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April 27, 1999
PUD No. 20559

Mr. Gary Engman
Washington Dept. of Wildlife
Region 4
16018 Mill Creek Blvd.
Mill Creek, WA 98012

Mr. Gwill Ging
U.S. Fish & Wildlife Service
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Department of Natural Resources
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Sedro Woolley, WA 98284

Mr. Daryl Williams
Tulalip Tribes, Inc.
6700 Totem Beach Road
Marysville, WA 98270

Reference: Wildlife Habitat Management Plan
1998 Annual Report
Jackson Hydroelectric Project – FERC #2157 License Article 53

Gentlemen:

A copy of the 1998 Annual Report on the Jackson Project Wildlife Habitat Management Program is enclosed for your records.

If you have any questions or concerns, please contact me at 425-783-1746.

Sincerely,

Karen Bedrossian
for
Bernice Tannenbaum
Environmental Coordinator

Enclosure
BT:nda

Cc: Mr. Don Farwell, City of Everett
Public Works Department

1998 ANNUAL PROGRESS REPORT

WILDLIFE HABITAT MANAGEMENT PROGRAM

For the

HENRY M. JACKSON HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
Project Number 2157 – License Article 53

Submitted by

PUBLIC UTILITY DISTRICT NO. 1 OF SNOHOMISH COUNTY

and

THE CITY OF EVERETT, WASHINGTON

April 1999

1998 ANNUAL PROGRESS REPORT
WILDLIFE HABITAT MANAGEMENT PLAN

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1.0 SUMMARY

1.1 MAJOR TASKS ACCOMPLISHED DURING 1998

- Tiki Sale sold and harvested (Lake Chaplain Tract)
- Road constructed and right-of-way seeded (Lake Chaplain Tract)
- Continued work on Linetree Sale layout (Lake Chaplain Tract)
- Preliminary layout of two year-2000 harvest units at Lost Lake Tract
- Brush control and re-planting on 1991-2 harvest unit (Lake Chaplain Tract)
- Lake Chaplain plantations monitored
- Lake Chaplain access roads maintained
- Monitored understory vegetation and water quality on biosolids application sites (Lake Chaplain Tract)
- Snag inventory and creation (Lake Chaplain Tract, Lost Lake Tract)
- Snag tree monitoring (Lake Chaplain Tract, Lost Lake Tract)
- Deer forage monitoring (Lake Chaplain Tract)
- Seeding of power pipeline ROW
- Monitoring of vegetation coverage on power pipeline ROW
- Monitoring of test plantings in the Spada Lake drawdown zone
- Monitoring of nest structures
- Monitoring of revegetation and wetland sites
- Excess trees removed from ROW along Chaplain Marsh and north end of Lake Chaplain
- Management program developed for Williamson Creek Tract

1.2 TASKS SCHEDULED FOR 1999:

- Replant and re-seed Tiki Sale units (Lake Chaplain Tract)
- Begin layout of unnamed 1999 sale (Lake Chaplain Tract)
- Complete layout of Linetree Sale units, and offer for sale (Lake Chaplain Tract)
- Biosolids application site monitoring – understory vegetation and water quality (Lake Chaplain Tract)
- Harvest unit stocking monitoring (Lake Chaplain Tract)
- GPS data collection (Lake Chaplain Tract)
- Continue year 2000 sale layout at Lost Lake Tract
- Continue snag management program on Lake Chaplain and Lost Lake Tracts
- Snag inventory on Spada Lake Tract and Williamson Creek Tract
- Monitor nest structures
- Monitor revegetation sites
- Deer forage monitoring (Lake Chaplain)
- Coarse woody debris monitoring on Lake Chaplain harvest units
- Monitor buffer zones and green tree areas in harvested units (Lake Chaplain Tract)

- *Monitor precommercial thinning units (Spada Lake Tract, Lost Lake Tract)*
- Layout of precommercial thinning units at Spada Lake Tract
- Plant shrubs on pipeline ROW
- Monitor vegetation coverage on pipeline ROW

Problems or changes needed during implementation of the WHMP are discussed in this report, and updated schedules are presented. A cumulative summary of tasks accomplished since the initiation of the Wildlife Habitat Management Plan (WHMP) in 1989 is presented in this report. A draft of this report was submitted for comments to the U.S. Fish and Wildlife Service (USFWS), the Washington Department of Fish and Wildlife (WDW), and the Tulalip Tribes. The Washington Department of Natural Resources (DNR) was also consulted.

2.0 INTRODUCTION

The 1998 Annual Progress Report on the Wildlife Habitat Management Plan (WHMP) for the Henry M. Jackson Hydroelectric Project was prepared by Public Utility District No. 1 of Snohomish County (District) and the City of Everett (City), who are co-licensees in the Project. The WHMP project area and management tracts are shown in Figure 1.

This annual report describes activities conducted during calendar year 1998 and summarizes activities completed since the management program was initiated in 1989. Activities anticipated for the calendar year 1999 are described. Activities, procedures and schedules described in this report are based on the WHMP approved by the Federal Energy Regulatory Commission on May 19, 1989, in accordance with Project License Article 53 and subsequent related orders from the Commission.

3.0 WORK COMPLETED DURING 1998

3.1 FOREST VEGETATION MANAGEMENT

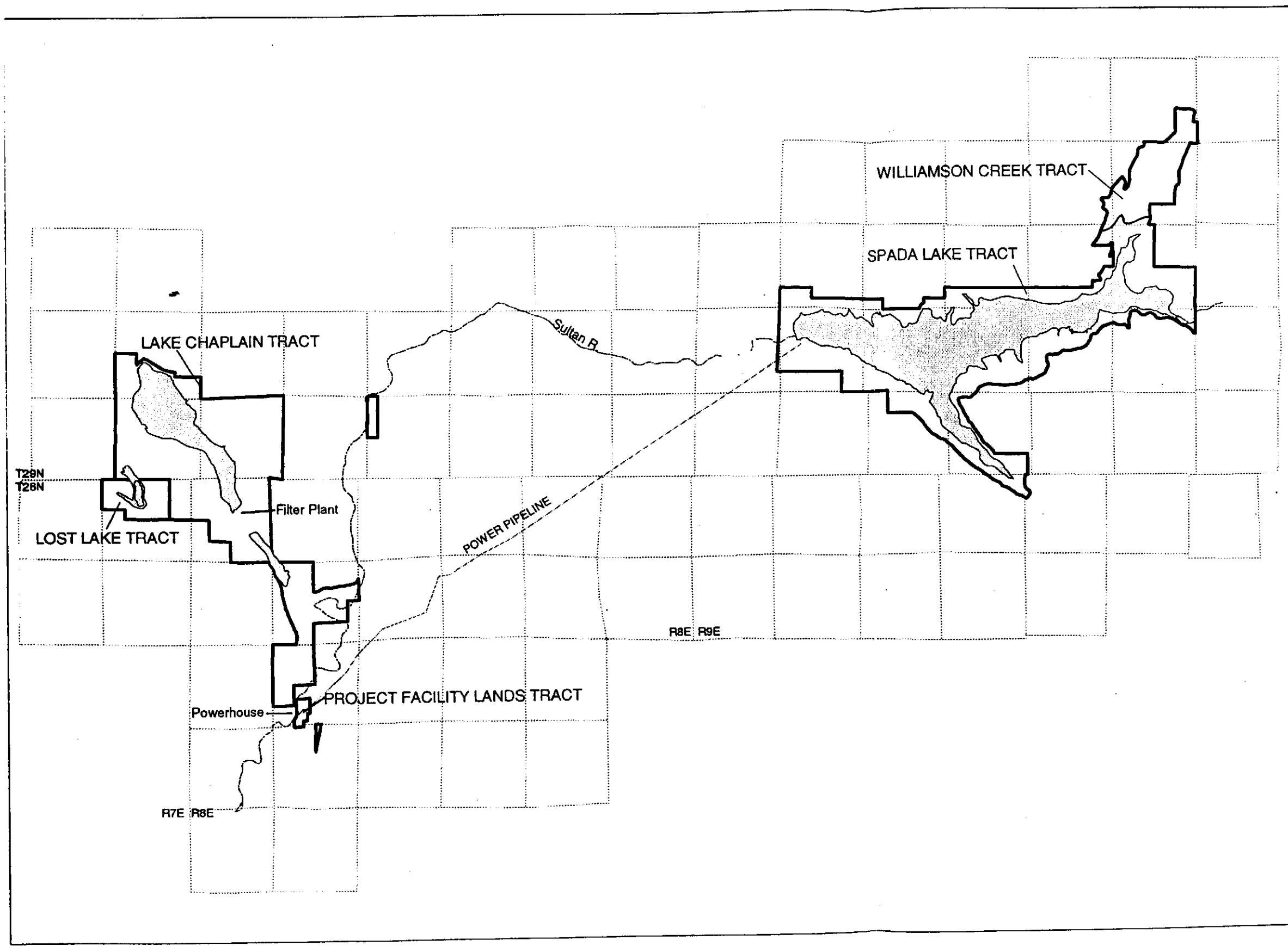
3.1.1 Timber Harvest

The Tiki timber sale, consisting of two units totaling 45 acres, was sold to Buse Timber and Sales, Inc. in April 1998. In mid-September construction began on the road system that will provide access to the two units of this sale and future timber sales on the west side of Lake Chaplain (Figure 2). The rights of way were seeded with a grass-forb mix following completion of construction. Harvest activities began in late September and all logging activity was completed by the end of November. During the last week of harvest activity a strong windstorm struck and there was some blowdown along the stream buffer and the northeast boundary of Tiki 2 (i.e. a small area within the adjacent unit 2025-3) (see Figure 2). Seven loads of logs from this portion of 2025-3 were salvaged as part of the Tiki Sale harvest. It was not possible to salvage log the blowdown in the buffer zone. We will evaluate future management options for this buffer zone.

Immediately after logging was completed, the two harvested units were inspected for compliance with the contract specifications. As directed, the contractors left designated snag and CWD trees on the units, and left replacement trees for the small number of designated trees that they found had to be felled. Most of the hardwoods that were marked for retention were cut down, unfortunately, due to a miscommunication within

HENRY M. JACKSON PROJECT
WILDLIFE HABITAT MANAGEMENT PLAN

FIGURE 1. MANAGEMENT TRACTS



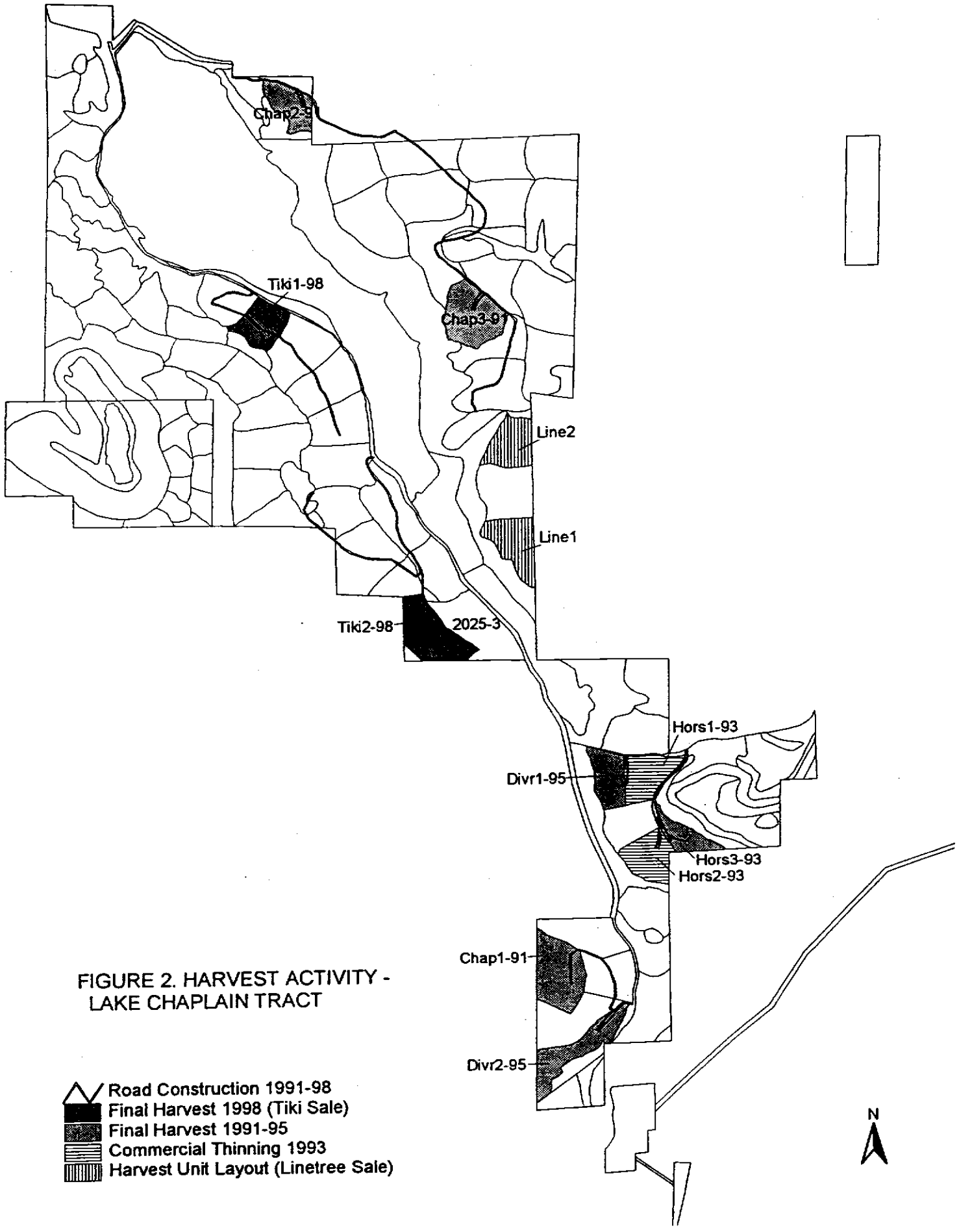


FIGURE 2. HARVEST ACTIVITY - LAKE CHAPLAIN TRACT

the contractor's crew. We will develop procedures to improve communications with the contractor to avoid similar incidents in the future. In Tiki 2, eleven of the designated snag trees fell over during the windstorm described above, at a point in the process in which no replacement trees were available. The snag requirement for this unit will be completed by creating additional snags in the GTA, the buffer zone, or along the edge of the unit.

3.1.2 Sale Layout

Layout of two units of the Linetree sale was completed in 1998 (Figure 2), including marking the units with boundary tags, locating and designing the access roads, and delineation of green tree areas (GTAs). Fifty-foot buffer zones were also located on two streams and a 200-foot buffer zone was located along a wetland during sale layout. Trees were marked for snag and coarse woody debris (CWD) creation on Tiki 1, and hardwoods were marked with paint for retention during the harvest. These tasks will be accomplished on Tiki 2 during 1999. The total area of the units, excluding GTAs, is approximately 36.9 acres.

3.1.3 Vegetation Management

A small area in unit Chap2-91 (Figure 2) that had excessive alders with a few large maple clumps was treated to change the species composition, as follows:

- Reduce the density of stems in the alder thicket, interplanting with western red cedar and cottonwood. Approximately 25 cottonwood cuttings/acre and 25 red cedar seedlings/acre were planted, so that the ultimate spacing of stems of all tree species will be about 18-20 ft (equivalent to approximately 120 trees/acre).
- Reduce the number of bigleaf maple stems. Maple in the Lake Chaplain harvest units regenerates primarily from stump sprouts, forming dense thickets of numerous stems rather than a single stem. Since it is a desirable species, we selectively removed all but the largest 4-5 stems on a clump to promote growth into the canopy.

