HIGH ROSS WILDLIFE MITIGATION, COMPENSATION, AND ENHANCEMENT PLAN

Washington Department of Game

under contract with

Seattle City Light

October, 1981

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HIGH ROSS WILDLIFE MITIGATION STUDY

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EXECUTIVE SUMMARY

HIGH ROSS MITIGATION AND COMPENSATION PLAN

The High Ross Mitigation Plan provides for offsetting wildlife habitat losses resulting from the raising of Ross Lake. Raising Ross Dam will inundate 3,458 acres in the United States. The plan is comprised of habitat improvement and preservation practices that are designed to fully compensate for these losses. The plan will improve or preserve high value habitats for the duration of the 50 year project license.

The mitigation plan is divided into two sections, on-site and off-site. The on-site section concerns mitigation and enhancement practices on Ross Lake National Recreation Area (RLNRA) lands immediately adjacent to Ross Lake. The off-site section concerns enhancement and compensation practices on public and private lands in north central Washington. The essential difference between on-site and off-site practices is on-site mitigates and off-site compensates for the habitat losses.

Habitat losses due to inundation and increased habitat value due to mitigation and compensation measures were evaluated using the Habitat Evaluation Procedures (HEP) of the U.S. Fish and Wildlife Service. The focus of the plan is twofold -- 100% mitigation of habitat values lost as measured by HEP and replacement in-kind of wildlife habitat types which are scarce in the state of Washington and critical to the survival of certain wildlife.

The on-site mitigation plan includes the construction of 14 pond-marshes on the lake shoreline, forest overstory removal in patches within dense forest types on 1,557 acres, shoreline planting of riparian vegetation on 39 acres, seeding of grasses and forbs on exposed shoreline

during drawdown on 114 acres, and snag retention within the drawdown zone on 434 acres. These measures will mitigate for 37% of habitat value lost due to inundation.

Off-site compensation measures are recommended on public and private land in three areas: RLNRA below Ross Dam, S.F. Nooksack River and Twisp River in Eastern Washington. Compensation measures include overstory removal on 107 acres, construction of two ponds on SCL land; overstory removal on 704 acres, construction of 11 ponds, preservation of 1,528 acres of old-growth and mature forests; and streamside rehabilitation on 5 acres in the S.F. Nooksack drainage; protection of 437 acres of Eastern Washington habitats; and rehabilitation of 598 acres of powerline right-of-way. Implementation of these measures will replace 65% of habitat value lost.

To implement the plan management agreements and land purchases are required from willing public and private landowners. Costs for implementing, maintaining and monitoring the plan over 50 years is estimated to be between $25 million and $27 million.

Alternatives to the recommended plan as well as a plan for implementing, maintaining and monitoring the recommended plan over the 50 year life of the project license are included in the report.

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1.0 INTRODUCTION

1.1 Setting

Ross Dam is located in Whatcom County, Washington. The dam creates Ross Lake immediately upstream from Seattle's Diablo and Gorge projects. High pool of Ross Lake is now 1602.5 ft. el. Seattle City Light is licensed by the Federal Energy Regulatory Commission to raise Ross Dam by a fourth and final stage. High Ross would bring the reservoir level up to 1725 ft. el., an additional 122.5 feet.

Presently, Ross Lake floods 11,680 acres, a small portion of which is in Canada. High Ross would cause flooding of an additional 3,600 acres in Washington and 4,720 acres in British Columbia, Canada.

Ross Lake occupies a deep valley cut by the Skagit River as it descends through the heart of the North Cascades. Flanked on the west side by steep slopes with dense western Washington type forest cover from lake side to alpine meadows, and on the east side by only slightly less steep slopes covered with dense eastern Washington type forest cover, Ross Lake marks the transition zone between western and eastern Washington plant community types.

Forest types range from immature conifer to old-growth conifer, with deciduous and mixed deciduous and conifer forests occupying riparian or disturbed sites. Ponds, marshes and bogs mixed with the varous forest types characterize Big Beaver Valley, a low, flat bottom tributary to Ross Lake. The slopes surrounding the lake have had a long fire history reflected by large homogenous stands of even-aged conifers, broken only by small stands of old-growth that escaped the conflaguration.

Even though the impact area is at a low elevation (1,720 ft.), ecological characteristics are that of high mountain country. Winters are cold, but moderated somewhat by the large body of water. Summers are dry and warm.

During High Ross licensing hearings there was considerable testimony about wildlife values of areas to be flooded, particularly in Big Beaver Valley in Washington and Skagit Valley in Canada. The Federal Power Commission (now Federal Energy Regulatory Commission) required, as a condition of the license, that wildlife mitigation plans be prepared for both United States and Canada.

Although British Columbia signed an agreement in 1967 allowing flooding of their lands, Canada's provincial and federal governments now oppose High Ross. British Columbia and Seattle City Light are currently trying to reach agreement for power replacement and compensation, in lieu of High Ross. Pending final outcome of these negotiations, British Columbia has been unwilling to prepare a wildlife mitigation plan for losses in Canada.

The Washington Department of Game, under contract to Seattle City Light, is taking the lead in developing a wildlife mitigation plan for High Ross impacts in the United States. This report contains the On-Site and Off-Site Wildlife Mitigation, Compensation and Enhancement Plan for High Ross.

1.2 Federal Legal Background for High Ross Wildlife Mitigation

In 1977, the Federal Power Commission granted permission to build High Ross and specified conditions for its construction and operation.

Among those conditions was the requirement to prepare a Wildlife Mitigation Plan. Specifically the Commission ordered:

> Article 57. The Licensee shall, within one year of the date of this order, file for Commission approval a plan for mitigating the loss of wildlife habitats of the Ross Reservoir - Skagit River basin above Ross Dam that will result from enlarging Ross Reservoir. This wildlife mitigation plan shall be developed through consultation with the Washington Department of Game; the Fish and Wildlife Service and National Park Service of the U.S. Department of Interior; the Fish and Wildlife Branch and Provincial Parks Branch of the British Columbia Department of Recreation and Conservation; the Forest Service of the British Columbia Department of Lands, Forests, and Water Resources; and the Canadian Wildlife Service. The plan shall include a schedule of its implementation and for filing of periodic progress reports.
>
> If the above-named agencies do not concur on a comprehensive plan for the Ross Reservoir - Skagit River basin within one year of the date of this order, the Licensee shall in cooperation with the above-named agencies of British Columbia and Canada, develop a plan for the British Columbia section of the basin; and in cooperation with the above-named agencies of Washington and the United States, develop a separate plan for the Washington section of the basin. The separate plans shall be completed and filed for Commission approval within one year of their commencement or two years from the date of this order, whichever is earlier.
>
> If Licensee and the above-named agencies cannot concur on a plan for the entire Ross Reservoir - Skagit River basin or for one or both of the separate United States and Canadian sections thereof within two years from the date of this order, the Commission, on its own motion or upon the recommendation of any of the above agencies, may, after notice and opportunity for hearing, prescribe such plan as the public interest may warrant.
>
> Article 58. The Licensee shall, within three years following the initial filling of the reservoir, complete a study to assess the impact of the enlarged reservoir on the wildlife resources of the project area. The study shall be conducted in cooperation with the Washington Department of Game; the Fish and Wildlife Service of the U.S. Department of the Interior; the Fish and Wildlife Branch of the British Columbia Department of Recreation and Conservation; and the Canadian Wildlife Service. Within six months following completion of the study, Licensee shall file for Commission approval as part of its revised Exhibit S a report on the results of the study with recommendation for any changes in the wildlife mitigation measures or any further studies which may be necessary. (FERC Opinion 808 - Opinion and Order Affirming and Adopting Initial

Decision Authorizing Amendment of License to Increase Height of Ross Dam, August 1978).

By requiring City Light to prepare a mitigation plan, the Federal Power Commission met provisions of the Federal Power Act (FPA), Fish and Wildlife Coordination Act (FWCA) (amended 8/5/65), and of the National Environmental Protection Act (NEPA). Each Act recognizes the public interest to conserve "wildlife resources", defined in the FWCA as "birds, fishes and mammals and all other classes of wild animals and all types of aquatic and land vegetation upon which wildlife is dependent."

In general, the FWCA (Appendix C) provides that:

1. Fish and Wildlife conservation"... shall receive equal consideration and be coordinated with other features of water-resource development programs through effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation and rehabilitation...";
2. Any agency proposing to modify or control streams or bodies of water must consult with the Federal and State Fish and Wildlife agencies "...with a view to the conservation of wildlife resources by preventing damage to such resources as well as providing for the development and improvement thereof...";
3. Wildlife mitigation reports "...shall be made an integral part of any report prepared or submitted by any agency of Federal Government responsible for engineering surveys and construction of such projects when such reports are presented..." for authorization or modification;

4. Wildlife conservation cost is to be considered an integral part of project cost.

The NEPA states that "all practical means" must be employed to avoid environmental degradation. Courts have held that it is not sufficient to pay homage to environmental review while proceeding with the project. In fact, Federal agencies, and agencies obtaining Federal permits, must at least address NEPA (Swanson 1979).

The FWCA interpretation is that funding and investigation of mitigation aspects must proceed concurrently with the project (Akers versus Resor 1973, and Texas Committee on Natural Resources versus Alexander 1978).

1.3 Use of the Terms For This Report

For this report we use our contract definitions of mitigation, compensation, and enhancement. We would like to note, however, that Federal agencies generally group the strict meanings of mitigation and compensation into one term, "mitigation"; hence the title "High Ross Mitigation Plan".

MITIGATION Definition

Measures taken to reduce the magnitude of any adverse environmental impacts resulting from a project;

COMPENSATION Definition

Mitigation to the extent that a particular impact is offset (i.e., post-mitigation conditions approximate pre-project conditions).

ENHANCEMENT Definition

Mitigation to the extent that a particular adverse environmental impact is more than offset (i.e., post-mitigation conditions represent an improvement over pre-project conditions).

1.4 Scope of the High Ross Mitigation Study

The primary goal of the High Ross Mitigation Study as defined in the contract is to:

> ...develop a plan for managing wildlife habitats within Ross basin which would assure full compensation [i.e., replacement in-kind on-site for wildlife losses resulting from raising Ross Dam (p. 3, High Ross Mitigation Study Scope of Study].

In-kind and on-site are defined in the Scope of Study (p. 3):

> Replacement in-kind - compensation for wildlife losses such that pre-project species' diversity and population numbers are maintained.
> On-site - within the Ross Lake National Recreation Area (RLNRA) upstream from Ross Dam.

Complete replacement of wildlife values is not possible on-site; therefore, off-site compensation areas were selected during the second year of the study. Seattle City Light (SCL) and the Federal Engergy Regulatory Commission (FERC) will evaluate the Preliminary On-Site Mitigation and Compensation Plan after the first year of this two-year

study. The extent of mitigation to be addressed by the High Ross Mitigation Plan was initially set forth in the judge's decision on High Ross (p. 62, Initial Decision):

> "in the event that an impasse is reached, however, the Missouri system remains available as a method which is, in staff's words, 'practical, expeditious and fair'." (see Appendix D)

The Missouri Plan is the forerunner of the U.S. Fish and Wildlife Service Habitat Evaluation Procedures. John Gill, as a staff member of the FERC, described use of Habitat Evaluation Procedures in detail (Gill 1974). (See Section 3.2 of this report, p. 16, for evaluation and description of Habitat Evaluation Procedures.)

Washington Department of Game's separate role under FWCA, the FERC rules, and the terms of the License amendments oblige WDG to separately recommend to FERC appropriate mitigation and reasonable enhancement measures.

1.5 Goals and Objectives for On-Site Mitigation and Compensation

The on-site goal is to fully mitigate and compensate lost wildlife habitat values within Ross basin. To achieve this goal, a preferred method is to reduce or eliminate damages through project modification. However, the project has already been licensed and extensive design changes would be difficult or impossible. Therefore, other measures were developed to reduce losses or offset the unavoidable damages of project construction. Thus, the objective was to mitigate and compensate loss of Big Beaver Valley communities and loss of wildlife habitats elsewhere in the project area on-site and in-kind to the extent possible.

1.6 Goals and Objectives for Off-Site Compensation and Enhancement

The off-site goal is to increase wildlife values on lands outside Ross basin, to the extent that on-site mitigation and compensation falls short of full replacement of wildlife losses. By contract, the off-site search for compensation sites was to proceed as follows:

a. Ross Lake National Recreation Area below Ross Dam;

b. North Cascades National Park;

c. Pasayten Wilderness; and

d. Adjacent lands.

Since both the Federal Power Act and Fish and Wildlife Coordination Act require consideration of enhancement by the Licensee, enhancement measures were also considered.

Wildlife losses are to be replaced in-kind. Therefore, during the off-site search, an initial attempt was made to locate habitats of the same types as those lost in Ross basin. As a second priority, similar habitats of the same quality as those lost were considered. Thirdly, dissimilar habitats of the same quality as those lost were considered.

As stated previously, the goal was to increase wildlife values in areas outside Ross basin. This means that in order to preserve a habitat type, of the same type as one lost in Ross basin, a habitat which is itself threatened with disturbance or destruction must be located. The concept behind this is that by preserving an area that otherwise would be lost, we can actually substitute one for the other. To manage a habitat for wildlife, its wildlife values must be increased above what it would have been over the life of the project.

In pursuing compensation and enhancement lands, the following means were available:

a. Purchase, in full fee, lands that are "threatened within a 50-year period (the duration of the High Ross project), with SCL paying management and monitoring costs for 50 years;

b. Trade SCL lands for public or private lands threatened within a 50-year period. SCL would also pay management and monitoring costs for 50 years;

c. Negotiate management agreements or leases with public or private landowners, at SCL expense, with SCL paying management and monitoring costs for 50 years;

d. Condemn (using Federal Energy Regulatory Commission authority) public or private lands, with SCL paying the land cost, and management and monitoring costs for 50 years.

2.0 PREVIOUS STUDIES OF WILDLIFE IN ROSS BASIN

Previous wildlife studies of Ross basin identified the general nature of impacts which would occur as a result of High Ross. Because the area is remote, very little was known about plants and wildlife in Ross basin. Wildlife studies initially focussed on gathering baseline information. Dr. Richard Taber's group (College of Forest Resources, UW) studied effects of the enlarged reservoir on wildlife, concentrating on deer and beaver habitat and populations. The group studied extensively the locations and nature of deer winter ranges in the basin and recommended mitigation for losses of deer winter range.

Joseph and Margaret Miller surveyed some ecological relationships of Big Beaver Valley. They described biotic communities and influence of beavers on Big Beaver Valley habitat. They listed plants and wildlife of the Valley (Miller and Miller 1971).

When potential wildlife losses from High Ross were investigated in the early 1970s, there were few acceptable methods of quantifying habitat values. In general, results of these wildlife studies did not give a clear picture of the impacts of High Ross on habitat. The results, in themselves, are not adequate for developing a mitigation plan for all wildlife affected. In fact, a major obstacle in mitigation studies has been scarcity of data showing how wildlife will respond to various project options or mitigation measures (Truett 1979).

Many testified, at High Ross hearings, about effects of High Ross on wildlife species and values. Following are the Federal Power Commission's "Findings of Fact" regarding the general nature of impacts to wildlife in the U.S. portion of Ross basin (Lesch et al. 1975).

"The sole wildlife species recorded in the Ross Reservoir basin which is included on the United States List of Endangered Fauna, issued by the Fish and Wildlife Service, United States Department of the Interior in May 1974, is the American peregrine falcon; this bird would not be affected by raising the reservoir. (Note: the Grizzly bear, also on the List of Endangered Fauna is known to inhabit the Wilderness areas in the vicinity of Ross basin; but should not be affected by High Ross.)

About one-half of the beaver habitat in Big Beaver Valley would be lost by High Ross Reservoir.

Cougar, black bears and mountain goats in the Ross Reservoir basin would not be significantly affected by raising the reservoir as proposed, although improved access to the area could result in increased hunting pressure on species.

Most species of birds, reptiles and amphibians in the Ross Reservoir basin would lose some habitat if the reservoir were raised as proposed.

The wildlife species in the Ross Reservoir basin absorbing the greatest impact would be those which inhabit stream-bottom or marshy plant communities, which are located in large part in Big Beaver Valley.

The sole species which would be eliminated from the United States portion of the Ross Reservoir basin is the red-wing blackbird; some breeding habitat for this species would remain in the Canadian Skagit Valley above elevation 1,725 feet.

The deer population of the Ross Reservoir basin in the United States is limited by winter habitat conditions.

A zone exists around the reservoir which shows less winter snow accumulation than is found at higher elevations; a rise in reservoir level may be accompanied by a rise in the zone of shallow snows.

If the zone of shallow snows does not rise, and no efforts are made to replace lost winter range, approximately one-third of the current deer population around Ross Reservior in the United States could be lost as a result of raising the reservoir.

If the zone of shallow snows rises with the reservoir, and substantial measures are successfully implemented to replace flooded winter range, the deer population could be sustained at its current level even though the reservoir is raised.

> Even if the zone of shallow snows does not rise with the reservoir, sufficient measures could be carried out to replace lost winter range to ensure that the deer population is maintained at its current level.
>
> In the context of the North Cascades National Park Complex and surrounding wilderness, the natural characteristics of Big Beaver Valley, while unusual, are not unique.
>
> Big Beaver Valley is the best candidate for a Research Natural Area representing the community mosaic which was once typical of most of the major valley bottoms of the northern Cascade Range; there exist adequate, albeit less complete and well-balanced, alternative sites for such a Research Natural Area.
>
> Many of the natural features which make Big Beaver Valley unusual would remain, to a limited extent, above elevation 1,725 feet after the reservoir was raised."

The table in Appendix E lists wildlife species losses that each person testifying believed would occur in the U.S. portion of Ross Basin. The table was compiled from testimony at the hearings by Joseph and Margaret Miller of Bellevue, Washington.

As deer populations decline, there will most likely be a subsequent decline in cougar populations. Black bear populations should also decline due to loss of habitat. In addition, the plant and wildlife characteristics of Big Beaver Valley have not been studied in sufficient detail to determine if it is either unusual or unique.

In this study, WDG is looking at loss of communities, or habitats, rather than wildlife populations due to the great deal of public concern expressed during High Ross hearings for the ecological values of areas to be flooded. From a practical standpoint, impacts of a development project are more readily understood and mitigated when habitat losses are studied. Since wildlife depend on habitat, evaluating how each habitat type or mix of habitat types supplies the life-requirements of selected wildlife species gives an estimate of its habitat value. And, the

effectiveness of mitigation, compensation, and enhancement programs can be measured by evaluating post-mitigation habitat. A method for quantifying habitat values is now available which allows the habitat values of impacted areas to be compared to mitigation and compensation sites on a common basis.

3.0 METHODS FOR DEVELOPING MITIGATION AND COMPENSATION

3.1 Selection of Habitat Evaluation Technique

The concept of wildlife mitigation is not new. Yet actual implementation and monitoring were unsuccessful for many projects (Short and Schamberger 1979, Prosser et al. 1979, and Horak 1979). The reasons for unsuccessful mitigation and compensation efforts span both political and procedural realms. One procedural reason was lack of standard methods capable of quantifying wildlife values.

The need for a method based on quantifying habitat values is shown by the following review of traditional methods.

1. Evaluations or opinions from various types of biologists are often subjective. The biases of biologists (big game, waterfowl, upland game, trout, salmon, plant, etc.) have largely determined types and degree of mitigation, if any. Problems of this method are difficulty of replication, inconsistent consideration of wildlife resources, disagreements among biologists, and little credibility in legal situations. Frequently, losses that were difficult to assess (for example, predator losses) were often ignored. Biologists rarely agreed on relative values of different wildlife species.
2. Until recently, population data were considered the best indicator of impacts to "socially important species." Unfortunately numbers are merely a snapshot in time and space of an extremely variable parameter. Population numbers provide no way to predict trends or to evaluate the numbers of animals that habitats can sustain. Very often numbers cannot be replicated

or substantiated. Again, only large and easily counted animals received any attention.

3. The impact on the amount of recreational use provided by the area or its animal inhabitants was evaluated. A value based upon "man-day use" of an area rather than its productivity is contrary to the requirements of the U.S. Fish and Wildlife Coordination Act. This act specifically requires that mitigation focus primarily upon replacing "wildlife resources productivity". A "man-day use" approach also ignores the intrinsic values of all organisms, plant and animal alike, regardless of their exploitation by man. Additionally, areas close to metropolitan areas receive greater use (and abuse) than inaccessible wilderness areas, and therefore were rated as having higher "value". These problems are unacceptable to many who believe that an area can have high values without being accessible and popular.

A method that is quantitative, standardized, and accepted by all parties is critical to mitigation and compensation studies. In 1976 the U.S. Fish and Wildlife Service formulated a technique for habitat evaluation (USFWS 1976). They had been developing this quantitative assessment method since 1974. There have been various refinements to that original version (Ellis et al. 1978, Schamberger and Farmer 1978, Schamberger et al. 1979, and Short and Schamberger 1979).

The Habitat Evaluation Procedures (HEP) are an attempt to fill a need for a method that is acceptably valid, and replicable. A significant accomplishment of HEP is that it can quantify noneconomic values of wildlife resources. HEP can measure impacts and mitigation and compensation

needs in ecological terms rather than purely on a "use" or wildlife population basis. The Fish and Wildlife Service is currently adding new capabilities to the 1976 version, which is now state-of-the-art knowledge. One thing that no method currently does directly is to evaluate unique aspects of an ecosystem. Despite this, HEP is the best method available for evaluating project-induced losses.

HEP was chosen to evaluate wildlife habitat losses due to raising Ross Dam and to plan wildlife mitigation and compensation of High Ross. HEP offers considerable improvements over traditional methods for determining mitigation and compensation. The 1976 version has been used successfully for many other mitigation studies. A notable example of the application of HEP is the Dickey-Lincoln Lakes Dam project in Maine, proposed by the U.S. Army Corps of Engineers.

3.2 Description of Habitat Evaluation Procedures

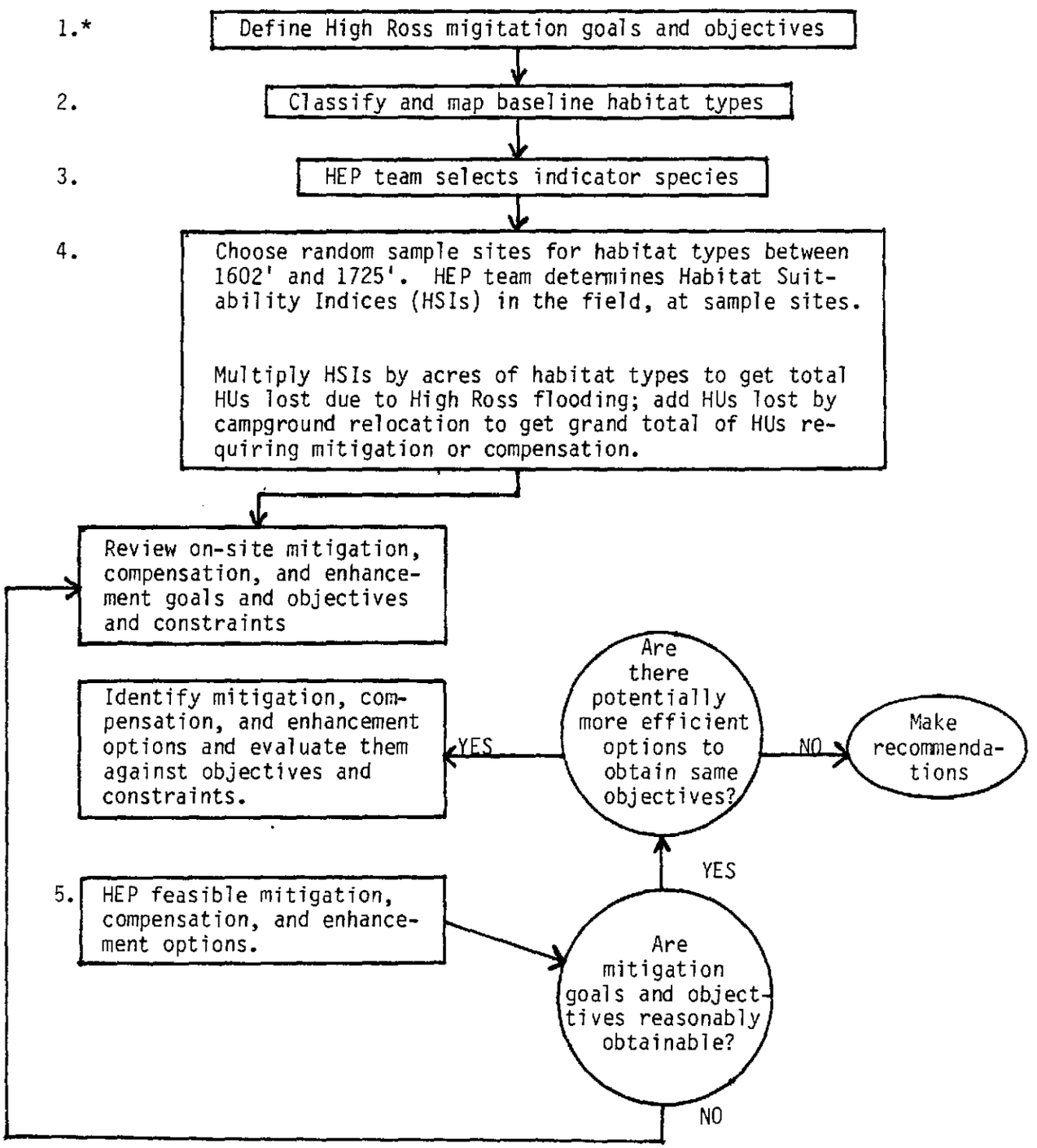
The objectives of habitat evaluation of Ross basin are:

1. To assess impacts of High Ross to the ecological community of Big Beaver Valley and Ross basin; and
2. To assess impacts to wildlife of high social interest.

These two objectives governed the application of HEP to the mitigation study. Figure 1 shows the mitigation process, and steps in the HEP.

The first step in the HEP is classification and mapping of habitat types in the study area (Ross Lake National Recreation Area above the dam) prior to inundation. The second step is to identify evaluation animal species (evaluation species are the basis for HEP since they are the means of evaluating each habitat type). The third step is field evaluation of sample habitat types and calculation of a Habitat Suitability

Figure 1. HEP Application to the High Ross Mitigation Study



* Numbers indicate steps in the HEP

Index for each habitat type (the Index is a ratio of the value of a habitat type to a standard of comparison for each evaluation species). The fourth step is multiplying the area of each habitat type by the Habitat Suitability Index to get total habitat units in the baseline (without project) condition. Each of these steps is discussed in detail below, beginning with Habitat Type Mapping.

Once baseline conditions are known, wildlife losses can be determined by comparing baseline to conditions following project completion. In the case of High Ross, areas flooded would be lost to most terrestrial wildlife. The final steps in HEP are evaluating mitigation, compensation, and enhancement options and selecting recommendations from these options.

Evaulation species selection and field evaluation are done by a HEP team. The High Ross team consisted of representatives from National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, Seattle Audubon Society, Seattle City Light, an independent consultant, and Washington Department of Game. The purpose of having the team is to guarantee that interests of each agency are represented.

3.2.1 Habitat Type Mapping

Land cover mapping is used:

1. To delineate habitat types for field evaluation,
2. To calculate areas of habitat types, and
3. To help select evaluation species.

On-site and off-site areas were mapped on available aerial photography from Department of Natural Resources and U.S. Forest Service. Table 1 lists area imagery, scale and source of photography used.

Table 1. Aerial Photographs Used to Map Mitigation and Compensation Areas.

Area	Photo Symbol	Scale[1]	Source
Ross basin	NW-C-76	1:29,000	DNR
S.F. Nooksack R.	NW-C-76	1:25,000	DNR
	USDA 616050	1:27,000	USFS
	NWP-80	1:13,000	DNR
Skagit R.	NW-C-76	1:29,000	DNR
Cascade R.	USDA 616050	1:30,000	USFS
Twisp R.	FWC	1:24,000	USFS
Toats Coulee	OC-C-79	1:27,000	DNR

[1] Scales listed are approximate average scales determined from photos for each area mapped.

The Washington Coastal Zone Atlas (State of Washington 1980) habitat classification system was used for land cover mapping. The system was modified somewhat to fit the High Ross project (Appendix A).

Mapping was done on a light table using a Lietz M8-27 mirror stereoscope. Mylar overlays were placed on photos and delineation of habitat types were drawn on the overlays. For purposes of determining habitat losses in Ross basin, a horizontal plane zoom transfer scope was used to transfer the 1,720 foot elevation line on USGS quadrangle maps to the aerial photo overlays. All photo interpreting was done by one individual to maintain consistency. Acres were determined by using a dot grid.

3.2.2 Evaluation Species Selection

HEP results, expressed as a Habitat Suitability Index (HSI), are directly related to species chosen as evaluation species. Therefore, the choice of evaluation species reflected stated objectives for the HEP. The HEP team chose some species that are "socially important", some that represent groups of species with common requirements, some that perform a key role in a community, and some that represent a particular habitat

type. The full list of 18 species chosen for the HEP balances both the desired ecological perspective and consideration of socially important wildlife in Ross basin and off-site areas. Table 2 lists the 18 species and criteria for their selection.

