FINAL

Appendix I
Vegetation Observations

1 Introduction

A visual inspection of shoreline vegetation along the upper reach of the Lower Duwamish Waterway was conducted by boat on June 20 and July 1, 2021, as part of the Phase II Pre-Design Investigation (PDI). This inspection built on the information collected during the PDI Phase I visual bank inspection but focused on areas where remediation is anticipated to occur. The inspection included the collection of photographs and detailed observations to document shoreline vegetation within the Phase I remedial action level (RAL) exceedance areas along the upper reach. During the planning phase of the program, periods of predicted daytime moderately low tides (i.e., low enough to observe bank conditions while still being accessible by boat) were identified as potential survey dates, and actual inspection dates were selected based on forecasted weather conditions and team availability.

This appendix provides focused information related to vegetation that may be disturbed during remedial action. Methods to collect this information are detailed in the PDI Quality Assurance Project Plan (QAPP) (Windward and Anchor QEA 2020).

1.1 Vegetation Observation and Photos

Abbreviated terms for species of trees, shrubs, and grass/herbaceous communities observed are defined in Tables I-1 and I-2. At each Phase I RAL exceedance area, photographs were taken and observations were recorded to document vegetation types. Typically, observations were made for the top of bank, middle of bank, and toe of bank. Along the east bank near river mile 3.8, four distinct shoreline conditions were observed, so the photographs and observations were split into four different subarea groups: RM 3.8E-a, RM 3.8E-b, RM 3.8W-c, and RM 3.8W-d. Along the east bank near river mile 4.9, four distinct shoreline conditions were observed, so photographs and observations were split into four subarea groups: RM 4.9E-a, RM 4.9E-b, RM 4.9E-c, and RM 4.9E-d. The vegetation types and shorelines are detailed in Table I-3. Representative photographs for each segment are included in Attachment I-1.

Table I-1
Plant Community Definitions

Plant Community[1,2]	Species[3]	Notes
Trees		
T1	ALRU, POBA, PONI, SABA	Dominated by native, typically overbank zone
T2	ALRU, ARME, PONI, POTR	Dominated by native, typically overbank zone
T3	ALRU, ARME, PIMO, POBA, POTR, PSME, THPL	Dominated by native, typically overbank zone
T4	PSME	Landscaping plantings
Shrubs		
S1	BUDA, RUAR	Dominated by non-native species
S2	BUDA, POCU, RUAR	Dominated by non-native species
S3	BUDA, HEHE, RUAR	Dominated by non-native species
S4	BUDA, CYSC, RUAR	Dominated by non-native species
S5	HODI, RONU, SARA	Dominated by native species, mitigation plantings
Grass, Ferns, Herbaceous		
GH1	ACMI, BRRA, CIAR, COAR, EQAR, FERU, HOLA, HYRA, LOCO, PLLA, SOAS, TAOF, TAVU	Dominated by non-native, typically includes a variety of these species
GH2	IRPS, JUEF, PHCO, SCAC	Wetland species, typically at or below OHWM
GH3	IRPS, JUEF, SCAC	Wetland species, typically at or below OHWM
GH4	DECE, PHAR	

Notes:
1. Plant community categories represent typically present and dominant species.
2. Categories are not intended to provide a comprehensive list of all species present.
3. Species codes are defined in Table I-2.
OHWM: ordinary high water mark

