# AQUATIC MACROPHYTE IDENTIFICATION AND DISTRIBUTION STUDY

# WELLS HYDROELECTRIC PROJECT

# FERC NO. 2149

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# ABSTRACT

In August and September of 2005, the Public Utility District No. 1 of Douglas County conducted a study to address the species composition, relative abundance and spatial distribution of macrophyte beds within the waters of the Wells Hydroelectric Project (Wells Project). Study methods consisted of an initial estimation of probable locations of macrophytes using detailed bathymetry and high resolution orthophotography. Macrophyte locations were estimated based upon water depth and based upon results from studies in nearby reservoirs. The estimated location of aquatic plant beds were then mapped using a Geographic Information System (GIS). The estimated locations were then field verified through a comprehensive survey of the Wells Reservoir to determine presence or absence of macrophyte beds in the estimated locations. During the field verification surveys, relative abundance and species composition data was collected and categorized into aquatic plant community types. Information collected was integrated into a final continuous macrophyte map layer in the GIS.

Sixty-one transects totaling 396 sample points were completed during the 2005 study. Depths of up to 30 feet were sampled and sampling points along transects were completed at intervals of 5 feet or less. A total of 9 aquatic plant species were documented. The two most dominant species in samples (samples in which the dominant species consisted of greater than 60% of the sample) collected were common waterweed (*Elodea canadensis*) and leafy pondweed (*Potamogeton foliosus*) at 24.7% and 16.7%, respectively. Both of these species are native to the Mid-Columbia River Basin. Non-native Eurasian watermilfoil (*Myriophyllum spicatum*) (EWM), which is an invasive species of concern, was dominant in only 6.3% of samples (25/396) collected. All of these samples were collected at depths between 4 and 15 feet. Samples in which no plants were identified (absent) consisted of 41.7% of all samples taken throughout the Wells Reservoir and supported the concept that macrophyte communities maintain a patchy distribution.

The study found that in general, macrophyte communities in the Wells Project were patchy and were distributed by depth. Water depth proved to be the most consistent variable in predicting the distribution of macrophyte communities in the Wells Reservoir. This observation was similar to the results from studies conducted in downstream reservoirs (Rocky Reach, Priest Rapids, Wanapum reservoirs).

In general, macrophyte communities did not recruit to depths of less than 4 feet in the Wells Project. Depths between 5 and 15 feet were characterized by a species composition where native species were dominant. In locations where Eurasian watermilfoil was present, this species was most often sub-dominant and present at relatively low densities (less than 10% milfoil). From depths of 15 to 24 feet, species composition consisted exclusively of native species. From 24 feet to 30 feet, macrophyte communities were absent most likely due to the limited availability of light at these depths. Overall, the study identified a total of 2,379 acres of macrophyte beds out of a total surface area of 9,740 acres.

# 1.0 INTRODUCTION

Aquatic plants are often an integral component of aquatic ecosystems and can be of ecological importance since they represent the major structural component of littoral habitats, acting as shelter, nesting, and feeding grounds for a wide variety of micro-organisms, fish and waterfowl (Hudon et al., 2000). The nature of these plant communities has been shown to affect light, temperature, turbulence, water and sediment chemistry, and the abundance and composition of other biotic assemblages from epiphytes to phytoplankton (Johnson and Ostrofsky, 2004). Within the Mid-Columbia River basin, native aquatic plant communities play an integral role in the success of both fish and wildlife communities. The abundance of native plant communities typically maintain a balance within the ecosystem encouraging the success of these communities as well as the success of other species of varying trophic levels that interact with it. These native aquatic plant communities create structural complexity resulting in high quality rearing habitat for juvenile fish, a stable prey base of forage fish for larger predatory fish, increased lower level trophic production (primary and secondary production), increased nutrient cycling and benefits to water quality.

Although aquatic plants are a natural component of aquatic habitat, their proliferation, especially non-native species, can result in a variety of detrimental impacts. Excessive proliferation of non-native species can displace diverse communities of native aquatic plants, affect trophic structure of fish assemblages, create over-populations of fish stunted in size, degrade water quality, and reduce the recreational and aesthetic enjoyment of a water body (Duke, 2001). The recent spread of invasive exotic macrophytes such as EWM into the Mid-Columbia River Basin is of particular concern. Like many invasive species, the spread of EWM can result in the displacement of diverse native plant communities and create a near monoculture of dense macrophytes (Olson et al., 1998) which in turn affect the entire aquatic ecosystem. The first documented occurrence of EWM in the State of Washington was in 1965. The source of introduction was most likely from sources in Canada and despite an effort to stop its spread, EWM infestations in Lake Osooyos, British Columbia spread down through the Okanogan Lakes and into the Okanogan River and Columbia River in 1974 (Duke, 2001).

Currently, some information exists on aquatic vegetation in the Mid-Columbia River system. Vegetation mapping in and around the Rocky Reach Reservoir (river miles 473.6 to 515.5) identified 979 acres of aquatic macrophyte habitat out of a total surface area of 8,167 acres (Duke, 2001). EWM percent biomass (oven dried weight) for plant communities in the Rocky Reach Reservoir represented 34 percent of all biomass samples taken (Duke, 2001). In the Priest Rapids and Wanapum reservoirs, the composition of EWM in the aquatic macrophyte community was higher at 42 percent of littoral plant biomass. Average macrophyte biomass in Wanapum and Priest Rapids reservoirs was 56.8 $g/m^2$ and 10 $g/m^2$, respectively (Normandeau et al., 2000). Various species such as EWM, a State-listed noxious weed, and several native species such as duckweed, sago pondweed, and waterweed, have been documented in aquatic macrophyte communities in the Wells Reservoir (NMFS, 2002). However, more detailed information is lacking on the location, size, habitat characteristics and species composition of macrophyte communities as well as the extent of EWM proliferation in the Wells Project. The primary goal of this study was to document, characterize and map the aquatic macrophyte communities present in the Wells Project.

## 2.0 STUDY GOALS

The goal of the study was to develop a better understanding of the aquatic macrophyte communities that are present within Wells Project waters. The specific study objectives were to:

1) Collect information on the location, size and relative species composition of aquatic macrophyte communities present in the Wells Project.

2) Produce a GIS map of the aquatic macrophyte communities using the information collected during the study.

## 3.0 STUDY AREA

Wells Dam is located at river mile (RM) 515.8 on the Columbia River in the State of Washington (Figure 3.0-1). It is located approximately 30 river miles downstream from Chief Joseph Dam which is owned and operated by the United States Army Corps of Engineers (COE), and 42 miles upstream from Rocky Reach Dam which is owned and operated by Chelan County PUD. The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from Wells Dam. Wells Dam impounds 29.5 miles of the Columbia River upstream to the tailrace of the Chief Joseph Hydroelectric Project at RM 545.1. The drainage area of the Columbia River Basin upstream of Wells Dam is approximately 85,300 square miles.

