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2011 Aquatic Weed Surveys in Timothy Lake, Lake Harriet and North Fork Reservoir : final report

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2011 AQUATIC WEED SURVEYS IN TIMOTHY LAKE, LAKE HARRIET & NORTH FORK RESERVOIR - FINAL REPORT

Prepared for:

Portland General Electric, Clackamas River Hydroelectric Project

By:

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Center for Lakes and Reservoirs

Portland State University

November 2011

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Introduction

Portland General Electric (PGE) was issued a new license by the Federal Energy Regulatory Commission (FERC) for the continued operation and maintenance of the Clackamas River Hydroelectric Project No. 2195 (Project) on December 21, 2010. This Project is located on both the lower 16 miles of Oak Grove Fork of the Clackamas River (Oak Grove Fork) and the mainstem of the Clackamas River in Clackamas County, Oregon. The effects of relicensing this Project were addressed in the Final Environmental Impact Statement (FEIS) completed in December 2006 and included the issue of invasive aquatic weed species. The term “aquatic weed” is used here to refer to any non-native aquatic plant species.

Surveys of Timothy Lake conducted by Portland State University (PSU) in 1996 and a subsequent survey of Timothy Lake and Lake Harriet in 2004 did not locate any problematic aquatic weed species. However, repeated monitoring is necessary to detect infestations in a timely fashion and, if noxious weeds are present, to allow treatment when weed cover is low and eradication efforts more cost effective. With that aim, PSU conducted aquatic vegetation surveys of Lake Harriet, Timothy Lake, and North Fork Reservoir between August 31 and September 13, 2011. The purpose of these surveys was to detect any populations of aquatic weeds occurring in the lakes while also establishing baseline information regarding native aquatic vegetation abundance and distributions in each waterbody.

Study Area

Timothy Lake, Harriet Lake and North Fork Reservoir are within Mt. Hood National Forest, south of Mt. Hood, Oregon and each is accessible by paved road (Appendix A, Figure A-1).

Timothy Lake is 1,413 acres (572 ha) in size and is located at an elevation of about 3,191 feet (973 m). The lake is drawn down during the winter by about 20-25 feet (6-8 m); drawdown typically begins in early September. Summer water levels range between 1-2 feet (0.3-0.6 m) of full pool (3,189.9-3,191.9 feet [972.3-972.9 m]); the lake is usually full by Memorial Day weekend. Summer water depths exceed 80 feet (24 m) in the center of the lake; the North Arm of the lake is fairly shallow, generally less than 20 feet (6 m) deep (Appendix A, Figure A-2).

Lake Harriet is only about 22 acres (8 ha) and is lower in elevation - about 2,031 feet (619 m). This lake is relatively shallow throughout, with a maximum depth of about 30 feet (9 m). Water levels are relatively stable throughout the year.

The North Fork Reservoir is 350 acres (142 ha) at normal high water surface elevation of 665 feet (202.6 m) with a steep relief and daily fluctuations of ~4 feet. While some of the reservoir's shoreline is undeveloped private property, most of the North Fork is situated within the Mt. Hood National Forest and is used heavily for recreational pursuits such as boating, water-skiing and fishing.

Doughty (2004) reported that average summer (June-September) water temperatures in Timothy Lake in 2001 ranged from 59.6-67.6°F (15.4-19.8°C) at a depth of 6.6 feet (2 m); from

52.0-61.0°F (11.1-16.1°C) at 32.8 feet (10 m) deep; and from 45.9-47.5°F (7.7-8.6°C) at 65.6 feet (20 m) deep. Average water temperatures in Lake Harriet for the same period ranged from 47-48.9°F (8.4-9.4°C) at a depth of 6.6 feet (2 m) and from 45.6-46.7°F (7.6-8.2°C) at 29.5 feet (9 m) deep. Within June and July, North Fork Reservoir temperatures ranged between 54.0-58.5°F (12.2-14.7°C) at 19.7 feet (6 m) deep¹. The narrow range of temperatures at Lake Harriet suggests very little stratification, while the opposite occurs at Timothy Lake. Stratification of the North Fork Reservoir is typically weak and occurs only in the lower reaches where surface temperatures exceed those at 6 meters deep by 2-3°C; the shallow upper reaches of the North Fork do not appear to stratify (Johnson et al. 1985, Doughty 2004).

Each of these lakes has camping and picnic sites on their shores which are open to the public from May through September. Timothy Lake has four public boat ramps, each of which is located within a public campground. Lake Harriet has public camping sites and only one primitive boat ramp. North Fork Reservoir has public camping, two boat ramps and a small marina.

Methods

Surveys of Timothy Lake and North Fork Reservoir were conducted from a motorized boat equipped with a depth finder; at Lake Harriet we utilized a canoe. At each waterbody an aquatic plant sampling rake fixed to a variable-length pole was dropped to the bottom, the depth recorded to the nearest decimeter, then the pole was turned one full rotation and retrieved. The total area sampled by the rake was approximately 1.23 ft² (0.15 m²). All plants retrieved on the rake were identified and estimates of relative abundance were made for each species. We employed supplemental sampling where sparse plant cover did not afford good capture with the plant rake (typically where firmly rooted plants with limited vegetation were not snared by the rake tines); such sampling typically involved repeated dragging of the plant rake to dislodge visible plants and collection as material floated to the surface.

Transects were done perpendicular to the shore, sampling from the shore to the maximum depth of macrophyte colonization and a minimum of one sampling point (rake grab) for every two meter increase in depth. Global Positioning System (GPS) coordinates were recorded for each of the sample points with a Trimble GeoXT GPS unit. Specimens for each species were pressed, labeled and will be submitted to the PSU Herbarium. At Timothy Lake, twelve transects were sampled (Figure 1); these were sited at approximately the same locations as those made in the 2004 survey by Portland State University, which were in turn sited according to the 1996 survey (Heaton, et al 1996). At Lake Harriet, we sampled by canoe across 16 transects generally following a N-S orientation (Figure 2). In North Fork Reservoir, we sampled 16 transects sited in the narrow littoral band found in the mid-to-lower reaches of the reservoir and also in embayments and shallow upper reservoir (Figure 3).

¹ Vandalism to the temperature loggers prevented data collection for August-September of 2001 (Doughty 2004).