Table I-2
Species Codes

Species Name	Common Name	Native/ Non-Native	Code
Trees			
Alnus rubra	Red alder	Native	ALRU
Acer macrophyllum	Big-leaf maple	Native	ACMA
Arbutus menziesii	Madrone	Native	ARME
Betula papyrifera	Paper birch	Native	BEPA
Crataegus douglasii	Douglas' hawthorn	Native	CRDO
Cupressus leylandii	**Leyland cypress**	**Non-native**	**CULE**
Fraxinus latifolia	Oregon ash	Native	FRLA
Malus pumila	Cultivated apple	Non-native	MAPU
Pinus contorta	Shore pine	Native	PICO
Pinus monticola	Western white pine	Native	PIMO
Populus balsamiera syn. trichocarpa	Black cottonwood	Native	POBA
Populus nigra	Lombardy poplar	Native	PONI
Prunus domestica	Domestic plum	Native	PRDO
Pseudotsuga menziesii	Douglas fir	Native	PSME
Quercus rubra	Red oak	Native	QURU
Salix babylonica	Weeping willow	Native	SABA
Salix scouleriana	Scouler willow	Native	SASC
Thuja plicata	Western red cedar	Native	THGPL
Shrubs			
Buddleia davidii	Butterflybush	Non-native	BUDA
Cornus sercia	**Red-twigged dogwood**	**Native**	**COSI**
Cytisus scoparius	Scotch broom	Non-native	CYSC
Hedera helix	English ivy	Non-native	HEHE
Holodiscus discolor	Oceanspray	Native	HODI
Polygonum cuspidatum	Japanese knotweed	Non-native	POCU
Rosa nutkana	Nootka rose	Native	RONU
Rubus armeniacus	Himalayan blackberry	Non-native	RUAR
Prunus laurocerasus	European laurel	Non-native	PRLA
Rubus ursinus	Trailing blackberry	Native	RUUR
Sambucus racemosa	Red elderberry	Native	SARA
Grass, Ferns, Herbaceous			
Achillea millefolium	Yarrow	Native	ACMI
Alisma plantago-aquatica	**American water-plantain**	**Native**	**ALPL**
Brassica rapa	Common mustard	Non-native	BRRA
Bromus tectorum	Cheat grass	Non-native	BRTE
Carex lyngbii	**Lyngbi sedge**	**Native**	**CALY**
Cirsium arvense	Canada thistle	Non-native	CIAR
Convolvulus arvensis	Field bindweed	Non-native	COAR
Deschampsia cespitosa	Tufted hairgrass	Native	DECE
Digitalis purpurea	Foxglove	Non-native	DIPU
Equisetum arvense	Field horsetail	Native	EQAR
Festuca rubra	Red fescue	Non-native	FERU
Holcus lanatus	Velvet grass	Non-native	HOLA
Hypericum perforatum	**St. John's-wort**	**Non-native**	**HYPE**

Species Name	Common Name	Native/ Non-Native	Code
Hypochaeris radicata	Hairy cat's-ear	Non-native	HYRA
Iris pseudoacorus	Yellow-flag iris	Non-native	IRPS
Juncus effusus	Soft rush	Non-native	JUEF
Lactuca serriola	**Prickly lettuce**	**Non-native**	**LASE**
Lapsana communis	**Nipplewort**	**Non-native**	**LACO**
Lepidium latifolium	**Perennial pepperweed**	**Non-native**	**LELA**
Lotus corniculatus	Birds-foot trefoil	Non-native	LOCO
Phalaris arundinacea	Reed canarygrass	Non-native	PHAR
Phragmites communis	Reed	Non-native	PHCO
Plantago lanceolata	Narrow-leaved plantain	Non-native	PLLA
Polystichum munitum	Swordfern	Native	POMU
Potentilla palustris	**Marsh cinquefoil**	**Native**	**POPA**
Pteridium aquilinum	Bracken fern	Native	PTAQ
Ranunculus repens	Creeping buttercup	Non-native	RARE
Rumex crispus	Curly dock	Native	RUCR
Schoenoplectus acutus	Hardstem bulrush	Native	SCAC
Sonchus asper	Prickly lettuce	Non-native	SOAS
Symphyotrichum lanceolatum	**Panicled aster**	**Native**	**SYLA**
Tanacetum vulgare	Common tansy	Non-native	TAVU
Taraxacum officinale	Common dandelion	Non-native	TAOF

Notes:
Bolded items are new observations made in 2021.

