is capable of growing or developing into suitable habitat in the future.
Precommercial Thinning	The practice of thinning young trees of no commercial value to assure adequate growing space and crown area for the remaining trees.
Predator	Any animal that preys externally on others by hunting, killing, and generally feeding on a succession of hosts (i.e., the prey).
Prescribed Burning	The burning of logging slash under controlled conditions to accomplish one or more of the following objectives: the elimination of wood fuel; exposure of mineral soil; creation of planting spots; elimination of unwanted competing vegetation; and the release of nutrients from wood fiber.
Proposed Threatened Species	Before a species can become listed as threatened, the intent to list the species as threatened by the FWS must first be published in the Federal Register, followed by a 60 to 90 day comment period. Following the comment period, the FWS usually deliberates an additional year to determine whether the species is threatened. If the FWS determines that the species is indeed threatened, the FWS publishes their findings in the Federal Register. If the FWS determines that the species does not qualify for threatened status, the species is returned to its former status.
Protection	In this HCP, protection means to avoid disturbing or destroying a particular habitat or area important to wildlife species in the planning area.
Q	
Quad Mean Diameter	Diameter of trees of average basal area or diameter corresponding to the mean basal area. Diameter is measured at breast height or 4.5 feet above ground level.
R	
Radio-Telemetry	Automatic measurement and transmission of data from remote sources via radio to a receiving station for recording and analysis. In this HCP radio-telemetry refers to the tracking of spotted owls by means of small radio transmitters attached to the owls.
Rearing Habitat	Areas in rivers and streams where juvenile salmon and trout find food and shelter to live and grow.
Reasonable and Prudent Measures	Actions that Plum Creek believes may be necessary to minimize or avoid impacts to species in the HCP planning area as a result of forest management.
Refugia	Locations and habitats that support populations of organisms that are limited to small fragments of their previous geographical range.
Regeneration	A cutting method by which a new age class of trees is created, or young established seedlings as a result of a cutting method.
Relative Density	Diameter based mathematical expression founded on the relationship between tree size and stand density. Expresses the function of crowdedness within a stand
Riparian Area	A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it. This includes floodplains, woodlands, and all areas within proximity of the normal line of high water of a stream channel or from the shoreline of a

	standing body of water.
Riparian Habitat Areas (RHAs)	Areas designated by Plum Creek in the HCP that contribute to the creation and maintenance of fish habitat and protect the riparian and/or streamside zone. RHAs include those terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics.
S	
Section 7	A section of the Endangered Species Act that provides for consultation between Federal agencies and the U.S. Fish and Wildlife Service to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species.
Section 9	A section of the Endangered Species Act that prohibits the "taking" of an endangered species.
Section 10(a)	An amendment to the Endangered Species Act that allows for incidental takings of an endangered species if the permit for the proposed activity is accompanied by a habitat conservation plan that will demonstrably benefit the species.
Seed Tree Harvesting	Removal of all trees except for a small number per acre, which are left standing to regenerate the site naturally.
Selection Harvesting	Harvesting of individual trees or clumps for the creation or maintenance of uneven-aged stands comprising at least three well defined age classes.
Seral Stages	The series of relatively transitory planned communities that develop during ecological succession from bare ground to the climax stage.
Shelterwood	A harvest/regeneration method where most trees are removed from a site in which the natural or artificial regeneration of an even-aged stand will develop beneath the partially shaded canopy provided by the residual live trees Residual trees are usually harvested to minimize competition.
Silvicultural Practices (Treatments)	The set of field techniques and methods used to modify and manage a forest stand over time to meet desired conditions and objectives.
Silvicultural Prescriptions	A professional plan for controlling the establishment, composition, constitution, and growth of forests.
Silviculture	The art and science of controlling the establishment, composition, growth, health, and quality of forests. It may include the control or production of stand structures such as snags and down logs, in addition to live vegetation.
Site Index	A measure of forest productivity expressed as the height of the tallest trees in a stand at an index age.
Site Preparation	Manipulation of the vegetation or soil of an area prior to planting or seeding. Site preparation may include the application of herbicides; burning or cutting living vegetation that competes with the favored species; tilling the soil; or burning organic debris (i.e., harvesting slash) that makes planting or seeding difficult.
Slash	The residue left on the ground after tree felling and tending, and/or accumulating as a result of storms events, fire, or tree decadence.
Slope Stability	The resistance of a natural or artificial slope or other inclined surface to failure by landsliding.
Snag	Any standing dead, partially dead, or defective (Cull) tree at least 10 inches in diameter at breast height and at least 6 feet tall. A hard snag is composed primarily of sound wood, generally merchantable. A soft snag is composed primarily of wood

	in advanced stages of decay and deterioration, generally not merchantable.
Snag Dependent Species	Birds and animals dependent upon snags for nesting, roosting or foraging habitat.
Species	The Endangered Species Act defines species as including any species or subspecies of plant or animal. Distinct populations of vertebrates also are considered to be species under the act.
Spotted Owl Habitat Areas (SOHAs)	An area reserved from timber harvesting to provide forest habitat for one pair of northern spotted owls under the spotted owl management plans for National Forest and Bureau of land Management Districts
Stand (Forest Stand)	An aggregation of trees occupying a specific area and sufficiently uniform in composition, age, arrangement, and condition so that it is distinguishable from adjoining areas.
Stand Condition	A description of the physical stand properties.
Stand Density	A quantitative, absolute measure of tree occupancy per unit area. May be expressed in terms of numbers of trees, basal area, volume, stand density index, or relative density index.
Stream Order	A hydrologic system of stream classification. Each small unbranched tributary is a first order stream. Two first order streams join to make a second order stream. A third order stream has only first and second order tributaries, and so forth.
Stream Reach	An individual first order stream or segment of another stream that has beginning and end points at a stream confluence.
Structural Retention	Harvest practices that leave physical elements (i.e., green trees, snags, down logs) typical of old growth forests on site after harvest.
Subadult	A young spotted owl that has dispersed but not yet reached breeding age. Subadults are in their second, or in some cases, third year of life.
Succession	A series of dynamic changes by which one group of organisms succeeds another through stages leading to potential natural community or climax. An example is the development of series of plant communities (known as seral stages) following a major disturbance.
Successional Stage	A stage or recognizable plant community condition that occurs during development from bare ground to climax.
Suitable Habitat	An area of forest vegetation with the age-class, species of trees, structure, sufficient area, and adequate food source to meet some or all of the life needs of the northern spotted owl. This habitat is synonymous with nesting, roosting, and foraging habitat.
T	
Take	Under the Endangered Species Act, take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect an animal, or to attempt to engage in any such conduct.
Taking	Under the Endangered Species Act, section 7, taking is an action that results in take.
Talus	A slope landform, typically covered by coarse rock debris forming a more or less continuous layer that may or may not be covered by duff and litter.
Territory	The area that an animal defends, usually during the breeding season, against intruders of its own species.
Territorial Single	An unpaired owl that is defending a territory.
Threatened Species	Those plant and animal species likely to become endangered species throughout all

	or a significant portion of their range within the foreseeable future. A plant or animal and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register.
Timber Harvest Schedule	The quantity of timber planned for sale and harvest, by time period, from the area of land administered by Plum Creek.
Timber Management	A general term for the directing, managing or controlling of forest crops and stands of trees.
Travel Corridor	A route used by animals along a belt or band of suitable cover or habitat.
Type 1 Waters	Those waters inventoried as "shorelines of the state" under chapter 90.58 RCW and includes the larger rivers and fish-bearing streams of the state.
Type 2 Waters	Those waters not designated as Type 1 and have a high level of fish, wildlife, or human use. These streams usually have a defined channel width at the ordinary high water mark of a t least 20 feet and have a gradient of less than 4 percent.
Type 3 Waters	Those waters not designated as Type 1 or 2 and have moderate fish, wildlife, or human use. These streams usually have a defined channel at least 5 feet wide and have a gradient of less than 12 percent.
Type 4 Waters	Those waters not designated as Types 1-3 (i.e., non-fish bearing) and are at least 2 feet in width. These streams are considered significant for maintaining downstream water quality and may be perennial or intermittent.
Type 5 Waters	Those waters not classified as Type 1-4 and include streams with or without well-defined channels, areas of perennial or intermittent seepage, ponds, natural sinks, and drainways having short periods of spring or storm water runoff.
U	
Uneven-aged Harvest Management	A planned sequence of treatments designed to maintain and regenerate a stand with three or more age classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection
Unsuitable Habitat	Forested lands that currently do not meet the habitat needs of spotted owls for nesting, roosting, or foraging, but are ecologically capable of doing so in the future. This habitat is typically deficient in tree size, canopy closure, and/or stand decadence. It results from timber harvest or natural disturbance. This habitat is often referred to as "potential habitat."
W	
Watershed	The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake.
Watershed Analysis	A systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives.
Well Distributed	A geographic distribution of habitats that maintains a population throughout a planning area and allows for interaction of individuals through periodic interbreeding and colonization of unoccupied habitats.

Section 8.0

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Watershed Analysis 12
Adaptive Management~~5.4.3.1+++ 329
Federal Watershed Analysis~~1.5.2.3+++ 40
Riparian Management~~3.3.2+++ 204
Spotted Owl Management Strategy~~5.4.3.2+++ 329

Watersheds
Key Watersheds~~1.5.2.2+++ 40
Major Subbasins~~1.2.2.2+++ 5
Restoration~~1.5.2.4+++ 41

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Buffer Size and Shape~~3.4.1.1+++ 213
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APPENDIX 1

Legal Description for the Boundary Encompassing Plum Creek's Cascades Habitat Conservation Plan (HCP) Area

Plum Creek Timber Company, Inc.

Seattle, Washington

Township 17 North, Range 15 East, W.M.	
Section 5:	All
Section 7:	All
Section 9:	All
Section 11:	All
Section 13:	All
Section 15:	All
Section 17:	All
Section 19:	All
Section 21:	All
Section 23:	All
Section 25:	All
Section 27:	All
Section 29:	All
Section 31:	All
Section 33:	All
Section 35:	All
Township 18 North, Range 15 East, W.M.	
Section 1:	Lots 1-12, inclusive, S1/2
Section 2:	Lots 1, 2, 3, 4, 5, 6, 7, 8, 11 and 12, S1/2SE1/4
Section 3: **OPTION TO BUY**	All
Section 7:	All
Section 9:	All
Section 11:	All
Section 12	NE1/4NE1/4, W1/2NE1/4, NW1/4, N1/2SW1/4, NW1/4SE1/4
Section 13:	All
Section 15:	All
Section 17:	All
Township 19 North, Range 10 East, W.M.	
Section 1:	All
Section 3:	All
Section 5:	All
Section 9:	N1/2, NW1/4SW1/4
Section 11:	N1/2, N1/2, S1/2
Township 19 North, Range 11 East, W.M.	
Section 1:	All
Section 3:	All
Section 5:	All

Section 6:	That portion lying East of the thread of Sawmill Creek
Section 7:	All
Section 9:	All
Section 11:	All
Section 13:	All
Section 15:	All
Section 17:	All
Section 21:	NE1/4, NE1/4NW1/4, NE1/4SE1/4
Section 23:	All
Section 25:	All
Section 27:	E1/2, E1/2W1/2
Section 35:	E1/2, NW1/4, NE1/4SW1/4
Township 19 North, Range 12 East, W.M.	
Section 1:	All
Section 3:	All
Section 11:	All
Section 15:	All
Section 23:	All
Section 25:	All
Section 27:	All
Section 35:	All
Township 19 North, Range 13 East, W.M.	
Section 3:	All
Section 5:	All
Section 7: **ESCROW**	All
Section 9:	All
Section 13:	All
Section 15:	All
Section 17:	All
Section 19:	All
Section 21:	All
Section 27:	All
Section 29:	All
Section 31:	All
Section 33:	All
Section 35:	All
Township 19 North, Range 14 East, W.M.	
Section 7:	All
Section 9: **OPTION TO BUY**	All

Section 11:	All
Section 13:	All
Section 15:	All
Section 16:	All
Section 17:	All
Section 18:	All
Section 19:	All
Section 20:	All
Section 21:	All
Section 22:	All
Section 23:	All
Section 25: **ESCROW**	All
Section 27:	All
Section 28:	All
Section 29:	All
Section 33:	All
Section 35:	All
Township 19 North, Range 15 East, W.M.	
Section 13:	N1/2
Section 15:	N1/2
Section 17:	All
Section 19:	All
Section 29: **OPTION TO BUY**	All
Section 31: **ESCROW**	All
Township 20 North, Range 9 East, W.M.	
Section 1:	W1/2
Section 3:	All
Section 4:	All
Section 5:	All
Section 6:	Fractional NE1/4, Fractional S1/2
Section 7:	NE1/4
Section 8:	NW1/4
Section 9:	N1/2
Section 13:	SW1/4
Section 15:	NW1/4, Fractional S1/2
Section 17:	All
Section 19:	Fractional NW1/4, Fractional N1/2SW1/4, E1/2
Section 21:	All
Section 23:	All

Section 25:	All
Section 27:	NE1/4, NE1/4NW1/4
Section 29:	NW1/4, N1/2SW1/4, W1/2NE1/4, NE1/4NE1/4
Section 35:	NE1/4, NE1/4NW1/4
Township 20 North, Range 10 East, W.M.	
Section 1:	Fractional NW1/4, S1/2
Section 2:	Lots 1 to 4, inclusive, SE1/2NE1/4, S1/2NW1/4, SW1/4, SE1/4
Section 7:	Fractional N1/2, Fractional SE1/4
Section 9:	All
Section 11:	All
Section 13:	Fractional N1/2, Fractional SW1/4
Section 14:	Lots 1 to 4, inclusive, NE1/4, NW1/4, N1/2SW1/4, N1/2SE1/4
Section 15:	All
Section 16:	Lots 1 to 4, inclusive, NE1/4, NW1/4, N1/2SW1/4, N1/2SE1/4
Section 17:	Fractional N1/2, Fractional SE1/4
Section 19:	Fractional W1/2, SE1/4
Section 29:	Fractional S1/2, Fractional NW1/4
Section 30:	Lots 1 to 7, inclusive, S1/2NE1/4, SE1/4NW1/4, E1/2SW1/4, SE1/4
Section 31:	All
Section 33:	All
Township 20 North, Range 11 East, W.M.	
Section 1:	All
Section 3: **(Includes Timber Harvesting Rights on City of Tacoma lands)**	That portion S1/2 and SE1/4NE1/4 lying Southerly Burlington Northern Railroad R/W, government lots 3 and 4, all those portions of S1/2N1/2 and N1/2S1/2 lying Northerly of the Burlington Northern Railroad R/W and those portions government lots 1 and 2 lying Southerly of Burlington Northern Railroad R/W
Section 5:	All
Section 6:	Lots 1 to 7, inclusive, S1/2NE1/4, SE1/4NW1/4, E1/2SW1/4, SE1/4
Section 7:	Lot 1, E1/2NE1/4, NW1/4NE1/4, NE1/4NW1/4
Section 9: **(Includes Timber Harvesting Rights on City of Tacoma lands)**	S1/2SW1/4, SE1/4, E1/2NE1/4 and those portions of the W1/2NE1/4, SE1/4NW1/4, N1/2SW1/4 lying Southerly of the Burlington Northern Railroad R/W, N1/2NW1/4, SW1/4NW1/4, all those portions of W1/2NE1/4, SE1/4NW1/4 and N1/2SW1/4 lying Northerly of the Burlington Northern Railroad R/W
Section 11:	All
Section 13:	SW1/4, W1/2SE1/4, SE1/4SE1/4

Section 15:	All
Section 17: **(Includes Timber Harvesting Rights on City of Tacoma lands)**	Those portions of the NE1/4, N1/2SE1/4, N1/2S1/2SE1/4 lying Easterly of BNRR R/W, W1/2, S1/2S1/2SE1/4 lying Easterly of BNRC R/W, and all those portions of W1/2NE1/4, NW1/4SE1/4 and SW1/4SE1/4 lying Westerly of BRNC RR R/W except 43.1 acres deeded to Tacoma under AFN 8591300454.
Section 21: **(Includes Timber Harvesting Rights on City of Tacoma lands)**	SE1/4, portions SW1/4NE1/4 and E1/2SW1/4, N1/2NE1/4, SE1/4NE1/4 and the Northeasterly diagonal ½ of the SW1/4NE1/4 and the Southwesterly diagonal ½ of the E1/2SW1/4 and that portion of the NW1/2 lying Northeasterly of the centerline of the US Forest Service Road as described in that easement to BNRC, dated 8/20/86, file 9/16/86 under AF#8609160567.
Section 23:	All
Section 25:	All
Section 27: **(Includes Timber Harvesting Rights on City of Tacoma lands)**	E1/2E1/2, NE diagonal ½ of the W3/4, all portions of W1/2 and W1/2SE1/4 lying Southwesterly of a line extending in a Southeasterly direction from the Northwest corner to the Southeast corner of the SW1/4SE1/4
Section 29:	All
Section 30:	That portion lying East of the thread of Sawmill Creek
Section 31:	That portion lying East of the thread of Sawmill Creek
Section 32	All
Section 33:	All
Section 35:	All
Township 20 North, Range 12 East, W.M.	
Section 1:	Fractional NW1/4, Fractional S1/2, Partial fractional NE1/4, less 53.62 ac. Burlington Northern R/W
Section 3:	All
Section 11:	All
Section 13:	All
Section 15:	All
Section 23:	SW1/4 and E1/2, NW1/4
Section 25:	All
Section 27:	All
Section 35:	W1/2, W1/2NE1/4 and SE1/4, E1/2NE1/4
Township 20 North, Range 13 East, W.M.	
Section 1:	Portion of N1/2
Section 7:	All
Section 9:	N1/2 less 53.18 ac. Burlington Northern R/W, less

	14.57 ac. former Milwaukee R/W, less that part SE1/4NW1/4 lying South of Burlington Northern R/W, NW1/4SW1/4, S1/2SW1/4, SE1/4
Section 14:	S1/2SW1/4, SW1/4SE1/4
Section 15:	All
Section 17:	All
Section 19:	All
Section 21:	All
Section 23:	All
Section 27:	All
Section 28:	S1/2SW1/4
Section 29:	All
Section 31:	All
Section 33:	All
Township 20 North, Range 14 East, W.M.	
Section 1:	E1/2NW1/4, NE1/4SW1/4
Township 20 North, Range 15 East, W.M.	
Section 5:	S1/2
Section 7:	NE1/4, N1/2SE1/4, E1/2NW1/4, NW1/4NW1/4
Section 8:	N1/2, N1/2SW1/4, N1/2SE1/4
Section 9:	E1/2, NW1/4, E1/2SW1/4, NW1/4SW1/4
Section 14:	N1/2S1/2
Section 15:	All
Section 16:	E1/2, E1/2NW1/4, NE1/4SW1/4
Township 21 North, Range 9 East, W.M.	
Section 8:	Lots 2, 6, 7, 8, 9, 12, S1/2SW1/4, SW1/4SE1/4
Section 15:	SW1/4
Section 16:	Lots 3, 5, 6, 9, SW1/4NW1/4, SW1/4, W1/2SE1/4, SE1/4SE1/4
Section 17:	N1/2
Section 18:	Fractional W1/2, SE1/4
Section 19:	All fractional
Section 20:	All
Section 21:	All
Section 22:	Lots 2, 31 4, 7, 8, W1/2NW1/4, SW1/4, S1/2SE1/4
Section 23:	S1/2S1/2, NW1/4SW1/4, NE1/4SE1/4
Section 24:	Lots 1, 4, 6, 7, NE1/4NE1/4, S1/2NE1/4, S1/2
Section 26:	All
Section 27:	All
Section 28:	All