Aquatic plants were the focus of the survey, thus no systematic effort was made to survey emergent vegetation or for invasive aquatic animals. However we did watch for invasive emergent species like purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis* ssp. *australis*), giant hogweed (*Heracleum mantegazzianum*) and yellow flag iris (*Iris pseudacorus*) as well as zebra/quagga mussels (Dreissenid mussels), New Zealand mudsnails (*Potamopyrgus antipodarum*) and Asian clam (*Corbicula fluminea*).

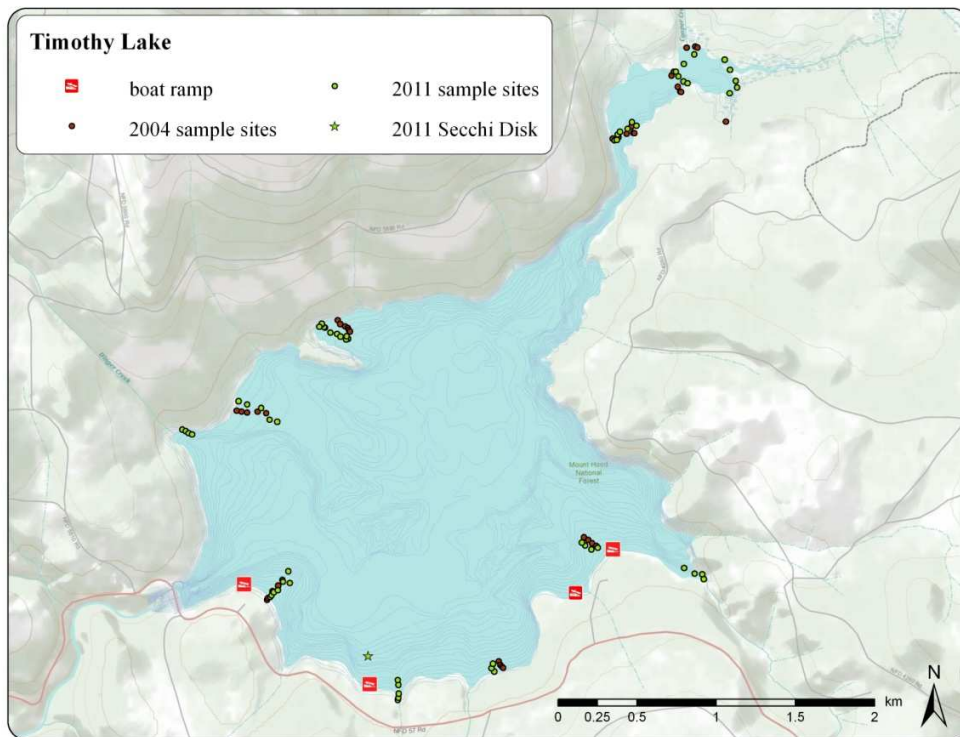


Figure 1. Macrophyte sampling sites in Timothy Lake in 2004 & 2011.

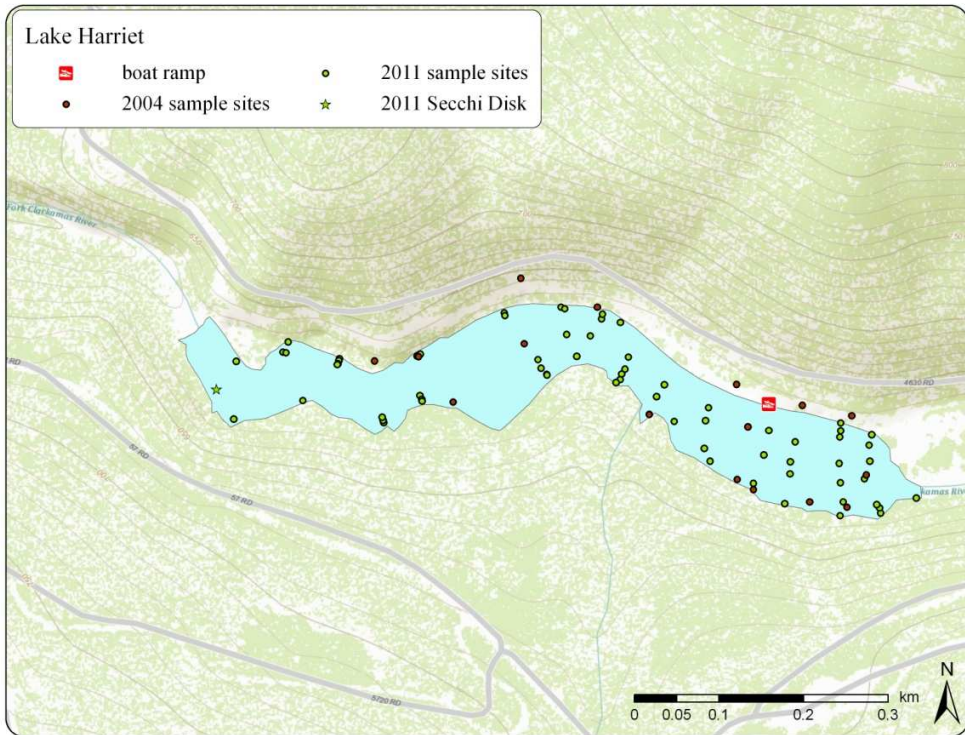


Figure 2. Macrophyte sampling sites in Lake Harriet in 2004 & 2011. Those 2004 sampling sites which appear to be outside the lake basin likely reflect errors in the recorded GPS coordinates caused by limited satellite availability in the steep sided canyon.