3.2.3 Field Evaluation and Calculation of Habitat Suitability Index

HEP was used to measure existing ecological conditions in habitat types to be flooded by High Ross. For HEP, many originally mapped habitat types were grouped into more general categories. Grouping reduced sample sites while maintaining acceptable homogeneity within each grouped type.

Table 2. Evaluation Species Selected for HEP and Criteria for Their Selection

Evaluation Species	Criteria for Selection
1. Black-tailed deer	Socially important - the one most people are concerned with; multi-cover species.
2. Mule deer	Same as above; eastside Cascade Mountains subspecies.
3. Black bear	Socially important - common in the area.
4. Ruffed grouse	Game species; represents wildlife requiring valley-bottom habitats.
5. Snowshoe hare	Game species; an important prey of several predators; multi-cover type species.
6. Cougar	Socially important; important predator; probably relatively common in Ross basin.
7. Bobcat	Socially important; important predator; widespread.
8. Beaver	Socially important; important regulator of the environment.

Table 2 (Continued)

Evaluation Species	Criteria for Selection
9. Spotted Owl	Socially important; uncommon elsewhere but does well in this area; indicator of old growth.
10. Goshawk	Eastside raptor; prefers old-growth forest.
11. Pileated woodpecker	Socially important; indicator of species requiring dead and decaying wood; cavity creator.
12. Yellow warbler	Non-game animal; indicator of riparian areas.
13. Douglas squirrel	Non-game animal; indicator of predominately coniferous forests.
14. Red squirrel	Replaces Douglas squirrel east of Cascade Mountains.
15. Pika	Non-game animal; indicator of talus slopes.
16. Mountain beaver	Lowland rodent; indicator of abundant ground vegetation.
17. Northern alligator lizard	Reptilian representative; indicator of open areas.
18. Wood duck	Socially important; representatives of waterfowl requiring large snags near water.

The HSI is a rating of habitat value for each habitat type. In practice, it is an index of the difference between Study Area conditions and optimal habitat conditions. Optimal conditions were defined in fact sheets for each evaluation species. The fact sheets were compiled from scientific literature by the U.S. Fish and Wildlife Service, and by the study team. Fact sheets describe life requirements of each evaluation species for the ecoregion of which Ross basin is a part.

Prior to on-site field evaluation, sample sites were systematically selected for each habitat type in Ross Basin between 1602 and 1725 ft. el. Sample sites were selected until a final number, proportional to the number of acres in each habitat type, was reached.

Field evaluation of sample sites was done by the HEP team. The team evaluated each sample site for each species using fact sheets and criteria previously agreed upon by the team. Ranking criteria for each evaluation species were simple word models describing the extent to which a sample site fulfilled life requirements for that species. Rankings were as follows: poor (1 or 2); fair (3 or 4); moderate (5 or 6); good (7 or 8); and excellent (9 or 10). For example, a poor habitat might be described as an area which only marginally supplies some of the life requirements of a species. Each team member rated the sample site separately for each species and recorded the value on a field form. Then the team discussed the values. A value of zero reflected no use of that site by that species. A value of ten represented ideal conditions. Habitat suitability ratings were obtained by averaging ratings of all team members.

An HSI value of 100 indicates that the team feels that existing conditions are optimal for the evaluated species. Table 3 shows which species were evaluated for each area.

3.2.4 Calculation of Habitat Units

A Habitat Unit (HU) is the measure by which wildlife losses, evaluated compensation sites and predicted percent of mitigation and compensation possible on-site were quantified. HUs are the product of mean HSIs for a given habitat type and acres of that habitat type. Using HUs,

wildlife values can be compared for various project designs and management changes.

HUs were first used to measure baseline conditions (1979-80) between 1602 and 1725 ft. el. With High Ross, all habitats in this zone will be flooded, resulting in a loss of all baseline HUs. These HUs are wildlife values lost each year for the 50-year life of the project. The area within each habitat type is assumed to remain constant over 50 years as certain areas advance successionally while others return to earlier seral stages following fire, blow-down, etc.

Table 3. Evaluation Species Used for Each Area

	Ross Basin	S.F. Nooksack R.	Cascade R.	Skagit R.	Twisp R.	Toats Coulee
1. Black-tailed deer	x	x	x	x		
2. Mule deer					x	x
3. Black bear	x	x	x	x	x	x
4. Ruffed grouse	x	x	x	x	x	x
5. Snowshoe hare	x	x	x	x	x	x
6. Cougar	x	x		x		
7. Bobcat		x	x		x	x
8. Beaver	x	x	x	x	x	x
9. Spotted owl	x	x	x	x		
10. Goshawk					x	x
11. Pileated woodpecker	x	x	x	x	x	x
12. Yellow warbler	x	x	x	x	x	x
13. Douglas squirrel	x	x	x	x		
14. Red squirrel	x	x	x	x		
15. Pika					x	x
16. Mountain beaver		x	x	x		
17. Northern alligator lizard	x	x	x	x	x	x
18. Wood duck	x	x	x	x	x	x

Next, HUs were used to assess management potential of areas above 1725 ft. el. This aided selection of mitigation and compensation options. For example, areas with a certain mixture of successional forest and shrub habitat types have more HUs than large expanses of either type alone. Therefore, partial compensation of habitat losses may be achieved by creating an interspersion of forest and shrub communities.

Effects of project design changes on quality and/or quantity of habitat types were also estimated and then evaluated for HU changes. Likewise, effects of compensation measures on alternative sites were predicted. Habitat evaluation of compensation measures is discussed in a following section. Finally, for some compensation measures, HUs were used to assess gains and losses in wildlife values from vegetation succession changes over the 50-year project life.

Aside from flooding impacts, relocation of campgrounds to areas above 1725 ft. el. will also cause wildlife losses. These additional losses were quantified by totalling the differences between campground HUs and HUs of habitat types at each proposed campground site.

3.3 Evaluation of Mitigation and Compensation Options

3.3.1 Evaluation of On-Site Mitigation Options

The goal of in-kind mitigation and compensation on-site restricts the number of possible options for increasing the HUs on-site. Mitigation and compensation measures must increase HUs equal to HUs lost, for each habitat type. Compensation measures which do not address in-kind losses were given lower priority. Since lands within Ross Lake National Recreation Area are publically owned, preservation of lands above 1725

ft. el. is already accomplished. Preservation is thus not an option for on-site mitigation and compensation.

Two other types of mitigation measures are possible:

1. Changes in project design and other measures to avoid or reduce impacts of High Ross; and
2. Habitat management measures which increase upland HUs in-kind.

Changes in project design or options which require a license change are outside the scope of this study and were not considered.

In search of possible mitigation methods, previous wildlife studies of Ross basin and testimony during High Ross hearings were reviewed (Taber 1972, 1975, 1976; Slaney 1972, 1973; and Gill 1974). Also reviewed were wildlife management and wildlife mitigation and compensation literature. Not surprisingly, many of the same mitigation and compensation options were recommended by several sources. Options recommended, by source, are listed in Table 4.

Potential mitigation and compensation options were evaluated using the following criteria:

1. Is the option compatible with High Ross operation and license?
2. Is the option compatible with National Park Service policies for North Cascades National Park?
3. Does the option address in-kind HU losses?
4. Has the option been successful in areas similar to Ross basin?
5. Are there suitable sites in Ross basin?
6. Would application at suitable sites result in a net gain of HUs, in-kind, in an economically-efficient manner?

Table 5 lists mitigation and compensation options and an evaluation of their feasibility for implementation in the High Ross Mitigation Plan.

Table 4. Possible Mitigation and Compensation Options for On-Site, by Source

Taber (1972, 1975, 1976)
1. Fertilize successional shrub in deer winter ranges
2. Enhance shrub productivity by controlled fire
3. Enhance shrub productivity by removal of competing vegetation

Slaney (1972, 1973)
1. Fertilize deer spring ranges
2. Create artificial openings in deer spring ranges
3. Cut to improve browse
4. Develop alternative meadow areas
5. Develop ponds at seepages

U.S. Army (1980)
1. Acquire habitat types and deer winter ranges
2. Manage wetlands on mitigation lands
3. Plan and manage logging road systems
4. Research and monitor population status, habitat use, and habitat tolerance
5. Protect nesting habitat
6. Minimize clearing along shorelines
7. Maintain and enhance streams
8. Maintain buffer zones along streams

Gill (1974)
1. Set back succession in scattered patches
2. Preserve land and manage it, particularly if it would otherwise be lost
3. Fertilize upland areas
4. Establish ponds and marshes
5. Blast potholes in upland areas

Nelson et al. (1978)
1. Selective clearing
2. Create brush and tire shelters
3. Plant exposed areas
4. Control fluctuation
5. Manipulate the pool seasonally
6. Plant food and cover
7. Create fish and waterfowl ponds
8. Dredge and dike wetlands
9. Acquire land
10. Zone the reservoir and floodplains
11. Build nesting boxes
12. Create nesting islands
13. Selective clearing of drawdowns
14. Create artificial meanders

Table 5. Evaluation of On-Site Mitigation and Compensation Options*

On-Site Mitigation and Compensation Options	Evaluation Comments
1. Fertilize successional shrub dominated communities in deer winter ranges.	On-site tests showed significant increase in browse production after fertilizing; this measure would raise carrying capacity of deer winter range with net benefits possible.
2. Increase browse production by prescribed burning.	Prescribed burning is not permitted by the National Park Service in the recreation area at this time.
3. Increase browse production by selective cutting of trees.	Much shrub vegetation in deer winter ranges is overtopped by trees. Clearing of trees would increase the carrying capacity of deer winter ranges substantially.
4. Fertilize deer spring ranges.	In the U.S. portion of Ross Basin, the only meadow-type spring range is in the drawdown. On-site tests of drawdown fertilization showed that grass and forb production increased significantly. This measure could improve drawdown areas as spring range. However, there could be a problem with algal bloom as the reservoir rises in July.
5. Create artificial openings in deer spring range.	This is not applicable to the U.S. portion, since all meadow-type spring ranges are in the drawdown. This measure was proposed by Slaney to compensate loss of spring range in Canada.
6. Develop alternate spring range meadow areas.	The only meadow-type spring range remaining in the U.S. portion is in some drawdown areas. Additional drawdown sites can be fertilized and seeded to provide new spring range, provided that fertilization does not cause algal problems as the reservoir level rises.

Table 5 (Continued)

On-Site Mitigation and Compensation Options	Evaluation Comments
7. Create ponds and marsh areas at seepages or creek mouths along lake shorelines.	Many small cove areas along Ross Lake shoreline are suitable sites for pond and marsh development. Since the ponds could be created in drawdown areas, just below 1725 ft., net wildlife benefits could be substantial.
8. Create potholes in upland stream areas and seepages by blasting.	Although potholes have high wildlife values, they would not have higher values than the pristine vegetation areas they would replace; this technique is more suitable for floodplains and water recharge areas than for most areas in Ross basin above 1725 ft.; Blasting, as a technique, is undesirable in the Recreation Area setting.
9. Selective clearing along reservoir edge.	Leaving some snags and live trees in the inundation zone near shore would benefit snag-dependent birds; selective clearing near pond/marsh sites, such that most shrub and forest vegetation is left, would increase values of these sites.
10. Provide nesting structures for birds.	Leaving snags in the drawdown, near shore will provide some nesting habitat in addition to feeding and resting habitat for birds.
11. Provide nesting islands.	Nesting islands could benefit waterfowl; this measure can be integrated into pond/marsh development to increase net benefits at those sites.
12. Create artificial meanders.	Topography in Ross basin above 1725 ft. generally precludes this option; meanders already occur naturally where topography is suitable.
13. Shoreline planting.	Planting of riparian and shrub species along high pool will provide habitat type similar to those lost in Big Beaver Valley and cover for access to water.

Table 5 (Continued)

On-Site Mitigation and Compensation Options	Evaluation Comments
14. Plan and manage logging road systems.	Logging is not currently permitted in the Recreation Area. However, careful planning and managing of logging road systems for reservoir clearing operations can prevent disturbance of wildlife not already lost due to inundation. Close coordination with Game Dept. biologists could be maintained.
15. Create brush and tire shelters.	This measure would not offset losses to wildlife due to flooding, although it could have net benefits for fish.
16. Special hunt.	A special hunt of game species within Ross and Big Beaver Valleys could mitigate for habitat destruction caused by wildlife overuse of reduced ranges.

* Acquisition and preservation measures are not listed since all land within the Ross Lake National Recreation Area is already in public ownership.

3.3.2 Evaluation of Off-Site Compensation and Enhancement Options

Compensation and enhancement options off-site include those techniques listed in Table 5 for on-site mitigation and compensation except those options which deal specifically with the reservoir clearing and pool level. In addition to the techniques considered for on-site mitigation and compensation, a host of other habitat improvement methods exist that could be implemented off-site to offset habitat losses due to High Ross (USDA 1971, 1979, Thomas 1979, USDI 1977, 1978a, 1978b). Of the myriad of habitat improvement techniques, only those which can improve or create habitats similar to those lost to inundation, or can

improve habitats that support the wildlife species of Ross Basin and Big Beaver Valley were considered (Table 6).

The compensation and enhancement options considered are ones that have worked in other areas of the western United States. They were designed to either increase wildlife diversity or productivity or both. The options represent the state-of-the-art in cost-effective wildlife habitat protection, rehabilitation, and enhancement.

Table 6. Compensation and Enhancement Options for Off-Site

Option	Evaluation
1. Fertilize successional shrub	This will increase productivity and carrying capacity along with increasing nutritional value.
2. Create mosaic of successional stages	This will provide the plant structural and species diversity required by many wildlife species.
3. Create ponds	Ponds along with riparian vegetation will provide nesting and foraging sites for many wildlife species, offsetting those types lost in Big Beaver Valley.
4. Rehabilitate disturbed streams	Streams devoid of streamside vegetation due to logging or other disturbances can be made more productive for wildlife and fish by planting willows and other vegetation.
5. Provide bird nesting structures	The number of adequate nest sites often limits bird use of an area. Providing nesting structures can increase bird productivity and diversity.

Table 6 (Continued)

Option	Evaluation
6. Protect plant communities threatened with destruction	Plant communities which are unusual, unique, scarce or highly productive for wildlife and are imminently threatened with destruction can be protected by management agreement or acquisition.
7. Plant forage plants on disturbed sites	Powerline rights-of-way, mining areas, and other disturbed areas can be enhanced for wildlife by planting propagules of selected plant species.
8. Time logging or road construction	Avoiding logging during periods when wildlife bear and rear young will reduce wildlife mortality provided that enough suitable habitat remains.

3.4 Selection of On-Site Mitigation and Off-Site Compensation Sites

On-site mitigation areas were selected according to their suitability for mitigation options. Consideration was given to future location of campgrounds, topography, lake level fluctuations, vegetation, and NPS restrictions.

The areas selected for off-site compensation were chosen on the following basis:

1. Proximity to High Ross Dam;
2. Similarity of habitat types with Ross Basin;
3. Potential for wildlife habitat improvement;
4. Availability.

Land owners were contacted prior to including their lands in the off-site study to assure availability of the land for management agreements, sale or trade. Any further negotiation is the responsibility of SCL.

4.0 RESULTS

4.1 Wildlife Habitat Losses On-Site by Habitat Type

Habitat losses which would occur due to High Ross were measured using HEP. The grand total of HUs (Table 7) represents wildlife values that will be lost each year for the 50-year life of the High Ross project. The purpose of "annualizing" HUs is to display future losses in a manner compatible with project benefit/cost analysis. In addition to HUs lost due to flooding, the grand total includes HUs lost due to campground relocation. National Park Service plans call for relocation of 21 existing campgrounds above 1725 ft. (NPS campground map, undated). Since campgrounds have lower mean HSI values than all other habitat types (see Table 7), there will be net losses for wildlife. These additional losses were calculated by summing the differences between campground HUs and HUs of habitat types at each campground site.

Looking at Table 7, the extent and diversity of potential wildlife losses becomes evident. In the event of High Ross, 3,458 acres will be flooded in the U.S. These 3,458 acres are represented by 130,145 Habitat Units. To get an idea of what 130,145 HUs mean, they are equivalent to managing 17,290 acres of similar habitat types to increase their carrying capacity by 20%. Of course, the greater the management potential of mitigation lands, the less land required to offset lost HUs. Table 7 also indicates the diversity of habitat types that would be flooded, particularly of wetland habitat types in Big Beaver valley. Compensating these losses, in-kind, is thus a complicated undertaking, especially on-site.

Table 7. Habitat Suitability Indices, Acres, and Annualized Habitat Units by Habitat Type, Between 1602.5 and 1725 ft. el.

Habitat Type	Habitat Suitability Index	Acres	Annualized Habitat Units
Big Beaver Valley HEP			
Immature conifer	28.1	70	1,967
Mixed mature	56.5	21	1,187
Mature conifer	40.5	153	6,197
Old-growth	48.2	313	15,087
Vegetated talus	46.2	21	970
Rock outcrop	33.8	3	101
Non-vegetated talus	23.6	7	167
Vegetated chute	38.5	10	385
Forested slope	37.9	80	3,032
Bog marsh	35.9	84	3,016
Pond	26.3	41	1,078
Shrub swamp	38.9	73	2,840
Riparian shrub	30.5	111	3,387
Forested swamp	54.6	69	3,767
Forested floodplain	52.8	84	4,435
Total		1,140	47,616
Rest of Ross basin HEP			
Regenerating conifer	20.8	85	1,768
Pole stage conifer	24.4	597	14,567
Regenerating mixed	41.0	355	14,555
Pole stage mixed	35.6	223	7,939
Mixed mature	28.8	59	1,699
Mature conifer	38.5	348	13,398
Old-growth	46.9	300	14,070
Broadleaf	35.0	29	1,015
Shrub	42.3	29	1,227
Campground	42.3	37	1,565
Vegetated rock/talus	41.9	256	10,726
Total		2,318	82,529

Total Habitat Units Lost: 130,145

Grand total Habitat Units lost: 130,639
(Includes net loss at relocated campground sites of 494 HUs)

In addition to habitat lost to inundation, habitats above high pool will be impacted when wildlife displaced from the inundation zone put additional foraging pressure on them. Deer, especially, have the ability to overbrowse their range and deteriorate their own habitat when they are forced to concentrate in reduced range or they exceed the carrying capacity.

Habitat Evaluation Procedures do not fully account for the unique or unusual values of certain plant communities, such as bogs or old-growth forests. Since few vertebrate wildlife species depend on bogs, HSI values were low. During Big Beaver Valley HEP, the team was impressed with wildlife values and uniqueness of old-growth forests there. During the HEP of old-growth forests in the rest of Ross basin, it was evident to the team that wildlife values were not as high as those in Big Beaver Valley. Nevertheless, HUs of old-growth in both areas are essentially the same.

4.2 Feasible Mitigation and Compensation Options

4.2.1 On-Site

Sixteen potential mitigation and compensation options were evaluated to determine their feasibility for implementation within Ross basin (Table 5). The evaluation shows that 9 options can be used successfully for on-site mitigation or compensation. Feasible on-site mitigation and compensation options are listed in Table 8.

Extensive project design changes were not considered feasible at this stage. Although design changes could reduce wildlife losses significantly, they might require changes in the High Ross license.

One mitigation option, shoreline planting of riparian and shrub species, could include planting below high pool. This is not a tried and proven technique for wildlife habitat improvement, but planting of flood tolerant species below high pool could be of significant value to wildlife, both as riparian habitat and as cover for access to the drawdown pool. Red-stem dogwood and willow are very tolerant to flooding and can survive months of total submersion even during the growing season (Walter and others 1980). Since no study has been conducted to show that these species will survive four months of partial or total submersion in all kinds of soils on all aspects, planting the species below high pool in Ross Lake may not be 100% successful. Nonetheless, if experimental plantings below high pool prove successful, much habitat loss could be mitigated for by creating strips of shrubs extending from high to low pool.

There are two other feasible mitigation options. During reservoir clearing, impacts to wildlife above 1725 ft. el. could be avoided by careful planning and management of logging operations and by leaving buffer zones along tributaries should operations extend above 1725 ft. The purpose of these measures would be to minimize wildlife disturbance at critical periods such as migration, nesting, and breeding. Costs of these measures would be minimal since all that would be required is close coordination with Game Department biologists prior to and during reservoir clearing.

Listed in Table 8 are seven feasible habitat management options for on-site compensation. Each option has a high probability of success. Some of these options address type losses in-kind. Other measures address loss of critical habitat components or functions, such as deer

spring and winter range, and snags for birds. Several measures can be applied extensively in Ross basin.

Finally, an essential compensation measure is continued research and monitoring of wildlife populations and habitat use during and after project construction for the life of the project. This is necessary to ensure success of mitigation measures and to evaluate results of the mitigation study.

The number of feasible options is limited by the goal to mitigate or fully compensate in-kind and on-site. However, during on-site studies, a number of additional constraints were identified that are specific to the site and the project. Altogether, the constraints greatly restrict the number of feasible mitigation and compensation options.

Table 8. On-Site Mitigation and Compensation Options

Mitigation and Compensation of Losses due to Flooding

1. Increase habitat diversity by selective cutting of trees (3)
2. Fertilize drawdown areas to increase spring forage available to deer (4)
3. Seed additional drawdown areas to increase spring forage available to deer (6)
4. Create ponds and marsh areas at seepages or creek mouths along lake shorelines (7)
5. Selective cutting along reservoir edges (9)
6. Provide nesting islands (11)
7. Plant riparian and shrub species along high pool shoreline (13)

Table 8 (Continued)

Mitigation of Potential Losses due to Reservoir Clearing

1. Leave buffer zones along tributaries (9)
2. Plan and manage logging operations during reservoir clearing (14)

[1] Numbers in parentheses indicate option number in Table 5. Evaluation of On-Site Mitigation and Compensation Options.

4.2.2 Off-Site

Compensation measures feasible for off-site (Table 6) are similar to measures for on-site. The possibilities for application, however, are vastly increased due to the much larger area of consideration.

Several options are unique to off-site. Preservation is an option which is not feasible on-site, but is an important option for off-site. Rehabilitation of streams degraded by logging is also an important option that is applicable off-site. It is listed as an altenative option to the recommended plan.

The mitigation and compensation plan (Chapter 5.0) uses all of the listed options. Some of them are combined as a single recommended activity.

4.3 Constraints Limiting Mitigation and Compensation

4.3.1 Constraints On-Site

There are several constraints to compensating lost habitat values on-site.

First, most of Ross basin consists of relatively undisturbed vegetation. Habitat maps show that areas above 1725 ft. are currently composed

of many different habitat types. The possiblities of increasing habitat values by creating a mosaic of habitat types are therefore limited.

Second, because much of Ross basin has steep slopes and shallow soils above 1725 ft., management options are few. For example, managing for valley-bottom old-growth western red cedar habitat, such as will be lost in Big Beaver valley, will not be possible on-site. Poor habitat with low management potential is distinguished here from habitat that is poor solely because of its successional stage. Where possible, the latter would be managed for on-site compensation in the plan.

Third, National Park Service policy for Ross Lake National Recreation Area restricts certain kinds of habitat management techniques and levels of disturbance that will be allowed.

Elements of Park Service policy that constrain the mitigation and compensation effort include (Miller 1979):

1. Prescribed burning as winter range improvement technique will not be permitted at this time;
2. Drawdown seeding and planting must be done with species native to the Park;
3. Drawdown planting sites must be approved;
4. Clearing, thinning, slash disposal, and other browseway management techniques must be approved;
5. Pond/marsh construction techniques must be approved;
6. Three potential pond/marsh sites conflict with proposed campground sites, and two other pond/marsh sites are near campground sites;
7. Sites where snags will remain standing must be approved.

Fourth, flood control and power regimes of High Ross Dam, as currently licensed, preclude considering measures for changing reservoir levels and drawdown timing. In addition, since High Ross is already licensed, changes in project design which would lessen impacts substantially, such as a high pool level of 1675 ft., cannot be recommended at this stage.

These constraints limit the nature and extent of mitigation and compensation that can be achieved on-site. However, certain types of losses can be partially offset.

4.3.2 Constraints Limiting Off-Site Compensation and Enhancement

The major limiting constraint on off-site compensation and enhancement is the willingness of land owners to sell or enter into a management agreement for the purpose of compensation, mitigation, or enhancement. The Ross Basin, south of Canada, is completely surrounded by federally owned land. Immediately adjacent to Ross Lake is the Ross Lake National Recreation Area (RLNRA). The National Park Service (NPS) has indicated that they are willing to allow some kinds of mitigation and compensation measures implemented within the RLNRA. Just outside the RLNRA are the Mt. Baker-Snoqualmie National Forest and the North Cascades National Park. The Forest Service and the NPS have stated that entering into management agreements for off-site compensation is not compatible with existing policies of their agencies.

NPS and FS policies exclude most areas proximal to the High Ross project from being considered for mitigation purposes. These federal lands are the most similar to those to be lost to inundation. Private land owners and the Washington Department of Natural Resources (DNR) have indicated a willingness to consider entering into management agreements

with SCL, but much of these lands are either quite dissimilar to those to be lost to inundation, have been recently logged, or are scheduled to be logged in the near future. Timber harvesting does not necessarily eliminate the opportunity for wildlife habitat improvement, but managing forests for maximum yield of forest products precludes many habitat improvement options. Landowners may be willing to forsake some or all wood production provided that they are suitably compensated.

In addition to the availability of lands for mitigation purposes, there are other limitations such as economic and technologic constraints. These constraints limit the feasibility of many options. Options, such as animal rearing or transplanting mature trees, are not economically if not technologically feasible, and were not even considered in this study.

5.0 RECOMMENDED WILDLIFE MITIGATION PLAN

5.1 Recommended Mitigation Plan

5.1.1 Goal - 100% Mitigation and Compensation

The Federal Power Commission when granting the license for High Ross specified that SCL shall prepare a wildlife mitigation plan pursuant to the Federal Power Act, the Fish and Wildlife Coordination Act, and the National Environmental Protection Act. It is in the interest of the people of the state of Washington to protect their wildlife heritage as much as possible through the legal framework provided by Congress. The wildlife mitigation plan recommended by the Washington Department of Game study team fulfills the legal obligation of SCL to prepare a mitigation plan as well as its obligation to the people of Washington to protect the wildlife resource. The plan provides for mitigation and compensation of wildlife losses due to High Ross to the extent possible using existing habitat improvement practices as well as mitigating measures on-site.

The plan outlined below is based upon both the amount of habitat value to be lost and the relative acreage of the plant communities to be inundated. The aim is to fully compensate and mitigate for these losses.

5.1.2 Habitat to be Inundated in the U.S.

Raising Ross Dam from 1,602.5 to 1,725 ft. el. will inundate 2,318 acres in Ross Basin in addition to 1,140 acres in Big Beaver Valley (Table 7). Inundation will expand Ross Lake from 11,700 acres to 20,000 acres and increase shoreline from 64.5 miles to 95.0 miles (high pool, including Canada). There will be 17 terrestrial habitat types (including

campgrounds) and four aquatic habitat types inundated including 7.3 miles of Big Beaver Creek and 20 ponds.

Several habitat types in Big Beaver Valley and Ross Basin are unique or unusual and it is in the interest of the state of Washington to fully mitigate or compensate for the loss of these types. Of particular concern are those listed in Table 9.

Table 9. Habitat Types of Special Interest

Type	Acres	Habitat Units
Bog/marsh	84	3,016
Pond	41	1,078
Shrub swamp	73	2,840
Forested swamp	69	3,767
Old-growth forest	613	29,157

5.1.3 Feasible Options for Compensation and Mitigation

Of the numerous theoretical wildlife mitigation and compensation measures, seven appear to be practical to offset wildlife habitat losses following the raising of Ross Dam and are used in this mitigation plan. These mitigation and compensation measures include:

1. Overstory clearing in irregular patches;
2. Pond development;
3. Drawdown seeding;
4. Drawdown snag retention;
5. Shoreline planting of woody species in disturbed areas (streams or lake);

6. Protection of plant communities threatened with destruction;

7. Powerline right-of-way rehabilitation.

Specifications for their implementation are in Section 5.4.

5.1.4 Recommended Mitigation Measures

The recommended mix of mitigation and compensation measures is based upon the abundance and value of the habitats to be lost by inundation. On-site measures are given first priority in order to increase the carrying capacity of lands adjacent to the new pool to accommodate wildlife displaced from the inundation zone. Measures within the RLNRA and immediately down river on the Skagit were given second priority, again, in hopes of providing habitat for displaced wildlife. Measures which protect, create, or improve habitats of special value, such as wetlands and old-growth forests, are given third priority. HEP, as the accepted measure of habitat value, is used to ensure full, but not excessive, compensation.

Table 10 lists mitigation and compensation measures in order of priority. In the event that any recommended mitigation and compensation measure(s) is impossible to implement, a supplemental list is provided in Section 5.2. It is recommended that replacement mitigation and compensation alternatives be of similar benefit to wildlife as the measure(s) rejected.