Section 29:	All
Section 30:	Lots 1, 2, 3, 4, E1/2NW1/4, NE1/4, NE1/4SW1/4, NW1/4SE1/4, E1/2SE1/4
Section 31:	All fractional
Section 32:	N1/2N1/2, SE1/4NE1/4, SW1/4SW1/4
Section 33:	All
Section 34:	All
Section 35:	N1/2NW1/4
Section 36:	All
Township 21 North, Range 11 East, W.M.	
Section 3:	E1/2
Section 5:	Fractional E1/2, Fractional E1/2NW1/4
Section 9:	All
Section 11: **MOUNTAIN TO SOUNDS**	S1/2, W1/2NW1/4, SE1/4NW1/4, SW1/4NE1/4, those parts of lots 1, 2, NW1/4NE1/4 lying Southeast of Milwaukee R/W
Section 13: **MOUNTAIN TO SOUNDS**	N1/2
Section 15:	All
Section 17:	All
Section 19:	Fractional NE1/4, E1/2SE1/4
Section 21:	All
Section 23:	All
Section 25:	All
Section 27:	All
Section 29:	All
Section 31:	All
Section 33: **(Includes Timber Harvesting Rights on City of Tacoma lands)**	All
Section 35:	All
Township 21 North, Range 12 East, W.M.	
Section 1:	All
Section 15: **ESCROW**	Fractional SW1/2NW1/4, fractional SW1/4, NE1/4 less 4.99 ac. Milwaukee R/W, less 17.90 ac. Sold to USA, less 33.14 ac. State Highway R/W
Section 23: **ESCROW**	All less 30.40 ac. State Highway R/W across NE1/4 NE/4NW1/4
Section 25: **ESCROW**	All less 38.02 ac. State highway R/W across W1/2E1/2, SE1/4SE1/4
Section 27:	Fractional N1/2, SW1/4 less Burlington Northern R/W, SE1/4 North of Burlington Northern R/W less 0.57 ac. Milwaukee R/W

Section 35:	All less 67.75 ac. Burlington Northern R/W and 14.73 ac. Chicago, Milwaukee St. Paul R.R. Co.
Township 21 North, Range 13 East, W.M.	
Section 5:	Lot 1, 3, 4, 5, SE1/4NE1/4, NE1/4SE1/4, Less 11.50 ac. Overflow area
Section 9:	All fractional, less 0.88 ac. overflow area
Section 19:	All
Section 27:	All less 35.29 ac. overflow area
Section 31: **MOUNTAIN TO SOUNDS**	All less State Highway R/W, less West 500' of the North 3065' of lots 1, 2, and 3, and 1.38 ac. Sold
Township 21 North, Range 14 East, W.M.	
Section 7: **OPTION TO BUY**	All
Section 8:	Portion of SE1/4NE1/4 East of overflow area
Section 9:	E1/2
Section 15:	All
Section 16:	E1/2NW1/4, E1/2SW1/4, E1/2
Section 21:	E1/2
Section 22:	All
Section 23:	All
Section 25:	All
Section 26:	All
Section 27:	N1/2
Section 28	Lots 5, 7, 8, and 9, NE1/4NE1/4
Section 35:	N1/2, E1/2SE1/4
Section 36:	Lots 1-4, inclusive, W1/2NE1/4, NW1/4, SW1/4, W1/2SE1/4
Township 22 North, Range 11 East. W,M,	
Section 3: **ESCROW**	All
Section 19: **ESCROW**	All
Section 21:	NW1/4, SE1/4, W1/2NE1/4, SE1/4NE1/4
Section 23: **MOUNTAIN TO SOUNDS**	E1/2, Portion fractional W1/2
Section 25:	All
Section 27: **MOUNTAIN TO SOUNDS**	W1/2W1/2, SE1/4SW1/4, Portion of lots 3 and 4, SE1/4NW1/4, NE1/4SW1/4 lying West of Milwaukee R/W
Section 33:	All
Section 35: **MOUNTAIN TO SOUNDS**	Portion of lots 1-7, SW1/4SW1/4, less 11.52 ac. R/W across lots 2, 5 and 6
Township 22 North, Range 12 East, W.M.	

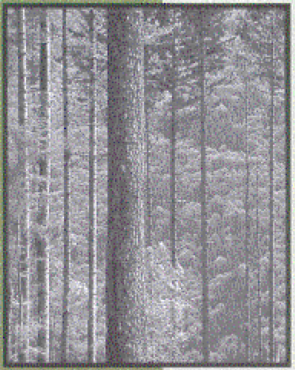
Section 25:	All
Section 35: **OPTION TO BUY**	All
Township 22 North, Range 13 East, W.M.	
Section 3: **OPTION TO BUY**	All
Section 9: **OPTION TO BUY**	All
Section 11: **OPTION TO BUY**	All
Section 13: **OPTION TO BUY**	All
Section 15: **OPTION TO BUY**	All
Section 25: **OPTION TO BUY**	All
Section 31:	All
Section 33: **OPTION TO BUY**	All
Section 35: **OPTION TO BUY**	All
Township 22 North, Range 14 East, W.M.	
Section 7: **OPTION TO BUY**	All
Section 9: **OPTION TO BUY**	N1/2 less that portion of NE1/4 NE1/4 lying Easterly of Cle Elum river and Northerly of Paris Creek, SE1/4, N12SW1/4 less homesites in Southwest corner, less 2.00 ac. sold in S1/2n1/2
Section 11: **OPTION TO BUY**	All
Section 15: **OPTION TO BUY**	All
Section 17: **OPTION TO BUY**	All
Section 21: **OPTION TO BUY**	All
Section 27: **OPTION TO BUY**	All
Section 31: **OPTION TO BUY**	All

APPENDIX 2

Plum Creek Timber Company, Inc., Environmental Principles

Plum Creek Timber Company, Inc.

Seattle, Washington



ENVIRONMENTAL PRINCIPLES RESOURCES

As one of the largest private timberland owners in the United States, Plum Creek is committed to being the leader in environmentally responsible forest resources management. We believe the stewardship of forest resources is fundamental to economically prudent timber growth and harvest. Our forest management practices are based on sound scientific and economic principles and we abide by all legal and regulatory requirements.

Leaders in

Environmental

Forestry

All elements of Plum Creek's forest management activities, including site preparation, road building, harvesting and reforestation, are conducted according to the following principles:

- *Sustainable Forest Management* Manage our forests in a sustainable, socially responsible, economical manner. Work with others to foster the concepts of land stewardship and environmental responsibility.
- *Ecological and Structural Diversity* Enhance ecological and structural diversity where feasible and prudent by using a variety of silvicultural techniques and by retaining a diversity of vegetation and unique structural features.
- *Water Quality* Meet or exceed state and federal standards by employing Best Management Practices for the protection of water quality and aquatic resources, including the retention of buffers along streams, lakes and wetlands.
- *Air Quality* Protect air quality by burning only when prescribed burning is an appropriate silvicultural technique for the improvement of forest conditions or aesthetics in visually sensitive areas or when required by law for hazard abatement.
- *Reforestation* Ensure future forest growth and sustainable productivity by reforesting all harvested areas in a timely manner consistent with ecological conditions—within two years in the Cascades and Southern Regions, and five years in the Rocky Mountain Region.
- *Soil Conservation* Maintain soil and site productivity by minimizing soil disturbance and by recycling harvest residues for soil nutrient enhancement.
- *Fish and Wildlife Resources* Conserve fish and wildlife resources through judicious control of road access, timber harvest management and cooperation with state and federal fish and wildlife agencies.
- *Visual Quality* Recognize and manage for aesthetic values near communities and major travel corridors by using appropriate design standards and harvest methods.
- *Adjacent Land Management* Cooperate with adjacent landowners to address and minimize potential impacts of forest management activities.
- *Research and Development* Apply new scientific, social and economic information to improve silvicultural practices and enhance environmental and financial performance.
- *Performance Audits* Conduct regular performance audits to ensure that environmental commitments have been met or exceeded through the application of these environmental principles.

PlumCreek Timber Company, L.P.

June 1998 *Recycled/Recyclable*

APPENDIX 3

Section 10(a) Permit Species and Unlisted Agreement Species Included in Plum Creek's Cascades Habitat Conservation Plan

Lorin L. Hicks

Plum Creek Timber Company, Inc.

Seattle, Washington

SECTION 10(A) PERMIT SPECIES AND UNLISTED SPECIES

(This group includes Special Emphasis Species, Species of Concern and Associated Species described in the HCP)

INCLUDED IN PLUM CREEK'S CASCADES HABITAT CONSERVATION PLAN

I. SECTION 10(a) PERMIT SPECIES (4 species)

Common Name	Scientific Name	Life Form
1. Northern Spotted Owl	*Strix occidentalis caurina*	14
2. Marbled Murrelet	*Brachyramphus marmoratus*	12
3. Grizzly Bear	*Ursus arctos*	15
4. Gray Wolf	*Canis lupus*	5

II. UNLISTED SPECIES (311 species)

Common Name	Scientific Name	Life Form
Amphibians (13 Species):		
1. Tailed frog	*Ascaphus truei*	2
2. Northern red-legged frog	*Rana aurora aurora*	2
3. Cascade frog	*Rana cascadae*	2
4. Spotted frog	*Rana pretiosa*	2
5. Larch Mountain salamander	*Plethodon larselli*	4
6. Northwestern salamander	*Ambystoma gracile*	2
7. Long-toed salamander	*Ambystoma macrodactylum*	2
8. Pacific giant salamander	*Dicamptodon tenebrosus*	2
9. Ensatina	*Ensatina eschsholtzii*	5
10. Western red-backed salamander	*Plethodon vehiculum*	5
11. Rough-skin newt	*Taricha granulosa*	2
12. Western toad	*Bufo boreas*	2
13. Pacific treefrog	*Pseudacris regilla*	2

Common Name	Scientific Name	Life Form
Reptiles (13 species):		
1. Northwestern pond turtle	*Clemmys marmorata marmorata*	3

Common Name	Scientific Name	Life Form
Reptiles (continued)		
2. Painted turtle	*Chrysemys picta*	3
3. Northern alligator lizard	*Elgaria coerulea*	5
4. Sagebrush lizard	*Sceloprus graciosus*	5
5. Western fence lizard	*Sceloporus occidentalis*	5
6. Western skink	*Eumeces skiltonianus*	3
7. Rubber boa	*Charina bottae*	5
8. Racer	*Coluber constrictor*	5
9. Sharptail snake	*Contia tenuis*	5
10. Western garter snake	*Thamnophis elegans*	5
11. Northwestern garter snake	*Thamnophis ordinoides*	5
12. Common garter snake	*Thamnophis sirtalis*	3
13. Western rattlesnake	*Crotalus viridis*	5

Common Name	Scientific Name	Life Form
Fish (34 Species):		
1. Bull trout	*Salvelinus confluentis*	1
2. Rainbow/steelhead trout	*Oncorhynchus mykiss*	1
3. Spring chinook salmon	*Oncorhynchus tshawytscha*	1
4. Coho salmon	*Oncorhynchus kisutch*	1
5. Sockeye salmon	*Oncorhynchus nerka*	1
6. Golden trout	*Oncorhynchus aquabonita*	1
7. Cutthroat trout	*Oncorhynchus clarki*	1
8. Kokanee	*Oncorhynchus nerka*	1
9. Brown trout	*Salmo trutta*	1
10. Brook trout	*Salvelinus fontinalis*	1
11. Dolly Varden	*Salvelinus malma*	1
12. Lake trout	*Salvelinus namaycush*	1
13. Mountain whitefish	*Prosopium williamsoni*	1
14. Pygmy Whitefish	*Prosopium coulteri*	1
15. Northern squawfish	*Ptychocheilus oregonensis*	1
16. Western brook lamprey	*Lampetra richardsoni*	1
17. River lamprey	*Lampetra ayresi*	1
18. Pacific lamprey	*Entosphenus tridentatus*	1
19. Chiselmouth	*Acrocheilus alutaceus*	1
20. Peamouth	*Myloceleilus caurinus*	1
21. Speckled dace	*Rhyinichthys osculus*	1

Common Name	Scientific Name	Life Form
Fish (continued)		
22. Leopard dace	*Rhyinichthys falcatus*	1
23. Longnose dace	*Rhyinichthys cataractae*	1
24. Redside shiner	*Richardsonius balteatus*	1
25. Longnose sucker	*Catostomus catostomus*	1
26. Bridgelip sucker	*Catostomus columbianus*	1
27. Mountain sucker	*Catostomus platyrhynchus*	1
28. Largescale sucker	*Catostomus macrocheilus*	1
29. Mottled sculpin	*Cottus bairdi*	1
30. Torrent sculpin	*Cottus rhotheus*	1
31. Piute sculpin	*Cottus beldingi*	1
32. Shorthead sculpin	*Cottus confusus*	1
33. Three-spine stickleback	*Gasterosteus aculeatus*	1
34. Burbot	*Lota lota*	1

Common Name	Scientific Name	Life Form
Birds (176):		
1. Harlequin duck	*Histrionicus histrionicus*	3
2. Northern goshawk	*Accipter gentilis*	11
3. Black tern	*Chlidonias niger*	3
4. Bald eagle*	*Haliaeetus leucocephalus*	12
5. Golden eagle	Aquila chrysaetos	4
6. Peregrine falcon*	*Falco peregrinus*	4
7. Flammulated owl	*Otus flammeolus*	14
8. Lewis' woodpecker	*Melanerpes lewis*	13
9. Pileated woodpecker	*Dryocophus pileatus*	13
10. White-headed woodpecker	*Picoides albolarvatus*	13
11. Vaux's swift	*Chaetura vauxi*	14
12. Western bluebird	*Sialia mexicana*	14
13. Common loon	*Gavia immer*	3
14. Eared grebe	*Podiceps nigricollis*	3
15. Great blue heron	*Ardea herodias*	12
16. Green heron	*Butorides virescens*	7
17. Canada goose	*Branta canadensis*	3
18. Wood duck	*Aix sponsa*	14
19. Green-winged teal	*Anas crecca*	3
20. Mallard	*Anas platyrhnchos*	3

Common Name	**Scientific Name**	**Life Form**
Birds (continued)		
21. Northern pintail	*Anas acuta*	3
22. Cinnamon teal	*Anas cyanoptera*	3
23. American wigeon	*Anas americana*	3
24. Northern shoveler	*Anas clypeata*	3
25. Gadwall	*Anas strepera*	3
26. Canvasback	*Aythya valisineria*	3
27. Ring-necked duck	*Aythya collaris*	3
28. Lesser scaup	*Aythya affinis*	3
29. Common goldeneye	*Bucephala clangula*	14
30. Barrow's goldeneye	*Bucephala islandica*	14
31. Bufflehead	*Bucephala albeola*	14
32. Hooded merganser	*Lophodytes cucullatus*	14
33. Common merganser	*Mergus merganser*	14
34. Red-breasted merganser	*Mergus serrator*	3
35. Turkey vulture	*Cathartes aura*	4
36. Osprey	*Pandion Haliaetus*	12
37. Northern harrier	*Circus cyaneus*	5
38. Sharp-shinned hawk	*Accipter striatus*	11
39. Cooper's hawk	*Accipter cooperii*	11
40. Red-tailed hawk	*Buteo jamaicensis*	12
41. Swainson's hawk	*Buteo swainsoni*	7
42. Rough-legged hawk	*Buteo lagopus*	5
43. American kestrel	*Falco sparverius*	14
44. Merlin	*Falco columbarius*	11
45. Spruce grouse	*Dendragapus canadensis*	5
46. Blue grouse	*Dendragapus obscurus*	5
47. Ruffed grouse	*Bonasa umbellus*	5
48. California quail	*Callipepla californica*	5
49. Mountain quail	*Oreortyx pictus*	5
50. Virginia rail	*Rallus limicola*	3
51. Sora	*Porzana carolina*	3
52. American coot	*Fulica americana*	3
53. Killdeer	*Charadrius vociferus*	3
54. Greater yellowlegs	*Tringa melanoleuca*	3
55. Lesser yellowlegs	*Tringa flavipes*	3
56. Solitary snadpiper	*Tringa solitaria*	7
57. Spotted sandpiper	*Actitis macularia*	3

Common Name	**Scientific Name**	**Life Form**
Birds (continued)		
58. Western sandpiper	*Calidris mauri*	3
59. Least sandpiper	*Calidris minutilla*	3
60. Baird's sandpiper	*Calidris bairdii*	5
61. Common snipe	*Gallinago gallinago*	3
62. Ring-billed gull	*Larus delawarensis*	3
63. California gull	*Larus californicus*	3
64. Band-tailed pigeon	*Columba fasciata*	11
65. Mourning dove	*Zenaida macroura*	11
66. Yellow-billed cuckoo	*Coccyzus maericus*	8
67. Barn owl	*Tyto alba*	14
68. Western screech-owl	*Otus kennicottii*	14
69. Grat horned owl	*Bubo virginianus*	12
70. Northern pygmy-owl	*Glaucidium gnoma*	14
71. Barred owl	*Strix varia*	14
72. Great gray owl	*Strix nebulosa*	12
73. Long-eared owl	*Asio otus*	11
74. Northern saw-whet owl	*Aegolius acadicus*	14
75. Common nighthawk	*Chordeiles minor*	6
76. Common poorwill	*Phalaenoptilus nuttalli*	6
77. Black swift	*Cypseloides niger*	4
78. Calliope hummingbird	*Stellula calliope*	7
79. Black-chinned hummingbird	*Archilochus alexandri*	7
80. Rufous hummingbird	*Selasphorus rufus*	11
81. Belted kingfisher	*Ceryle alcyon*	16
82. Red-breasted sapsucker	*Sphyrapicus ruber*	13
83. Red-naped sapsucker	*Sphyrapicus nuchalis*	13
84. Williamson's sapsucker	*Sphyrapicus thyroides*	13
85. Downy woodpecker	*Picoides pubescens*	13
86. Hairy woodpecker	*Picoides villosus*	13
87. Three-toed woodpecker	*Picoides tridactylus*	13
88. Black-backed woodpecker	*Picoides arcticus*	13
89. Northern flicker	*Colaptes aratus*	13
90. Olive-sided flycatcher	*Contopus borealis*	10
91. Western wood-pewee	*Contopus sordidulus*	11
92. Little willow flycatcher'	*Empidonax traillii brewsterii*	10
93. Hammond's flycatcher	*Empidonax hammondii*	11
94. Ducky flycatcher	*Empidonax oberholseri*	8

Common Name	Scientific Name	Life Form
Birds (continued)		
95. Gray flycatcher	*Empidonax wrightii*	7
96. Pacific-slope flycatcher	*Empidonax difficilis*	11
97. Ash-throated flycatcher	*Myiarchus cinerascens*	14
98. Western kingbird	*Tyrannus verticalis*	11
99. Horned lark	*Eremophila alpestris*	5
100. Violet-green swallow	*Tachycineta thalassina*	14
101. Northern rough-winged swallow	*Stelgidopteryx serripennis*	16
102. Cliff swallow	*Hirundo pyrrhonota*	4
103. Barn swallow	*Hirundo rustica*	4
104. Gray jay	*Perisoreus canadensis*	11
105. Steller's jay	*Cyanocitta stelleri*	11
106. Clark's nutcracker	*Nucifraga columbiana*	10
107. Black-billed magpie	*Pica pica*	7
108. American crow	*Corvus brachyrhynchos*	11
109. Common raven	*Corvus corax*	11
110. Black-capped chickadee	*Parus atricapillus*	14
111. Mountain chickadee	*Parus gambeli*	14
112. Chestnut-backed chickadee	*Parus rufescens*	14
113. Bushtit	*Psaltriparus minimus*	8
114. Red-breasted nuthatch	*Sitta canadensis*	13
115. White-breasted nuthatch	*Sitta carolinensis*	13
116. Pygmy nuthatch	*Sitta pygmaea*	13
117. Brown creeper	*Certhia americana*	14
118. Rock wren	*Salpinctes obsoletus*	4
119. Marsh wren	*Cistothorus palustris*	3
120. Bewick's wren	*Thrymanes bewickii*	14
121. Winter wren	*Troglodytes troglodytes*	14
122. American dipper	*Cinclus mexicanus*	3
123. Golden-crowned kinglet	*Regulus satrapa*	10
124. Ruby-crowned kinglet	*Regulus calendula*	10
125. Veery	*Catharus fuscenscens*	5
126. Mountain bluebird	*Sialia currucoides*	14
127. Townsend's solitaire	*Myadestres townsendi*	6
128. Swainson's thrush	*Catharus ustulatus*	7
129. Hermit thrush	*Catharus guttatus*	7
130. American robin	*Turdus migratorius*	11
131. Varied thrush	*Ixoreus naevius*	11