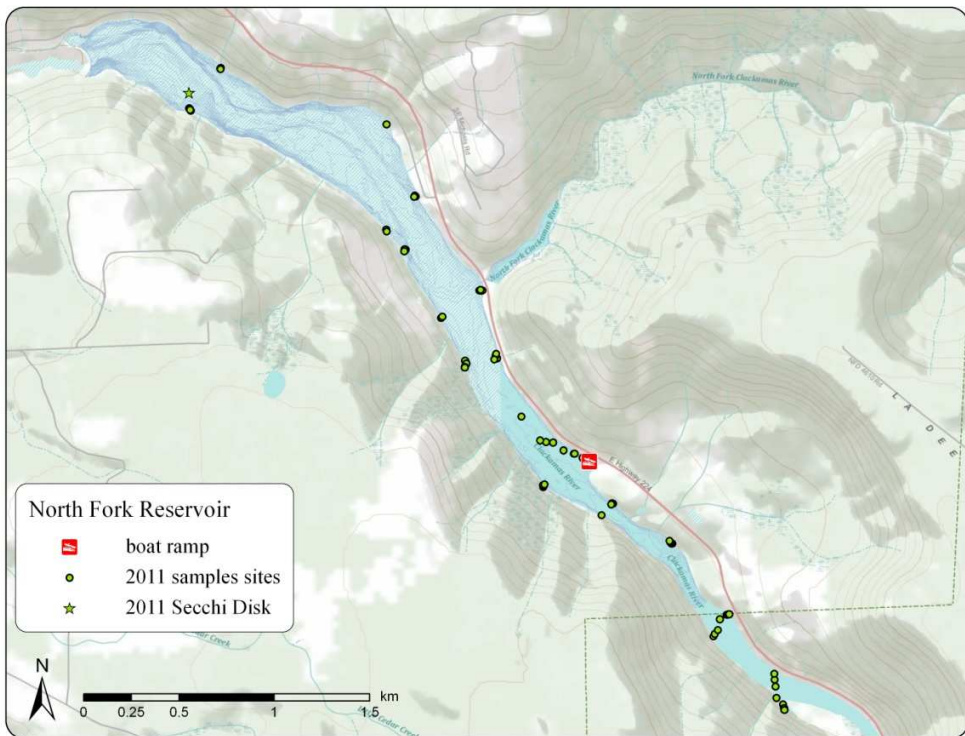


Figure 3. Macrophyte sampling sites in North Fork Reservoir in 2011.

Results

During this year's survey, a total of 14 different aquatic macrophytes were identified in the three waterbodies sampled (Table 1). No aquatic weeds were found in any of the gathered samples. Of the 14 species collected, there were nine angiosperms, four bryophytes (three species of *Fontinalis* spp. and one species of *Sphagnum*) and one macro-alga (*Nitella* sp.). Only *Nitella* sp. and one or more species of *Fontinalis* were found in all three waterbodies. Appendix B shows all the 2011 survey data, including transect numbers, GPS coordinates, genus and species and abundance estimates.

Table 1. Aquatic plant species found in Timothy Lake, Lake Harriet, and North Fork Reservoir between August 31 and September 13, 2011.

Genus and species	Classification ¹	Timothy Lake	Lake Harriet	North Fork Reservoir
<i>Callitriche hermaphroditica</i>	A	x		
<i>Eleocharis acicularis</i>	A	x		
<i>Elodea canadensis</i>	A		x	x
<i>Fontinalis</i> sp. ¹	B	x	x	x
<i>Limosella aquatica</i>	A	x		
<i>Nitella</i> sp.	Al	x	x	x
<i>Persicaria amphibia</i> (formerly <i>Polygonum aquaticum</i>)	A	x		
<i>Potamogeton alpinus</i>	A	x		
<i>Potamogeton pusillus</i>	A	x		x
<i>Ranunculus aquatilis</i>	A	x	x	
<i>Sparganium angustifolium</i>	A	x		
<i>Sphagnum</i> sp.	B			x

¹ A - angiosperm, B - bryophyte, Al - algae

² Three distinct species of *Fontinalis* were collected; see discussion for further information.

As in 2004, in Timothy Lake the greatest abundance and diversity of macrophytes was in the North Arm, where Cooper and Crater creeks flow into the lakes. Plants occurred in 14 of 18 samples taken and included ten species in the North Arm. Depths in the four transects within the North Arm ranged between 0.1-3.5 m, with plants occurring at all depths and at abundances ranging between "very sparse" and "dense". The greatest concentration of abundant macrophytes was along Transect #7, located near the neck of the North Arm, where stands of *Potamogeton pusillus*, *P. alpinus*, and *Nitella* sp. were dominant between depths of 2.4 to 3.5 m. Three species found in 2004 in this North Arm were not seen this year although sampling intensity was similar across years²; these included *Potamogeton natans*, *Schoenoplectus subterminalis* and *Utricularia macrorhiza*³.

² In 2004 within the North Arm of Timothy Lake, five transects were done with a total of 16 samples; in 2011, four transects were completed with 18 samples collected.

³ *Schoenoplectus subterminalis* and *Utricularia macrorhiza* are the current accepted names for *Scirpus subterminalis* and *Utricularia vulgaris*, which are referenced in the previous survey report by Pfauth & Systma (2004).

The main portion of the Timothy Lake has a steeply sloping bottom with water depths typically greater than 20 feet and rocky to gravelly substrate. Macrophytes were found on just two of the seven transects distributed around this portion of the lake. These included *Potamogeton alpinus*, *P. alpinus*, *P. pusillus*, *Ranunculus flammula* and *Eleocharis acicularis* near Meditation Point and *Fontinalis* sp. at the mouth of the Oak Grove Fork of the Clackamas enters the lake.

In Lake Harriet, plants were present in 78.8% of the samples and the maximum depth of colonization was 5.5 m (18 ft). Suitable plant habitat was more common in the shallow eastern half of the lake, compared to the western portion of the lake where steep gradients only allowed a narrow littoral band for macrophyte colonization. *Elodea canadensis* was the most common and abundant species, gathered in 74% of our samples and with 61.2% of samples at abundances of moderate to very dense. *Nitella* sp. and *Ranunculus aquatilis* were the next most commonly encountered plants, found in 10.6 and 9.1% of the samples respectively.

In the North Fork Reservoir, plants were present in 44.3% of the samples up to a maximum depth of 4.8 m (15.7 ft). Areas with suitable plant habitat were concentrated around the marina and upper reaches of the reservoir, but a solitary protected embayment midway along the reservoirs' western shoreline was also heavily colonized. Similar to Lake Harriet, *Elodea canadensis* was the most common and abundant species by far in this waterbody; it was found in 44.3% of the samples at abundances of moderate to very dense 61.3% of the time. Other species found in North Fork Reservoir were retrieved in less than 4.3% of samples.

Although detailed surveys were not conducted, there were no evident populations of invasive emergent vegetation or aquatic animals at any of the three waterbodies.

Discussion

Results from this year's surveys were largely similar to those conducted in 2004, when a total of eleven species – all native – were found in Timothy Lake and Lake Harriet. In these 2011 surveys of Timothy, Harriet and North Fork, we found 14 species, again all native. The newly documented plants (*Fontinalis* spp., *Sphagnum* sp. and *Persicaria amphibia*) were likely present in their respective waterbodies in 2004, but were probably overlooked due to their patchy and infrequent distributions and/or low abundances.