The Wells Reservoir has riverine characteristics in the upper 5-mile section downstream from the Chief Joseph Dam tailrace. The middle 10-mile section is more characteristic of a lacustrine environment. The lowermost 15-mile section is relatively narrow and fast flowing, compared to the middle section, but eventually slows and deepens as it nears the forebay of Wells Dam (Beak, 1999). The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at an elevation of 781. The normal maximum water surface elevation of the reservoir is 781 feet (Figure 3.0-1). The two major tributaries within the Wells Project are the Methow and Okanogan rivers.

The Methow River enters the Columbia River (RM 524) at the town of Pateros, Washington. The Wells Project impoundment affects 1.5 miles of the Methow River upstream from its confluence with the Wells Reservoir. The Okanogan River originates near Armstrong, British Columbia and flows south through a series of lakes to the Columbia River. It enters the Wells Reservoir at RM 534, approximately 18 miles upstream of Wells Dam. The Wells Project impoundment affects approximately 15.5 miles of the Okanogan River upstream from its confluence with the Columbia River.

The study area will include all water bodies within the Wells Project, including the Wells Reservoir and sections of the Methow and Okanogan rivers below the Wells Project Boundary. Field observations have found aquatic macrophytes to be non-existent in the Wells Dam tailrace. The absence of macrophytes is likely due to the incompatible habitat which consists of relatively deep water, high flows, and predominantly large substrate. Consequently, the absence of macrophytes in this area excluded it from the study area.

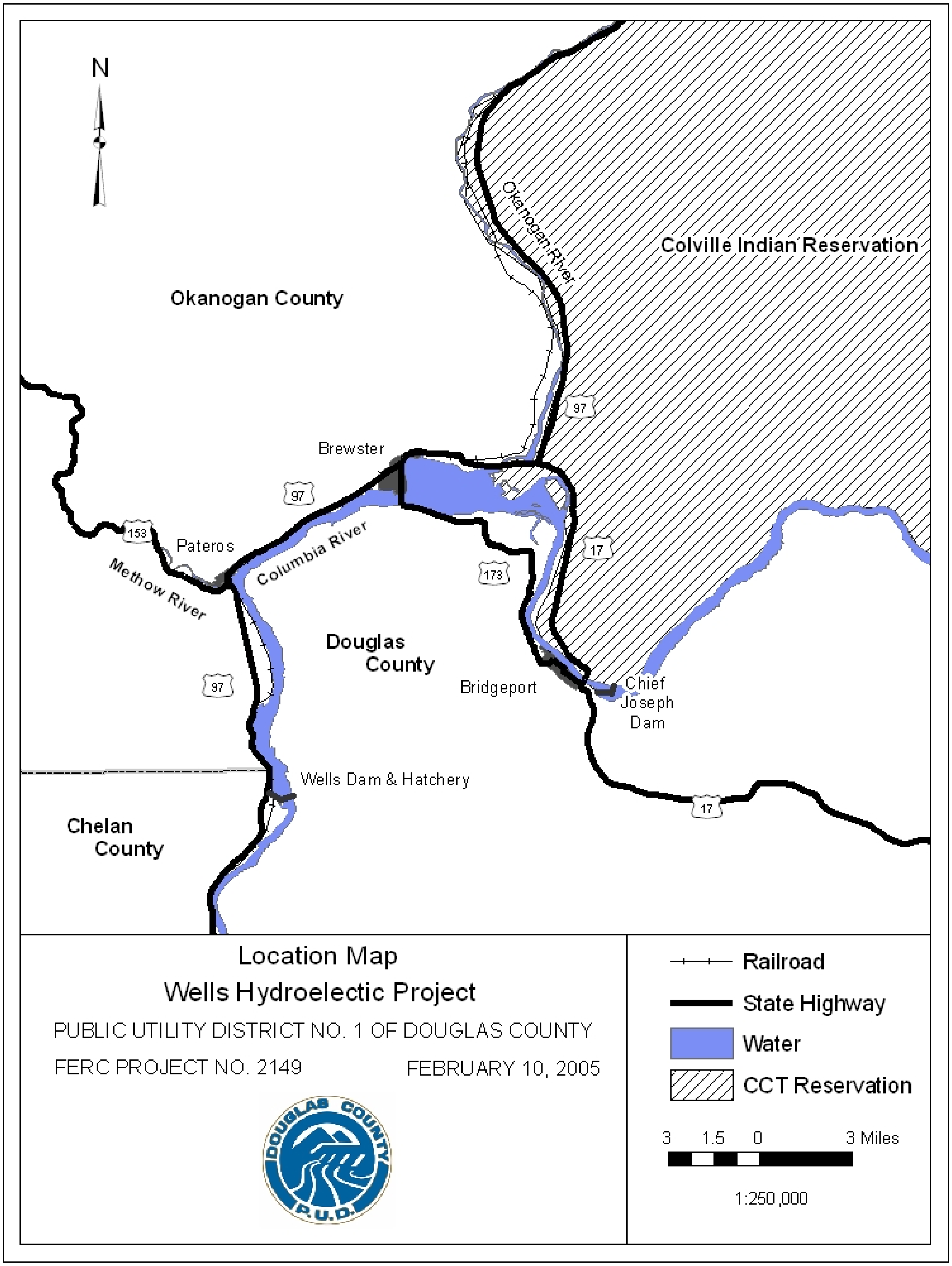


**Figure 3.0-1 Location Map of the Wells Project**

# 4.0 METHODS

The study methodology consisted of using high resolution orthophotography and detailed bathymetry to estimate probable locations of macrophyte beds throughout the reservoir. Estimates were made based on trends observed in similar studies at the Rocky Reach, Wanapum, and Priest Rapids reservoirs. These studies observed that depth gradients were a significant determinant in the distribution of aquatic macrophyte communities. Therefore, probable macrophyte locations in Wells Reservoir waters were estimated and mapped based on depth using a Geographic Information System (GIS). The presence or absence of macrophyte beds at these estimated locations were then field verified through a comprehensive survey of the reservoir.

Species composition of macrophyte beds were also field verified through a combination of randomized and non-randomized sampling. To increase the efficiency of data sampling and analysis, Wells Project waters were divided into six zones where distinct breaks were observed in habitat characteristics, macrophyte distribution, abundance and species composition (Table 4.0-1). Parameters such as river flow, bathymetry, and substrate type were considered during this exercise. Sampling was completed in each of the six designated zones in the Wells Project. At a minimum, sampling in each zone consisted of lateral transect surveys beginning at randomly selected points at 2 mile increments along the entire shoreline of all six zones. Lateral transects began near shore moving away from and perpendicular to shore. Sampling points along each transect were taken at a change in depth of every 4-5 feet until macrophytes were not present. Additionally, selected individual macrophyte beds that occurred at distinct habitat breaks were also surveyed using methods similar to the lateral transect sampling. Macrophyte sampling consisted of the deployment of a grappling hook at various depths along each transect. For each transect sampling point, the following information was collected:

- GPS beginning and end points, date and time for each transect;
- A measurement for water depth;
- Qualitative assessment of total plant density of the macrophyte bed;
- Aquatic macrophyte species present and their relative proportions using both visual surface assessment and sub-surface grab samples; and
- When necessary, GPS data points to assist in characterizing macrophyte bed surface size and shape.