Common Name	**Scientific Name**	**Life Form**
Birds (continued)		
132. Water pipit	*Anthus spinoletta*	5
133. Cedar waxwing	*Bombycilla cedrorum*	9
134. Northern shrike	*Lanius excubitor*	7
135. European starling	*Sturnus vulgaris*	14
136. Solitary vireo	*Vireo solitarius*	11
137. Warbling vireo	*Vireo gilvus*	11
138. Red-eyed vireo	*Vireo olivaceus*	11
139. Orange-crowned warbler	*Vermivora celata*	6
140. Nashville warbler	*Vermivora ruficapilla*	6
141. Yellow warbler	*Dendroica petechia*	8
142. Yellow-rumped warbler	*Dendroica coronata*	10
143. Black-throated gray wearbler	*Dendroica nigrescens*	10
144. Townsend’s warbler	*Dendroica townsendi*	10
145. MacGillivray’s warbler	*Oporornis tolmiei*	8
146. American redstart	*Setophaga ruticilla*	9
147. Common yellowthroat	*Geothlypis trichas*	3
148. Wilson’s warbler	*Wilsonia pusilla*	6
149. Yellow-breasted chat	*Icteria virens*	8
150. Western tananger	*Piranga ludoviciana*	10
151. Black-headed grosbeak	*Pheuticus melanocephalus*	9
152. Lazuli bunting	*Passerina amoena*	7
153. Rufous-sided towhee	*Pipilo erythrophthalmus*	7
154. Chipping sparrow	*Spizella passerina*	11
155. Savannah sparrow	*Passerculus sandwichensis*	5
156. Fox sparrow	*Passerella iliaca*	7
157. Song sparrow	*Melospiza melodia*	7
158. Lincoln’s sparrow	*Melospiza lincolnii*	6
159. Golden-crowned sparrow	*Zonotrichia articapilla*	5
160. White-crowned sparrow	*Zonotrichia leucophrys*	7
161. Dark-eyed junco	*Junco hyemalis*	5
162. Red-winged blackbird	*Agelaius phoeniceus*	7
163. House sparrow	*Passer domesticus*	14
164. Western madowlark	*Sturnella neglecta*	5
165. Brewer’s blackbird	*Euphagus cyanocephalus*	7
166. Brown-headed cowbird	*Molothrus ater*	7
167. Northern oriole	*Icterus galbula*	9
168. House finch	*Carpolacus mexicanus*	9

Common Name	**Scientific Name**	**Life Form**
Birds (continued)		
169. Pine grosbeak	*Pinocola enucleator*	11
170. Purple finch	*Carpolacus purpureus*	11
171. Cassin's finch	*Carpolacus cassinii*	11
172. Red crossbill	*Loxia curvirostra*	10
173. White-winged crossbill	*Loxia leucoptera*	10
174. Pine siskin	*Carduelis pinus*	11
175. American goldfinch	*Carduelis tristis*	8
176. Evening grosbeak	*Coccothraustes vespertinus*	11

Common Name	**Scientific Name**	**Life Form**
Mammals (75 species):		
1. Townsend's big-eared bat	*Plecotus towndsendii*	4
2. California wolverine	*Gulo gulo luteus*	5
3. Fisher	*Martes pennanti*	14
4. Virginia opossum	*Didelphis virginiana*	5
5. Pacific water shrew	*Sorex bendirii*	16
6. Masked shrew	*Sorex cinereus*	15
7. Dusky shrew	*Sorex monticolus*	15
8. Pacific shrew	*Sorex palustris*	16
9. Water shrew	*Sorex palustris*	16
10. Trowbridge's shrew	*Sorex trowbridgii*	15
11. Vagrant shrew	*Sorex vagrans*	15
12. Shrew-mole	*Neurotrichus gibbsii*	15
13. Broad-footed mole	*Scapanus latimanus*	15
14. Coast mole	*Scapanus orarius*	15
15. Townsend's mole	*Scapanus townsendii*	15
16. Pallid bat	*Antrozous pallidus*	4
17. Big brown bat	*Eptesicus fuscus*	14
18. Silver-haired bat	*Lasionycteris noctivagans*	14
19. Hoary bat	*Lasiusus cincereus*	11
20. California myotis	*Myotis californicus*	14
21. Long-eared myotis	*Myotis evotis*	14
22. Keen's myotis	*Myotis keenii*	14
23. Little brown myotis	*Myotis lucifugus*	14
24. Fringed myuotis	*Myotis thysanodes*	14
25. Long-legged myotis	*Myotis volans*	14

Common Name	Scientific Name	Life Form
Mammals (continued)		
26. Small-footed myotis	*Myotis ciliolabrum*	14
27. Yuma myotis	*Myotis yumanensis*	14
28. Coyote	*Canis latrans*	15
29. Red fox	*Vulpes vulpes*	15
30. Black bear	*Ursus americanus*	15
31. Raccoon	*Procyon lotor*	14
32. River otter	*Lutra canadensis*	16
33. Marten	*Martes americana*	14
34. Striped skunk	*Mephitis mephitis*	15
35. Ermine	*Mustela erminea*	15
36. Long-tailed weasel	*Mustela frenata*	15
37. Mink	*Mustella vison*	14
38. Western spotted skunk	*Spilogate gracilis*	15
39. American badger	*Taxidea taxus*	15
40. Mountain lion	*Felis concolor*	4
41. Bobcat	*Lynx rufus*	4
42. Elk	*Cervus elaphus*	5
43. Mule deer and black-tailed deer	*Odocoileus hemionus*	5
44. Mountain goat	*Oreamnos americanus*	4
45. Big-horned sheep	*Ovis canadensis*	4
46. Mountain beaver	*Aplodontia rufa*	15
47. Northern flying squirrel	*Glaucomys sabrinus*	14
48. Hoary marmot	*Marmota caligata*	4
49. Yellow-bellied marmot	*Marmota flaviventris*	4
50. California ground squirrel	*Spermophilus beecheyi*	15
51. Golden-mantled ground squirrel	*Spermophilus saturatus*	15
52. Yellow-pine chipmunk	*Tamias amoenus*	15
53. Townsend’s chipmunk	*Tamias townsendii*	15
54. Douglas’ squirrel	*Tamiasciusus douglasii*	10
55. Northern pocket gopher	*Thomomys talpoides*	15
56. Beaver	*Castor canadensis*	16
57. Bushy-tailed woodrat	*Neotoma cinerea*	5
58. Deer mouse	*Peromyscus maniculatus*	15
59. Southern red-backed vole	*Clethrionomys gapperi*	15
60. Long-tailed vole	*Microtus longicaudus*	15
61. Montane vole	*Microtus montanus*	15
62. Creeping vole	*Microtus oregoni*	15

Common Name	**Scientific Name**	**Life Form**
Mammals (continued)		
63. Water vole	*Microtus richardsoni*	15
64. Townsend's vole	*Microtus townsendii*	15
65. Common muskrat	*Ondatra zibethicus*	16
66. Heather vole	*Phenacomys intermedius*	15
67. House mouse	*Mus musculus*	15
68. Norway rat	*Ratus norvegicus*	15
69. Pacific jumping mouse	*Zapus trinotatus*	3
70. Common porcupine	*Erethizon dorsatum*	6
71. American pika	*Ochotona princeps*	4
72. Snowshoe hare	*Lepus americanus*	5
73. Black-tailed jackrabbit	*Lepus californicus*	5
74. Eastern cottontail	*Sylvilagus floridanus*	15
75. Nuttall's cottontail	*Sylvilagus nuttallii*	15

The Unlisted Species also includes any and all unnamed vertebrate species that:

1. **May occur in the planning area during the Permit period,**
2. **Can be placed within one of the 16 Life Forms described in the HCP (vertebrates), and**
3. **May become listed during the Permit period.**

NOTE: Plum Creek is not seeking an incidental take permit for the bald eagle or peregrine falcon. Although both species are federally listed, there are other Federal and State programs already in place which adequately protect the bald eagle, and the forest management plan described in the HCP will avoid harming or impacting the peregrine falcon and its habitat**.**

APPENDIX 4

No Surprises: Assuring Certainty for Private Landowners in Endangered Species Act Habitat Conservation Planning

and

Region 1 Guidelines for Determining Covered Species Lists and Assurances Relative to Habitat Conservation Planning

United States Department of the Interior

Fish and Wildlife Service

Washington, DC

08/09/94

NO SURPRISES

ASSURING CERTAINTY FOR PRIVATE LANDOWNERS IN ENDANGERED SPECIES ACT HABITAT CONSERVATION PLANNING

"The Committee intends that the Secretary may utilize this provision [on HCPs] to approve conservation plans which provide long-term commitments regarding the conservation of listed as well as unlisted species and long-term assurances to the proponent of the conservation plan that the terms of the plan will be adhered to and that further mitigation requirements will only be imposed in accordance with the terms of the plan. In the event that an unlisted species addressed in an approved conservation plan is subsequently listed pursuant to the Act, no further mitigation requirements should be imposed if the conservation plan addressed the conservation of the species and its habitat as if the species were listed pursuant to the Act.

. . . .

"It is also recognized that circumstances and information may change over time and that the original plan might need to be revised. To address this situation the Committee expects that any plan approved for a long-term permit will contain a procedure by which the parties will deal with unforeseen circumstances."

H. Rep. No. 835, 97th Cong., 2d Sess. 30-31 (1982)

PURPOSE:

The purpose of this policy is to provide assurances to non-federal landowners participating in Endangered Species Act Habitat Conservation Planning (HCP) that no additional land restrictions or financial compensation will be required for species adequately covered by a properly functioning HCP in light of unforeseen or extraordinary circumstances.

SUPPLEMENTARY INFORMATION:

The HCP process promotes endangered species conservation and habitat protection within the context of land use or development. Ideally, HCPs contribute to the long-term conservation of federally listed and unlisted species, while providing predictability and economic stability for non-federal landowners.

Species receive a variety of benefits under a properly functioning HCP. Private financial resources supplement limited federal funding, essential habitat areas are often preserved, and comprehensive conservation programs are developed and promptly implemented. Although landowners must ultimately demonstrate that a species has been covered adequately under an HCP, the major benefit from the HCP process from the perspective of the development community is certainty. In exchange for adherence to long-term conservation commitments, an HCP permittee is provided assurance that development may move forward despite the incidental taking of protected species.

Significant development projects often take many years to complete, therefore adequate assurances must be made to the financial and developmental communities that an HCP permit will remain valid for the life of the project. In authorizing the HCP process, Congress recognized that permits of 30 years or more may be necessary to trigger long-term private sector funding and land use commitments for species conservation. Congress also recognized that circumstances may change over time, generating pressure to reconsider the mitigation commitments in an HCP agreement. Often referred to as "unforeseen" or extraordinary circumstances, Congress intended that additional mitigation requirements not be imposed upon an HCP permittee who has fully implemented his or her conservation commitments except as may be provided for under the terms of the HCP itself.

POLICY:

In negotiating "unforseen circumstances" provisions for HCPs, the FWS shall not require the commitment of additional land or financial compensation beyond the level of mitigation which was otherwise adequately provided for a species under the terms of a properly functioning HCP. Moreover, FWS shall not seek any other form of additional mitigation from an HCP permittee except under extraordinary circumstances.

A. General Assurances Provided to Landowners

- If additional mitigation measures are subsequently deemed necessary to provide for the conservation of a species that was otherwise adequately covered under the terms of a properly functioning HCP, the primary obligation for such measures shall not rest with the HCP permittee.

- FWS shall not seek additional mitigation for a species from an HCP permittee where the terms of a properly functioning HCP agreement were designed to provide an overall net benefit for that particular species and contained measurable criteria for the biological success of the HCP which have been or are being met.

- If extraordinary circumstances warrant the requirement of additional mitigation from an HCP permittee who is in compliance with the HCP's obligations, such mitigation shall limit changes to the original terms of the HCP to the maximum extent possible and shall be limited to modifications within Conserved Habitat areas or to the HCP's operating conservation program for the affected species. Additional mitigation requirements shall not involve the payment of additional compensation or apply to parcels of land available for development under the original terms of the HCP without the consent of the HCP permittee.

B. Determination of Extraordinary Circumstances.

- FWS shall have the burden of demonstrating that such extraordinary circumstances exist, using the best scientific and commercial data available. FWS findings must be clearly documented and based upon reliable technical information regarding the status and habitat requirements of the affected species.

- In deciding whether any extraordinary circumstances exist which might warrant requiring additional mitigation from an HCP permittee, the FWS shall consider, but not be limited to, the following factors:

  - the size of the current range of the affected species
  - the percentage of range adversely affected by the HCP
  - the percentage of range conserved by the HCP
  - the ecological significance of that portion of the range affected by an HCP
  - the level of knowledge about the affected species and the degree of specificity of the species' conservation program under the HCP
  - whether the HCP was originally designed to provide an overall net benefit to the affected species and contained measurable criteria for assessing the biological success of the HCP
  - whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild

C. ADDITIONAL CONSERVATION AUTHORITY

- Nothing in this policy shall be construed to limit or constrain FWS or any other governmental agency from taking any additional actions at its own cost with respect to the conservation or enhancement of a species which is included under an HCP.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

AUG - 1 1995

Memorandum

To: Assistant Regional Directors, All Ecoregions
Region 1 (Attn: Field Supervisors, Ecological Services)

From: Regional Director
Region 1, Portland, Oregon

Subject: Region 1 Guidelines for Determining Covered Species Lists and Assurances Relative to Habitat Conservation Planning

The following guidelines are designed to help U.S. Fish and Wildlife Service (Service) personnel in assisting applicants develop covered species lists for Habitat Conservation Plans and Natural Community Conservation Plans (collectively referred to as HCPs). These guidelines supersede the policy in a November 30, 1994, memorandum ("Clarification of Policy Concerning Adequate National Environmental Policy Act and Species Coverage in Habitat Conservation Plans"). The basis for these guidelines is found in Secretary Babbitt's "No Surprises" policy, the draft National HCP Handbook (dated September 15, 1994), and the Endangered Species Act (Act), its implementing regulations and legislative history.

It is important for the Service and permit applicant to agree early in the planning process which species will be targeted for protection; i.e., develop a "target" species list for which the applicant will provide adequate coverage and seek assurances at the end of the planning process. The Service encourages applicants to include, at a minimum, federally listed and proposed threatened and endangered species, Federal candidate species, and state-listed or sensitive species. A well designed target species list can: 1) provide incentives for permit applicants to conserve as many species, habitat types, and ecosystems as possible; and 2) increase the likelihood that applicants will receive assurances for as many species as possible. In addition, early agreement on the target species list will aid in data gathering, developing survey requirements, and mapping, and in general will make the entire HCP process more efficient.

The Assurances Policy

On August 11, 1994, Secretary of the Interior Bruce Babbitt issued a joint U.S. Fish and Wildlife Service/National Marine Fisheries Service (Services) "No Surprises" policy. This policy is based on the conference report to the 1982 amendments to the Act, which states: "In the event that an unlisted species addressed in an approved conservation plan is subsequently listed pursuant to the Act, no further mitigation requirements should be imposed if the conservation plan addressed the conservation of the species and its habitat as if the species were listed pursuant to the Act."

The "No Surprises" policy was intended to "...provide assurances to non-Federal landowners participating in habitat conservation planning that no additional land restrictions or financial compensation will be required from an HCP permittee for species adequately covered by a properly functioning HCP...except under extraordinary circumstances."

If extraordinary circumstances warrant additional mitigation, the primary obligation will not rest with the HCP permittee. Additional mitigation for covered species from an HCP permittee who is in compliance with the HCP's obligations shall be limited to changes within conserved habitat areas or to the HCP's operating conservation program. No additional land or funding will be required of the permittee.

For Which Species Will Assurances Be Given?

Assurances will be given for those species that are adequately covered by the HCP; i.e., 1) the HCP must address the conservation of the species and its habitat (either individually or by habitat association), and 2) all section 10 issuance criteria specified in the Act and its implementing regulations must be met (see section 10(a)(2)(B) of the Act, 50 CFR 17.22 and 17.32(b), and Chapter 7 of the National HCP Handbook).

To conserve a listed species, an HCP must either contribute to its recovery or at least not preclude it. To conserve unlisted species, an HCP must not significantly contribute to the subsequent need to elevate that species to candidate or emergency listing status.

For an HCP to satisfy the section 10 issuance criteria: 1) the taking must be incidental to an otherwise lawful activity; 2) the impacts must be minimized and mitigated to the maximum extent practicable; 3) adequate funding must be provided; 4) the taking must not appreciably reduce the likelihood of the survival and recovery of the species; and 5) any other necessary measures must be met.

The final evaluation of the adequacy of a conservation plan rests with the professional judgment of the Service. For single species and multi-species plans, the Service must articulate in its findings documents why the species and associated habitat type(s) or ecosystem are adequately covered and all permit issuance criteria are met.

The Service recognizes that multiple species planning efforts may, by necessity, be based on ecosystem health. This means that a multi-species HCP will be analyzed to determine how the proposal will adequately provide for the quality of natural habitat and the species that depend upon those habitats in the planning area. This analysis may find that not all species within the planning area will receive equal benefits from the mitigative measures of the plan, but the overall benefits of a successful plan to the natural ecosystem will provide for the species that inhabit that ecosystem.

As a cross-check of the adequacy of an ecosystem-based plan, the Service also will analyze the effects of the plan on certain species. In general, those species which are under the greatest degree of threat (e.g., listed species, proposed species, and Category 1 candidate species) or which will be subject to the greatest impact from the project should receive the most detailed analyses, factoring in what is known about the species' numbers, productivity, threats, and other limiting factors. More generalized habitat-based analyses may be acceptable for other species. For example, other species with similar needs or functions in a habitat type within an ecosystem could be analyzed together, provided that the impacts of the project on the group of species are described and a sound scientific rationale is presented supporting the conclusion that the group (and therefore each species) is adequately covered by the HCP and section 10 issuance criteria are met.

Mitigation Principles

Determining how much mitigation is adequate can be a frustrating experience for both the Service and the permit applicants. The following guidelines describe the "rules of the game" and are intended to provide for consistency.

The Service should discuss with the applicant the impacts of their project on the status of the species and associated habitat types, and should emphasize the applicants' responsibility to adequately mitigate for those impacts through their HCP. The Service should explore with the applicant specific methods of mitigating for adverse impacts on species, in descending priority, by: 1) avoiding the impact; 2) minimizing the impact; 3) rectifying the impact; 4) reducing or eliminating the impact over time, and 5) compensating the impact (40 CFR 1508.20).

The Service and applicant also should discuss what mitigation methods are "practicable." Practicable connotes something feasible that can be put into effect, given technological and economic constraints. The discussion of alternatives in the HCP should include a discussion of practicability, so that the Service has a written basis for its required finding that the applicant will, to the maximum extent practicable, minimize and mitigate impacts.

In general, the mitigation requirements should be correlated to the level of impact to the species. A higher level of mitigation should be required to offset significant impacts than to offset insignificant impacts. Little to no mitigation should be required if the impacts are insignificant or discountable.

An evaluation of significance requires consideration of both the context and severity of adverse and beneficial impacts. Context includes the status of the species rangewide and locally; the importance of the affected population to the recovery and survival of the species; existing and future threats to the species; and the degree to which the plan contributes to species' conservation. Severity includes the duration and intensity of the impact; the degree to which possible effects on the species are highly uncertain or involve unique or unknown risks; the degree to which the action may establish a precedent for future actions with significant effects on the species; and whether the action is related to other actions with individually insignificant but cumulatively significant impacts on the species. For multi-species plans, the context and severity of impacts also can be evaluated with respect to habitat types and ecosystems.

A significant impact could be one that jeopardizes or precludes the recovery of covered species, or necessitates the addition of species to the candidate, proposed, threatened, or endangered species lists. Despite adequate information, an effect that cannot meaningfully be detected, measured, or evaluated relative to the species' status or habitat as a whole could be insignificant. An effect that would not reasonably be expected to occur, could be discountable. Little may be required to mitigate or minimize the potential take associated with an insignificant or discountable effect. Further, those actions which are found to have a discountable or insignificant effect (51 FR 19949) upon covered species would not likely be found to appreciably reduce the likelihood of survival and recovery of the species. Thus, for example, assurances could be given for a wide-ranging species that barely occurs in the HCP area, for which impacts are insignificant or discountable and little to no mitigation is provided.

The applicant should articulate in their HCP how the species are being treated to adequately mitigate impacts of the proposed action consistent with these guidelines. Factors to be analyzed may include breeding, nesting, dispersing, feeding, resting, behavioral, and/or developmental needs, etc. Ideally, the HCP will address an essential limiting factor; however, in some cases, management for a non-limiting factor may be adequate provided that limiting factors are being adequately met elsewhere (such as on Federal lands).

At times it may not be possible to determine whether some species are adequately covered by the HCP. For example, there may be little or no information on the species within the HCP area, or the HCP may depend on a preserve that will be developed based on the availability of willing sellers; thus it is uncertain whether a specific habitat type will be conserved. In situations such as these, the applicant and Service should identify a process for ensuring that species assurances will be granted at a later date; e.g., identify areas which if conserved, would result in species coverage; or identify monitoring procedures with specified results that will lead to species coverage.