Sampling by boat in Lake Harriet allowed a greater overall picture of the lake's macrophyte community than afforded by the 2004 survey, which sampled from the shoreline (Pfauth & Sytsma 2004). However, this year's sampling day coincided with a release of trout by Oregon Department of Fish and Wildlife, thus complicating sampling along the North shore where anglers closely positioned themselves. However, a visual inspection of this area from shore did not reveal any differences in the composition of aquatic macrophytes there versus other areas of Lake Harriet.

Three species (*Schoenoplectus subterminalis*, *Potamogeton natans* or *Utricularia macrorhiza*) that were sampled in 2004 in Timothy Lake's North Arm were not collected in this year's

survey. Future surveys of this area may allow confirmation of persistent populations for these species. Of particular interest is *S. subterminalis*, which remains on the Oregon Natural Heritage Program list of S2 species – a ranking that denotes the species is “imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6 to 20 occurrences.” Additionally, Pfauth & Sytsma (2004) found one floating fragment of *Utricularia* and because no flower structures were present, made a tentative identification of the common *U. macrorhiza* (formerly *U. vulgaris*); as was noted then, the related *Utricularia ochroleuca* is another species on HNHP’s S2 list which was found during other surveys within the same region (EDAW 2003). Any future samples of this genus should be closely inspected to confirm identity at the species level.

Numerous vectors for aquatic weeds exist, including trailered boats, fishing equipment, aquarium releases and wildlife, which might harbor plant fragments or seeds. Heavy recreational use of these three waterbodies and their proximity to neighboring waterbodies with existing populations of aquatic weeds suggest introduction of one or more undesirable plant species is likely. Timothy Lake is particularly vulnerable since it has four public boat ramps, increasing the potential for boater access from neighboring waterways which may harbor existing infestations of aquatic weeds. If a viable seed or plant fragment is transported to a new waterbody, it must settle in a suitable habitat and successfully reproduce for a number of years before reaching the nuisance levels likely to be noticed by the general public. The natural topography and water-level fluctuations at Timothy Lake and North Fork Reservoir may serve as an impediment to successful establishment, but pockets suitable for macrophyte growth exist in both these waterbodies and many aquatic weeds are well adapted to variable water regimes.

Lake Harriet is at increased risk for successful establishment due to its fairly stable water levels and the relatively shallow eastern portion with ample sediment. Sediment in this eastern half of the lake may be the result of a recent release of an upstream log-jam and may redistribute with winter and spring flows.

Species of concern include *Myriophyllum spicatum* (Eurasian watermilfoil) and *Potamogeton crispus* (curlyleaf pondweed), *Egeria densa* (Brazilian egeria), *Cabomba caroliniana* (Fanwort), *Myriophyllum aquaticum* (parrotfeather), *Myriophyllum heterophyllum* (variable-leaf milfoil), *Nymphoides peltata* (yellow floatingheart), *Ludwigia* spp. (floating water primrose) and *Hydrilla verticillata* (Hydrilla). Some of these are well established in the Columbia River or Willamette River basins. As noted by Pfauth & Sytsma (2004):

Nymphaea odorata (Fragrant waterlily) is widely planted in the region as an ornamental pond plant [and] has water dispersed seeds which are eaten by waterfowl. It is possible that seeds could be transported to Timothy Lake or Lake Harriet by this means. *Iris pseudacorus* (Yellow flag iris) is a serious pest of lakes, ponds, reservoirs, and irrigation systems. It was originally planted as a garden ornamental but has escaped cultivation and become a serious aquatic nuisance. *I. pseudacorus* plants produce

numerous seeds which are dispersed by water. It is possible for it to be introduced into the lakes from seeds embedded in mud which is transported among lakes by trailers or waterfowl.

Several of these species of concern are capable of prolific vegetative reproduction and can rapidly overwhelm a waterbody. Early detection coupled with eradication of pioneer infestations has been shown to be the most cost effective way to deal with invasive species (Rejmanek and Pitcairn, 2002). Thus, it is critical that both of these lakes be regularly surveyed in order to detect the presence of introduced, invasive, aquatic plants.

Recommendations

The new license period for the Clackamas River Project expires in 2050. Repeated surveys in Timothy Lake, Lake Harriet and the North Fork Reservoir are required to allow for rapid response to newly introduced species. Other lakes that have not yet been surveyed for potential aquatic weeds and/or baseline information regarding native aquatic vegetation include River Mill Reservoir, Faraday Lake, and Clackamas Lake.

Ideally aquatic plant surveys should be conducted every two to three years; this interval would allow weed infestations that may be already present at low densities limited time to spread and thereby facilitate control or eradication measures. Even at less frequent intervals, repeated surveys still provide valuable information about the health of existing plant populations and improve understanding about potential infestation sites.

Future surveys should follow methods used in this survey. Signs instructing boaters to clean their trailers and boats before and after launching in the lakes should be maintained at all boat ramps.