**Table 4.0-1 Wells Project zone designations for aquatic macrophyte identification and distribution study, 2005.**

| Zone | Description |
|---|---|
| 1 | Wells Dam tailrace (RM 515.8) to the upstream end of Pateros (RM 524) |
| 2 | Mouth of Methow River upstream to RM 1.5 of the Methow River |
| 3 | Pateros upstream to the Brewster Bridge (RM 530) |
| 4 | Brewster Bridge (RM 530) upstream to the north end of Park Island (RM 538.3) |
| 5 | Park Island upstream to Chief Joseph Dam (RM 545.1) |
| 6 | Mouth of the Okanogan River upstream to RM 15.5 of the Okanogan River |

Qualitative information collected on the density and relative proportions of aquatic macrophyte species during the survey were used to categorize observations into pre-determined aquatic plant community types (Table 4.0-2). These (12) aquatic plant community types assisted in summarizing the information collected in the field into categories that can be integrated into the GIS. A final continuous macrophyte map layer was then generated in the GIS. The map layer shows the locations of all macrophyte beds and their respective plant community types as designated by species composition information observed in the field. Additional information that can be queried from the GIS includes the total area of community types and community type associations within the Wells Project boundary.

**Table 4.0-2 Aquatic plant community types for the aquatic macrophyte identification and distribution study of the Wells Project, 2005. Community types are defined by two parameters at a particular site, species composition and plant density.**

| **Aquatic Plant Community Type** | |
|---|---|
| **Species Composition** | **Density** |
| Native (100% Native) | D, M, S[1] |
| Native Dominant (>60% Native) | D, M, S |
| EWM Dominant (>60% EWM) | D, M, S |
| EWM (100% EWM) | D, M, S |
| Absent | N/A |

The proposed methodology for mapping macrophyte communities is consistent with professional practices used in previous aquatic habitat mapping studies (Duke, 2001, Normandeau et al., 2000) in the Mid-Columbia Basin. Field investigations on Wells Project waters were conducted in late summer (August and September) when macrophyte densities were at their peak and when water clarity was highest. All macrophyte samples were identified in the field using An Aquatic Plant Identification Manual for Washington’s Freshwater Plants (WDOE, 2001). Samples for macrophyte species were also collected and verified by an independent reviewer for accuracy.

[1] D=Dense, M=Medium, S=Sparse

# 5.0 RESULTS

Field sampling for the study occurred between August 18 and September 8, 2005. Water temperatures during the study period ranged from 21.2°C in the Okanogan River to 19.4°C at the forebay of Wells Dam. With the exception of the Okanogan River, water clarity during the study was high with secchi disk readings (taken at Wells Dam) during the study period ranging from 12 to 15 feet.

In total, sixty-one transects totaling 369 sample points were completed during the study (Appendix A). The numbers of transects for zones 1 to 6 were 10, 2, 10, 15, 11, and 13, respectively. Average number of sample points per transect was 6.05. Depths ranging from 0.5 to 30 feet were sampled and sampling points along transects were completed at intervals of 5 feet or less.

A total of 9 aquatic plant species were documented (Table 5.0-1). Seven of these aquatic plant species are native to the Mid-Columbia River Basin whereas two of these species are considered non-native (Table 5.0-1). Table 5.0-1 presents the percentage of samples in which each of the identified aquatic species was categorized as the dominant species (consisting of >60% of the sample composition). The two most dominant species in samples collected were common waterweed (*Elodea canadensis*) and leafy pondweed (*Potamogeton foliosus*) at 24.7% and 16.7%, respectively. Both of these species are native and were present over the entire range of depths where macrophytes were present in samples. Non-native EWM was dominant in only 6.3% of samples taken (Table 5.0-1) and all of these samples were taken at depths between 4 and 15 feet. Samples in which no plants were collected (absent) consisted of 41.7% of all samples taken and support the concept that macrophyte communities maintain a patchy distribution (Table 5.0-1). Of the samples in which macrophytes were collected, 116 samples were qualitatively assessed as dense, 41 samples were identified as medium density and 74 samples were assessed as sparse or low density.

**Table 5.0-1 Aquatic macrophyte species identified and the frequency at which each of the species was considered the dominant species (consisting of >60% of the total sample) in a given sample during the Wells Project Macrophyte Identification and Distribution Study, 2005.**

| Scientific Name | Common Name | Percentage of samples in which dominant | Native/Non-Native |
|---|---|---|---|
| *Ceratophyllum demersum* | Coontail | 1.8% (7/396) | Native |
| *Chara spp.* | Muskgrass | .003% (1/396) | Native |
| *Elodea canadensis* | Common waterweed | 24.7% (98/396) | Native |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 6.3% (25/396) | Non-native |
| *Potamogeton crispus* | Curly leaf pondweed | 4.3% (17/396) | Non-native |

| | | | |
|---|---|---|---|
| *Potamogeton foliosus* | Leafy pondweed | 16.7% (66/396) | Native |
| *Potamogeton nodosus* | American pondweed | 1.3% (5/396) | Native |
| *Potamogeton pectinatus* | Sago pondweed | 0.8% (3/396) | Native |
| *Potamogeton zosteriformis* | Flat-stemmed or eelgrass pondweed | 2.3% (9/396) | Native |
| **Absent** | | 41.7% (165/396) | N/A |

Results of the study found that in general, macrophyte communities in the Wells Project were distributed by various depth ranges. Table 5.0-2 presents the aquatic plant community types observed in each zone and how these community types shifted with changes in depth. In general, macrophyte communities did not recruit to depths of less than 4 feet in the Wells Project. Depths between 5 and 15 feet were characterized by a native dominant species composition (Table 5.0-2). If Eurasian watermilfoil were present at these depths, they were often sub-dominant or at low densities (less than 10% milfoil). From depths of 15 to 24 feet, species composition consisted of exclusively native species. From 24 feet to 30 feet, macrophyte communities were absent most likely due to the limited light at these depths. The maps in Appendix B graphically present the different aquatic plant community types observed in the Wells Project and the depth distributions at which they were observed. Table 5.0-3 presents total acreages for each of the aquatic plant community types observed in the Wells Project. Overall, 2,379 acres of macrophyte beds were identified out of a total surface area of 9,740 acres.