Table 10. Recommended Mitigation

Technique	Location	Acres	HUs gained
Overstory removal	On-site	1,557 1/	30,786
Pond construction[1]	On-site	1,144 1/	12,252
Drawdown seeding	On-site	114	1,710
Snag retention in drawdown	On-site	434	2,170
Shore planting	On-site	39	1,190
Overstory removal	RLNRA (NPS)	156 1/	2,392
Pond construction[1]	RLNRA (SCL)	237 1/	2,644
ROW rehabilitation	RLNRA	49	588
Overstory removal	RLNRA (SCL)	107	1,865
Protection	S.F. Nooksack R.	1,528	33,399
Protection	Twisp R.	437 1/	7,094
Pond construction[1]	S.F. Nooksack R.	1,037 1/	11,008
Overstory removal	S.F. Nooksack R.	704	17,426
Streamside rehabilitation	S.F. Nooksack R.	15	143
ROW rehabilitation	Sauk R.	549	6,590
			132,157

1/ Acres of pond improvement includes all habitats within one-quarter mile of each pond.

5.1.5 On-Site Plan Description

Ross Lake occupies a deep valley cut by the Skagit River through high mountainous country. Slopes are generally steep with rock outcrops. Forest types include immature, pole stage, mature and old-growth conifer, mixed conifer and broadleaf, and broadleaf forests of all age classes. Some forest types, especially pole stage conifer, are extensive, while others occur in small patches adding some diversity. Wetlands are restricted to Big Beaver Valley where a complex ecosystem of river, pond, marsh, bog and shrub swamp wetlands intermingle with old-growth red cedar, hemlock and Douglas-fir.

The plan for on-site mitigation and compensation consists of six measures. They are: overstory removal, pond/marsh construction, seeded drawdown, snag retention, fertilization of shrub areas, and shoreline

planting. Specification for implementing these measures are in Section 5.4.

Overstory removal would occur on 1,557 acres of deer winter range (Figure 2) resulting in a net gain of 30,786 habitat units (Appendix G). Habitat types most effected by this measure are dense pole stage conifer in extensive stands. By creating clearings in these stands, shrub growth will increase providing diversity and new habitats for a number of species.

Pond/marsh construction would occur at 14 sites around the lakeshore (Figure 2). Habitat units gained from the ponds themselves will be 952 HUs (Appendix G). An additional 11,300 HUs (Appendix G) will be gained because of increased values to all habitat types within a quarter-mile radius of each pond. As riparian vegetation gets established at each pond, wildlife use of the ponds and surrounding areas will increase.

Seeding drawdown areas on 114 acres will make up for 1,710 HUs lost (Appendix G). These seed areas are located at various places around the lake (Figure 2) wherever drawdown will expose suitable soils for long enough time to grow grass for forage.

Leaving trees standing in the inundation zone will create snags providing habitat for species requiring snags. A total of 434 acres of snag retention has been located around the lake (Figure 2). These 434 acres will make up for 2,170 HUs lost (Appendix G).

Shoreline planting of 39 acres to riparian vegetation will replace 1,190 HUs lost (Appendix G). The location of planting will have to be done carefully by the implementation team. Selection of sites will partially determine the success or failure of the measure.

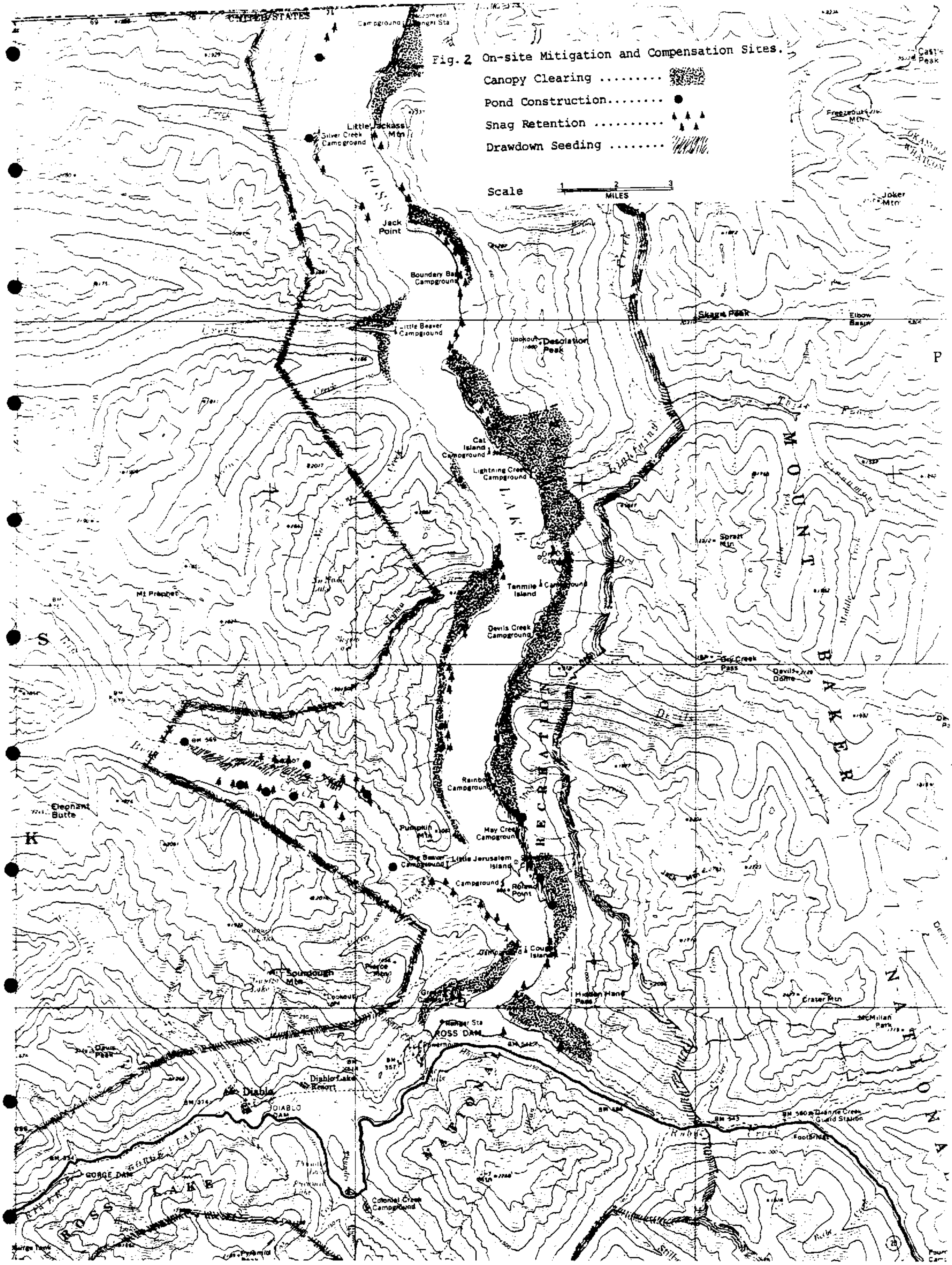


Fig. 2 On-site Mitigation and Compensation Sites.

5.1.6 Off-Site Plan Description

Off-site compensation and enhancement alternatives developed for this study involve five locations with a variety of management schemes. Management agreements with landowners or out-right purchase would be required to implement the plan. Landowners have been contacted and are willing to negotiate a lease, sale or trade agreement. Any further negotiations are the responsibility of SCL. While some of the areas chosen may not appear proximal to High Ross Dam, one must remember that High Ross Dam is totally surrounded by federal land, most of which is not available for mitigation purposes.

The five sites chosen are in three different drainages - South Fork Nooksack, upper Skagit, and Twisp Rivers.

South Fork Nooksack River - The portion of the S.F. Nooksack River that is being recommended for habitat management or compensation is approximately six miles north of Hamilton and is owned primarily by Scott Paper Company. The Department of Natural Resources (DNR) and private individuals own small parcels within the management area.

A corridor of land varying in width from one-fourth to two-and-one-half miles wide marked by the mainline logging road south of the river and roads and topographical differences north of the river and following the river from the U.S. Forest Service boundary downstream for 13 miles has been selected for off-site compensation measures. Approximately 4,730 acres are included (see Figure 3A and 3B).

This stretch of the river flows through old-growth, mature, pole stage and regenerating conifer (predominantly Douglas-fir), broadleaf, and mixed conifer and broadleaf forests. Some areas along the river have been recently clearcut. Logging has occurred continuously over a number

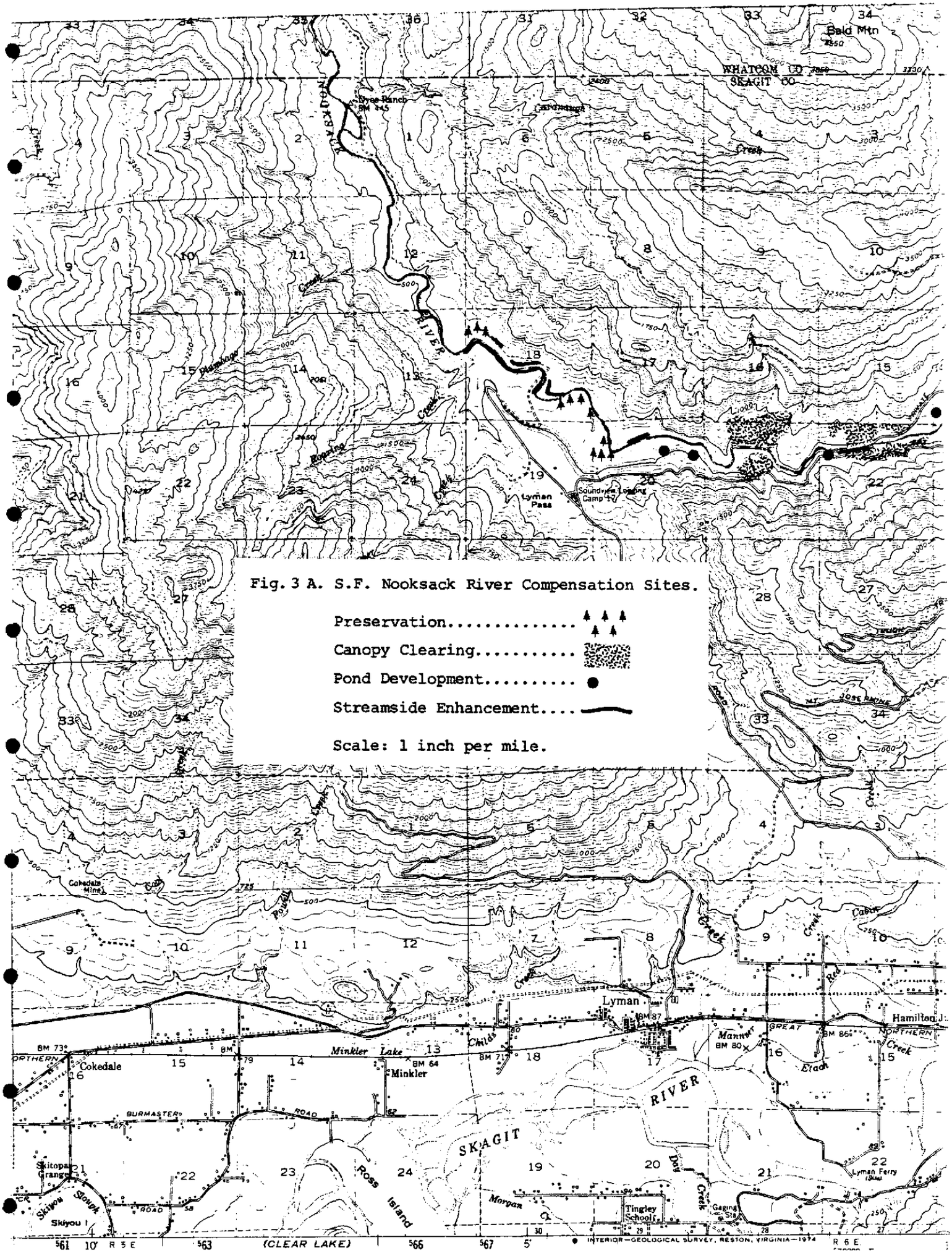


Fig. 3 A. S.F. Nooksack River Compensation Sites.

Preservation.....

Canopy Clearing.....

Pond Development.....

Streamside Enhancement....

Scale: 1 inch per mile.

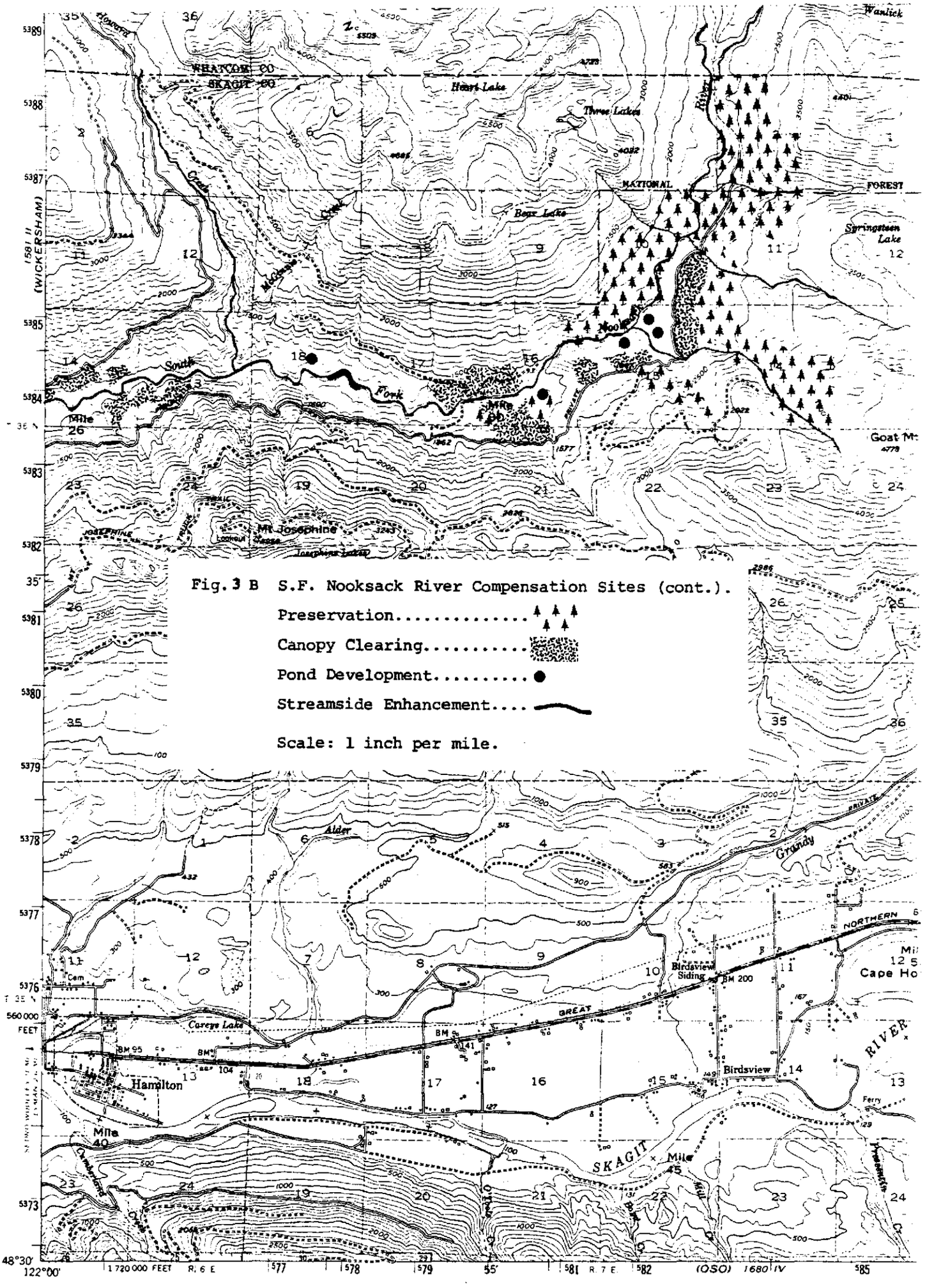


Fig. 3 B S.F. Nooksack River Compensation Sites (cont.).

Preservation.....

Canopy Clearing.....

Pond Development.....

Streamside Enhancement....

Scale: 1 inch per mile.

of years resulting in even-aged stands of different ages. The dominant forest type is deciduous (red alder, Alnus rubra). Conifer and mixed conifer and deciduous stands are common. Forest types extend continuously from the river upslope with little diversity. Topography is rolling to steep (1-60+% slope) on all aspects. With the exception of a beaver pond, alder swamp and the river itself, the area has few wetlands. Since recently logged lands are burned and planted immediately following logging, shrub types have a short lifespan. Additionally, recently logged areas that have shrub types are too large to be of much value to many kinds of wildlife since the best advantage of shrub types comes with interspersion with forest types where the shrub types are three hundred feet or less wide. Old-growth stands in the upper end of the area are contiguous with Forest Service and DNR holdings. These stands are predominantly western red cedar and hemlock, and are adjacent to or in close proximity to the river, similar to the old-growth forests of Big Beaver Valley.

Acres by habitat type within the corridor are listed in Table 11.

The management plan developed for this area includes pond development, overstory removal, preservation of old-growth and mature forests and streamside enhancement.

Pond construction is recommended at 11 sites within the corridor. They vary in size from approximately one to six acres. Table 12 shows which habitat types will be effected by pond construction. Each pond has its own characteristics, depending upon topography, water source and vegetation. Some ponds will depend on streams for water source and some will depend on ground water. Pond construction will be by dredging or damming a stream, or both. Some ponds will be open water ponds while

Table 11. South Fork Nooksack River Compensation Area. Acres by Habitat Type[1/2]

Habitat Type	TWP 36N R6E Section 17	18	19	20 Thomas	20 Scott	20 DNR	21 Nelson	21 Judy	21 Scott	16	22	15	14	23	13
412					7						2		34		15
4121				11											
413	6	8		7					3		2		19	7	30
414													39	11	
422		13	1			31	14	20	48	18	103		60	3	104
423	8			25	5			20	13	2			20	30	9
431	4	168	9		114		5		8				10	35	13
432		2		30	8	10	3		44	10	47		29	6	81
433	24	8			32	6	14	7	7				28	2	65
441															
451	12								16		50	8	23	5	
4621		16													
4622		23							3				3		5
4623					16								2		
4632															
4633	1	24													
4711			20		2										
4722															11
4731		3													
4732		26	12												
513	4	30		3	14				22		18		19	3	20
514															5
523			6		3										
6122			3		26										
622															
722											2		4		
Total Acres	59	321	51	76	227	47	36	47	164	30	224	8	290	102	358

Table 11 (Continued)

Habitat Type	TWP 36N RNG 7E Section 16											
	18	17	DNR	Scott	20	21	15	10	2	11	14	Total
412			27	48			91	91				315
4121									12			23
413	51	3	10	18	3		51	18	38	125	290	689
414	7	11	8	3			118	296	274	89	13	869
422	30	24	9	86		4	12	6				586
423		62			19	10						223
431	6		30	5								407
432		79	4	74	6	32	57		19			541
433	81	47		7	3			9	17			357
441			23									23
451	23											137
4621												16
4622	2	7					3		1			47
4623	45											63
4632							24					24
4633								3	4			32
4711												22
4722												11
4731												3
4732												38
513	17	29	7	9			18	24	9			246
514												5
523												9
6122									7			36
622								3				3
722												6
Total Acres	262	262	118	250	31	46	374	450	381	214	303	4,731

[1] See classification scheme for habitat type translation, Appendix A.
[2] Unless otherwise noted, all land is Scott Paper Company.

others will be relatively shallow with no clearing prior to flooding. Construction of these ponds, together with the added benefits to the area around them within a quarter-mile, will replace 11,008 HUs lost (Appendix G). Specifics of pond construction for each site will be developed by the implementation team. Figure 3A and 3B shows location of ponds on the S.F. Nooksack.

Table 12. S.F. Nooksack River Pond Development Habitat Types Acres by Location

Location SEC.	TWP	RNG	Habitat Type 413	422	423	431	432	433	451	Total
20	36N	6E 1				2.6				2.6
		2			2.0					2.0
22	36N	6E							2	2.0
14+23	36N	6E							3	3.0
16	36N	7E 1					4.5			4.5
		2	2	4						6.0
18	36N	7E						6		6.0
15	36N	7E 1					1.2			1.2
		2					2.1			2.1
		3					1.0			1.0
21	36N	6E		2.5			.5			3.0
Total Acres			2.0	6.5	2.0	2.6	9.3	6.0	5.0	33.4

Acres of land with increased habitat value due to ponds = 1,036.

Preservation of old-growth and mature conifer and mixed forests is an important aspect of the S.F. Nooksack plan. Within the plan area approximately 1,490 acres of forest, pond and swamp are recommended for preserving (Figure 3A and 3B, Table 13). Setting aside the old-growth and mature forests in the S.F. Nooksack will protect them from imminent destruction, thus replacing the old-growth lost in Ross basin. This action will result in saving 33,348 HUs lost in Ross basin (Appendix G).

Overstory removal in dense stands of conifer and broadleaf add diversity, edge and foraging areas that benefit many species of wildlife, within the S.F. Nooksack corridor. Approximately 704 acres (Table 14) located throughout the corridor are recommended for overstory removal habitat improvement (Figure 3A and 3B).

Table 13. S.F. Nooksack River Preservation Acres by Location and Habitat Type[1/]

Location	Habitat Type 4121	413	414	432	433	4622	4633	523	6122	Total
TWP 36N RNG 6E										
Sec. 17							1			1
Sec. 18							24			24
Sec. 19								6		6
Sec. 20								3	26	29
TWP 36N RNG 7E										
Sec. 2	12	38	274	19	17	1	4		7	372
Sec. 10		18	296	9				3		326
Sec. 11		125	89							214
Sec. 14		290	13							303
Sec. 15		51	118							169
Sec. 16 Scott		18	3		7					28
DNR		10	8							18
Total Acres	12	550	801	28	24	1	29	12	33	1,490

[1/] Unless otherwise noted, areas are Scott Paper Company lands.

Table 14. S.F. Nooksack River Overstory Removal Acres by Location and Habitat Type[1/]

Location			Habitat Type 412	422	423	432	Total
TWP 36N RNG 6E							
Sec. 13				51		10	61
Sec. 14	1			20			20
	2			23			23
	3		17	4			21
	4		13	1.5			14.5
Sec. 16				12		8	20
Sec. 21	1	Scott		7		25	32
		DNR		33		3	36
		Judy		7			7
	2	Scott		8			8
		Nelson		11		2	13
Sec. 22	1			68			68
	2					16	16
	3		2	24		14	40
Sec. 23				1.5			1.5
TWP 36N RNG 7E							
Sec. 10			57				57
Sec. 15	1		39				39
	2		45				45
Sec. 16	1	Scott	12				12
	2	DNR	1.7				1.7
	3	DNR			27	24	51
	4	DNR	33	3		6	42
Sec. 17				3	36		39
Sec. 21					9	27	36
Total Acres			219.7	277	86	121	703.7

[1/] Unless otherwise noted, areas are Scott Paper Company land.

Overstory removal in the S.F. Nooksack will replace approximately 17,423 HUs lost (Appendix G).

Streamside management along several short stretches of the S.F. Nooksack will provide 141 HUs lost (Appendix G). While this may not seem important, reestablishing streamside vegetation in areas where logging was conducted up to the shoreline is very important for maintaining water temperature regimes and nutrient sources in the river for aquatic

wildlife, as well as providing wildlife habitat for terrestrial species. Figure 3A and 3B show where streamside management is recommended.

If these measures are carried out, compensation in the S.F. Nooksack will account for approximately 61,924 HUs lost in Ross basin, or just under half the losses.

Upper Skagit River - Two areas are included in the upper Skagit. These include SCL lands within RLNRA and some of the RLNRA land near Diablo Dam. There are two units of SCL land, totaling 247 acres. Both have pole stage to mature broadleaf forests on relatively flat floodplain adjacent to the river as well as pole stage conifer on the steeper (20-60+% slope) hill sides above the river. The river bottom areas have well-developed shrub understories providing good habitat. The pole stage conifer on the slopes have closed canopies with poor understory development. Aspect is southeast. Table 15 shows habitat types and impacts of management schemes for SCL land.

Management schemes for the SCL land include overstory removal and pond construction. Figure 4 shows the location of these management measures.

Two ponds will create approximately 14 acres of wetland habitat with an HU value of 413 plus an additional 2,230 HUs for the increased value of surrounding habitats due to the presence of ponds (Appendix G). One pond would require dredging and the other simply damming the low end of a high water slough and tying into the river at the upper end as a source of water.

Overstory removal is recommended on 107 acres of immature, pole stage and mature conifer, broadleaf and mixed forests.

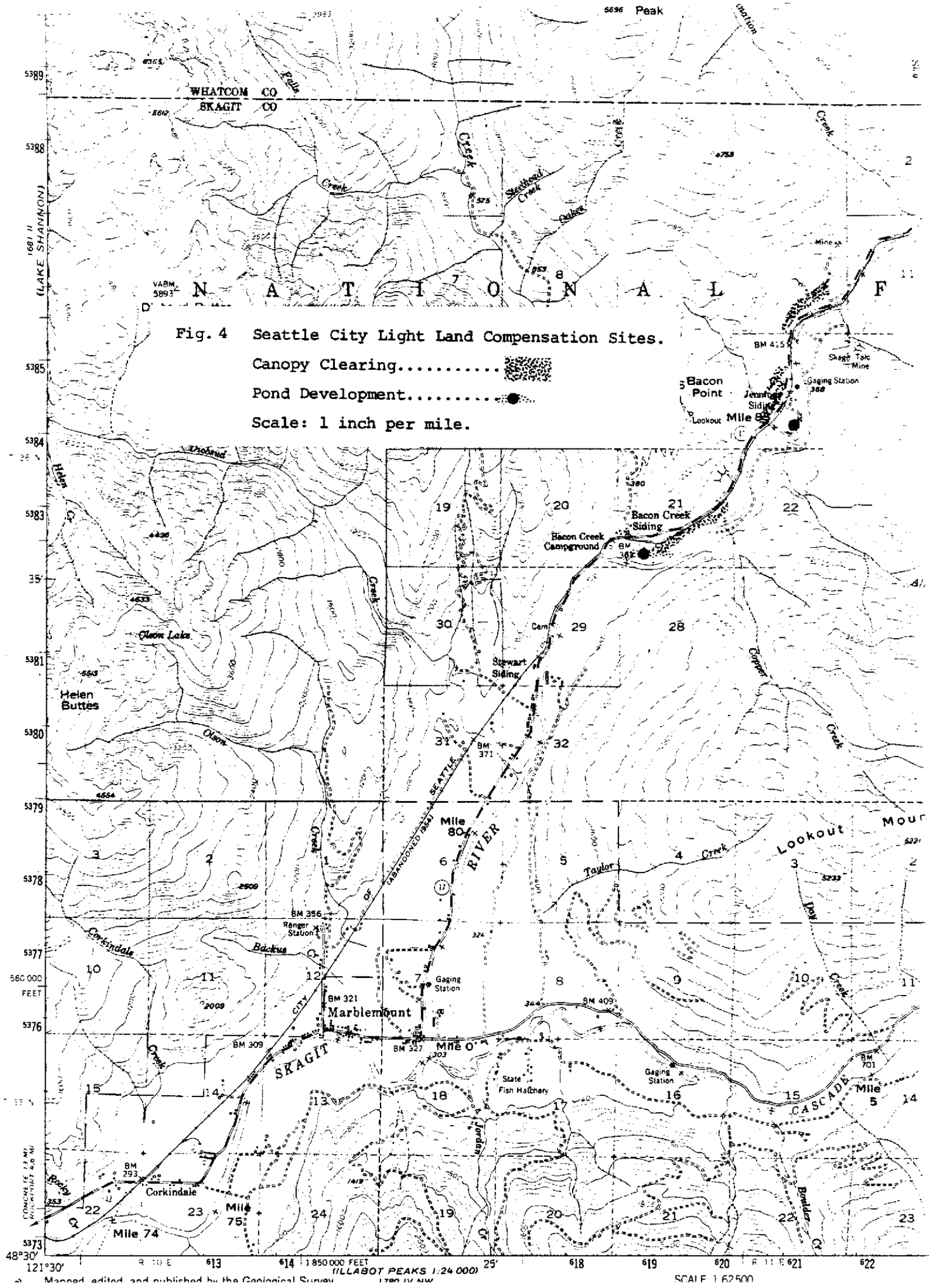


Fig. 4 Seattle City Light Land Compensation Sites.

Canopy Clearing.....

Pond Development.....

Scale: 1 inch per mile.

Table 15. Seattle City Light Land Habitat Types and Management Recommendations

Acres by habitat type

Area	Habitat Type 321	412	421	422	423	432	433	4622	4623	4632	4633	712	Total
Unit 1	2	12	6		35		3		34		30		122
Unit 2 and 3		10		39	18	4	3	19		5	24	3	125
Total Acres	2	22	6	39	53	4	6	19	34	5	54	3	247

Seattle City Light Land, Pond Development Acres by Habitat Type Lost

Area	Habitat Type 423	4622	4623	4633	Total
Unit 1	3		1	5	9
Unit 2		5			5
Total Acres	3	5	1	5	14

A total of 223 acres will be improved with pond construction.