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Appendix A

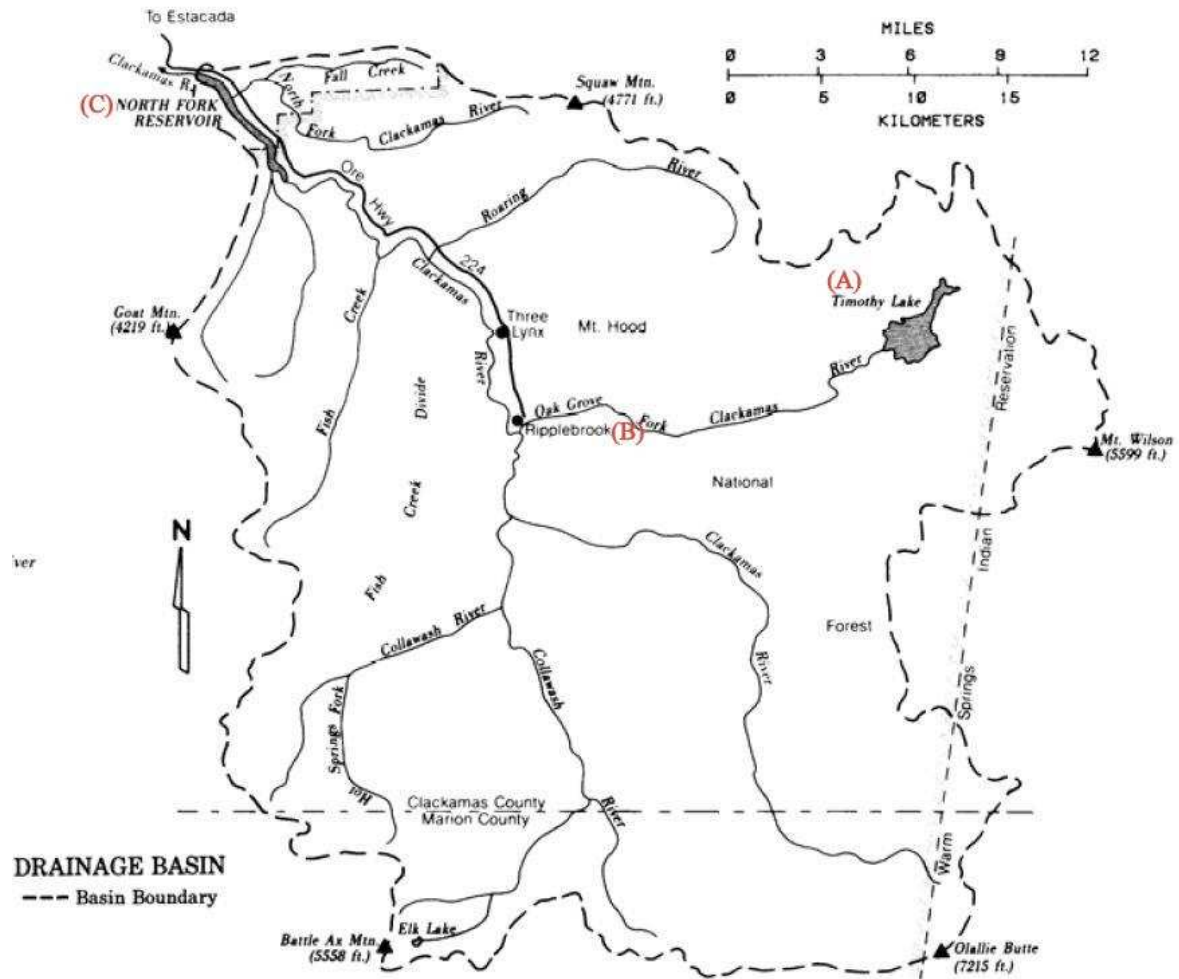


Figure A-1. Drainage basin of the Oak Grove and mainstem forks of the Clackamas River showing the general locations of (A) Timothy Lake, (B) Lake Harriet, and (C) North Fork Reservoir within Mt. Hood National Forest, OR (from Johnson et al. 1985)

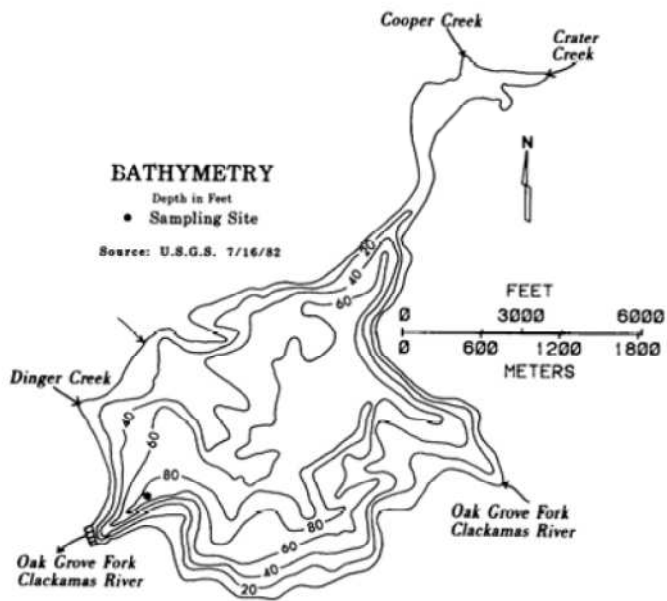


Figure A-2. Bathymetric map of Timothy Lake, Mt. Hood National Forest, OR (From Johnson, et al 1985).

Appendix B

Table B-1. Aquatic vegetation in Timothy Lake, Mt. Hood National Forest, OR on September 12, 2011

Latitude	Longitude	wpt	Depth (ft)	Depth (m)	Abundance estimates ²										
					CAHM	ELAC	FONT1	NITE	POAME	POAL	POPU	RAAQ	RAFL	SPAN	
Transect 1															
45.1092	-121.7811	54	4.6	1.4	-	-	-	-	-	-	-	-	-	-	-
45.1094	-121.7813	55	9.8	3	-	-	-	-	-	-	-	-	-	-	-
45.1097	-121.7812	56	16.4	5	-	-	-	-	-	-	-	-	-	-	-
Transect 2															
45.1077	-121.7889	57	3.3	1	-	-	-	-	-	-	-	-	-	-	-
45.1078	-121.7888	58	4.9	1.5	-	-	-	-	-	-	-	-	-	-	-
45.1081	-121.7888	59	9.5	2.9	-	-	-	-	-	-	-	-	-	-	-
45.1086	-121.7888	60	10.5	3.2	-	-	-	-	-	-	-	-	-	-	-
45.1088	-121.7888	61	17.7	5.4	-	-	-	-	-	-	-	-	-	-	-
Transect 3															
45.1136	-121.7990	1	3.9	1.2	-	-	-	-	-	-	-	-	-	-	-
45.1137	-121.7989	2	8.2	2.5	-	-	-	-	-	-	-	-	-	-	-
45.1139	-121.7987	3	9.8	3	-	-	-	-	-	-	-	-	-	-	-
45.1140	-121.7984	4	12.1	3.7	-	-	-	-	-	-	-	-	-	-	-
45.1145	-121.7979	5	12.5	3.8	-	-	-	-	-	-	-	-	-	-	-
45.1144	-121.7974	7	17.7	5.4	-	-	-	-	-	-	-	-	-	-	-
Transect 4															
45.1232	-121.8058	8	3.3	1	-	-	-	-	-	-	-	-	-	-	-
45.1232	-121.8056	9	9.2	2.8	-	-	-	-	-	-	-	-	-	-	-
45.1230	-121.8053	10	13.1	4	-	-	-	-	-	-	-	-	-	-	-
45.1230	-121.8051	11	16.1	4.9	-	-	-	-	-	-	-	-	-	-	-
Transect 5															
45.1237	-121.7988	12	18.7	5.7	-	-	-	-	-	-	-	-	-	-	-
45.1236	-121.7982	13	21.3	6.5	-	-	-	-	-	-	-	-	-	-	-
45.1246	-121.8006	14	7.5	2.3	-	-	-	-	-	-	-	-	-	-	-
45.1248	-121.8013	15	3.0	0.9	-	-	-	-	-	-	-	-	-	-	-
45.1244	-121.7995	16	14.1	4.3	-	-	-	-	-	-	-	-	-	-	-
Transect 6															
45.1283	-121.7924	17	22.6	6.9	-	-	-	-	-	-	-	-	-	-	-
45.1282	-121.7926	18	20.7	6.3	-	-	-	-	-	-	-	-	-	-	-