The objective of this treatment was to produce a mixed stand of conifer and hardwood from an almost pure alder stand with a few large maple clumps

3.1.4 Survey Work

The DNR completed their survey work in the Lost Lake vicinity. They set monuments and property line stakes between State property and the District's property, and put flagging along the line separating the District's property from the City's Lake Chaplain Tract. The flagging and other monuments will be used to define cutting line boundaries for future management units.

3.2 SNAG MANAGEMENT

3.2.1 Snag Inventory and Creation

Snag inventorying in 1998 covered 12 units totaling about 454 acres on the Lake Chaplain and Lost Lake Tracts (Figure 3). As reported in the 1997 Annual Report,

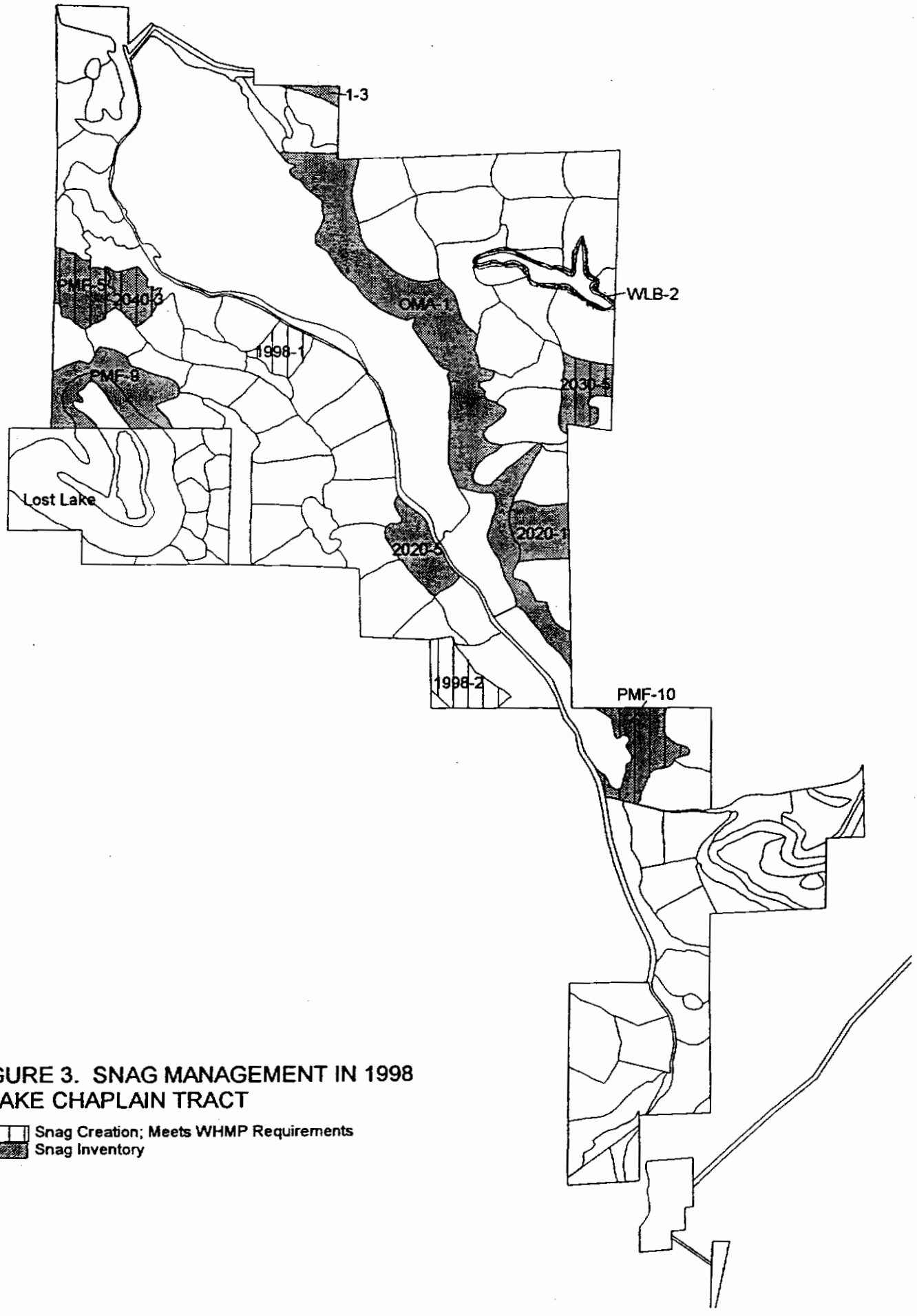


FIGURE 3. SNAG MANAGEMENT IN 1998 LAKE CHAPLAIN TRACT

Snag Creation; Meets WHMP Requirements
Snag Inventory

several units were eliminated from the inventory because they are scheduled for commercial thinning within the next few years (2020-2, 2020-3, 2025-6, and 2045-1). These units will have snags created after the commercial thinning has been completed. Unit 2020-1 was reinstated into the snag inventory program after it was decided not to commercially thin it (see Section 4.1.2). Eleven of the inventoried units required creation of additional snags to meet the WHMP's targets (Figure 3, Table 1). The remaining unit (PMF-5)had sufficient snags to meet the snag density and size distribution targets stated in the WHMP, and no additional snags will be created there. A total of 245 snags were created on five units (119 acres) in 1998. These totals include the two Tiki Sale harvest units (45 acres) in which almost all required snags were created following the harvest in late 1998. (See Sec. 3.1.1; 11 additional snags are required in Tiki 2.)

As in past years, snags were created by topping live trees and leaving a few branch stubs near the top. Due to safety concerns for the climber, many alders had to be girdled between 24 and 40 feet high. It is expected that these trees will break off at this point within the next few years. After creation, all snags were tagged, painted, and their location mapped for future monitoring, as has been done with all snags created to date.

It was reported in the 1997 Annual Report (Section 3.2.2, p. 7) that unit 2020-5 had been inventoried but that the number and sizes of snags to be created was still under discussion. A decision was made in 1998 on this unit that reduced the number of required snags but increased the size range. The process used to reach this decision was documented in a letter to representatives of the WDW and the USFWS, who expressed their interest during the 1997 annual agency meeting. The letter and supporting information are included in Appendix 1 of the present annual report.

3.2.2 Long-Term Monitoring

Long term monitoring of created snag trees started in 1998 following the procedures that were finalized in 1997. For this monitoring, subsets of snag trees were selected that represent the different species, size classes, position within stands (edge of clear-cut, interior of clear-cut, or interior of forested stand), and time since the snag was created. The effects of these variables on the type of use by wildlife species, and the physical changes in the snags themselves will be tracked.

A subset of 100 snags that were created from 1991 to 1993 was monitored to study wildlife use and other decay processes. Slightly over half of the trees in the sample had evidence of wildlife use, which consisted primarily of woodpecker foraging. Most of these trees had wood-boring insects present as well. Douglas firs and hemlocks comprised most of the sampled snags, and insects and woodpecker holes were present in both species in all size categories. Approximately 65 percent of Douglas fir snags (N=66) and 43 percent of hemlock snags (N=28) had woodpecker activity; 90 percent of all created snags in the sample were in decay class 1 and the remainder in class 2. In 1999 we will increase the sample size in order to permit some of the comparisons listed in the paragraph above.

Table 1. Summary of Snag Management In 1998

UNIT	ACRES INVENT-ORIED IN 1998	SNAGS CREA-TED IN 1998	AVG DBH (In.)	AVG HT (ft.)	AVG. # PER ACRE	NOTES
2030-5	24.0	48	18.0	50.0	3.2	√ Includes natural and created snags
2040-3	16.3	14	21.4	50.0	6.9	√ Includes natural and created snags
PMF #10	34.1	56	18.3	45.1	4.5	√ Includes natural and created snags
PMF #5	27.4	0	23.5	47.3	5.3	√ Includes natural snags only
TIKI 1-98	21.0	54	17.5	55.6	3.1	√ Includes natural and created snags
TIKI 2-98	23.8	62	18.0	56.1	2.6	Includes natural and created snags
Stand 1-3 1/	4.4					Inventoried in 1998; snag creation will be completed in 1999-2000
Wetland Buffer #2	25.0					Inventoried in 1998; snag creation will be completed in 1999-2000
2020-1	25.0					Inventoried in 1998; snag creation will be completed in 1999-2000
2020-5	27.5					Inventoried in 1998; snag creation will be completed in 1999-2000
PMF #9	52.1	2/	16.9	52.4		Inventoried in 1998; snag creation will be completed in 1999-2000
OMA #1	173.6	2/	17.3	40.0		Inventoried in 1998; snag creation will be completed in 1999-2000
TOTALS	147	234	Totals for those units which meet WHMP requirements (5 units).			
	454	234	Totals for all units having snag management activity (12 units).			

√ Meets WHMP requirements for size class distribution and number per acre.

1/ Remainder of stand, exclusive of already delineated units.

2/ Some snags created prior to 1998.

3.3 COARSE WOODY DEBRIS MANAGEMENT

Live trees that were designated for CWD creation on the two Tiki Sale units were felled (or blown down in the windstorm) at the end of the logging process. Existing snags in decay classes 1 and 2 that were designated as future CWD were not cut down, as per the CWD Standard Operating Procedures (PUD 1998) although two fell over and broke in the windstorm or as a result of logging. The contractor felled and removed two designated live trees, but left suitable replacement trees. Additionally, some designated snag trees fell over during the storm or were cut down during logging. Those that were greater than 16 inches at the large end (N=7) were added to the CWD tally. As a result, the two Tiki Sale units are in compliance with the targets stated in the General Procedures for managing CWD (PUD/City 1995) (Table 2).

Table 2. Summary of Designated CWD in Tiki Sale Units

Unit	No. of trees, snags & logs	Avg. Diam. (large end) of trees [range]	No. logs/ac. preharvest	Total no. logs preharvest	No. logs/ac. postharvest	Total no. logs postharvest
Tiki1-98	32 live trees 6 snags 1 log	29.9" [16-38.5]	7.9	166	8.0	168
Tiki2-98	42 live trees 12 snags 2 logs	27.85" [18-32.2]	7.9	189	8.2	194

Six large logs in decay classes 3 and 4 were marked and photographed during sale layout on each unit of the Tiki Sale for monitoring post-harvest. The objective of this monitoring is to determine the effects of logging on existing CWD. These logs were marked with paint over 1-1/2 years before the logging took place, and it was found, as the logging operation started, that the paint was no longer easily visible. It was possible to re-mark all of the logs on Unit 2 just prior to harvest, but only one log on Unit 1. All but one of the re-marked logs were located again post-harvest. Results were fairly consistent among these logs. Vegetation growing on the tops of the logs was scraped off, and chunks of wood were broken off the sides of the logs. Wildlife runways adjacent to the logs were covered with debris. However, the logs were not moved, or broken into significantly smaller pieces, and they remained essentially intact, offering substrate for revegetation, and future hiding, foraging and travel corridor opportunities for wildlife. One log that was suspended over a depression in the ground remained intact in this position. Therefore, the logs sustained loss of vegetation, disruption of established runways, and some deterioration due to breakage, but their long-term functions are expected to re-establish.

3.4 REVEGETATION

Activities in 1998 consisted of monitoring previously revegetated sites, seeding the right of way, and quantitative measurements of the right of way. Details of the original plantings are described in earlier annual reports, and summarized in Section 4.

3.4.1 Spada Lake Drawdown Zone

Wetland emergent species were planted from 1430 ft. to 1445 ft. in 1994. At that time there was very little vegetation present in this zone at the two planting sites. The sites have been monitored annually since planting, and the results reported in Annual Reports. The test plantings at the North Fork site were monitored in September 1998. Five planted rows of sedges (Carex obnupta and C. rostrata) were present and all had volunteer sedges in addition to the planted sedges. We found few sedges anywhere on the site that were not in close proximity to the planted rows. We conclude that most sedges on the site propagated vegetatively from the planted sedges. The sedges, whether planted or volunteers, grew best between 1438-1441 ft. elevation.

Scirpus microcarpus (small fruited-bulrush) plantings survived in one row, in which volunteers were too numerous to count. As we reported in the 1997 Annual Report, this species is so widespread on the site (and elsewhere in the Spada Lake drawdown zone) that we do not attribute its coverage to our plantings. The 1997 Annual Report lists other volunteer species that have become established over time on the North Fork site.

Plantings at Williamson Creek were monitored in September 1998. The lake elevation was unusually low during the summer of 1998, which permitted some revegetation of the drawdown zone well below the usual cutoff elevation (about 1436 ft). Smartweed, buttercup and grass seedlings were growing as low as about 1410 ft. As reported in the 1997 Annual Report, most of the planted slough sedge (C. obnupta) at Williamson Creek have survived, and volunteers have filled in these rows and spread to the sides (Figure 4). Other volunteer species growing from 1436 ft. up the slope include bedstraw, smartweed, mare's tail, buttercup, small-fruited bulrush. Above about 1441 ft. reed canarygrass has become established. The dominant ground cover species on this site are mare's tail and buttercup. Small-fruited bulrush is the dominant species among the grasses, similar to the North Fork site.

3.4.2 Power Pipeline Right-of-Way

A few remaining small patches of bare soil on the pipeline ROW were seeded with the same seed mixture used in previous years. The thirty-foot portion over the center of the pipeline was mowed to suppress the growth of invading trees such as alder. Photo-documentation of the ROW was conducted again this year to document the effects of management practices. Shrubs that were planted in 1997 near tree root wad piles on the ROW were inspected and appeared in general to be growing well.

Prior to the mowing, vegetative cover was quantitatively sampled in June at sixty 20 x 50 cm sample plots located near fourteen of the sixteen manholes along the pipeline. Vegetation coverage of the pipeline consisted chiefly of grasses (35 %), moss (33%), cottonwood seedlings (25%), alders (33%), and miscellaneous forbs such as composites, clovers and trefoils (63%). Bare ground occurred on 39 % of sample plots. The trees (primarily alder, western hemlock and cottonwood) are mowed annually and are not permitted to overtop the grass/forb layer.

Figure 4. Spada Lake Drawdown Zone. Slough sedge (Carex obnupta) was planted in a row on 12-15 inch centers. The row has filled in with numerous additional sedge plants.

Culvert placement on a Marsh Creek tributary was completed this year. This project, which completed road work intended to facilitate inspection of the pipeline and reduce erosion, will also prevent off-road vehicle damage to the riparian area.

3.4.3 Chaplain Marsh

Shrubs were planted along the western edge of Chaplain Marsh in 1993 to create a vegetative screen between the Lake Chaplain road and the marsh, and to provide a food source for fruit- and seed-eating birds. Species planted included red-osier dogwood, English holly, huckleberry, serviceberry, Nootka rose, red-flowering currant, and western red cedar. The plantings have been monitored since then by walking along the edge and looking for gaps or dead shrubs. The 1997 Annual Report describes the growth of the plantings, and mentioned that management of other species, especially red alder, salmonberry and willow, would be necessary. These volunteer shrubs and trees were encroaching on the right of way for the water return pipeline to the filter plant, and had to be removed. In addition, they had overtopped the planted shrubs and were likely to stunt their growth.

In July 1998 we manually cut down the red alders that were growing between the plantings and the road ROW, essentially removing the vegetation that had overtopped the planted shrubs. The small number of red alder trees greater than 25 ft tall were retained, as they did not seem to be shading the plantings excessively.