Example HCPs Completed Under these Guidelines

The Fieldstone HCP and Murray Pacific HCP were completed in June 1995 under these guidelines (then in draft form). The Fieldstone HCP involved permanent habitat loss due to home and road construction on 1,955 acres of primarily coastal sage scrub habitat (30-year permit). The Murray Pacific HCP involved temporary changes in successional stages of a 54,000-acre coniferous forest tree farm (100-year permit). Fieldstone received assurances for 63 of 66 requested covered species, whereas Murray Pacific received assurances for all species that could occur on the HCP area. For both HCPs, the Service named only currently listed species on the permit. Unlisted covered species can be added to the Fieldstone permit automatically upon listing and to the Murray Pacific permit through formal permit amendment.

For Murray Pacific, the Service determined that assurances could be given for "all species" because all habitat types that comprise the tree farm would either increase in quantity or quality, or not change significantly over the life of the permit when compared to the baseline condition of not implementing the HCP. Because the baseline habitat conditions would improve or remain the same for all species on the tree farm, all species associated with those habitats would benefit or not be significantly affected by tree farm management. Should unlisted species be listed in the future, the Service would re-initiate internal section 7 consultation for those newly listed species that would be adversely affected by tree farm management practices. In addition, if Murray Pacific requests that such species be added to the permit, an evaluation will occur during the permit amendment process to determine if extraordinary circumstances exist. If extraordinary circumstances warrant additional mitigation or funding, the obligation will not rest with Murray Pacific. The permit amendment process will provide the Service additional opportunity to evaluate, in greater detail than its original opinion, the impacts on individual covered species.

In contrast to Murray Pacific, Fieldstone requested an upfront permit for all covered species. Further, the Service could not provide assurances to Fieldstone for all species on-site because the conservation requirements of all species were not addressed in the HCP. The Service gave Fieldstone assurances only for those species that were adequately conserved, and agreed to automatically add unlisted covered species to the permit upon listing. Fieldstone is not obligated to provide additional mitigation or funding for covered species; however, Fieldstone could be obligated for species not covered by the HCP if those species subsequently are listed and project development or HCP implementation would adversely affect them, necessitating that the Service re-initiate internal section 7 consultation. The Service was able to more rigorously address impacts to individual species in the Fieldstone biological opinion than in the Murray Pacific opinion, further justifying the difference in approaches for adding covered species to the permit.

Conclusion

The Service believes that these guidelines will encourage multi-species HCPs by providing a fair, cooperative, and scientifically sound approach to determining covered species. Questions or comments on this guidance should be directed to the Regional Director, attention Vicki Finn, U.S. Fish and Wildlife Service, 911 Northeast 11th Avenue, Portland, Oregon 97232, telephone (503) 231-6241.

APPENDIX 5

Washington State Forest Practices Rules and Regulations

Steven Toth
Plum Creek Timber Company, Inc.
Seattle, Washington

WASHINGTON STATE FOREST PRACTICES RULES AND REGULATIONS

STEVEN TOTH
Plum Creek Timber Company, L.P.
Seattle, Washington

I. INTRODUCTION

In Washington, all forest practices are regulated under the Forest Practices Act. The state legislature adopted this statute in 1974 to regulate activities such as timber harvesting, road construction, replanting, and chemical application. The Act's purposes are broad: to protect public resources (water, fish, wildlife, and public capital improvements such as county roads), while also maintaining a viable forest products industry. The Act did not establish detailed rules for forest practices, but created a Forest Practices Board to write regulations that apply to forestry and timber harvesting activities. The Department of Ecology (DOE) also jointly adopts the rules that affect water quality. The Department of Natural Resources (DNR) administers and enforces the rules developed by the Forest Practices Board.

This paper provides a general overview of forest practice rules that are important for the protection of public resources. For detailed information and exact wording, please refer to the Washington Forest Practices Act (RCW 76.09) and the Forest Practices Rules (WAC 222).

II. CLASSIFICATION OF FOREST PRACTICES

There are four classes of forest practices created by the Forest Practices Act. Classification of forest practices ensures that adequate review occurs and allows monitoring and enforcement of compliance for those practices that have the potential to affect public resources. Applications are not only reviewed by the DNR, but can be reviewed by other state agencies, tribal representatives, environmental groups or other interested parties. Forest practices that have the potential to damage public resources (i.e., most Class III and all Class IV - Special applications) will have field review by the DNR forester and, when appropriate, interdisciplinary teams of scientists.

Class I forest practices are defined as those operations that have no direct potential for damaging public resources. These forest practices include: 1) road maintenance with the exception of bridge and culvert replacement on permanently flowing streams and larger non-forested wetlands; 2) construction of landings less than 1 acre in size; 3) construction of less than 600 feet of road on sideslopes less than 40 percent; 4) installation and replacement of relief culverts; 5) rocking of existing roads; 6) precommercial thinning or pruning; 7) ground application of chemicals; and 8) aerial application of chemicals except insecticides when applied to less than 40 contiguous acres. These operations may occur without notification or application to the DNR.

Those operations that have less than ordinary potential to damage public resources are defined as Class II forest practices. These forest practices include: 1) construction of fire trails; 2) salvage of logging residue; 3) partial cutting of 40 percent or less of live timber volume west of the Cascade summit or partial cutting of less than 5,000 board feet per acre east of the Cascade summit; 4) harvest of less than 40 acres; 5) salvage of dead, down, or dying timber if less than 40 percent of the total timber volume is removed in any 12-month period; and 6) construction of more than 600 feet of road that does not occur within a riparian management zone, ordinary high water mark of streams, wetland management zone or wetland, or on sideslopes greater than 40 percent. These operations require notification of the DNR.

Class III forest practices are those not listed as Class I, II, or IV and may include: 1) operations that require hydraulic project approvel (e.g., culvert placement in Type 1-3 Waters); 2) are within shorelines of the state; 3) aerial application of insecticides; and 4) most road construction and harvest or salvage of timber, except where classed as Class I, II, or IV forest practices. Forest practices cannot commence without an approved application from the DNR.

Some forest practices have the potential for substantial impact to public resources and, therefore, constitute a Class IV- Special application. The special application requires an environmental checklist in accordance with the State Environmental Policy Act (SEPA) because of the potential for substantial impact to the environment. Additional information or a detailed environmental statement may be required before the following forest practices can be conducted:

1) Aerial application of pesticides that have the potential for substantial impact on the environment or ground application of a pesticide within larger non-forested wetlands;
2) Forest practices within designated critical wildlife habitat for state or federal threatened or endangered species;
3) Timber harvest and/or construction of roads, landings, gravel or borrow pits on slide prone areas where there is a potential for debris flow, mass failure, or avalanche to cause significant impacts to public resources;
4) Filling or draining of more than 0.5 acres of a wetland; and
5) Forest practices on registered archaeological or historic sites or on sites containing evidence of Native American cairns, graves or glyptic records.

III. WILDLIFE RESOURCES

The following sections describe forest practice rules that address activities affecting terrestrial wildlife resources.

Wildlife Reserve Trees

Forest practice rules require that landowners leave two (eastern Washington) or three (western Washington) wildlife reserve trees, two green recruitment trees, and two downed logs for each acre harvested. Wildlife reserve trees are defective, dead, damaged, or dying trees that provide important habitat for cavity-nesting birds and other wildlife. Wildlife reserve trees must be a minimum of 10 feet high and 12 inches in diameter at breast height (dbh). Green recruitment trees are living trees that are a minimum of 30 feet high and 10 inches dbh. Green recruitment trees provide increased structural diversity for wildlife and future recruitment of dead or dying trees (i.e., snags). Downed logs must be at least 20 feet long and 12 inches in diameter at the smallest end and are important for forest floor dwelling wildlife such as rodents and amphibians. Landowners may clump leave trees, as long as no point in the harvest unit is more than 800 feet from a leave tree or a clump of leave trees.

Critical habitat

The forest practices rules regulate activities in areas used for nesting or breeding by threatened or endangered species listed by the federal government under the Endangered Species Act as Class IV Special forest practices. Familiar examples of federally listed species are the northern spotted owl and grizzly bear.

Forest practice rules incoporate species listed by the Washington Wildlife Commission and define "critical habitat" for these species (Table 1). For the northern spotted owl, the Forest Practices Board set as critical habitat 500 acres around each nest or activity center of a pair or resident single owl. For the grizzly bear and seven additional state listed species, the Board defined similar areas, generally corresponding to the habitat used for nesting and breeding. Landowners may also prepare

Table 1. Critical Habitat for Threatened or Endangered Species as Defined by the Washington State Forest Practices Board.

Critical Habitat				
Species	**Activity**	**Distance During Nesting/Breeding Season**	**Distance Rest Of Year**	**Other**
Bald Eagle	harvesting, road construction site preparation *	within 1/2 mile of active nest sites between January 1 and August 15	within 1/4 mile of active nest sites	within 1/4 mile of communal roosting sites year-round
Gray Wolf	harvesting, road construction, site preparation	within 1 mile of active den sites between March 15 and July 30	within 1/4 mile of active den sites	
Grizzly Bear	harvesting, road constructon, site preparation	within 1 mile of active den sites between October 11 and May 30	within 1/4 mile of active den sites	
Mountain Caribou	harvesting, road construction, site preparation	within 1/4 mile of active breeding areas year-round		
Northern Spotted Owl	harvesting, road construction	within 500 acres of suitable nesting, breeding and foraging habitat around activity center, year-round		applies to pairs and resident single owls
Oregon Silverspot Butterfly	harvesting, road construction, ground application of pesticides, site preparation			within 1/4 mile of any individual occurrence, year-round
Peregrine Falcon	harvesting, road construuction site preparation	within 1/2 mile of active nest sites between March 1 and July 30	within 1/4 mile of active nest sites (site preparation exempt outside nesting season)	
Sandhill Crane	harvesting, road construction, site preparation	within 1/4 mile of active nesting area, year-round		
Western Pond Turtle	harvesting, road construction, site preparation			within 1/4 mile of any individual occurrence, year-round

* Aerial application of pesticides in the habitat of any threatened or endangered species is a Class IV - Special forest practice.

site-specific wildlife management plans with the Washington State Department of Fish and Wildlife to better define and protect critical habitat.

IV. AQUATIC RESOURCES

The following sections describe forest practice rules that address activities in riparian areas and wetlands and activities with the potential for sediment production. Sediment from landslides or poorly constructed roads can be detrimental to fisheries and other aquatic resources.

Riparian Areas

Water Typing

The DNR in cooperation with the Departments of Ecology and Fish and Wildlife, and in consultation with affected Indian tribes, classifies streams, lakes and ponds into five types. All fish-bearing streams are considered Type 1-3 waters. Type 1 waters are those inventoried as "shorelines of the state" under chapter 90.58 RCW and includes the larger rivers of the state. Type 2 waters are those waters not designated as Type 1 and have a high level of fish, wildlife, or human use. Type 2 waters typically have a defined channel width at the ordinary high water mark of at least 20 feet and have a gradient of less than 4 percent. Type 3 waters are those not designated as Type 1 or 2 and have moderate fish, wildlife, or human use. Type 3 waters typically have a defined channel at least 5 feet wide and a gradient of less than 12 percent.

Type 4 waters are those not designated as Type 1-3 (i.e., non-fish bearing) and are at least 2 feet in width. Type 4 waters are considered significant for maintaining downstream water quality and may be perennial or intermittent. Type 5 waters are all waters not classified as Type 1-4 and include streams with or without well-defined channels, areas of perennial or intermittent seepage, ponds, natural sinks, and drainageways having short periods of spring or storm runoff.

Leave Tree Requirements

Various riparian management zone (RMZ) widths are applied depending on the stream's water type, width and bed material (Table 2). Standard RMZ widths and leave tree requirements are based on: 1) the amount of large woody debris (LWD) found in undisturbed old-growth forests, and 2) the characteristics of stable debris for a given stream (Bilby and Wasserman 1989).

Estimates of the average amount of LWD found in streams draining undisturbed, old-growth forests are based on research in southwestern Washington and the Olympic Peninsula (Bilby and Wasserman 1989; Table 3). In southwest Washington, Bilby (1988) found that LWD density varied as a function of stream size, with a sharp decrease in the frequency of wood as streams increased in size. Also, the average piece size of wood increased as stream size increased. These patterns are likely caused by the increased capacity for larger streams to move bigger pieces of wood downstream. In addition, streams with gravel/cobble substrate contained twice as many pieces of LWD as similar-sized streams with larger substrate (Bilby and Wasserman 1989). Different sets of requirements were thus developed for four different channel-width categories and for streams with gravel/cobble beds versus bedrock/boulder beds.

Table 4 contains estimates of the amount of stable LWD pieces available to the stream channel at the end of a 70-year rotation. The number of trees to be left for each of the four channel-width categories shown in Table 4 was estimated using the formula:

(1) Target LWD density = (Input from leave trees) + (Input from new stand) + (Residual LWD).

Table 2. Riparian Management Zone Standards in Washington State Forest Practice Rules for Cascade HCP Project Area (WAC 222-30-020).

Water Type/ Average Channel Width	RMZ Maximum Width	Ratio of Conifer to Deciduous	Gravel/Cobble <10" Diameter Streambed	Boulder/ Bedrock Streambed
Type 1 & 2 > 75 Ft. Width	100 Feet	representative of stand	50 trees/1000 ft. each side	25 trees/1000 ft. each side
Type 1 & 2 < 75 Ft. Width	75 Feet	representative of stand	100 trees/1000 ft. each side	50 trees/1000 ft. each side
Type 3 > 5 Ft. Width	50 Feet	2 to 1	75 trees/1000 ft. each side	25 trees/1000 ft. each side
Type 3 < 5 Ft. Width	25 Feet	1 to 1	25 trees/1000 ft. each side	25 trees/1000 ft. each side
Type 4 (where necessary)	25 Feet	no requirement	25 trees/1000 ft. each side	25 trees/1000 ft. each side

Table 3. Old-Growth LWD Frequency and Stable LWD Diameters [Adapted from Bilby and Wasserman (1989)].

Channel Width (feet)

	> 75	**50 - 75**	**7 - 50**	**< 7**
Old-growth LWD frequency (pieces/m)	0.03[a]	0.11[b]	0.26[b]	0.60[c]
Mean diameter of stable LWD (inches)	30	25	18	8

[a] Data from Cederholm (personal communication).

[b] Data from Bilby (1988).

[c] Estimated value.

Table 4. Estimated LWD at end of 70-year rotation [Adapted from Bilby and Wasserman (1989)]

Channel Width (feet)

	> 75	**50-75**	**7-50**	**< 7**
Residual in-channel LWD (pieces/m)	0.01	0.03	0.08	0.18
Input from leave trees (pieces/m)	0.08	0.21	0.25	0.08
Input from new stand (pieces/m)	0	0	0.04	0.18
Total LWD at end of rotation (pieces/m)	0.09	0.24	0.37	0.44

Assuming an average dbh of 18 inches, a 70-year old stand would provide stable LWD in the two smallest stream width categories, but providing stable LWD for the two largest stream width categories would likely require another 25 and 35 years of growth respectively.

The estimated frequency of LWD in streams in the three largest width categories (i.e., > 75 feet, 50-75 feet, and 7-50 feet) at the end of the rotation following institution of the regulations would exceed levels occuring naturally in old-growth systems. The smallest stream size class (i.e., < 7 feet) shows levels lower than those in old-growth systems; however, in these small streams, branches and tops of trees would likely increase the frequency of input to those of old-growth systems.

The diameter of leave trees cited in the forest practice rules for each stream size class (Table 2) are smaller than the mean diameter of stable pieces of LWD in these streams, but since leave tree requirements represent minimum values, the average tree size remaining would approximate the size needed to be stable in the stream. Leave trees for the two largest stream width categories (i.e., > 75 feet and 50-75 feet) must be representative of the present stand to ensure that some of the largest trees on site are retained after harvest. Also, to ensure that conifer trees are not eliminated from riparian stands, ratios of conifer/hardwood leave trees were established.

Shade Requirements for Maintaining Stream Temperature

In addition to leave tree requirements for large woody debris, trees are retained for shade to maintain cool stream temperatures. Depending on elevation, shade from trees in the riparian area can be important for regulating stream temperatures in Washington state (Sullivan et al. 1990). The forest practice rules contain a temperature screen that specifies the amount of canopy coverage needed at a given elevation to meet or exceed state water quality standards for stream temperature. Different temperature screens have been created for western and eastern Washington streams based on empirical data (Figure 1 and 2). Shade requirements often preclude harvest within riparian management zones.

Wetlands

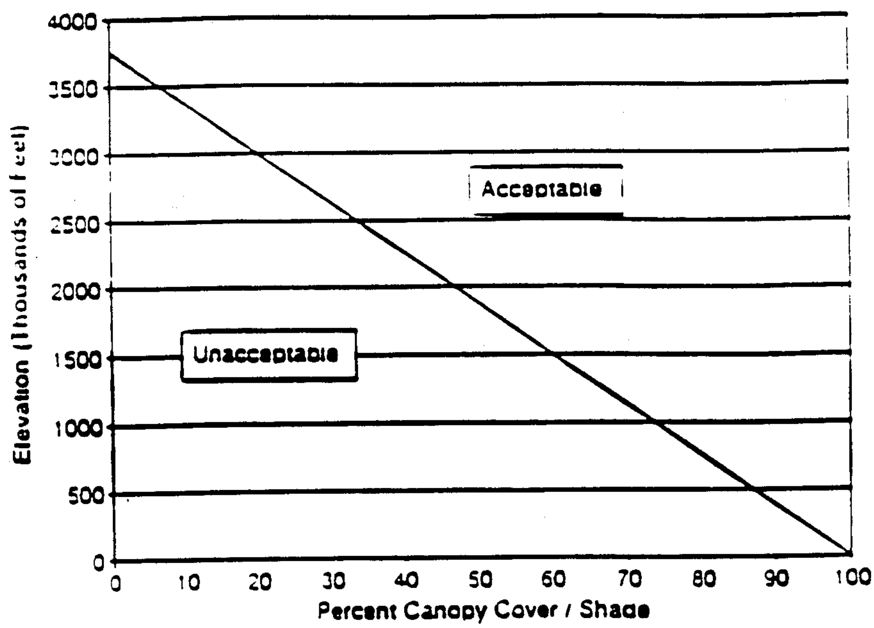
Wetlands are swamps, bogs, fens and similar areas in which the soils are inundated or saturated by water enough of the year that the vegetation is specially adapted to the wet conditions. Wetlands can be either forested or nonforested. The rule divides nonforested wetlands into two classes: Type A (generally larger than 0.5 acre, with open water) and Type B (other nonforested wetlands).

Forest practices rules require buffers, called wetland management zones (WMZs), on all Type A wetlands and on most Type B wetlands. Type A wetlands greater than 5 acres in size require an average WMZ width of 100 feet, while wetlands between 0.5 and 5 acres require a 50-foot average WMZ. Type B wetlands greater than 5 acres require an average WMZ of 50 feet, while wetlands between 0.5 and 5 acres require a minimum WMZ width of 25 feet.

In addition to leaving WMZs, there are several other restrictions on harvest around nonforested wetlands. For example, individual trees and small (<0.5 acre) patches of forested wetland cannot be harvested if surrounded by a Type A or B wetland, although these trees can contribute to the leave tree requirement in the WMZ. Harvest of upland areas or larger forested wetlands, if they are surrounded by Type A or B wetlands, requires a plan approved by DNR. Timber cannot be felled into or cable yarded across a Type A or B wetland without DNR's approval. Also, tractors or wheeled skidders cannot be used in Type A or B wetlands without DNR's approval. Slash disposal is not allowed in Type A or B wetlands or in WMZs. Scarification is not allowed in any wetland, and machine piling is discouraged.

Figure 1. Western Washington Canopy Cover Requirement to Remain Within State of Washington Stream Temperature Standards.