**Table 5.0-2 Aquatic plant community types by Wells Reservoir zone designation and water depth, Wells Macrophyte Identification and Distribution Study 2005.**

| Zone Designation | Depth Range (ft) | Aquatic Plant Community Type | Density |
|---|---|---|---|
| 1 | 0-4 | Absent | N/A |
| | 4.01-10 | Native Dominant | Dense |
| | 10.01-16 | Native | Dense |
| | 16.01-20 | Native | Medium |
| | 20.01-30 | Absent | N/A |
| 2 | 0-2 | Absent | N/A |
| | 2.01-9 | Native Dominant | Dense |
| | 9.01-15[2] | Absent | N/A |
| 3 | 0-4 | Absent | N/A |
| | 4.01-15 | Native Dominant | Dense |
| | 15.01-18 | Native | Dense |
| | 18.01-24 | Native | Medium |

[2] Maximum depth along transect was 15 feet for all transects in Zone 2.

| | | | |
|---|---|---|---|
| | 24.01-30 | Absent | N/A |
| 4 | 0-4 | Absent | N/A |
| | 4.01-10 | Native Dominant | Dense |
| | 10.01-15 | Native Dominant | Medium |
| | 15.01-20 | Native | Sparse |
| | 20.01-30 | Absent | N/A |
| 5 | 0-5 | Absent | N/A |
| | 5.01-8 | Native Dominant | Dense |
| | 8.01-10 | Native Dominant | Medium |
| | 10.01-30 | Absent | N/A |
| 6 | 0-4 | Absent | N/A |
| | 4.01-6 | Native Dominant | Dense |
| | 6.01-8 | Native | Sparse |
| | 8.01-30 | Absent | N/A |

**Table 5.0-3 GIS acreage estimates for the observed Aquatic Plant Community Types in the Wells Project. 2005 Wells Project Macrophyte Identification and Distribution Study.**

| ***Aquatic Plant Community Type*** | ***Total Acreage*** |
|---|---|
| Native Dense | 201 |
| Native Dominant Dense | 995 |
| Native Dominant Medium | 433 |
| Native Medium | 348 |
| Native Sparse | 402 |
| **Total Acres** | **2379** |

## 6.0 DISCUSSION

The observation that depth may be a primary determinant of macrophyte distribution and species composition in Wells Project waters was consistent with the results of studies conducted in the Rocky Reach Reservoir (Duke, 2001) and the Priest and Wanapum reservoirs (Normandeau et al., 2000). Despite the general trend, there were some areas in which macrophyte presence was expected at appropriate water depths, but not observed.

In the Wells Project, macrophytes did not establish below 10 feet in Zone 5 (downstream of Chief Joseph Dam). The bathymetry in this zone is characterized by steep shoreline slopes and high water velocities due to the operations of Chief Joseph Dam. These characteristics created near shore environments similar to mid-channel environments downstream where high water velocities appeared to exclude macrophytes. In Zone 3 (Brewster Bridge to Park Island), depths below 20 feet were located in the middle of the Columbia River where it appears that river velocity was not conducive to macrophyte colonization. In Zone 6 (Okanogan River), limited light due to turbid conditions appeared to exclude macrophytes from depths greater than 8 feet (Table 5.0-2). These observations demonstrate that although depth may be a significant and effective parameter in determining macrophyte distribution and composition, macrophyte communities are complex and their colonization success is likely governed by multiple parameters.

Non-native EWM, although present in the Wells Project, was not observed at levels found in studies conducted in downstream Mid-Columbia River reservoirs. In the Rocky Reach Reservoir, EWM was found to be the most abundant species. Approximately one third of all the macrophyte bed acreage in the Project area was vegetated by dense EWM dominant growth (Duke, 2001). In the Priest Rapids and Wanapum reservoirs, EWM made up the highest percent composition over all samples at 41.7% (Normandeau et al., 2000). In the Wells Project, only 6.3% of samples collected were dominated by EWM. During the Wells Project study, EWM was often sub-dominant to several native species in samples collected. These contrasting observations between the Wells Reservoir and downstream reservoirs are not clearly understood. One would expect similar levels of EWM abundance in the Wells Project compared to that of the Rocky Reach Reservoir given their close proximity and connectivity. One possible explanation may be that EWM, which is a species that can proliferate from plant fragments (Ecology, 2001) has increased its ability to colonize due to potentially higher levels of disturbance in the Rocky Reach Reservoir as compared to the Wells Reservoir. The Rocky Reach Reservoir serves a larger population base, maintains an EWM removal program at recreational sites, and has higher levels of recreational use and development as compared to the Wells Reservoir. It is possible that these activities directly and indirectly re-mobilize EWM plant fragments and increase the potential for colonization in the Rocky Reach Reservoir as well as in downstream reservoirs.