Seattle City Light Land Acres by Habitat Type Improved by Overstory Removal

Area	Habitat Type 412	421	422	423	432	433	Total
Unit 1		6		31		3	40
Unit 2			22	11			33
Unit 3	5		13		16		34
Total Acres	5	6	35	42	16	3	107

For the most part, the rest of RLNRA below Ross Dam is too steep and inaccessible to consider for compensation measures. However, around Diablo Lake are several areas where overstory removal in dense lodgepole pine can be accomplished with relative ease and with positive results (Figure 5). Approximately 156 acres are recommended for overstory removal resulting in a net gain of 3,292 HUs (Appendix G).

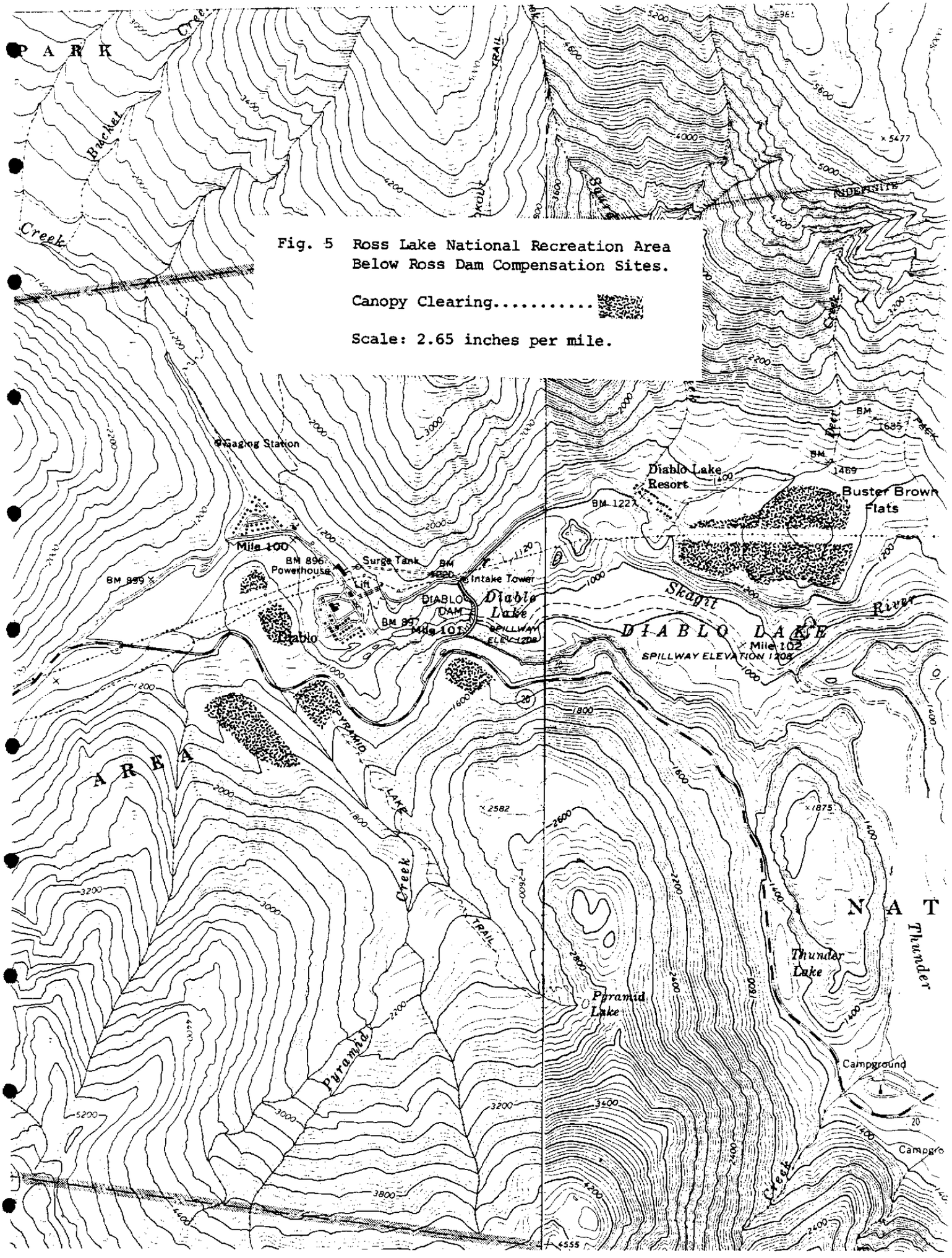


Fig. 5 Ross Lake National Recreation Area Below Ross Dam Compensation Sites.

Canopy Clearing.....

Scale: 2.65 inches per mile.

Table 16. Ross Lake National Recreation Area Below Ross Dam Overstory Removal Acres by Habitat Type

Unit	Habitat Type 412	441	Total Acres
1	3.5		3.5
2	12.5		12.5
3	12		12.0
4	21	14	35.0
5	14		14.0
6	57		57.0
7	36		36.0
Total Acres	156	14	170.0

Twisp River - Six miles upstream from Twisp, Washington on the Twisp River is approximately 438 acres of private land scheduled for development by Walsh Real Estate Company, Twisp, Washington. The area is dissected by two draws (Myers Creek and an intermittant creek) separated by a low ridge. Aspect is generally southerly with east and west facing slopes on the ridge. The draws are dominated by ponderosa pine (Pinus ponderosa), Douglas-fir (Pseudotsuga menziezii), aspen (Populus tremuloides) and a variety of shrubs. The slopes are dominated by bitterbrush (Purshia tridentata), other shrubs, forbs and grasses. Table 17 shows acres by habitat types.

While visiting the site an impressive array of birds were sited in a relatively short period of time, indicating its value as wildlife habitat. This parcel will help satisfy the in-kind compensation requirement for eastern Washington habitat types lost along the northeast side of Ross Basin.

Management recommendation for this area is simply preservation. Because it is scheduled to be developed, wildlife habitat losses will be significant. Approximately 7,094 HUs will be gained if this property is purchased and held for wildlife habitat (Appendix G).

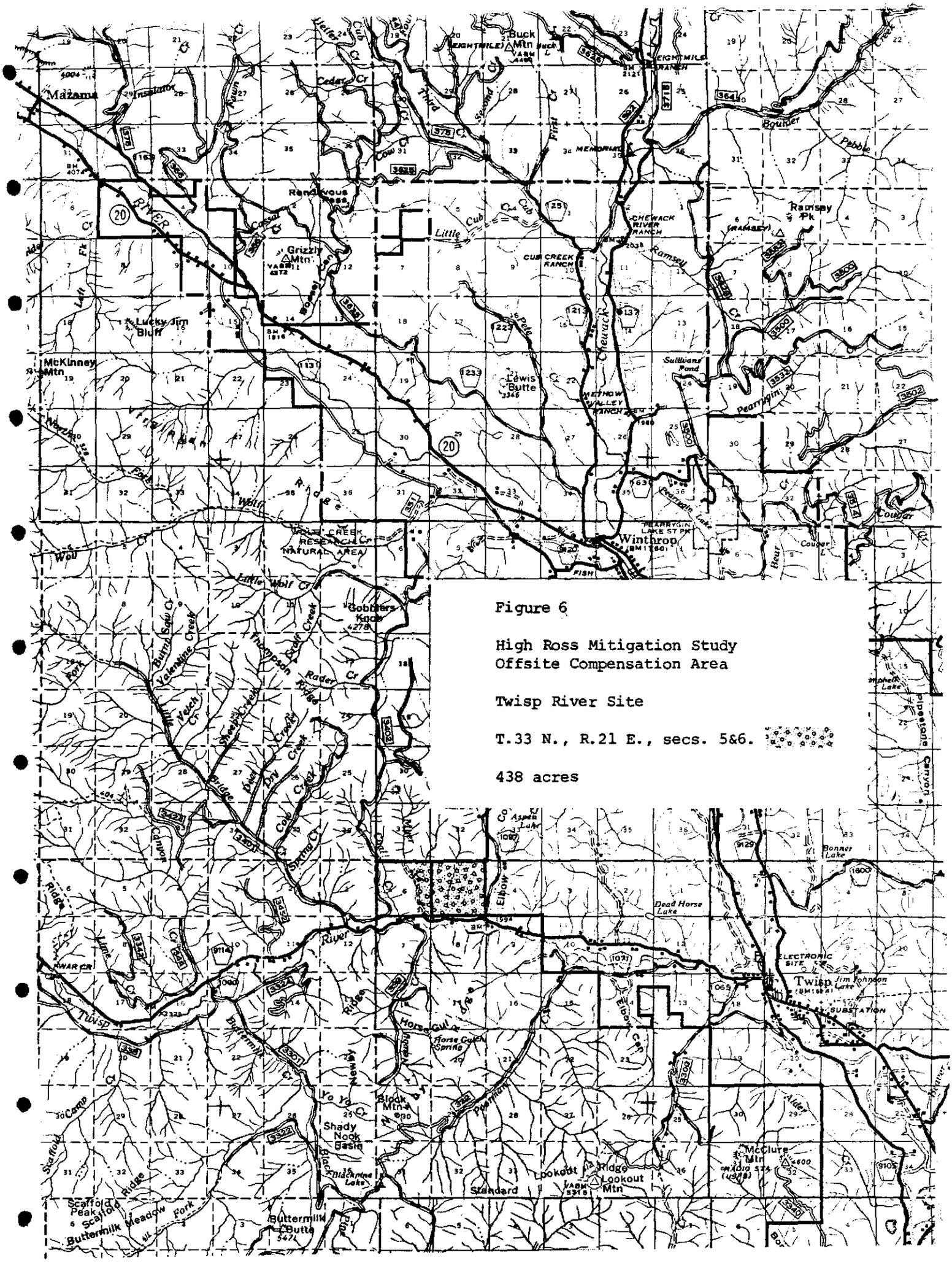


Figure 6

High Ross Mitigation Study
Offsite Compensation Area

Twisp River Site

T.33 N., R.21 E., secs. 5&6.

438 acres

Table 17. Twisp River (Myer Creek) Area, Walsh Real Estate Company Secs. 5 and 6, T 33N, R 21E, Acres by Habitat Type

Habitat Type	321	325	415	416	422	4632	Total
Acres	6	341	60	38	16	16	477

Seattle City Light Powerline Rights of Way (ROW) - Beginning at Ross Dam and continuing down the Skagit River to the confluence of the Sauk and then south up the Sauk to Darrington is a ROW corridor that varies in width from 200 to 300 feet. The ROW traverses rough terrain at first, especially in the Skagit Canyon between Ross and Gorge Dams. As the valley widens, the terrain becomes more gentle until some of the powerline cuts across open farm fields.

Vegetation on the ROW varies from grass to reproduction conifer. Some shrub development occurs but due to herbicial treatments in the past, shrub development is minimal at this time.

The possibilities for management of the ROW for wildlife habitat is extensive. Research indicates that much can be done to maximize use by wildlife while reducing risk to the transmission lines if certain plant species were selected for and encouraged by various management practices. Certain plant species that are important for food and cover are well adapted to ROW corridors (Taber 1977). The fact that a number of streams cross the ROW suggests excellent opportunities for wetland development as well.

Since the ROW covers a wide range of soil types from loams to bedrock, a specific plan for ROW development requires an intensive look at each mile of the corridor. Some areas may best be left alone while

others could be vastly improved. Access, slope, aspect, soil conditions and moisture regimes will dictate how the ROW can best be managed.

At this point, recommendations for ROW management consist of encouraging no risk (trees not tall enough to endanger the lines) shrubs and tree growth intermingled with grass and forb meadows. The arrangement would be to have the tallest species to the outside. Areas suitable to wetlands should be so developed.

A complete plan will be formulated by the implementation team following careful examination of the ROW and determining from the literature which management options are best suited to each condition found along the ROW. It is estimated that habitat values can be raised 10.1 HUs (Appendix G) per acre for the entire ROW corridor between Ross Dam and Darrington. With careful planning this may be exceeded.

5.2 Alternative Options for Off-Site Compensation

In the preparation of the mitigation and compensation plan, a number of off-site areas were considered. Some of the areas not included in the plan were studied in detail. Each of these and other ideas not fully explored could serve as alternative options if the plan is not accepted. If any portion of the plan is rejected, then the replacement option should contain similar habitat types as those rejected.

5.2.1 Descriptions of Alternative Off-Site Compensation Areas

Cascade River - Two sites were considered in the Cascade River drainage. One would require purchase or trade and the other would involve a management agreement with the DNR. The land requiring purchase or trade is owned by Publishers Forest Products Company, a willing seller.

The Publishers Forest Products parcel occupies wet floodplain and steep forested slopes along the Cascade River beginning at the mouth of Marble Creek and extending upstream past the next USFS bridge across the Cascade River. At the time of HEP evaluation, a portion of area had been clearcut and the rest was in old-growth forest and mature broadleaf and mixed mature broadleaf and conifer forests. At the time of this writing, however, the old-growth forest and part of the bottomland broadleaf and mixed forest are being logged. Thus the HEP results and cover type information presented in this report regarding Publishers Forest Products are not necessarily accurate on all the area, especially as far as the number of acres of each habitat type is concerned. Since logging will continue through the fall of 1981, there is no way to present at this time an accurate description of this parcel.

Habitat management recommendations for this parcel includes pond construction and overstory removal of second-growth that will come in following the clearcutting. The value of this property as wildlife habitat, even though much if not all of the old-growth forest has been or will be removed, is still quite high. A new HEP to determine the full potential of HU gains from intensive management of the new conditions will have to be conducted. Its value as a site for preserving old-growth in close proximity to wetlands and a stream has been lost, however, the potential for creating other needed wildlife habitat is still there.

Table 18 shows habitat types and management recommendations for Publishers Forest Products Company land. Figure 7 shows location of parcels.

Table 18. Acres by Habitat Type and Management Techniques for Publishers Forest Products Land on the Cascade River

Habitat Type	Sections in T 35N R 12E 7	8	15	16	21	28	Total
413		13					13
414[1/]	12	54		86	6	9	167
421	9			1			10
451					49	39	88
4621				4			4
4622				12	4	1	17
4623		12	4	21	7	4	48
4633		8	19	23		4	54
513						12	12
611		3		3			6
621					4		4
622		1					1
7132				3			3
Total	21	91	23	153	70	69	427

[1/] 414 expected to be logged in fall of 1981.

Management Techniques

Pond Construction

Locations	Habitat Types 4622	4623	611	621	451	Total
Section 16	8	10	2			21
21				4		4
28					4	4
Total	8	10	2	4	4	29

Acres improved by pond construction 387

Overstory Removal[2/]

Location	Habitat Type 451
Section 21	49
28	35
Total Acres	84

[2/] Overstory removal will occur after planted trees in clearcuts have grown to closed canopy.

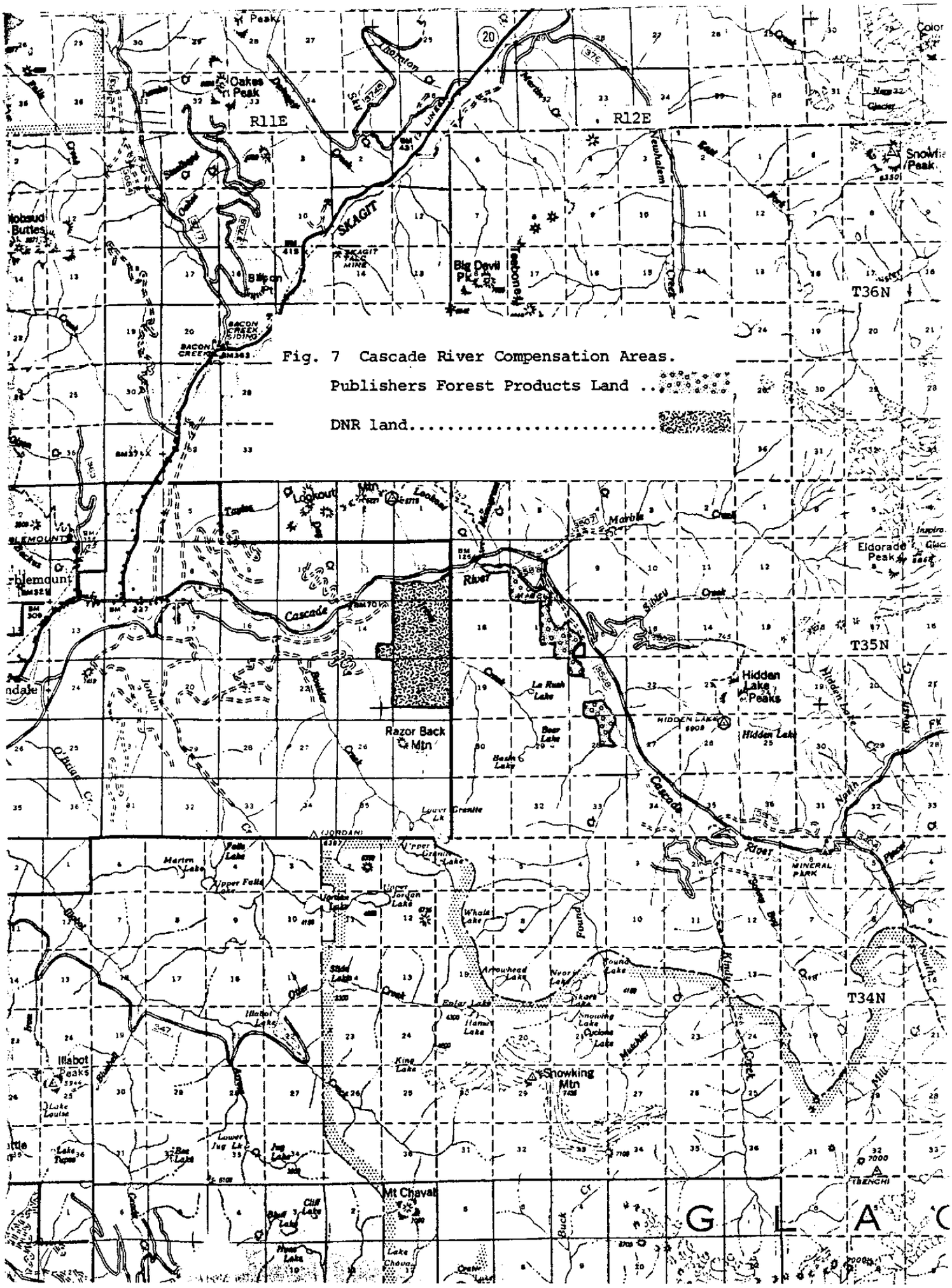


Fig. 7 Cascade River Compensation Areas.

The DNR land on the Cascade is located on the south side of the river five miles east of Marblemount on approximately 992 acres of rolling to steep hillside.

Cover types on this site include old-growth, mature and pole stage conifer. A stream transects a portion of the parcel providing additional habitat for some wildlife species.

Management recommendations for this parcel are preservation of old-growth and overstory removal in second-growth. Figure 7 shows location of this parcel.

Table 19. DNR Protection and Overstory Removal[1/] Acres by Habitat Types by Section in T 35N R 11E

Location	Habitat Type 412	413	414	441	4613	7131	Total
Section 12	22(18)	80	71		13	4	190
13	129(62)	207	146	4	40	13	539
14			27				27
24		64	92				156
Total	151(80)	351	336	4	53	17	912

[1/] Overstory removal acres in parentheses.

Toats Coulee - Located two miles northwest of Loomis, Okanogan County, Washington, Toats Creek cuts through rugged hills before breaking out onto a broad valley bottom south of Palmer Lake. The steep hillsides support ponderosa pine, Douglas-fir and lodgepole pine, shrubs, forbs and grasses. Bitterbrush and sage brush (Artamissia sp.) occupy benches at lower elevations.

Forest communities are immature to mature conifers with rock outcrops and talis slopes interspersed. Riparian vegetation follows several creek draws including Toats Creek.

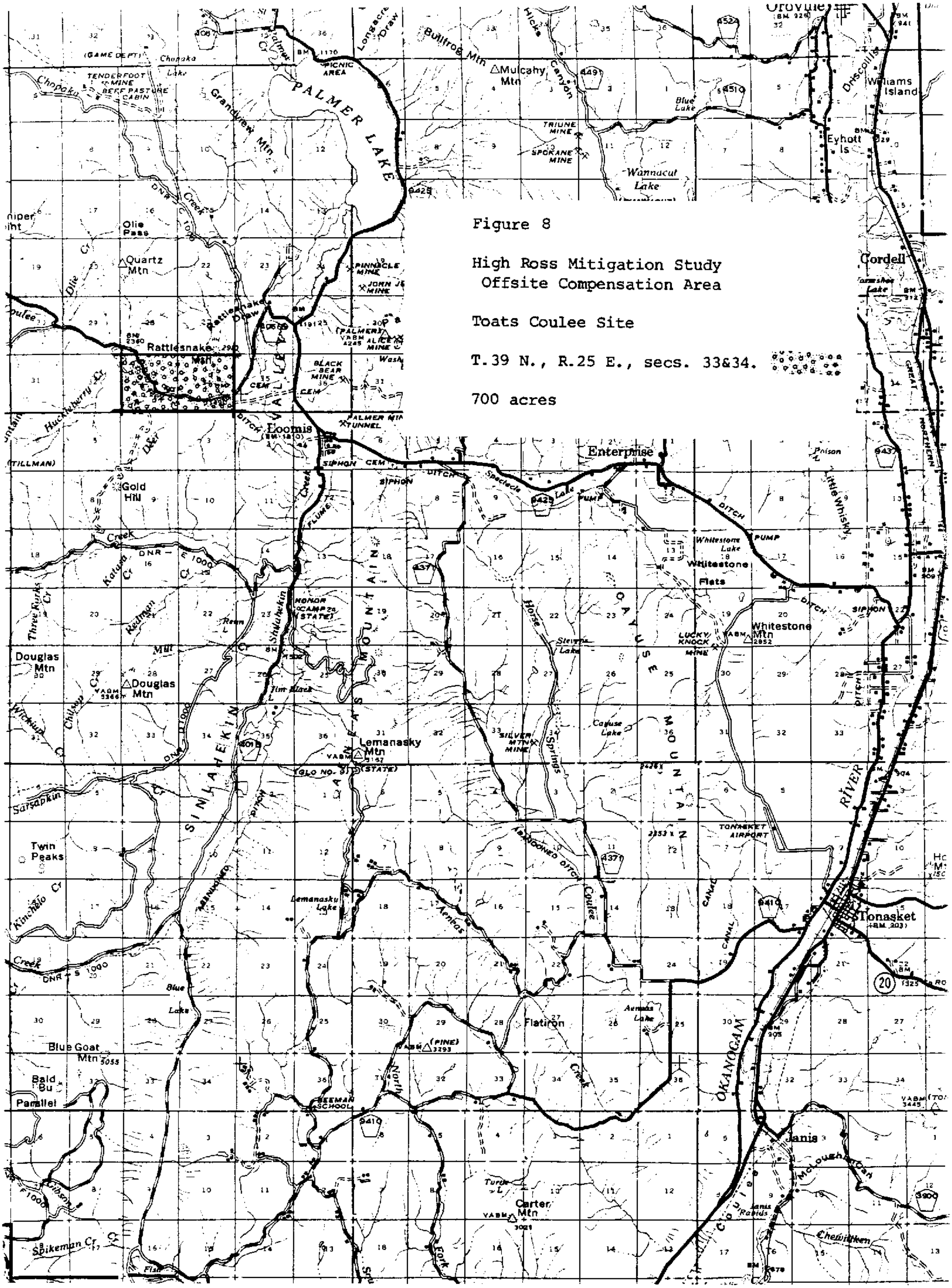


Figure 8

High Ross Mitigation Study
Offsite Compensation Area

Toats Coulee Site

T.39 N., R.25 E., secs. 33&34.

700 acres

Part of the area is being sold in lots by a real estate firm, thus, encouraging development which would destroy existing wildlife habitat. Overgrazing by cattle has reduced wildlife habitat value in some areas, presenting an opportunity to improve wildlife habitat values through management. Figure 8 shows location of Toats Coulee parcel.

Other DNR Old-Growth - Besides the old-growth mentioned above, three other DNR parcels with sizeable stands of old-growth have been located. These stands have been examined in aerial photos only.

In Sec. 36 T 35N R 10E is a stand of old-growth covering approximately 427 acres. O'Brien Creek rises from the center of the stand. A large block of U.S. Forest Service old-growth lies just to the south. The other three sides have been logged, one side fairly recently. Aspect is NNE and NNW on steep slopes (20% to 60%+), at 2,000 foot to 4,200 foot elevation.

A second parcel is located in Sec. 6 T 36N R 8E. The parcel lies just south of U.S. Forest Service boundary and two miles east of the S.F. Nooksack River area recommended for management in the mitigation plan. Old-growth forests surround this parcel.

The old-growth (approximately 456 acres) in this parcel occupies a hanging valley (elevation 3,400 feet) below Washington Monument, and extends upslope to 4,500 feet elevation. A stream with riparian vegetation winds through a portion of the stand before plummeting to the Wanlick Creek Valley. Talis slides, and open meadow types break up the continuity of the old-growth forest.

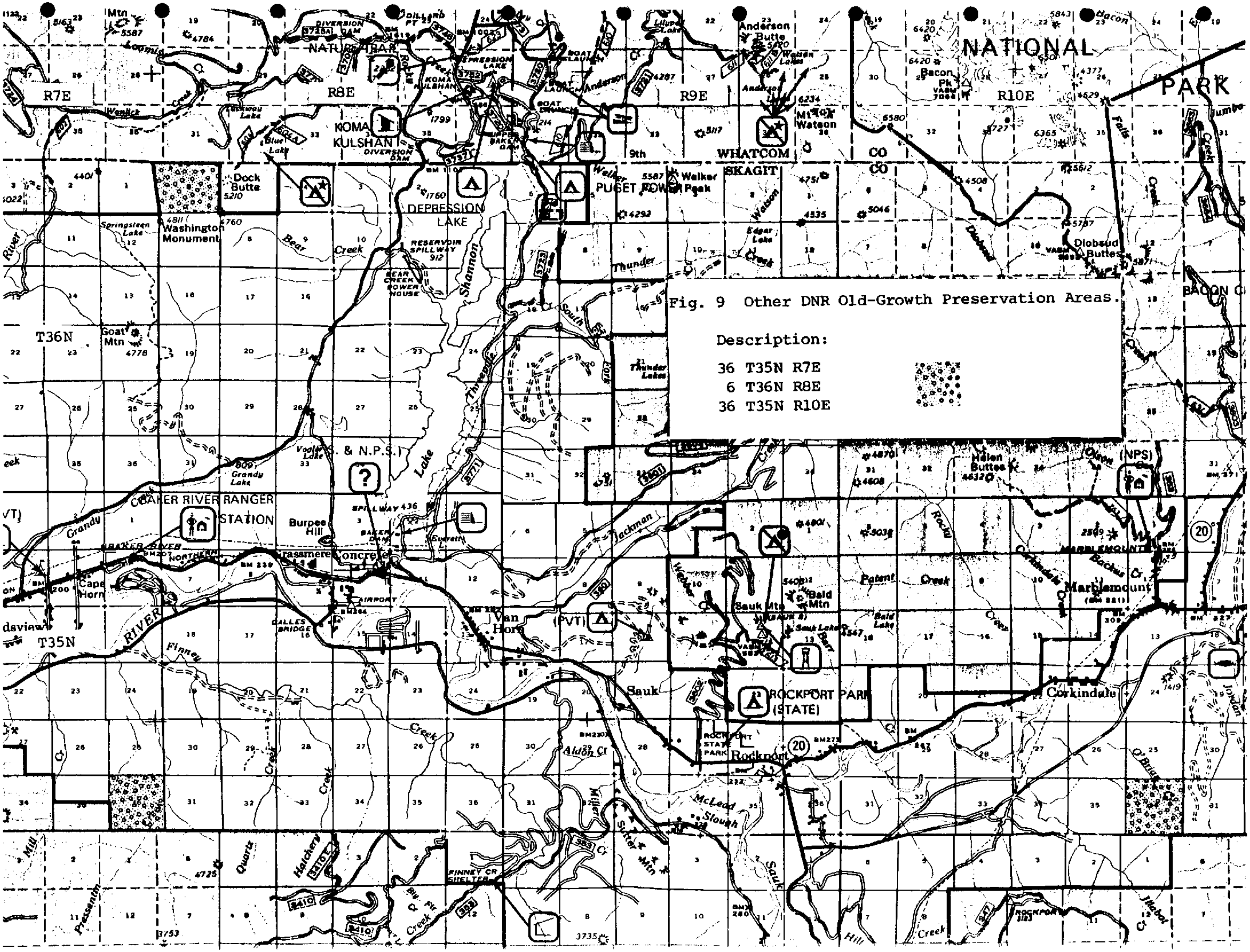


Fig. 9 Other DNR Old-Growth Preservation Areas.

Description:

36 T35N R7E
6 T36N R8E
36 T35N R10E

Table 20. Alternative DNR Land, Acres by Habitat Type

Sec.	TWP.	RNG.	Habitat Type 412	413	414	423	4614	4131	7131	7132	311	441	451	Total
36	35N	7E	135	195	290	3	17							640
6	36N	8E	35		456		24	42	16	14	12			599
36	35N	10E	170		428				3	9		8	22	640
Total Acres			340	195	1174	3	41	42	19	23	12	8	22	1879

The third parcel is in Sec. 36 T 35N R 7E on Pressentin Creek. Approximately 290 acres of old-growth and 195 acres of mature conifer cover steep slopes descending to Pressentin Creek. Logging has occurred on the north and east sides, but the remainder is contiguous with a large stand of old-growth and mature conifer. Elevation varies from 1,200 to 3,600 feet.

