SITCUM WATERWAY REMEDIATION PROJECT

MILWAUKEE HABITAT AREA MONITORING REPORT, 2004

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1. INTRODUCTION

This report presents the results of the 2004 physical and biological monitoring activities at the Milwaukee Habitat Area (habitat area) at the Port of Tacoma, Washington. The habitat area is located within and beyond the mouth of what was the Milwaukee Waterway prior to partial filling of the waterway as a nearshore confined disposal site for contaminated sediments. The habitat area was constructed pursuant to the EPA-approved plans and specifications for the Sitcum Waterway Remediation Project. In the aquatic portion of the habitat area, elevations range from approximately +12 ft Mean Lower Low Water (MLLW) to –10 ft MLLW, with the bulk of the habitat falling within the intertidal zone (approximately +12 to –4 ft MLLW). Substrates range from select materials (gravel and angular cobbles) to dredged material (sand and silt).

The results of the 2004 monitoring activities, presented herein, represent the final test against the performance standards, which were developed to determine if the mitigation goals of the project were met. The monitoring activities are described in Section 5 of the Operations, Maintenance, and Monitoring Plan (OMMP) for the Sitcum Waterway Remediation Project (Port of Tacoma 1994). In accordance with the OMMP, physical site monitoring and limited biological sampling was conducted during 1995. In 1996, 1998, and 2000, full physical site monitoring and biological sampling efforts were conducted at the habitat area (PIE 1998a, PIE 2000, PIE 2001), as well as physical site monitoring in 1997 (PIE 1998b). Based on the successful compliance with performance standards in years 1998 and 2000, the Port of Tacoma (Port) and EPA agreed that specific elements of the biological monitoring would not be conducted in 2002 and 2004. The biological monitoring that was not conducted in 2002 and 2004 included benthic infauna, macroalgae surveys, microalgae measurement, and avifauna surveys (EPA 2002). After the 2002 monitoring, epibenthic plankter monitoring was also discontinued for 2004 (EPA 2004).

The 2004 sampling consisted of physical monitoring and upland vegetation monitoring. This report is presented in four sections and two appendices and has been designed to provide a concise description of the results for 2004 compared to the performance standards contained in the OMMP.

Section 2 describes the physical monitoring results for 2004 and contrasts that information with the 1995 “as-built” condition, and the 1996, 1997, 1998, 2000, and 2002 conditions, where appropriate. Section 3 describes the methods and results of the biological sampling, including a description of any deviations from the OMMP, and draws conclusions from the sampling results relative to the performance standards. Section 4 presents a summary table of the results compared to the applicable performance standards.

Appendix A contains the monitoring photographs. Appendix B contains the complete list of the field sampling data sheets and laboratory sheets.

2. PHYSICAL MONITORING

2.1 HABITAT TYPES

Distinct aquatic habitat types (i.e., high intertidal sandflat/mudflat, gravel/cobble, and sandflat/mudflat) within the habitat area were delineated by surveying points along the habitat boundaries. A biologist delineated the habitat by walking the edges with a pole-mounted prism, while a surveyor used a total station EDM (electronic distance measuring device) to locate the position of the points. This process was repeated at 50 to 200 ft intervals. The 1995 survey of habitat types was used to establish the "as-built" acreage for each habitat type. The acreages of each intertidal habitat type surveyed in all years are presented below in Table 1.

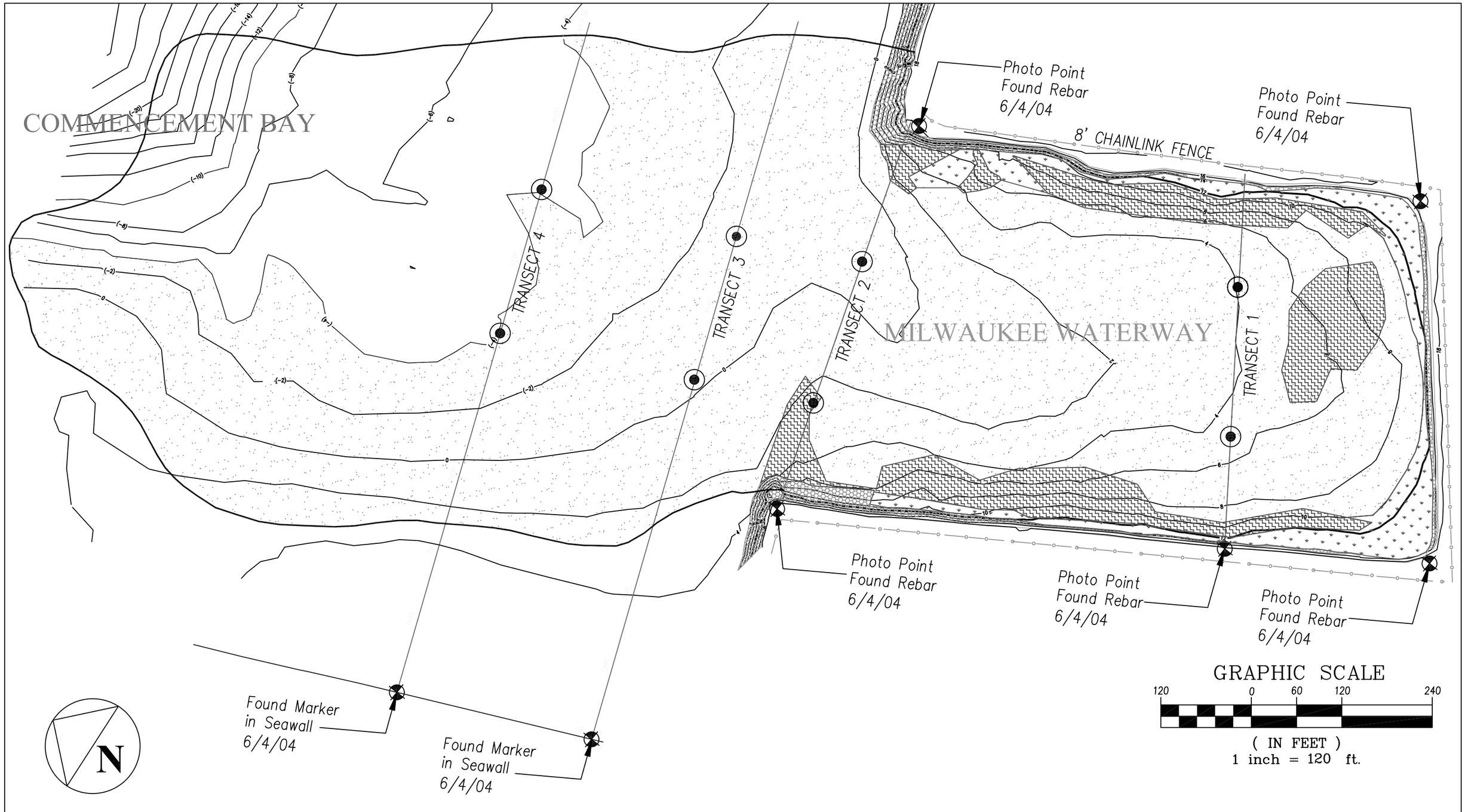
The upland habitat includes the area from the toe of the bank (approximately elevation +12 ft MLLW) to the fence surrounding the habitat area (Figure 1). The high intertidal sandflat/mudflat habitat type was delineated from the toe of the bank to the high elevation edge of the gravel/cobble habitat type. The gravel/cobble habitat type was delineated by following the contours of the rock substrate and closing the habitat polygon at the bayward edge of this rock substrate (Figure 1).

Table 1. Results of physical survey in the Milwaukee Habitat Area.

	Acreage Totals						
Habitat Type	**1995**	**1996**	**1997**	**1998**	**2000**	**2002**	**2004**
Saltmarsh	0.80	0.00	0.07[1]	0.07[1]	0.00	0.00	0.00
High intertidal sandflat/mudflat	2.47	3.16	3.27	3.30	3.31	3.31	0.23
Gravel/cobble	5.50	5.61	5.05	5.05	5.51	1.25	1.63
Sandflat/mudflat	9.77	9.43	11.24	11.24	9.87[4]	12.63	16.12
TOTAL intertidal habitat (+12 to –4 ft)	**18.54**	**18.20**	**19.63**	**19.66**	**18.68[4]**	**17.19**	**17.98**
Sandflat/mudflat (between –4 and –10 ft)	3.24	3.58[2]	2.48	2.48	3.58[4]	5.12	4.30
TOTAL intertidal/shallow subtidal habitat (+12 to –10 ft)	**21.78**	**21.78[3]**	**22.11**	**22.14**	**22.26[4]**	**22.31**	**22.28**

[1] Acreage of goose protection system. Area of coverage by saltmarsh vegetation was very small.
[2] The –10 contour could not be located during the 1996 survey, but based on the effort to determine its location it is known that it lay well bayward of the 1995 position of the –10 ft contour. The 1995 –10 ft contour was used in the calculation of this area. The –10 ft contour was located for subsequent surveys.
[3] This value is a minimum estimate of the acreage due to the incorporation of the –10 ft contour from 1995 into the calculation.
[4] Acreages were estimates due to incomplete contour lines in the NW corner of the sandflat/mudflat habitat type.

No saltmarsh was present in 2002. The Port and EPA have addressed the saltmarsh issues through the contingency planning process. It is noted that EPA (EPA 2003) made a final determination that no further contingency planning or response efforts are necessary for the performance standards pertaining to saltmarsh.



LEGEND

- GRAVEL/COBBLE
- RIPRAP
- SANDFLAT/MUDFLAT
- HIGH INTERTIDAL SANDFLAT/MUDFLAT
- SUBSTRATE SAMPLE SITE (PHYSICAL MONITORING)

Figure 1
Milwaukee Habitat Area
Physical Configuration

The intertidal habitat acreage increased by 0.79 acre (approximately 5 percent) between 2002 and 2004 (Table 1). This increase in intertidal acreage is the result of the migration of the –4 ft contour bayward towards Commencement Bay. Based on comparisons between the 2002 and 2004 surveys, the –4 ft contour migrated bayward, while the –10 ft contour moved slightly landward towards the mouth of the habitat area. The migration of the –4 ft contour led to an increase of intertidal habitat (+12 ft to –4 ft MLLW) and a decrease in shallow subtidal habitat (-4 ft to –10 ft MLLW). The landward migration of the –10 ft MLLW contour led to a 0.03 acre decrease in total intertidal and shallow subtidal habitat from 2002 to 2004. These bayward and landward movements of the contours lines are consistent with the discussion presented in the 2002 monitoring report. Overall intertidal and shallow subtidal habitat acreage combined (+12 to –10 ft) has increased 0.5 acre from the 1995 "as-built" survey (Table 1).

Physical performance standard 1 requires that the acreage of intertidal habitat must equal the acreage measured in the "as-built" survey. A total of 17.98 acres of intertidal habitat is present at the site in 2004, which is 0.56 acre less than the intertidal acreage measured in the "as-built" survey. Thus, performance standard 1 was not met in 2004. However, as discussed above, the total intertidal and shallow subtidal acreage at the site has increased 0.5 acre from the acreage reported in the "as built" survey (Table 1) due to the continued growth of the Puyallup River delta.

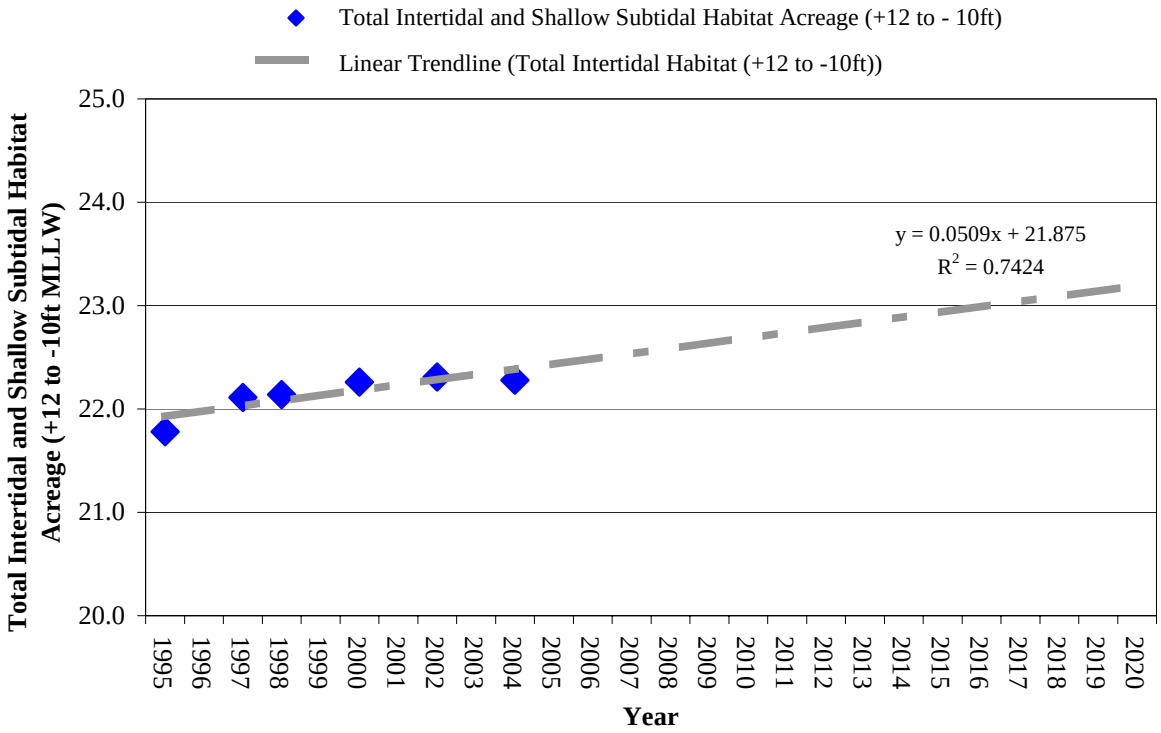
The design of the Milwaukee Habitat Area maximized the acreage of intertidal habitat while recognizing that both intertidal and shallow subtidal habitat is valuable for juvenile salmonids. Further, due to the proximity of the site to the Puyallup River, it was expected that sediment accumulation would occur at the site and increase the acreage of shallow water habitat. This expectation has been borne out by the monitoring as the total acreage of intertidal and shallow subtidal habitat combined has increased and is expected to continue to increase based on the results of a linear regression (Figure 2). The linear regression, which was presented in the 2002 monitoring report (Grette Associates 2003) has been recalculated incorporating the results of the 2004 monitoring. The linear regression includes extrapolation with these data and is considered valid based on the observed growth of the Puyallup River delta. The location of the –4 ft MLLW contour has moved either bayward or landward during the different monitoring years, with the 2004 results indicating a bayward movement of approximately 22 ft (this is based on the length of the –4 ft MLLW contour and the increase in area encompassed by the –4 ft MLLW contour). The –10 ft MLLW contour has primarily moved bayward since 1995 due to the constant input of sediments from the river, however from 2002 to 2004 the –10 ft MLLW contour has moved approximately 3.5 ft landward (calculated the same way as the –4 ft MLLW contour).