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# Appendix A

# 2005 Wells Project Macrophyte Identification and Distribution Study
# Raw Data

# Appendix A 2005 Wells Project Macrophyte Identification and Distribution Study Raw Data

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| 8/18/2005 | 1 | 1 | 1 | 5 | n/a | n/a | n/a | 47 57.143 | 119 51.712 |
| | | | 2 | 8 | <10 EWM | m | pc,ww,ewm | | |
| | | | 3 | 14 | <10 EWM | l | ww,pc,ewm | | |
| | | | 4 | 20 | <10 EWM | m | pc,ww,lp,ct | | |
| | | | 5 | 25 | <10 EWM | l | ww,lp,pc | | |
| | | | 6 | 30 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/18/2005 | 2 | 1 | 1 | 5 | n/a | n/a | n/a | 47 58.115 | 119 53.057 |
| | | | 2 | 6 | 30-60 EWM | d | pc/ww/ewm | | |
| | | | 3 | 8 | 30-60 EWM | d | pc/ww/ewm | | |
| | | | 4 | 8 | 30-60 EWM | d | pc/ewm | | |
| | | | 5 | 14 | <10 EWM | s | ct/pc/ww | | |
| | | | 6 | 20 | <10 EWM | s | ww/pc/ct | | |
| | | | 7 | 25 | | n/a | n/a | | |
| | | | 8 | 27 | | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/18/2005 | 3 | 1 | 1 | 5 | n/a | n/a | n/a | 47 58.912 | 119 53.354 |
| | | | 2 | 8 | <10 ewm | d | lp/ww/ct/ewm | | |
| | | | 3 | 5 | n/a | n/a | n/a | | |
| | | | 4 | 8 | >60 ewm | m | ewm/ww | | |
| | | | 5 | 10 | <10 ewm | d | lp/ww/ewm/pc | | |
| | | | 6 | 13 | <10 ewm | m | lp/pc/ww | | |
| | | | 7 | 18 | <10 ewm | m | lp/pc/ww/ct | | |
| | | | 8 | 20 | <10 ewm | s | ct | | |
| | | | 9 | 25 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/19/2005 | 4 | 1 | 1 | 30 | n/a | n/a | n/a | 47 59.419 | 119 52.755 |
| | | | 2 | 26 | <10 ewm | s | lp/pc/ct | | |
| | | | 3 | 21 | <10 ewm | s | ww/lp/ewm/ct | | |
| | | | 4 | 16 | <10 ewm | d | lp/ww/ct/pc | | |
| | | | 5 | 11 | <10 ewm | s | lp/ww/ct/pc/ewm | | |
| | | | 6 | 11 | <10 ewm | d | lp/pc/ww | | |
| | | | 7 | 6 | <10 ewm | d | ww/ewm/pc | | |
| | | | 8 | 8 | <10 ewm | d | lp/ww/ewm | | |
| | | | 9 | 9 | <10 ewm | d | lp/ww/ewm | | |
| | | | 10 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | 47 59.423 | 119 53.054 |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| 8/19/2005 | 5 | 1 | 1 | 26 | n/a | n/a | n/a | 47 58.527 | 119 52.789 |
| | | | 2 | 21 | <10 ewm | s | lp/ww | | |
| | | | 3 | 16 | <10 ewm | d | ww | | |
| | | | 4 | 11 | <10 ewm | d | ww/pc/ct | | |
| | | | 5 | 8 | <10 ewm | d | lp/ww/pc | | |
| | | | 6 | 5 | <10 ewm | m | ww/lp/pc/ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/19/2005 | 6 | 1 | 1 | 26 | <10 ewm | s | ww/lp | 48 00.042 | 119 51.941 |
| | | | 2 | 21 | <10 ewm | d | ww/lp/pc/ct | | |
| | | | 3 | 16 | <10 ewm | d | lp/ww/ct | | |
| | | | 4 | 11 | <10 ewm | d | ww/lp/ct | | |
| | | | 5 | 6 | <10 ewm | d | ww/pc/ewm | | |
| | | | 6 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/19/2005 | 7 | 1 | 1 | 26 | n/a | n/a | n/a | 48 01.199 | 119 52.536 |
| | | | 2 | 21 | <10 ewm | s | lp/ww | | |
| | | | 3 | 16 | <10 ewm | d | ww/lp/ct | | |
| | | | 4 | 11 | <10 ewm | d | ww/pc | | |
| | | | 5 | 11 | 30-60 ewm | d | ewm/ww | | |
| | | | 6 | 6 | 30-60 ewm | d | ewm/ww | | |
| | | | 7 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/19/2005 | 8 | 1 | 1 | 26 | <10 ewm | s | ww/lp/ct | 48 01.930 | 119 52.815 |
| | | | 2 | 26 | <10 ewm | s | ww/ct | | |
| | | | 3 | 21 | <10 ewm | d | ww/ct/lp | | |
| | | | 4 | 16 | <10 ewm | d | ww/ct | | |
| | | | 5 | 10 | 30-60 ewm | d | ww/ewm/ct | | |
| | | | 6 | 6 | n/a | n/a | n/a | | |
| | | | 7 | 5 | n/a | n/a | n/a | 48 01.938 | 119 52.787 |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/19/2005 | 9 | 1 | 1 | 26 | n/a | n/a | n/a | 48 02.795 | 119 53.822 |
| | | | 2 | 21 | <10 ewm | d | ww/lp | | |
| | | | 3 | 16 | <10 ewm | d | lp/ct | | |
| | | | 4 | 13 | <10 ewm | d | lp | | |
| | | | 5 | 11 | <10 ewm | d | lp/pc/ct | | |
| | | | 6 | 10 | <10 ewm | d | lp/ewm | | |
| | | | 7 | 6 | <10 ewm | d | pc/ww | | |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 8 | 5 | n/a | n/a | n/a | 48 02.770 | 119 53.904 |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/19/2005 | 10 | 1 | 1 | 26 | n/a | n/a | n/a | 48 02.838 | 119 53.515 |
| | | | 2 | 26 | n/a | n/a | n/a | | |
| | | | 3 | 21 | <10 ewm | d | ww/ct/pc | | |
| | | | 4 | 16 | <10 ewm | d | ww/pc/ct | | |
| | | | 5 | 11 | <10 ewm | d | ww/pc | | |
| | | | 6 | 6 | <10 ewm | d | lp/pc/ww | | |
| | | | 7 | 5 | n/a | n/a | n/a | 48 02.861 | 119 53.475 |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/19/2005 | 11 | 2 | 1 | 5 | <10 ewm | dense | ww/pc/ewm | no GPS | |
| | | | 2 | 5 | n/a | n/a | n/a | | |
| | | | 3 | 16 | n/a | n/a | n/a | | |
| | | | 4 | 11 | n/a | n/a | n/a | | |
| | | | 5 | 12 | n/a | n/a | n/a | | |
| | | | 6 | 16 | n/a | n/a | n/a | | |
| | | | 7 | 6 | <10 ewm | dense | ww/pc | | |
| | | | 8 | 5 | | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/19/2005 | 12 | 2 | 1 | 9 | <10 ewm | d | pc/lp/ww | no GPS | |
| | | | 2 | 10.5 | n/a | n/a | n/a | | |
| | | | 3 | 10 | <10 ewm | m | pc | | |
| | | | 4 | 4 | <10 ewm | m | lp | | |
| | | | 5 | 11 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/24/2005 | 13 | 3 | 1 | 25 | n/a | n/a | n/a | 48 03.573 | 119 52.631 |
| | | | 2 | 20 | <10 ewm | d | lp/ww/pc | | |
| | | | 3 | 15 | <10 ewm | d | ww/lp/pc/ct | | |
| | | | 4 | 7 | <10 ewm | d | ww/pc/ct | | |
| | | | 5 | 10 | <10 ewm | d | lp/ww/ct/pc | | |
| | | | 6 | 5 | <10 ewm | d | lp/pc | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/23/2005 | 14 | 3 | 1 | 26 | <10 ewm | sparse | ct/lp/ww | 48 04.109 | 119 51.810 |
| | | | 2 | 21 | <10 ewm | medium | lp/ww/ct | | |
| | | | 3 | 16 | <10 ewm | dense | lp/pc/ww/ct | | |
| | | | 4 | 11 | <10 ewm | dense | lp/ww/pc/ewm | | |
| | | | 5 | 7 | <10 ewm | dense | ww/lp/pc | | |
| | | | 6 | 6 | <10 ewm | dense | lp/pc | | |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 7 | 26 | n/a | n/a | n/a | | |
| | | | 8 | 24 | <10 ewm | sparse | lp | | |
| | | | | | | | | | |
| 8/24/2005 | 15 | 3 | 1 | 25 | n/a | n/a | n/a | 48 04.175 | 119 51.687 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | <10 ewm | sparse | lp/pc/ewm | | |
| | | | 4 | 15 | <10 ewm | medium | ww/lp/pc/ewm | | |
| | | | 5 | 10 | >90 ewm | dense | ewm/ww | | |
| | | | 6 | 7 | >90 ewm | dense | ewm/ww/ct | | |
| | | | 7 | 5 | >90 ewm | dense | ewm/ww | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/24/2005 | 16 | 3 | 1 | 26 | n/a | n/a | n/a | 48 04.943 | 119 49.375 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | <10 ewm | sparse | ewm | | |
| | | | 5 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/23/2005 | 17 | 3 | 1 | 26 | n/a | n/a | n/a | 48 04.843 | 119 49.809 |
| | | | 2 | 21 | <10 ewm | dense | ww/lp/pc/ct | | |
| | | | 3 | 16 | <10 ewm | dense | pc/ww/lp/ct | | |
| | | | 4 | 11 | >60 ewm | dense | ewm/ct/pc/ww | | |
| | | | 5 | 9 | 30-60 ewm | dense | ww/ewm/pc | | |
| | | | 6 | 8 | 30-60 ewm | dense | ww/ewm/pc | | |
| | | | 7 | 6 | 10-30 ewm | dense | ww/pc/ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/23/2005 | 18 | 3 | 1 | 26 | n/a | n/a | n/a | 48 05.304 | 119 47.535 |