Table 20 shows acres by habitat types for each DNR alternative old-growth preservation site. Figure 9 shows location of each site.

A possible compensation option that has not been explored is the development of streamside management on the Cedar River watershed. Intensive timber removal has left long stretches of the upper Cedar River without protective riparian vegetation. A program of planting riparian vegetation (such as described in recommended mitigation and compensation plan) would benefit terrestrial as well as aquatic wildlife. Since the City of Seattle Water Department owns most of this stream and its tributaries, management agreements should be easily negotiated.

5.3 Habitat Evaluation of Mitigation Alternatives

HEP was again used to determine the net gain in habitat value resulting from compensation and enhancement alternatives. The general approach was to subtract the average HSI value of the habitat type or

types through 50 years, if no habitat treatment were applied, from the average HSI value of the habitat type or types through 50 years if the habitat treatment were implemented. The difference between these values is the average net HSI gain or loss. The net HSI multiplied by the number of acres to be treated within that habitat type equals the net number of HUs attributable to the treatment.

Assigning an average HSI to sites required estimating successional changes through 50 years, with or without treatment, assigning the HSI of each successional stage, and then averaging the product of the HSI of each stage and the number of years within each stage.

Certain compensation and enhancement alternatives required visualizing the results of the treatment through 50 years. All the habitat improvement treatments recommended in this report have been tried and proven to benefit wildlife, but, applying these treatments to other locations may change the magnitude of the value to wildlife. Therefore, assigning HSIs to the treated areas over time required a "best guess" of treatment results by Game Department biologists.

The HSI values assigned to treated and untreated areas along with the calcuations of net HSIs appear in Appendix I. Justification of assigned HSIs are included in the descriptions of the treatment (Section 5.4).

5.4 Habitat Improvement Specifications

Five habitat management strategies were chosen as the basis for the on-site mitigation and compensation plan. The five strategies consist of seven feasible management measures (Table 8, No. 1 through 7). Each strategy contains provisions for monitoring and maintenance during and after construction.

5.4.1 Overstory Removal In and Adjacent to Deer Winter Ranges

Overstory removal is the cutting of trees which allows better light penetration to shrubs. The primary purposes of clearing are improvement of deer browse (shrub) growth in and adjacent to traditional deer winter ranges and increasing the interspersion of habitats. Clearing will create openings and paths in pole stage and regenerating forest areas. For deer, the optimal proportion of openings (forage areas) to forest areas (thermal and hiding cover) in winter ranges is about 50:50 (Thomas 1979).

High Ross will flood approximately one-third of the present deer winter range, or 700 acres (Gordon 1975). This represents about 30,000 Habitat Units, using the average HU value of habitat in deer winter ranges. Because amount of winter range probably limits Ross basin deer populations, deer numbers are expected to decline proportionately (Taber 1972, 1976).

Clearing would benefit wildlife species other than deer. Of the evaluation species (besides deer), black bear, ruffed grouse, snowshoe hare, cougar, and northern alligator lizard would also benefit. Therefore, there would be a net gain in Habitat Units over many existing habitat types in deer winter ranges.

Deer winter ranges in Ross basin are either in shrub or mature forest areas. Shrub areas, however, contain regenerating and pole stage forest habitat types. Studies of major deer winter ranges (Taber 1972) showed that trees will overtake and shade most shrub areas within 20 years. Closure of the canopy by trees will greatly reduce shrub production, and therefore, reduce browse for deer. The number of habitat units in shrub areas can be increased by removing some trees. There is

not much that can be done to improve winter range in mature forest without degrading it for other wildlife species, therefore there are no net gains in HUs by modifying mature forest types.

Thinning trees in stands with closed canopies stimulates understory growth if at least 25-30% of the trees are removed. Dealy (1975) reported that nine years after thinning a 47-year-old lodgepole pine forest in Central Washington, the understory was producing 300 to 1000% more browse. Clearing will create high browse biomass for 20-25 year periods. Clearing should be repeated at this interval.

Thomas (1979) reported the results of research on deer winter range use in the Blue Mountains. Optimal size of thermal cover in the Blue Mountains was found to be 2-5 acres, at least 300 feet wide. Cover adjacent to wet meadows and streams is used most heavily. For maximum use by deer, forage areas should have no point farther than 600 feet from the edge of cover. Circular forage areas can be up to 1200 ft. wide (26 acres). Heavy slash accumulation in forage areas will limit shrub production, so some slash should be piled and the rest piled and burned or removed.

Traditional deer winter range areas identified by Taber (1972) were evaluated for management potential. Taber (1976) found that Ross basin deer select fairly small, well-defined winter range areas. Therefore, winter range improvement was confined to areas within and adjacent to winter ranges identified by Taber. Extensive areas within and adjacent to major and minor winter ranges can be improved for deer and other wildlife by creating a mosaic of openings and forested areas. There are certain habitat types whose Habitat Unit values would show a net increase after clearing. These habitat types are Shrub, Regenerating Conifer,

Pole Stage Conifer, Regenerating Mixed and Pole Stage Mixed. Creating a mixture of forage and cover would result in higher net HUs than extensive areas of these habitats alone.

On the basis of field evaluation, findings by Taber (1972, 1976), and examination of habitat type maps, a total of 1557 acres, between 1725 and 2500 ft. el., were identified that could be modified to create clearings. The resulting net Habitat Unit gain is 30,786 HUs. Canopy removal areas in Ross basin are shown in Figure 2.

The following recommendations should be applied to clearings:

1. A field crew of wildlife biologists should prescribe boundaries of forage and cover areas, and mark trees for clearing;
2. Individual openings should be no wider than 1200 ft.;
3. Cover areas should be at least 300 ft. wide;
4. Proportion of openings to cover should be about 50:50;
5. Cuts should be in irregular patches and strips;
6. Cover should be left adjacent to streams and wet areas to maximize use;
7. Slash should be piled within the clearings;
8. Cutting can be coordinated with reservoir clearing;
9. Repeat thinning at 20-25 year intervals;
10. Wildlife biologists should monitor and evaluate wildlife populations and habitat use of clearings each year for the first three years of the project beginning the year prior to reservoir clearing and every 10th year for the life of the project. Assessments of the success of clearings should be made and corrective measures implemented, if needed.

5.4.2 Pond/Marsh Construction

Loss of pond and marsh habitat types in Big Beaver valley can be partially offset by creating these types at suitable lake shoreline sites.

Several sources reviewed pond and marsh construction as a mitigation measure. Slaney (1973) recommended that a series of terraces surround small creek mouths, in the drawdown area. Ponds created by the terraces should be shallow, with adequate water supply (via creek seepage) to maintain the ponds throughout fall, winter, and spring months. During these months, reservoir pool level would be below the level of the ponds. The terraces create settling ponds for silt.

Some plant species survived better than others on berms and shorelines of their pond (Slaney 1973). Transplanted rushes were most successful. Clovers (seeded) acted as excellent soil-binders on the tops of terraces. Several aquatic species volunteered. Willow and cottonwood were two woody species that rooted successfully. Some plantings of red-osier dogwood succeeded. Seeded meadow foxtail, orchardgrass, and timothy also did well on terraces.

Several others have reported on wetland construction. The Army Corps of Engineers in the Dickey-Lincoln Mitigation Plan (1980) recommended some additional measures. To counteract wave erosion of dikes, the Corps proposed floating log booms around the perimeter of the dike. The Corps also recommended dikes in the stream (water source), designed and constructed to catch and fan out water into the pond, and to prevent soil erosion.

Nelson et al. (1978) reviewed construction, effectiveness, and cost of wetland ponds. They recommended the use of bentonite (a non-porous

clay) to seal the bottom of the pond, if other methods do not work. The ponds they reviewed were constructed either by blasting or bulldozing. Cost of constructing 4 ponds (totaling 50 acres) was $58,000 (1977 dollars), with an annual maintenance cost of $1,000.

Washington Department of Game biologists visited Slaney's experimental pond in August, 1979. Reed canary grass (Phalaris arundinacea) and a few woody plants were virtually the only vegetation remaining at the pond site. It was postulated that lack of incoming water in spring prevented aquatic plants from being permanently established.

With the aid of topographic maps and field checking, 17 suitable sites for pond/marsh construction have been identified. Sites with sources of incoming water were given priority. Since three of these sites are proposed campground relocation areas, 14 of the sites could be used for pond/marsh construction. Average size of ponds would be one acre. Creation of pond and marsh habitat types would raise wildlife values of adjacent upland habitat types. Total net gain from construction of 14 sites would be 16,812 HUs.

The following pond specifications are designed to minimize construction costs while maximizing benefit to wildlife on-site:

1. Because of steep slopes in the proposed drawdown area and wave action of the reservoir, pond/marsh sites are only feasible in shallow-gradient cove areas at the mouths of small streams. Such sites have been identified. Locating sites in coves, or draws, also provides relatively large pond sites while minimizing berm length;
2. A 2-6' high dike, constructed at high pool level, should be designed to catch and fan out streamflow into the pond;

3. A series of terraces, the number depends on the site, should be constructed between 1725' and about 1720'. The terraces will create continuous ponding between 1725' and 1720';
4. A floating log boom around the perimeter of the berm will minimize wave action and soil erosion;
5. Ponds should be excavated to about 10 feet to insure some water remains during drawdown. Sides of the pond should slope gently towards the center to maximize shallow water;
6. Clearing around the stream and pond/marsh shoreline should be monitored by biologists. Selected trees to become snags should be left in the drawdown. Vegetation to be left should be marked prior to reservoir clearing;
7. Willow, cottonwood, and red-osier dogwood cuttings should be planted on and around the berm;
8. Rushes and sedges should be transplanted from marsh areas that will be flooded;
9. Native clovers, grasses, and sedges should be seeded on and around the berm;
10. Islands should be created in the larger ponds to maximize waterfowl nesting habitat and other water-edge phenomena;
11. Success of pond/marsh construction should be monitored for the first three years of the mitigation plan implementation;
12. Annual maintenance will probably be necessary;
13. When using bentonite clay to seal pond bottoms, care should be taken to minimize the escape of clay to Ross Lake.

On off-site areas pond construction techniques will be dictated by site conditions. Dredging, small dam construction, dikes, or all three,

will be necessary. Areas on flat bottomland adjacent to the S.F. Nooksack and Skagit Rivers will be dredged, with the water source either from ground water or drawn from the rivers. Other pond sites on the S.F. Nooksack will require a simple dam with allowance for spillage over the top. Depending on available materials, dam construction may be by log crib and fill, or land fill with a concrete spillway. The same precautions as those mentioned for on-site, to protect the structures from flood damage, must be used here. Disturbance at each site should be kept to a minimum.

5.4.3 Drawdown Seeding

Seeding of areas exposed during drawdown would increase spring forage available to deer. While some areas currently "green-up" naturally, spring forage production can be increased in these and other areas by fertilizing and seeding with native grasses, forbs, sedges, and rushes.

Slaney (1973) studied the importance of areas exposed during drawdown to deer. Exposed areas, both in the U.S. and Canada, green up about two weeks earlier than meadows above high pool level. Slaney found that grasses, sedges, and forbs usually appear in these areas by the first week in April; sometimes by mid-March. It is during March and April that drawdown plants are eaten by deer. By May, deer in Canada spend 75% of their time in shrub areas.

Valley meadowlands in exposed areas near Lightning Creek were heavily used historically by deer for winter and spring range (Slaney 1973, Taber 1972). With inundation of these meadowlands by Ross Dam, spring deer forage in the form of meadows have largely been lost in the U.S. Various sources (Slaney 1973, Taber 1972) have hypothesized that

the partial migratory pattern of the U.S. deer to Canadian spring ranges is due to loss of spring range in the U.S. Slaney (1972) suggests that grasses, sedges, and forbs occurring naturally in the drawdowns are not required by deer in the spring. However, other studies have indicated that spring ranges are important (Harestad 1979). While spring ranges may not be required by deer, Slaney did find that grasses, sedges, and forbs have higher nutritive value than winter range browse, during early spring.

A total of 114 acres of drawdown are suitable for fertilizing and seeding for spring browse. Suitable sites are those having a gentle slope and a southern aspect, two factors promoting early spring growth. These areas green up to some extent each spring. Seeding and fertilizing would increase production for a net Habitat Unit gain of 1710 HUs.

Fertilizing of drawdown areas may cause algal blooms as water rises in spring and early summer. The extent to which this causes problems should be monitored and fertilizer application rates should be reduced to alleviate problems associated with algal blooms.

The following recommendations should direct the seeding of drawdown areas:

1. Vegetation native to the area should be used;
2. Seeds of grasses, seedges, rushes, and forbs native to the drawdown areas can be obtained on contract from local seed companies - one possible source is Abundant Life Seed Foundation, Port Townsend, Washington;
3. Seeds of plants native to the drawdown will be broadcast, at a rate to be determined (20 lb./acre);

4. Seeding should be timed for early green-up, in March and April;
5. Effectiveness of seeding should be monitored each year for the first three years of plan implementation, and every 10th year for the life of the project.

5.4.4 Retention of Snags

Many birds are dependent on snags for nesting, feeding and/or resting habitat. A snag is any dead or partially dead tree. Leaving some snags and living trees in the inundation zone will avoid loss of other snag habitat. To meet the requirements of snag-dependent wildlife, snags must be at least four inches in diameter at breast height and at least six feet tall (Thomas 1979). Snags change from hard to soft from the time the tree dies until final collapse. At each stage in the process the snag is valuable to some wildlife. Other conditions that affect their use are surrounding vegetation types and height and diameter of the snag. Coniferous trees preferred by woodpeckers are ponderosa pine and firs. Preferred broadleaf trees are cottonwood, aspen, and willow. Riparian and mixed conifer habitats have the highest number of tree cavity users according to Thomas (1979).

Snags and living trees left in the inundation zone near 1720 ft. el. during reservoir clearing can partially mitigate loss of this habitat. Living trees that are drowned make good snags. Swamp trees, for example, are killed by drowning and are heavily used by woodpeckers. Leaving existing snags in the drawdown would be first priority. Second priority are old-growth trees that may have heart rot setting in. Other trees will also be designated.

A total of 434 acres in the inundation zone, near shore, where snags and living trees could be left were located. This would result in a net

gain of 2,170 HUs. Snag retention areas are shown in Figure 2. Recommendations for snag retention are:

1. Snags and other trees to be left standing near shore below high pool be designated by biologists prior to reservoir clearing;
2. Snags should be left in clumps and singly;
3. Snags should be left near pond/marsh sites;
4. Use of snags by wildlife should be monitored for three years after implementation of the plan, and every 10th year for the life of the project;
5. Snags would not be left near proposed campground sites;
6. Snag retention areas should be off limits to boats or people use.

5.4.5 Shoreline And Streamside Planting

The planting of riparian and shrub species along the shoreline of the new high pool and along streambanks on off-site areas will have the greatest benefit to wildlife and high probability of success if the proper species are used and planting is properly timed. A mixture of species will have the greatest benefit to wildlife. These should include upland shrub such as wild rose (Rosa nutkana), ocean spray (Holidiscus discolor), red-stem dogwood (Cornus stolonifera), red elderberry (Sambucus racemosa), huckleberry (Vaccinium parvifolium or V. ovolifolium), and salal (Ganltheria shallon) and riparian trees and shrubs such as black cottonwood (Populus trichecarpa) and willow (Salix spp.). Planting should be during the plant dormant period although willow can be handled almost any time of year (Juelson 1980).

Although the planting of seeds or cuttings can be a successful method of establishing the desired shrubs and trees, the planting of rooted

stock will have the highest probability of successful establishment and in the long run will probably be the most economical (Juelson 1980).

Recommendations for shoreline and streamside planting are:

1. Rooted stock provided by a commercial nursery should be used;
2. Planting should be done in late fall, winter, and early spring;
3. Species to be used include wild rose, ocean spray, red-stem dogwood, elderberry, huckleberry, black cottonwood, and willow; (Note: arrangements for rooted stock should be made with nurserymen one year in advance.)
4. Planting along shore should form a ten-foot band on just those soils which are well deveoped (excluding rock shorelines);
5. At least one-third of the new shoreline (or 32 miles) should be planted;
6. Red-stem dogwood and willow should be planted in 16 locations between high and low pool. The 16 locations should be such that there are four in each cardinal direction (N, S, E, W), two of which are 0-30% slope and two 30-60% slope. The strips can be irregularly shaped but average 25 feet in width. The plantings on 0-30% slopes will average .22 acres, while the plantings on 30-60% slopes will average .08 acres;
7. Plant density should approximatly one shrub per eight square feet within the ten-foot band.

5.4.6 Powerline Rights-Of-Way Rehabilitation

Powerline rights-of-way (ROW) may or may not have potential for significant improvement for wildlife depending on existing conditions. Those areas of the ROW dominated by one species of shrub or tree, to the exclusion of almost all others, can be made more productive for wildlife

and support a greater number of species by interspersing other species of shrubs. Some portions of the ROWs already have desirable species well interspersed and it would be difficult to improve these for wildlife.

No single management technique is applicable to all the various ROW vegatation types within RLNRA, the Skagit Valley, and the Sauk River Valley. It will be necessary for the mitigation implementation team to develop strageties for those portions of the ROW corridor that can be significantly improved for wildlife. In general, though, all risk trees should be removed and replaced by no risk trees and shrubs. Shrubs selected for planting should be well suited to the site conditions. Rooted stock will have the best chance of survival compared to seeds or cuttings. Rooted stock of desired species can be supplied by nurserymen and must be arranged at least one year in advance. In some instances only tree removal will be necessary because sufficient numbers of shrubs exist on-site to fill in behind the trees.

ROW rehabilitation may require intensive management through the first few years to insure successful establishment of shrubs and to remove undesirable species. Annual maintenance time will decrease as established shrubs inhibit the establishment of undesirable species.

5.5 Costs of Mitigation and Compensation

5.1.1 Introduction

In this section, costs for implementing the plan will be outlined. The estimates given are based on communications with experts in the field. In some cases, several experts were questioned about the same measure and both estimates are given, providing a range of costs.

The reader is cautioned that the costs listed are average costs for doing similar projects under similar conditions. However, every project has its own problems affecting costs and, at this stage of development, all the variables that will effect the cost are not known. Some of the variables which will effect costs and that are not known are the following:

1. When will plan be implemented;
2. Who will lease and purchase lands (SCL, WDG);
3. Who will contract the work;
4. Cost of leasing land;
5. Costs of planning and engineering some of the measures (i.e., ponds).

These and other variables fall outside the scope of this study.

Estimates are given in 1980 and 1981 dollars, not including interest or contingency costs.

5.5.2 Costs of Planning Mitigation and Compensation Measures

As outlined in the implementation plan (Section 7), there are two activities occurring at the start of project implementation. The first is the acquisition of land. The second is planning the field work for the various measures. Other than stating the necessity of making purchases and management agreements rapidly, there is no recommended plan for carrying out the first activity, this being the domain of SCL. The second activity is outlined in more detail, especially to the kind of people necessary to successful planning. The cost for this phase of implementation will vary depending on who does the work. For the purposes of this report, cost estimates for salaries of the professionals required to carry out the work are based on state salary scales at

middle range. Table 21 shows estimated cost for the first phase of implementation.

Table 21. Estimated Cost for First Phase of Implementation

Position	Salary/Month	Time (Month)	Cost
Lands Agent	$1,900	1	$ 1,900
Administrator	2,188	4	8,752
Wildlife Biologist 2	1,887	4	7,548
Forester 2	2,082	4	8,328
Engineer	2,357	4	7,548
Clerk-Typist	1,123	4	4,492
Total			$47,996

Additional cost for office space, equipment and supplies are not included in Phase 1 cost estimates.

5.5.3 Cost of On-Site Mitigation and Compensation

The following cost estimates are for mitigation and compensation measures on-site, behind Ross Dam. The estimates assume that implementation of the various measures will occur concomitant with dam construction and land clearing operations, thus affording use of equipment already on site.

Table 22 shows estimated costs for the various activities required to implement the recommended measures. Below is a brief description of the activities considered in estimating the costs of each measure.

Overstory removal costs - A description of the 1,500 acre overstory removal proposal, of which 750 acres would be cleared, was given to foresters in both the Washington Department of Natural Resources (DNR) and the Mount Baker/Snoqualmie National Forest Supervisors Office (USFS). Their estimates were developed by foresters familiar with the Ross basin area. Costs cover both planning and design of a timber harvest system,

cutting, yarding and slash removal of pole stage and immature trees. It was assumed that logs would be transported and delivered to a mill along with logs from reservoir clearing. USFS estimates for cutting, yarding, and slash removal are average for the upper Skagit River area. DNR estimates assume that cable logging is done from a raft on the reservoir (except Big Beaver Valley). Timber harvest specifications suggested by USFS include full suspension of logs, no tree-link yarding and flush-cutting of stumps.

Costs for precutting and postcutting activities do not include transportation, equipment or administrative expenditures. Estimated costs are based on salaries for a consultant forestry firm, Wildlife Biologist, Plant Ecologist and Fish and Game Technical Aides.

Pond/Marsh construction - Preliminary cost estimates for pond/marsh construction on-site are based on estimates obtained from Ivon Lines of the Soil Conservation Service, Spokane, Washington. Preliminary costs for seeding, transplanting and monitoring are WDG estimates.

Cost estimates are for construction of 14 ponds on the perimeter of Ross Lake by a contractor, planning by an Engineer and Wildlife Biologist, and monitoring by a Wildlife Biologist, Plant Ecologist and Fish and Game Technical Aides. Costs do not include transportation, equipment or administrative expenditures.

Drawdown seeding - Cost for drawdown seeding are based on WDG estimates, including identifying plant species in vicinity of drawdown area, obtaining seed, broadcast and monitoring. A Wildlife Biologist, Plant Ecologist and Fish and Game Technical Aides would carry out the work. Costs do not include transportation, equipment or administrative expenditures.

Snag retention - Cost for snag retention was estimated by WDG. Costs include salaries for a Forester, two Wildlife Biologists and two Fish and Game Technical Aides. Time for planning, marking areas and trees, and monitoring results were considered. Cost for transportation, equipment and administration are not included.

Shoreline planting - Costs for shoreline planting are based on interviews with people associated with similar projects. One project in particular seems most comparable to the Ross Lake situation. The Army Corps of Engineers estimated costs to implement a mitigation and compensation proposal for impacts resulting from raising Chief Joseph Dam on the Columbia River by 10 feet. Included in the plan is planting a variety of riparian shrubs and trees. Their cost estimates included gathering seeds of native species on or near site, propagation in a nursery and transplanting. A per acre estimate was calculated from their figures and applied to the estimated acreage of planting on Ross Lake.

Costs for shoreline planting on Ross Lake can be lowered from the estimated cost by obtaining cuttings of some species on-site. Initial costs could be lower, also, if only a portion of the recommended acreage is planted pending the results of experimental plantings.

Table 22. Estimated Cost for On-Site Mitigation and Compensation[1/]

Technique	Planning	Construction	Maintenance	Monitoring	Total
Overstory removal	$38,000	$1,133,000 (USFS) 2,245,000 (DNR)	$183,600	$ 97,800	$1,452,400 2,564,400
Pond/Marsh	8,714	80,297	22,500	16,000	127,511
Drawdown seeding	2,900	115,000			117,900
Snag retention	3,000	13,500		8,400	24,900
Shoreline planting[2/]		195,000			195,000
Total (USFS)	$52,614	$1,536,797 (USFS)	$206,100	$122,200	$1,917,711
Total (DNR)	$52,614	$2,648,797 (DNR)	$206,100	$122,200	$3,029,711

[1/] Costs were estimated for life of project, 1980-81 dollars.
[2/] Planning, construction, maintenance and monitoring costs not separated.

5.5.4 Costs of Off-Site Compensation

The estimated costs for off-site compensation are the result of interviewing people associated with similar projects, literature review and researching public records. Actual costs for the projects will depend upon final designs, negotiations for land acquisition, timing of implementation and contractor(s) hired to do the job. The estimates attempt to include as much as possible expected activities and associated costs. Since hidden costs may not be included, it should be assumed that all costs are minimum. Costs are in 1981 dollars.

Cost estimates are broken down to four categories: planning, implementation, maintenance and monitoring. Costs for equipment, administration, travel and contingencies are not included. The following discussion briefly describes what is included in each category for each technique.

Overstory removal - Overstory removal costs were derived from discussions with DNR foresters, bidding results on DNR thinning sales, and estimates by WDG biologists. Planning costs include salaries for a Wildlife Biologist 2, Plant Ecologist and consultant forestry firm. Planning includes designing clearing pattern, marking clearing areas in the field and cruising clearing areas to determine merchantible timber volumes and stems per acre for clearing contract purposes. Implementation costs are based on average bids for DNR thinning sales and also include slash clean-up costs. Maintenance costs are salaries of a crew to periodically remove new trees over the life of the project. Monitoring costs include salaries for a Wildlife Biologist 2, Plant Ecologist and Fish and Game Technical Aide to set up a monitoring system and monitor quarterly for the first three years after establishment, and every tenth year thereafter for the life of the project to determine wildlife use and vegetation development in the clearings and forests adjacent to clearings. The purpose is to determine if compensation goals are being met.

Pond construction - Costs for pond construction are estimates based on conversations with WDG engineers. These estimates are not reliable since specific pond construction plans have not been drawn and restraints for each site are not known. Planning costs include salaries for an Engineer, Wildlife Biologist 2 and Plant Ecologist. Implementation cost is an estimate of average costs for all ponds. Maintenance costs are an estimate of average annual cost per pond over fifty years. Monitoring costs include a Wildlife Biologist 2 and Plant Ecologist salary for monitoring for the first three years after establishment, and every tenth year thereafter for the life of the project. The purpose of monitoring

is to determine if the technique is reaching the expected compensation goal.

Protection - Cost for protection of old-growth forest types include salaries of a consultant forester and Wildlife Biologist to plan and cruise save areas. The rest of the cost is an estimated price for standing old-growth and mature forests based on average volume of similar forests and average price per thousand board feet of similar timber. Not included in the cost is bare land value, mean annual increment, and taxes. No maintenance or monitoring costs are expected. On protected land in Eastern Washington, costs include estimated price of land, fencing and fence maintenance costs. No monitoring costs are expected. Costs for negotiating purchase is included in costs of Phase 1.

Streamside Rehabilitation - Costs for streamside rehabilitation are based on discussions with USFS personnel actively doing streamside rehabilitation. Planning costs include salaries for a Wildlife Biologist 2 and a Plant Ecologist. Implementation costs include cutting willow and transplanting along shoreline by a labor crew and purchase of new stock. Monitoring costs cover the first three years following establishment and every tenth year thereafter for the life of the project. Maintenance costs are not anticipated.

ROW rehabilitation - Rehabilitation of powerline right-of-ways include several techniques being used on other areas. Cost included planning by a Wildlife Biologist 2, Plant Ecologist and ROW Engineer. Cost for implementation will depend on what techniques are chosen, how often they are used along the ROW and how much area is included. A rough estimate of the possibilities was made by WDG biologists. Maintenance costs will vary similarly, depending on which techniques are used and how

often. Monitoring costs include salaries for a Wildlife Biologist 2 and Plant Ecologist to conduct quarterly transects for the first three years and every tenth year thereafter for the life of the project to determine wildlife use and vegetation development.

The following discussion outlines the estimated minimum cost of implementing the recommended off-site plan by technique and area.

RLNRA - Cost estimates for the RLNRA are for implementing an overstory removal program on 156 acres of pole stage timber. Cost of clearing is based on clearing an estimated 80 acres, or 50% of the total area involved. Table 23 shows estimated cost of overstory removal on RNLRA.

Table 23. Estimated Cost of Overstory Removal on RLNRA Land

Technique	Planning	Implementation	Maintenance	Monitoring	Total
Overstory removal	$12,500	$12,800	$45,900	$32,600	$103,800
Total	$12,500	$12,800	$45,900	$32,600	$103,800

Seattle City Light land - Two techniques are recommended for SCL land. Cost estimates are for overstory removal on 50 acres of the total 107 acres involved in overstory removal and construction of two ponds. Table 24 shows estimated minimum cost of SCL land compensation measures.

Table 24. Estimated Cost of SCL Land Compensation Measures

Technique	Planning	Construction	Maintenance	Monitoring	Total
Overstory removal	$10,620	$ 8,000	$ 45,360	$13,040	$ 77,020
Pond construct.	3,757	32,800	100,000	5,600	142,157
Total	$14,377	$40,800	$145,360	$18,640	$219,177

S.F. Nooksack River - Cost estimates for implementation of management techniques on the S.F. Nooksack are given in Table 25. Cost of leasing land with old-growth and mature conifer forests are based on estimated timber value. Cost of leasing land for pond construction and overstory removal are based on an estimated land value of $1,000/acre at 12% interest rate per year, or $120 per acre per year for 50 years. Costs were estimated for overstory removal 50% of the 704 acres recommended in the overstory removal plan, construction of 11 ponds, protecting 1,528 acres of old-growth and mature conifer, and streamside enhancement of 30 acres.

Table 25. Estimated Cost of Implementing Compensation Plan for the S.F. Nooksack River Area.