Temperature Standard AA Waters - 61º Farenheit or 16º Celsius



Temperature Standard A Waters - 65º Farenheit or 18º Celsius

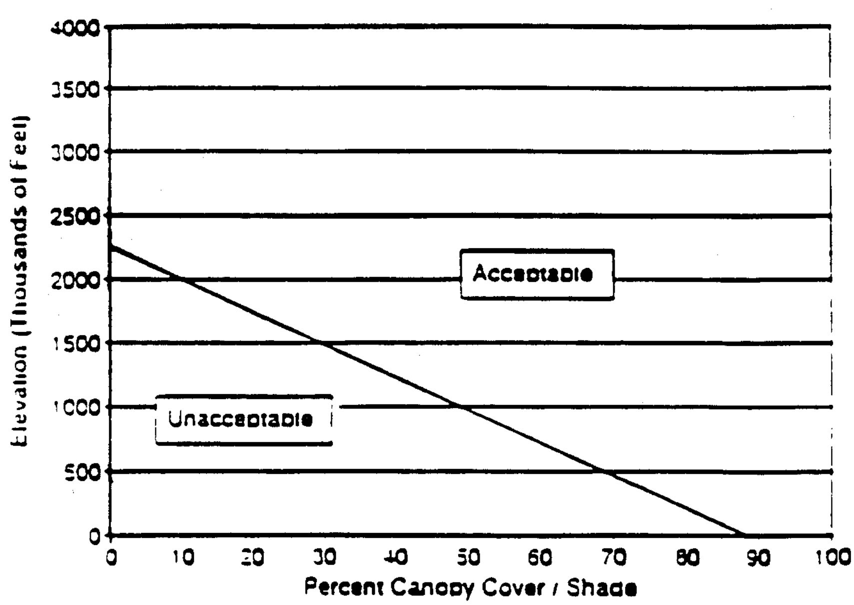
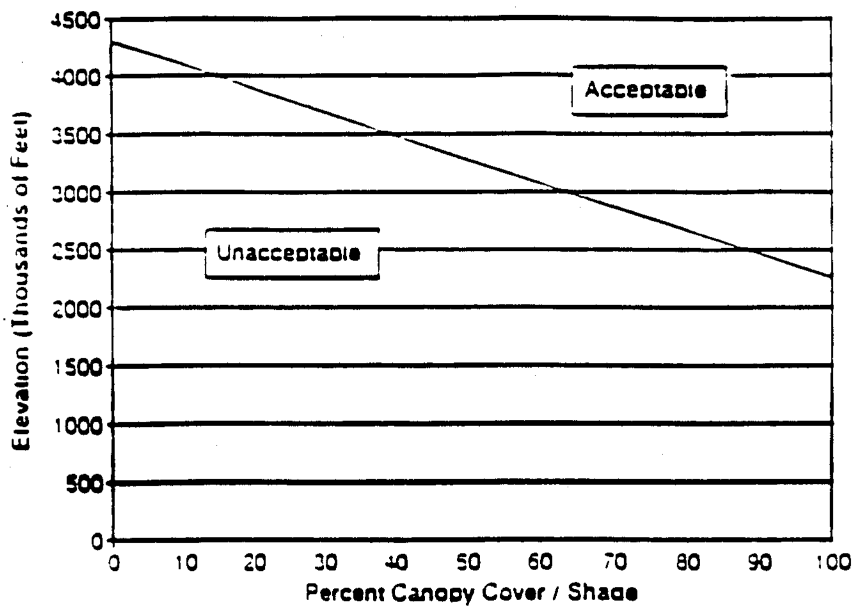
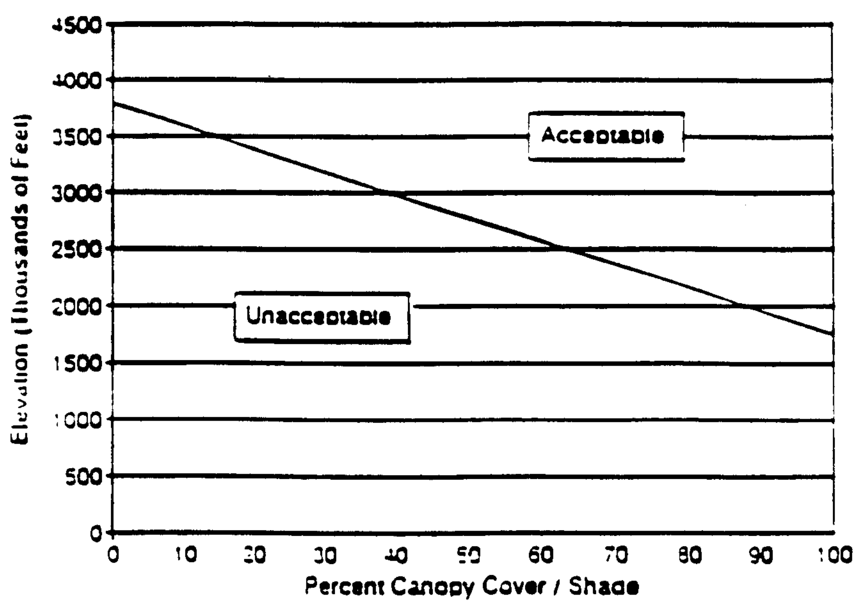


Figure 2. Eastern Washington Canopy Cover Requirement to Remain Within State of Washington Stream Temperature Standards.

Temperature Standard AA Waters - 61° Farenheit or 16° Celsius



Temperature Standard A Waters - 65° Farenheit or 18° Celsius



Forested wetlands have fewer restrictions on timber harvest than nonforest wetlands, but have special rules designed to protect wetland soils. Cable systems are allowed in forested wetlands, but tractors, wheeled skidders, and other ground-based logging systems may be used only when soil moisture is low or the ground is frozen. At all times, equipment use must minimize compaction or disturbance of the soils.

In planning roads and landings in wetlands, landowners must select the least environmentally damaging landing location, road location and road length. If wetlands cannot be avoided, landowners must reduce impacts by minimizing subgrade width and spoil areas. If landowners cannot minimize impacts, they must restore affected areas, reduce or eliminate impacts, or replace affected wetlands. Also, if landowners fill (or drain) more than 0.5 acre of wetland, they must compensate for that fill (or drainage) by creating new wetlands of equal acreage or by enhancing existing wetlands.

Sediment Production from Roads and Harvest Activities

Forest practices rules contain a number of narrative standards and guidelines for road location and design. Roads should be fit to the topography to minimize alteration of the landscape. Road length along or within narrow canyons, riparian zones and wetland management zones should be minimized unless other alternatives would cause greater damage to public resources. Stream crossings should be minimized and whenever possible crossed at right angles to the main channel. Duplicative roads should be avoided and located away from steep or unstable slopes.

A number of road design factors are considered to minimize road-related erosion and to reduce sediment entry to streams. All roads should be outsloped or ditched on the uphill side with appropriate surface drainage provided using cross drains, ditches, dips, water bars or other such structures. Surface water cannot discharge onto erodible soil or over fill slopes without adequate outfall protection. Road surface drainage should minimize erosion of the road bed, cut bank, ditches, and fill slopes. Drainage structures should be installed at all natural drainage points, all low points in the road gradient, and spaced no wider than specified in the matrix below.

Grade	Distance Westside	Distance Eastside
0 - 7 Percent	1,000 feet	1,500 feet
8 - 15 Percent	800 feet	1,000 feet
Over 15 Percent	600 feet	800 feet

More frequent culvert spacing or other drainage improvements are required where site-specific evidence of peak flows or soil instability exists. Cross drains are required in wetlands to provide hydrologic connectivity. Relief culverts must be at least 18 inches in diameter in western Washington and at least 15 inches in eastern Washington. Where roadside ditches slope toward a Type 1-3 Water or larger non-forested wetland for more than 300 feet, ditchwater must be diverted onto the forest floor at the first practical point.

Loose stumps, logs, chunks of wood, or significant amounts of organic debris are not allowed in road fill. Fills or embankments must be compacted over the entire surface. Soil exposed by road construction that is unstable or erodible should be seeded with ground cover or treated by erosion control measures. Endhaul or overhaul construction is required where significant amounts of sidecast material would rest in the floodplain of streams, within wetlands or wetland management zones, or where there is a potential for mass wasting.

All permanent culverts must be sized to carry the 50-year flood, or the road must be constructed with erosion protection that can withstand a 50-year flood. Culverts smaller than 24 inches in diameter cannot be installed for anadromous fish waters or smaller than 18 inches for resident fish waters. The alignment and slope of the culvert should parallel the natural flow of the stream and, where fish are present, the bottom of the culvert should be constructed at or below the natural stream bed. For anadromous fish, culverts can be either open bottomed or have the bottom covered with gravel and installed at least 6 inches below the natural stream bed. Culvert installation can occur only at times that would not interfere with migration or spawning of anadromous fish. The entrance of all culverts should have adequate catch basins and headwalls to minimize erosion.

Any drainage structures or road systems that have a potential to damage public resources shall be subject to a road maintenance and abandonment plan. This plan is subject to annual review by the DNR.

V. CUMULATIVE EFFECTS

Watershed Analysis

Forest practices rules include a process called "watershed analysis" to regulate the cumulative effects of forest practices. To conduct a watershed analysis, the DNR or a sponsoring landowner sends a team of qualified scientists into a basin to analyze the fish, water, and capital improvements in the basin and to identify problem areas where forest practices have had or could have an adverse effect on these resources. A team of managers then set prescriptions that must be used to operate on these sensitive areas. All future forest practices in the sensitive areas must adhere to the prescriptions developed during watershed analysis. For more detailed information on watershed analysis, please refer to Technical Report No. 12 for the HCP document (Toth 1995).

Clearcut size and timing

Forest practices rules also regulate the size of clearcuts and other units harvested by even-aged harvest methods, such as seed tree harvests, shelterwoods, and "new forestry" type harvests. The new rules prohibit even-aged harvests units larger than 240 acres. The rules also allow DNR to call for an interdisciplinary team to review even-aged harvest units larger than 120 acres. The rules require that an area "green-up" through approximately five years of regrowth before an adjacent unit can be harvested. In addition to limiting the size of harvest units, the new rules impose perimeter requirements for every even-aged harvest unit, regardless of size.

VI. SILVICULTURE

Chemicals

The aerial application of pesticides in most cases is classified as a Class IV Special forest practice requiring an environmental checklist under State Environmental Policy Act (SEPA). For aerial application of pesticides, the forest practice rules require 50 foot buffers on Type A and B wetlands, as well as on all flowing streams.

Reforestation

Reforestation is required on all forest lands, with the exception of lands that are converted to urban use. Reforestation must take place within 3 years of completion of clearcut harvest, or 1 to 10 years as determined by the DNR for natural regeneration plans, to acceptable stocking levels. Reforestation plans must be submitted with forest practice applications and reports must be filed upon completion of planting or at the end of the planting season.

VII. CONCLUSIONS

Washington state forest practice rules are among the strictest in the United States. The majority of forest practices undergo regulatory review prior to any action. Forest practices that have significant potential to impact public resources require field review by DNR foresters and, when appropriate, interdisciplinary teams of scientists, environmental checklists and full public review under SEPA. The forest practice rules provide broad protection for public resources in all forested lands.

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APPENDIX 6

Washington Natural Heritage Program

Letter from Ms. Sandy Norwood, Division of Land Water Conservation, Washington Department of Natural Resources, Olympia, Washington, regarding Washington State Endangered, Threatened, and Sensitive Plants and Wetlands

WASHINGTON STATE DEPARTMENT OF
Natural Resources

JENNIFER M. BELCHER
Commissioner of Public Lands
KALEEN COTTINGHAM
Supervisor

December 22, 1994

Lorin Hicks
Plum Creek
999 Third Ave - Suite 2300
Seattle WA 98104-4096

SUBJECT: Habitat Conservation Plan for the Central Cascade Mountain Range

We've searched the Natural Heritage Information System for information on rare plants, high quality native wetlands and high quality native plant communities in the vicinity of your planning area in the Central Cascades. A summary of this information is enclosed.

The Washington Natural Heritage Program is responsible for information on the state's endangered, threatened, and sensitive plants as well as high quality native plant communities and wetlands. The Department of Fish and Wildlife manages and interprets data on wildlife species of concern in the state. For information on animals of concern in the state, please contact the Priority Habitats and Species Program, Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501-1091, or by phone (206) 902-2543.

The Natural Heritage Information System is not a complete inventory of Washington's natural features. Many areas of the state have never been thoroughly surveyed. There may be significant natural features in your study area that we don't yet know about. This response should not be regarded as a final statement on the natural features of the areas being considered and doesn't eliminate the need or responsibility for detailed on-site surveys.

I hope you'll find this information helpful.

Sincerely,

Sandy Norwood

Sandy Norwood, Environmental Review Coordinator
Washington Natural Heritage Program
Division of Forest Resources
PO Box 47016
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Enclosure

WASHINGTON NATURAL HERITAGE INFORMATION SYSTEM
ENDANGERED, THREATENED AND SENSITIVE PLANTS
HIGH QUALITY NATIVE WETLANDS AND HIGH QUALITY NATIVE PLANT COMMUNITIES
IN THE VICINITY OF PLUM CREEK'S CENTRAL CASCADES HABITAT CONSERVATION PLAN
REQUESTED BY LORIN HICKS, PLUM CREEK

Data current as of December 1994

TOWNSHIP, RANGE AND SECTION	ELEMENT NAME	ELEMENT STATUS	SITE STATUS
T21N R14E S11 NEOFSE	Cypripedium fasciculatum (clustered lady's-slipper)	T,C	
T21N R14E S11 SWOFSW	Chaenactis thompsonii (Thompson's chaenactis)	S	
T22N R14E S35 NWOFNW	Carex scopulorum var. prionophylla (saw-leaved sedge)	M3	
T23N R14E S26	Montia diffusa (branching montia)	S	G,H

WASHINGTON NATURAL HERITAGE INFORMATION SYSTEM
Endangered, Threatened, and Sensitive Vascular Plants

ELEMENT STATUS

Federal Status definitions:

LE = Listed Endangered: Any taxon which is in danger of extinction throughout all or a significant portion of its range and which has been formally listed as such in the Federal Register pursuant to the Federal Endangered Species Act.

LT = Listed Threatened: Any taxon which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and which has been formally listed as such in the Federal Register pursuant to the Federal Endangered Species Act.

PE = Proposed Endangered: Any taxon which is in danger of extinction throughout all or a significant portion of its range and which has been proposed for listing as such in the Federal Register pursuant to the Federal Endangered Species Act.

PT = Proposed Threatened: Any taxon which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and which has been proposed for listing as such on the Federal Register pursuant to the Federal Endangered Species Act.

C = Candidate species: Taxa for which current information indicates the probable appropriateness of listing as Endangered or Threatened.

State Status definitions:

E = Endangered: Any vascular plant taxon in danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue. Populations of these taxa are at critically low levels or their habitats have been degraded or depleted to a significant degree.

T = Threatened: Any vascular plant taxon likely to become Endangered in Washington within the foreseeable future if factors contributing to its population decline or habitat degradation or loss continue.

S = Sensitive: Any vascular plant taxon that is vulnerable or declining and could become Endangered or Threatened in the state without active management or removal of threats.

X = Possibly Extinct or Extirpated from Washington: Based on recent field searches a number of plant taxa are considered to be possibly extinct or extirpated from Washington. Taxa in this group are all high priorities for field investigations. If found, they will be assigned one of the above status categories.

M = Monitor: Taxa of potential concern, but for which no status has yet been assigned.

SITE STATUS

H = Historic: This occurrence is known only from historic records.

G = General: This occurrence is known from general information, its exact location is unknown.

Chapter Two: Monitor List

The monitor list includes taxa of potential concern, but for which no status is currently assigned. The monitor list consists of three groups:

Group	Description
1	Taxa in need of additional field work before a status can be assigned
2	Taxa with unresolved taxonomic questions
3	Taxa more abundant and/or less threatened in Washington than previously assumed

Groups 1 and 2 are presented in the same format as taxa on the main list (i.e. Endangered, Threatened, Sensitive and Possibly Extinct or Extirpated in Washington). Taxa in Group 3 are simply listed alphabetically by scientific name.

The Washington Natural Heritage Program does not currently have the information necessary to accurately assess the status of the taxa in groups 1 and 2. Therefore, both site-specific and species-specific information is being sought for these taxa. The taxa in Group 3 have been determined to be more abundant and/or less threatened than previously assumed. Although the WNHP does not focus on these taxa, information about them is still gathered and stored in our information system.

Washington Natural Heritage Program. 1994. Endangered, threatened and sensitive vascular plants of Washington. Department of Natural Resources. Olympia. 52 p.

PlumCreek

November 30, 1994

Ms. Sandy Norwood
Washington Natural Heritage Program
Division of Land & Water Conservation
Washington Department of Natural Resources
P.O. Box 47047
Olympia, WA 98504-7047

RE: Plum Creek's Habitat Conservation Plan for the central Cascade Mountain Range

Dear Ms. Norwood:

We are conducting an investigation of the plants and animals for a Habitat Conservation Plan (HCP) in the central Casade Mountain Range. The HCP planning area encompasses more than 418,000 acres, and is located in portions of King and Kittitas counties. The Township, Section, and Range for all properties within the HCP planning area is attached. The HCP planning area is approximately 60 miles east of Seattle in the I-90 corridor. I have enclosed a vicinity map showing the boundaries of the HCP planning area.

We would appreciate any information you have regarding plant species observed in the area. Of particular interest are species of plants listed as threatened, endangered, or sensitive.

We would also appreciate a reply at your earliest convenience. Thank you for your time and cooperation. Please notify me of any fees regarding this information. If you have any questions regarding this request, Please call me at (206) 467-3629.

Sincerely,

Lorin Hicks, Ph.D.

attachments

999 Third Avenue Suite 2300 Seattle, Washington 98104-4096 206/467-3600

APPENDIX 7

"Frost Meadows: Applying New Forestry Techniques in Spotted Owl Habitat"

"Cougar Ramp: Contoured Patch New Forestry for Wildlife Habitat"

Lorin L. Hicks

Plum Creek Timber Company, Inc.

Seattle, Washington

Application of "New Forestry" Concepts for Wildlife Habitat

LORIN L. HICKS, Director Fish and Wildlife Resources, Plum Creek Timber Co.
Seattle, Washington, USA

Forest ecosystems in the Pacific Northwest have become the focal point for discussion and debate regarding the effects of commercial forest management on ecological values such as wildlife habitat. Though much of the debate has centered on the amount and location of old growth forests remaining in the region, concern has also been expressed about the quality of second growth forests. Recent research suggests that second growth forests created by commercial forestry lacks some of the wildlife habitat characteristics found in second growth created by natural disturbance such as fire and windthrow.

The concept of "New Forestry" has been proposed as a management paradigm to address the issue of increased structural retention in managed forests. At the stand level, New Forestry is defined as the silvicultural practice of retaining green trees representative of the pre-harvest stand, retaining standing dead and dying trees, and conserving coarse woody debris such as large down logs. These treatments are prescribed for forested stands that normally would be subjected to conventional even-aged management such as clearcut, seedtree or shelterwood treatments. One of the primary benefits of New Forestry prescriptions is thought to be more diverse and productive wildlife habitat. However, little research has been completed to evaluate this assumption.

Since 1990, Plum Creek Timber Company has been experimenting with New Forestry concepts in the management of commercial forestlands. This paper describes Plum Creek's operational and economic evaluation of various types of New Forestry treatments such as dispersed retention, "wedges", and contoured patches. Application of New Forestry prescriptions to address habitat concerns for sensitive wildlife species such as northern spotted owls (*Strix occidentalis)* is described. Results from recently completed and ongoing research to evaluate avian, small mammal and herptile use of New Forestry prescriptions and conventional harvest treatments is displayed. Preliminary results of the research to date suggest that these treatments are effective in providing more structural diversity for wildlife habitat.

The evolution of New Forestry experimentation to Plum Creek's Environmental Principles is discussed. Results from Plum Creek's experience with New Forestry have been used to develop a comprehensive 50-year Habitat Conservation Plan for 284 species of wildlife in Washington's Central Cascades.

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***ABSTRACT** of paper presented August 8, 1995 at IUFRO World Congress, Tampere, Finland*

FROST MEADOWS: APPLYING NEW FORESTRY TECHNIQUES IN SPOTTED OWL HABITAT

Plum Creek Timber Company, L.P. owns 1.2 million acres of forestland in the Pacific Northwest states of Washington, Idaho and Montana. The diverse nature of the company's forestland holdings requires our foresters to use a wide array of silvicultural techniques to accommodate regional biological, economic, and environmental conditions.

Recently, Plum Creek has been experimenting with "new forestry" techniques as advocated by Dr. Jerry Franklin, Bloedel Professor of Ecosystem Analysis at the University of Washington. Plum Creek is evaluating these techniques as operational and economic alternatives to the standard practices of clearcut harvesting and even-aged management in western coniferous forests.

Habitat concerns for the Northern Spotted Owl (Strix occidentalis caurina) have become a major consideration for both public and private forestland managers within the range of this species. Forest managers are trying to develop techniques which allow limited harvest opportunities in spotted owl habitat. Yet, biologists must be convinced that timber harvest strategies can provide essential habitat components for spotted owls today and into the future. Plum Creek's application of new forestry concepts in its Frost Meadows unit is an attempt to accommodate these seemingly diverse objectives.

The Frost Meadows harvest unit is located in the Manastash Creek drainage which is on Plum Creek lands intermingled with the Wenatchee National Forest. A 183-acre timber sale was modified to accommodate an active spotted owl nest discovered in 1990 just before harvest was to begin. The nest was found in the cavity of a large tree at nearly 5,000 feet in elevation, in old growth timber within 100 yards of a four year-old clearcut.