3.4.4 Powerhouse Site

Ten mast/fruit tree groups and ten shrub/tree groups were established near the Powerhouse in 1993 and 1994. Species included Oregon ash, western crabapple, black hawthorn, red-flowering currant, serviceberry, Nootka rose, and red huckleberry. Five cascara, eight crabapple and one serviceberry were added in the shrub/tree groups in April 1997. The plantings were monitored in late August 1998 (Table 3).

Crabapple and ash have showed satisfactory growth on the site, and some produced fruit this year. Several of the cascaras planted in 1997 died during 1998, and the remainder were in poor condition. Among the shrubs that we have tried on this site, only Nootka rose has done very well. Some volunteer species, including spirea and thimbleberry, are performing better and these will be retained wherever they become established in and around the planted groups. Red alder saplings and Himalayan blackberry were cut down within and around the planted areas. Also, the wire netting that originally surrounded each group was removed.

3.4.5 North End Lake Chaplain

Douglas fir and western red cedar seedlings were planted in 1992 at the north end of Lake Chaplain to provide a visual screen between the lake and the adjacent road. Red alder trees established in and around the conifer hedgerow over time, and overtopped the western red cedars. Alders growing within ten feet of the planted conifers were cut down in July 1998. The plantings were monitored in August 1998. As previously reported, the Douglas fir trees are generally in excellent condition, with less than 10 percent mortality since planting. Average height is over twelve feet. The western red cedar grew more slowly due to suppression by faster-growing alders. However, after the

brush removal on the site, it was determined that mortality of the cedars since planting was only 20 percent. Average height of red cedars was about six feet. It is expected that growth and survival of western red cedars will improve now that they have been freed from competing vegetation.

Table 3. Condition of Tree and Shrub Groups at Powerhouse

Species	No. planted	No. Present	Condition of Plants	No. of Volunteers
Crabapple	47	44	E: 14, G:9, F:13, P:7	0
Oregon Ash	14	14	E:3, G:5, F:5, P:1	0
Black Hawthorn	26	24	G:5, F:12, P:7	0
Red flowering currant	33	1	F:1	0
Serviceberry	53	30	G:1, F:12, P:17	9
Nootka rose	32	54+	E:3, G:13, F:31. P:5	TNTC
Red huckleberry	43	17	G:1, F:5, P:11	1
Cascara	5	2	P:2	0
Spirea	0	10+	G-F:10+	10+
Thimbleberry	0	-	G	Present; not counted
Salmonberry	0	-	G	Present; not counted
Buddleia	0	2	G:2	2
Willow	0		G	Present; not counted

E - excellent, G - good, F - fair, P - poor

3.5 NEST STRUCTURES

3.5.1 Floating Nest Platforms

District staff monitored the two platforms at Lost Lake (Figure 5). In 1997 it was discovered that the two platforms at Spada Lake had moved from their anchored positions and were not functional. It was decided at the agency meeting in March 1998 that only one platform would be reinstalled at Spada Lake, in a new location. The platform was installed on the Williamson Creek Arm of Spada Lake in mid-summer (Figure 6). District biologists did not observe wildlife use of any of the floating platforms in 1998 during the monitoring periods or at other times. Hooded mergansers, wood ducks, bufflehead and common mergansers were observed on Lost Lake. Loons, mallards, lesser scaup, common and hooded mergansers were observed on Spada Lake.

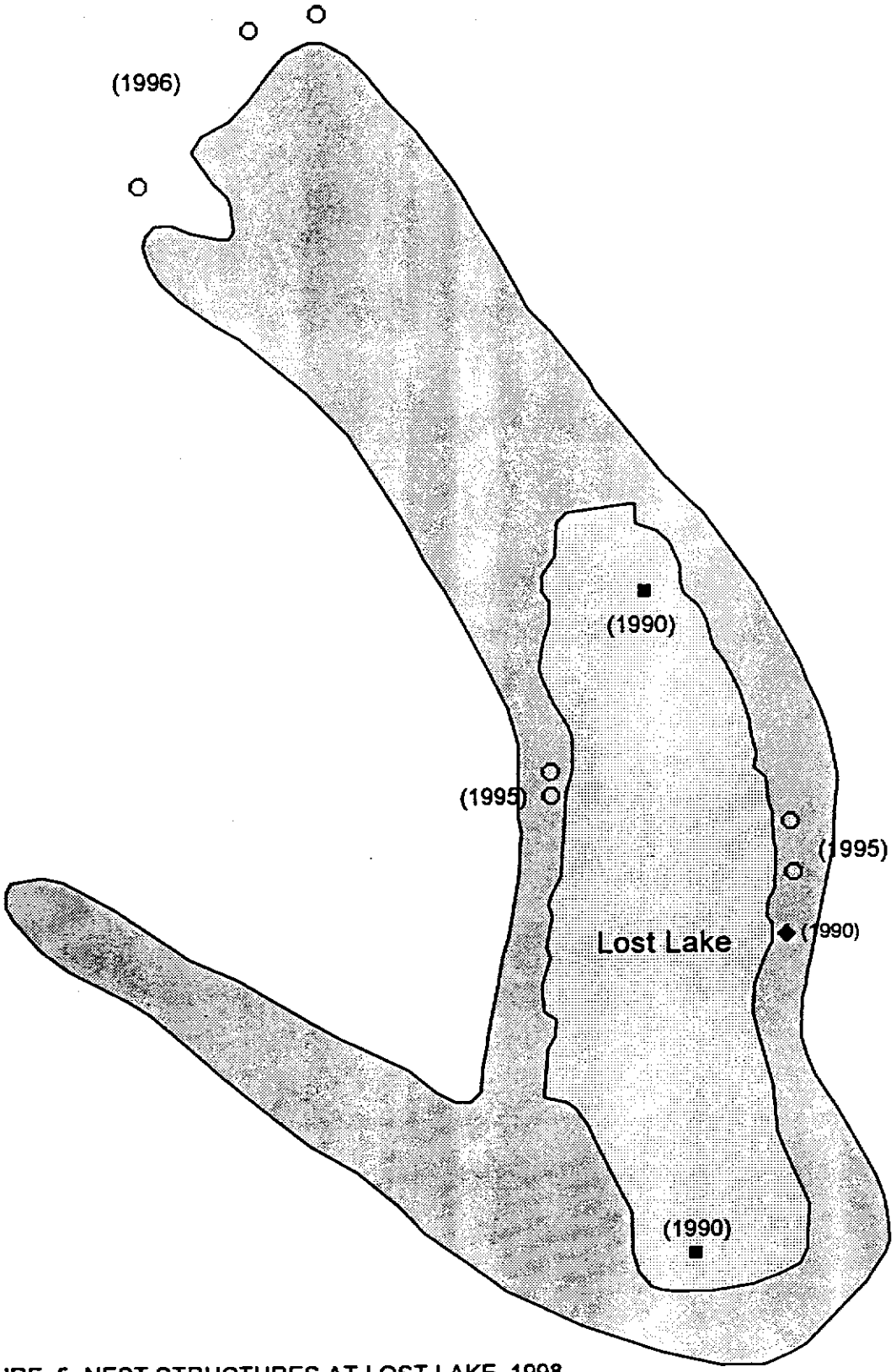


FIGURE 5. NEST STRUCTURES AT LOST LAKE, 1998
○ Duck Nest Box
■ Floating Nest Platform
◆ Osprey Platform

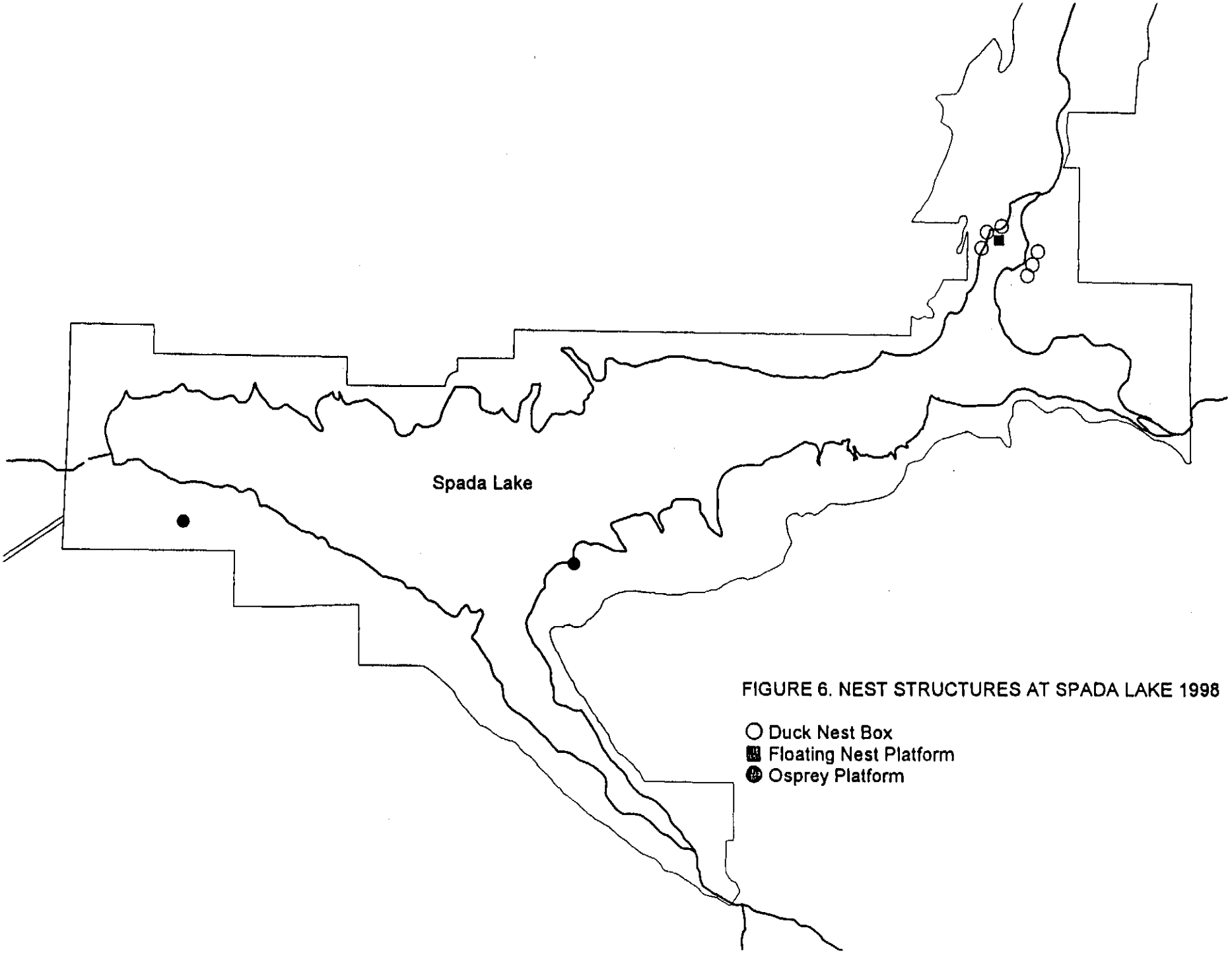


FIGURE 6. NEST STRUCTURES AT SPADA LAKE 1998

3.5.2 Nest Boxes

Three new nest boxes were installed on the Williamson Creek Arm of Spada Lake on March 10, 1998. The nest boxes at Lost Lake (Figure 5), Spada Lake (Figure 6) and Chaplain Marsh (Figure 7) were maintained and monitored by District staff in March and June/July of 1998. Production was estimated by examining eggshell remains in the boxes.

Nesting results are summarized in Table 4. Hooded mergansers used four of the boxes at Lost Lake. Wood ducks used one of the nest boxes at Chaplain Marsh, but the eggs were abandoned before hatching. A nest box was considered successful if the contents of the box showed that at least one duckling had successfully fledged from the nest box (egg membrane present, no presence of duckling remains). In 1998, 3 boxes were used successfully with 23 ducklings successfully fledged from the nest boxes.

Table 4. Use of Nest Boxes at Lost Lake and Chaplain Marsh.

Site	Number of Boxes	Number of Boxes with Duck Eggs	Number of Successful Boxes	Number of Eggs Hatched by Species	Number of Boxes Used by Other Species
Lost Lake	7	4	3	23 Hooded Merganser	2 (1 honey bees, 1 chipmunk)
Chaplain Marsh	6	1	0	0	0
Spada Lake	6	0	0	0	1 (carpenter ant nest)
Totals	19	5	3	23 Hooded Merganser	1

3.5.3 Osprey Nest Platforms

District staff monitored the osprey nest platform at Lost Lake from the opposite side of the lake during spring and summer 1998. A pair of ospreys occupied the platform from April into July 1998, but it appears that they abandoned the nest in July.

No osprey activity was observed on the two nesting platforms at Spada Lake. However, a natural nest in the gorge downstream of Culmback Dam has been occupied since 1996. Because of its distance from vantage points at Spada Lake, it has been difficult to determine whether the pair has produced offspring.

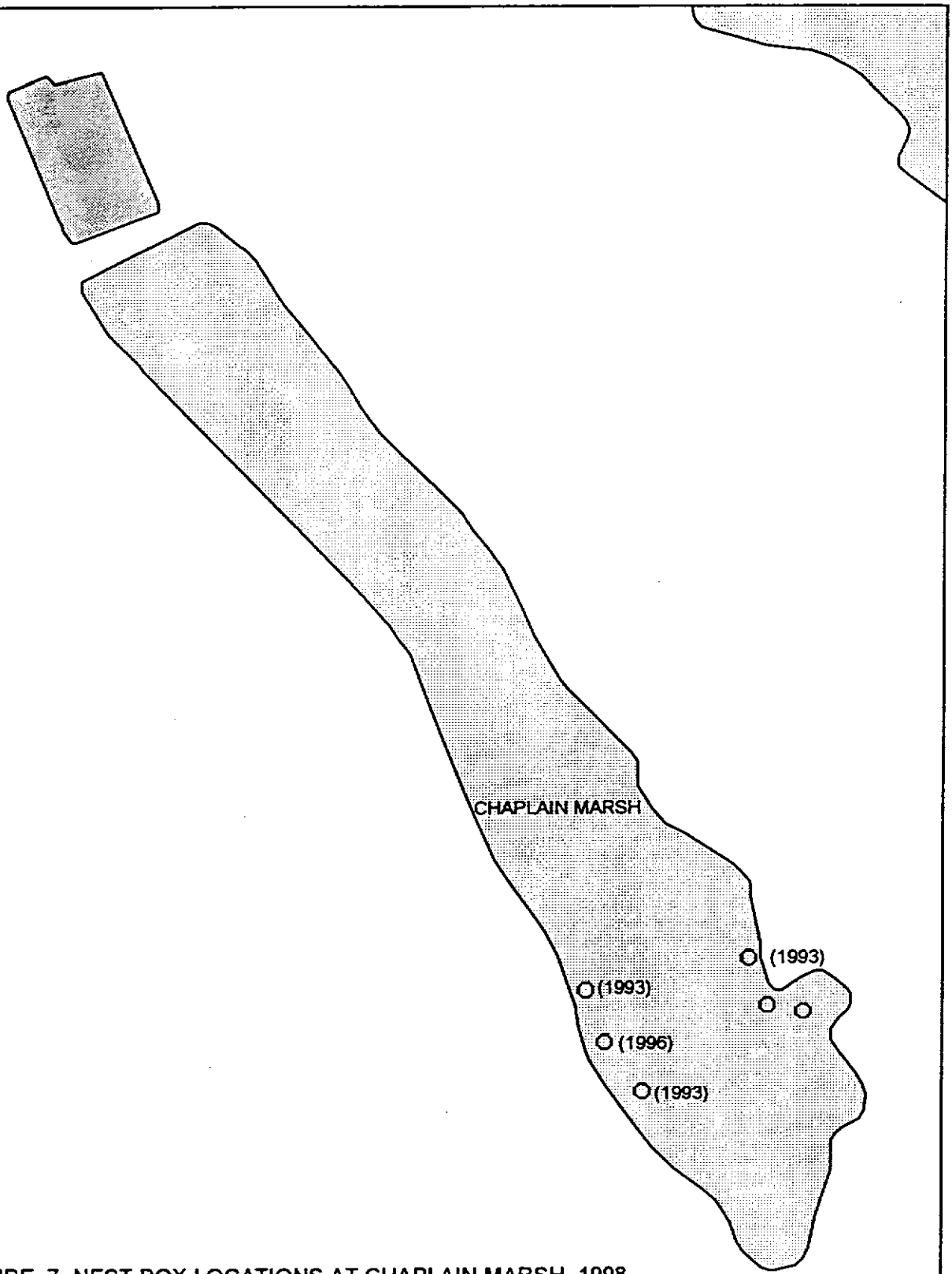


FIGURE 7. NEST BOX LOCATIONS AT CHAPLAIN MARSH, 1998

○ Nest Box

3.5.4 Bald Eagle Nesting

The bald eagle nest established in 1997 on the Lake Chaplain Tract was occupied again in 1998. One eaglet fledged from this nest and was observed around Lake Chaplain during the following winter.