Technique	Planning	Lease	Construction	Maintenance	Monitoring	Total
Overstory removal	$24,000	4,218,000	$ 56,000	$ 91,800	$30,280	$ 4,420,080
Pond construct.	6,357	198,000	235,600	550,000	28,000	1,017,957
Protection	6,000	16,042,500	-	-	-	16,048,500
Streamside enhance.	2,000		7,800	-	5,600	15,400
Total	$38,357	$20,458,500	$299,400	$641,800	$63,880	$21,501,937

Twisp River - Cost for protecting the property on the Twisp River include estimated cost of purchasing 437 acres, construction of fence and maintenance of fence for 50 years. Construction costs for fencing includes materials and installation. Total construction costs were doubled to include total replacement after 20-25 years. Maintenance costs were calculated over 40 years since little or no maintenance will be required during the first five years after new fence construction. Fencing costs may be less since there is an existing fence in place.

Table 26 shows estimated costs of Twisp River property and fence construction and maintenance.

Table 26. Estimated Cost of Implementing Compensation Plan for the Twisp River Property

Technique	Planning	Purchase	Construction	Maintenance	Monitoring	Total
Protection Fence		$524,400				$524,400
construct.	$500		$118,000	$15,000		133,500
Total	$500	$524,400	$118,000	$15,000		$657,900

ROW - Costs for ROW rehabilitation includes planning by a Wildlife Biologist 2, Plant Ecologist and ROW Engineer. Activities for which costs were estimated are clearing undesirable plant species and transplanting desirable species on 400 acres, and pond construction at two unknown sites. Cost estimates are based on costs of similar activities on other project sites. Cost of ROW rehabilitation can vary considerably depending on management plan adopted by implementation team. Table 27 shows cost estimates for ROW rehabilitation.

Table 27. ROW Rehabilitation Cost Estimates

Technique	Planning	Construction	Maintenance	Monitoring	Total
Clearing & planting	$10,357	$864,000	$ 91,800	$27,480	$ 993,637
Pond construct.	8,714	20,000	9,400	6,400	44,514
Total	$19,071	$884,000	$101,200	$33,880	$1,038,151

Table 28 summarizes cost estimates for recommended mitigation and compensation plan.

Table 28. Summary of Cost Estimates for Recommended Mitigation and Compensation Plan

Area	Overstory Removal	Pond Const.	Drawdown Seeding	Snag Retention	Shoreline & Streamside Planting	Protection	Fence Const.	Planning	Total
Phase 1	-	-	-	-	-	-	-	$47,996	$ 47,996
	(USFS)								(USFS)
On-Site	$1,452,400	$127,511	$117,900	$24,900	$195,000	-	-	-	1,917,711
	(DNR)								(DNR)
	2,564,400	-	-	-	-	-	-	-	3,028,711
RLNRA	103,800	-	-	-	-	-	-	-	103,800
SCL Land	77,020	142,152	-	-	-	-	-	-	219,172
S.F. Nooksak River	4,420,080	1,017,957	-	-	15,400	$16,048,500	-	-	21,501,937
Twisp River	-	-	-	-	-	524,400	$133,500	-	657,900
ROW rehab.	993,637	44,514	-	-	-	-	-	-	1,038,151
TOTAL (USFS)	$7,046,937	$1,332,134	$117,900	$24,900	$210,400	$16,572,900	$133,500	$47,996	$25,486,667
(DNR)	$8,158,937								26,598,667

Cost estimates do not include administration cost, equipment, personnel travel, or contingencies.

5.5.5 Costs of Alternative Compensation Measures

Cost estimates were developed for the alternatives to the recommended plan. The same methods and restrictions used to estimate costs for the recommended off-site plan were used to estimate costs for the alternative sites.

Cascade River - Publishers Forest Products Land - Compensation potential for Publishers Forest Products ownership on the Cascade River depends on the logging activities that occur prior to purchase. Standing old-growth is now being logged. Average cost estimates for bare land in the area is approximately $800 per acre. With river frontage this parcel could be worth more, however, restrictions on use due to the Wild and Scenic River classification of the Cascade River could nullify the increased value. For purposes of estimating cost, $1,000 per acre was used. Cost estimates are based on construction of three ponds, overstory removal on 40 acres, and estimated purchase price. Table 29 shows estimated cost for the Cascade River parcel.

Table 29. Estimated Cost for Compensation Measures on Publishers Forest Products Land on the Cascade River

Technique	Planning	Implementation	Maintenance	Monitoring	Purchase	Total
Acquisition					$447,000	$447,000
Pond construct.	$ 4,357	$64,280	$150,000	$ 4,000		222,637
Overstory removal	7,580	6,400	22,960	13,000		49,980
Total	$11,937	$70,680	$172,960	$17,040	$447,000	$719,617

Cascade River - DNR - Cost of protecting old-growth and mature conifer on DNR land was estimated in the same manner as the old-growth protection area on the S.F. Nooksack River. An estimate of average board

feet per acre was multiplied by the number of acres of old-growth and mature conifer which was then multiplied by an estimated average price per thousand board feet. This gives an estimate of the value of the standing timber. Cost estimates do not include bare land value, value of annual increment of new timber growth or taxes. Overstory removal on a portion of the DNR land was also evaluated and included leasing the land at an estimated rate of $120 per acre per year for 50 years. Table 30 shows cost estimates for Cascade River DNR land.

Table 30. Estimated Cost for Preservation of Cascade River DNR Old-Growth and Mature Conifer and Overstory Removal

Site	Activity	Plan.	Implement.	Maintain.	Monitor.	Acquisition	Total
Cascade River	Preserv.	$ 3,520	-	-	-	$9,080,000	$9,083,520
	Overstory removal	7,580	6,400	22,960	13,040	480,000	529,980
Total		$11,100	$6,400	$22,960	$13,040	$9,560,000	$9,613,500

Toats Coulee - Cost estimates for the Toats Coulee parcel includes estimated purchase price and cost of fencing to exclude cattle. Table 31 shows estimated cost of acquisition and management of the Toats Coulee parcel.

Table 31. Cost Estimate for Toats Coulee Parcel

Activity	Planning	Implementation	Maintenance	Purchase	Total
Acquisition				$700,000	$700,000
Fencing	$1,000	$208,879	$26,400	-	236,279
Total	$1,000	$208,879	$26,400	$700,000	$936,279

Other DNR Land - Cost estimates were not calculated for other DNR land listed under alternatives. Further study is required on these lands to determine habitat values and cost factors.

5.5.6 Relative Costs Per Habitat Unit Gains

The recommended mitigation and compensation plan and alternatives includes activities for improving and protecting wildlife habitat on different sites. Each activity provides for the different kinds of habitat required by the species affected by High Ross. Table 32 and Figure 10 show the relative cost per habitat unit gain for each of the recommended activities. One can thus compare costs between the recommended plan and the alternatives, so long as one compares the cost of similar activities.

Table 32. Relative Cost Per Habitat Unit Gain by Area and Technique

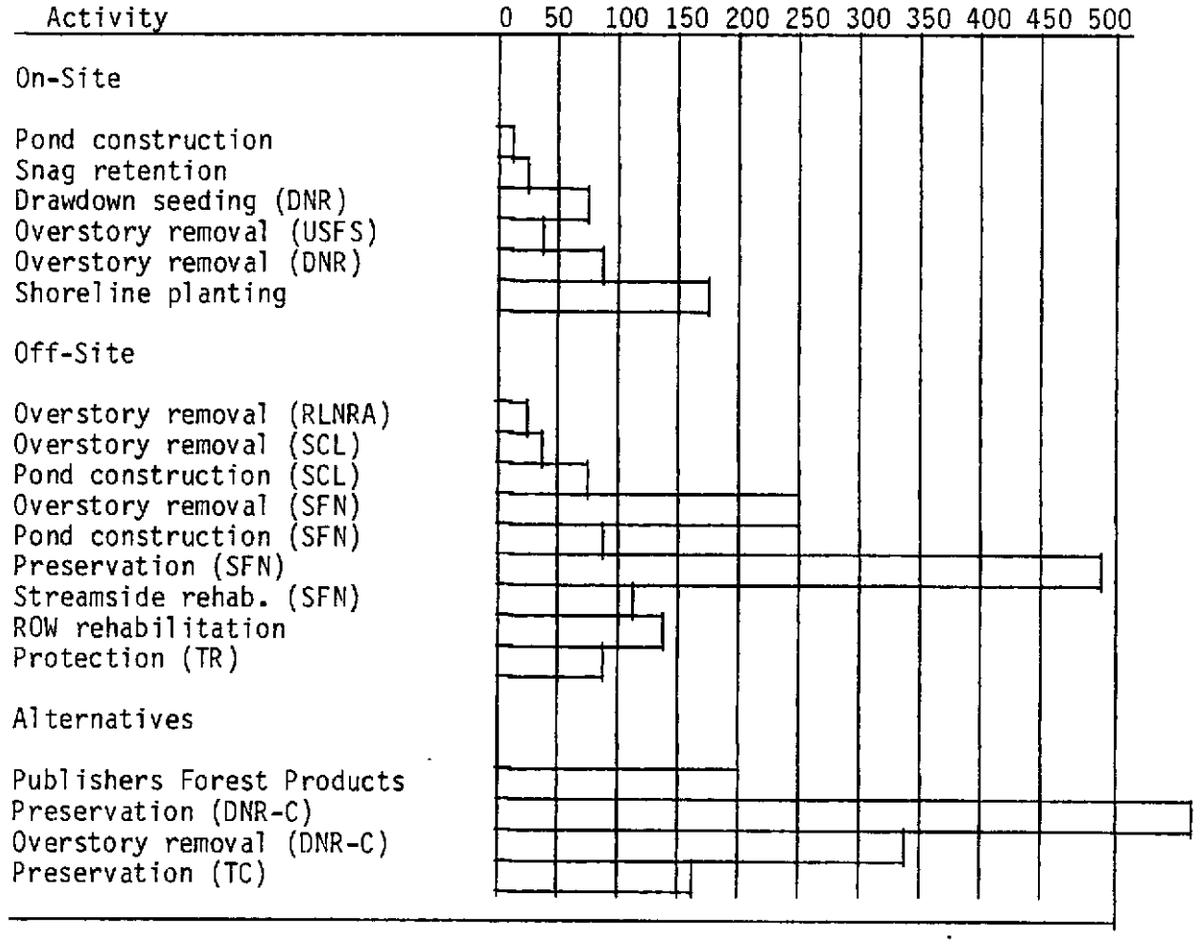
Area	Technique	Cost	HUs Gained	Cost/HU
On site	Overstory removal	$ 2,564,400(DNR)	30,786	$ 83.00
		1,452,000(USFS)	30,786	47.00
	Pond construction	127,511	12,252	10.00
	Drawdown seeding	117,900	1,710	69.00
	Snag retention	24,900	2,170	11.00
	Shoreline planting	195,000	1,190	164.00
RLNRA	Overstory removal	103,800	2,392	43.00
SCL	Pond construction	142,152	2,644	54.00
	Overstory removal	77,020	1,865	41.00
S.F. Nooksack	Protection	16,048,500	33,399	480.00
	Pond construction	1,017,957	11,008	92.00
	Overstory removal	4,420,080	17,426	254.00
	Streamside rehab.	15,400	143	107.00

Table 32 (Continued)

Area	Technique	Cost	HU Gained	Cost/HU
Twisp River	Protection	658,700	7,094	93.00
RLNRA to Darrington	ROW Rehabilitation	1,038,151	7,178	145.00
Alternatives				
Cascade River (Publishers)	Acquisition & manage.	719,617	3,559	202.00
Cascade River (DNR)	Protection	9,083,520	16,378	555.00
	Canopy clearing	529,980	1,520	349.00
Toats Coulee	Protection	936,279	5,882	159.00

The use of HEP to measure losses and gains in wildlife habitat in this proposal is valid and sound. However, the system has its shortcomings when cost analysis is done. There are other measures of the value of various habitat types which must be considered. For instance, HEP does not address scarcity when evaluating habitats. If it did, old-growth forest, ponds and wetlands would receive much higher scores, thus the cost effectiveness of preserving old-growth forest HUs would be much greater than demonstrated in Table 32. There is no comparison between the value of HU gains from preserving old-growth and HU gains from changing dense pole stage conifer to shrub types. There must be replacement of each of the lost habitat types in the plan, regardless of the cost effectiveness of one measure over another.

Figure 10. Relative Cost Per Annualized Habitat Unit For Each Recommended Activity and Alternatives



DNR: Washington Department of Natural Resources estimate
USFS: US Forest Service estimate
RLNRA: Ross Lake National Recreation Area
SCL: Seattle City Light
SFN: South Fork Nooksack River
TR: Twisp River
DNR-C: DNR - Cascade River
TC: Toats Coulee

6.0 CONCLUSION AND SUMMARY

Following a number of hearings in the early 1970s, the Federal Energy and Regulatory Commission ordered Seattle City Light (SCL) to prepare a plan for mitigating and compensating lost wildlife habitat from raising Ross Dam on the Skagit River in Washington. The Washington Department of Game (WDG) was contracted by SCL to prepare the mitigation and compensation plan. Beginning in May of 1979, wildlife biologists from WDG determined habitat losses that would occur if the dam is raised and possible mitigation and compensation options on-site and off-site.

With the raising of Ross Lake from 1,602 ft. elev. to 1,725, 1,140 acres of habitat will be inundated in Big Beaver Valley and an additional 2,318 acres around Ross Lake Basin in the United States. By using the U.S. Fish and Wildlife Service Habitat Evaluation Procedure for evaluating wildlife habitat, it was determined that a total of 130,145 Habitat Units (HUs) would be lost each year for the 50 year life of the project. Included are 613 acres or 29,157 HUs of old-growth, 581 acres or 19,595 HUs of mature conifer, and 462 acres or 18,523 HUs of wetland habitats (ponds, bogs, swamps, etc.); habitats critical to a number of wildlife species. Wetlands, for instance, in the U.S. have been reduced by over one-third.

In order to recover these losses in-kind or as nearly in-kind as possible, an intensive management plan was developed which included both on-site and off-site areas. There were restrictions to on-site mitigation which included both natural and administrative limitations (i.e., remoteness, ruggedness of terrain, National Park Service regulations). The on-site plan includes partial overstory removal on 1,557 acres of

pole stage timber, construction of 14 ponds on the perimeter of the lake, seeding 114 acres of selected drawdown sites, snag retention within the drawdown on 434 acres, and planting riparian vegetation along one-third of the new shoreline. These mitigation and compensation measures will replace 48,108 HUs, or approximately one-third of the HUs lost.

Off-site compensation sites are on the Skagit, S.F. Nooksack and Twisp River drainages. On the Skagit river, overstory removal on 263 acres and construction of two ponds are recommended within the Ross Lake National Recreation Area on both federal and SCL land. On the S.F. Nooksack River, Scott Paper Company land was chosen for a broad management area including preservation of 1,528 acres of old-growth, overstory removal on 704 acres, construction of 11 ponds and streamside management. On the Twisp River, 438 acres of ponderosa pine, bitterbrush and riparian habitat threatened with development is recommended for purchase and preservation. Improvement of 598 acres of powerline right-of-way from Ross Dam to Darrington will provide the additional HU gains necessary to fully compensate the losses from High Ross.

Additionally, other options are suggested in case implementation of some of the recommendations proves impossible. Publishers Forest Products Company has 447 acres on the Cascade River available for sale with potential for compensation. The Department of Natural Resources has old-growth and mature forest on the Cascade River and elsewhere suitable for preservation to replace those habitat types lost behind High Ross. In Eastern Washington, two private landowners hold land in Toats Coulee near Tonasket that is available for sale and would be suitable as compensation for Eastern Washington habitat types that occur on-site.

Rehabilitation of streamsides in the Cedar River watershed and elsewhere is also a possible alternative to the recommended plan.

Cost estimates were calculated for implementing, maintaining and monitoring the plan over the 50 year license period. Costs for on-site are estimated to be between two and three million dollars and off-site $23,570,000. Costs do not include administration, equipment, travel or contingencies.

A plan for implementing mitigation and compensation is included in this report.

7.0 MITIGATION AND COMPENSATION IMPLEMENTATION PLAN

7.1 Background

The recommended plan for mitigating and compensating for losses due to High Ross has taken several years to formulate, but the recommendations are just that. What the final plan will entail has not been determined. However, it is known what basic requirements will have to be met and that some or all of the recommendations will have to be incorporated in the final plan. The next step will be to implement the plan once all appropriate public agencies have concurred. How this step is taken can have a bearing on the success or failure of the plan.

The lead agency in approving the mitigation package is the Washington Department of Game (WDG). As the plan is initiated and implemented, biologists from WDG will have to work closely with whomever Seattle City Light (SCL) contracts to implement the plan.

One of the problems with implementing the plan is that the question of whether or not Ross will be raised and when is still undecided. Since time is a factor in certain facets of the recommended plan (i.e., availability of certain lands for purchase), the sooner the plan is implemented the better. Beginning immediately, this plan will lose some of its validity unless steps are taken now to secure the lands recommended for management. This applies to management agreements as well as purchase. Old-growth stands recommended for preservation are scheduled to be logged within five years and lands recommended for purchase are on the open market. Obviously, if the plan is not implemented for five years, a very important aspect of the plan will be lost and a new search for in-kind compensation of that valuable habitat will have to be made.

The implementation plan, then, assumes the following:

1. Participation by Game Department biologists;
2. Successful negotiation for land purchases and management agreements;
3. Prompt implementation of the recommendations.

7.2 Initial Steps

Upon acceptance by all interested parties, the recommended plan should begin to be implemented.

The following actions are included in this phase:

1. Negotiation and settlement of land purchases and management agreements;
2. Contracting the implementation project;
3. Establishment of implementation team core;
4. Designating responsibility for the various projects to core individuals.

The negotiations of land purchases and management agreements with the public and private land holders is the responsibility of SCL, as is contracting the implementation team. WDG assistance would be available if necessary.

The decision as to whom will manage the recommended plan is critical. In order to be successful, the implementation team must have a minimum of the followng expertise:

1. Administrator
2. Wildlife biologists
3. Forester

4. Engineer
5. Plant ecologist

The team vested with preparing the detailed work plan should have at least one of each profession. As the field work begins, additional people will be required. It is recommended that the team be originated from as few single contractors as possible to minimize costs and confusion.

If negotiations for land purchases and management agreements are successful, the team will begin to plan the implementation of the mangagement recommendations. Each management recommendation will require its own steps and will be discussed individually below. If negotiations are not entirely successful, the team will have to decide which of the recommended alternative options to use in place of the lost parts of the recommended plan.

Each of the recommended management techniques will require input from the core team. Assignment of responsibilities will be based on the requirements of the technique. The following techniques will require input from the listed professionals:

1. Overstory removal - Forester, Wildlife Biologist, Plant Ecologist
2. Pond construction - Engineer, Wildlife Biologist, Soils and Hydrology Expert;
3. Preservation - Forester, Wildlife Biologist;
4. Snag retention - Forester, Wildlife Biologist;
5. Drawdown seeding - Wildlife Biologist, Plant Ecologist;
6. Streamside and shoreline planting - Wildlife Biologist, Plant Ecologist;

7. ROW management - Wildlife Biologist, Plant Ecologist, Engineer. An administrator will be required to coordinate the work. A small clerical staff will handle associated paper work.

7.3 Implementation

The next phase of implementation involves the detailed planning and layout of field work. Each management technique will require its own specific steps and are discussed individually.

Overstory removal - A Forester, Plant Ecologist and Wildlife Biologist will study the recommended areas for overstory removal and lay out an efficient system for clearing which meets the goal of a 50:50 interspersion of trees to clearing. Specifications for overstory removal are found in Section 5.4.1. Included in the plan should be the following:

1. Field examination of on-site and off-site canopy clearing areas;
2. Determination of clearing pattern best suited to each site, considering topography, soils, tree species, size class, access, wildlife habitat requirements, etc.;
3. Determination of manpower required to do the job in reasonable length of time;
4. Implementing the field work, including flagging boundaries, marking trees, cutting and removal of trees, clearing site and establishment of monitoring plots;
5. Develop monitoring study for 50 years;
6. Plan maintenance program for 50 years.

Pond construction - An engineer and wildlife biologist, with the aid of plant ecologist, soils and hydrology experts, will plan the construction of the ponds recommended on-site and off-site. Specifications for

pond construction are found in Section 5.4.2. Included in the plan should be the following:

1. Field examination of each site;
2. Acquisition of required government permits;
3. Design pond structures that best use existing topography, soil, water and vegetation conditions with the minimum amount of disturbance to the surroundings;
4. Determine and design secondary construction requirements, i.e., access roads, disposition of excess materials, etc.;
5. Determine manpower requirements to construct ponds;
6. Construct ponds;
7. Revegetate with riparian plant species;
8. Monitor for 50 years;
9. Maintenance for 50 years.

Preservation - A Wildlife Biologist and Forester will prepare a plan for managing areas preserved. The purpose of the Forester is to determine timber volume and set boundaries of preserved forest types. Timber volume will be needed to establish value for lease agreement. Preservation of forest and wetland types should not require any management other than periodic monitoring to assure that the areas are not being logged or otherwise disturbed. In eastern Washington, preservation of the Twisp River and Toats Coulee parcels will require some fence construction, maintenance and replacement over 50 years. A plan covering this project should be made by the Wildlife Biologist.

Snag retention - A Forester and Wildlife Biologist will prepare a plan for snag retention on-site. Specifications for snag retention

management are found in Section 5.4.5. The plan should include the following:

1. Field examination of sites selected for snag retention;
2. Drawing of specific boundaries, taking into consideration tree size, depth of lake, density of stands, surrounding vegetation types and hazards to human use;
3. Flagging boundaries and marking cut trees prior to logging;
4. Monitoring logging operations to insure leave trees are left;
5. Monitoring over 50 years.

Drawdown seeding - A Wildlife Biologist and Plant Ecologist will plan the seeding of recommended drawdown areas. Specifications for drawdown seeding are found in Section 5.4.3. Included in the plan should be the following:

1. Field examination of drawdown sites;
2. Determination of proper species for planting at each site;
3. Determination of feasibility of harvesting seed from immediate locale;
4. Determine planting mixture, pounds per acre, planting schedule, necessity of and/or ground preparation;
5. Disseminate seed;
6. Establish monitoring transects;
7. Plan reseeding program;
8. Plan monitoring for 50 years.

Streamside and shoreline planting - Planning the planting of streamsides and lake shorelines on- and off-site should follow the same plan as above for drawdown seeding. The major difference is that species used

will be shrubs and trees and could be planted as rootstock. Replanting should not be required.

ROW management - A Wildlife Biologist and Plant Ecologist with the assistance of ROW Engineers will prepare a plan for managing the ROW between Ross Dam and Darrington. Some specifications for ROW management are found in Section 5.5.7. Included in the plan should be the following:

1. Mapping habitat types within the corridor on low level aerial photography;
2. Field examination;
3. Determination of most suitable management techniques for areas that can be improved for wildlife;
4. Make final management plan;
5. Implement field work;
6. Establish monitoring transects;
7. Develop maintenance plan for 50 years;
8. Monitor for 50 years.

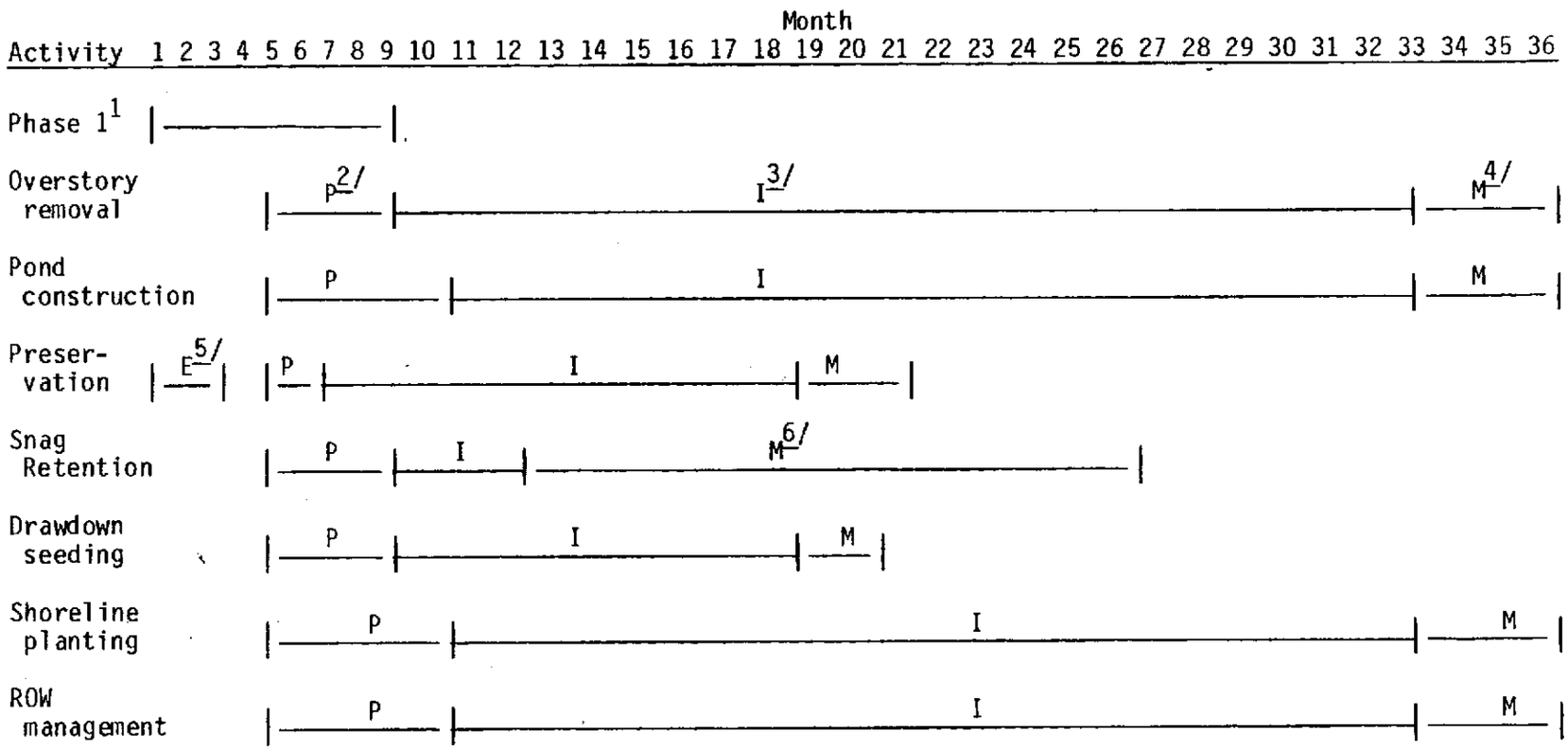
Maintaining and monitoring for 50 years is an important aspect of the project. Mitigation and compensation success requires replacement of the lost habitats for 50 years (life of the High Ross Project). Monitoring will include periodic HEP evaluations to assure that estimated HEP values for management techniques are met and that 100% mitigation and compensation is achieved. If HEP values are less than anticipated, that is, if full mitigation and compensation is not being met by the techniques applied, then revisions to the plan must be made to achieve 100% mitigation and compensation.

7.4 Time Schedule

An estimated time schedule for implementation is found in Table 33. The first phase includes negotiating land acquisition agreements, establishing the core of professionals that will set up and manage the implementation plan. Land purchases and management agreements may take some time to finalize, however, some areas will be available immediately (i.e., SCL land), therefore, there is an overlap in the planning and implementation schedule with the time to complete Phase 1. The actual time it takes to implement and complete the tasks will depend upon the number of people involved. This schedule assumes that each task will have its own professionals. That is, the Wildlife Biologist assigned to develop the overstory removal task will not also have the responsibility of planning and implementing pond construction.

Once the task of implementing is done, monitoring and maintenance begins. Table 34 shows the estimated time schedule for monitoring and maintaining each activity. Maintenance will de done as required, after monitoring. The time it takes to do maintenance will vary with the task. It may take only several months work, for example, to do maintenance on the ponds. Overstory removal, however, may take the whole year, depending on the size of the crew.

Table 33. Mitigation and Compensation Plan Implementation Schedule



1/ Obtaining land, letting management contracts, establishing core personnel.
2/ P - Planning details of implementation.
3/ I - Implementing project.
4/ M - Monitoring results.
5/ E - Estimating timber volumes of preservation old-growth.
6/ Monitoring of snag retention area would cease when clearing around retention areas are done.