Table B-1. Aquatic vegetation in Timothy Lake, Mt. Hood National Forest, OR on September 12, 2011 (continued)

Latitude	Longitude	wpt	Depth (ft)	Depth (m)	Abundance estimates ²									
					CAHM	ELAC	FONT1	NITE	POAME	POAL	POPU	RAAQ	RAFL	SPAN
45.1285	-121.7933	19	11.8	3.6	-	-	-	-	-	-	-	-	-	-
45.1286	-121.7938	20	8.5	2.6	-	-	-	-	-	-	-	-	-	-
45.1289	-121.7943	21	5.2	1.6	-	-	-	-	-	-	-	-	-	-
45.1289	-121.7944	22	5.2	1.6	-	-	-	-	-	-	-	-	-	-
45.1291	-121.7945	23	3.6	1.1	-	1	-	-	-	1	-	-	-	-
45.1291	-121.7945	24	2.0	0.6	-	-	-	-	-	2	1	-	2	-
45.1290	-121.7947	25	3.9	1.2	-	-	-	-	-	-	-	-	-	-
45.1284	-121.7925	26	20.7	6.3	-	-	-	-	-	-	-	-	-	-
45.1284	-121.7930	27	15.1	4.6	-	-	-	-	-	-	-	-	-	-
Transect 7														
45.1393	-121.7708	28	8.9	2.7	-	-	-	1	-	3	3	3	-	-
45.1393	-121.7706	29	10.2	3.1	-	-	-	1	-	-	4	-	-	-
45.1396	-121.7705	30	10.2	3.1	-	-	-	2	-	-	2	-	-	-
45.1398	-121.7704	31	9.8	3	-	-	-	2	-	-	2	-	-	-
45.1399	-121.7697	32	11.5	3.5	-	-	1	-	-	1	-	-	-	-
45.1403	-121.7693	33	9.8	3	-	-	-	3	-	2	2	3	-	-
45.1401	-121.7690	34	7.9	2.4	-	-	-	2	-	2	3	-	-	-
Transect 8														
45.1431	-121.7658	35	3.0	0.9	1	1	-	-	-	-	1	-	-	-
45.1429	-121.7656	36	3.9	1.2	-	-	-	-	-	-	-	-	-	-
45.1426	-121.7652	37	4.9	1.5	-	-	-	-	-	-	-	-	-	-
45.1425	-121.7649	38	8.2	2.5	-	-	-	-	-	-	-	-	-	-
Transect 9														
45.1426	-121.7610	39	2.0	0.6	3	-	2	-	-	-	-	-	-	-
45.1422	-121.7609	40	1.1	0.35	-	3	-	-	4	-	-	-	3	-
45.1419	-121.7615	41	4.3	1.3	-	-	3	-	-	-	-	-	-	2
45.1432	-121.7614	42	0.3	0.1	1	-	-	-	-	-	-	-	1	-
45.1438	-121.7618	43	3.9	1.2	-	-	-	-	-	-	-	-	-	-
Transect 10														
45.1441	-121.7643	44	2.0	0.6	1	-	-	3	-	3	1	-	1	-
45.1436	-121.7651	45	3.6	1.1	-	-	-	3	-	-	-	-	-	-
Transect 11														
45.1143	-121.7642	46	0.7	0.2	-	-	4	-	-	-	-	-	-	-
45.1146	-121.7643	47	4.9	1.5	-	-	-	-	-	-	-	-	-	-

Table B-1. Aquatic vegetation in Timothy Lake, Mt. Hood National Forest, OR on September 12, 2011 (continued)

Latitude	Longitude	wpt	Depth (ft)	Depth (m)	Abundance estimates ²									
					CAHM	ELAC	FONT1	NITE	POAME	POAL	POPU	RAAQ	RAFL	SPAN
45.1146	-121.7649	48	8.9	2.7	-	-	-	-	-	-	-	-	-	-
45.1149	-121.7657	49	14.4	4.4	-	-	-	-	-	-	-	-	-	-
Transect 12														
45.1162	-121.7726	50	2.6	0.8	-	-	-	-	-	-	-	-	-	-
45.1161	-121.7731	51	8.2	2.5	-	-	-	-	-	-	-	-	-	-
45.1163	-121.7736	52	11.8	3.6	-	-	-	-	-	-	-	-	-	-
45.1165	-121.7739	53	15.7	4.8	-	-	-	-	-	-	-	-	-	-

¹ CAHM – *Callitriche hermaphroditica*, ELAC – *Eleocharis acicularis*, FONT1 – *Fontinallis* sp., NITE – *Nitella* sp., POAME – *Persicaria amphibium* (formerly *Polygonum aquaticum*), POAL – *Potamogeton alpinus*, POPU – *Potamogeton pusillus*, RAAQ – *Ranunculus aquatilis*, RAFL – *Ranunculus flammula*, SPAN – *Sparganium angustifolium*.

² - = Species not present in sample, 1 = Species present in very sparse amounts (1% to 20%), 2 = Species present in sparse amounts (20-40%), 3 = Species present in moderate amounts (40-60%), 4 = Species present in dense amounts (60-80%), 5 = Species present in very dense amounts (80-100%)

Table B-2. Aquatic vegetation in Lake Harriet, Mt. Hood National Forest, OR on August 31, 2011