3.7 MONITORING OF BIOSOLIDS APPLICATION SITES

The City of Everett applied biosolids to stands 2035-6 and 2040-5 in the Chaplain management unit in August and September of 1996, as described in the 1996 Annual Report.

Vegetation monitoring was conducted on sample plots established in 1996 in units 2040-5 and 2035-6 and control plots southwest of unit 2040-5. Understory cover and height were measured in mid-September 1998. Percent cover increased in all plots from September 1997 to September 1998. Much of the increase in percent cover is attributable to increases in bracken fern and salal cover. Analysis of palatable species present on the site show increases of 28, 14, and 3 percent in total percent palatable species cover in stands 2035, 2040, and the control respectively (Figure 8a). Understory plants increased in height in the treated plots but no increase in average height growth was seen in the control plots (Figure 8b).

Water quality data was collected through December of 1998 (Table 5). Nitrates in both upstream and downstream sampling points remained low. Fecal coliforms also remained low. No biosolids effect on water quality is apparent.

3.8 DEER FORAGE MONITORING

Deer forage availability was sampled on the two units of the Tiki Sale prior to their harvest in late 1998. Results on these forested units were similar: sword fern (90-100%), moss (70-77%), and non-vegetated (41-47%) including woody debris and bare ground were the most frequently-occurring ground covers. These results will comprise the baseline for future post-harvest comparisons on these units.

Figure 8a. Biosolids Application Project - Understory Cover Response

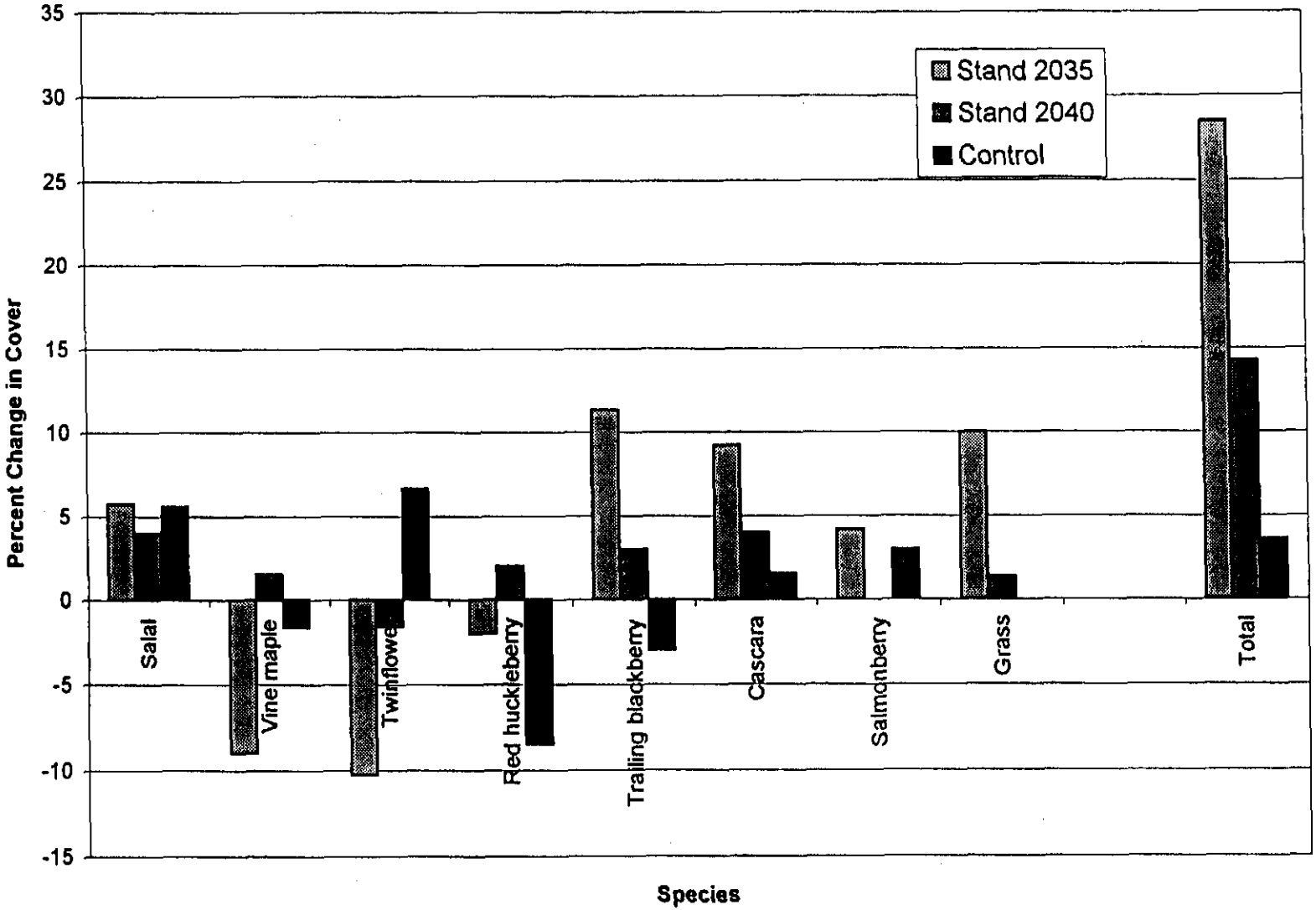


Figure 8b. Biosolids Application Project - Understory Height Response

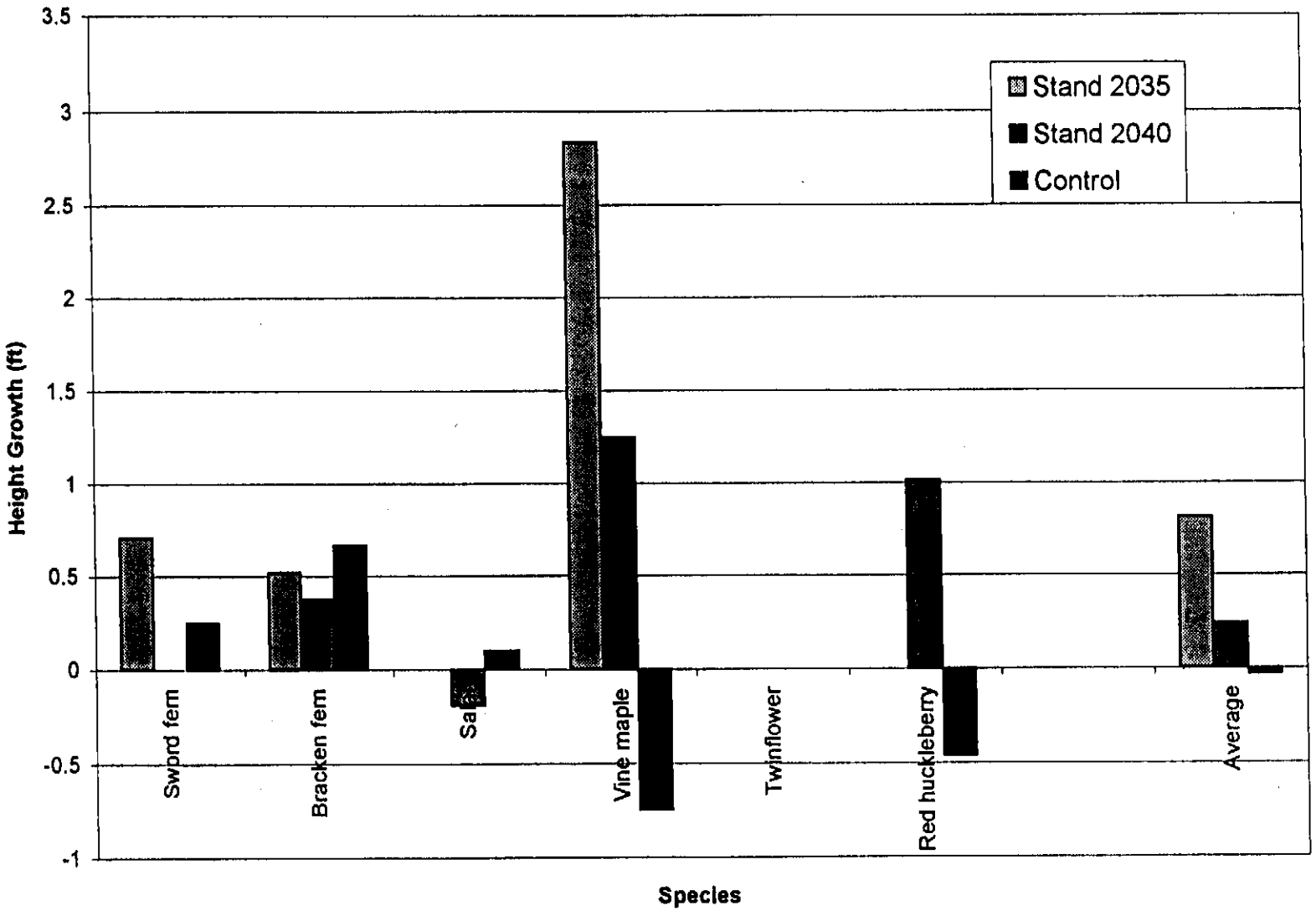


Table 5. Water Quality Sampling at Biosolids Application Site - Lake Chaplain Tract

Sample Date		8/27/96	9/19/96	10/29/96	11/12/96	12/10/96	1/21/97	2/12/97	3/26/97	4/9/97	5/14/97	6/5/97	7/29/97
Analyte/Sample Site	**Units**	**Results**											
Ammonia (NH3)													
Upstream (CHAPCR08)	mg/L	0.020	0.005	<0.003	<0.003	0.004	0.011	0.028	0.028	0.057	0.009	0.014	0.037
Downstream(CHAPCR38)		0.008	<0.005	<0.003	<0.003	0.005	0.011	0.017	0.016	0.022	0.011	0.022	0.028
Nitrate (NO3)													
Upstream (CHAPCR08)	mg/L	not sampled	<0.002	0.197	0.073	0.201	0.233	0.108	0.036	0.022	0.012	0.033	0.007
Downstream(CHAPCR38)		not sampled	<0.002	0.315	0.125	0.286	0.194	0.152	0.083	0.044	0.032	0.079	0.024
Total Phosphate													
Upstream (CHAPCR08)	mg/L	0.010	<0.005	0.006	0.005	<0.005	<0.005	0.007	0.007	0.016	0.017	0.019	0.019
Downstream(CHAPCR38)		0.009	<0.005	0.006	0.005	<0.005	<0.005	0.007	0.007	0.014	0.021	0.023	<0.016
Chloride													
Upstream (CHAPCR08)	mg/L	2.2	2.5	1.5	1.4	1.7	1.5	1.6	1.3	1.6	1.4	1.5	1.6
Downstream(CHAPCR38)		2.1	2.2	1.7	1.8	1.7	1.4	1.7	1.4	1.6	1.5	1.5	1.5
Fecal Coliforms													
Upstream (CHAPCR08)	CFU/100mL	11	7	<2	2	5	<2	4	<2	4	<2	52	8
Downstream(CHAPCR38)		16	27	8	2	11	<2	<2	<2	3	42	24	4
pH													
Upstream (CHAPCR08)	s.u.	6.8	6.8	6.5	6.5	6.4	6.6	6.6	6.5	6.6	6.5	not sampled	6.6
Downstream(CHAPCR38)		7.1	7.1	6.6	6.6	6.6	6.6	6.8	6.7	6.8	6.6	not sampled	7.0

Sample Date		8/20/97	9/22/97	10/7/97	11/4/97	12/3/97	1/6/98	2/3/98	3/3/98	4/21/98	5/5/98	6/3/98	7/16/98
Analyte/Sample Site	**Units**	**Results**											
Ammonia (NH3)													
Upstream (CHAPCR08)	mg/L	0.039	0.048	0.016	0.032	0.017	0.035	0.010	<0.004	0.025	0.035	0.015	0.015
Downstream(CHAPCR38)		0.038	0.053	0.012	0.034	0.020	0.032	0.009	<0.004	0.016	0.029	0.016	0.011
Nitrate (NO3)													
Upstream (CHAPCR08)	mg/L	0.012	0.042	0.206	0.222	0.287	0.246	0.156	0.196	0.031	0.017	0.022	0.010
Downstream(CHAPCR38)		0.035	0.083	0.284	0.282	0.206	0.351	0.249	0.277	0.096	0.058	0.054	0.039
Total Phosphorus													
Upstream (CHAPCR08)	mg/L	0.029	<0.016	<0.016	<0.016	<0.016	0.005	0.008	0.007	0.010	0.013	0.009	0.013
Downstream(CHAPCR38)		0.026	<0.016	<0.016	0.018	<0.016	0.005	0.004	0.006	0.008	0.010	<0.002	0.010
Chloride													
Upstream (CHAPCR08)	mg/L	2.7	2.2	1.8	2.1	1.7	2.0	1.6	1.6	1.0	1.2	1.0	1.7
Downstream(CHAPCR38)		2.1	2.3	2.0	1.9	1.9	1.2	1.8	1.8	1.1	1.3	1.3	1.7
Fecal Coliforms													
Upstream (CHAPCR08)	CFU/100mL	9	4	6	<2	11	6	2	12	2	10	6	14
Downstream(CHAPCR38)		7	12	20	<2	44	8	2	10	4	20	10	48
pH													
Upstream (CHAPCR08)	s.u.	6.6	6.4	6.6	6.6	6.5	6.6	6.6	6.5	6.6	6.5	6.7	6.6
Downstream(CHAPCR38)		7.1	6.8	6.6	6.6	6.6	6.6	6.8	6.7	6.8	6.6	6.6	7.0

Sample Date		8/13/98	9/10/98	10/20/98	11/3/98	12/1/98
Analyte/Sample Site	Units	Results				
Ammonia (NH3)						
Upstream (CHAPCR08)	mg/L	0.021	0.015	0.016	0.009	0.024
Downstream(CHAPCR38)		0.013	<0.004	0.012	<0.004	0.027
Nitrate (NO3)						
Upstream (CHAPCR08)	mg/L	0.011	0.010	0.245	0.038	0.260
Downstream(CHAPCR38)		0.081	0.050	0.284	0.075	0.301
Total Phosphorus						
Upstream (CHAPCR08)	mg/L	0.013	0.010	0.006	0.005	0.005
Downstream(CHAPCR38)		0.016	0.010	0.005	0.003	0.004
Chloride						
Upstream (CHAPCR08)	mg/L	<1.0	1.5	2.5	3.0	1.6
Downstream(CHAPCR38)		<1.0	1.6	2.6	2.8	1.2
Fecal Coliforms						
Upstream (CHAPCR08)	CFU/100mL	19	6	16	12	4
Downstream(CHAPCR38)		38	36	8	4	8
pH						
Upstream (CHAPCR08)	s.u.	6.6	6.6	6.4	6.6	6.3
Downstream(CHAPCR38)		6.4	6.6	6.8	7.1	6.5

4.0 CUMULATIVE SUMMARY

A summary of all activities completed under the WHMP, from the earliest implementation in 1988 through the end of December 1998, is presented in this section. Appendix 1 lists milestones of WHMP implementation to date, with a reference to the location in past annual reports of discussions of each activity. This Appendix is included in this Annual Report as a method of cross-referencing reports of past activities without repeating the complete details of information presented in previous reports. For complete discussion of a particular subject, the reader should refer to the referenced annual reports.