The difference in behavior of the two contour lines is likely due to the different wave energy experienced at these elevations. Habitat at the –4 ft MLLW elevation is susceptible to wave energy at a greater range of tidal elevations and wave heights than is habitat at –10 ft MLLW. With continued input of sediment from the Puyallup River, habitat experiencing low wave energy should increase in area, while shallower habitats should show less consistent short term trends depending upon whether deposition or wave action dominates over the period. Another possible reason for the movement of the

two contour lines is the accuracy associated with standard land surveying methods. The –4 ft MLLW contour is likely more difficult to accurately establish as the slope is relatively flat and uniform. With relatively flat and uniform slopes more data points are required to determine the location of specific contours, due to the variation in depths over larger areas. The accuracy of the survey data could account for variations in the location of the –4 ft MLLW contour. The location of the –10 ft MLLW contour was more accurately established based on the increased slope within the bayward portion of the habitat area.

Based on the growth in the delta over the last 50 to 60 years and the monitoring results for the –10 ft MLLW contour, it is expected that shallow subtidal habitat will continue to increase beyond the limits of the habitat area. As this habitat receives more deposition it will reduce wave energy at the –4 ft MLLW contour allowing greater deposition at that elevation. Therefore, the –10 ft MLLW contour is expected to continue to move bayward while the –4 ft MLLW contour will change each year based on the balance between wave action and deposition. The intertidal habitat area (+12 ft to –4 ft MLLW) is expected to vary between years, but that area is expected to eventually follow the increasing trend shown in Figure 2 for intertidal and shallow subtidal habitat combined. The results of the monitoring activities support these statements; as the shallower –4 ft MLLW contour varies more from year to year (approximately 22 ft from 2002 to 2004), then the location of the –10 ft MLLW contour, which varies very little (approximately 3.5 ft from 2002 to 2004). Overall, it is expected that performance standard 1 will be met in the future as the –4 ft contour moves bayward in response to the continued growth of the Puyallup River delta.

Figure 2. Total intertidal and shallow subtidal habitat acreage at the Milwaukee Habitat Area with extrapolated linear trendline, 1995 to 2020[1].



[1] 1996 data not included in regression (see Table 1)

2.2 PERMANENT TRANSECTS

Four permanent transects were established through the habitat area (Figure 1). Elevations were surveyed along the transects to identify a profile. The first transect was established 300 ft northwest from the top of the closure berm and parallel to the berm (Figure 1). The second transect was established across the mouth of the waterway. Benchmarks consisting of one-half inch diameter rebar stakes were installed at each end of transects 1 and 2. The two outer transects (transects 3 and 4) were established parallel to transect 2, 200 and 500 ft north of transect 2. Benchmarks for these transects were established along the training wall that extends beyond the end of the Milwaukee Waterway/Puyallup River peninsula.

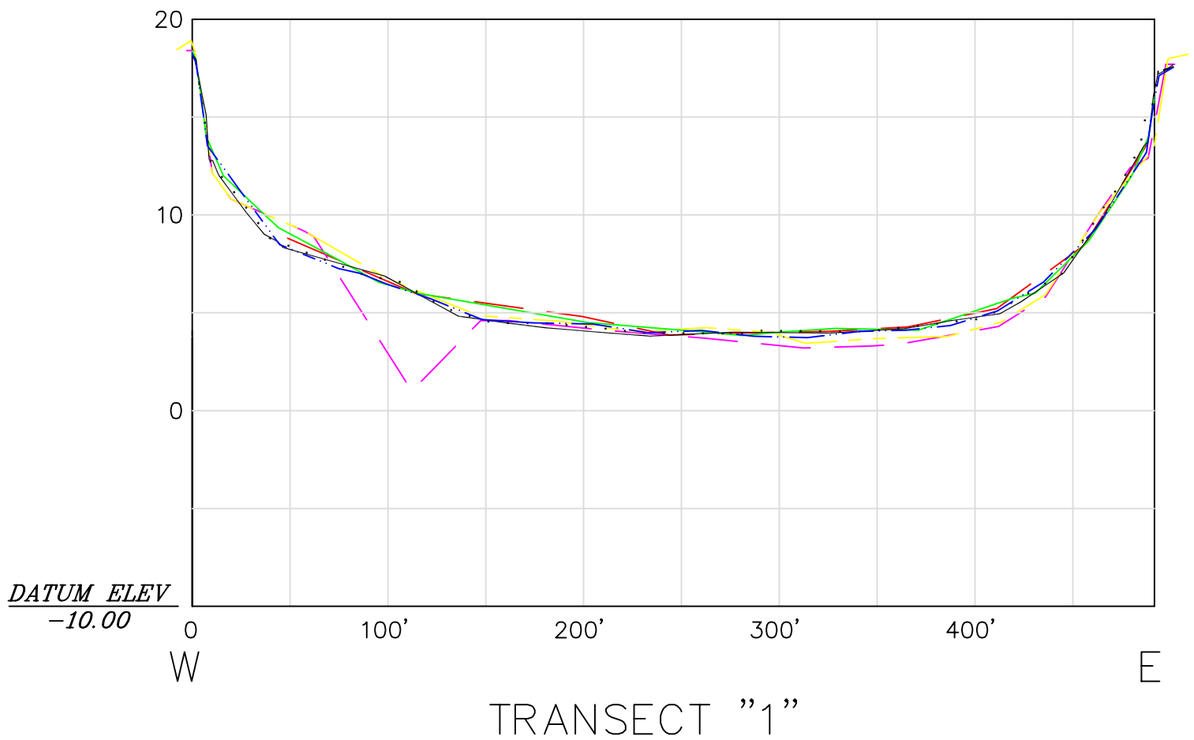
Surveyors determined the locations and elevations of points along all transects (Figure 1). All elevation data were referenced to MLLW and all survey coordinates were referenced to state plane coordinates (Washington State Plane South, North American Datum 1983). The survey information was downloaded into a CAD (Computer Aided Design) format for mapping. Results from the 2004 survey of transects 1 and 2 were compared with the 1995 profiles, as well as all subsequent surveys (Figure 3).

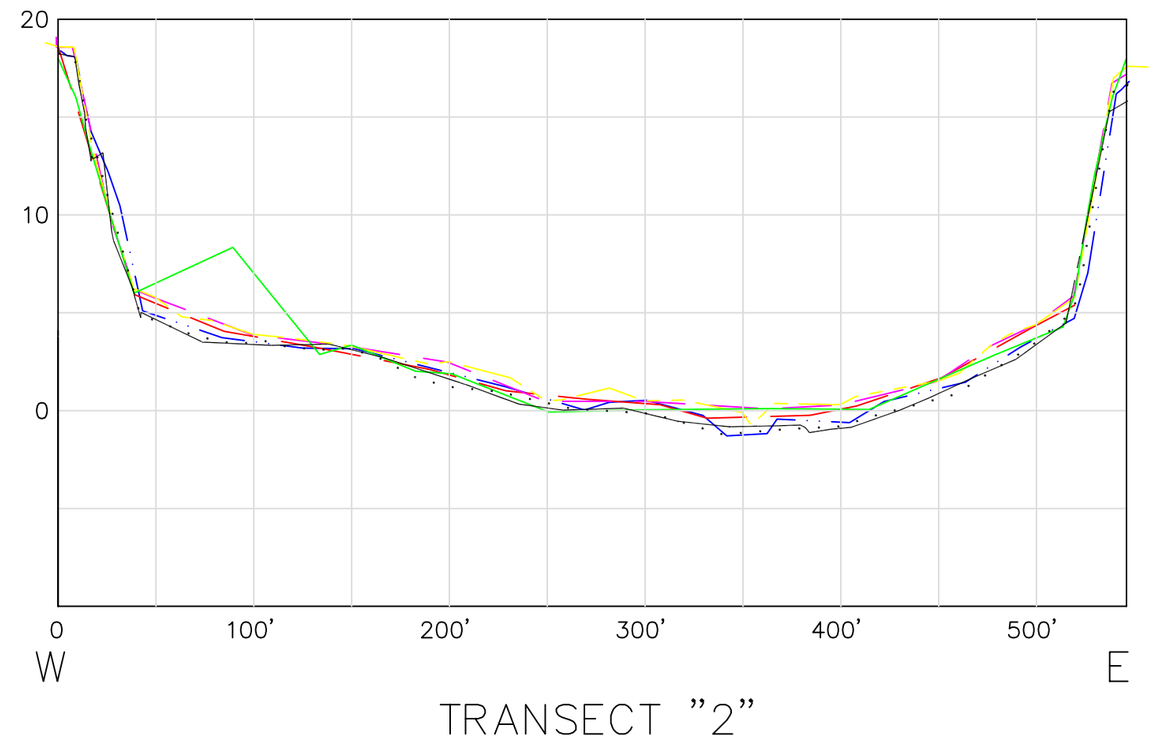
In 1995, transect data for transects 3 and 4 were developed by overlaying the transect location on the "as-built" drawing and determining an elevation and a relative location from the 0 point of the transect (defined as the training wall). Therefore, the 1996 data

are the first measured profiles for transects 3 and 4. These are compared with the all subsequent profiles in Figure 4.

2.3 PHOTO POINTS

Photographs were taken at the Milwaukee Habitat Area from the location of the re-bar benchmarks that define the ends of the permanent transects (Figure 1). Typically 3 to 4 photographs were taken at each photo-point. Photographs are presented in Appendix A.

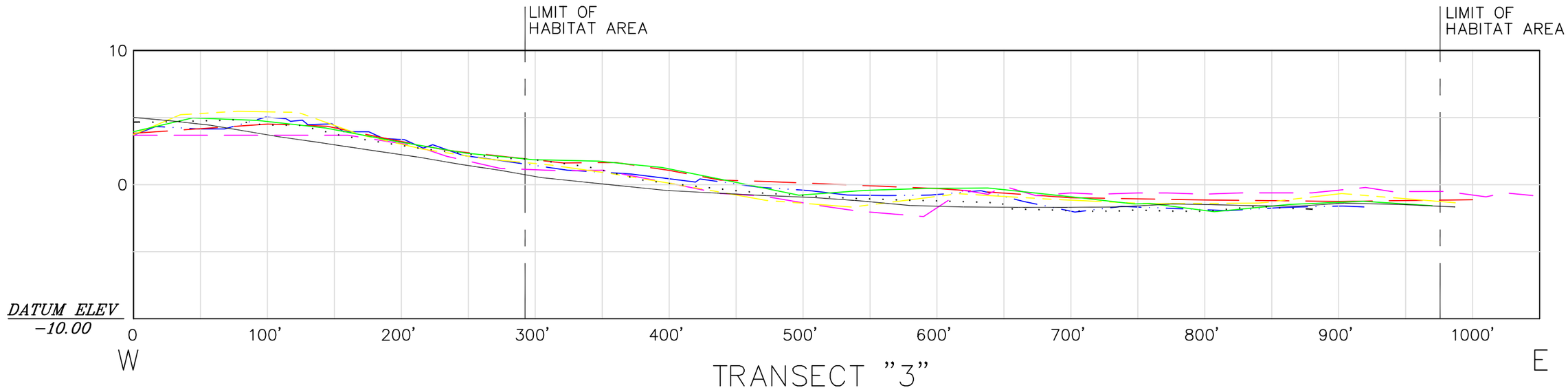


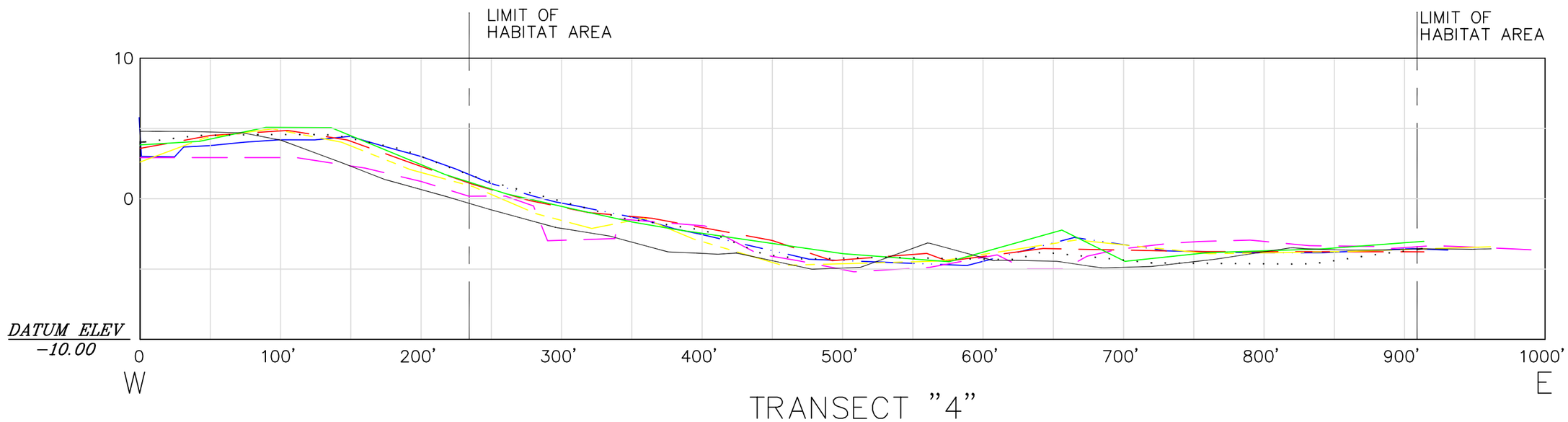


Legend

'95 PROFILE
'96 PROFILE
'97 PROFILE
'98 PROFILE
'00 PROFILE
'02 PROFILE
'04 PROFILE

Figure 3
Milwaukee Habitat Area,
Transect Profiles 1 & 2





Legend

- '95 PROFILE
- '96 PROFILE
- '97 PROFILE
- '98 PROFILE
- '00 PROFILE
- '02 PROFILE
- '04 PROFILE

Figure 4
Milwaukee Habitat Area,
Transect Profiles 3 & 4

2.4 SUBSTRATE CHARACTERIZATION

Surface sediments were collected to determine the substrate grain size in the habitat area. Two sampling points were established along each transect in 1995. These sites were re-sampled in all subsequent sampling years. For transects 1 and 2, the sampling points were 150 and 350 ft, respectively, east of the top of the west bank of the habitat area that was originally constructed as gravel/cobble habitat (Figure 1). For transects 3 and 4, samples were collected at 500 and 700 ft, respectively, east of the training wall in the areas originally constructed as sandflat/mudflat habitat.