Table 34. Monitoring and Maintenance Schedule Over 50 Years

Activity	Year 1-5	6-8	9	10	11-18	19	20	21-28	29	30	31-38	39	40	41-50
Overstory removv.[1/]	X		X	O	XO	X	O	XO	X	O	XO	X	O	XO
Ponds Preserv.	XO	O	O	XO	O	O	XO	O	O	XO	O	O	XO	O
Snag reten.				X			X			X			X	
Drawdown seeding	O	O	O	XO	O	O	XO	O	O	XO	O	O	XO	O
Shoreline planting				X			X			X			X	
ROW manage.			O	X		O	X		O	X		O	X	
Fencing		O	O	O	O	O	R	O	O	O	O	O	O	O

[1/] Every 5th year overstory removal areas will require maintenance.
X - monitoring
O - maintenance
R - replacement

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APPENDICES

APPENDIX A

HIGH ROSS MITIGATION STUDY LAND COVER CLASSIFICATION SYSTEM

1. Urban
   - 11 Residential--Cabins, Resorts
     - 111 Low density
     - 112 High density
     - 113 Wooded Res.
   - 12 Commercial Services
   - 13 Industrial (dam)
   - 14 Transportation Utilities
     - 141 Airport
     - 142 Ferry Service
     - 143 Highway
     - 144 Railroad
     - 145 Pipeline
     - 146 Bridge
     - 147 Powerlines Right-of-Way
     - 148 Water treatment/storage
     - 149 Other
   - 15 Port
   - 16 Construction
     - 161 Residential construction
     - 162 Commercial construction
     - 163 Industrial construction
   - 17 Extractive
     - 171 Mineral
     - 172 Stone
     - 173 Sand, Gravel, Clay
     - 175 Abandoned mining
   - 18 Open land
     - 181 Scraped area
     - 182 Dredge/Fill
     - 183 Refuse stations
   - 19 Recreation
     - 191 Park/Campgrounds
     - 192 Golf course
     - 193 Urban wooded

2. Agriculture
   - 21 Crops/Pasture
     - 211 Row crops
     - 212 Field crops/Pasture
   - 22 Orchards, Vineyards, Nurseries
   - 24 Inactive agriculture

3. Non-Forested Lands
   - 31 Grassland
     - 311 Meadow
     - 313 Open grassland

- 32 Shrub
  - 321 Successional shrub
  - 323 Shrub/exposed rock
  - 324 Sagebrush/rabbitbrush
  - 325 Bitterbrush
- 33 Riparian
  - 331 Shrub
  - 332 Grass
- 34 Bluff
  - 341 Grass
  - 342 Shrub

4. Forested Lands
   - 41 Coniferous
     - 411 Regeneration conifer
     - 412 Pole stage
       - 4121 Pole stage/successional shrub
       - 4122 Pole stage/grass
     - 413 Mature
       - 4131 Mature/shrub
       - 4132 Mature/grass
     - 414 Old-growth
     - 415 Ponderosa Pine
     - 416 Mixed conifer
   - 42 Broadleaf
     - 421 Regeneration broadleaf
       - 4211 Regeneration broadleaf/successional shrub
     - 422 Pole stage
       - 4221 Regeneration broadleaf/successional shrub
   - 43 Mixed Forest
     - 431 Regeneration mixed
       - 4311 Regeneration mixed/successional shrub
     - 432 Pole stage
       - 4321 Pole stage mixed/successional shrub
     - 433 Mature mixed
       - 4331 Mature mixed/successional shrub
       - 4332 Mature mixed/old growth
   - 44 Forested/Exposed Rock
     - 441 Conifer/exposed rock
     - 442 Broadleaf/exposed rock
     - 443 Mixed/exposed rock
   - 45 Disturbed Forest
     - 451 Clearcut
     - 452 Selectively logged
     - 453 Burned
     - 454 Grazed

- 46 Riparian Forest
  - 461 Conifer
    - 4611 Regeneration
    - 4612 Pole stage
    - 4613 Mature
    - 4614 Old-growth
  - 462 Broadleaf
    - 4621 Regeneration
    - 4622 Pole stage
    - 4623 Mature
  - 463 Mixed
    - 4631 Regeneration
    - 4632 Pole
    - 4633 Mature
- 47 Forested Slope
  - 471 Conifer
    - 4711 Regeneration
    - 4712 Pole stage
    - 4713 Mature
    - 4714 Old-growth
  - 472 Broadleaf
    - 4721 Regeneration
    - 4722 Pole stage
    - 4723 Mature
  - 473 Mixed
    - 4731 Regeneration
    - 4732 Pole stage
    - 4733 Mature

5. Water
   - 51 River/Stream
     - 511 Estuarine zone
     - 512 Pastoral zone
     - 513 Floodway zone
     - 514 Boulder zone
     - 515 Intermittent
   - 52 Lakes/Ponds
     - 521 Lake _____
     - 522 Pond _____*
     - 523 Beaver pond
     - 526 Farm pond
   - 53 Reservoir
   - 54 Bays/Estuaries
   - 55 Impoundment
   - 56 Lagoon
   - 57 Slough
   - 58 Canal/Channel

6. Wetlands
   - 61 Swamps
     - 611 Shrub swamp
     - 612 Forested swamp
       - 6121 Conifer
       - 6122 Broadleaf
       - 6123 Mixed
   - 62 Marshes/Bogs
     - 621 Marsh
     - 622 Bog

7. Exposed and Other Lands
   - 71 Rock
     - 711 Rock outcrop
     - 712 Cliff
     - 713 Talus
       - 7131 Vegetated
       - 7132 Nonvegetated
     - 714 Island
       - 7141 Nonvegetated
       - 7142 Vegetated
   - 72 Sand
     - 721 Sand island
     - 722 Slide
     - 723 Sand/gravel bar
   - 73 Avalanche Chute
     - 731 Vegetated
     - 732 Nonvegetated

APPENDIX B

LANDOWNER CONTACTS BY SITE

Ross Lake National Recreation Area:

National Park Service
North Cascades National Park
800 State Street
Sedro Woolley, WA 98284

Superintendent
206-855-1331

Seattle City Light
1015 3rd Avenue
Seattle, WA 98104

S.F. Nooksack River:

Scott Paper Company
P.O. Box 925
Everett, WA 98206

Jim Short, Land Use Supervisor
206-259-7469

Department of Natural Resources
Public Lands Building
Olympia, WA 98504

Lands Section
206-753-5327

Richard Judy
1740 Olympia Place
Mt. Vernon, WA 98273
206-336-3220

H. B. Nelson
301 N. Section
Burlington, WA 98233

R. E. Thomas
P.O. Box 467
Hamilton, WA 98255
206-826-3221

Twisp River:

Walsh Real Estate Company
P.O. Box 728
Twisp, WA 98856
509-997-7100

Cascade River:

Publishers Forest Products
P.O. Box 588
Ancortes, WA 98221

John Carver
206-293-2101

FISH AND WILDLIFE COORDINATION ACT*

The following compilation of provisions of the Fish and Wildlife Coordination Act has been prepared for convenient reference:

SEC. 1. For the purpose of recognizing the vital contribution of our wildlife resources to the Nation, the increasing public interest and significance thereof due to expansion of our national economy and other factors, and to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs through the effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation and rehabilitation for the purposes of this Act in the United States, its Territories and possessions, the Secretary of the Interior is authorized (1) to provide assistance to, and cooperate with, Federal, State, and public or private agencies and organizations in the development, protection, rearing, and stocking of all species of wildlife, resources thereof, and their habitat, in controlling losses of the same from disease or other causes, in minimizing damages from overabundant species, in providing public shooting and fishing areas, including easements across public lands for access thereto and in carrying out other measures necessary to effectuate the purposes of this Act; (2) to make surveys and investigations of the wildlife of the public domain, including lands and waters or interests therein acquired or controlled by any agency of the United States; and (3) to accept donations of land and contributions of funds in furtherance of the purposes of this Act.

SEC. 2 (a) Except as hereafter stated in subsection (h) of this section, whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and

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*The Act of March 10, 1934, 48 Stat. 401, as amended by the Act of August 14, 1946, 60 Stat. 1080; the Act of June 19, 1948, 62 Stat. 497; the Act of August 12, 1958, 72 Stat. 563; 16 U.S.C. 661 et seq., and the Act of July 9, 1965, 79 Stat. 213.

The Act of August 12, 1958 established the official title of this legislation as the "Fish and Wildlife Coordination Act"; it also revised the first four sections of the legislation and contains an authorization for appropriations.

*Rev. 8/5/65

drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license, such department or agency first shall consult with the United States Fish and Wildlife Service, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular State wherein the impoundment, diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing loss of and damage to such resources as well as providing for the development and improvement thereof in connection with such water-resource development.

(b) In furtherance of such purposes, the reports and recommendations of the Secretary of the Interior on the wildlife aspects of such projects, and any report of the head of the State agency exercising administration over the wildlife resources of the State, based on surveys and investigations conducted by the United States Fish and Wildlife Service and such State agency for the purpose of determining the possible damage to wildlife resources and for the purpose of determining means and measures that should be adopted to prevent the loss of or damage to such wildlife resources, as well as to provide concurrently for the development and improvement of such resources, shall be made an integral part of any report prepared or submitted by any agency of the Federal Government responsible for engineering surveys and construction of such projects when such reports are presented to the Congress or to any agency or person having the authority or the power, by administrative action or otherwise, (1) to authorize the construction of water-resource development projects or (2) to approve a report on the modification or supplementation of plans for previously authorized projects, to which this Act applies. Recommendations of the Secretary of the Interior shall be as specific as is practicable with respect to features recommended for wildlife conservation and development, lands to be utilized or acquired for such purposes, the results expected, and shall describe the damage to wildife attributable to the project and the measures proposed for mitigating or compensating for these damages. The reporting officers in project reports of the Federal agencies shall give full consideration to the report and recommendations of the Secretary of the Interior and to any report of the State agency on the wildlife aspects of such projects, and the project plan shall include such justifiable means and measures for wildlife purposes as the reporting agency finds should be adopted to obtain maximum overall project benefits.

(c) Federal agencies authorized to construct or operate water-control projects are hereby authorized to modify or add to the structures and operations of such projects, the construction of

which has not been substantially completed on the date of enactment of the Fish and Wildlife Coordination Act, and to acquire lands in accordance with section 3 of this Act, in order to accommodate the means and measures for such conservation of wildlife resources as an integral part of such projects: Provided, That for projects authorized by a specific Act of Congress before the date of enactment of the Fish and Wildlife Coordination Act (1) such modification or land acquisition shall be compatible with the purposes for which the project was authorized; (2) the cost of such modifications or land acquisition, as means and measures to prevent loss of and damage to wildlife resources to the extent justifiable, shall be an integral part of the cost of such projects; and (3) the cost of such modifications or land acquisition for the development or improvement of wildlife resources may be included to the extent justifiable, and an appropriate share of the cost of any project may be allocated for this purpose with a finding as to the part of such allocated cost, if any, to be reimbursed by non-Federal interests.

(d) The cost of planning for and the construction or installation and maintenance of such means and measures adopted to carry out the conservation purposes of this section shall constitute an integral part of the cost of such projects: Provided, That such cost attributable to the development and improvement of wildlife shall not * extend beyond that necessary for (1) land acquisition, (2) facilities as specifically recommended in water resource project reports, (3) modification of the project, and (4) modification of project operations, but shall not include the operation of wildlife facilities. *

(e) In the case of construction by a Federal agency, that agency is authorized to transfer to the United States Fish and Wildlife Service, out of appropriations or other funds made available for investigations, engineering, or construction, such funds

*Rev. 8/5/65

as may be necessary to conduct all or part of the investigations required to carry out the purposes of this section.

(f) In addition to other requirements, there shall be included in any report submitted to Congress supporting a recommendation for authorization of any new project for the control or use of water as described herein (including any new division of such project or new supplemental works on such project) an estimation of the wildlife benefits or losses to be derived therefrom including benefits to be derived from measures recommended specifically for the development and improvement of wildlife resources, the cost of providing wildlife benefits (including the cost of additional facilities to be installed or lands to be acquired specifically for that particular phase of wildlife conservation relating to the development and improvement of wildlife), the part of the cost of joint-use facilities allocated to wildlife, and the part of such costs, if any, to be reimbursed by non-Federal interests.

(g) The provisions of this section shall be applicable with respect to any project for the control or use of water as prescribed herein, or any unit of such project authorized before or after the date of enactment of the Fish and Wildlife Coordination Act for planning or construction, but shall not be applicable to any project or unit thereof authorized before the date of enactment of the Fish and Wildlife Coordination Act of the construction of the particular project or unit thereof has been substantially completed. A project or unit thereof shall be considered to be substantially completed when sixty percent or more of the estimated construction cost has been obligated for expenditure.

(h) The provisions of this Act shall not be applicable to those projects for the impoundment of water where the maximum surface area of such impoundments is less than ten acres, nor to activities for or in connection with programs primarily for land management and use carries out by Federal agencies with respect to Federal lands under their jurisdiction.

SEC. 3 (a) Subject to the exceptions prescribed in section 2 (h) of this Act, whenever the waters of any stream or other body of water are impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, adequate provision, consistent with the primary purposes of such impoundment, diversion, or other control, shall be made for the use thereof, together with any areas of land,

water, or interests therein, acquired or administered by a Federal agency, in connection therewith, for the conservation, maintenance, and management of wildlife resources thereof, and its habitat thereon, including the development and improvement of such wildlife resources pursuant to the provisions of section 2 of this Act.

(b) The use of such waters, land, or interests therein for wildlife conservation purposes shall be in accordance with general plans approved jointly (1) by the head of the particular department or agency exercising primary administration in each instance, (2) by the Secretary of the Interior, and (3) by the head of the agency exercising the administration of the wildlife resources of the particular State wherein the waters and areas lie. Such waters and other interests shall be made available, without cost for administration, by such State agency, if the management of the properties relate to the conservation of wildlife other than migratory birds, or by the Secretary of the Interior, for administration in such manner as he may deem advisable, where the particular properties have value in carrying out the national migratory bird management program: Provided, That nothing in this section shall be construed as affecting the authority of the Secretary of Agriculture to cooperate with the States or in making lands available to the States with respect to the management of wildlife and wildlife habitat on lands administered by him.

(c) When consistent with the purposes of this Act and the reports and findings of the Secretary of the Interior prepared in accordance with section 2, land, waters, and interests therein may be acquired by Federal construction agencies for the wildlife conservation and development purposes of this Act in connection with a project as reasonably needed to preserve and assure for the public benefit the wildlife potentials of the particular project area: Provided, That before properties are acquired for this purpose, the probable extent of such acquisition shall be set forth, along with other data necessary for project authorization, in a report submitted to the Congress, or in the case of a project previously authorized, no such properties shall be acquired unless specifically authorized by Congress, if specific authority for such acquisition is recommended by the construction agency.

(d) Properties acquired for the purposes of this section shall continue to be used for such purposes, and shall not become the subject of exchange or other transactions if such exchange or other transaction would defeat the initial purpose of their acquisition.

(e) Federal lands acquired or withdrawn for Federal water-resource purposes and made available to the States or to the Secretary of the Interior for wildlife management purposes, shall be made available for such purposes in accordance with this Act, notwithstanding other provisions of law.

(f) Any lands acquired pursuant to this section by and Federal agency within the exterior boundaries of a national forest shall, upon acquisition, be added to and become national forest lands, and shall be administered as a part of the forest within which they are situated, subject to all laws applicable to lands acquired under the provisions of the Act of March 1, 1911 (36 Stat. 961), unless such lands are acquired to carry out the National Migratory Bird Management Program.

SEC. 4. Such areas as are made available to the Secretary of the Interior for the purposes of this Act, pursuant to sections 1 and 3 or pursuant to any other authorization, shall be administered by him directly or in accordance with cooperative agreements entered into pursuant to the provisions of the first section of this Act and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon, as may be adopted by the Secretary in accordance with general plans approved jointly by the Secretary of the Interior and the head of the department or agency exercising primary administration of such areas: Provided, That such rules and regulations shall not be inconsistent with the laws for the protection of fish and game of the States in which such area is situated (16 U.S.C., sec. 664): Provided further, That lands having value to the National Migratory Bird Management Program may, pursuant to general plans, be made available without cost directly to the State agency having control over wildlife resources, if it is jointly determined by the Secretary of the Interior and such State agency that this would be in the public interest: And provided further, That the Secretary of the Interior shall have the right to assume the management and administration of such lands in behalf of the National Migratory Bird Management Program if the Secretary finds that the State agency has withdrawn from or otherwise relinquished such management and administration.

SEC. 5. The Secretary of the Interior, through the Fish and Wildlife Service and the Bureau of Mines, is authorized to make such investigations as he deems necessary to determine the effects of domestic sewage, mine, petroleum, and industrial wastes, erosion silt, and other polluting substances on wildlife, and to make reports to the Congress concerning such investigations and of recommendations for alleviating dangerous and undesirable effects of such pollution.

These investigations shall include (1) the determination of standard of water quality for the maintenance of wildlife; (2) the study of methods of abating and preventing pollution, including methods for the recovery of useful or marketable projects and byprojects of wastes; and (3) the collation and distribution of data on the progress and results of such investigations for the use of Federal, State, municipal, and private agencies, individuals, organizations, or enterprises.

SEC. 5A. In the management of existing facilities (including locks, dams, and pools) in the Mississippi River between Rock Island, Illinois, and Minneapolis, Minnesota, administered by the United States Corps of Engineers of the Department of the Army, that Department is hereby directed to give full consideration and recognition to the needs of fish and other wildlife resources and their habitat dependent on such waters, without increasing additional liability to the Government, and, to the maximum extent possible without causing damage to levee and drainage districts, adjacent railroads and highways, farm lands, and dam structures, shall generally operate and maintain pool levels as though navigation was carried on throughout the year.

SEC. 6. There is authorized to be appropriated from time to time, out of any money in the Treasury not otherwise appropriated, such amounts as may be necessary to carry out the provisions of this Act and regulations made pursuant thereto, including the construction of such facilities, buildings, and other improvements necessary for economical administration of areas made available to the Secretary of the Interior under this Act, and the employment in the city of Washington and elsewhere of such persons and means as the Secretary of the Interior may deem necessary for such purposes.

SEC. 7. Any person who shall violate any rule or regulation promulgated in accordance with this Act shall be guilty of a misdemeanor and upon conviction thereof shall be fined not more than $500 or imprisoned for not more than one year, or both.

SEC. 8. The terms "wildlife resources" as used herein include birds, fishes, mammals, and all other classes of wild animals and all types of aquatic and land vegetation upon which wildlife is dependent.

SEC. 9 The provisions of this Act shall not apply to the Tennessee Valley Authority.

APPENDIX D

United States Department of the Interior

NATIONAL PARK SERVICE

North Cascades National Park
800 State Street
Sedro Woolley, Washington 98284

IN REPLY REFER TO:
N1615(PNR)NOCA

December 10, 1979

Mr. Bill Nelson
509 Fairview Ave. N.
Seattle, WA 98109

Dear Mr. Nelson:

To assist you in development of the wildlife compensation plan for High Ross Dam we are enclosing the National Park Service policy on (1) Management of Animal Populations, (2) Landscape and Vegetative Manipulation, and (3) Fire Management.

Without specific proposals and an assessment of the environmental impacts of those proposals it is generally not possible to give a definite response. For example, the possibility of shoreline manipulation and leaving some trees standing below the high water line in certain areas appears to be worthy of consideration. However, without a specific proposal stating the extent of the manipulation and possible impacts, we can not approve or reject the idea. The possibility of using prescribed fire in some areas to set back succession was mentioned as a possibility. While this may be considered at some future time, it is not addressed in the existing fire management plan for the area, therefore would not be permitted.

We hope this information will be helpful to you.

Sincerely,

Keith E. Miller

Keith E. Miller
Superintendent

Enclosure

Elimination of Grazing - Where grazing is permitted and its continuation is not in the best interest of public use or maintenance of the park ecosystem, it will be eliminated, wherever possible, through orderly and cooperative procedures with the individuals concerned.

MINERAL EXPLORATION, LEASING, AND MINING

Mineral exploration, leasing, and mining are not permitted except where expressly authorized by law, except that the Secretary of the Interior has authority for the utilization of resources in certain units of the National Park System. Such utilization is authorized when it will promote, or is compatible with and does not significantly impair, public recreation and the conservation of scenic, scientific, historic, or other values contributing to public enjoyment. Administrative authorization shall be contingent upon compliance with the Procedures for the Protection of Historic and Cultural Properties promulgated by the Advisory Council on Historic Preservation. The National Park Service will strive to control mineral leasing, and eliminate mining activities that are inimical to the purpose of any unit of the National Park System.

(See Special Use Zone II-4 , Wilderness--Mining and Prospecting VI-4 .)

Reference: Regulation of Park Mining Act, September 28, 1976, P.L. 94-429.

MANAGEMENT OF ANIMAL POPULATIONS

The Service will perpetuate the native animal life of the parks for their essential role in the natural ecosystems. Such management, conformable with general and specific provisions of law and consistent with the following provisions, will strive to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals in natural portions of parks as part of the park ecosystem.

Native species are those that occur, or occurred due to natural processes on those lands designated as the park. These do not include species that have moved into those areas, directly or indirectly as the result of human activities.

Native animal life in the National Park System shall be given protection against harvest, removal, destruction, harassment, or harm through human action, except where:

- hunting and trapping are permitted by law;

- fishing is permitted by law for either sport or commercial use or is not specifically prohibited;

- control of specific populations of wildlife is required for the maintenance of a healthy park ecosystem; or

- removal or control of animals is necessary for human safety and health.

Natural processes shall be relied upon to regulate populations of native species to the greatest extent possible. Unnatural concentrations of native species, caused by human activities, may be regulated if those activities causing the concentrations cannot be controlled. Non-native species shall not be allowed to displace native species if this displacement can be prevented by management. The need for, and results of, regulating animal populations, either native or non-native, shall be documented and evaluated by research studies.

(See Wildlife Observation VII-7.)

HUNTING

Hunting, trapping, or other methods of harvest of native wildlife, is not permitted by the public in natural and historic zones, except where specifically permitted by law. Where specifically authorized by Congress, public hunting shall be in accordance with applicable State and Federal laws and regulations. However, the Service may designate zones where, and establish periods when, no hunting shall be permitted for reasons of public safety, administration, or other public use and enjoyment of the area. Under the above provision, the Service, in consultation with States, may ban hunting in part or all of a park for any or all legally huntable game or non-game species for reasons of their:

- being officially designated as endangered, threatened, or locally of rare or unusual occurrence in the park;

- occurring in numbers below the natural capacity of their range; or

- being of greater overall value for wildlife viewing and interpretation.

Regulations prescribing such restrictions shall be issued after consultation with the States.

FISHING

Fishing has been traditionally permitted in the National Park System since the establishment of Yellowstone. The Service will continue this practice, but, in so doing, it affirms that:

- Waters may be closed to fishing to protect rare, threatened, or endangered plant and animal species in the waters on in adjacent habitat.

- Portions of park waters may be closed to fishing when the fish life and other aquatic life has greater value to greater numbers of visitors for the appreciation of plant and animal life, for scientific study, interpretation, or environmental education.

- Fishing may be prohibited in certain waters and at certain times when necessary to protect spawning grounds of endemic fish species or to maintain natural distributions of densities of native wildlife species that use fish for food.

- Fishing may be permitted in historic zones when it does not intrude adversely on the historic scene or harm cultural resources.

Where fishing is permitted, such fishing shall be carried out in accordance with applicable State and Federal laws and regulations. Park regulations may be different for native and non-native species and may be modified for specified waters. Commercial fishing is permitted only where authorized by law.

Natural Zones - Fisheries management shall be:

- specifically aimed towards preservation or restoration of the full spectrum of native species, including fish; and

- regulated for native species so that mortality is compensated by natural reproduction.

No artificial stocking of exotic fish species will occur; artificial stocking of fish may be employed only to reestablish native species. Areas that are added to the National Park System that have had an artificial stocking program shall phase it out. Waters naturally barren of fish will not be stocked with either native or exotic fish species but will be allowed to remain in, or revert to, their natural state.

Special Use Zones - Reservoirs, occurring in a number of areas, represent altered natural environments which may reduce populations of some native species of fish and encourage others. New ecological environments and niches are created which may be most successfully filled by exotic fish species; however, native species will be given precedence over exotic species wherever they are adaptable to the altered environment. Rivers and streams may be stocked with exotic species of fish when it has been determined that exotic species are already present and established and where scientific data indicate the introduction of exotics would not seriously diminish native species populations. Accordingly, the Service, in cooperation with State fish and game officials, may work out programs of fish stocking of reservoirs and other waters for purposes of recreational fishing, using either exotic or native species, or both. Active fishery management programs are encouraged in such waters.

WILDLIFE AND FISH MANAGEMENT IN SPECIFIED AREAS

In areas set aside with legal requirements for wildlife and fish management, the Service will still perpetuate native animal life and protect the integrity of natural ecosystems. Management will be directed towards maintaining populations of fish and wildlife for aesthetic, ecological, recreational, educational or scientific value. In those areas where recreational hunting, trapping, and fishing programs are authorized by law and consistent with park objectives, management programs may be directed toward the maintenance and enhancement of habitat for game animals (including fish, amphibians, mammals, birds, mollusks, and crustaceans). The management of fish and wildlife in these areas must be a cooperative endeavor with the States. These cooperative endeavors will be effected through a Memorandum of Understanding with the respective State.

REGULATION OF WILDLIFE POPULATIONS

Regulation of native animal populations in natural zones shall be permitted to occur by natural means to the greatest extent possible. In parks where hunting is not authorized by law, public hunting on land outside of the park is recognized as a means of controlling wildlife populations that move in and out of park boundaries. Cooperative studies and management plans with States and other Federal agencies will be initiated or continued to facilitate desirable public hunting outside of park boundaries, especially through extended or special seasons established by the States.

Other control measures to be used as necessary may include (1) live trapping in the areas for transplanting elsewhere; (2) providing research specimens for National Park Service and cooperating

scientists; and (3) direct reduction by Service personnel. It is recognized that it may be necessary, on occasion, to carry on various phases of this program simultaneously. The Service will adjust the use of these control measures to meet varying weather and other relevant conditions, giving highest priority to the opportunities for public hunting outside the parks and live trapping within parks for transplanting purposes.

The Service will control wildlife populations or individual animals when necessary for visitor safety and health. Where persistent control problems exist, the Service must determine whether or not curtailment or modification of visitor use and other human activities might not be a desirable alternative. Control may include trapping and transplanting or, only when necessary, destruction of offending animals.

DISPOSAL OF SURPLUS WILDLIFE AND CARCASSES

Where the Service removes animals from the parks, consistent with Service policy, the animals or their carcasses shall be disposed of in accordance with applicable agreements, laws, and regulations. Generally, first priority for disposal of ungulates, both live and as carcasses, is with the various Indian tribes in furtherance of their programs.

Cooperation with States - The Service will consult with the appropriate State fish and game departments in carrying out programs of control of populations of fish and wildlife, or research programs involving the taking of such fish and resident wildlife, including the disposition of carcasses. The Service will refer any resultant disagreements to the Secretary of the Interior, who shall provide for a thorough discussion of the problems with representatives of the affected State fish and game department and the Service for the purpose of resolving the disagreement.

REINTRODUCTION OF NATIVE PLANTS AND ANIMALS

The reintroduction of native species into parks is encouraged, provided that:

- adequate habitat exists in the park and on adjacent public lands and waters to support the species;

- the species, based on an effective management plan, does not pose a serious threat to the safety of park visitors or park resources, or to persons or property outside of park boundaries;

- the species being reintroduced most nearly approximates the extirpated subspecies or race;

- the species disappeared, or was substantially diminished, because of human-induced changed--either directly or indirectly--to the ecosystem; and

- confinement of the animals by fencing will be permitted only until the animals become thoroughly accustomed to the new area or they have become established sufficiently that threats from predators, poaching, disease, or other factors have been minimized.

Such programs will be carried out in cooperation with other affected parties and agencies.

THREATENED AND ENDANGERED PLANTS AND ANIMALS

The Service will identify all threatened and endangered species within park boundaries and their critical habitat requirements. As necessary, the Service shall control visitor use and access to such habitat, including closure to entry for other than official purposes. Active management programs, where necessary, may be carried out to perpetuate the natural distribution and abundance of threatened or endangered species and the ecosystem on which they depend, in accordance with existing Federal laws.

The Service will cooperate with the Fish and Wildlife Service, which is recognized as the lead agency in matters pertaining to threatened or endangered species, including delineation of critical habitat on parklands.

Plant and animal species considered to be rare or unique to a park shall be identified also and their distribution within the park mapped. Management actions for their protection and perpetuation shall be incorporated into the natural resources management plan.

Reference: Endangered Species Act of 1973, December 28, 1973, (P.L. 93-205, 87 Stat. 884)

(See Natural Resources Management Plan IV-3, Research and Collecting Permits VII-20.)

EXOTIC PLANTS AND ANIMALS

Definitions - Exotic species are species that occur in a given place, area, or region as the result of direct or indirect, deliberate or accidental introduction of the species by humans. For example, species that humans deliberately have introduced into, and established in, the

Control of Exotic Species Already Present in a Park - Manipulation of population numbers of exotic plant and animal species, up to and including total eradication, will be undertaken whenever such species threaten protection or interpretation of resources being preserved in the park. Examples of threatening situations include: 1) being detrimental to public health, 2) disrupting the faithful presentation of the historic scene, 3) damaging historic and archeological resources, 4) threatening the perpetuation of natural features, native species (including especially those that are endangered, threatened, or otherwise unique), natural ecological communities, or natural ecological processes, and 5) significantly hampering the management of adjacent park or non-park lands. Control programs will most likely be taken against exotic species which have a high impact on protected park resources and where the program has a reasonable chance for successful control; programs are least likely to be initiated against exotic species which have almost no impact on park resources and where there is a minimal probability for successful control. The decision to initiate a control program will be based on existing and newly acquired, scientifically valid resource information that identifies the exotic status of the species, demonstrates its impact on park resources, and indicates alternative control methods and their probabilities of success. Development of a control plan and implementation of actions to protect the park resources will be done according to established planning procedures and will include provisions for public review and comment. Care will be taken that programs to control exotic species do not result in significant damage to native species, natural ecological communities, natural ecological processes, or historic objects.