4.1 FOREST VEGETATION MANAGEMENT AT LAKE CHAPLAIN TRACT

4.1.1 Road System Layout and Construction

The main road systems for the northeast side of the Tract, the area south of the Diversion Dam Road, and portions of the west side of the tract have been constructed, as shown in Figure 2. Additional spur roads will be constructed to serve individual harvest units in the future.

4.1.2 Timber Harvest

Harvest activity to date is depicted in Figure 9. As described in Section 3.1.1, the Tiki Sale was harvested in 1998, with additional salvage in a small portion of an adjacent stand. Setup work for the Line Tree Sale was started in 1997 (Figure 9). All of the units boundaries have been reconfigured somewhat to improve operational feasibility, reduce impacts to streams and wetlands, and reduce the length of access roads. Additionally, there have been some substitutions of units (Table 6). However, the final harvest program is in compliance with the WHMP's schedule and requirements including the restriction on harvest unit size and the required green-up period for adjacent harvest units.

Table 6. Modifications of the Final Harvest (FH) Schedule on Lake Chaplain Tract

Unit Name (see Fig. 9)	Scheduled FH	Reasons for Modification
2005-5 ("Gold Camp" unit)	1990	Existing wildlife habitat value is high. Unit Divr2-95 (portions of units originally scheduled for FH in 2005 and 2030) was harvested instead of 2005-5 in 1995
2030-3	2005 (part) and 2030 (part)	Units originally scheduled for FH in 2005 and 2030 reconfigured into Divr2-95 and 2030-3

Commercial thinning scheduled in the WHMP (Figure 9) from 1990 to 2005 has been under consideration for several reasons, including potential problems related to access, soil type and timber type. These issues were discussed more fully in the 1996 Annual Report (Section 4.1.3). After on-site evaluation, it has been determined that several units will be eliminated from the commercial thinning schedule. The units, and the reasons for not thinning them, are listed in Table 7.

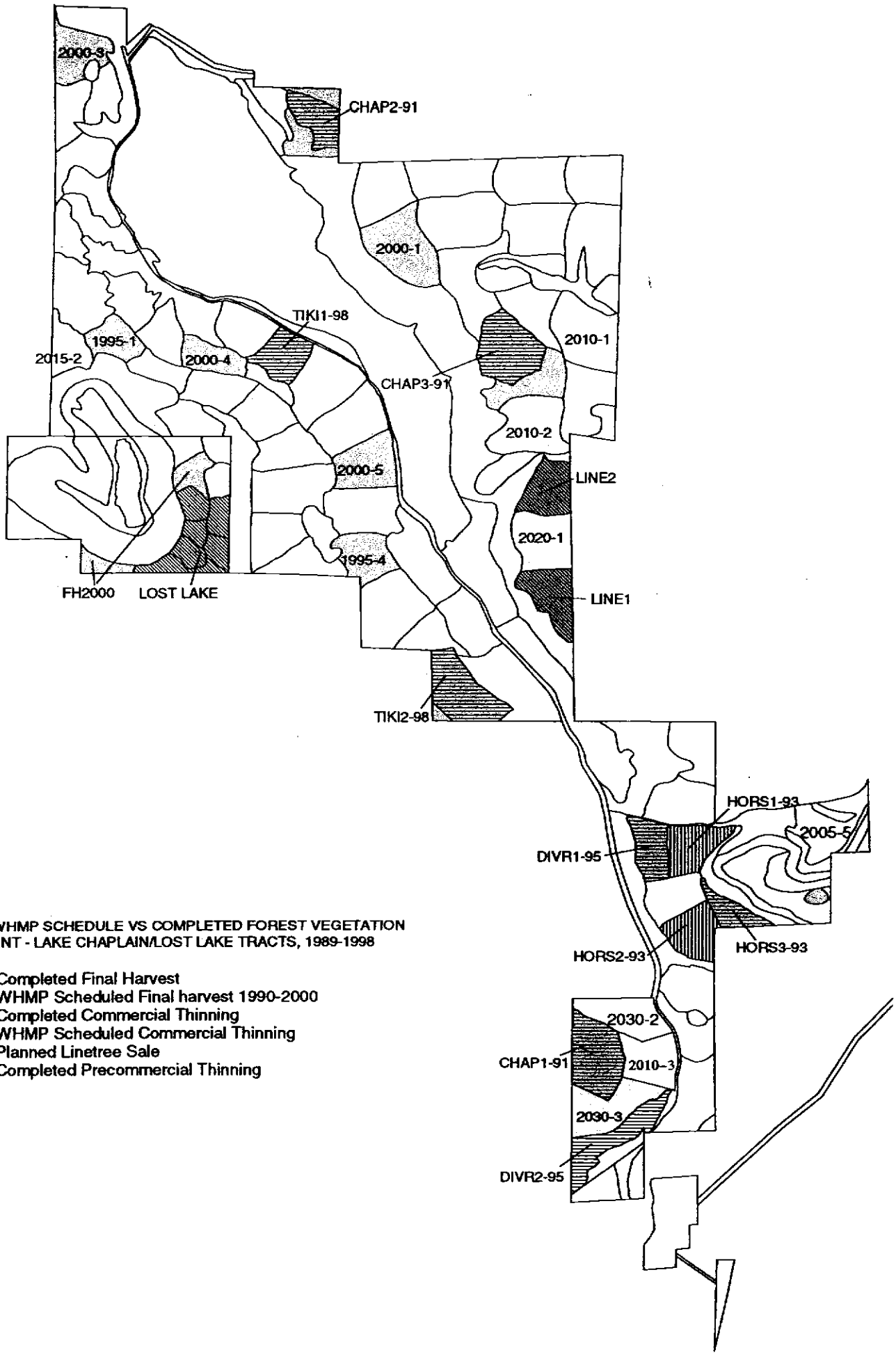


FIGURE 9. WHMP SCHEDULE VS COMPLETED FOREST VEGETATION MANAGEMENT - LAKE CHAPLAIN/LOST LAKE TRACTS, 1989-1998

Two units that were not scheduled in the WHMP were thinned in 1993 (Table 6). Additional opportunities for commercial thinning will be evaluated in the northeast and northwest corners of the Lake Chaplain Tract.

Table 7. Modifications of the Commercial Thinning (CT) Schedule on Lake Chaplain Tract

Unit	Scheduled CT	Reasons for Modification
2010-1	1990	Wet soil; timber type (hemlock) not suited to CT
2010-2	1990	Wet soil; timber type (hemlock) not suited to CT
2015-2	1995	Wet soil
2020-1	1990	Wet soil
2030-2	2005	Steep slope
2030-3	1990	High potential for blowdown; no benefit expected from CT
Hors1-93	Not scheduled	Opportunity to improve understory vegetation; CT operationally feasible; FH scheduled in 2040
Hors2-93	Not scheduled	Opportunity to improve understory vegetation; CT operationally feasible; FH scheduled in 2035

4.1.3 Management of Roads and Post-harvest Units

All final harvest units, with the exception of the recently harvested Tiki Sale, have been seeded with a grass/forb mix on bare areas, and replanted with Douglas fir and red cedar seedlings. Road ROW's have also been seeded, and access roads outside the closed watershed have been gated to prevent vehicular access by the public. A small timber salvage sale was held adjacent to a 1991 harvest unit following a major storm in January 1993. Monitoring of stocking levels in post-harvest units was started in 1997. Results in one unit showed adequate overall density, although distribution of hardwood species is clumped. Some hardwood removal and replanting was done in a 1991 harvest unit.

4.2 FOREST VEGETATION MANAGEMENT AT LOST LAKE TRACT

As described in the 1996 Annual Report, the stand that was precommercially thinned in 1991 has been monitored annually with photo documentation. The slash has begun to decompose, and access through the stand has gradually improved over time. The shrub layer, especially salmonberry, has responded to the reduction in the tree canopy, and signs of deer browsing have been observed. Field reconnaissance of two units scheduled in the WHMP for final harvest in 2000 began in 1998 (Figure 9).

4.3 FOREST VEGETATION MANAGEMENT AT SPADA LAKE TRACT

The Spada Supplement, a plan for lands surrounding Spada Lake that were acquired in 1991, was approved by the FERC in 1997. The Spada Supplement calls for commercial and precommercial thinning of some forest stands on the Tract. Three young second growth stands (totaling about 30 acres) on the south shore of Spada Lake were precommercially thinned in September 1996.

The DNR informed the District that it was planning to abandon the North Shore Road near Recreation Site 8 during the summer 1999. The road became inaccessible east of Recreation Site 8 due to a massive landslide in 1997 (Figure 10). Some of the planned forest management activities, including commercial thinning and precommercial thinning, in units served by this road therefore will be affected. With the loss of road access, the most promising option for future commercial harvest north of the lake will be helicopter logging. Some information was obtained from a contractor who does helicopter logging, but additional consideration will be necessary to advance the plan. Until the feasibility of future commercial thinning can be determined, the emphasis in forest management will be on stands that are accessible by road.

4.4 SNAG MANAGEMENT

Snag management activity from the beginning of implementation in 1989 through 1998 is shown in Figure 11 and summarized in Table 8. A target was established in the 1994 Annual Report to complete snag inventories in a large number of units on the Lake Chaplain and Lost Lake Tracts by the end of the 1998. This target was achieved in 1998, with the exception of four units that were removed from the inventory following the decision to commercially thin them in the near future (see Section 3.2.1). Snag creation on these four units will follow the harvest to achieve the WHMP's required size distribution. On all other targeted units, if sufficient snags to comply with the WHMP's requirements did not exist, snags were created or are scheduled for creation in early 1999, to meet the requirements. Snag inventory/creation has been completed on all units that have been harvested or thinned, as well as all units scheduled for harvest by 2020, except one scheduled for commercial thinning within 20 years. A detailed discussion of modifications to the snag management program was presented in the 1994 Annual Report (Section 4.2).

To date, 1191 snags have been created on 987 acres on the Lake Chaplain and Lost Lake Tracts (Table 8). A total of 585 acres (35 units) has been verified as meeting the WHMP's minimum requirements of 3.07 snags per acre as well as the required size class distribution for snags.

In 1996 the inventory/monitoring methods for snags were revised. Methods were field tested in 1997 and revised in 1998. These methods were implemented on the Tiki Sale units, and other units of the Lake Chaplain Tract, as reported in Section 3.2.1.

4.5 COARSE WOODY DEBRIS MANAGEMENT

The 1995 Annual Report described the first inventories of CWD on the Lake Chaplain Tract, and the subsequent development of the CWD management procedure to ensure compliance with WHMP targets. The procedure was implemented on the 1995 Diversion Sale and the 1998 Tiki Sale. The 1995 and 1996 Annual Reports describe more fully the earlier inventories and consultations with the agencies regarding standards for compliance. In 1996, the inventory/monitoring methods were revised following a consultant's review of the procedures, as described in the 1996 Annual report. The methods were finalized in 1997, field tested, and implemented on the units of the 1998 Tiki Sale, and will be used on future harvest units.