The sediment cores were collected at low tide using a 4-inch diameter hand-held corer. Sediment cores were removed from the top 10 cm of the substrate. Samples were placed in double Ziploc bags with internal and external labels and transported on ice to Amtest Inc., Redmond, Washington for standard grain size analysis.

Grain size distribution was determined using methods in general accordance with ASTM 422-63. Particles greater than 0.063 mm in diameter were separated using standard-sized sieves (dry sieve analysis). Smaller particle sizes were determined by their relative sinking rates in a water column (pipette analysis). Percent solids were determined using Standard Methods 2540-B, where the samples are weighed wet, then completely dried and weighed again.

In 2004, sand and silt were the dominant substrate materials within all transects (Table 2, Figures 5 and 6). Transects 1 and 2, which were located within the area that once was gravel/cobble habitat type now contains less than 1 percent gravel. Deposition of sand and silt from the Puyallup River has covered the gravel. This deposition of fine material has yielded a decrease in gravel/cobble habitat and an increase in sandflat/mudflat habitat (Figure 5 and Table 1). Substrates from transects 3 and 4 have remained consistent from year to year (Figure 6). Clay was not abundant within any of the transects (Table 2).

The sediments contain a high percentage of solids, indicating that the samples contained little organic and colloidal clay material. The full results of the grain size analyses are presented in Appendix B.

The substrate at the Milwaukee Habitat Area has undergone changes over the course of the monitoring period that are consistent with its location near the mouth of the Puyallup River. Specifically, sand and silt have covered much of the gravel/cobble habitat. The resulting sandflat/mudflat habitat is providing a high quality substrate for the production of epibenthic prey for juvenile salmonids (PIE 2001; Grette Associates 2003).

Table 2. Results of grain size analysis.[1,2]

	Gravel >U.S. Sieve No. 10 (≥ 2 mm)							Sand Sieve No. 10 – 230 (1.9999 mm – 0.0625 mm)							Silt (6.24μm – 3.9μm)						
Sample No.	**1995**	**1996**	**1997**	**1998**	**2000**	**2002**	**2004**	**1995**	**1996**	**1997**	**1998**	**2000**	**2002**	**2004**	**1995**	**1996**	**1997**	**1998**	**2000**	**2002**	**2004**
1-1	49	<1	5.4	7	27.9	<1	0.3	39	49	75	42	59	74.0	79.7	12	45	15	45	13	20.1	16.1
1-2	11	<1	25.8	4	21.3	<1	0.3	58	56	37	49	25	83.5	30.4	28	36	29	40	40	11.7	63.4
2-1	32	27	25.4	11	2.5	<1	50.3	48	26	27	23	39	33.4	36.4	19	38	35	59	50	57.3	10.9
2-2	35	<1	7.4	13	3.5	<1	0.5	22	17	28	38	37	33.6	16.1	42	71	57	46	52	58.2	75.5
3-1	1	<1	0.5	<1	0.3	<1	0.3	51	72	55	40	75	54.4	23.6	45	21	40	57	22	38.7	70.4
3-2	1	1	<0.1	<1	<0.3	<1	0.3	72	83	77	66	67	70.6	33.8	25	12	22	33	24	24.4	58.6
4-1	<1	<1	0.6	1	0.3	<1	0.3	40	67	38	26	29	36.4	10.9	57	26	54	66	67	55.6	80.3
4-2	<1	-[3]	<0.2	1	0.6	<1	0.5	19	-[3]	48	27	68	62.5	46.0	59	-[3]	42	67	28	31.3	49.7

	Clay (<3.9μm)							% Solids						
Sample No.	**1995**	**1996**	**1997**	**1998**	**2000**	**2002**	**2004**	**1995**	**1996**	**1997**	**1998**	**2000**	**2002**	**2004**
1-1	1	6	4	6	<0.3	5.5	4.2	85	64	76	80	93	75	75.2
1-2	3	8	9	7	13.7	4.7	6.1	77	70	63	77	61	77	72.4
2-1	1	9	12	7	8.2	8.9	2.5	84	73	70	67	75	73	89.7
2-2	2	13	8	3	7	8.2	7.9	68	70	72	69	71	74	69.1
3-1	3	6	5	3	2.7	6.7	5.9	68	75	69	72	77	71	74.4
3-2	2	5	2	2	6.2	4.9	7.6	71	72	81	76	76	77	71.3
4-1	3	6	8	8	4	7.9	8.3	66	70	62	61	67	70	66.8
4-2	22	-[3]	10	6	3.5	6.2	4.0	56	-[3]	71	63	76	80	78.1

[1] Sediment grain size distribution in fractional percent.
[2] In each pair of samples, the first listed sample is the most westerly sample.
[3] No sample in 1996 due to unsafe substrate conditions.

Figure 5. Substrate characterization from transects 1 & 2 of the Milwaukee Habitat Area, as an average percent of total solids.

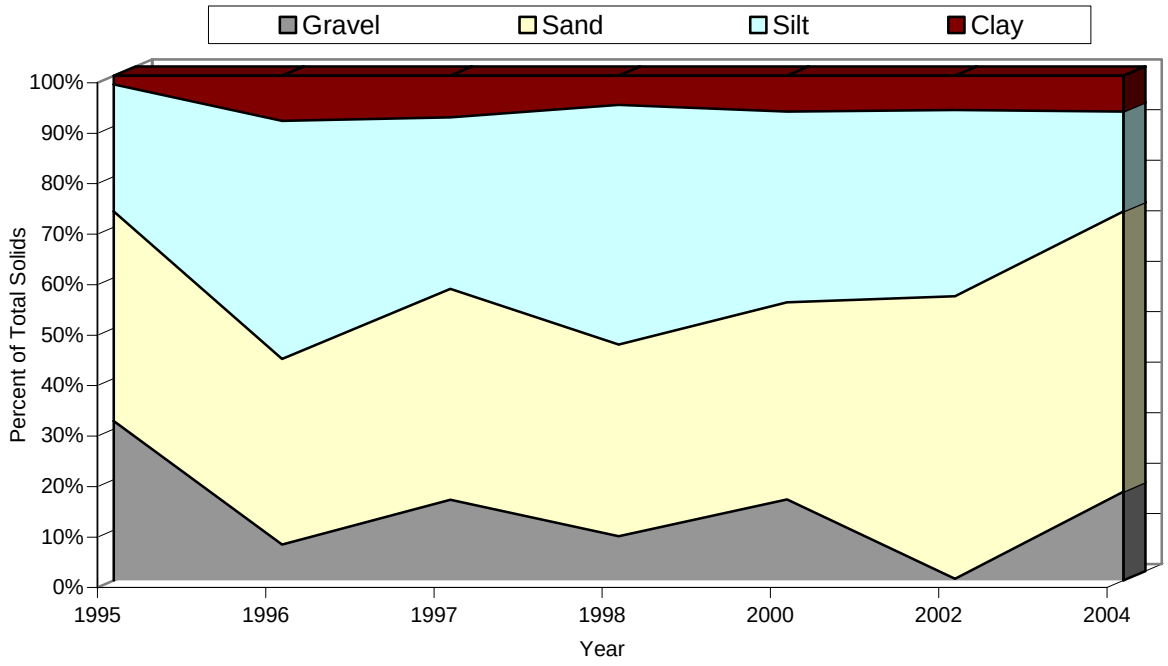
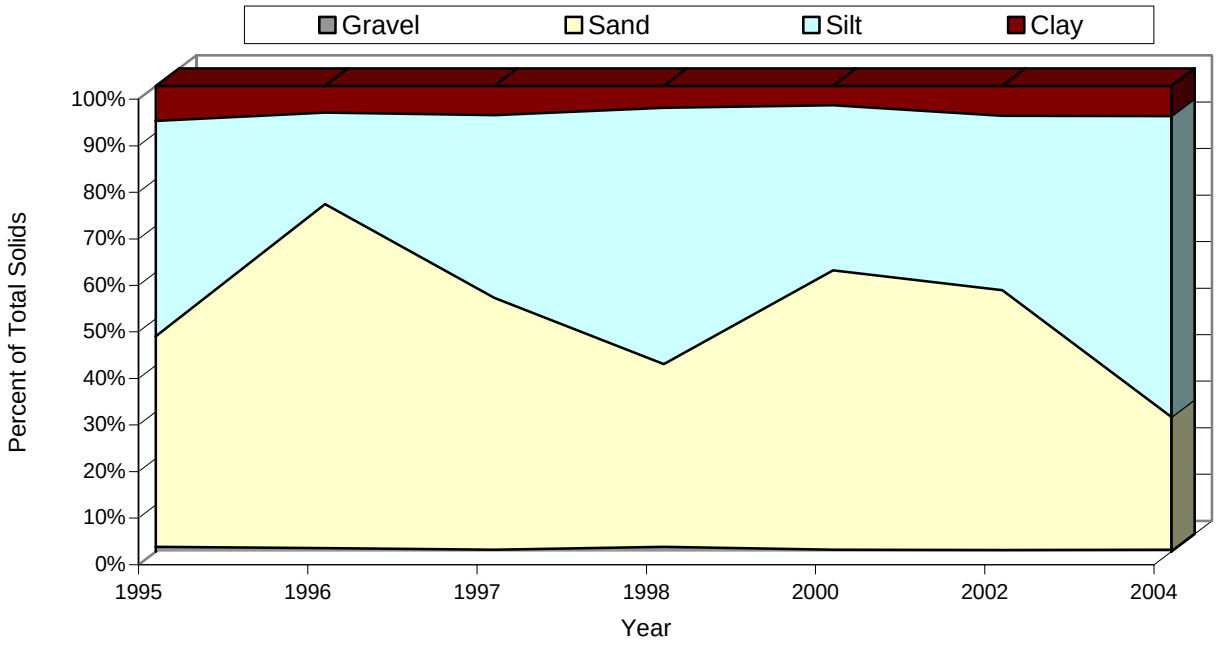


Figure 6. Substrate characterization from transects 3 & 4 of the Milwaukee Habitat Area, as an average percent of total solids.



3. BIOLOGICAL MONITORING

3.1 INTRODUCTION

Biological monitoring in the habitat area was conducted to assess upland plant assemblage and coverage. Section 4 summarizes the results of the comparisons of all 2004 biological monitoring to the performance standards.

3.2 UPLAND PLANT ASSEMBLAGE AND COVERAGE

3.2.1 Sampling

Survival, diversity, and coverage of upland vegetation were assessed on August 10, 2004. Sampling units for upland vegetation were 10-foot radius plots. Replicating the studies done in prior years, twelve numerically denoted (1-12) vegetation plots were evenly spaced along the east side of the site, and thirteen (1-13) were evenly spaced along the west side. Plots were placed above the top of the bank in the flat portion of the upland habitat.

The percent coverage by each species was visually estimated. Total percent cover often exceeded 100 percent due to multiple canopy layers in each plot. The overall percent survival of all planted tree and shrub species was calculated by simply dividing the number of living plants within each plot by the total number of plants present. These values were recorded on data sheets (Appendix B). Qualitative observations of volunteer species, plant stress, and other pertinent features were also recorded. Performance curves for upland plant assemblage and coverage are in Appendix B.

Due to the low survival rate of willow stakes during the 1996 and 1998 monitoring efforts, the Port and the EPA determined that planting potted willows would be more appropriate (EPA 1998). Based on this agreement between the Port and EPA, performance standard 1 for percent survival of installed willow stakes was not evaluated. Instead the percent coverage by willows, from +12 ft elevation to the top of the bank, was calculated for the entire habitat area.

3.2.2 Results

Survival of planted trees and shrubs located between the top of the bank and the fence was 99.5 percent. Total plant coverage between the top of the bank and the fence averaged 100 percent for both sides and no tree or shrub species that were originally planted at the site failed to survive (Table 3). Trees species observed at the site included red alder, Sitka spruce, Douglas fir, and shore pine. Shrubs species observed included willows (Pacific, Hooker's, Sitka and Scouler's), nootka rose, snowberry, salmonberry, California wax myrtle, vine maple, salal and Oregon grape. Invasive plant coverage averaged 9.6 percent. Willows between elevation +12 ft MLLW and the top of the bank, provided coverages of 50 percent on the west side and 25 percent on the east side (see data sheets in Appendix B). Volunteer native tree species also observed included black cottonwood, Pacific madrone, bitter cherry, and Oregon white oak.

Results of sampling show that performance standards 1A through 1F for Upland Habitat were met in 2004 (Table 5).

Table 3. Plant survival and coverage results for the east and west sides of the Milwaukee Habitat Area.

Vegetation Plot	Percent Survival	Herbaceous/ Ground Coverage (percent)	Woody Plant[1] Coverage (percent)	Invasive Plant Coverage[2] (percent)	Total Plant Coverage[3,4] (percent)
West Side					
1	100	100	40	12	100
2	100	85	75	25	100
3	100	60	100	7	100
4	100	100	77	15	100
5	100	100	67	3	100
6	100	86	97	10	100
7	100	95	77	3	100
8	100	51	100	8	100
9	100	5	100	1	100
10	100	47	100	1	100
11	100	96	68	5	100
12	100	47	100	5	100
13	96	53	100	2	100
East Side					
14	100	14	90	5	100
15	100	16	100	1	100
16	100	30	100	7	100
17	100	95	100	7	100
18	100	90	70	25	100
19	100	15	100	2	100
20	100	45	100	2	100
21	100	22	100	6	100
22	92	100	85	1	100
23	100	95	27	3	100
24	100	100	30	13	100
25	100	20	85	70	100
Average (east and west)	**99.5**	**62.7**	**83.5**	**9.6**	**100**

[1] Woody plant coverage includes trees and shrubs.

[2] Invasive weeds encountered in the habitat area included Himalayan blackberry (*Rubus procerus*), Scot's broom (*Cytisus scoparius*),purple loosestrife (*Lythrum salicaria*), bull thistle (*Cirsium vulgare*), and Canadian thistle (*Cirsium arvense*). Invasive weeds species were determined from the Washington State Noxious Weed List.

[3] Total plant coverage has been calculated excluding areas of overlap amongst vegetation layers. Therefore, the totals shown in this table are typically less than the sum of the coverage values for the different vegetation layers reported in Appendix B.

[4] Total plant coverage includes trees, shrubs and groundcovers.

4. CONCLUSIONS

The 2004 monitoring efforts evaluated the success of the Milwaukee Habitat Area. The habitat area was assessed using performance standards presented in the OMMP for the Sitcum Waterway Remediation Project (Port of Tacoma 1994). The results of the 2004 monitoring activities were used as the final test against the performance standards. Based on the success of the habitat area during previous monitoring efforts, the Port and EPA have dropped several monitoring activities. The discussion below identifies which performance standards were assessed and whether they were met during 2004 monitoring.