The sale was modified from the planned traditional clearcut in the following manner:

1. A minimum 400-foot-wide, no-cut corridor was established along the creek as a travel and dispersal route for owls.

2. The unit closest to the nest site was changed from a clearcut to a new forestry prescription. About 80% of the residual stand in this marked "cut tree" unit was left intact to maintain old growth habitat characteristics such as large diameter trees and decayed, dead and downed timber. Yet, nearly 50% of the merchantable timber volume was removed in this stand.

3. The remainder of the sale was changed to marked leave tree units which reflect new forestry concepts of green tree retention and conservation of coarse woody debris. About 18-20 old growth overstory trees per acre and the associated understory trees in their immediate vicinity were retained. Plum Creek's objective was to accelerate the development of future spotted owl habitat by providing for multilayered tree canopies and interspersed overmature trees which appear to be important spotted owl habitat components.

Since harvest, the adult spotted owls at Frost Meadows have been banded with colored leg bands. Radio transmitters have also been attached to monitor their movements throughout the year. Plum Creek continues to survey the area intensively for additional owls.

This work has revealed that the female spotted owl discovered just prior to harvest at Frost Meadows in 1990 remained in the harvested area. In 1991, the male with whom she had previously nested was replaced by a sub-adult. The new pair did not mate in 1991. In 1992, however, this pair successfully raised two young at the highest elevation nest site in the state. Both young have been banded and fitted with radio transmitters.

Through tracking spotted owls, Plum Creek has also learned that the project area is within the home range of both the Frost Meadows male and female spotted owls. More importantly, though, Plum Creek has monitored spotted owl use at the "cut tree" unit during the 1992 nesting season within two years of active cutting. Plum Creek will continue to monitor spotted owls at the Frost Meadows site.

COUGAR RAMP: CONTOURED PATCH NEW FORESTRY FOR WILDLIFE HABITAT

Since 1990, Plum Creek has been experimenting with "new forestry" techniques as advocated by Dr. Jerry Franklin, Bloedel Professor of Ecosystem Analyses at the University of Washington. Plum Creek has been evaluating the ecologic, operational and economic implications of new forestry across the company's 1.2 million acres of forestland in Montana, Idaho and Washington.

Cougar Ramp represents a major conceptual breakthrough in the application of New Forestry on commercial forestlands. Located in the Lewis River drainage of southwestern Washington, the Cougar Ramp unit was designed to meet three management objectives:

1. Retain patches of representative green trees, snags and downed logs with as little disturbance as possible for wildlife habitat.

2. Address aesthetic concerns for travelers along a nearby highway.

3. Allow for future blowdown salvage and site preparation for reforestation should the need arise.

The Cougar Ramp site differed from earlier new forestry experiments in that the leave trees were clustered in patches rather than scattered through the unit. This design minimized additional harvest costs while reducing safety risks and damage to retained trees.

Harvesting occurred on Cougar Ramp in 1990 using uphill cable logging. Approximately 15% of the 73 acre unit was set aside in contoured patches. The patches were designed, mapped and marked within each tower setting. Timber was directionally fallen away from the patches. Cutting of non-hazard snags and understory vegetation was avoided in the harvested areas.

Following harvest, University of Washington researchers under the direction of Dr. Franklin and others evaluated residual vegetation and microclimate conditions in the unit. Wildlife habitat studied by comparing bird, small mammal and amphibian use of cut areas, uncut patches and adjacent forest.

The contoured patch design at Cougar Ramp provided a diverse mixture of trees and shrubs representative of the pre-harvest stand. Douglas fir was the primary tree species retained in the unit, although red alder, maple and western hemlock were also represented. Trees retained in the unit range from 8" to 76" in diameter in conditions ranging from vigorous and healthy to dead and dying. In addition, over 23 species of understory plants have been inventoried in the contour patches.

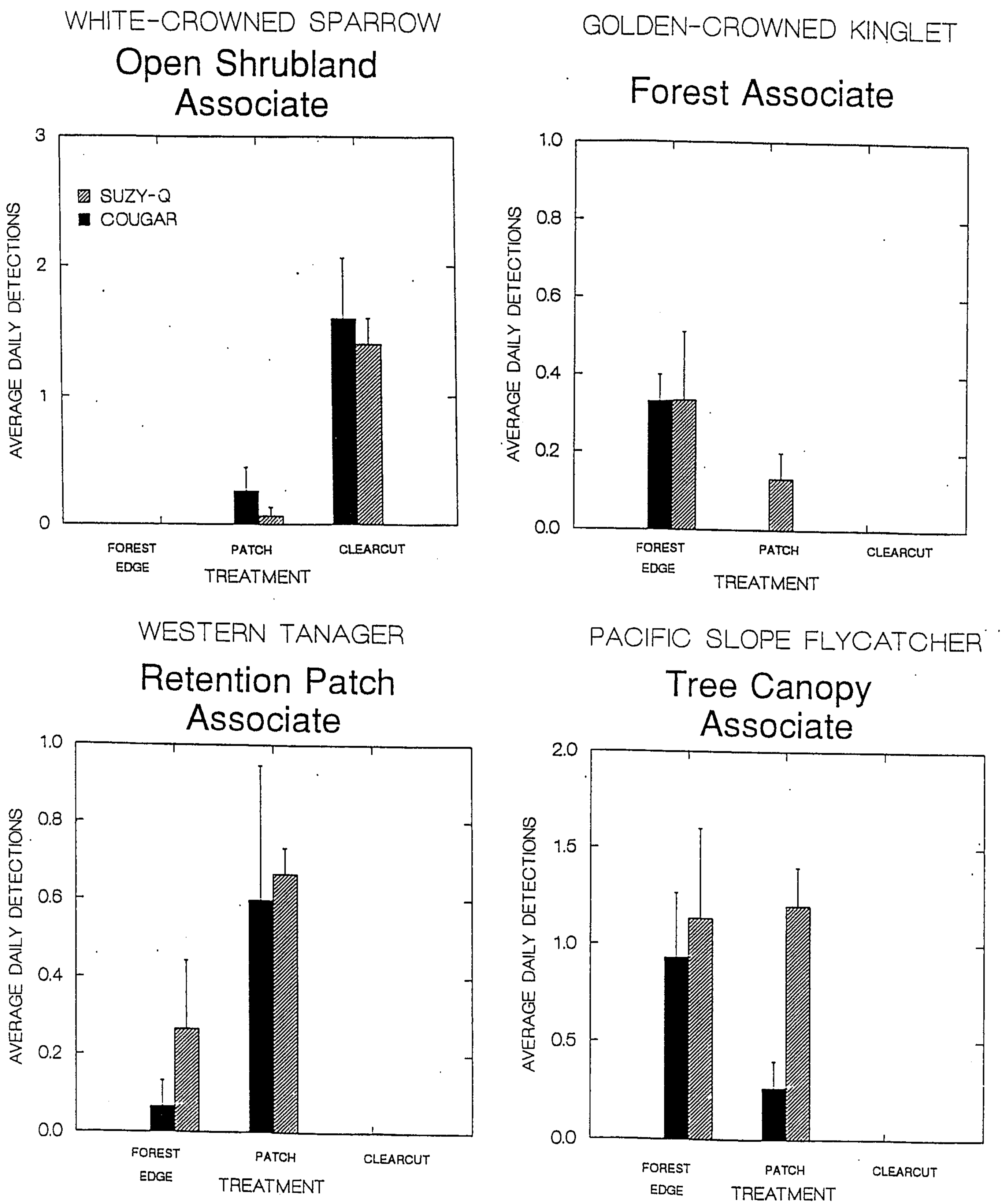
Preliminary results of the wildlife research indicate that bird species diversity and abundance is highest in the contoured retention patches. The fifty-five bird species using the Cougar Ramp unit represent groups normally associated with forest canopies as well as species commonly found in clearcuts and openings.

Small mammal species diversity and abundance was highest in the harvested portions of the unit and lowest in the adjacent interior forest. Retention patches provided moderate habitat for amphibians, a wildlife group that does poorly in cleared areas.

Research and monitoring will continue at Cougar Ramp, especially as the harvested areas regenerate to provide additional forest structure. Lessons learned at Cougar Ramp have provided Plum Creek with valuable experience in applying new forestry techniques to Washington Cascades forest habitats.

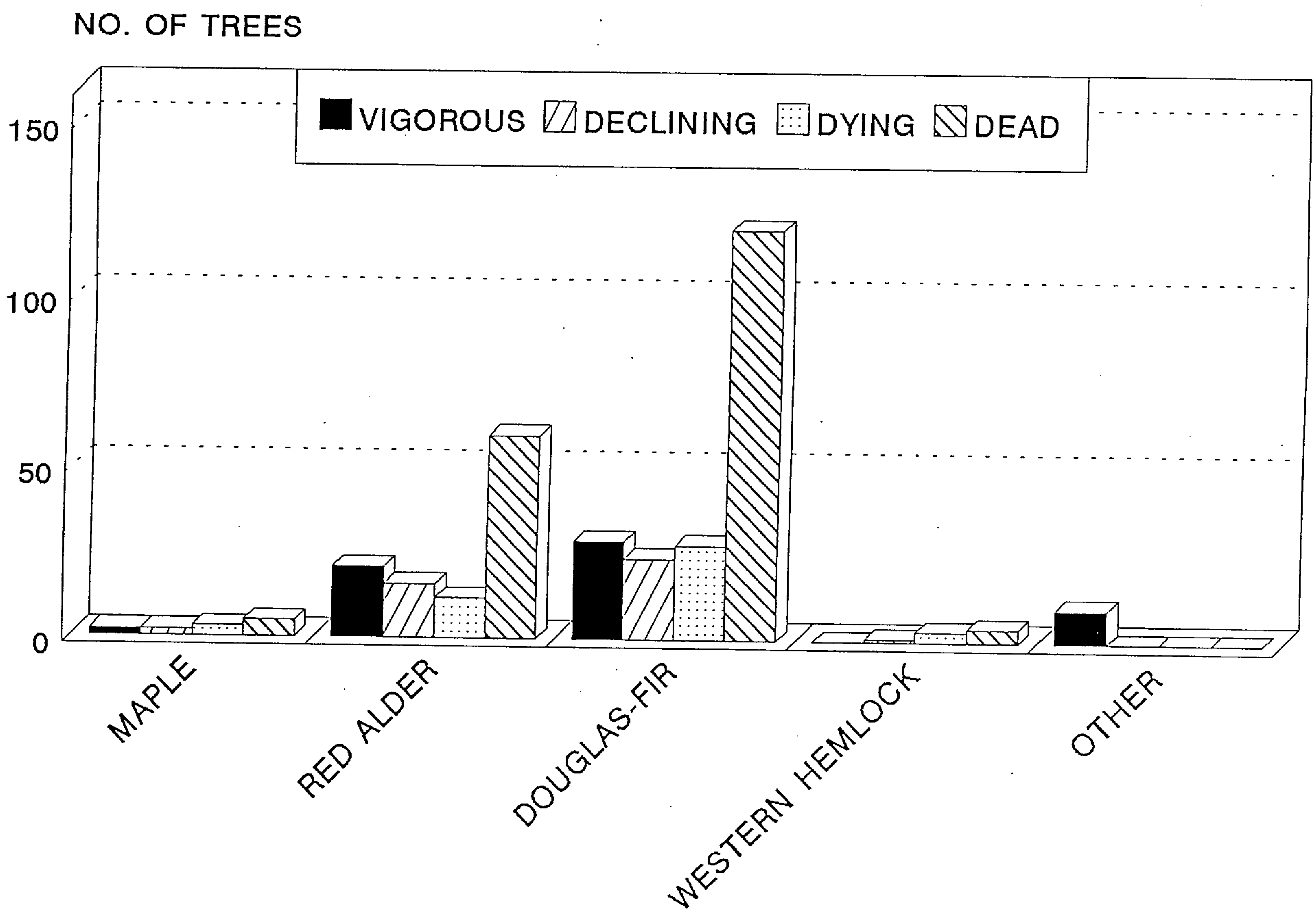
March 1993

Use by Birds of Habitat Elements Created by Contour Patch Harvesting



TREE SPECIES BY VIGOR CLASS

COUGAR RAMP NEW FORESTRY UNIT



APPENDIX 8

The Role of Industrial Forestlands in the Management of Western Washington's Forest Ecosystems

The "Pack Forest Agreement"

From a Workshop on March 1-3, 1993
Sponsored by the
Olympic Natural Resources Center
University of Washington
College of Forest Resources

The Role of Industrial Forestlands in the Management of Western Washington's Forest Ecosystems

Private timberlands have unique roles and responsibilities, distinct from public forests. Yet, much of the public does not differentiate between public and private forestlands and assumes that practices on public forest lands should be applied to all forest lands. Private lands must be managed for profitable timber production even while fulfilling environmental obligations; if societal restrictions make this impossible, investment capital and the associated industrial base will go elsewhere.

Given such pressure, private forestland owners have a need to collectively develop and state the ecological objectives that are appropriate for industrial forestlands. In doing so, consideration must be given to the economic objectives of the industrial landowner, state and federal forest management regulations, interaction with other ownerships, and our current knowledge of the biological responses to various silvicultural practices. In the absence of such a statement, there is likely to be continued confusion among landowners and the public over roles and responsibilities, which in turn leads to unrealistic demands that industrial forestland owners meet all expectations.

Recognizing the need for positive action, the following statement of ecological objectives appropriate for private forest landowners in western Washington was developed by a sample of individuals affiliated with industrial forest companies, academia, agencies, and nonindustrial owners.* We believe this statement represents a significant step toward clarifying the appropriate role of industrial forestlands in managing western Washington's forest ecosystems. It builds on the substantial existing voluntary commitments and regulatory responsibilities of private forestland owners, and is placed within the context of the roles and responsibilities of other landownerships.

The appropriate key roles identified for private industrial landowner are as follows:

1. Protection of riparian areas and wetlands

Private forest landowners have the responsibility for managing riparian areas and wetlands to provide for water quality, fish habitat, and associated wildlife values. Management objectives may include: provision of shade and large organic debris for streams, increasing the conifer component in riparian areas, assessing and monitoring the effectiveness of current regulations, and cooperating with adjacent landowners to achieve desired riparian conditions.

2. Provision of habitat for early and mid-successional species

Private forest landowners will provide habitat for early successional species in conjunction with their primary operational goal of sustainable timber production. In addition, through silvicultural treatments designed to create and retain structures (large trees, snags, and down logs) and diverse vegetative conditions, they will provide for many mid successional species (those that depend on the above structures) and some late-successional species (those that require structural attributes or features of old forest stands).

3. Assist public land managers in meeting their responsibilities for late successional ecosystems

While the protection of late successional ecosystems and species is primarily the responsibility of public land

* *This statement is the result of a workshop on March 1-3, 1993 sponsored by the Olympic Natural Resources Center at the University of Washington's College of Forest Resources*

continued on page 2

managers, it is appropriate and desirable for private forest landowners to cooperate, where practical, in meeting these objectives. For example, private landowners might complement public obligations by providing owl dispersal habitat, participating in land trades or sales critical to conservation programs, and working within incentive and/or compensation programs that encourage protection of late successional species.

4. Maintaining Site Productivity

Private forest landowners will maintain the basic productive capacity of their lands, with particular reference to soil properties. This may be accomplished through such measures as minimizing soil disturbance and compaction, improving road construction and maintenance, and identifying and protecting fragile soils.

Premises

The key premises that underlie the private industrial forest landowner's commitment to the above ecological objectives are as follows:

1. Private landowners must have the opportunity to earn an acceptable rate of return on capital. Failing to achieve this economic goal will result in the loss of working forestlands throughout the state.

2. The spotted owl controversy must be resolved on private land and the roles of different landowners clarified with regard to this issue. While protection of the owl is necessary, current requirements are not compatible with the economic needs of private landowners. It is therefore not appropriate to require private landowners to support spotted owl populations without compensation.

3. We must look beyond traditional species-by-species approaches to conservation and begin focusing on ecosystems. Resolution of the spotted owl recovery process on private lands will mean little if we find ourselves facing one endangered species—and hence one crisis— after another. Developing new approaches that deal collectively with groups of species and habitats is critical; to be successful, these new approaches must accommodate the different goals of various landownerships.

4. Our current knowledge base is inadequate to the task of guiding the development and application of on-the-ground ecosystem management. Hence, private, public, and academic institutions need to make a strong collective commitment to developing the necessary knowledge base for ecosystem approaches to forest management. In addition, we need to make a stronger and more concerted commitment to monitoring and evaluating activities and programs already underway.

5. In light of the long-term nature of forest investments, much greater regulatory certainty than currently exists is required for private forest landowners to achieve ecological objectives in particular, and to stay in the forestry business in general.

6. Achieving some ecological objectives can impose significant economic costs on private landowners. Incentive and/or compensation programs are often a more appropriate and efficient means of meeting these objectives than are regulations. For example, when landowners make a commitment to forgo harvesting in a given area (e.g., extended riparian areas), tax relief measures might be provided. More investigation of appropriate incentives of this sort should be pursued.

7. Proposals that coordinate activities across landscapes must comply with antitrust laws.

This statement is proposed as the basis for defining social responsibilities between private forest landowners and society, in which the private landowner recognizes and accepts significant ecological responsibilities in return for regulatory stability and an acceptance of the basic economic principles that are necessary to maintain productive working forests.

Workshop Participants

The following individuals which participated in all or part of the workshop acted in a variety of roles including: representing companies, speaking on selected topics, and advising the process.

Ralph Alig
USDA Forest Service, PNW Forest Research Station

Dick Best
Murray Pacific

Jean Bolton
Washington Farm Forestry Association

Conor Boyd
Weyerhaeuser Company

Donna Brown (facilitator)
Weyerhaeuser Company

Mason Browne
John Hancock Timber Resource Group

Kaleen Cottingham
Washington State Department of Natural Resources

Dave Crooker
Plum Creek Timber Company

Catherine Elliott
Governor's Timber Team

Jerry Franklin
Olympic Natural Resources Center
College of Forest Resources, University of Washington

John Gorman
Simpson Timber Company

Jerry Gutzwiler
Weyerhaeuser Company

Don Hanley
College of Forest Resources, University of Washington

Andy Hansen
Montana State University

Bob Lee
College of Forest Resources, University of Washington

Kathryn Kohm (facilitator)
Olympic Natural Resources Center

Wayne Marion
John Hancock Timber Resource Group

Rex McCullough
Weyerhaeuser Company

Bob Meier
ITT Rayonier Inc.

Bob Naiman
College of Forest Resources, University of Washington

Cathy O'Halloran
Olympic National Forest

Chad Oliver
College of Forest Resources, University of Washington

Dick Pierson
Weyerhaeuser Company

Cassie Phillips
Weyerhaeuser Company

Jim Rochelle
Weyerhaeuser Company

John Shumway
Washington State Department of Natural Resources

Gordon Smith (facilitator)
Olympic Natural Resources Center

Art Stearns
Washington State Department of Natural Resources

Tom Terry
Weyerhaeuser Company

David Thorud
College of Forest Resources, University of Washington

John Warjohn
Port Blakely Tree Farms

Neil Wilkins
Port Blakely Tree Farms

Steve West
College of Forest Resources, University of Washington

APPENDIX 9

List of HCP Preparers, Science Advisory Teams, and Federal and State Agency Advisory Team Members

Plum Creek Timber Company, Inc.

Seattle, Washington

LIST OF HCP PREPARERS, SCIENCE ADVISORY TEAMS, AND FEDERAL AND STATE AGENCY ADVISORY TEAM MEMBERS

Plum Creek HCP Team	Role in HCP
Michael Collins Director, Operations Support Seattle, WA	Project Manager
William Brown Vice President Resource Management Seattle, WA	Resource Management
Lorin Hicks, Ph.D. Director Fish & Wildlife Resources Seattle, WA	HCP Science Team Leader
James Kraft Vice President, Law Seattle, WA	Legal Affairs
Robert Jirsa Director, Environmental & Corporate Affairs Seattle, WA	Corporate Affairs
David Crooker Director of Operations, Cascades Region Seattle, WA	Operations Evaluation
Peter Heide Timberlands Superintendent, Yakima Unit Roslyn, WA	Operations Evaluation
Sam Boyd Timber Procurement Manager Seattle, WA	Resource Analysis and GIS Mapping

Plum Creek HCP Team	Role in HCP
Randall Greggs Cascades Region Silviculturist Enumclaw, WA	Forest Health/Stand Structure
William Sonnenfeld Manager, Resource Planning and Information Services Columbia Falls, MT	Resource Planning

Plum Creek HCP Science Teams

Wildlife Team

Lorin Hicks,Ph.D. Team Leader
William Escholz
Henning Stabins
Plum Creek Timber Company, L.P.
Seattle, WA

Larry Irwin, Ph.D.
National Council for Air
and Stream Improvement (NCASI)
Darby, MT

Dale Herter
Rick Lundquist
Dr. Kenneth Raedeke
Raedeke Associates, Inc.
Seattle, WA

Silviculture Team

Randall Greggs, Team Leader
Sam Boyd
Plum Creek Timber Company, L.P.
Seattle, WA

Silviculture Team (continued)
Chad Oliver, Ph.D.
College of Forest Resources
University of Washington
Seattle, WA

Donald Reimer, Ph.D.
D.R. Systems, Inc.
Nanaimo, B.C.