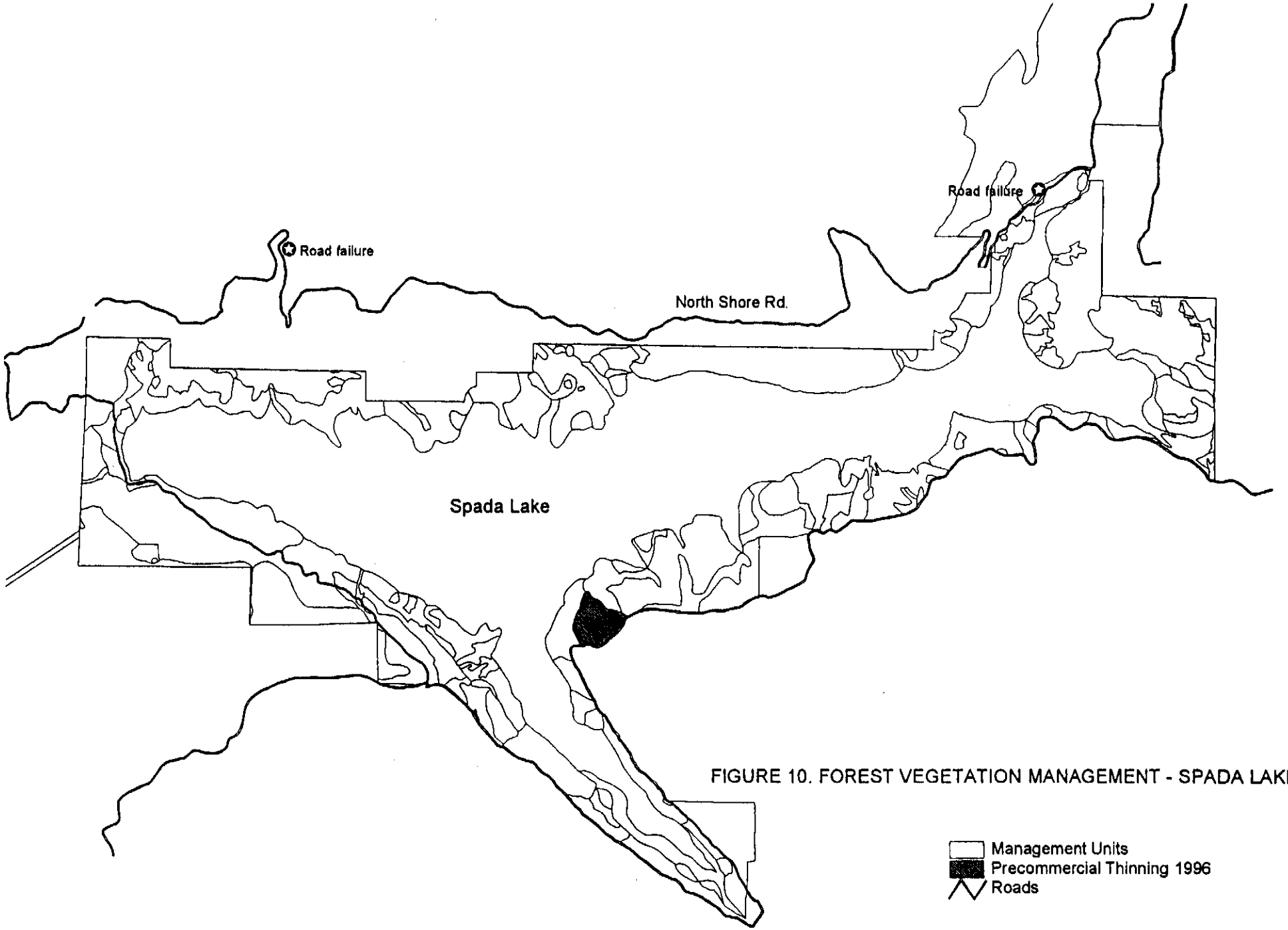


FIGURE 10. FOREST VEGETATION MANAGEMENT - SPADA LAKE

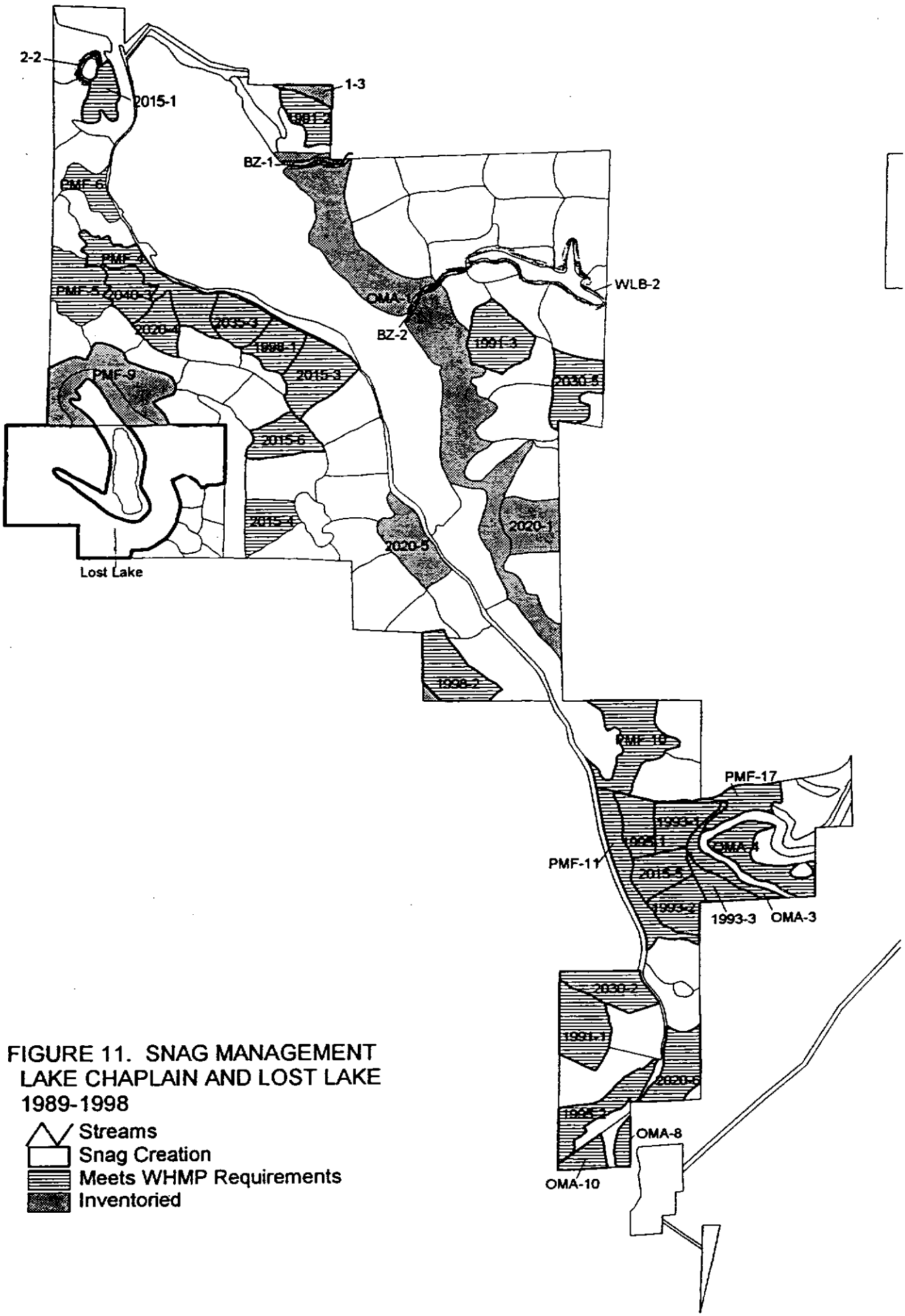


FIGURE 11. SNAG MANAGEMENT
LAKE CHAPLAIN AND LOST LAKE
1989-1998

Table 8. Summary of Snag Management Through 1998						
UNIT	ACRES INVENT-ORIED	SNAGS CREA-TED	AVG DBH (in.)	AVG HT (ft.)	AVG # PER ACRE	NOTES
2030-5	24.0	48	18.0	50.0	3.2	√ Includes natural and created snags
2040-3	16.3	14	21.4	50.0	6.9	√ Includes natural and created snags
PMF #10	34.1	56	18.3	45.1	4.5	√ Includes natural and created snags
PMF #5	27.4	0	23.5	47.3	5.3	√ Includes natural snags only
TIKI 1-98	21.0	54	17.5	55.6	3.1	√ Includes natural and created snags
TIKI 2-98	23.8	54	18.0	56.1	2.6	Includes natural and created snags
Stand 1-3 [1/]	4.4				[2/]	Inventoried in 1998
Wetland Buffer #2	25.0				[2/]	Inventoried in 1998
2020-1	25.0				[2/]	Inventoried in 1998
2020-5	27.5				[2/]	Inventoried in 1998
PMF #9	52.1	36	16.9	52.4	[2/]	Inventoried in 1998
OMA #1	173.6	23	17.3	40.0	[2/]	Inventoried in 1998
2015-1	12.2	15	16.1	66.5	4.5	√ Includes natural and created snags
2015-3	18.0	13	16.9	48.4	7.4	√ Includes natural and created snags
2015-4	18.8	0	20.6	46.1	4.7	√ Includes natural snags only
2015-5	17.7	26	16.0	44.1	5.4	√ Includes natural and created snags
2015-6	19.0	45	17.5	55.4	4.0	√ Includes natural and created snags
2020-4	15.3	36	17.0	49.3	4.4	√ Includes only created snags
2020-6	12.0	26	17.7	50.5	6.3	√ Includes only created snags
2030-2	22.1	60	17.0	50.3	3.1	√ Includes natural and created snags
2035-3	18.5	30	18.0	55.0	4.9	√ Includes natural and created snags
Buffer Zone # 1	2.7	20	17.0	40 [3/]	[4/]	
Buffer Zone # 2	3.8	10	15.7	40 [3/]	[4/]	
CHAP1-91	26.0	70	16.6	33.5	3.1	√ Includes natural and created snags
CHAP2-91	15.0	46	16.1	27.4	3.1	√ Includes only created snags
CHAP3-91	24.0	66	18.0	31.0	3.6	√ Includes natural and created snags
Chaplain Crk. Buffer	8.7	23	16.6	46.6	4.5	√ Includes natural and created snags
DIVR1-95	15.6	41	16.8	50.3	3.1	√ Includes natural and created snags
DIVR2-95	19.7	61	18.3	47.9	3.1	√ Includes natural and created snags

UNIT	ACRES INVENT-ORIED	SNAGS CREA-TED	AVG DBH (In.)	AVG HT (ft.)	AVG # PER ACRE	NOTES
HORS1-93	20.0	0	14.5	89.0	11.5	√ Includes natural snags only
HORS2-93	18.0	23	16.9	55.2	4.6	√ Includes natural and created snags
HORS3-93	13.7	43	16.0	33.8	3.1	√ Includes natural and created snags
Lost Lake Tract	130.7	43	16.9	49.5	5/	
OMA #3	11.8	27	16.2	63.6	6.3	√ Includes natural and created snags
OMA #4	26.5	22	16.1	54.5	6.7	√ Includes natural and created snags
OMA #8	5.3	7	18.1	54.3	18.4	√ Includes natural and created snags
OMA #10	8.6	4	20.0	56.3	18.4	√ Includes natural and created snags
PMF #4	31.8	54	16.5	46.2	4.9	√ Includes only created snags
PMF #6	13.3	0	23.9	64.3	6.0	√ Includes natural snags only
PMF #7	8.9	4	19.5	48.8	4/	
PMF #11	12.0	25	16.8	43.7	4.3	√ Includes natural and created snags
PMF #17	14.7	35	17.0	58.1	4.4	√ Includes natural and created snags
Stand 2-2 1/	30.7	12	19.0	47.9	4/	
TOTALS	**585**	**1024**	Totals for those units which meet WHMP requirements (34 units).			
	1069	**1172**	Totals for all units having snag management activity to date (43 units			

BOLD denotes those units where snag management activity occurred in 1998.

√ Meets WHMP requirements for size class distribution and number per acre.

1/ Remainder of stand, exclusive of already delineated units.

2/ Inventoried in 1998; snag creation will be completed in 1999-2000.

3/ Estimated heights

4/ No inventories have been done in these units.

5/ Incomplete inventories have been done, and some snags have been created, but the target densities have not yet been met.

4.6 REVEGETATION

4.6.1 Spada Lake Drawdown Zone

Test plots of five wetland emergent species were planted at two sites in October/November 1994 and monitored each following year. Two sedge species became well established and spread vegetatively at Williamson Creek. Most plantings at the North Fork site were damaged by wave action and floating debris. To date, natural recruitment of wetland species on both sites, especially small-fruited bulrush, has been far more successful in covering the ground than the test plantings. In 1998 a prolonged summer drought permitted wetland plants to establish naturally at lower elevations than normal, but these plants are not expected to survive the prolonged summer inundation during a more normal year. The 1997 Annual Report (Section 4.6.1) describes more fully the response of wetland plantings and natural recruitment on these sites with respect to the management of lake elevation.

4.6.2 Power Pipeline Right-of-Way

The pipeline ROW has been seeded annually, all or in part, since 1990. Only those areas where vegetation is still sparse are seeded. Most of the ROW has been successfully revegetated, but some areas are likely to remain somewhat bare due to extremely sandy or rocky soil. Quantitative sampling of vegetative cover on the ROW was done in 1998. Some shrubs and trees have been planted, primarily as test plantings to evaluate the potential for creating small shrub or mast-tree clumps on the right-of-way.

Work on rebuilding a portion of the access road and replacing a washed out culvert has been completed.

4.6.3 North End of Lake Chaplain and Chaplain Marsh

The required plantings at the north end of Lake Chaplain were monitored twice annually from the time of planting in 1992 through 1995, and once in the following years. Survival of western red cedar at the north end of the lake from the time of planting to 1998 was 80 percent. Alders growing among the planted conifers were cut down in 1998 to release the western red cedars from competition. Douglas fir saplings have had excellent growth, with overall survival over 90 percent.

The required plantings adjacent to Chaplain Marsh were monitored twice annually from the time of planting in 1993 through 1995, and once in the following years. Survival of shrubs has been close to 100 percent with generally good growth. Most planted western red cedars have survived and reached heights of 10 to 12 feet by 1998. Alders growing among the plantings were cut down in 1998 to release the planted shrubs from competition. As a result, the density of the vegetative screen between the Lake Chaplain Road and the marsh decreased, but it will increase in effectiveness as the shrubs continue to grow.

4.6.4 Powerhouse Site

Shrub and tree plantings were monitored at least twice each growing season between planting (in 1993) and 1995, and once in the following years. In 1997, we planted a small number of cascara saplings to test whether this species is suitable for the site. Survival of the tree species has been greater than 90 percent, and growth has been variable: crabapples have grown more than ash and hawthorn (Table 3). Most of the shrubs, with the exception of Nootka rose, have not done very well on this site.

4.7 NEST STRUCTURES

All of the nest structures that were required by the WHMP have been installed and monitored annually thereafter (see Figures 12, 13and 14) for all nest structure locations). In 1990, two floating nest platforms were placed in Lost Lake. The required two duck nest boxes were installed at Lost Lake in 1990. One osprey platform was installed at Lost Lake in 1990 and 2 at Spada Lake in 1992.

In addition to the required nest structures, we placed two floating platforms (one of these in place of the third platform required at Lost Lake), in Lake Chaplain in 1990 in hopes of recruiting loons. In February 1996 the floating platforms at Lake Chaplain were moved to Spada Lake. One was destroyed in late 1996 or early 1997 by unknown causes, and the other floated away from its anchor. The latter was placed at a different location on Spada Lake, in the Williamson Creek area in 1998.

We placed six nest boxes in Chaplain Marsh in 1993. In 1995 we placed four additional nest boxes at Lost Lake and three more at the north end of Chaplain Marsh. In 1996 we removed the three boxes from the north end of Chaplain Marsh because only starlings were using them. They were installed at Lost Lake in 1996. Three new nest boxes were put up at Williamson Creek in the Spada Lake Tract in summer 1996, and three new boxes were added in March 1998.

The nest structures have been monitored every year since installation. Ducks used over half of the boxes each year (61% in 1997) until 1998, when nest box success was 16 percent. The osprey platform at Lost Lake produced one fledgling in 1994 and one in 1995. Nesting was attempted in 1996, 1997 and 1998, but did not appear to be successful. A nest was partially constructed at the platform near the South Fork at Spada Lake during 1994 and in 1995 osprey completed a nest and were observed setting prior to nest abandonment in June. Nesting has not been observed on the osprey platforms at Spada Lake since then. A new nest has been actively used from 1996 through 1998, downstream from Culmback Dam. The floating platforms have been used for resting and feeding by waterfowl and otters, but no breeding attempts have been noted.

4.8 BIOSOLIDS APPLICATION

The City of Everett applied biosolids to stands 2035-6 and 2040-5 in the Lake Chaplain Tract in August and September of 1996, as described fully in the 1996 Annual Report (Section 3.8). One half of the prescribed amount of biosolids (based on measured nitrogen requirements) was applied at that time. The ultimate intention is to apply the remainder when sufficient material is available for application at this site. Based on the positive