The OMMP contains only one performance standard tied to 2004 physical monitoring results. This performance standard (performance standard 1) requires that the intertidal acreage (+12 ft MLLW to –4 ft MLLW) be equal to the acreage measured in the "as-built" survey. The results of the 2004 physical monitoring indicated that the intertidal acreage has decreased by 0.56 acre (approximately 3 percent) from the acreage measured in the "as-built" survey, thus the performance standard was not met (Table 4). The acreage of intertidal habitat has varied with the position of the –4 ft MLLW contour. As discussed in 2002 and in Section 2.1 of this report, the location of the –4 ft MLLW contour is dependent on the balance between deposition and wave action. Based on this, the location of the –4 ft MLLW contour has the potential to vary from year to year. From 2002 to 2004 the –4 ft MLLW contour has migrated approximately 22 ft bayward. As previously discussed, it is expected that the location of the –4 ft MLLW contour will continue to vary between years, but the area is expected to eventually follow the increasing trend anticipated for the intertidal and shallow subtidal habitat combined.

Biological monitoring involved testing the 2004 monitoring results against 6 performance standards (all for upland vegetation) listed in the OMMP. The remaining biological performance standards were not evaluated in 2004, per agreements between the Port and the EPA (EPA 1998, EPA 2002;and EPA 2004). Results of the 2004 monitoring activities indicate that the Milwaukee Habitat Area met all 6 of the biological performance standards evaluated (Table 5). Upland vegetation at the habitat area is thriving and providing coverage throughout the entire habitat area. All of the originally planted tree and shrub species have survived and several volunteer native tree species, including black cottonwood, Pacific madrone, bitter cherry, and Oregon white oak have been established at the habitat area.

Table 4. Physical performance standards and monitoring conclusions.

Habitat Type	Objective	Performance Standards[1]	Results	Performance Standard Met?
Intertidal Habitat	1. A persistent habitat.	1. The acreage of intertidal habitat must equal the acreages measured in the "as-built" survey.	Intertidal acreage was approximately 0.56 acres less than the as-built survey (decrease of 3 percent)[2]	No[2]
Emergent Marsh	1. A persistent saltmarsh	1. Areal extent of 0.7 acres of saltmarsh at the end of the monitoring period	Not assessed in 2004 as part of agreement between the Port and EPA	N/A[3]

[1] Applied in years 6, 8, and 10.
[2] Future passage of this performance standard is anticipated, see text in Section 2.1.
[3] The emergent saltmarsh habitat has been addressed through the Contingency Planning Process, thus a comparison to the performance standard is not provided in the table. The EPA has made a final determination that no further contingency planning or response efforts are necessary for the performance standards pertaining to emergent saltmarsh (EPA 2003).

Table 5. Biological performance standards and monitoring conclusions.

Habitat Type	Objective	Performance Standards[1]	Results	Performance Standard Met?
Emergent Marsh	1. A diverse, dense, and self-sustaining saltmarsh.	1A. A minimum of 75% of the coverage measured at the reference site	Not assessed in 2004 as part of agreement between the Port and EPA	N/A[2]
		1B. A minimum of 75% of the stem density measured at the reference site	Not assessed in 2004 as part of agreement between the Port and EPA	N/A[2]

Table 5. Biological performance standards and monitoring conclusions (continued).

Habitat Type	Objective	Performance Standards[1]	Results	Performance Standard Met?
Sandflat/Mudflat	1. A diverse and abundant assemblage of benthic and epibenthic organisms similar to like habitats in Commencement Bay.	1A. Benthic infauna abundance not statistically less than reference.	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1B. Total number of infauna taxa not statistically less than reference and not less than 75% of the reference mean.	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1C. Number of numerically dominant infauna taxa not less than 75% of reference (direct comparison of means).	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1D. Number of numerically non-dominant infauna taxa not less than 75% of reference (direct comparison of means).	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1E. Total numerical abundance of all infauna not less than 75% of reference (direct comparison of means).	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1F. Total wet-weight biomass of benthic infauna not less than 75% of reference (direct comparison of means).	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1G. Salmonid prey epifauna taxa not statistically less than reference.	Not assessed in 2004 as part of agreement between the Port and EPA[4]	N/A[4]
		1H. Number of salmonid prey epifauna taxa not less than 50% of reference (direct comparison of means).	Not assessed in 2004 as part of agreement between the Port and EPA[4]	N/A[4]
		1I. Total numerical abundance of salmonid prey epifauna not statistically less than reference and not less than 50% of the reference mean.	Not assessed in 2004 as part of agreement between the Port and EPA[4]	N/A[4]
		1J. Total wet-weight biomass of salmonid prey epifauna not less than 50% of reference (direct comparison of means).	Not assessed in 2004 as part of agreement between the Port and EPA[4]	N/A[4]
	2. Abundant benthic macroalgae similar to like habitats in Commencement Bay.	2A. A minimum of 75% of the coverage in the reference site.	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]

Table 5. Biological performance standards and monitoring conclusions (continued).

Habitat Type	Objective	Performance Standards[1]	Results	Performance Standard Met?
Gravel/Cobble	1. A diverse and abundant assemblage of benthic and epibenthic organisms similar to like habitats in Commencement Bay.	1A. Benthic infauna abundance not statistically less than reference.	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1B. Total number of infauna species not statistically less than reference and not less than 75% of the reference mean.	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1C. Number of numerically dominant infauna taxa not less than 75% of reference (direct comparison of means).	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1D. Number of numerically non-dominant infauna taxa not less than 75% of reference (direct comparison of means).	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1E. Total numerical abundance of all infauna not less than 75% of reference (direct comparison of means).	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1F. Total wet-weight biomass of benthic infauna not less than 75% of reference (direct comparison of means).	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]
		1G. Salmonid prey epifauna taxa not statistically less than reference.	Not assessed in 2004 as part of agreement between the Port and EPA[4]	N/A[4]
		1H. Number of salmonid prey epifauna taxa not less than 50% of reference (direct comparison of means).	Not assessed in 2004 as part of agreement between the Port and EPA[4]	N/A[4]
		1I. Total numerical abundance of salmonid prey epifauna not statistically less than reference and not less than 50% of the reference mean.	Not assessed in 2004 as part of agreement between the Port and EPA[4]	N/A[4]
		1J. Total wet-weight biomass of salmonid prey epifauna not less than 50% of reference (direct comparison of means).	Not assessed in 2004 as part of agreement between the Port and EPA[4]	N/A[4]
	2. Abundant benthic macroalgae similar to like habitats in Commencement Bay.	2A. A minimum of 75% coverage.	Not assessed in 2002 as part of agreement between the Port and EPA[3]	N/A[3]

Table 5. Biological performance standards and monitoring conclusions (continued).

Habitat Type	Objective	Performance Standards[1]	Results	Performance Standard Met?
Upland Habitat	1. Provide a buffer for fish and wildlife using the intertidal habitats.	1A. 70 % survival of trees and shrubs	99.5% survival.	Yes
		1B. Survival of a minimum of three tree species.	All four species survived.	Yes
		1C. Survival of a minimum of four shrub species.	All eleven species survived.	Yes
		1D. Minimum of 30 % coverage of trees and shrubs.	83.5% coverage.	Yes
		1E. Minimum 70 % coverage by groundcover, shrubs, and trees.	100% coverage.	Yes
		1F. No more than 20 % coverage by invasive weedy species.	9.6% coverage.	Yes
Sideslope (+12 to top of bank)	1. Provide a visual buffer for fish and wildlife using the intertidal habitats.	1. No performance standard[5]	West side: 50% coverage East side: 20% coverage	N/A

[1] Applied in years 6, 8, and 10.
[2] The emergent saltmarsh habitat has been addressed through the Contingency Planning Process, thus a comparison to the performance standard is not provided in the table. The EPA has made a final determination that no further contingency planning or response efforts are necessary for the performance standards pertaining to emergent saltmarsh (EPA 2003).
[3] Monitoring discontinued and performance standard not assessed, per agreement between the Port and EPA (EPA 2002).
[4] Monitoring discontinued and performance standard not assessed, per agreement between the Port and EPA (EPA 2004).
[5] Performance standard assessing the survival of willow stakes was dropped based on the planting of potted willows in response to the low survival of the willow stakes (EPA 1998).
.

5. REFERENCES

Environmental Protection Agency (EPA). 1998. Letter from Christina Ngo to D. Gilmur (Port of Tacoma). Re: Sitcum Waterway Remediation Project; EPA Comments. 6 April 1998.

Environmental Protection Agency (EPA). 2002. Letter from K. Marcy to D. Gilmur (Port of Tacoma). Re: EPA response to "Milwaukee Habitat Monitoring". 19 February 2002.

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SITCUM WATERWAY REMEDIATION PROJECT

MILWAUKEE HABITAT AREA MONITORING REPORT, 2004
APPENDIX A: MONITORING PHOTOS

PREPARED FOR:

PORT OF TACOMA
P.O. BOX 1837
TACOMA, WASHINGTON 98401

PREPARED BY:

GRETTE ASSOCIATES LLC
151 SOUTH WORTHEN STREET, SUITE 101
WENATCHEE, WASHINGTON 98801
(509) 663-6300

2111 NORTH 30TH
TACOMA, WASHINGTON 98403
(253) 573-9300

NOVEMBER 2004

Grette Associates LLC
ENVIRONMENTAL CONSULTANTS

PHOTO 1: Milwaukee Habitat Area, June 6, 2004. Photopoint at southeast corner of the habitat, facing southwest. Tidal level = -3.5 ft MLLW.

PHOTO 2: Milwaukee Habitat Area, June 6, 2004. Photopoint at southeast corner of the habitat, facing west. Tidal level = -3.5 ft MLLW.

PHOTO 3: Milwaukee Habitat Area, June 6, 2004. Photopoint at southeast corner of the habitat, facing northwest. Tidal level = -3.5 ft MLLW.

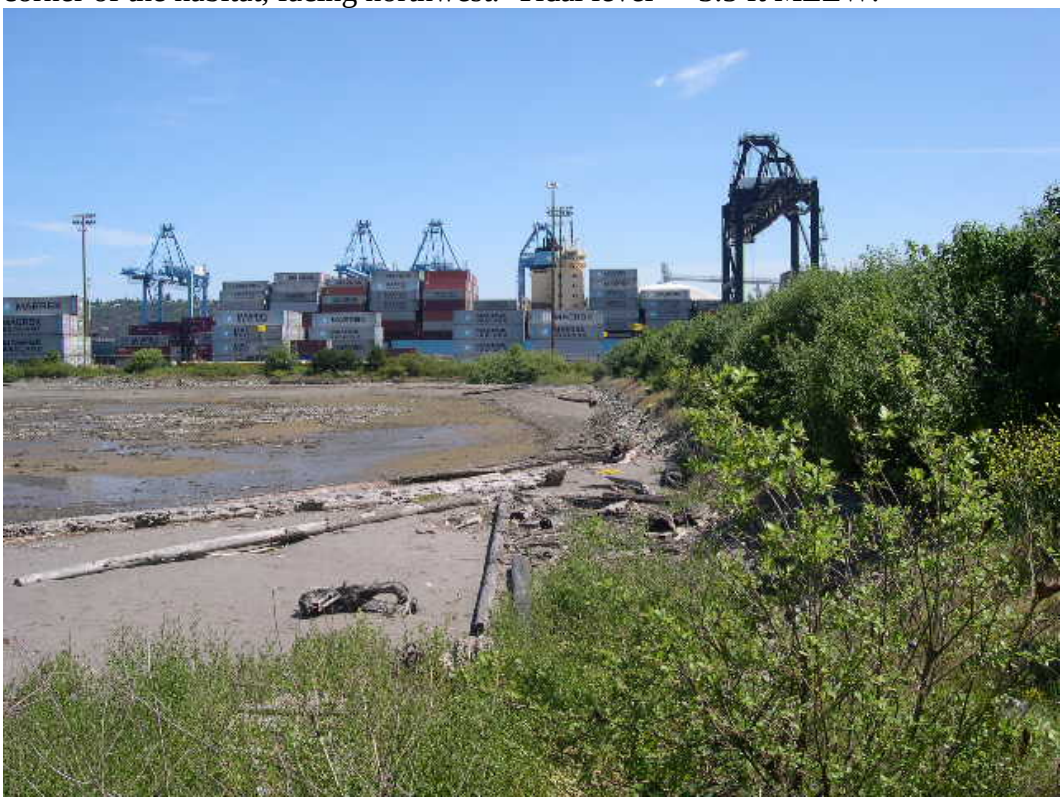

PHOTO 4: Milwaukee Habitat Area, June 6, 2004. Photopoint at southwest corner of the habitat, facing northeast. Tidal level = -3.4 ft MLLW.

PHOTO 5: Milwaukee Habitat Area, June 6, 2004. Photopoint at southwest corner of the habitat, facing north. Tidal level = -3.4 ft MLLW.

PHOTO 6: Milwaukee Habitat Area, June 6, 2004. Photopoint at southwest corner of the habitat, facing northwest. Tidal level = -3.4 ft MLLW.

PHOTO 7: Milwaukee Habitat Area, June 6, 2004. Photopoint at the middle of the west side of the habitat, facing east. Tidal level = -3.2 ft MLLW.