Fisheries and Watershed Analysis Team

Steven Toth, Team Leader
Greg Watson
Plum Creek Timber Company, L.P.
Seattle, WA

William Platts, Ph.D.
Don Chapman Consultants, Inc.
Boise, ID

GIS Mapping Team

Sam Boyd, Team leader
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Seattle, WA

Sherman Jensen
White Horse & Associates, Inc.
Smithfield, UT

William Brodie
Brett Melton
The Brodie Group
Bellevue, WA

Ted Hitzroth
Resource Management Mapping, Inc.
Bellevue, WA

Federal and State Agency Advisory Team

Curt Smitch, Ph.D., Program Leader
William Vogel, Wildlife Biologist
Craig Hansen, Fish & Wildlife Biologist
Sharon Kramer, Ph.D., Fisheries Biologist
U.S. Fish and Wildlife Service
Pacific Northwest Habitat Conservation Plan Program
Olympia, WA

Brian Cates, Regional Fisheries Biologist
U.S. Fish and Wildlife Service
Mid-Columbia River Fishery Resource Office
Leavenworth, WA

Dennis Mackey, Fish and Wildlife Biologist
Nancy Lee, Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
Portland Regional Office
Portland, OR

Steven W. Landino, Fish Biologist
National Marine Fisheries Service
Endangered Species Branch
Olympia, WA

Elizabeth Garr, Chief
Ben Meyer, Fisheries Biologist
National Marine Fisheries Service
Endangered Species Branch
Portland, OR

Joe Buchanan, Wildlife Biologist
Washington State Department of Fish and Wildlife
Olympia, WA

Technical Writing and Document Preparation

Steven T. White, Ph.D.
Raedeke Associates, Inc.
Seattle, WA

APPENDIX 10

IMPLEMENTATION AGREEMENT for the Plum Creek Timber Company, Inc. Cascades Habitat Conservation Plan

Plum Creek Timber Company, Inc.
Seattle, Washington
United States Fish and Wildlife Service
Olympia, Washington
National Marine Fisheries Service
Olympia, Washington

IMPLEMENTATION AGREEMENT
for the
PLUM CREEK TIMBER COMPANY, L.P.,
MULTI-SPECIES HABITAT CONSERVATION PLAN

This Implementation Agreement is entered into between Plum Creek Timber Company, L.P., ("Plum Creek"), the United States Fish and Wildlife Service ("USFWS"), and the National Oceanic & Atmospheric Administration ("NOAA") through the National Marine Fisheries Service ("NMFS") (collectively, the "Services"), on this 27th day of June, 1996.

1.0 BACKGROUND INFORMATION

Capitalized terms used herein are defined in Section 2.0 of this Agreement.

1.1 Plum Creek owns approximately 169,177 acres in the 1-90 corridor of the central Cascades Mountain Range in Washington State, the boundaries of which are described more fully in Appendix 1 of the HCP. Plum Creek manages those lands primarily for commercial timber production with some minor collateral uses such as rock quarries and electronic transmission sites.

1.2 Plum Creek's ownership is intermingled in a checkerboard pattern with approximately 249,513 acres of lands managed by the U.S. Forest Service and other private owners. Thus, the total planning area for purposes of this Implementation Agreement encompasses approximately 418,690 acres.

1.3 Under the ESA, it is unlawful for any person to "take" a species listed as endangered. Under Federal regulations, the same prohibition applies to species listed as threatened. However, under Section 10(a) of the ESA, the Services may issue an incidental take permit authorizing the take of threatened or endangered species incidental to the carrying out of otherwise lawful activities if certain statutory requirements are met by the applicant and such take would not appreciably reduce the likelihood of the survival and recovery of the species in the wild. To obtain an incidental take permit, the applicant must submit a habitat conservation plan describing, among other things, the steps the applicant will take to minimize and mitigate the impact of such taking to the maximum extent practicable.

1.4 Congress also intended that a habitat conservation plan submitted under Section 10(a) of the ESA could cover species not listed at the time of permit issuance. The legislative history indicates that if the conservation needs of such unlisted species are addressed adequately in the habitat conservation plan, should such species become listed during the life of the incidental take permit, no mitigation other than that provided in the habitat conservation plan itself should normally be imposed on the applicant. In such instances, the Services can amend the incidental take permit to cover such species promptly provided doing so would not appreciably reduce the likelihood of the survival and recovery of the species in the wild. Thus, coverage of multiple listed and unlisted species within a habitat conservation plan area can provide long-term conservation commitments from an applicant and long-term assurances from the Services to the applicant.

1.5 The Planning Area provides habitat for approximately 285 vertebrate species of fish and wildlife, including 77 mammals, 178 birds, 13 reptiles, 13 amphibians, and 4 fish. There are four species listed under the ESA that could occupy some portions of the Planning Area, but only the northern spotted owl has a confirmed presence. The gray wolf, which is listed as endangered and the threatened grizzly bear are not known to reside currently in the Planning Area; and Plum Creek presently is surveying for threatened marbled murrelets to confirm their absence or presence. There are also two Candidate 1 species and twenty-one Candidate 2 species; and nine other species have been identified by Washington State's Department of Fish and Wildlife as having special status (locally rare or considered endangered).

1.6 Pursuant to Section 10(a) of the ESA, Plum Creek has prepared and submitted an ecosystem, habitat-based HCP that adequately covers and mitigates for all vertebrate species that use the habitat types found within the Planning Area. The HCP uses accepted scientific principles for classification of wildlife into terrestrial lifeform groups plus fish and then displays the stand structural stages that constitute the primary and secondary habitat for each lifeform. Based on this information, the HCP contains target percentage ranges for each of eight structural stages throughout the life of the HCP. In this way, all species dependent on these habitat types should be adequately protected. The mitigation described above also includes specific habitat measures for currently listed species as well as for some candidate species and other species of concern, which are analyzed individually in the HCP.

1.7 Plum Creek's landscape approach also relies on a riparian habitat strategy and watershed analysis because of the benefit to fish and fish habitat, the high occurrence of other lifeforms and wildlife in these areas, and the benefit to spotted owls, which concentrate their home ranges in habitats with proximity to streams. Riparian habitat areas will be identified, designed and maintained through an accelerated watershed analysis process across Plum Creek ownership in the Planning Area. Where the terms of the HCP are determined through the operation of existing State law and regulation, such as the provisions for watershed analysis pursuant to WAC Chapter 222-22, the parties find the resulting prescriptions, based upon current standards and practices, are adequate and necessary for the purposes of this Agreement and the parties expect a comparable level of protection to be provided through the term of this Agreement.

1.8 Plum Creek's comprehensive, habitat-based approach reflected in the HCP is a mitigation strategy for species and the ecosystems upon which they depend. The incidental take permit issued by the Services to Plum Creek would authorize immediately any incidental take of the four listed species that might result from Plum Creek's otherwise lawful forest management and related land use activities conducted within the Project Area as discussed in Section 1.1 of the HCP. This Agreement also provides for amendment of the incidental take permit should any other species covered in the HCP be listed under the ESA in the future and if doing so would not appreciably reduce the likelihood of the survival and recovery of the species in the wild.

1.9 The HCP, Permit and this Agreement run concurrently for a period of fifty (50) years during Phase I . The HCP also addresses, the Permit provides and this Agreement implements, a Phase II incidental take authorization as an additional incentive to Plum Creek to improve wildlife and fish habitat so that the HCP may yield benefits after Phase I beyond those anticipated at the time this Agreement is executed. To the extent that habitat conditions exceed the Phase II Baseline, the Permit would continue after Phase I to authorize incidental take of certain Permit Species and Plan Species listed after Phase I associated with that habitat during Phase II . In addition, Section 5.3.3 of the HCP and Sections 2.0, 7.0-8.0 and 11.0-16.0 of this Agreement remain in effect throughout Phase II .

1.10 The purpose of this Agreement is to implement the HCP on which the Permit is based; to contractually bind the parties to the terms of the HCP; to describe the remedies and recourse in the event of a breach of the terms hereof; to obtain assurances that, to the extent the ESA and this Agreement provide, the Permit will be amended to add any species dependent on the various habitat types analyzed in the HCP should such species be listed as threatened or endangered after the effective date of this Agreement; and to implement Phase II .

1.11 The Services are authorized to enter into this Agreement pursuant to the ESA and by the Fish and Wildlife Coordination Act (16 U.S.C. §§ 661-666c). Under the ESA, the Secretary of the Interior, through the USFWS, and the Secretary of Commerce, through NOAA and NMFS, share the responsibilities for the statute's implementation, including the issuance of incidental take permits. Reorganization Plan No. 4 of 1970 governs the allocation of their respective responsibilities. It is the intent of the Services to coordinate their respective responsibilities under this Agreement to achieve maximum administrative efficiencies.

2.0 DEFINITIONS

2.1 The term "Agreement" shall mean this Implementation Agreement, as the same may be amended from time to time.

2.2 The term "critical habitat" has the same meaning as the term is defined in 16 U.S.C. § 1532(5) and implementing regulations.

2.3 The term "ESA" means the Endangered Species Act of 1973, as amended, 16 U.S.C. §§ 1531 *et seq.*

2.4 The term "Endemic Species" means Plan Species approximately 80% or more of the members of which are thought to exist within the Planning Area based on the best scientific information available.

2.5 The term "Extraordinary Circumstances" means a substantial and material adverse change in the status of a species.

2.6 The term "HCP" means Plum Creek's habitat conservation plan and associated documents, as the same may be amended from time to time.

2.7 The terms "Peer Review" or "peer reviewed" mean that consistent with Section B(1) of the Interagency Cooperative Policy for Peer Review in Endangered Species Act Activities (59 Fed. Reg. 34,270), the Services will provide for peer review of the scientific data on which the agencies base any finding requiring peer review in this Agreement to ensure that any such findings are based on the best scientific data available. In the event Peer Review of such data is not available in time to enable the Services to meet their obligations established by statute, regulation and this Agreement, the required finding or decision based on such data will be effective but may be subject to reconsideration by the Services as soon as that information becomes available.

2.8 The term "Permit" means, collectively, the incidental take permit, and any future amendments made thereto, issued pursuant to 50 C.F.R. §§ 13.21-1.29, 17.22(b), 17.32(b) by USFWS and 50 C.F.R. Part 220 and § 222.22 by NMFS. The Services will coordinate between themselves to obtain the necessary determinations if and when Plum Creek requests Permit amendments in accordance with this Agreement.

2.9 The term "Permit Species" means those species covered by the Permit, as the same may be amended from time to time.

2.10 " Phase I" means the fifty (50) year period during which the HCP, Permit and this Agreement run concurrently unless sooner terminated under Section 11.0 of this Agreement.

2.11 "Phase II" means that period of up to fifty (50) years after Phase I during which the Permit would continue to authorize certain incidental take of Permit Species and Plan Species that become listed after Phase I to the extent habitat conditions exceed the Phase II Baseline for such species.

2.12 The term "Plan Species" means all of the vertebrate species dependent on the various habitat types analyzed in the HCP, whether or not such species currently are found within the Planning Area.

2.13 The term "Planning Area" means those lands depicted in Figure 1 of the HCP.

2.14 The term "Project Area" means those portions of the Planning Area owned by Plum Creek as described in Appendix 1 of the HCP.

2.15 "Phase II Baseline" means those habitat conditions existing on lands within the Project Area as described in Section 5.3.3 of the HCP, as the same may be amended from time to time.

2.16 The term "take" as used in this Agreement has the same meaning as the term is used in the ESA, 16 U.S.C. § 1533(19), and implementing regulations, as they may be amended from time to time.

2.17 The term "Unforeseen Circumstances" means a change in circumstances or information that might give rise to the need to revise a habitat conservation plan prepared under Section 10(a) of the ESA or a Phase II Baseline. The listing of any Plan Species or the designation of critical habitat are not Unforeseen Circumstances.

3.0 INCORPORATION OF HCP

The HCP and each of its provisions are intended to be, and by this reference are, incorporated into this Agreement. In the event of any direct contradiction between the terms of this Agreement and the terms of the HCP, the terms of this Agreement shall control. In all other cases, the terms of this Agreement and the terms of the HCP shall be interpreted to be supplementary to each other.

4.0 TERM

This Agreement, the HCP, and the Permit will remain in effect until fifty (50) years from the original date of issuance of the Permit unless sooner terminated under Section 11 of this Agreement. In addition, following written confirmation by the Services that the Phase II provisions of Section 12 of this Agreement are available, the Permit, Sections 5.3.3 of the HCP and Sections 2.0, 7.0-8.0 and 11.0-16.0 of this Agreement remain in effect during Phase II to authorize certain incidental take associated with activities within the Project Area as is more fully described in Section 12.0 of this Agreement.

5.0 FUNDING

As discussed in Sections 3.7 and 5.3.6 of the HCP, Plum Creek has sufficient financial resources to, and by this Agreement does commit to, fund its affirmative obligations under the HCP. To ensure notification of any material change in the financial ability of Plum Creek to discharge its obligations during the life of the Permit, Plum Creek will provide the Services with a copy of its annual report each year of the Permit or other reasonably available financial information as mutually agreeable.

6.0 RESPONSIBILITIES OF THE PARTIES

6.1 In consideration of the Services' authorization of any incidental takes that may result from activities conducted consistent with the HCP, Plum Creek will perform all obligations assigned to it in the Permit, HCP, and this Agreement.

6.2 Plum Creek's HCP is an ecosystem, habitat-based, habitat conservation plan that relies upon measures developed by means of a number of scientifically proven, peer-reviewed processes and strategies as described in Section 3 of the HCP that alone or in combination result in adequate conservation for the ecosystem upon which the Plan and Permit Species depend. The processes and strategies are based upon adaptive management concepts and it is anticipated that refinements will take place over the life of the HCP pursuant to pertinent amendment procedures specified in Section 7.0 of this Agreement. The parties intend that adaptive management will minimize the likelihood that there will be Unforeseen or Extraordinary Circumstances that must be addressed through Section 8.0 of this Agreement.

6.3 Special Mitigation

Special consideration has been given to the needs of certain listed species, candidate species or species of concern as follows:

6.3.1 Northern Spotted Owl: See Section 3.2.1.1 of the HCP.

6.3.2 Marbled Murrelet: See Section 3.2.1.2 of the HCP.

6.3.3 Grizzly Bear: See Section 3.2.1.3 of the HCP.

6.3.4 Gray Wolf: See Section 3.2.1.4 of the HCP.

6.3.5 Other Species: See Section 3.2.2 of the HCP.

7.0 AMENDMENT

7.1 Amendment of Permit

7.1.1 Generally

Amendment of the Permit may be made in accordance with regulations in existence at the time the amendment is proposed. If the Federal regulations that govern Permit amendment have been modified from those codified at 50 C.F.R. §§ 13.23, 220.11, 222.25 and 222.26, as of the date of original execution of this Agreement, the modified regulations will apply only to the extent the modifications were required by subsequent action of Congress or court order.

7.1.2 Amendment of Permit upon Listing

(a) Notice by the Services. The Services shall notify Plum Creek in a timely manner if they become aware of any Plan Species that is likely to be the subject of any listing, emergency or otherwise. The Services and Plum Creek shall share available scientific and commercial information, subject to proprietary protections, related to such species so that Plum Creek may determine whether or not to give notice to the Services to have such species added to the Permit pursuant to subsection (b) and (c) of this Section.

(b) Non-Emergency Listings.

(1) Notice by Plum Creek. If any of the Plan Species are proposed for listing after initial execution of this Agreement, Plum Creek may give notice to the Services under Section 16.4 of this Agreement at any time thereafter of its desire to have the Permit amended to include that species in the Permit.

(2) Preliminary Determination. USFWS or NMFS shall notify Plum Creek that it:

(A) has made a preliminary determination that, absent new information, the Permit will be amended upon the date of such listing without further action by Plum Creek; or

(B) has made a preliminary determination that, absent new information, the Permit may be amended on the date of listing, but due to Extraordinary Circumstances, additional mitigation will be required from Plum Creek under Section 8.0 of this Agreement prior to such amendment; or

(C) has made a preliminary determination that, absent new information, the Permit will not be amended because such action cannot be taken without appreciably reducing the likelihood of the survival and recovery of the affected species in the wild.

USFWS or NMFS shall provide Plum Creek with its preliminary determination 90 days after notice by Plum Creek of its desire for a Permit amendment, unless the Service notifies Plum Creek that additional time is required, in which case the Service may have up to 60 additional days to provide its preliminary determination.

(3) Final Determination. If Plum Creek provides notice of its desire for a Permit amendment at least 195 days prior to the end of the one year period described in 16 U.S.C. § 1533(b)(6)(A), the Service will make a final decision on the Permit amendment concurrent with the publication of the final listing regulation.

(c) Emergency Listings.

(1) Notice by Plum Creek. If a Plan Species covered in the HCP is the subject of an emergency listing, Plum Creek may give notice to the Services under Section 16.4 of this Agreement at any time of its desire to have the Permit amended to include that species.

(2) Interim Determination. If Plum Creek provides notice of its desire for a Permit amendment to include a Plan Species that is the subject of an emergency listing, the appropriate Service will make an interim determination whether such species may be added to the Permit for a period not to exceed the duration of the emergency listing. If Plum Creek provides such notice regarding a non-Endemic Species at least 30 days before the effective date of the emergency listing, the Service will make its interim determination concurrent with the effective date of such listing. In any event, the appropriate Service will make an interim determination regarding such non-Endemic Species not later than 30 days after notice by Plum Creek. The Service will make an interim determination regarding an Endemic Species as soon as possible after notice by Plum Creek.

(3) Final Determination. If Plum Creek provides notice of its desire for a Permit amendment to include a Plan Species that is the subject of an emergency listing no later than 45 days after the date of publication of the emergency listing, the appropriate Service will make a final decision on the

Permit amendment concurrent with the effective date of any final listing regulation. Such final decision may be to:

(A) amend the Permit without further action by Plum Creek;

(B) require additional mitigation from Plum Creek under Section 8.0 of this Agreement prior to such amendment due to Extraordinary Circumstances; or

(C) not amend the Permit because such action cannot be taken without appreciably reducing the likelihood of the survival and recovery of the affected species in the wild.

(d) With regard to non-Endemic Species, if Plum Creek (i) provides notice under subparagraph (b) no later than 195 days prior to the end of the one year period described in 16 U.S.C. § 1533(b)(6)(A), or under subparagraph (c) no later than 30 days prior to the effective date of the emergency listing, and (ii) is in compliance with the terms and conditions of this Agreement, the Permit, and the HCP, Plum Creek may continue its activities in accordance with the Permit until the appropriate Service has made a decision on the requested Permit amendment unless that Service notifies Plum Creek that its activities may appreciably reduce the likelihood of the survival and recovery of such species. In such case, the Service will specify those activities which are not expected to have such an impact and which can proceed until the Service makes its determination under subparagraph (b) or (c). In addition, the Service will coordinate with Plum Creek to modify other activities where necessary to avoid such an impact.

7.2 Amendment of Implementation Agreement

This Agreement may be amended only with the written consent of each party.

7.3 Amendment or Modification of the HCP

Either the Services or Plum Creek may propose amendments or modifications to the HCP at any time.

7.3.1 Material Modifications

Material changes to the HCP proposed after the effective date of the Permit shall be processed under Section 7. 1 above.

7.3.2 Other Modifications

(a) Generally. Minor changes in the HCP may be initiated by written notice from Plum Creek or the Services. Such notice must contain a full description of the change and factual analysis that demonstrates the expected effect of the change on any Plan or Permit species or habitat types and the basis for the conclusion that the change is minor. Minor changes are deemed approved and become effective 60 days after receipt of written notice unless the responding party provides written disapproval of the proposed change or written notice that the proposed modification must be processed as an amendment under paragraph 7.3.1 of this Agreement. Minor changes under this paragraph include, but are not limited to, minor modifications to the mitigation program described in Section 5.3 of the HCP, changes by the Services in the Phase II Baseline in accordance with Section 12.3.2 of this Agreement, or any reporting requirements; correction of typographical, grammar, or editing errors in the HCP; and correction of any maps or exhibits to reflect previously approved changes in the HCP or other new information.