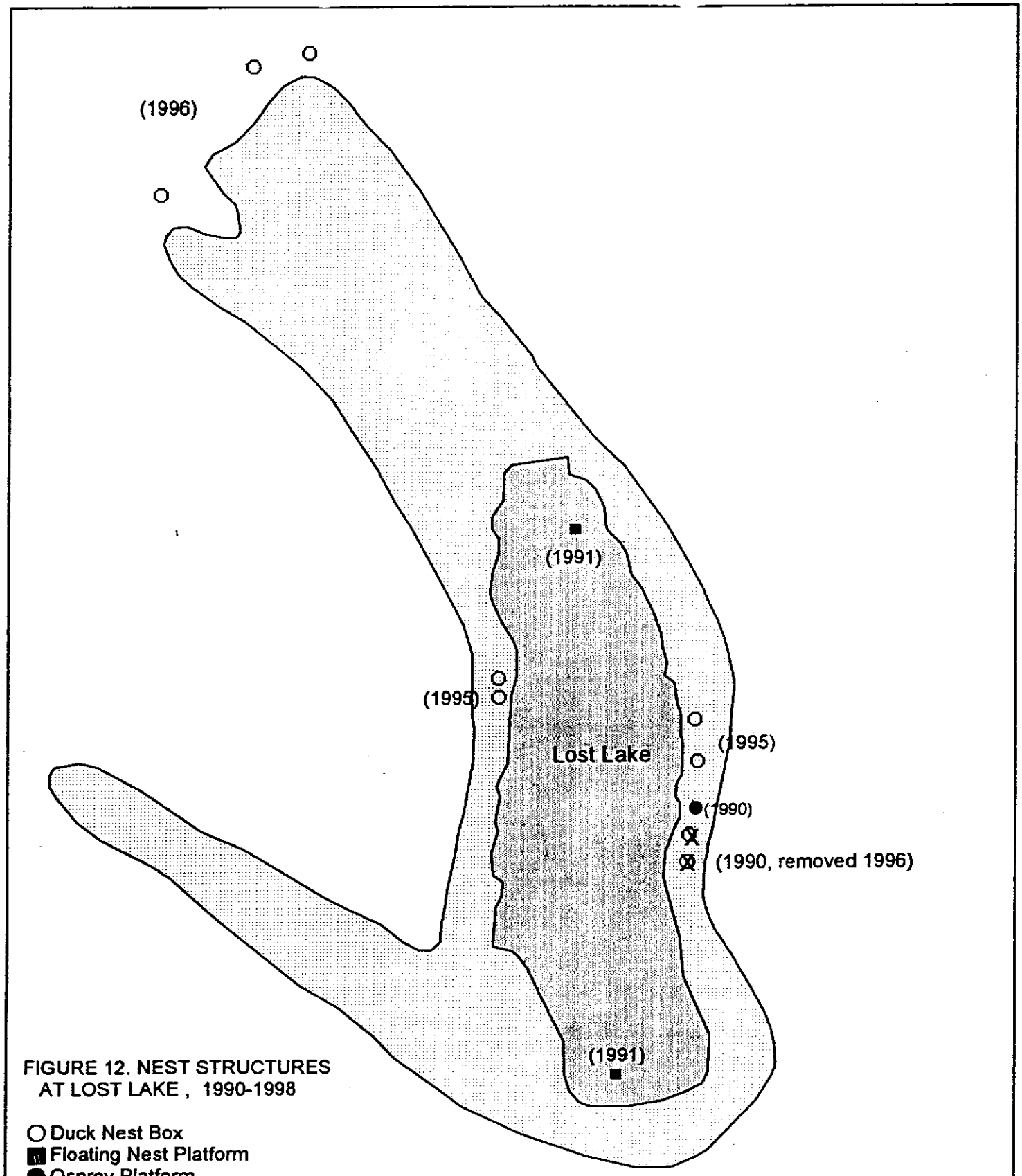


FIGURE 12. NEST STRUCTURES AT LOST LAKE , 1990-1998

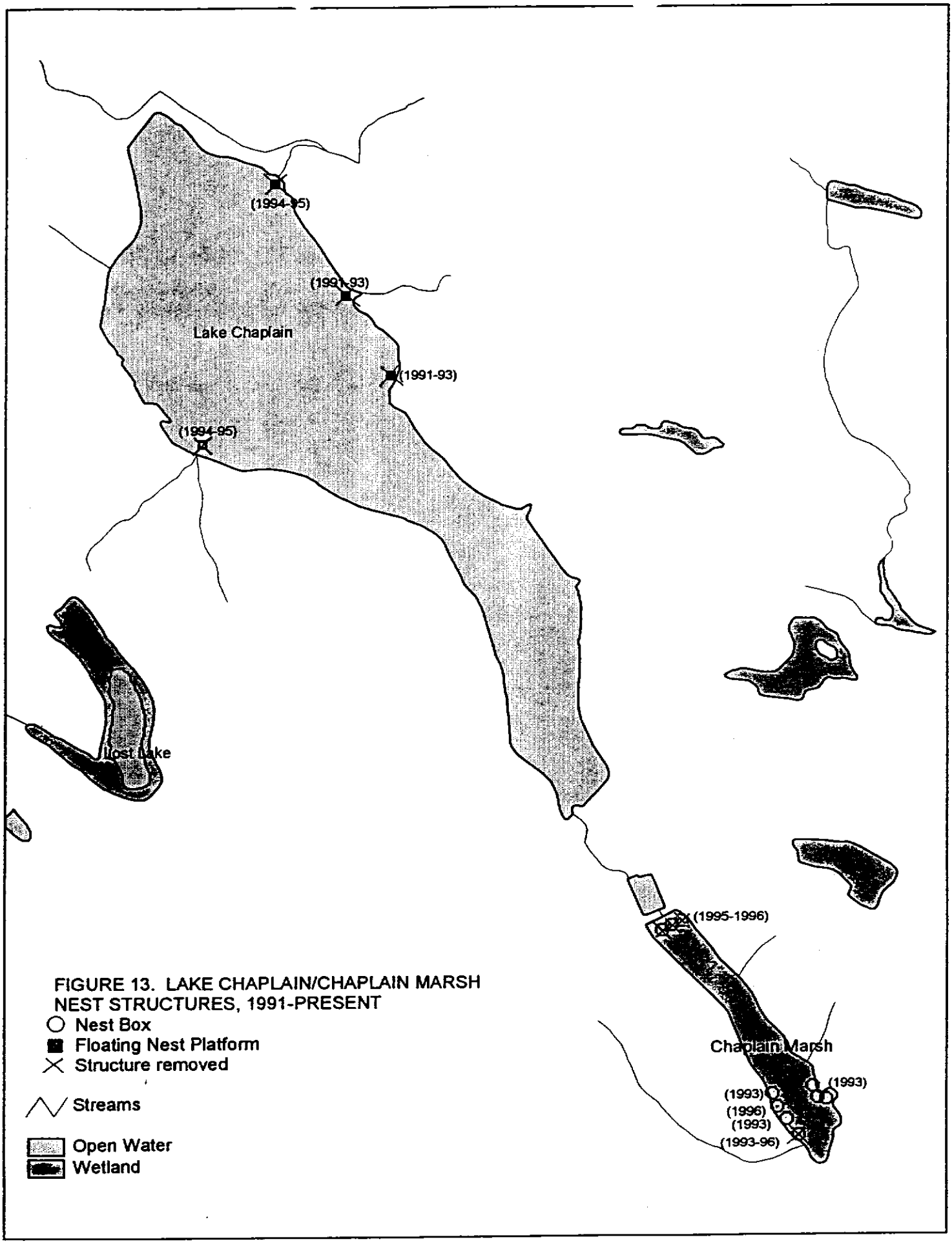


FIGURE 13. LAKE CHAPLAIN/CHAPLAIN MARSH NEST STRUCTURES, 1991-PRESENT

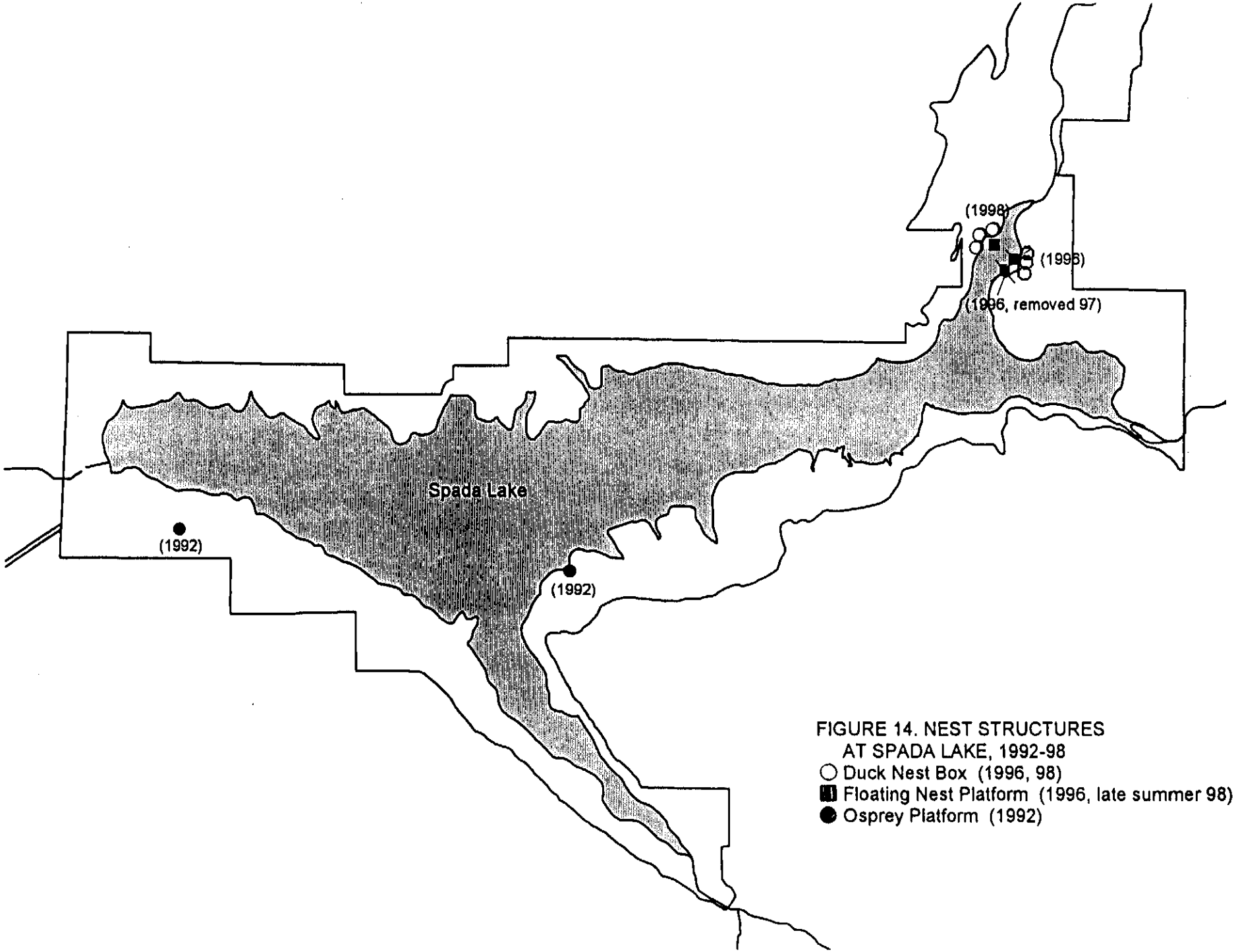


FIGURE 14. NEST STRUCTURES
AT SPADA LAKE, 1992-98
○ Duck Nest Box (1996, 98)
▮ Floating Nest Platform (1996, late summer 98)
● Osprey Platform (1992)

response of the understory, the City will finish the prescribed biosolids applications in Stands 2035-6 and 2040-5.

Two water quality monitoring sites were established on Chaplain Creek. Creek waters were sampled monthly beginning in August 1996 through the end of 1998. Parameters examined were nitrates, phosphorus, fecal coliform, ammonia, and chloride. Water quality monitoring has indicated no biosolids effect on the water quality parameters measured.

4.9 DEER FORAGE MONITORING

A revised sampling procedure was finalized in 1997, after several other procedures proved unsatisfactory in previous years. The procedure was used in 1997 on two final harvest units (Diversion Sale unit 1 and Chaplain Sale unit 1) on the Lake Chaplain Tract and results were compared to forage availability on forested control units. In 1998 the two units of the Tiki Sale were sampled prior to harvest and will serve as their own controls in future monitoring according to the procedures.

4.10 LAND ACQUISITION

In 1988 the District purchased the 205 acre Lost Lake Tract as part of the WHMP requirement. The District/USFS/DNR land exchange was completed in 1991. The District acquired 2,295 acres of upland and wetland habitat at Spada Lake and Williamson Creek. This included the entire Williamson Creek Tract identified in the WHMP. With the exception of existing recreation sites and areas used for hydroelectric operations, the land in the Spada Lake Tract has been incorporated into the wildlife habitat management program as prescribed by the WHMP and the Spada Lake Tract Supplemental Plan. The Supplemental Plan was approved by the FERC on April 18, 1997 and will guide future forest vegetation management for that tract.

The City/DNR land exchange was completed in late 1991. All of the land specified in the WHMP in the Lake Chaplain Tract was acquired by the City and dedicated to management under the WHMP.

5.0 WORK PLANNED FOR 1999

5.1 FOREST VEGETATION MANAGEMENT

5.1.1 Lake Chaplain Tract

The Linetree Sale will be offered in the first half of 1999, following completion of the layout Unit 2 (Figure 2). Remaining tasks include allocating trees for created snags, CWD, and inventory of existing snags and CWD. Road construction and harvest activities may begin on this sale in 1999. Layout work will begin on two units of the next, as yet unnamed, timber sale.

The Tiki Sale units (Figure 2) will be replanted with Douglas fir and western red cedar in early 1999. Total density will not exceed 300 stems per acre. Red cedar will average 50

stems/acre on the units, but will be concentrated in wetter sites. Shovel-logged portions of the units will be re-seeded with the grass-forb mix used in previous years.

Tree seedlings on all reforested harvest units will be monitored for survival and vigor.

Property line location work on the Chaplain Tract will be done in 1999. Approximately one mile of line between the City and DNR will be completed and approximately one-half mile of line between the City and PUD will be located.

We will complete work on GTA management procedures in 1999, and draft management plans for existing GTA's.

5.1.2 Spada Lake Tract

We will evaluate the need for precommercial thinning on South Fork and South Shore units that were identified for possible management in the Spada Supplement. If the canopy in a unit is close to closure, it will probably be thinned promptly; if not, action will be deferred. We will investigate the feasibility of helicopter logging for units that were identified in the Spada Supplement for commercial thinning.

5.1.3 Lost Lake Tract

Field reconnaissance will continue in 1999 for the units that were scheduled for harvest in the WHMP in 2000 (Figure 9). The wildlife benefits of harvesting as scheduled in the WHMP will be examined in light of the timber harvesting adjacent to the Lost Lake Tract in recent years.

5.2 SNAG MANAGEMENT

The units described in Section 3.2 as having already been inventoried and the two Linetree Sale units will be the first priority for snag creation in 1999. It is estimated that roughly 500 snags will be made on these 8 units totaling about 460 acres. Additional acreage on the Lake Chaplain, Spada Lake, and Williamson Creek Tracts will be inventoried as time permits. Long term monitoring of snags created prior to 1995 will continue in 1999.

5.3 COARSE WOODY DEBRIS MANAGEMENT

CWD on one or more stands on the Williamson Creek Tract will be inventoried as described in the Williamson Creek Tract SOP (PUD 1999).

5.4 REVEGETATION

5.4.1 Spada Lake Drawdown Zone

Survival of wetland plantings and natural recruitment of vegetation will be monitored on the two shoreline revegetation sites in 1999.

5.4.2 Power Pipeline Right-of-Way

Quantitative measurements of vegetation cover on the ROW will be done in 1999 to determine the results of the revegetation program, and what species would be best suited for seeding of problem areas on the right-of-way. The condition and percent survival of the shrubs and trees that were planted in 1997 will also be evaluated to determine those species best suited for additional plantings.

Thinning of the buffer strip between the access road and the pipeline may continue this year. This will reduce competition among the remaining trees, allowing them to develop into perch trees, and also increase production in the shrub layer underneath.

5.4.3 Chaplain Marsh, North End of Lake Chaplain, and Powerhouse Site

Monitoring will be conducted as in previous years.

5.5 NEST STRUCTURES

The two floating nest platforms at Lost Lake will be monitored every two weeks from April through late June. The floating platform at Spada Lake will be monitored every two weeks in April. If no sign of use is observed, then it will be monitored once per month through late June. Visits will be more frequent and observation time may be longer if the platforms are being used for nesting. At the end of the nesting season the platforms will be visited to look for signs of use by wildlife.

Nest boxes will be cleaned and repaired in February and checked for nesting success in June. The osprey platform at Lost Lake will be monitored every two weeks from April through September. Visits will be more frequent and observation time may be longer if the platform is being used for nesting. The osprey platforms at Spada Lake will be monitored every two weeks in April. If there is no sign of use they will be monitored at least once per month in May and June.

5.6 DEER FORAGE MONITORING

The final harvest unit of the Horseshoe Sale and an adjacent control unit will be sampled in 1999, using the procedure developed in 1997.