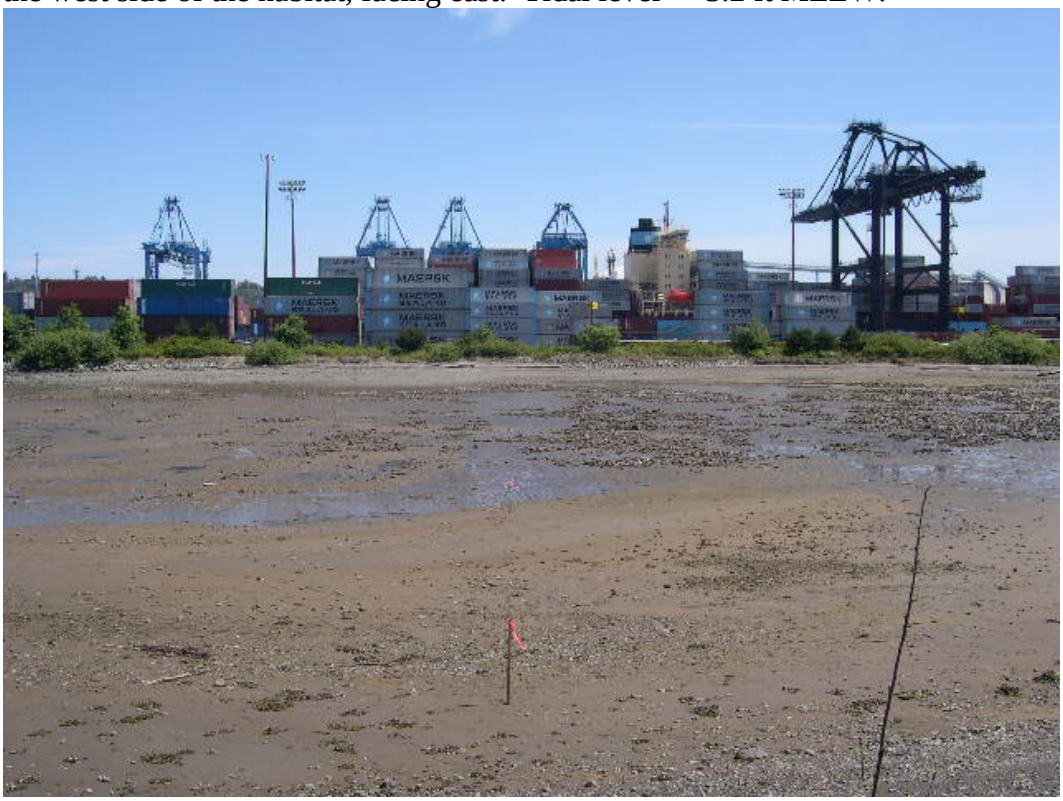

PHOTO 8: Milwaukee Habitat Area, June 6, 2004. Photopoint at the middle of the west side of the habitat, facing northeast. Tidal level = -3.2 ft MLLW.

PHOTO 9: Milwaukee Habitat Area, June 6, 2004. Photopoint at the middle of the west side of the habitat, facing north. Tidal level = -3.2 ft MLLW.

PHOTO 10: Milwaukee Habitat Area, June 6, 2004. Photopoint at the northeast tip of the habitat, facing south. Tidal level = -3.8 ft MLLW.

PHOTO 11: Milwaukee Habitat Area, June 6, 2004. Photopoint at the northeast tip of the habitat, facing southwest. Tidal level = -3.8 ft MLLW.

PHOTO 12: Milwaukee Habitat Area, June 6, 2004. Photopoint at the northeast tip of the habitat, facing west. Tidal level = -3.8 ft MLLW.

PHOTO 13: Milwaukee Habitat Area, June 6, 2004. Photopoint at the northwest tip of the habitat, facing northeast. Tidal level = -2.9 ft MLLW.

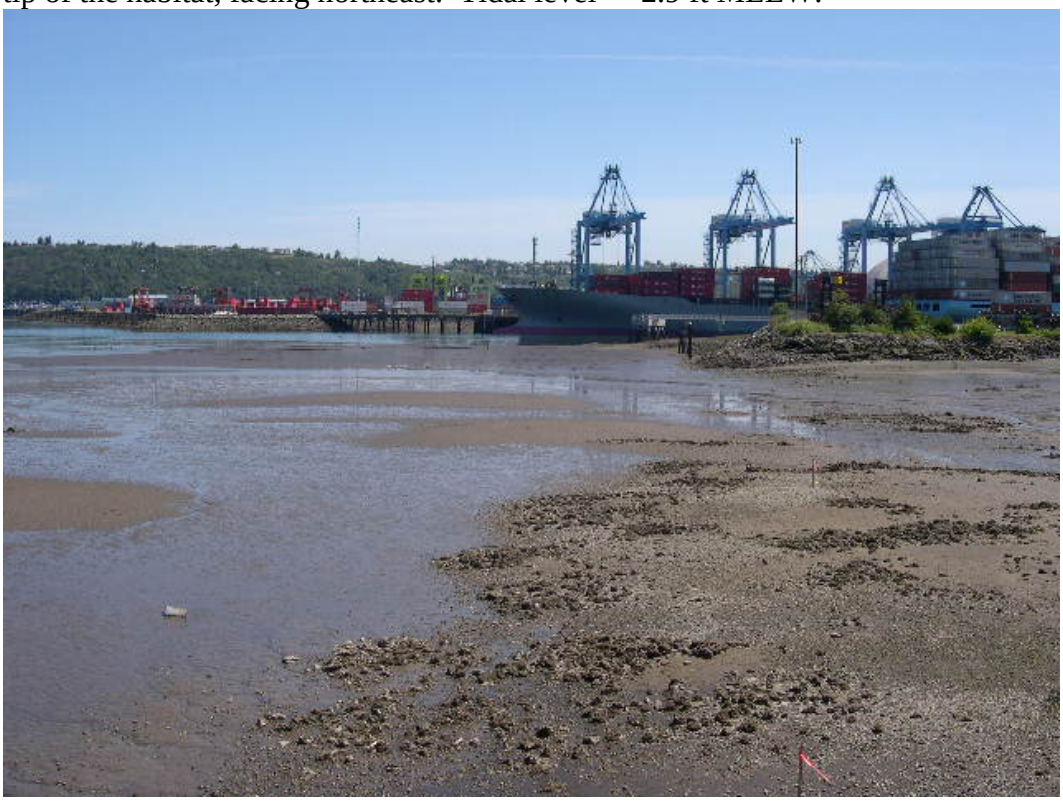

PHOTO 14: Milwaukee Habitat Area, June 6, 2004. Photopoint at the northwest tip of the habitat, facing north. Tidal level = -2.9 ft MLLW.

PHOTO 15: Milwaukee Habitat Area, June 6, 2004. Photopoint at the northwest tip of the habitat, facing northwest. Tidal level = -2.9 ft MLLW.

SITCUM WATERWAY REMEDIATION PROJECT

MILWAUKEE HABITAT AREA MONITORING REPORT, 2004
APPENDIX B: DATA APPENDIX

PREPARED FOR:

PORT OF TACOMA
P.O. BOX 1837
TACOMA, WASHINGTON 98401

PREPARED BY:

GRETTE ASSOCIATES LLC

151 SOUTH WORTHEN STREET, SUITE 101
WENATCHEE, WASHINGTON 9880
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TACOMA, WASHINGTON 98403
(253) 573-9300

NOVEMBER 2004

Grette Associates LLC
ENVIRONMENTAL CONSULTANTS

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Grain Size Samples Chain of Custody Forms

Upland Vegetation Data Sheets

Upland Vegetation Performance Curves

GRAIN SIZE ANALYSIS PHYSICAL MONITORING

Am Test Inc.
14603 N.E. 87th St.
Redmond, WA
98052

Tel: 425.885.1664
Fax: 425.883.3495
www.amtestlab.com

AMTEST LABORATORIES

Professional Analytical Services

Jun 18 2004
GRETTE ASSOCIATES
151 S. WORTHEN ST.
WENATACHEE, WA 98801

Enclosed please find the analytical data for your SITCUM WATERWAY REME project.

The following is a cross correlation of client and laboratory identifications for your convenience.

CLIENT ID	MATRIX	AM TEST ID	TEST
1-1 TRANSECT 1 WEST	Soil	04-A007198	CONV, GR SIZE,
1-2 TRANSECT 1 EAST	Soil	04-A007199	CONV, GR SIZE,
2-1 TRANSECT 2 WEST	Soil	04-A007200	CONV, GR SIZE,
2-2 TRANSECT 2 EAST	Soil	04-A007201	CONV, GR SIZE,
3-1 TRANSECT 3 WEST	Soil	04-A007202	CONV, GR SIZE,
3-2 TRANSECT 3 EAST	Soil	04-A007203	CONV, GR SIZE,
4-1 TRANSECT 4 WEST	Soil	04-A007204	CONV, GR SIZE,
4-2 TRANSECT 4 EAST	Soil	04-A007205	CONV, GR SIZE,

Your eight (8) samples were received on Friday, June 4 2004. This was within 24 hours of the time that the samples were collected (6/ 3/04). At the time of receipt, the samples were logged in and properly maintained prior to their subsequent analyses.

The analytical procedures used at Am Test are well documented, and are typically derived from the protocols of the EPA, USDA, FDA or the Army Corps of Engineers.

Following the analytical data you will find the QC results and "Methodology Report". This table includes information relative to the detection limits, analyses dates and method references.

Please note that the detection limits that are listed in the body of the report refer to the Method Detection Limits (MDL's), as opposed to Practical Quantitation Limits (PQL's).

If you should have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

Aaron Young
Am Test Inc.

Project #: 120.002.400

BACT = Bacteriological
CONV = Conventionals
MET = Metals
ORG = Organics

AMTEST LABORATORIES

ANALYSIS REPORT

GRETTE ASSOCIATES
151 S. WORTHEN ST.
WENATACHEE, WA 98801
Attention:

Date Received: 6/ 4/04
Date Reported: 6/18/04

Project Name: SITCUM WATERWAY REME
Project #: 120.002.400

SOIL SAMPLES

AM TEST Identification Number	04-A007198
Client Identification	1-1 TRANSECT 1 WEST
Sampling Date	6/ 3/04

PARAMETER	RESULT	Q	D.L.
Conventionals			
Total Solids (%)	75.2		
Total Volatile Solids (%)	1.21		

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION	FRACTION	PERCENT
	4.75	0.10	gravel	0.20
-2	4.00	< 0.1		
-1	2.00	0.10		
0	1.00	0.30		
+1	0.50	3.90	sand	79.7
+2	0.25	12.2		
+3	0.125	46.9		
+4	0.063	16.4		
+5	0.032	4.60		
+6	0.016	6.80	silt	16.1
+7	0.008	3.30		
+8	0.004	1.40		
+9	0.002	< 0.1		
+10	0.001	< 0.1	clay	4.00
>+10	<0.001	4.00		

Gravel <-2 to -1 phi
Silt +5 to +8 phi
Sand 0 to +4 phi
Clay +9 to >+10 phi

Analysis by Tyler Screens and Hydrometer (ASTM D-422)

AMTEST LABORATORIES

ANALYSIS REPORT

GRETTE ASSOCIATES
151 S. WORTHEN ST.
WENATACHEE, WA 98801
Attention:

Date Received: 6/ 4/04
Date Reported: 6/18/04

Project Name: SITCUM WATERWAY REME
Project #: 120.002.400

SOIL SAMPLES

AM TEST Identification Number	04-A007199
Client Identification	1-2 TRANSECT 1 EAST
Sampling Date	6/ 3/04

PARAMETER	RESULT	Q	D.L.
Conventionals			
Total Solids (%)	72.4		
Total Volatile Solids (%)	1.91		

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION	FRACTION	PERCENT
	4.75	< 0.1	gravel	0.10
-2	4.00	< 0.1		
-1	2.00	0.10		
0	1.00	0.30		
+1	0.50	1.40	sand	58.7
+2	0.25	5.80		
+3	0.125	22.9		
+4	0.063	28.3		
+5	0.032	13.0		
+6	0.016	11.6	silt	35.1
+7	0.008	6.90		
+8	0.004	3.60		
+9	0.002	1.50		
+10	0.001	0.70	clay	6.10
>+10	<0.001	3.90		

Gravel <-2 to -1 phi
Silt +5 to +8 phi
Sand 0 to +4 phi
Clay +9 to >+10 phi

Analysis by Tyler Screens and Hydrometer (ASTM D-422)

AMTEST LABORATORIES

ANALYSIS REPORT

GRETTE ASSOCIATES
151 S. WORTHEN ST.
WENATACHEE, WA 98801
Attention:

Date Received: 6/ 4/04
Date Reported: 6/18/04

Project Name: SITCUM WATERWAY REME
Project #: 120.002.400

SOIL SAMPLES

AM TEST Identification Number	04-A007200
Client Identification	2-1 TRANSECT 2 WEST
Sampling Date	6/ 3/04

PARAMETER	RESULT	Q	D.L.
Conventionals			
Total Solids (%)	89.7		
Total Volatile Solids (%)	1.56		

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION	FRACTION	PERCENT
	4.75	22.0	gravel	50.3
-2	4.00	6.60		
-1	2.00	21.7		
0	1.00	8.80		
+1	0.50	12.9	sand	38.5
+2	0.25	13.4		
+3	0.125	1.30		
+4	0.063	2.10		
+5	0.032	3.00		
+6	0.016	3.20	silt	8.80
+7	0.008	1.70		
+8	0.004	0.90		
+9	0.002	0.20		
+10	0.001	< 0.1	clay	2.40
>+10	<0.001	2.20		

Gravel <-2 to -1 phi
Silt +5 to +8 phi
Sand 0 to +4 phi
Clay +9 to >+10 phi

Analysis by Tyler Screens and Hydrometer (ASTM D-422)

AMTEST LABORATORIES

ANALYSIS REPORT

GRETTE ASSOCIATES
151 S. WORTHEN ST.
WENATACHEE, WA 98801
Attention:

Date Received: 6/ 4/04
Date Reported: 6/18/04

Project Name: SITCUM WATERWAY REME
Project #: 120.002.400

SOIL SAMPLES

AM TEST Identification Number	04-A007201
Client Identification	2-2 TRANSECT 2 EAST
Sampling Date	6/ 3/04

PARAMETER	RESULT	Q	D.L.
Conventionals			
Total Solids (%)	69.1		
Total Volatile Solids (%)	2.79		

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION	FRACTION	PERCENT
	4.75	< 0.1	gravel	0.30
-2	4.00	< 0.1		
-1	2.00	0.30		
0	1.00	0.10		
+1	0.50	1.70	sand	40.4
+2	0.25	4.60		
+3	0.125	9.70		
+4	0.063	24.3		
+5	0.032	10.8		
+6	0.016	24.2	silt	51.2
+7	0.008	10.2		
+8	0.004	6.00		
+9	0.002	1.70		
+10	0.001	0.70	clay	7.90
>+10	<0.001	5.50		

Gravel <-2 to -1 phi
Silt +5 to +8 phi
Sand 0 to +4 phi
Clay +9 to >+10 phi

Analysis by Tyler Screens and Hydrometer (ASTM D-422)

AMTEST LABORATORIES

ANALYSIS REPORT

GRETTE ASSOCIATES
151 S. WORTHEN ST.
WENATACHEE, WA 98801
Attention:

Date Received: 6/ 4/04
Date Reported: 6/18/04

Project Name: SITCUM WATERWAY REME
Project #: 120.002.400

SOIL SAMPLES

AM TEST Identification Number	04-A007202
Client Identification	3-1 TRANSECT 3 WEST
Sampling Date	6/ 3/04

PARAMETER	RESULT	Q	D.L.
Conventionals			
Total Solids (%)	74.4		
Total Volatile Solids (%)	2.55		