Latitude	Longitude	wpt	Depth (ft)	Depth (m)	Abundance estimates ²				
					ELCA	FONT1	FONT2	NITE	RAAQ
Transect 1									
45.0728	-121.9590	1	2.0	0.6	-	-	-	-	-
Transect 2									
45.0727	-121.9596	2	3.0	0.9	-	-	-	-	1
45.0727	-121.9596	3	3.6	1.1	-	-	-	-	-
45.0728	-121.9596	4	5.2	1.6	-	-	-	-	-
45.0730	-121.9598	5	5.2	1.6	3	-	-	-	-
45.0732	-121.9597	6	4.6	1.4	2	-	-	3	2
45.0734	-121.9597	7	5.9	1.8	3	-	-	3	-
45.0735	-121.9597	8	1.0	0.3	1	-	-	-	-
Transect 3									
45.0736	-121.9601	9	1.0	0.3	-	-	-	-	-
45.0735	-121.9601	10	5.2	1.6	2	-	-	-	-
45.0735	-121.9602	11	6.9	2.1	2	-	-	3	-
45.0732	-121.9602	12	3.9	1.2	2	-	-	2	2
45.0730	-121.9602	13	5.2	1.6	1	-	-	-	-
45.0728	-121.9601	14	5.2	1.6	-	-	-	-	-
45.0726	-121.9602	15	0.3	0.1	-	-	-	-	-
Transect 4									
45.0728	-121.9610	16	8.2	2.5	-	-	-	-	-
45.0731	-121.9609	17	4.6	1.4	-	-	-	-	-
45.0732	-121.9609	18	7.5	2.3	4	1	-	-	-
45.0734	-121.9608	19	8.5	2.6	4	-	-	4	-
Transect 5									
45.0730	-121.9615	20	2.0	0.6	-	-	-	-	1
45.0733	-121.9613	21	5.2	1.6	4	-	1	-	-
45.0736	-121.9612	22	7.9	2.4	5	-	-	-	-
Transect 6									
45.0732	-121.9621	23	8.9	2.7	4	1	-	-	-
45.0734	-121.9622	34	6.6	2	4	-	-	-	-
45.0737	-121.9622	35	6.6	2	1	-	-	-	-
45.0738	-121.9621	36	8.2	2.5	1	-	-	-	-
Transect 7									

Table B-2. Aquatic vegetation in Lake Harriet, Mt. Hood National Forest, OR on August 31, 2011 (continued)

Latitude	Longitude	wpt	Depth (ft)	Depth (m)	Abundance estimates ²				
					ELCA	FONT1	FONT2	NITE	RAAQ
45.0737	-121.9626	33	3.3	1	3	-	-	-	-
Transect 8									
45.0737	-121.9630	37	8.9	2.7	-	-	-	-	-
45.0739	-121.9629	38	14.1	4.3	4	-	-	-	-
45.0741	-121.9628	39	11.2	3.4	3	-	-	-	-
Transect 9									
45.0747	-121.9634	32	2.0	0.6	2	-	-	2	-
45.0741	-121.9635	40	7.9	2.4	5	-	-	-	-
45.0741	-121.9635	41	1.6	0.5	-	-	-	-	2
45.0742	-121.9634	42	12.5	3.8	4	-	-	-	-
45.0742	-121.9634	43	8.5	2.6	-	-	-	-	-
45.0744	-121.9633	44	13.1	4	3	-	2	-	-
Transect 10									
45.0744	-121.9641	45	3.9	1.2	2	-	-	-	1
45.0746	-121.9639	46	15.1	4.6	4	-	-	-	-
45.0748	-121.9637	47	14.1	4.3	3	-	-	-	-
45.0748	-121.9637	48	4.3	1.3	-	-	-	-	-
Transect 11									
45.0749	-121.9643	30	3.3	1	-	-	-	-	-
45.0749	-121.9643	31	8.2	2.5	3	-	-	-	-
45.0746	-121.9642	49	13.8	4.2	2	-	-	-	-
Transect 12									
45.0748	-121.9652	29	1.6	0.5	5	-	-	-	-
45.0748	-121.9652	50	6.2	1.9	3	-	-	-	-
45.0743	-121.9647	51	17.7	5.4	2	-	-	-	-
45.0743	-121.9646	52	11.2	3.4	3	-	-	-	-
45.0742	-121.9645	53	8.5	2.6	3	-	-	-	-
Transect 13									
45.0744	-121.9664	28	5.9	1.8	1	-	-	-	-
45.0740	-121.9665	63	18.0	5.5	2	-	-	-	-
45.0739	-121.9664	64	16.4	5	2	-	-	-	-
45.0739	-121.9664	65	8.2	2.5	5	-	-	-	-
45.0744	-121.9665	66	12.1	3.7	4	-	-	-	-
Transect 14									
45.0744	-121.9677	27	4.3	1.3	3	-	-	-	-

Table B-2. Aquatic vegetation in Lake Harriet, Mt. Hood National Forest, OR on August 31, 2011 (continued)

Latitude	Longitude	wpt	Depth (ft)	Depth (m)	Abundance estimates ²				
					ELCA	FONT1	FONT2	NITE	RAAQ
45.0744	-121.9677	57	6.2	1.9	3	-	-	-	-
45.0743	-121.9677	58	11.8	3.6	2	-	-	-	-
45.0743	-121.9677	59	15.7	4.8	4	-	-	-	-
45.0737	-121.9670	60	5.2	1.6	4	-	-	-	-
45.0737	-121.9670	61	11.8	3.6	4	-	-	-	-
45.0738	-121.9670	62	20.3	6.2					
Transect 15									
45.0745	-121.9685	25	5.9	1.8	2	-	-	-	-
45.0746	-121.9684	26	3.0	0.9	5	-	-	-	-
45.0739	-121.9682	55	3.3	1		-	-	-	-
45.0744	-121.9685	56	8.2	2.5	2	-	-	-	-
Transect 16									
45.0744	-121.9692	24	12.8	3.9	3	-	-	1	-
45.0738	-121.9693	54	13.1	4	2	-	-	-	-

¹ ELCA – *Elodea canadensis*, FONT1 – *Fontinallis* sp., FONT2 – *Fontinallis* sp., NITE – *Nitella* sp., RAAQ – *Ranunculus aquatilis*.

² - = Species not present in sample, 1 = Species present in very sparse amounts (1% to 20%), 2 = Species present in sparse amounts (20-40%), 3 = Species present in moderate amounts (40-60%), 4 = Species present in dense amounts (60-80%), 5 = Species present in very dense amounts (80-100%)

Table B-3. Aquatic vegetation in North Fork Reservoir, Mt. Hood National Forest, OR on September 13, 2011