| | | | 2 | 14 | 10-30 ewm | dense | ww/ewm/pc/lp | | |
| | | | 3 | 11 | <10 ewm | dense | lp/ww/pc/ewm | | |
| | | | 4 | 12 | <10 ewm | dense | ww/pc/lp/ewm | | |
| | | | 5 | 9 | <10 ewm | dense | lp/ww/pc | | |
| | | | 6 | 11 | <10 ewm | dense | lp/ww/ct | | |
| | | | 7 | 15 | <10 ewm | dense | ww/pc/ct | | |
| | | | 8 | 19 | <10 ewm | sparse | lp/ww | | |
| | | | 9 | 7 | 10-30 ewm | dense | lp/ww/ewm/pc | | |
| | | | 10 | 9 | 30-60 ewm | dense | ewm/pc/lp/ww | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/24/2005 | 19 | 3 | 1 | 25 | n/a | n/a | n/a | 48 04.464 | 119 50.746 |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 20 | <10 ewm | medium | ww/lp/pc | | |
| | | | 3 | 15 | <10 ewm | dense | pc/ww/lp | | |
| | | | 4 | 7 | <10 ewm | dense | ww/lp/pc/ct | | |
| | | | 5 | 5 | <10 ewm | dense | ww/lp | | |
| | | | | | | | | | |
| 8/24/2005 | 20 | 3 | 1 | 7 | 10-30 ewm | medium | lp/ww/ewm | 48 04.940 | 119 48.799 |
| | | | 2 | 5 | <10 ewm | sparse | ww/pc | | |
| | | | | | | | | | |
| | | | 3 | 7 | <10 ewm | sparse | ww/pc/ewm | | |
| | | | | | | | | | |
| | | | 4 | 25 | n/a | n/a | n/a | | |
| | | | 5 | 20 | <10 ewm | sparse | lp | | |
| | | | 6 | 15 | <10 ewm | medium | lp/ww/pc | | |
| | | | 7 | 10 | <10 ewm | medium | ww/lp/pc | | |
| | | | 8 | 5 | <10 ewm | dense | ww/lp/ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/24/2005 | 21 | 3 | 1 | 25 | n/a | n/a | n/a | 48 05.097 | 119 46.986 |
| | | | 2 | 15 | >90 ewm | sparse | ewm | | |
| | | | 3 | 20 | n/a | n/a | n/a | | |
| | | | 4 | 10 | <10 ewm | sparse | ww/lp | | |
| | | | 5 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/24/2005 | 22 | 3 | 1 | 25 | n/a | n/a | n/a | 48 04.335 | 119 51.019 |
| | | | 2 | 20 | <10 ewm | dense | lp/ct/pc | | |
| | | | 3 | 13 | 10-30 ewm | dense | ewm/lp/ww | | |
| | | | 4 | 15 | <10 ewm | dense | lp/ww/ct | | |
| | | | 5 | 11 | 10-30 ewm | dense | lp/ewm/ww | | |
| | | | 6 | 7 | <10 ewm | dense | lp/pc/ww/ewm | | |
| | | | 7 | 8 | <10 ewm | dense | lp/ww/ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/30/2005 | 23 | 4 | 1 | 25 | n/a | n/a | n/a | 48 06.050 | 119 46.580 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | <10 ewm | sparse | ww/ewm | | |
| | | | 5 | 8 | <10 ewm | sparse | ct/ww/pc/ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/30/2005 | 24 | 4 | 1 | 25 | n/a | n/a | n/a | 48 06.079 | 119 46.125 |
| | | | 2 | 20 | <10 ewm | sparse | ct/lp/ww | | |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 15 | <10 ewm | sparse | ww/ct | | |
| | | | 4 | 10 | <10 ewm | dense | lp/pc/ww/ct | | |
| | | | 5 | 5 | <10 ewm | sparse | pc/ct/lp | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/30/2005 | 25 | 4 | 1 | 25 | <10 ewm | sparse | ct/ww/lp | 48 06.360 | 119 45.958 |
| | | | 2 | 20 | <10 ewm | sparse | lp/ww | | |
| | | | 3 | 20 | <10 ewm | dense | ww/lp/pc | | |
| | | | 4 | 15 | 30-60 ewm | dense | ewm/ww/lp/ct | | |
| | | | 5 | 9 | 30-60 ewm | dense | ewm/ww/ct/lp | | |
| | | | 6 | 5 | 30-60 ewm | medium | ewm/pc/ww | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/30/2005 | 26 | 4 | 1 | 25 | n/a | n/a | n/a | 48 06.019 | 119 44.236 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | <10 ewm | sparse | ww/lp/ct | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 10 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/30/2005 | 27 | 4 | 1 | 10 | <10 ewm | dense | lp/pc/ww/ewm | 48 05.128 | 119 45.445 |
| | | | 2 | 10 | <10 ewm | dense | lp/pc/ww/ewm | | |
| | | | 3 | 10 | <10 ewm | medium | lp/pc/ww/ewm | | |
| | | | 4 | 18 | <10 ewm | sparse | ww/pc/lp | | |
| | | | 5 | 15 | <10 ewm | dense | lp/pc/ww/ewm | | |
| | | | 6 | 23 | <10 ewm | sparse | ww/pc | | |
| | | | 7 | 9 | <10 ewm | dense | lp/pc | | |
| | | | 8 | 6 | <10 ewm | medium | ww/pc/lp | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/30/2005 | 28 | 4 | 1 | 7 | <10 ewm | medium | ww/lp/pc | 48 05.000 | 119 44.355 |
| | | | 2 | 13 | n/a | n/a | n/a | | |
| | | | 3 | 13 | n/a | n/a | n/a | | |
| | | | 4 | 10 | <10 ewm | dense | ww/pc/lp | | |
| | | | 5 | 5 | <10 ewm | medium | ww/pc/ewm/lp | | |
| | | | 6 | 15 | <10 ewm | medium | pc/ww/lp | | |
| | | | 7 | 0-4 | n/a | n/a | n/a | | |
| | | | 8 | 5 | <10 ewm | dense | ww/lp/pc | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/30/2005 | 29 | 4 | 1 | 25 | n/a | n/a | n/a | 48 04.860 | 119 42.890 |
| | | | 2 | 20 | n/a | n/a | n/a | | |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 11 | <10 ewm | very sparse | ww | | |
| | | | 4 | 5 | n/a | n/a | n/a | | |
| | | | 5 | 10 | <10 ewm | medium | ww/lp/pc | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/30/2005 | 30 | 4 | 1 | 12 | <10 ewm | sparse | lp/ww/pc | 48 04.712 | 119 41.203 |
| | | | 2 | 14 | <10 ewm | sparse | lp/pc/ww | | |
| | | | 3 | 6 | <10 ewm | dense | lp/pc/ww/ewm | | |
| | | | 4 | 4 | <10 ewm | sparse | ww/pc/ewm | | |
| | | | 5 | 5 | <10 ewm | dense | ww/lp/pc/ewm | | |
| | | | 6 | 25 | n/a | n/a | n/a | | |
| | | | 7 | 20 | n/a | n/a | n/a | | |
| | | | 8 | 15 | <10 ewm | very sparse | pc/lp | | |
| | | | 9 | 10 | <10 ewm | very sparse | ww/lp | | |
| | | | 10 | 7 | n/a | n/a | n/a | | |
| | | | 11 | 10 | <10 ewm | sparse | ww/lp/pc | | |
| | | | 12 | 10 | <10 ewm | dense | ww/lp/pc/ewm | | |
| | | | 13 | 7 | <10 ewm | sparse | ww/lp/pc/ewm | | |
| | | | 14 | 6 | <10 ewm | sparse | ww/pc/lp/ewm | | |
| | | | 15 | <5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/31/2005 | 31 | 4 | 1 | 12 | <10 ewm | sparse | lp/ww | 48 05.576 | 119 43.249 |
| | | | 2 | 10 | >60 ewm | dense | ewm/lp | | |
| | | | 3 | 15 | <10 ewm | sparse | ww/lp/ewm | | |
| | | | 4 | 22 | n/a | n/a | n/a | | |
| | | | 5 | 22 | <10 ewm | sparse | ww/lp | | |
| | | | 6 | 10 | 30-60 ewm | medium | ewm/pc/ww/lp | | |
| | | | 7 | 8 | 30-60 ewm | sparse | ewm/pc/ct/lp | | |
| | | | 8 | 13 | <10 ewm | dense | lp/ww/pc/ewm | | |
| | | | 9 | 6 | <10 ewm | sparse | ww/pc/lp/ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/31/2005 | 32 | 4 | 1 | 12 | n/a | n/a | n/a | 48 05.319 | 119 42.906 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 10 | 30-60 ewm | sparse | ewm/ww | | |
| | | | 4 | 7 | <10 ewm | dense | ww/lp/pc/ewm | | |
| | | | 5 | 4 | <10 ewm | dense | ww/lp/pc/ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/31/2005 | 33 | 4 | 1 | 25 | n/a | n/a | n/a | 48 05.362 | 119 41.602 |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/31/2005 | 34 | 4 | 1 | 0-5 | n/a | n/a | n/a | 48 05.728 | 119 40.980 |
| | | | 2 | 7 | <10 ewm | medium | ww/pc/ewm | | |
| | | | 3 | 10 | 30-60 ewm | sparse | ewm/ww | | |
| | | | 4 | 20 | <10 ewm | sparse | lp | | |
| | | | 5 | 25 | n/a | n/a | n/a | | |
| | | | 6 | 20 | <10 ewm | medium | ww/lp | | |
| | | | 7 | 19 | <10 ewm | sparse | lp/ww | | |
| | | | 8 | 15 | 10-30 ewm | dense | ww/lp/ewm | | |
| | | | 9 | 10 | <10 ewm | dense | ww/lp/ewm/pc | | |
| | | | 10 | 6 | 30-60 ewm | sparse | ewm/pc/ww | | |
| | | | 11 | 0-5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/31/2005 | 35 | 4 | 1 | 22 | n/a | n/a | n/a | 48 05.310 | 119 41.138 |