(b) Land Acquisition. Pursuant to subparagraph (a) of this paragraph, and as analyzed in the HCP, Plum Creek may acquire lands within the Planning Area and add them to the HCP. Activities on such lands may also be covered by the Permit pursuant to subparagraph (a) unless the Services find during the 60-day notice period that such addition would result in additional incidental take of Permit Species not analyzed in connection with the original HCP.

(c) Land Sale or Exchange to the Federal Government. Pursuant to subparagraph (a) of this paragraph, and as analyzed in the HCP, Plum Creek may sell or exchange lands within the Project Area to any agency of the U.S. Government. Such a sale or exchange will result in removal of such lands from Permit coverage. The Services may review the proposed sale or exchange during the 60-day review period provided in subparagraph (a) to ensure that such sale or exchange will not compromise the effectiveness of the HCP.

(d) Land Sale or Exchange to Non-Federal Parties. Pursuant to subparagraph (a) of this paragraph, and as analyzed in the HCP, Plum Creek may sell or exchange lands within the Project Area to non-federal parties, subject to the following limitations: (1) any lands may be sold or exchanged to a nonprofit organization or other private entity, provided appropriate covenants or assurances have been given by the acquiring party to the Services that such lands will be managed consistent with the goals and objectives of the HCP: and (2) parcels of land not in excess of 640 acres other than those lands subject to the HCP's twenty (20) year harvest deferral period only may be sold to any private party without restriction so long as the cumulative total of all such transactions does not exceed 5 percent of the acreage covered by the Permit and the cumulative total of all such transactions in any township does not exceed 1,920 acres. During the 60-day review period provided in subparagraph (a), the Services will review any proposed sale or exchange pursuant to this subparagraph to ensure that the conditions of this subparagraph are met and, with respect to sales or exchanges of 640 acres or less, that Plum Creek can continue to meet the mitigation requirements of the HCP with respect to its remaining lands as if the lands to be sold or exchanged were still covered by the HCP.

7.3.3 Anticipated Modifications through Adaptive Management

Section 5.4 of the HCP analyzes and provides for on-going, active and adaptive management activities across the Project Area. Adaptive management will yield site-specific prescriptions that may vary over time. Such changes are provided for in the HCP and do not require modification of the HCP or amendment of the Permit. Plum Creek will report the results of adaptive management activities to the Services as provided in Section 5.4 of the HCP.

8.0 UNFORESEEN AND EXTRAORDINARY CIRCUMSTANCES

(a) The Services' policy regarding Unforeseen Circumstances is reflected in the "No Surprises" guidance document published by the Secretary of Interior and Secretary of Commerce titled "Assuring Certainty for Private Landowners in Endangered Species Act Habitat Conservation Planning." The Services find that the HCP and Permit meet the requirements of the No Surprises policy and intend to implement it fully through this Agreement.

(b) Because the HCP has adequately covered the conservation needs of the Plan species, consistent with the No Surprises policy, the Services agree that they will not seek further mitigation from Plum Creek to address Unforeseen Circumstances related to a Plan Species so long as Plum Creek is in compliance with the terms and conditions of this Agreement, the Permit, and the HCP. Changes in operational or management prescriptions resulting from watershed analysis, aquatic monitoring as it was designed to support watershed analysis, and other adaptive management as addressed in Section 5.4 of the HCP are neither Unforeseen nor Extraordinary Circumstances even though such changes may require more or less restrictions on operations than were provided for under the original HCP.

(c) (1) Only in the case of Extraordinary Circumstances may the Services seek additional mitigation from Plum Creek. The Services have the burden of demonstrating that Extraordinary Circumstances actually exist using the best scientific and commercial data available. The Services' findings of Extraordinary Circumstances must be clearly documented and based upon reliable, peer reviewed, technical information regarding the status and habitat requirements of the affected species. Peer review will be conducted pursuant to paragraph (d) of this Section.

(2) In determining whether Extraordinary Circumstances exist, the Services will consider, but not be limited to, the following factors: the size of the current range of the affected species; the percentage of the range adversely affected by the HCP; the percentage of range conserved by the HCP; the ecological significance of that portion of the range affected by the HCP; the level of knowledge about the affected species and the degree of specificity of the species' conservation program under the HCP; and whether the HCP was originally designed to provide an overall net benefit to the affected species and contained measurable criteria for assessing the biological success of the HCP.

(3) If the Services determine that additional mitigation is required due to Extraordinary Circumstances such mitigation shall be provided on Federal land to the maximum extent possible. Only if the protective measures available on then-existing Federal land are

insufficient may the Services seek additional mitigation from Plum Creek, which in any event shall be limited to the original terms of the HCP to the maximum extent possible. Additional mitigation requirements shall not involve the payment of additional compensation or apply to parcels of land available for harvest or other uses under the HCP without the consent of Plum Creek.

(4) If the Services make a finding of Extraordinary Circumstances, during the period necessary to determine whether additional mitigation can be provided on Federal land or to seek additional mitigation from Plum Creek if necessary, consistent with subparagraph (c)(3) of this paragraph, the parties will use their best efforts to avoid contributing to appreciably reducing the likelihood of the survival and recovery of the affected species.

(d) The Services will provide for Peer Review of the scientific data on which the agencies base a finding of Extraordinary Circumstances to ensure that any such finding is based on the best scientific data available. The Services will request Peer Review in a timely manner so that the reviews will be completed within 30 days. In the event Peer Review is not available in time to enable the Services to meet their obligations established by statute, regulation and this Agreement, a finding of Extraordinary Circumstances made without peer reviewed data will be effective although it may be subject to reconsideration by the Services as soon as that information becomes available.

9.0 FINDINGS

After opportunity for public comment with respect to the Permit application and the HCP, the Services find that:

a. Incidental Take

Any taking of Permit or Plan Species will be incidental to the carrying out of otherwise lawful activities;

b. Minimize and Mitigate

The HCP will, to the maximum extent practicable, minimize and mitigate the impacts of such incidental taking on Permit and Plan Species;

c. Adequate Funding

Plum Creek has sufficient financial resources to adequately fund its affirmative obligations under the HCP.

d. No Jeopardy

As long as measures to minimize/mitigate taking are implemented consistent with the HCP and this Agreement, any incidental taking of Permit Species will not appreciably reduce the likelihood of the survival and recovery of such species in the wild. Any incidental taking of Plan Species would not appreciably reduce the likelihood of the survival and recovery of such species in the wild if such species were listed as of the date of this Agreement.

e. Other Measures

Any other measures set forth in the HCP and required by the Services as being necessary or appropriate for the purposes of the HCP will be fulfilled. The Services shall issue the Permit to Plum Creek upon execution of this Agreement.

10.0 MONITORING AND REPORTING

Plum Creek will evaluate and report to the Services the percentages of the landscape containing each stand structure grouping and whether targets are met or exceeded as specified in Sections 3.5 and 5.1 of the HCP.

11.0 TERMINATION

The Permit may be terminated by either the Services or Plum Creek in accordance with the Services' regulations in force on the date of such termination; however, in addition, Plum Creek reserves the right to terminate the Permit in accordance with regulations in effect at the time of Permit issuance, now codified at 50 C.F.R. §§ 13.26 and 220.31 (1994 ed.) and incorporated herein by reference. In the event Plum Creek elects to terminate the Permit before the end of Phase I, Plum Creek agrees to provide the Services with 90-days advance notice of the proposed termination and a termination report as described in Section 5 of the HCP. Early termination under this Section is subject to compliance with the Permit condition requiring that any past incidental take has been sufficiently mitigated by conservation measures under the HCP implemented by Plum Creek prior to termination. The Services agree that Plum Creek may invoke the dispute resolution procedures of Section 14.2 of this Agreement to pursue resolution of any technical disagreement concerning the necessity or amount of such additional mitigation.

Termination of the Permit with respect to any species would also automatically terminate this Agreement and the HCP with respect to such species. This Agreement and HCP may be terminated by any party with respect to any unlisted species, not covered by the Permit, for any material breach of this Agreement and HCP with respect to that species. Any termination under this Section is subject to and limited by the Phase II provisions of Section 12.0 of this Agreement.

12.0 PHASE II

12.1 General

The HCP has addressed, the Permit provides and this Agreement implements, additional incidental take authorization during Phase II . Pursuant to such authorization, Plum Creek may incidentally take certain Permit Species and Plan Species listed after Phase I to the extent that habitat conditions for that species exceed the Phase II Baseline described in Section 5.3.3 of the HCP on lands within the Project Area, subject to the conditions and criteria set forth below in this Section. In the event a Phase II Baseline is established, the Permit, Section 5.3.3 of the HCP and Sections 7.0-8.0 and 11.0-16.0 of this Agreement remain effect throughout Phase II .

12.2 Phase II Baseline

The baseline at the end of Phase I shall be the Phase II Baseline as defined in Section 2.15 of this Agreement.

12.3 Phase II Procedures

12.3.1 Plum Creek Notice

In its 40-year report to the Services as required by Section 5 of the HCP, or as part of its 90-day advance notice for early termination under Section 11.0 of this Agreement, Plum Creek shall provide notice of any Phase II incidental take authorization it anticipates may be available after Phase I . Plum Creek's notice shall include the technical data and analysis that Plum Creek has relied upon in determining the availability of a Phase II Baseline, what actions, if any, Plum Creek will take to minimize incidental take of known species pursuant to Section 12.6 and an explanation of the extent to which the habitat conditions exceed the Phase II Baseline for each Permit Species. Nothing in this Section precludes a subsequent notice by Plum Creek to the Services as part of any amendment pursuant to Section 7.0 of this Agreement initiated after the 40-year report.

12.3.2 Services' Response

(a) 40 Year Report. In response to any Phase II notice in Plum Creek's 40-year report, or subsequent Phase II notice, the Services will advise Plum Creek in writing within one (1) year with respect to notices given prior to the end of Phase I and within 90 days with respect to notices given within Phase II after receipt of such notice that, for each Permit Species,

(1) the Services confirm Plum Creek's ability to enter Phase II so long as Plum Creek remains in compliance with the terms and conditions of the HCP throughout the remainder of Phase I; or

(2) the Services have determined, based on reliable, peer reviewed, technical information that the Phase II Baseline requires adjustment to adequately protect such species prior to the exercise of any Phase II incidental take authorization In such a case, the Services will use the amendment procedures in Section 7.3.2 to effectuate the adjustment. Any disputes regarding the proposed adjustment will be resolved under the dispute resolution procedures in Section 14.0 of this Agreement; or

(3) the Services have determined, based on reliable, peer reviewed, technical information, that the Phase II incidental take authorization is not available because such action would appreciably reduce the likelihood of the continued survival and recovery of such species in the wild.

(b) Early Termination. In the event that Plum Creek includes a Phase II notice as part of its 90-day advance notice for early termination under Section 11.0 of this Agreement, the Services will advise Plum Creek in writing within 60 days after receipt of such notice that, for each Permit Species,

(1) the Services confirm Plum Creek's ability to enter Phase II; or

(2) the Services have determined, based on reliable, peer reviewed, technical information, that the Phase II incidental take authorization is not available because such action would appreciably reduce the likelihood of the continued survival and recovery of such species in the wild.

Phase II incidental take authorization does not take effect until completion of any dispute resolution under Section 14.0 of this Agreement. Nothing in this Section should be construed to preclude Plum Creek forest management activities after Phase I so long as such activities otherwise are in accordance with existing law.

12.4 Phase II Monitoring

As provided in Section 5.3.3 of the HCP, Plum Creek will report the status of the Phase II Baseline and minimization efforts accomplished during Phase II every 10 years to the Services.

12.5 Phase II Termination

If at any time during Phase II the Services determine, based on reliable, peer reviewed, technical information, that Plum Creek's continued exercise of a Phase II incidental take authorization for a given species will appreciably reduce the likelihood of the continued survival and recovery of such species in the wild, they may terminate the Phase II incidental take authorization for such species. While any dispute resolution under Section 14.0 of this Agreement is pending, the Services may suspend such incidental take authorization for that species.

12.6 Minimization of Incidental Take during Phase II

Plum Creek will minimize the incidental take of species listed as of the date of this Agreement by undertaking the measures described in Section 5.3.3 of the HCP. In order to minimize any incidental take of species listed and added to the Permit subsequent to the signing of this Agreement that might occur during Phase II, Plum Creek will design and conduct its forest management activities during Phase II to the maximum extent practicable to avoid directly causing actual physical injury to or death of a known member of a listed species, as described in section 5.3.3 of the HCP. Plum Creek will also avoid unauthorized incidental take of other listed species (e.g. harvesting of safe-harbor owl habitat which may also be murrelet habitat for which there might not be Phase II protection under the Permit). The Services will provide Plum Creek with guidance regarding the methods to avoid such direct physical injury or death. The parties acknowledge and agree that it is not the intent of the parties to require Plum Creek to either survey for the presence or absence of a listed species or to manage to avoid all incidental take of listed species, but rather to minimize such effects by limited operations during the breeding season for a given listed species in areas immediately adjacent to nesting and breeding sites. The parties further agree that if an area is subject to two or more seasonal restrictions or take-minimization methods simultaneously, and if these restrictions would otherwise preclude economic operations in the Project Area, then Plum Creek may develop site-specific plans in conjunction with the Services which would minimize the risk of death or injury to a known member of a listed species to the maximum extent practicable while at the same time, allow economic operations to continue. If the parties cannot agree upon the methods necessary to avoid or minimize directly causing actual physical injury or death to a known member of a listed species, then the parties will use the dispute resolution process set forth in Section 14.0 of this Agreement.

13.0 SUSPENSION, REVOCATION AND RE-INSTATEMENT

The procedures and criteria for suspension, revocation, and re-instatement of the Permit shall be in accordance with regulations in existence at the time such action is taken. If the Federal regulations that govern should be modified from those codified at 50 C.F.R. §§ 13.26 to 13.29, and/or § 222.27, as of the date of original execution of this Agreement, the modified regulations will apply only to the extent the modifications were required by subsequent action of Congress or court order. Such procedures and criteria shall also apply to suspension, revocation and reinstatement of this Agreement and the HCP whether or not the species of concern is the subject of the Permit.

14.0 ALTERNATIVE DISPUTE RESOLUTION

Plum Creek and the Services recognize that disputes concerning implementation of, compliance with, or termination of the Permit, HCP or this Agreement may arise from time to time. It is the intention of the parties to use the alternative dispute resolution procedures in this Section and to work together in good faith to resolve all such issues. However, if at any time either party determines that circumstances warrant, they may utilize any remedy provided in Section 15 of this Agreement without waiting to complete this informal dispute resolution process. The Services specifically reserve the right to use whatever enforcement powers and remedies are available by law or regulation, including but not limited to, suspension or revocation of the Permit.

14.1 General Procedures

Any party having reason to believe that the other party has failed to meet its obligations under the Permit, HCP or this Agreement, must notify that party of the specific provisions which may have been violated, the reasons they believe a violation has occurred, and any remedies they propose to correct the alleged violation.

The party alleged to be in violation will then have 60 days, or such other time as may be mutually agreed, to respond. If any issues cannot be resolved within 30 days after such response was due, the parties will consider non-binding mediation and other alternative dispute resolution processes.

In the event that these procedures fail to result in a resolution of the dispute, the parties may seek their remedies under Section 15.0 of this Agreement.

14.2 Dispute Resolution Procedures for Early Termination

Plum Creek and the Services recognize that if Plum Creek exercises its termination rights under Section 11.0 of this Agreement prior to the end of the full fifty (50) year HCP Phase, or if the Permit is terminated by the Services, there may be some imbalance between the mitigation that has been provided under the HCP and the amount of incidental take of Permit Species that has occurred up to the date of termination.

If the Services believe that some continued mitigation is required to correct such an imbalance, the Services shall notify Plum Creek within 60 days of receipt of any early termination notice under Section 11 of this Agreement or concomitant with Permit termination by the Services of the basis for such belief and provide a detailed description of the mitigation they believe necessary. Plum Creek will then have 60 days, or such other time as may be mutually agreed, to respond. If any issues cannot be resolved within 30 days after the Services' receipt of Plum Creek's response, the parties will consider non-binding mediation and other alternative dispute resolution processes.

In the event that these procedures fail to result in a resolution of the dispute, the parties may seek their remedies under Section 15.0 of this Agreement. In no event may the Services seek to extend mitigation to new lands or beyond the original Permit Term without the consent of Plum Creek.

15.0 REMEDIES

The parties to this Agreement shall have all remedies at law and in equity available to them except that no party shall be liable in damages to any party or other person for any breach of this Agreement, any performance or failure to perform a mandatory or discretionary obligation imposed by this Agreement, or any other cause of action arising from this Agreement.

16.0 MISCELLANEOUS PROVISIONS

16.1 Third Party Beneficiaries

This Agreement shall not create third party beneficiary rights in the public or any member thereof. The rights of the public under the ESA are set forth in 16 U.S.C. § 1540(g) and nothing in this Agreement expands or otherwise alters the rights of citizens thereunder.

16.2 Integration and Severability

This Agreement, together with the HCP and the Permit, constitute the entire agreement between the parties. If any provision of this Agreement is found invalid or unenforceable, all other provisions shall remain in effect to the extent they can be reasonably applied in the absence of such invalid or unenforceable provision. This Agreement supersedes any and all other Agreements, either oral or in writing between the parties hereto with respect to the subject matter hereof and contains all of the agreements among them with respect to said matters, and each party acknowledges that no representation, inducement, promise or agreement, oral or otherwise, has been made by any other party or anyone acting on behalf of any party which are not embodied herein.

16.3 Counterparts

This Agreement may be executed in counterparts with each copy constituting an original. A complete original of this Agreement shall be maintained in the official records of each of the parties.

16.4 Services' Authority

Nothing in this Agreement is intended to limit the authority or responsibility of the Services to invoke the penalties or otherwise fulfill their responsibilities under the ESA. Moreover, nothing in this Agreement is intended to limit or diminish the legal obligation and responsibility of the Services as agencies of the Federal government.

16.5 Appropriations

Implementation of this Agreement and the HCP by the Services is subject to the availability of appropriated funds. Nothing in this Agreement will be construed by the parties to require the obligation, appropriation, or expenditure of any money from the U.S. Treasury. The parties acknowledge that the Services will not be required under this Agreement to expend any Federal agency's appropriated funds unless and until an authorized official of that agency affirmatively acts to commit to such expenditures as evidenced in writing.

16.6 Notice

Each party will designate a representative to whom notices under the Agreement shall be directed. The initial designated representatives are:

for Plum Creek:	for USFWS:	for NMFS:
William R. Brown V.P., Resource Management 999 Third Avenue, #2300 Seattle, Washington 98104 Tel.: (206) 467-3600 Fax: (206) 467-3794	Regional Director U.S. Fish and Wildlife Service 911 N.E. 11th Avenue Portland, Oregon 97232-4181 Tel.: (503) 231-6118 Fax: (503) 872-2716	Regional Director National Marine Fisheries Service 7600 Sand Point Way, N.E. Seattle, Washington 98115-0070 Tel.: (206) 526-6150 Fax: (206) 526-6426

The names, addresses, telephone and facsimile numbers of the designated representative may be changed at any time by notice to the other party. Notice will be deemed received when delivered personally to the office of the designated representative, on electronic confirmation that a facsimile message has been received at the FAX number most recently provided for the recipient representative, or 5 days after deposit in the United States registered mail, addressed to the recipient representative at the address most recently provided by the party being notified. Any authorized employee of the Services or Plum Creek may send or respond to any notice under this Agreement. The Services shall be responsible for coordination and notification between themselves. Delivery of notice by Plum Creek upon USFWS will constitute receipt by both Services for purposes of this Agreement.

Executed on the dates indicated below:

PLUM CREEK TIMBER COMPANY, L.P.
By Plum Creek Management Company, L.P.

By ______________________

Title Vice President, General Counsel and Secretary

Date June 24, 1996

UNITED STATES DEPARTMENT OF INTERIOR
through the U.S. FISH AND WILDLIFE SERVICE

By ______________________

Title Deputy Regional Director

Date 6/24/96

UNITED STATES DEPARTMENT OF COMMERCE
through the NATIONAL MARINE FISHERIES SERVICE

By ______________________

Title [illegible]

Date June 25, 1996