INSECT AND DISEASE CONTROL

Native insects and diseases existing under natural conditions are natural elements of the ecosystem. Accordingly, populations of native insects and the incidence of native diseases will be allowed to function unimpeded except where control is required (1) to prevent the loss of the host or host-dependent species from the ecosystem; (2) to prevent outbreaks of the insect or disease from spreading to forests, trees, other vegetative communities, or animal populations outside the area; (3) to conserve threatened or endangered, or unique plant specimens or communities; (4) to conserve and protect flora and fauna in developed zones; or (5) for reasons of public health and safety.

The basic objective of insect and disease control in historic zones is to preserve, maintain, or restore the historical integrity of the area. A concerted effort will be made to prolong the life of any

historically significant tree, grove, woodland, forest, or other plant community extant at or representative of the time of the event commemorated. The occurrence of normal endemic populations may be typical of historic, pesticide-free times.

Control operations may be initiated (1) to protect the integrity of the historic scene and (2) to prevent outbreaks from spreading to uninfested forests or trees outside the area.

The measure of control in wilderness areas will be the minimum necessary to prevent escape from the wilderness environment.

PESTICIDE USE

Chemical pesticides of any type will be used only where feasible alternatives are not available or acceptable. The Service's use of all pesticides shall be approved by the Director. Application shall be in accordance with applicable laws, Departmental and Service guidelines, and Environmental Protection Agency and Occupational Health and Safety Administration regulations.

(See Water IV-17.)

FIRE MANAGEMENT

Fire is a powerful phenomenon with the potential to drastically alter the vegetative cover of any park.

The presence or absence of natural fires within a given ecosystem is recognized as a potent factor stimulating, retarding or eliminating various components of the ecosystem. Most natural fires are lightning-caused and are recognized as natural phenomena which must be permitted to continue to influence the ecosystem if truly natural systems are to be perpetuated.

The fire management program of all parks must be designed around park objectives. In natural systems this may include the need for some areas to proceed through succession toward climax while others are set back by fire. Natural zones should represent the full spectrum of the parks' dynamic natural vegetative patterns. Sharply defined zones or blocks of vegetation limited to certain species locked in over time are not natural and only rarely justified. In historic zones fires may be controlled or used to perpetuate the historic scene.

(See Wilderness--Fire Management VI- 8.)

MANAGEMENT FIRES

Management fires, including both prescribed natural fires and prescribed burns, are those fires which contribute to the attainment of the management objectives of a park through execution of predetermined prescriptions defined in detail in the Fire Management Plan, a portion of the approved Natural Resources Management Plan.

Prescribed natural fire is the preferred means to achieve the prescriptions in natural zones. This use of natural ignition may be adopted when analysis of past fire occurrence, distribution, control, and influence, indicates that natural vegetative accumulation and composition has not been significantly altered by past management of fire control. It may also be used where the prescription provides for a transition from an altered state back to historic fuel loading.

In ecosystems modified by prolonged exclusion to fire, prescribed burning may be used to restore fuel loading or vegetative composition to natural levels followed by a prescribed natural fire program, or to create narrow fuel breaks along boundaries of a fire management area and thereby reduce the probability of wildfires crossing into or out of that area.

Prescribed burning may be used as a substitute for prescribed natural fire in natural zones only where the latter cannot meet park objectives. This determination will be documented in the Fire Management Plan. In natural zones, the objective for prescribed burning is to simulate, to the fullest extent, the influence of natural fire on the ecosystem. In other zones it may be used to recreate or perpetuate a historic setting or to attain other resources management objectives.

Clearly defined limits will be established in the prescription of all management fires, beyond which limited or complete control action will be undertaken.

Management fires in the park will be suppressed if they threaten:

- human life;
- cultural resources or physical facilities of the park;
- threatened or endangered species;
- to escape from predetermined zones or from the park, except where cooperative agreements provide for certain fires to cross such boundaries; or
- to exceed the prescription.

inside the Federal reservation or outside. All disposal will be in compliance with guidelines promulgated in the Solid Waste Disposal Act, which apply to waste generated by visitors, concessioners, contractors, park staff, and all other park users. In addition, any park area which issues any license or permit for disposal of solid waste on Federal property shall, before issuance of such license or permit, consult with the Environmental Protection Agency to insure compliance with guidelines contained in this Act.

The Service shall promote the use of biodegradable materials and the reuse and recycling of materials to the degree possible. Waste disposal sites outside of the park will be chosen whenever practical, but if this is impossible, in-park sites for disposal by sanitary landfill shall be carefully selected. Incineration as a means of solid waste disposal shall be used only if there is no other feasible alternative and shall be in compliance with applicable laws and regulations.

(See Comfort Stations III-10, Wilderness--Refuse Disposal VI-6 , Backcountry Sanitation VII-12.)

NOISE

Activities causing excessive or unnecessary noise in and adjacent to parks will be monitored and action taken to avoid or minimize noise which detracts from the visitor's enjoyment of park values, unduly disturbs the peace of adjacent neighborhoods, or adversely affects park resources. Maximum noise limits tolerated will, at least, be consistent with OSHA regulations and applicable State and local laws and regulations.

(See Design and Construction Considerations III- 5.)

LANDSCAPE AND VEGETATIVE MANIPULATION

Within the four primary management zones that may occur in parks, programs of landscape and vegetative manipulation have differing purposes and are carried out to achieve approved uses.

Examples are Turkey Run Farm in Washington, D.C., and the pastoral area at Point Reyes National Seashore. Management may include but is not limited to:

- encouragement of certain species of plants for aesthetic or wildlife and vegetative management purposes;

- maintenance of certain plant associations for approved livestock or agricultural uses;

- increasing the ability of certain areas to absorb recreational use through vegetative management; and

- retention of provision of open areas, meadows, vistas.

(See Management Zoning II- 3, Disposal of Trees and Other Natural Resources IV- 3, Exotic Plants and Animals IV-11, Fire Management IV- 13 Inventory of Cultural Resources V- 4, Proposal Formulation Affecting Cultural Resources V- 11 Pesticide Use IV-13.)

NATURAL ZONES

Manipulation of terrain and vegetative cover may be carried out to restore natural conditions on lands altered by human activity through, but not restricted to the following:

- removal of man-made features, restoration of natural gradients, and revegetation with native park species on acquired inholdings and sites from which park development is to be removed;

- restoration, to a natural appearance, of areas disturbed by fire control activities; and

- minor or infrequent rehabilitation of limited visitor impacted areas. Regular activities such as vista clearings should be limited to defined Landscape Management Area Subzones.

Conditions caused by natural phenomena such as landslides, earthquakes, floods, and natural fires will be modified as little as possible commensurate with public safety and the reconstruction--if necessary and desirable--of public use facilities in the affected area.

HISTORIC ZONES

Trees, other vegetation, and other natural features in a historic zone shall be managed to reflect the historic scene which prevailed during the historic period.

Every effort shall be made to extend the lives of specimen trees dating from the historic period. An individual tree of historical value posing a safety hazard, and diseased beyond recover, shall be removed and replaced. Provisions should be made, while unique trees or shrubs are healthy, for their eventual replacement by progeny through sprout, seed or cuttings.

(See Exotic Plants and Animals IV-11, Insect and Disease Control IV-12, The Historic Scene V-24.)

SPECIAL USE ZONES

Primary authority over these lands rests with entities other than the National Park Service. The management of the national resources of these zones will be directed (to the maximum extent possible) toward achievement of the defined objectives of the park. Vegetative manipulation may be used to achieve these objectives.

(See Exotic Plants and Animals IV-11.)

PARK DEVELOPMENT ZONES

Management of landscape and vegetation in developed areas shall be commensurate to the greatest extent possible with the purpose of a given park. The landscape and vegetation should be managed to affect the transition between park developments and the terrain, biota, and physical appearance of surrounding management zones commensurate with the requirements and impacts of visitor use.

Rehabilitation and maintenance is expected on areas impacted by visitor use including, if necessary, the redesign, relocation, removal--or the provision--of facilities to avoid or ameliorate adverse visitor impacts on the ecosystem.

(See Construction III-6, Design Quality and Control III-5, Employee and Community Gardens IV-4, Exotic Plants and Animals IV-11.)

WEATHER MODIFICATION

Weather modification projects affecting parks generally are in conflict with the congressional mandate to perpetuate the integrity of the park environment. Therefore, the National Park Service is opposed to modification proposals unless it can be conclusively demonstrated that weather modification will not influence the natural or historic environments of National Park System areas.

(See Hydrometeorologic Devices VI-6.)

CAVE MANAGEMENT

The National Park Service will manage caves for the perpetuation of their natural, geological and ecological conditions, and historic associations.

Developments such as artificial entrances, enlargement of natural entrances, pathways, lighting, interpretive devices, ventilation

Compilation of Wildlife Data[1]

	Interior Department Letter of May 31, 1974				Ronald G. Starkey				Fels				Biotic Surveys, Items DD, EE, FF (U.S. only)				Richard D. Taber (U.S. only)			
	Current Numbers	Ref.	Losses	Ref.	Current Numbers	Ref.	Losses	Ref.	Current Numbers	Ref.	Losses	Ref.	Current Numbers	Ref.	Losses	Ref.	Current Numbers	Ref.	Losses	Ref.
Deer	900	pp.3,6	350	p.11	900-1200	Tr 7671	650	Tr 7632	250-600	2-6	25-35% (73-210)	3-6	500-600	Item DD App. E p.2			250-300	Tr 5451	1/3 (83-100)	Tr 5445 5484
Cougars	40	p.6	25	p.11			2-6	Tr 7632												
Black bears	90	p.6	50	p.11			10-12	Tr 7632									12	Tr 5529 (Big Beaver Valley only)	2	Tr 5530
Bobcats	50	p.6	30	p.11			5	Tr 7632												
Coyotes	40	p.6	20	p.11			30	Tr 7632												
Raccoons	40	p.6	20	p.11																
Martens	180	p.6	100	p.11																
Minks	50	p.6	30	p.11			200	Tr 7632												
Weasels	180	p.6	140	p.11																
Otters	40	p.6	20	p.11																
Beavers	90	p.6	100	p.11			60	Tr 7631	35 (Big Beaver Valley only	3-7	50% (17)	3-7	35-45	Item DD App. G p. 14	50% (17-23) (Big Beaver only)	Item DD App. G p.14	34-36	Tr 5445 (Big Beaver Valley only)	4 (17-18)	Tr 5484
Porcupines																				
Squirrels	52,000	p.6	32,000	p.11			14,000	Tr 7632												
Chipmunks							28,000	Tr 7632												
Hares, pikas	76,000	p.6	41,000	p.11			7,000	Tr 7632												
Shrews, voles							35,000	Tr 7632												
Mice, moles							35,000	Tr 7632												
Pocket mice							70,000	Tr 7632												
Grouse	110	p.6	60-100	p.11			80-100	Tr 7632							95%	Item FF p.D-10				
Songbirds, Raptors, Waterfowl	Several hundred species	p.6	30-35% of total habitat	p.11			28,000-30,000	Tr 7632	187	App. B			133 species	Item EE App. B	28 species would suffer losses from 15-100%. Median loss 80%.	Item FF p. D-10				

Source: Margaret and Joseph Miller, Bellevue, Wash.

1. Exact references for this table are not known. The table is included to indicate differences of opinion regarding wildlife population losses due to High Ross.

APPENDIX E

APPENDIX F

HABITAT EVALUATION OF COMPENSATION SITES

Each compensation measure chosen will increase HSI values (habitat values/acre) of habitat types.

Three Game Department biologists applied Habitat Evaluation Procedures to theoretically optimum designs for pond/marsh sites, overstory removal, and drawdown seeding. From this optimum HSI value existing HSI values of the sites were subtracted to obtain net HSI values. Net HSI values were multiplied by the number of acres affected to obtain the total HU values offset by each compensation measure.

Points were assigned to some compensation measures in a manner suggested by Gill (1974). In calculating the net habitat unit value for pond/marsh sites, an additional HSI value of 10 was added to all habitat types within a one-fourth mile radius of the site. Adjacent areas are assumed to increase in value to wildlife by an average of one HSI point per species, due to the presence of the pond/marsh.

Leaving snags near shore, below high pool, should provide feeding, perching and some nesting habitat for birds, resulting in a net HSI gain of an estimated 5 points. There are a total of 434 acres near proposed high pool where snags can be left.

Appendix G lists the net Habitat Unit values for each of the compensation measures.

APPENDIX G

COMPILATION OF HU GAIN/ACRE FOR EACH SITE

	HU gain/acre	Acres	HUs
On-site			
Overstory removal	12.8-30.0	1,557	30,786
Pond/Marsh	68.0	14	952
1/4-mile radius of pond/marsh	10.0	1,130	11,300
Seeded drawdown	15.0	114	1,710
Snags in drawdown	5.0	434	2,170
Shoreline planting	30.5	39	1,190
			48,108
S.F. Nooksack R.			
Protection			
Old-growth	27.6	801	22,107.6
Mature Mixed	27.1	33	894.3
Mature Conifer	15.4	550	8,470.0
Mature Broadleaf	5.6	38	212.8
Riparian Mature Mixed	27.1	32	817.2
Beaver Pond	--	9	--
Broadleaf swamp	15.3	33	504.9
Pole conifer-shrub	14.1	12	169.2
Pole mixed	8.8	19	167.2
Riparian pole broadleaf	6.1	1	6.1
Pond Construction			
Clearcut (2)	23.6	2.6, 1.0	85.0
Mature Broadleaf	36.4	2.0	72.8
Pole Broadleaf	38.6	4.5	173.7
Pole Mixed (4)	25.8	4.5, 1.2, 2.1, 1.0	227.0
Pole Broadleaf	38.6	4.0	154.4
Mature Conifer	26.6	2.0	53.2
Mature Mixed	16.9	6.0	101.4
Pole Broadleaf	38.6	2.5	96.5
Mature Broadleaf	36.4	0.5	18.2
Pond influence	10.0	1,002.6	10,026.0
Overstory removal			
Pole stage conifer	19.0	219.7	4,174.3
Pole stage broadleaf	16.2	277	4,487.4
Pole stage mixed	9.6	121	1,161.6
Mature broadleaf	19.6	86	1,685.6
Clearcut	11.4	519	5,916.6

APPENDIX G (Continued)

	HU gain/acre	Acres	HUs
Streamside Management			
Riparian regenerating broadleaf	8.1	5.1	41.3
Regenerating mixed	--	14.1	--
Clearcut	10.0	10.0	100.0
			61,924.4
Skagit R. (SCL)			
Overstory removal			
Pole stage conifer	19.0	5	95.0
Regen. broadleaf	10.6	6	63.6
Pole stage broadleaf	16.2	35	567.0
Mature broadleaf	19.6	42	823.2
Mixed pole	14.2	16	227.2
Mixed mature	24.6	3	73.8
Pond construction			
Riparian pole broadleaf	35.9	5.0	179.5
Mature broadleaf	36.4	3.3	120.1
Mature mixed riparian	16.9	5.0	84.5
Mature broadleaf riparian	29.7	1.0	29.7
Pond influence	10.0	223.0	2,230.0
			4,493.6
Diablo Dam			
Overstory clearing			
Pole stage conifer	21.1	156	3,291.6
Cascade R. (Publishers)			
Overstory clearing			
Clearcut	11.4	84	957.6
Pond construction (3 ponds)			
Clearcut (Marsh)	23.6	4.0	94.4
Clearcut	23.6	4.0	94.4
Riparian mature broadleaf	29.7	10.0	297.0
Riparian pole broadleaf	35.9	8.0	286.4
Shrub swamp	14.7	2.0	29.4
Pond influence	10.0	180.0	1,800.0
			3,559.2

APPENDIX G (Continued)

	HU gain/acre	Acres	HUs
Cascade R. (DNR)			
Protection			
Pole stage conifer	7.6	151	1,147.6
Mature conifer	15.6	351	5,475.6
Old-growth	28.6	336	9,609.6
Riparian mature conifer	24.4	53	1,293.2
Vegetated Talus	21.7	17	368.9
Conifer/exposed rock	0.1	4	0.4
Overstory clearing			
Pole stage conifer	19	80	1,520.0
			19,415.3
Twisp R.			
Protection	16.2	437.9	7,094.0
Toats Coulee			
Protection	8.4	700.1	5,882.1

APPENDIX H

CALCULATION OF NET HABITAT UNIT GAINS FROM OFF-SITE MITIGATION MEASURES

Area	Treatment	Habitat Type	w/o treatment	w/treatment	Net Change
			HUs/acre		
S.F. Nooksack R.	Protection	Old-growth	3 yrs. 451 @ 5.2 10 yrs. 411 @ 22.5 37 yrs. 412 @ 21.0 50 yr. avg. = 20.4	50 yrs. 414 @ 48.0 50 yr. avg. = 48.0	+27.6
S.F. Nooksack R.	Protection	Mature mixed	3 yrs. 451 @ 5.2 10 yrs. 411 @ 22.5 37 yrs. 412 @ 21.0 50 yr. avg. = 20.4	50 yrs. 433 @ 47.5 50 yr. avg. = 47.5	+27.1
S.F. Nooksack R.	Protection	Mature broadleaf	3 yrs. 451 @ 5.2 10 yrs. 411 @ 22.5 37 yrs. 412 @ 21.0 50 yr. avg. = 20.4	50 yrs. 423 @ 26.0 50 yr. avg. = 26.0	+ 5.6
S.F. Nooksack R.	Protection	Mature conifer	3 yrs. 451 @ 5.2 10 yrs. 411 @ 22.5 37 yrs. 412 @ 21.0 50 yr. avg. = 20.4	50 yrs. 413 @ 35.8 50 yr. avg. = 35.8	+15.4
S.F. Nooksack R.	Protection	Riparian mature mixed	Same as mature mixed		+27.1
S.F. Nooksack R.	Protection	Beaver Pond	Not threatened with cutting		0
S.F. Nooksack R.	Protection	Pole conifer/shrub	Same as above 50 yr. avg. = 20.4	20 yrs. 4121 @ 32.6 30 yrs. 413 @ 35.8 50 yr. avg. = 34.5	+14.1
S.F. Nooksack R.	Protection	Pole staged mixed	50 yrs. 412 @ 21.0	50 yrs. 432 @ 30.8	+ 8.8
S.F. Nooksack R.	Protection	Riparian pole stage broadleaf	3 yrs. 451 @ 5.2 10 yrs. 441 @ 22.5 37 yrs. 421 @ 21.0 50 yr. avg. = 20.4	30 yrs. 4622 @ 22.3 20 yrs. 4623 @ 32.7 50 yr. avg. = 26.5	+ 6.1

APPENDIX H (Continued)

Area	Treatment	Habitat Type	w/o treatment	w/treatment	Net Change
			HUs/acre		
S.F. Nooksack R.	Pond construction	Clearcut	3 yrs. 451 @ 5.2 10 yrs. 411 @ 22.5 37 yrs. 412 @ 21.0 50 yr. avg. = 20.4	10 yrs. EP[1] @ 30.0 10 yrs. MP[1] @ 40.0 30 yrs. MP[2] @ 50.0 50 yr. avg. = 44.0	+23.6
S.F. Nooksack R.	Pond construction	Mature broadleaf	50 yrs. 423 @ 26.0 50 yr. avg. = 26.0	10 yrs. MP1 @ 40.0 40 yrs. 522 @ 68 50 yr. avg. = 62.4	+36.4
S.F. Nooksack R.	Pond construction	Pole stage broadleaf	30 yrs. 422 @ 22.3 20 yrs. 423 @ 26.0 50 yr. avg. = 23.8	10 yrs. MP1 @ 40 40 yrs. 522 @ 68 50 yr. avg. = 62.4	+38.6
S.F. Nooksack R.	Pond construction	Pole stage mixed	30 yrs. 432 @ 30.8 20 yrs. 422 @ 45.4 50 yr. avg. = 36.6	10 yrs. MP1 @ 40 40 yrs. 522 @ 68 50 yr. avg. = 62.4	+25.8
S.F. Nooksack R.	Pond construction	Mature conifer	50 yrs. 413 @ 35.8 50 yr. avg. = 35.8	10 yrs. MP1 @ 40 40 yrs. 522 @ 68 50 yr. avg. = 62.4	+26.6
S.F. Nooksack R.	Pond construction	Mature mixed	50 yrs. 422 @ 47.5 50 yr. avg. = 47.5	10 yrs. MP2 @ 50 40 yrs. 522 @ 68 50 yr. avg. = 64.4	+16.9
S.F. Nooksack R.	Overstory removal	Pole stage conifer	50 yrs. 412 @ 21.0	50 yrs. MT[5] @ 40.0	+19.0
S.F. Nooksack R.	Overstory removal	Pole stage broadleaf	30 yrs. 422 @ 22.3 20 yrs. 423 @ 26.0 50 yr. avg. = 23.8	50 yrs. MT @ 40 50 yr. avg. = 40.0	+16.2
S.F. Nooksack R.	Overstory removal	Pole stage mixed	30 yrs. 432 @ 30.8 20 yrs. 433 @ 47.5 50 yr. avg. = 37.4	30 yrs. MT @ 40.0 20 yrs. MT2 @ 50 50 yr. avg. = 47.0	+ 9.6
S.F. Nooksack R.	Protection	Broadleaf swamp	3 yrs. 451 @ 5.2 10 yrs. 411 @ 22.5 37 yrs. 412 @ 21.0 50 yr. avg. = 20.4	50 yrs. 6122 @ 35.7 50 yr. avg. = 35.7	+15.3

APPENDIX H (Continued)

Area	Treatment	Habitat Type	w/o treatment	w/treatment	Net Change
			HUs/acre		
S.F. Nooksack R.	Overstory removal	Mature broadleaf	50 yr. avg. = 20.4	50 yrs. MT @ 40.0	19.6
S.F. Nooksack R.	Overstory removal	Mature mixed	50 yr. avg. = 20.4	50 yrs. MT2 @ 50	29.6
S.F. Nooksack R.	Overstory removal	Regenerating conifer	Clear after 20 yrs. 30 yrs. 412 @ 21.0 50 yr. avg. = 12.6	 30 yrs. MT @ 40 50 yr. avg. = 24	 +11.4
S.F. Nooksack R.	Overstory removal	Regenerating broadleaf	Clear after 20 yrs. 30 yrs. 422 @ 22.3 50 yr. avg. = 13.4	 30 yrs. MT @ 40 50 yr. avg. = 24	 +10.6
S.F. Nooksack R.	Streamside rehabilitation	Riparian regenerating broadleaf	10 yrs. 421 @ 22.1 40 yrs. 422 @ 22.3 50 yr. avg. = 22.3	10 yrs. 431 @ 28.6 40 yrs. 432 @ 30.8 50 yr. avg. = 30.4	 + 8.1
S.F. Nooksack R.	Streamside rehab.	Regenerating mixed	No change in type		
S.F. Nooksack R.	Streamside rehabilitation	Clearcut	3 yrs. 451 @ 5.2 10 yrs. 411 @ 22.5 37 yrs. 412 @ 21.0 50 yr. avg. = 20.4	10 yrs. 431 @ 28.6 40 yrs. 432 @ 30.8 50 yr. avg. = 30.4	 +10.0
Twisp R.	Protection	Various types	50 yrs. developed land @ 10.0	Average type = 26.2	+16.2
Toats Coulee	Protection	Various types	50 yrs. developed land @ 10.0	Average type = 18.4	+ 8.4
RLNRA	Overstory removal	Pole stage conifer	50 yrs. 412 @ 18.9	50 yrs. MT @ 40.0	+21.1
RLNRA	ROW rehabilitation	Sapling conifer	50 yrs. 411 @ 18.3	50 yrs. 321 @ 30.5	+12.2
RLNRA (SCL)	Overstory removal	Pole and mature conifer	50 yrs. MT @ 40.0	Average type = 29.6	+10.4
RLNRA (SCL)	ROW rehabilitation	Conifer/shrub	50 yrs. 147 @ 20.4	50 yrs. 321 @ 30.5	+10.1
RLNRA (SCL)	Pond construction	Same as those for S.F. Nooksack R.			
Cascade R.	Protection	Old-growth	3 yrs. 451 @ 5.6 10 yrs. 411 @ 21.5 37 yrs. 412 @ 21.0 50 yr. avg. = 20.2	50 yrs. 414 @ 48.8 50 yr. avg. = 48.8	 +28.6
Cascade R.	Protection	Mature conifer	50 yr. avg. = 20.2	50 yrs. 413 @ 35.8	+15.6
Cascade R.	Protection	Riparian mature conifer	50 yr. avg. = 20.2	50 yrs. 4613 @ 44.6	+24.4

APPENDIX H (Continued)

Area	Treatment	Habitat Type	w/o treatment	w/treatment	Net Change
			HUs/acre		
Cascade R.	Protection	Pole stage conifer	No threat 1st 30 yrs. 3 yrs. 451 @ 5.6 10 yrs. 411 @ 21.5 7 yrs. 412 @ 21.0 50 yr. avg. = 7.6	20 yrs. 413 @ 35.8 50 yr. avg. = 14.3	+ 6.7
Cascade R.	Protection	Vegetated talus	Same as old-growth 20.2	50 yrs. 7131 @ 41.9 41.9	+21.7
Cascade R.	Protection	Conifer/exposed rock	Same as old-growth 20.2	50 yrs. 441 @ 20.3 20.3	+ 0.1
Cascade R.	Pond construction	Riparian mature broadleaf	50 yrs. 4623 @ 32.7 50 yr. avg. = 32.7	10 yrs. MP1 @ 40.0 40 yrs. 422 @ 68 50 yr. avg. = 62.4	+29.7
Cascade R.	Pond construction	Riparian pole stage broadleaf	30 yrs. 4622 @ 22.3 20 yrs. 4623 @ 32.7 50 yr. avg. = 26.5	10 yrs. MP1 @ 40 40 yrs. 522 @ 68 50 yr. avg. = 62.4	+35.9
Cascade R.	Pond construction	Shrub swamp	50 yrs. 611 @ 47.7	Same as above 50 yr. avg. = 62.4	+14.7
Cascade R.	Overstory removal	Clearcut	Clear after 20 yrs. 30 yrs. 412 @ 21.0 50 yr. avg. = 12.6	30 yrs. MT @ 40 50 yr. avg. = 24.0	+11.4

[1] w/o treatment assumes the area will be logged followed by listed successional stages.
[2] EP - early pond with little shoreline development.
[3] MP1 - pond with regenerating forest.
[4] MP2 - pond with pole stage and mature forest.
[5] MT - mixed type, pole stage and shrub.
[6] MT2 - mixed type, mature forest and shrub.

APPENDIX I

HABITAT SUITABILITY INDICES OF OFF-SITE HABITAT TYPES

Location	Habitat type	Habitat Code	Habitat Suitability Index
Skagit R. (SCL)	Regenerating broadleaf	421	14.6
	Pole stage broadleaf	422	27.2
	Mature broadleaf	423	31.9
	Powerline ROW	147	20.4
Diablo Dam	Pole stage conifer	412	18.9
	Powerline ROW	147	18.3
S.F. Nooksack R.	Regenerating conifer	411	22.5
	Pole stage conifer	412	21.0
	Old-growth - Douglas-fir	414	48.0
	Old-growth - Red cedar	414	44.9
	Regenerating broadleaf	421	22.1
	Pole stage broadleaf	422	22.3
	Mature broadleaf	423	26.0
	Regenerating mixed	431	28.6
	Pole stage mixed	432	30.8
	Conifer/exposed rock	441	20.3
	Clearcut	451	5.2
	Beaver pond	523	27.3
	Broadleaf swamp	6122	35.7
Twisp R.	Riparian broadleaf	462	41.5
	Pole stage broadleaf	422	26.9
	Riparian pole stage mixed	4632	46.2
	Riparian mature mixed	4633	41.8
	Mixed conifer	416	34.6
	Ponderosa pine	415	25.6
	Bitterbrush	325	23.7
Cascade R.	Regenerating conifer	411	21.5
	Pole stage conifer	412	32.6
	Mature conifer	413	35.8
	Old-growth	414	48.8
	Pole stage mixed	432	38.1
	Clearcut	451	5.6
	Meadow	311	10.0
	Riparian shrub	331	44.6
	Riparian mature conifer	4613	44.6
	Riparian mature broadleaf	4623	32.7
	Riparian mature mixed	4633	47.5
	Shrub swamp	611	47.7
	Broadleaf swamp	6122	47.1

APPENDIX I (Continued)

Location	Habitat type	Habitat Code	Habitat Suitability Index
Toats Coulee	Grassland	313	6.3
	Sagebrush	324	7.7
	Bitterbrush	325	13.5
	Regenerating conifer	411	26.9
	Pole stage conifer	412	25.0
	Riparian pole stage conifer	4612	11.9
	Riparian pole stage mixed	4632	38.2
	Riparian mature mixed	4633	45.4
	Ponderosa pine	415	24.6
	Conifer/exposed rock	441	36.9
	Shrub/exposed rock	323	16.9
	Vegetated talus	7131	17.7