| | | | 2 | 18 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | <10 ewm | sparse | ww/pc/ewm | | |
| | | | 5 | 12 | n/a | n/a | n/a | | |
| | | | 6 | 13 | <10 ewm | sparse | lp/ww/pc/ewm | | |
| | | | 7 | 6 | <10 ewm | sparse | ww/pc/lp | | |
| | | | 8 | 3 | n/a | n/a | n/a | | |
| | | | 9 | 8 | n/a | n/a | n/a | | |
| | | | 10 | 25 | <10 ewm | sparse | lp | | |
| | | | 11 | 10 | <10 ewm | dense | lp/ww/pc | | |
| | | | 12 | 15 | <10 ewm | medium | lp/ww/pc/ewm | | |
| | | | 13 | 0-8 | n/a | n/a | n/a | 48 04.899 | 119 41.324 |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/31/2005 | 36 | 4 | 1 | 25 | n/a | n/a | n/a | 48 04.382 | 119 40.090 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/31/2005 | 37 | 4 | 1 | 6 | n/a | n/a | n/a | 48 04.869 | 119 40.180 |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 8 | <10 ewm | sparse | pc/ewm/lp/ww | | |
| | | | 3 | 10 | 30-60 ewm | dense | ww/ewm/lp/pc | | |
| | | | 4 | 13 | <10 ewm | dense | ww/lp/ewm/pc | | |
| | | | 5 | 15 | <10 ewm | medium | ww/lp/pc | | |
| | | | 6 | 20 | <10 ewm | sparse | lp/ww | | |
| | | | 7 | 25 | n/a | n/a | n/a | | |
| | | | 8 | 20 | n/a | n/a | n/a | | |
| | | | 9 | 10 | n/a | n/a | n/a | | |
| | | | 10 | 5 | n/a | n/a | n/a | 48 04.752 | 119 39.958 |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 38 | 5 | 1 | 25 | n/a | n/a | n/a | 48 04.219 | 119 40.350 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 39 | 5 | 1 | 25 | n/a | n/a | n/a | 48 02.870 | 119 40.746 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | 100 ewm | medium | ewm | | |
| | | | 5 | 8 | 30-60 ewm | dense | ewm/ww/ct | | |
| | | | 6 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 40 | 5 | 1 | 25 | n/a | n/a | n/a | 48 02.805 | 119 40.991 |
| | | | 2 | 19 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 3 | <10 ewm | sparse | ww/lp/ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 41 | 5 | 1 | 25 | n/a | n/a | n/a | 48 02.309 | 119 41.246 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 42 | 5 | 1 | 25 | n/a | n/a | n/a | 48 01.854 | 119 41.721 |
| | | | 2 | 20 | n/a | n/a | n/a | | |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 8 | <10 ewm | sparse | ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 43 | 5 | 1 | 25 | n/a | n/a | n/a | 48 01.308 | 119 41.400 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | 10-30 ewm | medium | lp/ewm/pc/ww | | |
| | | | 5 | 5 | 10-30 ewm | dense | ww/ewm/lp | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 44 | 5 | 1 | 25 | n/a | n/a | n/a | 48 01.341 | 119 41.157 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 45 | 5 | 1 | 25 | n/a | n/a | n/a | 48 00.881 | 119 40.636 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 46 | 5 | 1 | 25 | n/a | n/a | n/a | 48 00.561 | 119 39.848 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | <10 ewm | dense | ww/ct/ewm/pc | | |
| | | | 4 | 10 | 10-30 ewm | medium | ct/lp/ewm/ww | | |
| | | | 5 | 8 | <10 ewm | dense | ww/ct/ewm | | |
| | | | 6 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| 9/6/2005 | 47 | 5 | 1 | 25 | n/a | n/a | n/a | 48 00.060 | 119 39.422 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 5 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/6/2005 | 48 | 5 | 1 | 10 | <10 ewm | sparse | ww/lp/pc | 48 03.674 | 119 40.749 |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 7 | <10 wm | dense | ww/lp/pc/ewm | 48 03.845 | 119 41.032 |
| | | | 1 | 7 | <10 ewm | dense | ww/lp/ct | 48 03.961 | 119 41.232 |
| | | | | | | | | | |
| | | | 1 | 5 | <10 ewm | medium | muskgrass/ww | 48 04.589 | 119 41.139 |
| | | | 2 | 10 | <10 ewm | sparse | ww | | |
| | | | 3 | 10 | <10 ewm | medium | lp/ww/pc | | |
| | | | 4 | 13 | <10 ewm | sparse | lp/pc/muskgrass | | |
| | | | 5 | 10 | <10 ewm | medium | lp/ww/pc/ewm | | |
| | | | 6 | 5 | n/a | n/a | n/a | 48 04.575 | 119 41.032 |
| | | | | | | | | | |
| | | | 1 | 4 | <10 ewm | sparse | ww/muskgrass | 48 04.322 | 119 41.349 |
| | | | 2 | 6 | <10 ewm | medium | ww/lp/pc/ewm | | |
| | | | 3 | 9 | <10 ewm | medium | ww/lp/pc | | |
| | | | | | | | | | |
| | | | 1 | 6 | <10 ewm | dense | ww/lp | 48 04.088 | 119 41.384 |
| | | | 2 | 10 | <10 ewm | dense | ww/lp/ewm | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 49 | 6 | 1 | 30 | n/a | n/a | n/a | 48 06.079 | 119 42.600 |
| | | | 2 | 25 | n/a | n/a | n/a | | |
| | | | 3 | 20 | n/a | n/a | n/a | | |
| | | | 4 | 15 | n/a | n/a | n/a | | |
| | | | 5 | 10 | n/a | n/a | n/a | | |
| | | | 6 | 5 | 10-30 ewm | medium | ewm/ww/lp | | |
| | | | 7 | 5 | <10 ewm | sparse | pc/ap | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 50 | 6 | 1 | 25 | n/a | n/a | n/a | 48 06.393 | 119 42.124 |
| | | | 2 | 20 | n/a | n/a | n/a | | |
| | | | 3 | 15 | n/a | n/a | n/a | | |
| | | | 4 | 10 | n/a | n/a | n/a | | |
| | | | 5 | 6 | <10 ewm | medium | ap/lp/ct/ewm | | |
| | | | 6 | 3 | <10 ewm | sparse | ap/ct | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 51 | 6 | 1 | 15 | n/a | n/a | n/a | 48 06.978 | 119 41.007 |
| | | | 2 | 10 | <10 ewm | sparse | eg | | |
| | | | 3 | 2 | <10 ewm | dense | ww/eg/ap/pc | | |
| | | | 4 | 2 | <10 ewm | medium | ww/ap | | |
| | | | 5 | 1 | <10 ewm | sparse | ap/sp | | |
| | | | | | | | | | |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| 9/8/2005 | 52 | 6 | 1 | 15 | n/a | n/a | n/a | 48 07.350 | 119 40.977 |
| | | | 2 | 10 | n/a | n/a | n/a | | |
| | | | 3 | 8 | <10 ewm | medium | ap/eg | | |
| | | | 4 | 5 | <10 ewm | dense | ww/ap/pc/ct | | |
| | | | 5 | 1 | <10 ewm | sparse | lp/ww/ap | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 53 | 6 | 1 | 10 | n/a | n/a | n/a | 48 08.811 | 119 40.172 |
| | | | 2 | 8 | <10 ewm | dense | eg | | |
| | | | 3 | 1 | <10 ewm | dense | ww/ap/sp | | |
| | | | 4 | 5 | <10 ewm | dense | pc/eg/ap | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 54 | 6 | 1 | 15 | n/a | n/a | n/a | 48 09.160 | 119 39.924 |
| | | | 2 | 10 | n/a | n/a | n/a | | |
| | | | 3 | 8 | n/a | n/a | n/a | | |
| | | | 4 | 7 | 30-60 ewm | sparse | pc/ewm | | |
| | | | 5 | 4 | 30-60 ewm | medium | ewm/ct | | |
| | | | 6 | 2 | <10 ewm | dense | ww/ewm/pc | | |
| | | | 7 | 1 | <10 ewm | sparse | ap/lp | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 55 | 6 | 1 | 12 | n/a | n/a | n/a | 48 10.411 | 119 40.508 |
| | | | 2 | 10 | <10 ewm | dense | eg | | |
| | | | 3 | 3 to 5 | <10 ewm | dense | ww/pc/eg | | |
| | | | 4 | <3 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 56 | 6 | 1 | 13 | n/a | n/a | n/a | 48 10.800 | 119 40.778 |
| | | | 2 | 9 | <10 ewm | dense | eg | | |
| | | | 3 | 6 | <10 ewm | dense | eg/pc | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 57 | 6 | 1 | 9 | n/a | n/a | n/a | 48 11.747 | 119 41.319 |
| | | | 2 | 8 | n/a | n/a | n/a | | |
| | | | 3 | 6 to 8 | <10 ewm | medium | ww | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 58 | 6 | 1 | 10 | n/a | n/a | n/a | 48 11.976 | 119 41.716 |
| | | | 2 | 8 | n/a | n/a | n/a | | |
| | | | 3 | 8 | <10 ewm | sparse | eg | | |