Table I-3
Phase II Vegetation Data

River Mile[1]	Location Along Bank	Substrate/ Structure	Species	%	Notes
3.5W	Top of bank	Chain link fence above ecology block wall	ACMA	5	Sparse vegetation due to ecology block wall and riprap
			HYPE	1	
			RUAR	1	
			LASE	1	
			LACO	1	
	Middle of bank	Ecology block wall	-	-	No vegetation
	Toe of bank	Medium rip rap	LELA	5	Algal mat and barnacles on subtidal riprap. Small woody debris at high tide line
			RUOC	1	
			SYLA	5	
3.8E-a	Top of Bank	Sheetpile wall	BUDA	75	Vegetation only at top of wall extending east 50 ft to staging area
			RUAR	15	
			POBA	5	
			HYPE	5	
	Middle of bank	Sheetpile wall	-	-	No vegetation
	Toe of bank	Sheetpile wall	-	-	No vegetation

River Mile[1]	Location Along Bank	Substrate/ Structure	Species	%	Notes
3.8E-b	Top of bank	Sheetpile wall	BUDA	5	Sparse vegetation
	Middle of bank	Sheetpile wall	-	-	No vegetation
	Toe of bank	Gravel and fines	-	-	No vegetation
3.8E-c	Top of bank	Eroded wooden bulkhead with layers of fill and soil	BUDA	60	Vertical slope of eroding fill
			RUAR	10	
			RULA	10	
			ARME	5	
	Middle of bank	Eroded fill from top of bank, 45% of the slope	RUAR	45	Middle of bank held in place by downslope eroded bulkhead
			LELA	5	
			BUDA	5	
			POPA	5	
			FRLA	5	
	Toe of bank	Rock, gravel, and fines	SYLA	5	Aster growing within bulkhead piles
3.8E-d	Top of bank	Sheetpile wall	BUDA	50	Vegetated top of bank is only 5 to 10 ft deep
			RUAR	40	
			BEPA	5	
			POBA	5	
	Middle of bank	Sheetpile wall	-	-	No vegetation
	Toe of bank	Rock, gravel, and fines	-	-	No vegetation
3.9E	Top of bank	Sheetpile wall	BUDA	90	Vegetated top of bank is only 5 to 10 ft deep
			RUAR	10	
	Middle to bank	Sheetpile wall	-	-	No vegetation
	Toe of bank	Rock, gravel, and fines	-	-	No vegetation
4.0E	Top of bank	Medium riprap	RUAR	75	Vegetated top of bank is only 5 to 10 ft deep
			BUDA	24	
	Middle of bank	Medium riprap	RUAR	50	Dense shrubs
			BUDA	40	
			LELA	10	
	Toe of bank	Riprap	-	-	Algal mat on riprap

River Mile[1]	Location Along Bank	Substrate/ Structure	Species	%	Notes
4.1E	Top of bank	Riprap, concrete debris, and fill	BUDA	45	Vegetated layer extends east 20 to 30 ft from top of bank. There is a canopy, shrub, and herb layer.
			FRLA	5	
			POBA	5	
			CULE	5	
			RUAR	10	
			RULA	5	
			HEHE	10	
			HYPE	5	
			PONI	10	
	Middle of bank	Riprap, concrete debris, and fill	RUAR	30	Mix of riprap and debris
			RULA	20	
			PONI	5	
			FRLA	5	
			LELA	5	
			LASE	5	
			BUDA	30	
	Toe of bank	Loose riprap, rock, gravel, sands, and fines	RUOC	10	Substrate is mix of fill and fines (50/50)
			IRPS	5	
			ALPL	5	
			POPA	5	
			SYLA	5	
4.2E (Slip 6)	Top of bank	Elevated pier	-	-	No vegetation
	Middle of bank	Open	-	-	No vegetation
	Toe of bank	Deepwater	-	-	No vegetation
4.6E	Top of bank	Parking lot bulkhead, riprap, and concrete slabs	BUDA	80	Very dense vegetation
			RUAR	20	
	Middle of bank	Riprap with 40%	BUDA	100	Very dense vegetation
	Toe of bank	Rock, gravel, and fines	-	-	No vegetation
4.7W	Top of bank	Native substrate	ALRU	40	Native substrate and vegetation
			BEPA	20	
			SASC	15	
			HOBI	10	
			PHAR	10	
			COSI	5	
	Middle of bank	Gravel, sand, and silt	TYLA	20	Native substrate and vegetation
			SCVA	20	
			CALY	40	
	Toe of bank	Silt	SCVA	10	Algal mat in depressions, piles in the nearshore
			CALY	10	