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION	FRACTION	PERCENT
	4.75	< 0.1	gravel	0.10
-2	4.00	< 0.1		
-1	2.00	0.10		
0	1.00	< 0.1		
+1	0.50	0.90	sand	54.5
+2	0.25	10.5		
+3	0.125	12.1		
+4	0.063	31.0		
+5	0.032	14.5		
+6	0.016	9.70	silt	39.4
+7	0.008	12.4		
+8	0.004	2.80		
+9	0.002	1.40		
+10	0.001	0.70	clay	5.90
>+10	<0.001	3.80		

Gravel <-2 to -1 phi
Silt +5 to +8 phi
Sand 0 to +4 phi
Clay +9 to >+10 phi

Analysis by Tyler Screens and Hydrometer (ASTM D-422)

AMTEST LABORATORIES

ANALYSIS REPORT

GRETTE ASSOCIATES
151 S. WORTHEN ST.
WENATACHEE, WA 98801
Attention:

Date Received: 6/ 4/04
Date Reported: 6/18/04

Project Name: SITCUM WATERWAY REME
Project #: 120.002.400

SOIL SAMPLES

AM TEST Identification Number	04-A007203
Client Identification	3-2 TRANSECT 3 EAST
Sampling Date	6/ 3/04

PARAMETER	RESULT	Q	D.L.
Conventionals			
Total Solids (%)	71.3		
Total Volatile Solids (%)	2.68		

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION	FRACTION	PERCENT
	4.75	< 0.1	gravel	
-2	4.00	< 0.1		
-1	2.00	< 0.1		
0	1.00	0.10		
+1	0.50	0.10	sand	56.4
+2	0.25	11.6		
+3	0.125	22.0		
+4	0.063	22.6		
+5	0.032	8.90		
+6	0.016	15.3	silt	36.0
+7	0.008	8.10		
+8	0.004	3.70		
+9	0.002	2.00		
+10	0.001	1.10	clay	7.60
>+10	<0.001	4.50		

Gravel <-2 to -1 phi
Silt +5 to +8 phi
Sand 0 to +4 phi
Clay +9 to >+10 phi

Analysis by Tyler Screens and Hydrometer (ASTM D-422)

AMTEST LABORATORIES

ANALYSIS REPORT

GRETTE ASSOCIATES
151 S. WORTHEN ST.
WENATACHEE, WA 98801
Attention:

Date Received: 6/ 4/04
Date Reported: 6/18/04

Project Name: SITCUM WATERWAY REME
Project #: 120.002.400

SOIL SAMPLES

AM TEST Identification Number	04-A007204
Client Identification	4-1 TRANSECT 4 WEST
Sampling Date	6/ 3/04

PARAMETER	RESULT	Q	D.L.
Conventionals			
Total Solids (%)	66.8		
Total Volatile Solids (%)	2.96		

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION	FRACTION	PERCENT
	4.75	0.10	gravel	0.20
-2	4.00	0.10		
-1	2.00	< 0.1		
0	1.00	0.10		
+1	0.50	0.10	sand	38.9
+2	0.25	2.80		
+3	0.125	7.90		
+4	0.063	28.0		
+5	0.032	3.10		
+6	0.016	28.0	silt	52.3
+7	0.008	15.2		
+8	0.004	6.00		
+9	0.002	2.40		
+10	0.001	1.10	clay	8.30
>+10	<0.001	4.80		

Gravel <-2 to -1 phi
Silt +5 to +8 phi
Sand 0 to +4 phi
Clay +9 to >+10 phi

Analysis by Tyler Screens and Hydrometer (ASTM D-422)

AMTEST LABORATORIES

ANALYSIS REPORT

GRETTE ASSOCIATES
151 S. WORTHEN ST.
WENATACHEE, WA 98801
Attention:

Date Received: 6/ 4/04
Date Reported: 6/18/04

Project Name: SITCUM WATERWAY REME
Project #: 120.002.400

SOIL SAMPLES

AM TEST Identification Number	04-A007205
Client Identification	4-2 TRANSECT 4 EAST
Sampling Date	6/ 3/04

PARAMETER	RESULT	Q	D.L.
Conventionals			
Total Solids (%)	78.1		
Total Volatile Solids (%)	1.78		

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION	FRACTION	PERCENT
	4.75	0.10	gravel	0.40
-2	4.00	< 0.1		
-1	2.00	0.30		
0	1.00	0.10		
+1	0.50	1.30	sand	68.4
+2	0.25	11.4		
+3	0.125	33.2		
+4	0.063	22.4		
+5	0.032	8.50		
+6	0.016	12.6	silt	27.3
+7	0.008	4.80		
+8	0.004	1.40		
+9	0.002	0.10		
+10	0.001	< 0.1	clay	3.90
>+10	<0.001	3.80		

Gravel <-2 to -1 phi
Silt +5 to +8 phi
Sand 0 to +4 phi
Clay +9 to >+10 phi

Analysis by Tyler Screens and Hydrometer (ASTM D-422)

AMTEST LABORATORIES

Quality Control Summary

QC for 442619

04-A007198
04-A007199
04-A007200
04-A007201
04-A007202
04-A007203
04-A007204
04-A007205

DUPLICATES

		sample value	duplicate value	RPD %
04-A007203 DUP: Total Solids	%	71.3	71.4	0.14
04-A007203 DUP: Total Volatile Solids	%	2.68	2.39	11.
04-A007203 DUP:	%	< 0.1	< 0.1	
04-A007203 DUP:	%	< 0.1	< 0.1	
04-A007203 DUP: - 2	%	< 0.1	0.10	
04-A007203 DUP: - 2	%	< 0.1	< 0.1	
04-A007203 DUP: - 1	%	< 0.1	< 0.1	
04-A007203 DUP: - 1	%	< 0.1	< 0.1	
04-A007203 DUP: 0	%	0.10	< 0.1	
04-A007203 DUP: 0	%	0.10	0.10	0.00
04-A007203 DUP: + 1	%	0.10	0.60	140
04-A007203 DUP: + 1	%	0.10	0.30	100
04-A007203 DUP: + 2	%	11.6	10.4	11.
04-A007203 DUP: + 2	%	11.6	12.6	8.3
04-A007203 DUP: + 3	%	22.0	24.4	10.
04-A007203 DUP: + 3	%	22.0	23.5	6.6
04-A007203 DUP: + 4	%	22.6	23.4	3.5
04-A007203 DUP: + 4	%	22.6	20.0	12.
04-A007203 DUP: + 5	%	8.90	5.00	56.
04-A007203 DUP: + 5	%	8.90	8.40	5.8
04-A007203 DUP: + 6	%	15.3	16.9	9.9
04-A007203 DUP: + 6	%	15.3	16.4	6.9
04-A007203 DUP: + 7	%	8.10	8.10	0.00
04-A007203 DUP: + 7	%	8.10	7.90	2.5
04-A007203 DUP: + 8	%	3.70	4.20	13.
04-A007203 DUP: + 8	%	3.70	3.90	5.3
04-A007203 DUP: + 9	%	2.00	2.10	4.9
04-A007203 DUP: + 9	%	2.00	1.60	22.
04-A007203 DUP: + 10	%	1.10	1.10	0.00
04-A007203 DUP: + 10	%	1.10	0.70	44.
04-A007203 DUP: > +10	%	4.50	3.80	17.
04-A007203 DUP: > +10	%	4.50	4.60	2.2

MATRIX SPIKES

sample value	sample+spk value	spike value	Recovery %

STANDARD REFERENCE MATERIALS

measured value	true value	Recovery %

BLANKS

Result

AMTEST LABORATORIES

METHODOLOGY REPORT

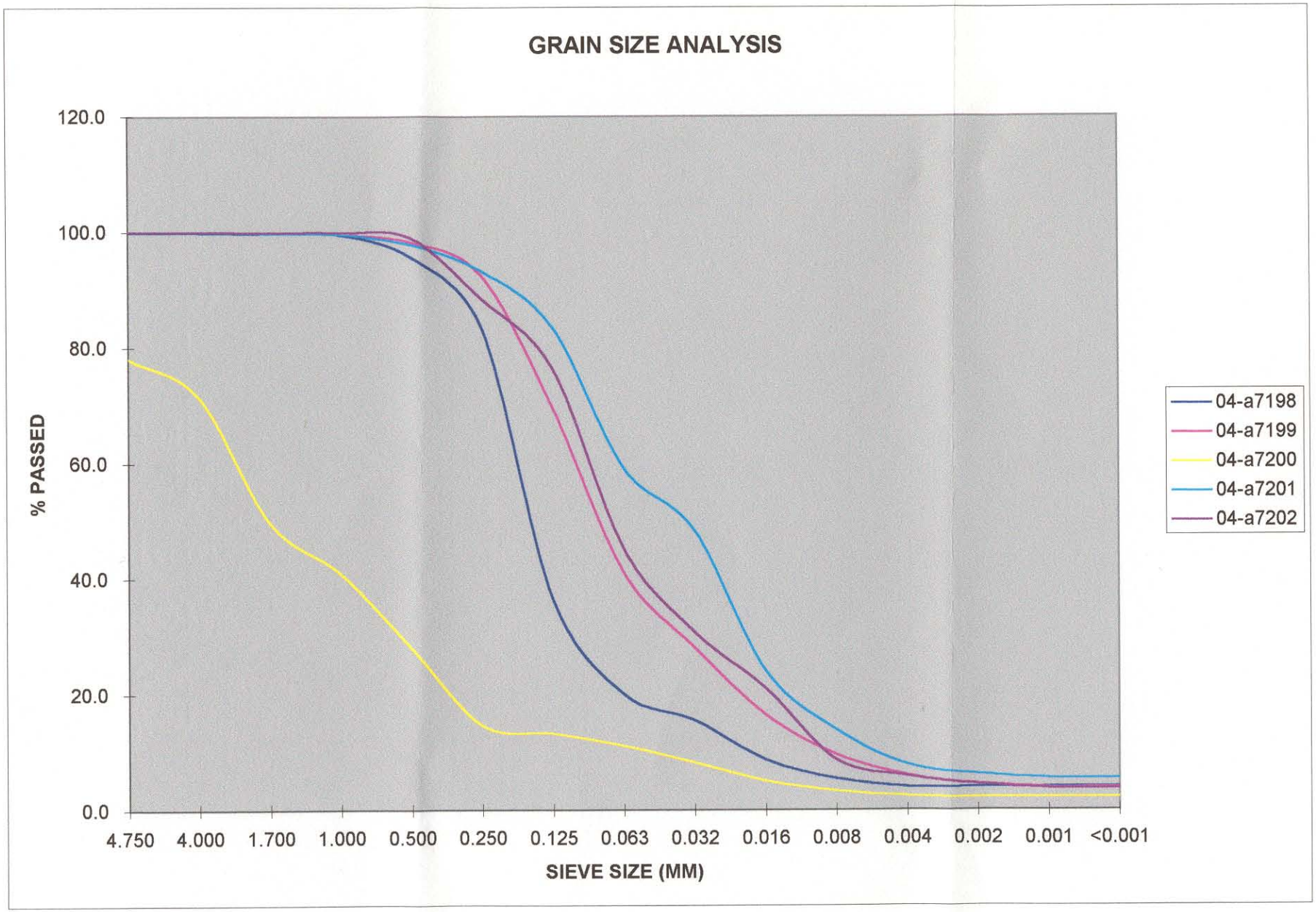
AM TEST ID 04-A007198
CLIENT ID 1-1 TRANSECT 1 WEST

MATRIX : Soil
SAMPLED: 6/ 3/04

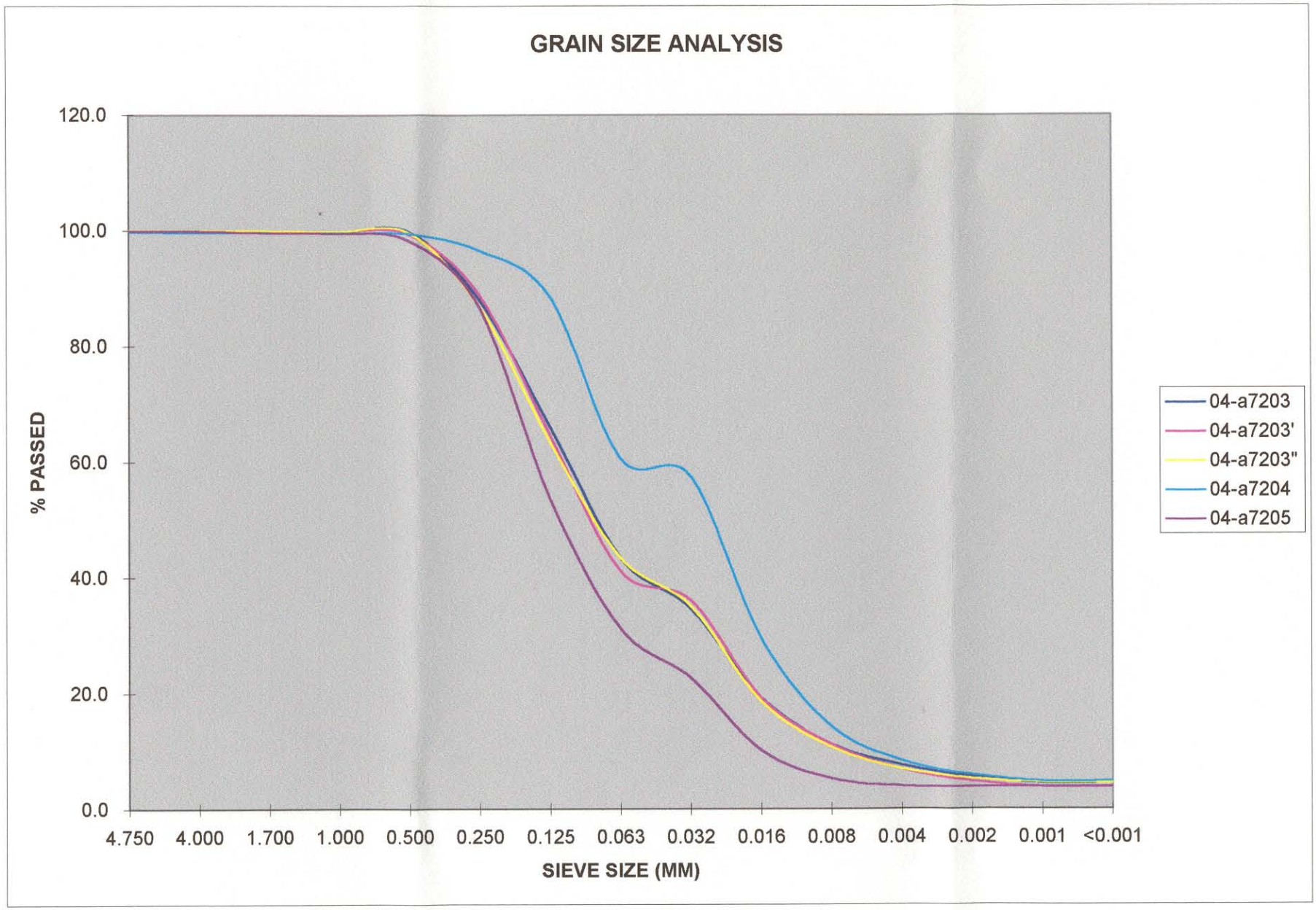
ANALYTE	UNITS	METHOD NUMBER	METHOD REFERENCE	DETECTION LIMIT *	DATE OF ANALYSIS
Grain Size	% Retained	D422	ASTM	0.10	6/10/04
Total Solids	%	p17	PSEP	0.01	6/ 9/04
Total Volatile Solids	%	p20	PSEP	0.01	6/10/04