**Appendix A** (Continued)

| Date | Transect | Zone | Sample | Depth (ft.) | Category | Density (D, M, S) | Species Comp | GPS (LAT) | GPS (LONG) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 4 | 6 | < 10 ewm | dense | eg/pc/ww/ewm | | |
| | | | 5 | 5 | <10 ewm | dense | eg/pc/ww | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 59 | 6 | 1 | 4 | <10 ewm | dense | sp/pc/eg | 48 12.796 | 119 43.163 |
| | | | 2 | 3 | n/a | n/a | n/a | | |
| | | | 3 | 2 | n/a | n/a | n/a | | |
| | | | 4 | 1 | n/a | n/a | n/a | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 60 | 6 | 1 | 6 | n/a | n/a | n/a | 48 12.433 | 119 42.469 |
| | | | 2 | 5 | n/a | n/a | n/a | | |
| | | | 3 | 4 | <10 ewm | sparse | eg/sp/ww | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9/8/2005 | 61 | 6 | 1 | 7 | n/a | n/a | n/a | 48 12.406 | 119 42.328 |
| | | | 2 | 6 | <10 ewm | dense | sp | | |
| | | | 3 | 3 | <10 ewm | medium | sp/ww/eg | | |
| | | | 4 | <2 | n/a | n/a | n/a | | |

# Appendix B

# GIS Maps of Macrophyte Beds in the Wells Project