River Mile[1]	Location Along Bank	Substrate/ Structure	Species	%	Notes
4.8W	Top of bank	Native substrate	ALRU	20	Native substrate and vegetation
			BEPA	20	
			SASC	10	
			HODI	5	
			PHAR	40	
			COSI	5	
	Middle of bank	Gravel, sand, and silt	TYLA	5	Native substrate and vegetation
			PHAR	20	
			SCVA	20	
			CALY	40	
	Toe of bank	Silt	SCVA	10	Algal mat in depressions, piles in the nearshore
			CALY	10	
4.9E-a	Top of bank	75% riprap, 25% concrete blocks	PICO	5	Mix of trees and shrubs extending to paved trail
			RUAR	25	
			POTR	30	
			BUDA	20	
	Middle of bank	Some riprap with exposed soil	FRLA	10	Scattered trees and saplings
			RUAR	60	
			BUDA	20	
	Toe of bank	Piles, riprap, gravels, and fines	SYLA	10	Aster rooted in the piles
4.9E-b	Top of bank	25% riprap, 25% steep soil	PICO	20	Mix of trees and shrubs
			RUAR	25	
			POTR	50	
			FRLA	5	
	Middle of bank	Soil with rock	RUAR	50	-
	Toe of bank	Piles, riprap, gravel, and fines	SYLA	5	Aster rooted in piles, algal mat on riprap
			JUEF	5	
			IRPS	10	
			POPA	10	
4.9E-c	Top of bank	75% soil, 20% riprap, 5% piles	PSME	25	-
			ACMA	40	
			RUAR	25	
	Middle of bank	Steep exposed soil	RUAR	40	
			LELA	10	
			HYPE	10	
	Toe of bank	High tide bench with piles	IRPS	5	
			POPA	10	
			ALPL	5	
4.9E-d	Top of bank	Concrete slabs and large riprap	SALA	50	Large debris
			FRLA	50	
	Middle of bank	Concrete slab and large riprap	RUAR	20	80% bare ground
			BUDA	5	
	Toe of bank	Concrete slab and large	CALY	5	Algal mat on riprap
			SYLA	5	

Notes:
1. This represents the closest river mile to the midpoint of the Phase I RAL exceedance area. Additionally, the side of the bank (i.e., east or west) is included for reference.
RAL: remedial action level

2 References

Windward, Anchor QEA. 2020. Lower Duwamish Waterway quality assurance project plan for remedial design of Upper Reach: pre-design investigation. Final. Submitted to EPA May 19, 2020. Windward Environmental LLC and Anchor QEA, Seattle, WA.

3 Attachments

Attachment I-1 Photographs

FINAL

Attachment I-1
Photographs

Photograph I-1
Representative Vegetation Conditions at RM 3.5W

Photograph I-2
Representative Vegetation Conditions at RM 3.8E-a

Photograph I-3
Representative Vegetation Conditions at RM 3.8W-b

Photograph I-4
Representative Vegetation Conditions at RM 3.8E-c

Photograph I-5
Representative Vegetation Conditions at RM 3.8W-d

Photograph I-6
Representative Vegetation Conditions at RM 3.9E

Photograph I-7
Representative Vegetation Conditions at RM 4.0E

Photograph I-8
Representative Vegetation Conditions at RM 4.1E

Photograph I-9
Representative Vegetation Conditions at RM 4.2E

Photograph I-10
Representative Vegetation Conditions at RM 4.6E

Photograph I-11
Representative Vegetation Conditions at RM 4.7W

Photograph I-12
Representative Vegetation Conditions at RM 4.8W

Photograph I-13
Representative Vegetation Conditions at RM 4.9E-a

Photograph I-14
Representative Vegetation Conditions at RM 4.9E-b

Photograph I-15
Representative Vegetation Conditions at 4.9E-c

Photograph I-16
Representative Vegetation Conditions at RM 4.9E-d