SM = Standard Methods for the Examination of Water and Wastewater 18th ed.
SW-846 = Test Methods for Evaluating Solid Waste Physical/Chemical Methods
EPA = Methods for Chemical Analysis of Water and Wastes 1983
* Instrument Detection Limit

AMTEST


GRAIN SIZE ANALYSIS
120.0
100.0
80.0
60.0
40.0
20.0
0.0
% PASSED
4.750
4.000
1.700
1.000
0.500
0.250
0.125
0.063
0.032
0.016
0.008
0.004
0.002
0.001
<0.001
SIEVE SIZE (MM)
04-a7198
04-a7199
04-a7200
04-a7201
04-a7202

AMTEST


GRAIN SIZE ANALYSIS
120.0
100.0
80.0
60.0
40.0
20.0
0.0
% PASSED
4.750
4.000
1.700
1.000
0.500
0.250
0.125
0.063
0.032
0.016
0.008
0.004
0.002
0.001
<0.001
SIEVE SIZE (MM)
04-a7203
04-a7203'
04-a7203"
04-a7204
04-a7205

GRAIN SIZE SAMPLES
CHAIN OF CUSTODY FORMS

Grette Associates

151 S. Worthen St. Wenatachee, WA 98801 / 509-663-6300 2111 North 30th Tacoma, WA 98403 / 253-573-9300

Project: Sitcum Waterway Remediation Project / Milwaukke Habitat Area **Client:** Port of Tacoma

Number: 120.002.400 **Samplers:** Haas

	Sample Number	Sample Type				# and Preservatives				Date	Time	Analysis
		Sediment	Water	Tissue	Other*	HCL	NAOH	ETOH	OTHER	MO/DA		
7198	1-1 (Transect 1 West)	X								6/3/2004		ASTM D-422
99	1-2 (Transect 1 East)	X								6/3/2004		ASTM D-422
7200	2-1 (Transect 2 West)	X								6/3/2004		ASTM D-422
01	2-2 (Transect 2 East)	X								6/3/2004		ASTM D-422
02	3-1 (Transect 3 West)	X								6/3/2004		ASTM D-422
03	3-2 (Transect 3 East)	X								6/3/2004		ASTM D-422
04	4-1 (Transect 4 West)	X								6/3/2004		ASTM D-422
05	4-2 (Transect 4 East)	X								6/3/2004		ASTM D-422
	Totals:	8										

Container(s): 8 Ziploc Bags

Airbill #N/A

Custody Tracking

Relinquished	Date/Time	Received	Date/Time	Intact?
Grette	1510	[illegible]	6/4/04	[illegible]

Quality Control

Recorder _____

Checked by _____

UPLAND VEGETATION
DATA SHEETS

Port of Tacoma
Upland Vegetation Field Form

Weather: Sunny
Plot: West Side

Date: 8-10-04
Recorder: LLL
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
	Willow	Good	40		Shrub
1	Rose	Good	40		Shrub
	Snowberry	Good	10		Shrub
	Grass	Good	10		Herb
	Fireweed	Good	2		Herb
	Curled Dock	Good	1		Herb
	Plantain	Good	1		Herb
	Blackberry	Good	2		Vine Inv
2	Canadian Thistle	Good	1		Herb Inv
	St John's wort	Good	2		Herb Inv
2	Pacific Madrone	Good	2		Tree
	Pearly Everlasting	Good	1		Herb
	Grass	Good	15		Herb
	St. John's wort	Good	1		Herb Inv
	Rose	Good	100		Shrub
	Shore pine	Good	5		Tree
3	Shore Pine	Good	5		Tree
	Butterfly Bush	Good	25		Shrub
	Red alder	Good	50		Tree
	Rose	Good	50		Shrub
	Vine Maple	Good	2		Shrub
	Snowberry	Good	2		Shrub
	Pearly Everlasting	Good	5		Herb

Layers: Herb Shrub Vine Tree
Vigor Classes: Dead Poor Good Excellent Dormant
Notes:

Port of Tacoma
Upland Vegetation Field Form

Weather: Sunny
Date: 8-10-04
Recorder: LLL
Plot: West Side
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
(3)	Grass	Good	25		Herb
	Blackberry	Good	5		Vine Inv
	St John's Wort	Good	2		Herb Inv
(4)	Douglas fir	Good	10		Tree
	Snowberry	Good	30		Shrub
	Rose	Good	40		Shrub
	Butterfly Bush	Good	15		Shrub
	Salmonberry	Good	10		Shrub
	Grass	Good	75		Herb
	Kinnickinnick	Good	20		Herb
	Blackberry	Good	5		Vine Inv
	St. John's Wort	Good	2		Herb Inv
(5)	Rose	Good	30		Shrub
	Shore Pine	Good	15		Tree
	Salmonberry	Good	5		Shrub
	Red Alder	Good	5		Tree
	Snowberry	Good	10		Shrub
	Oregon Grape	Good	5		Shrub
	Grass	Good	90		Herb
	Blackberry	Good	20		Vine Inv
	St. John's wort	Good	5		Herb Inv
(6)	Shore Pine	Good	25		Tree
	Rose	Good	80		Shrub

Layers: Herb Shrub Vine Tree
Vigor Classes: Dead Poor Good Excellent Dormant
Notes:

Port of Tacoma
Upland Vegetation Field Form

Weather: Sunny
Date: 8-10-04
Recorder: LLL
Plot: West
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
6	Vine Maple	Good	5		Shrub
	Grass	Good	15		Herb
	St John's wort	Good	2		Herb Inv
7	Rose	Good	65		Shrub
	Red alder	Good	10		Tree
	Shore Pine	Good	15		Tree
	Snowberry	Good	5		Shrub
	Oregon Grape	Good	2		Shrub
	Butterfly Bush	Good	10		Shrub
	Grass	Good	40		Herb
	Kinnickinnick	Good	5		Herb
	Blackberry	Good	2		Herb Inv
8	Willow	Good	70		Shrub
	Snowberry	Good	40		Shrub
	Red alder	Good	40		Tree
	California wax myrtle	Good	15		Shrub
	Kinnickinnick	Good	5		Herb
	Pearly Everlasting	Good	2		Herb
	Grass	Good	15		Herb
	Blackberry	Good	5		Vine Inv
	Canadian Thistle	Good	1		Herb Inv
9	Blackberry	Good	1		Vine Inv
	Grass	Good	95		Herb

Layers: Herb Shrub Vine Tree
Vigor Classes: Dead Poor Good Excellent Dormant
Notes:

Port of Tacoma
Upland Vegetation Field Form

Weather: Sunny
Date: 8-10-04
Recorder: LLL
Plot: West Side
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
9	Plantain	Good	5		Herb
	Pearly Everlasting	Good	1		Herb
	Pac. Madrone	Good	20		Tree
	Rose	Good	20		Shrub
	Willow	Good	40		Shrub
	Douglas fir	Good	5		Tree
10	Rose	Good	15		Shrub
	Shore Pine	Good	5		Tree
	Willow	Good	2		Shrub
	Douglas Fir	Good	5		Tree
	Grass	Good	95		Herb
	Blackberry	Good	2		Vine Inv
	St. John's wort	Good	1		Herb Inv
11	Willow	Good	25		Shrub
	Butterfly Bush	Good	5		Shrub
	Grass	Good	100		Herb
	Plantain	Good	2		Herb
	Blackberry	Good	1		Vine Inv
	St. John's wort	Good	2		Herb Inv
	Can. Thistle	Good	10		Herb Inv
12	Fireweed	Good	5		Herb
	Grass	Good	15		Herb
	Blackberry	Good	70		Vine Inv

Layers:	Herb	Shrub	Vine	Tree	
Vigor Classes:	Dead	Poor	Good	Excellent	Dormant

Notes:

Port of Tacoma
Upland Vegetation Field Form

Weather: Sunny
Date: 8-10-04
Recorder: LLL
Plot: West / East
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
12	Douglas fir	Good	35		Tree
	Butterfly Bush	Good	30		Shrub
	Rose	Good	5		Shrub
	Shore Pine	Good	15		Tree
13	Red Alder	Good	15		Tree
	Butterfly Bush	Good	10		Shrub
	Vine Maple	Good	5		Shrub
	Douglas fir	Good	10		Tree
	Grass	Good	100		Herb
	Plantain	Good	1		Herb
	Curled Dock	Good	1		Herb
	Blackberry	Good	10		Vine Inv
	St. Johns Wort	Good	<1		Herb Inv
	Can Thistle	Good	<1		Herb Inv
14	Red Alder	Good	10		Tree
	Shore Pine	Good	25		Tree
	Rose	Good	30		Shrub
	Willow	Good	10		Shrub
	Grass	Good	85		Herb
	Tansy Ragwort	Good	15		Herb Inv
	Blackberry	Good	10		Vine Inv
15	Blackberry	Good	5		Vine Inv
	Purple loosestrife	Good	2		Herb Inv

Layers:	Herb	Shrub	Vine	Tree	
Vigor Classes:	Dead	Poor	Good	Excellent	Dormant

Notes:

Port of Tacoma
Upland Vegetation Field Form

Date: 8-10-04
Weather: Sunny
Recorder: LLL
Plot: East Side
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
15	Rose	Good	5		Shrub
	Snowberry	Good	15		Shrub
	Willow	Good	40		Shrub
	Shore Pine	Good	50		Tree
	Salal	Good	20		Shrub
	Grass	Good	60		Herb
16	Red Alder	Good	10		Tree
	Douglas fir	Good	15		Tree
	Shore Pine	Good	20		Tree
	Willow	Good	30		Shrub
	Vine Maple	Good	2		Shrub
	Lupin	Good	10		Herb
	Grass	Good	95		Herb
	Curled Dock	Good	<1		Herb
	Blackberry	Good	15		Vine Inv
17	Snowberry	Good	5		Shrub
	Shore Pine	Good	20		Tree
	Pac. Madrone	Good	15		Tree
	Bitter cherry	Good	2		Tree
	Willow	Good	20		Shrub
	Red Alder	Good	5		Tree
	Blackberry	Good	2		Vine Inv
	Purple loosestrife	Good	<1		Herb Inv

Layers:	Herb	Shrub	Vine	Tree	
Vigor Classes:	Dead	Poor	Good	Excellent	Dormant

Notes:

Port of Tacoma
Upland Vegetation Field Form

Weather: Sunny
Date: 8-10-04
Recorder: LLL
Plot: East side
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
17	Grass	Good	90		Herb
	Plantain	Good	<1		Herb
	Kinnickinnick	Good	15		Herb
18	Rose	Good	45		Shrub
	Salal	Good	10		Shrub
	Snowberry	Good	2		Shrub
	Shore pine	Good	20		Tree
	Willow	Good	20		Shrub
	Grass	Good	1		Herb
	Plantain	Good	85		Herb
	Blackberry	Good	10		Vine Inv
19	Snowberry		2		Shrub
	Red alder		5		Tree
	Rose		20		Shrub
	Willow		15		Shrub
	Shore Pine		30		Tree
	Cottonwood, Black		5		Tree
	Common Vetch		30		Herb
	Lupin		5		Herb
	Grass		60		Herb
	Tansy Ragwort		<1		Herb Inv
	Blackberry		2		Vine Inv

Layers: Herb Shrub Vine Tree
Vigor Classes: Dead Poor Good Excellent Dormant
Notes:

Port of Tacoma
Upland Vegetation Field Form

Weather: Sunny
Date: 8-10-04
Recorder: LLL
Plot: East Side
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
20	Salal	Good	25		Shrub
	Salmonberry	Good	10		Shrub
	Red Alder	Good	15		Tree
	Willow	Good	30		Shrub
	Douglas fir	Good	20		Tree
	Snowberry	Good	1		Shrub
	Red-osier Dogwood	Good	10		Shrub
	Plantain	Good	1		Herb
	Grass	Good	50		Herb
	Blackberry	Good	5		Vine Inv
	Purple loosestrife	Good	2		Herb Inv
	Can. Thistle	Good	1		Herb Inv
21	Rose	Good	80		Shrub
	Willow	Good	10		Shrub
	Douglas fir	Good	15		Tree
	Butterfly Bush	Good	5		Shrub
	Grass	Good	5		Herb
	Blackberry	Good	1		Vine Inv
22	Grass	Good	45		Herb
	Plantain	Good	<1		Herb
	Common Vetch	Good	<1		Herb
	Scotch Broom	Good	1		Shrub Inv

Layers:	Herb	Shrub	Vine	Tree	
Vigor Classes:	Dead	Poor	Good	Excellent	Dormant

Notes:

Port of Tacoma
Upland Vegetation Field Form

Date: 8-10-04
Weather: Sunny
Recorder: LLL
Plot: East side
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
22	Red Alder	Good	2		Tree
	Rose	Good	60		Shrub
	Salal	Good	30		Shrub
	Snowberry	Good	10		Shrub
	Pac. Madrone	Good	2		Tree
	Willow	Good	5		Shrub
	Vine Maple	Good	1		Shrub
	Douglas fir	Good	2		Tree
23	Red alder	Good	10		Tree
	Shore Pine	Good	15		Tree
	Willow	Good	30		Shrub
	Salmonberry	Good	1		Shrub
	Pac. Madrone	Good	2		Tree
	Sitka Spruce	Good	10		Tree
	Grass	Good	75		Herb
	Lupin	Good	20		Herb
	Plantain	Good	1		Herb
	Blackberry	Good	5		Vine Inv
24	California Wax Myrtle	Good	20		Shrub
	Douglas fir	Good	50		Tree
	Red Alder	Good	20		Tree
	Willow	Good	20		Shrub
	Pac. Madrone	Good	2		Tree

Layers: Herb Shrub Vine Tree
Vigor Classes: Dead Poor Good Excellent Dormant
Notes:

Port of Tacoma
Upland Vegetation Field Form

Weather: Sunny
Plot: East Side

Date: 8-10-04
Recorder: LL
Time:

Percent Coverage:

	Species	Vigor	Cover	Comment	Layer
24	Grass	Good	45		Herb
	Lupin	Good	2		Herb
	Blackberry	Good	5		Vine Inv
25	Sitka spruce	Good	15		Tree
	Red alder	Good	10		Tree
	Shore Pine	Good	55		Tree
	Snowberry	Good	1		Shrub
	Rose	Good	35		Shrub
	Plantain	Good	2		Herb
	Grass	Good	50		Herb
	Lupin	Good	1		Herb
	Scots Broom	Good	1		Shrub Inv
	Blackberry	Good	1		Vine Inv

Layers:	Herb	Shrub	Vine	Tree	
Vigor Classes:	Dead	Poor	Good	Excellent	Dormant

Notes:

Milwaukee Willow Coverage Monitoring

Date: 8/10/04
Elevation: ~+16ft MLLW
West / East West
Samplers: LLL

	Transect Length	Willow Coverage	Percent Coverage
	300 ft	156 ft	52
	300 ft	131 ft	44
	183 ft	106 ft	58
Total	783	393	50%

Date: 8/10/04
Elevation: ~+16ft MLLW
West / East East
Samplers: LLL

	Transect Length	Willow Coverage	Percent Coverage
	300 ft	75	25
	300 ft	64	21
	74 ft	30	41
Total	674		25%

UPLAND VEGETATION
PERFROMANCE CURVES

Woody Plant Survival

	1996	1998	2000	2002	2004
Maximum within sampling plots	100	100	100	100	100
Minimum within sampling plots	50	75	60	67	92
Mean	91	94	87	95	99.5

Tree and Shrub Coverage

	1996	1998	2000	2002	2004
Maximum within sampling plots	100	100	100	100	100
Minimum within sampling plots	10	70	3	37	27
Mean within sampling plots	49	98	72	84	83.5

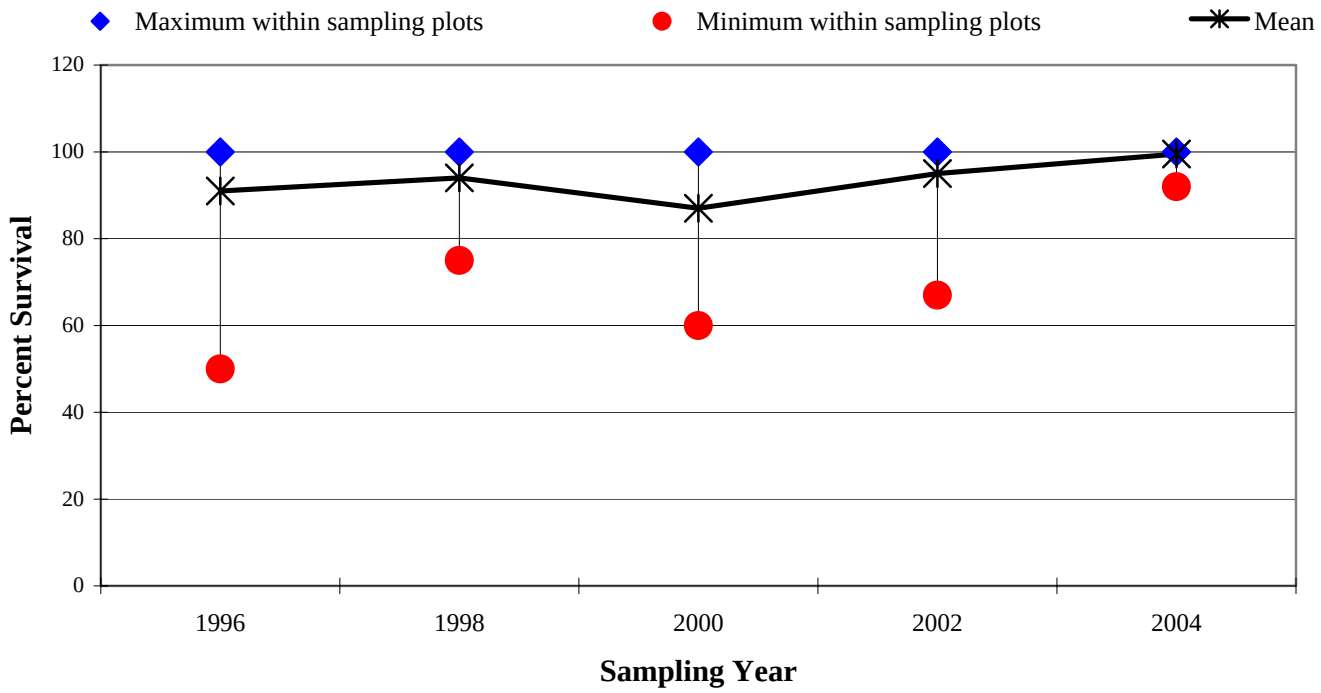
Total Vegetation Coverage

	1996	1998	2000	2002	2004
Maximum within sampling plots	100	100	100	100	100
Minimum within sampling plots	65	100	69	100	100
Mean	89	100	99	100	100

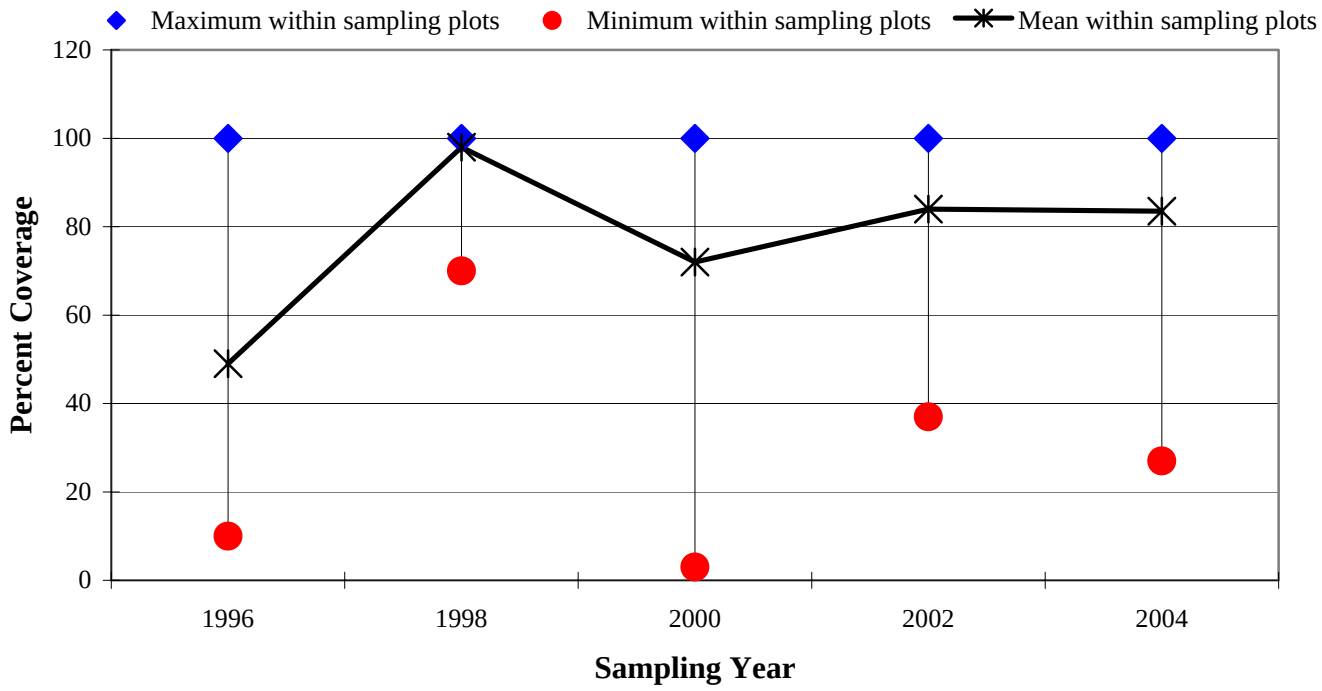
Invasive Species Coverage

	1996	1998	2000	2002	2004
Performance Standard	20	20	20	20	20
Maximum within sampling plots	15	75	55	40	70
Minimum within sampling plots	0	0	1	0	1
Mean	2	22	19	15	9.6

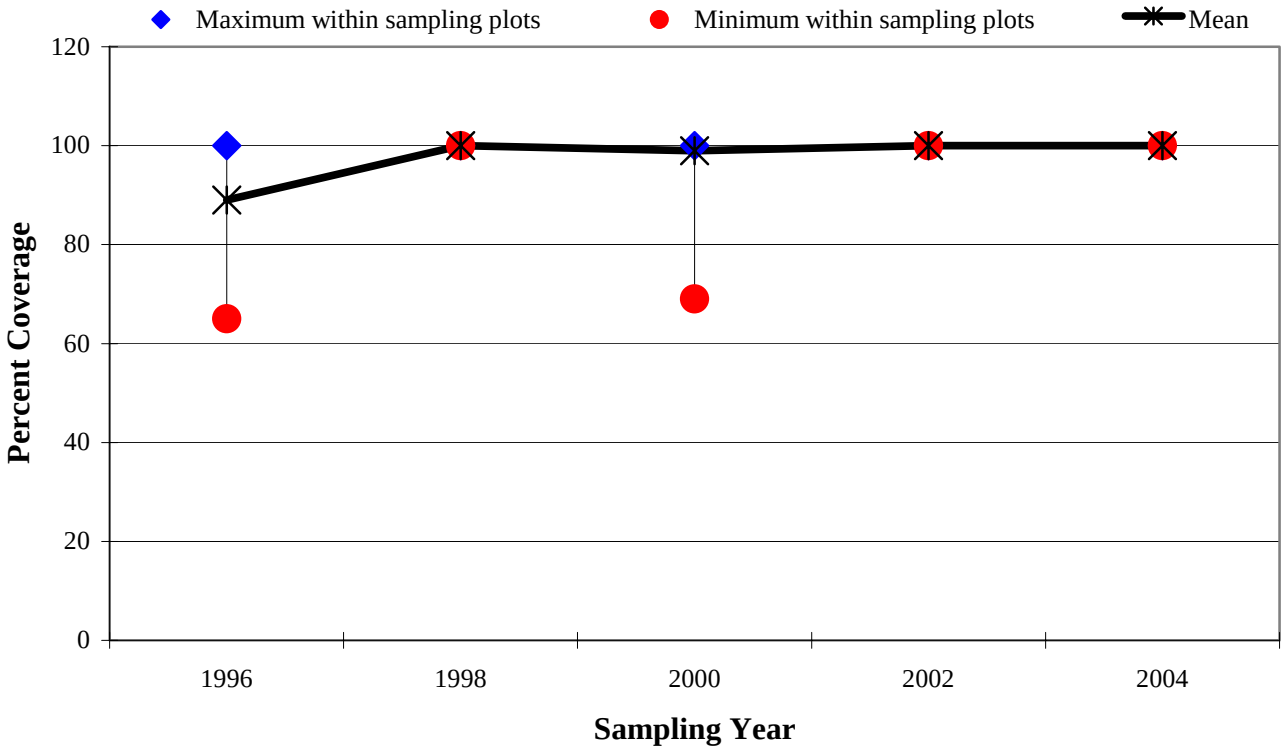
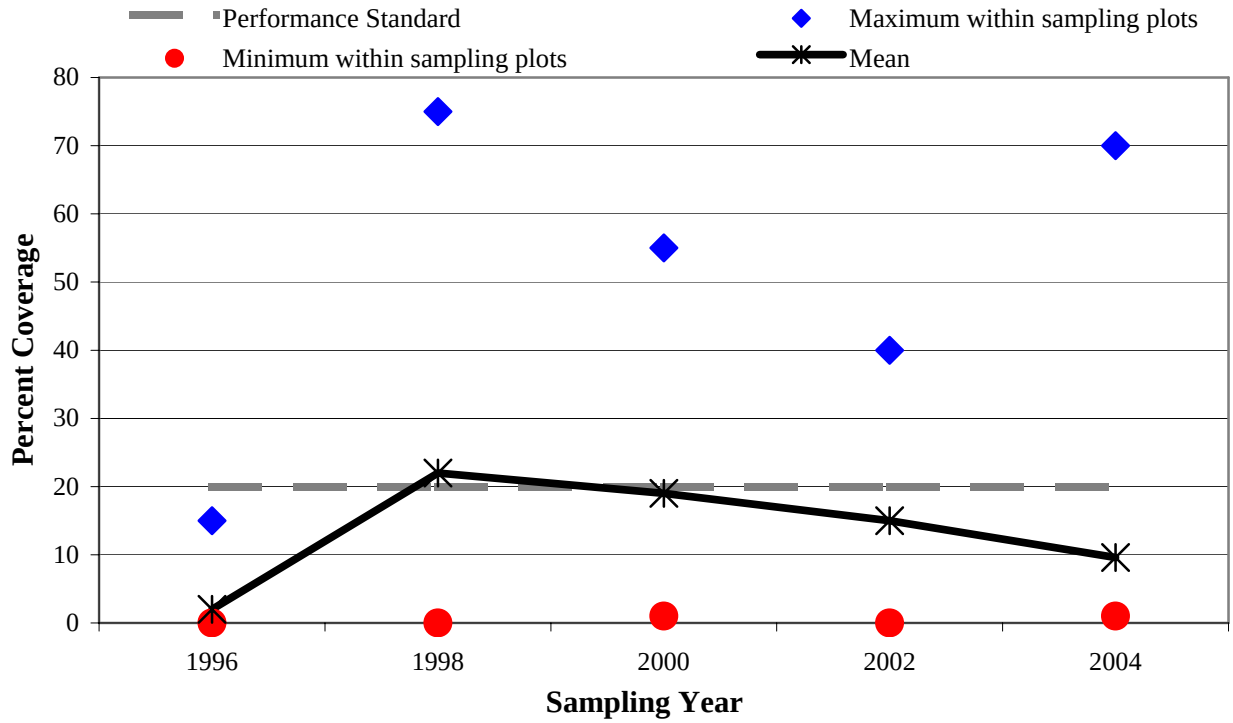
Average Woody Plant Survival on the East and West Sides of the Milwaukee Habitat Area, from Mointoring Efforts between 1996 and 2004.



Average Tree and Shrub Coverage on the East and West Sides of the Milwaukee Habitat, from Monitoring Efforts between 1996 and 2004.



Average Total Vegetation Coverage on the East and West Sides of the MIlwaukee Habitat Area, from Monitoring Efforts between 1996 and 2004.



Average Invasive Species Coverage on the East and West Sides of the Milwaukee Habitat Area, from Monitoring Efforts between 1996 and 2004.