Latitude	Longitude	wpt	Depth (ft)	Depth (m)	Abundance estimates ²					
					ELCA	FONT3	NITE	POPU	SPHAG	
Transect 1										
45.2243	-122.2469	45	5.9	1.8	2	-	2	-	-	
45.2245	-122.2475	46	5.6	1.7	2	-	-	-	-	
45.2245	-122.2475	47	4.9	1.5	3	-	-	-	-	
45.2247	-122.2482	48	5.7	1.75	2	-	-	-	-	
45.2251	-122.2489	49	7.9	2.4	-	-	-	-	-	
45.2251	-122.2493	50	7.9	2.4	-	-	-	-	-	
45.2252	-122.2497	51	6.6	2	-	-	-	-	-	
45.2263	-122.2510	52	7.5	2.3	-	-	-	-	-	
Transect 2										
45.2291	-122.2526	30	5.6	1.7	5	-	-	-	-	
45.2292	-122.2527	31	11.2	3.4	-	-	-	-	-	
45.2293	-122.2526	32	6.9	2.1	4	-	-	-	-	
45.2290	-122.2528	33	11.8	3.6	-	-	-	-	-	
Transect 3										
45.2323	-122.2537	34	15.1	4.6	-	-	-	-	-	
45.2322	-122.2536	35	11.5	3.5	-	-	-	-	-	
45.2323	-122.2535	36	3.6	1.1	-	-	-	-	-	
45.2323	-122.2536	37	14.1	4.3	-	-	-	-	-	
Transect 4										
45.2367	-122.2579	53	5.2	1.6	-	-	-	-	-	
45.2368	-122.2580	54	8.2	2.5	3	-	-	-	-	
45.2368	-122.2580	55	9.2	2.8	-	-	-	-	-	
45.2367	-122.2580	56	12.8	3.9	-	-	-	-	-	
Transect 5										
45.2401	-122.2598	57	14.8	4.5	-	-	-	-	-	
Transect 6										
45.2429	-122.2709	58	3.9	1.2	-	-	-	-	-	
45.2429	-122.2709	59	5.6	1.7	-	-	-	-	-	
45.2428	-122.2709	60	10.5	3.2	2	-	-	-	-	
45.2428	-122.2709	61	11.2	3.4	2	-	-	-	-	
Transect 7										
45.2410	-122.2730	63	14.4	4.4	-	-	-	-	-	

Table B-3. Aquatic vegetation in North Fork Reservoir, Mt. Hood National Forest, OR on September 13, 2011 (continued).

Latitude	Longitude	wpt	Depth (ft)	Depth (m)	Abundance estimates ²					
					ELCA	FONT3	NITE	POPU	SPHAG	
45.2410	-122.2730	64	9.8	3	5	-	-	-	-	
45.2409	-122.2729	65	10.2	3.1	5	-	-	-	-	
45.2409	-122.2730	66	4.9	1.5	3	-	-	-	-	
Transect 8										
45.2352	-122.2599	67	11.2	3.4	-	-	-	-	-	
45.2351	-122.2599	68	15.7	4.8	-	-	-	-	-	
Transect 9										
45.2342	-122.2586	69	8.2	2.5	4	-	-	-	-	
45.2342	-122.2587	70	8.5	2.6	4	-	-	-	-	
45.2342	-122.2587	71	4.3	1.3	2	-	-	-	-	
Transect 10										
45.2310	-122.2563	38	10.8	3.3	-	-	-	-	-	
45.2310	-122.2562	39	15.1	4.6	-	-	-	-	-	
Transect 11										
45.2289	-122.2547	40	8.7	2.65	-	-	-	-	-	
45.2288	-122.2547	41	3.3	1	2	-	-	2	-	
45.2288	-122.2546	42	2.1	0.65	3	-	2	3	-	
45.2287	-122.2547	43	2.0	0.6	2	-	1	4	-	
45.2286	-122.2547	44	0.7	0.2	-	-	-	-	-	
Transect 12										
45.2230	-122.2495	72	8.5	2.6	2	-	-	-	-	
45.2230	-122.2496	73	7.9	2.4	-	-	-	-	-	
45.2230	-122.2496	74	6.9	2.1	4	-	-	-	-	
45.2231	-122.2495	75	9.8	3	-	-	-	-	-	
Transect 13										
45.2221	-122.2449	76	3.9	1.2	-	-	-	-	-	
45.2222	-122.2450	77	9.5	2.9	2	-	-	-	-	
45.2221	-122.2450	78	15.4	4.7	-	-	-	-	-	
45.2216	-122.2457	79	15.7	4.8	-	-	-	-	-	
Transect 14										
45.2202	-122.2410	80	2.6	0.8	-	-	-	-	-	
45.2202	-122.2410	81	3.6	1.1	-	-	-	-	-	
45.2202	-122.2410	82	6.2	1.9	4	1	-	-	-	
45.2203	-122.2411	83	15.7	4.8	3	-	-	-	-	

Table B-3. Aquatic vegetation in North Fork Reservoir, Mt. Hood National Forest, OR on September 13, 2011 (continued).

Latitude	Longitude	wpt	Depth (ft)	Depth (m)	Abundance estimates ²				
					ELCA	FONT3	NITE	POPU	SPHAG
45.2204	-122.2412	84	10.2	3.1	5	-	-	-	1
Transect 15									
45.2158	-122.2383	93	15.7	4.8	-	-	-	-	-
45.2159	-122.2382	94	11.5	3.5	-	-	-	-	-
45.2161	-122.2380	95	5.6	1.7	-	-	-	-	-
45.2166	-122.2378	96	4.9	1.5	3	-	-	-	-
45.2168	-122.2374	97	3.6	1.1	3	-	-	-	-
45.2168	-122.2373	98	26.6	8.1	-	-	-	-	-
45.2169	-122.2373	99	9.2	2.8	4	-	-	-	-
45.2169	-122.2372	100	1.6	0.5	2	-	-	-	-
Transect 16									
45.2126	-122.2337	85	5.9	1.8	1	-	-	-	-
45.2124	-122.2336	86	3.3	1	3	-	-	-	-
45.2123	-122.2336	87	5.9	1.8	3	-	-	-	-
45.2129	-122.2341	88	6.2	1.9	-	-	-	-	-
45.2129	-122.2341	89	5.6	1.7	-	-	-	-	-
45.2134	-122.2341	90	3.0	0.9	-	-	-	-	-
45.2138	-122.2342	91	5.2	1.6	-	-	-	-	-
45.2140	-122.2342	92	5.6	1.7	-	-	-	-	-

¹ ELCA – *Elodea canadensis*, SPHAG – *Sphagnum* sp., FONT3 – *Fontinallis* sp., NITE – *Nitella* sp., POPU – *Potamogeton pusillus*.

² - = Species not present in sample, 1 = Species present in very sparse amounts (1% to 20%), 2 = Species present in sparse amounts (20-40%), 3 = Species present in moderate amounts (40-60%), 4 = Species present in dense amounts (60-80%), 5 = Species present in very dense amounts (80-100%)