5.7 BIOSOLIDS APPLICATION AT LAKE CHAPLAIN

Water quality monitoring for units 2035-6 and 2040-5 will continue at the established stations in Chaplain Creek in 1999. Understory monitoring will also be conducted on the treated stands and control plots as described in the 1997 Annual Report. Application of the remainder of the prescribed amount of biosolids is planned for 2000 after July 1. Other possible biosolids fertilization projects in 2000 could include stand 1993-3.

6.0 SCHEDULE OF ACTIVITIES FOR 1999

MAJOR ACTIVITIES	LOCATION	QUANTITY
Final Harvest		
Complete layout and sale	Linetree Sale, see Fig. 2	2 units (approx. 37 ac.)
Timber sale	Linetree Sale; see Fig.2	2 units
Layout	L. Chaplain Tract, Unnamed Sale, see Fig. 2	2 units (acreage TBD)
Field Reconnaissance	Lost Lake Tract	2 scheduled FH units (acreage TBD)
Reforestation/seeding	Tiki Sale, see Fig. 2	45 acres
Harvest Unit Stocking Monitoring	L. Chaplain Tract, all previously harvest units	6 units
Snag Creation	Lake Chaplain Tract, Lost Lake Tract	5 units (approx. 450 snags)
Snag Inventory	Lake Chaplain Tract, Spada Lake Tract, Williamson Creek	TBD
CWD Creation	Lake Chaplain Tract	2 units (Linetree Sale), if harvested in 1999
CWD Inventory	Lake Chaplain Tract, Williamson Creek Tract	TBD
Revegetation		
Grass seeding/fertilizer	Pipeline ROW	As needed to improve bare spots
Monitoring		
Revegetation Site Monitoring/Maintenance	West side, Chaplain Marsh North end, L.Chaplain Powerhouse site Spada L. drawdown zone Pipeline ROW	Monitoring of all planted/seeded areas. Maintenance as needed: Weeding, brush thinning, etc.
Deer Forage	Lake Chaplain Tract	1 FH unit1 and 1 unharvested control unit
Snags	TBD	100 created snag trees
Nesting Structures	Lost Lake, Spada Lake, and Chaplain Marsh	Monitor all structures .
Wetland Monitoring	Lost Lake, Williamson Creek Tracts	All wetlands designated in SOPs
Old Growth Survey	Williamson Creek Tract	TBD
Biosolids Application		
Understory monitoring	Units 2035-6, 2040-5	2 units plus controls
Water quality monitoring	Chaplain Creek	2 stations
GTA and BZ Management	All established units	Monitor and develop long-term management plans

APPENDIX 1 – SNAG MANAGEMENT DECISION FOR UNIT 2020-5 ON THE LAKE CHAPLAIN TRACT

SNOHOMISH COUNTY PUD
PUBLIC UTILITY DISTRICT NO. 1

EVERETT

Providers of quality water, power and service at a competitive price that customers value.

November 23, 1998
PUD 20536

Mr. Gary Engman
Washington Department of Wildlife
16018 Mill Creek Boulevard
Mill Creek, WA 98012

Mr. Gwill Ging
U.S. Fish & Wildlife Service
510 Desmond Dr. SE, Suite 102
Lacey, WA 98503

Gentlemen:

RE: Jackson Hydroelectric Project – FERC No. 2157
Wildlife Habitat Management Plan
Snag Management

In our 1997 progress report and meeting on March 17, 1998, we called your attention to our snag inventory results on one Lake Chaplain tract unit (2020-5). The existing snag population and our thoughts on how to manage the unit are described on page 7 of the 1997 Annual Report. We told you that we would inform you on what we decided after doing additional field work.

We told you at the meeting that we were considering exchanging the 36 small (15-16.9 inch) trees that would be required for snag creation under a strict interpretation of the WHMP's targets for a smaller number of larger (18+ inch) Douglas firs. If we use trees from the smaller size class, almost all will be hemlocks due to species and size distribution on this stand. Additionally, we already have 8.0 snags/acre, most of which are hemlocks, from the 11-14.9 inch range. We anticipate continued recruitment of hemlock snags in this size class and the 15.0-16.9 inch class through natural mortality until the time of final harvest. These smaller hemlock snags are not expected to last as long as larger Douglas fir snags. Our objective is to include in the unit's snag population some longer-lasting snags, so we determined that an exchange of a large number of small hemlocks for a smaller number of large Douglas firs would solve the problem.

The basis for the exchange is the estimated stumpage value of the trees. The attached spreadsheets show our selection of trees for snag creation later this year on this unit, and the stumpage values used to calculate the trade-off. The fourteen trees that we selected are roughly equivalent in value to 36 hemlocks in the 15-16.9 inch size class.

This exchange will result in a population of snag trees that we believe will survive through the next rotation on this unit and serve a more varied group of wildlife species. We believe this process is an improvement over the standard procedures for implementing snag creation for this unit.

If you have any questions on our procedures please call Bernice Tannenbaum (425-783-1746) or Mike Schutt (425-783-1712).

Sincerely,

Don Farwell
Management Forester
City of Everett

Bernice Tannenbaum
Environmental Coordinator
Snohomish Co. PUD

Enclosures

MARKED SNAGS IN 2020-5

revised **8/7/98**
MSS

unit acreage =
# of snags required = 0.0

VERIFY ALL BEARINGS AND SLOPES

FLAG #	SPECIES	DBH (in.)	HT. (ft.)	YEAR CREATED	LOCATION	NOTES
1	Fir	18.1			213' @ SE85, -8% from hydrant @ stand pipe.	
2	Hemlock	19.4			22' @ SE56 , -4% from 1	
4	Fir	18.4			300' @ NW20, 4% from 3	
6	Fir	18.0			+/-142' @ SW31 %% from 4	92' @ SW48, 13% from 5
8	Hemlock	18.9			+/- 128' @ SE65 %% from 6	66' @ East90, -15% from 7
9	Hemlock	18.2			153' @ NE40, -8% from 8	
14	Hemlock	18.1			+/-300' @ SE07 from 10	
15	Fir	18.4			88' @ SE38, 0% from 14	+/- 388' @ SE14 from 10
20	Fir	27.0			+/- 270' @ SE38 %%??from 15	+/-240' @ +/-SW11 SLOPE?? from18
19	Fir	19.2			84' @ +/-sw84, -23% from 20	
22	Fir	19.4			35' @ NE82, -27% from 19	
21	Fir	18.0			@ 22	
					or, 613' @ SE24 from #3 (slope???)	or 134' @ SW32, -28% from 16???
27	Fir	18.7			194' @ SW40, 34% from 28	
26	Fir	19.1			23' @ SE80, -19% from 27	71' @ NW76, 4% from 25
24	Fir	18.5			24 is 100' @ SW89 %%?? from26	

14 averaging 18.6 + 1@27"
15 trees total

Unit 2020-5
Snag Value Calculations

		LOG PRICES								
Species		4 saw	3 saw	2 saw						
DF		$500.00	$650.00	$690.00						
WH		$320.00	$460.00	$500.00						
						PRICE OF TREES		# Trees equivalent to		
	DBH	LOG VOLUMES (bf)				1 tree	37 trees	36 WH @ 16" dbh		
WH	16	70	180			$105.20	$3,892.40		-	
DF	16	70	180			$152.00	$5,624.00		25.61	
DF	17		70	190		$176.60	$6,534.20		22.04	
DF	18	30	120	240		$258.60	$14,430.00		15.05	
DF	19	30	130	260		$278.90	$15,540.00		13.96	
DF	20	30	150	290		$312.60	$17,390.00		12.45	
DF	21	40	180	360		$385.40	$21,460.00		10.10	
DF	22	40	170	400		$406.50	$22,570.00		9.58	
DF	23	40	180	400		$413.00	$22,940.00		9.42	

APPENDIX 2 – WHMP Implementation Milestones

General Activity Category	Management Tract	Milestone	Annual Report Reference – (Section/page #)
Timber Harvest	Lake Chaplain	Chaplain Sale	1991 (3.3.1, p.6), 1992 (3.2.1, p.4)
	Lake Chaplain	Horseshoe Sale	1992 (3.2.2, p.6), 1993 (3.1.1, p.6)
	Lake Chaplain	Diversion Sale	1995 (3.1.1, p.6)
	Lake Chaplain	Tiki Sale	1997 (3.1.1, p.2), 1998 (3.1.1, p.2)
	Lake Chaplain	Line Tree Sale	1997 (3.1.1, p.2), 1998 (3.1.2, p.5)
	Lake Chaplain	Salvage Sale	1993 (3.1.2, p.6), 1998 (3.1.1, p.2)
Reforestation	Lake Chaplain	Chaplain Sale	1992 (3.2.1, p.4)
	Lake Chaplain	Horseshoe Sale	1993 (3.1.1, p.6), 1994 (3.1.3, p.5)
	Lake Chaplain	Diversion Sale	1996 (3.1.1, p.4)
Roads	Lake Chaplain	S1000 (Chaplain Sale)	1991 (3.3.1, p.6)
	Lake Chaplain	C1300 (Chaplain Sale)	1991 (3.3.1, p.6)
	Lake Chaplain	C1900 (Tiki Sale)	1997 (3.1.2, p.5)
	Lake Chaplain	SP1500 (Tiki Sale)	1997 (3.1.2, p.5)
	Lake Chaplain	SP1000 (Tiki Sale)	1997 (3.1.2, p.5)
	Lake Chaplain	SP1300 (Tiki Sale)	1997 (3.1.2, p.5)
	Spada Lake	North Shore Road	1997 (4.3, p.28)
Forest Vegetation Management	Lake Chaplain	Chaplain Sale	1997 (3.1.3, p.5), 1998 (3.1.3, p5)
	Lost Lake	Precommercial Thinning	1991 (3.3.2, p.9)
	Spada Lake	Precommercial Thinning	1996 (3.1.5, p.6)
Stream and Wetland Buffer Zone Management	Lake Chaplain	Snag creation and monitoring	
GTA Management	Lake Chaplain	Chaplain Sale Unit 1	1994 (3.1.3, p.5)
Snag Management	Lake Chaplain	Implementation Decisions	1990 (3.3, p.6), 1993 (3.2, p.8), 1996 (3.2, p.6)
	Lake Chaplain	Snag Inventory Results	1991 (3.4, p.9), 1992 (3.3, p.6), 1995 (3.2, p.7), 1997 (3.2.2, p.7), 1998 (3.2.1, p.5)
	Lake Chaplain	Snag Creation	1990 (3.3, p.6), 1991 (3.4, p.12), 1992 (3.3, p.6), 1993 (3.2, p.8), 1994 (3.2, p.6), 1995 (3.2, p.7), 1996 (3.2, p.6), 1997 (3.2.2, p.7), 1998 (3.2.1, p.7)
	Lake Chaplain	Snag Monitoring	1998 (3.2.2., p.7)

General Activity Category	Management Tract	Milestone	Annual Report Reference – (Section/page #)
CWD Management	Lake Chaplain	Implementation Decisions	1991 (3.10.2, p. 27), 1992 (3.9.2, p.12), 1993 (4.5, p.22), 1994 (3.6.6, p.10), 1995 (3.3.2, p.11), 1995 (Appendix A-Exhibits 1-3), 1996 (3.3, p.10)
	Lake Chaplain	CWD Inventory Results	1991 (3.10.2, p.27), 1993 (3.7.2, p.14), 1995 (Appendix A-Exhibit 4)
	Lake Chaplain	CWD Creation	1994 (4.7.6, p.18), 1995 (3.3.1, p.7), 1995 (Appendix A-Exhibit 4), 1998 (3.3, p.9)
	Lake Chaplain	CWD Monitoring	1998 (3.3, p.9)
Revegetation	Spada Lake	Drawdown Zone Test Plantings	1994 (3.3.1, p.6), 1995 (3.4.1, p.12), 1996 (3.4.1, p.10), 1997 (Fig.4), 1998 (3.4.1, p. 10)
	Pipeline ROW	Revegetation Design	1991 (3.5, p.19)
	Pipeline ROW	Seeding	1992 (3.4, p.10), 1993 (3.3, p.11), 1994 (3.3.2, p.7), 1996 (3.4.2, p.11), 1997 (3.4.2, p.11), 1998 (3.4.2, p. 10)
	Pipeline ROW	Plant shrubs and trees	1997 (3.4.2, p.11), 1998 (3.4.2, p.10)
	Pipeline ROW	Place tree root wads	1989 (3.3, p.3), 1995 (3.4.2, p.13)
	Lake Chaplain	Revegetation Design	1991 (3.5, p.19)
	Lake Chaplain	Plantings at north end of lake	1992 (3.4, p.10), 1998 (3.4.5, p.12)
	Lake Chaplain	Plantings along Chaplain Marsh	1993 (3.3, p.11), 1998 (3.4.3, p.12)
	Powerhouse	Revegetation Design	1991 (3.5, p.19)
	Powerhouse	Plant shrubs and trees	1993 (3.3, p.11)
Nest Structures	Lost Lake	Floating platforms	1991 (3.6, p.20), 1992 (3.5, p.10), 1993 (3.4, p.11), 1998 (3.5.1, p.13)
	Lost Lake	Duck nest boxes	1990 (3.7, p.8), 1995 (3.5.2, p.16), 1996 (3.5.2, p.13)
	Lost Lake	Osprey Platform	1990 (3.8, p.8)
	Lake Chaplain	Floating platforms	1991 (3.6, p.20), 1992 (3.5, p.10), 1993 (3.4, p.11), 1994 (3.4, p.7)
	Lake Chaplain	Duck Nest Boxes	1993 (3.5, p.11), 1995 (3.5.2, p.16), 1996 (3.5.2, p.13), 1997 (3.5.1, p.16)
	Spada Lake	Floating Platforms	1996 (3.5.1, p.13), 1997 (3.5.1, p.16)
	Spada Lake	Duck Nest Boxes	1996 (3.5.2, p.13), 1998 (3.7, p.18)
	Spada Lake	Osprey Platforms	1992 (3.7, p.11)
Biosolids Application	Lake Chaplain	Biosolids Application	1996 (3.8, p.18), 1998 (3.7, p.18)
	Lake Chaplain	Monitoring	1996 (3.8, p.18), 1997 (3.7, p.19)

General Activity Category	Management Tract	Milestone	Annual Report Reference – (Section/page #)
Deer Forage Monitoring	Lake Chaplain	Implementation Decisions & Methods	1991 (3.10.1, p.21), 1996 (3.9, p.18) 1997 (3.8.1, p.19)
		Forage Availability Results	1991 (3.10.1, p.22), 1996 (3.9, p.18) 1997 (3.8.2, p.22), 1998 (3.8, p.18)
		Utilization Results	1991 (3.10.1, p.22)
Land Acquisition	Lost Lake		1989 (3.1, p.2)
	Lake Chaplain		1991 (3.1, p.3)
	Spada Lake		1990 (3.1, p.2)
	Williamson Creek		1991 (3.1, p.3)
Management Plans & Land Use Decisions	Lake Chaplain	Chaplain Property Comprehensive Plan	1995 (3.7, p.17)
	Lake Chaplain	Shoreline Zone development permit	1995 (3.7, p.17)
	Lake Chaplain	Zoning Code change	1996 (3.7, p.15)
	Lake Chaplain	Bald Eagle Nest Site Management Plan	1997 (Attachment 1)
	Lost Lake	Concrete Ford Installation	1991 (3.2, p.3)
	Spada Lake	Supplemental Plan	1997 (Attachment 2)
ROW Management	Power Pipeline	Gate to restrict public access	1994 (3.3.2, p.7)
	Power Pipeline	Access Road	1996 (3.4.2, p.11), 1997 (3.4.2, p.11)
Special Agency Consultation	All management tracts	Agency tour of WHMP Sites	1997 (3.9, p.22)