Parametrix, Inc. *Consultants in Engineering and Environmental Sciences*

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425-822-8880 • Fax: 425-889-8808

TRANSMITTAL FORM

To: **Muffy Walker**
P.O. Box 3755 (98124-3375)
U.S. Army Corps of Engineers
4735 E. Marginal Way S.
Seattle, Washington 98134-2385

Date: **October 26, 2001**
Project Number: **556-2912-001-03**
Project Name: **STIA MPU Natural Resource Mitigation**

We are transmitting the following materials:

Responses to ACOE request for additional information.

Comments:

Attached is the information you requested of the Port over the past several weeks.

Please call if you have any questions.

These are:
- ☐ PER YOUR REQUEST
- ☒ FOR YOUR INFORMATION
- ☐ FOR YOUR REVIEW AND APPROVAL
- ☐ FOR YOUR FILES
- ☐ FOR YOUR ACTION

Sent Via:
- ☐ U.S. MAIL
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- ☐ EXPRESS OVERNIGHT
- ☐ OTHER – INTEROFFICE
- ☐ HAND DELIVERY/PICK UP

Sincerely,

Jim Kelley

Jim Kelley, Ph.D.

cc: Elizabeth Leavitt, Port of Seattle

N

BORROW AREA 2

250

325.3

250

Wetland B1
Acres 0.27

B1-B

B1-A

HPB1

Wetland B4
Acres 0.04

B4-B

B4-A

Wetland C
Acres 0.61

Wetland B11
Acres 0.18

B11-A

B11-B

250

200

200

250

Wetland B13
Acres 0.33

Estimated
Wetland B12
Acres 0.56

Wetland B12
Acres 0.07

B12

B12-A

B12-B

38

48-B

48-A

48-C

Wetland 4B
Acres 1.12

Wetland 4B
Acres 0.46

309.0

B14-B

Wetland B14
Acres 0.78

B14-A

HPB15

B15a-B

B15a-A

Wetland B15a
Acres 0.19

Wetland B15b
Acres 0.02

ind B15a
s 1.82

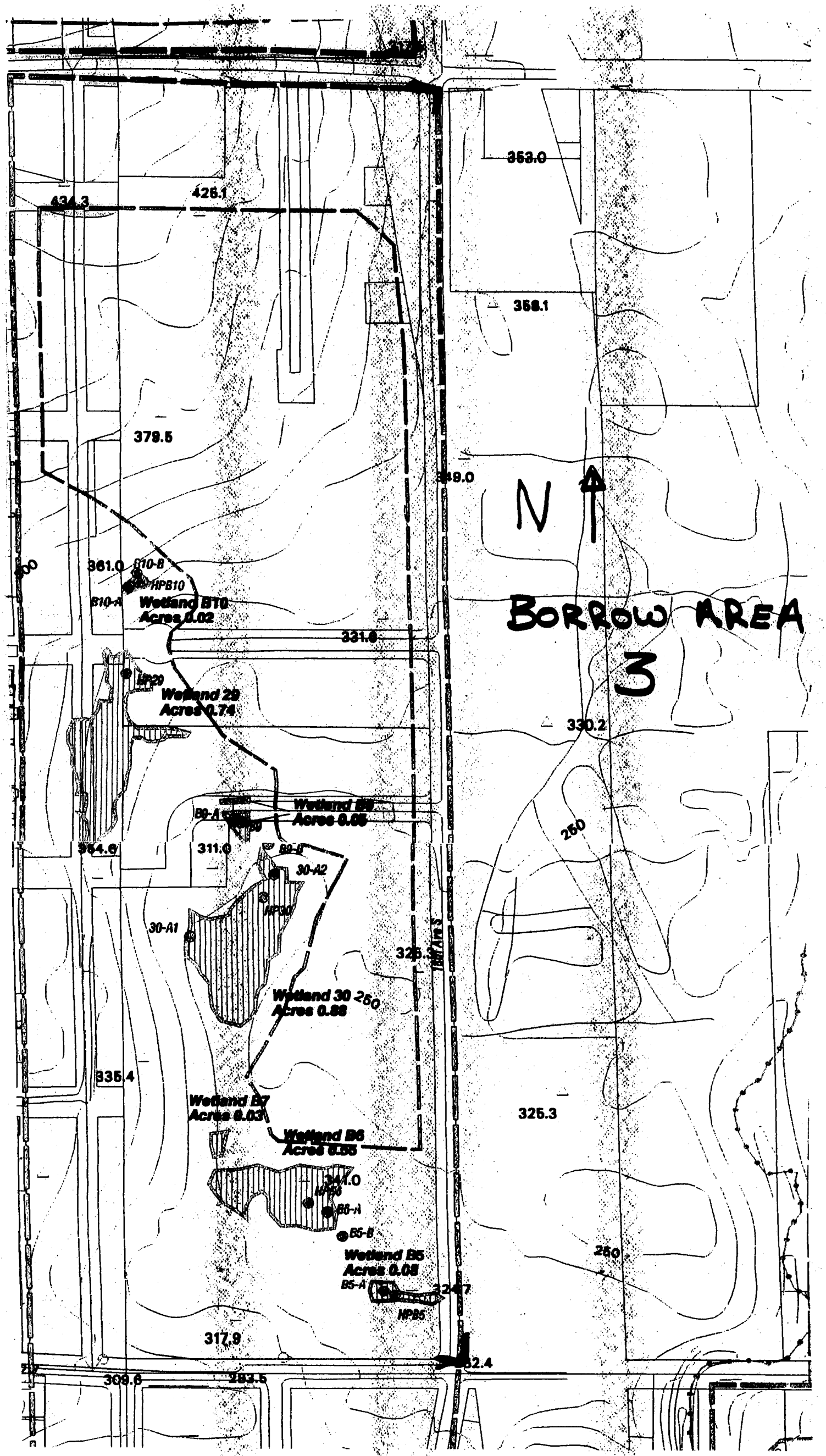
Wetland 2C
Acres 0.09

318.9

US

AR 026217


N4
BORROW
AREA I


353.0
426.1
434.3
358.1
379.5
349.0
N
361.0
B10-B
HPB10
B10-A
Wetland BT0
Acres 0.02
331.6
HP29
Wetland 29
Acres 0.74
330.2
Wetland B9
Acres 0.05
B9-A
260
364.6
311.0
B9-B
30-A2
HP30
30-A1
325.3
Wetland 30
Acres 0.88
260
335.4
Wetland B7
Acres 0.03
Wetland B6
Acres 0.55
BORROW AREA
3
325.3
B6-A
B5-B
Wetland B5
Acres 0.08
B5-A
HP85
317.9
309.6
283.5
260


N 4
BORRO 3
AREA 3

LAND USE IMPACTS

Miller	Embankment
Coniferous Forest	0.0
Deciduous Forest	55.4
Mixed Forest	6.3
Shrub	9.1
Grass	13.4
Medium Intensity Development	43.1
Low Intensity Development	73.2
High Intensity Development	2.5
Recently Cleared	2.2
Bare Ground/Asphalt/Concrete	6.5
Water	0.0
Total	**205.1**

MPU Project	Totals
Coniferous Forest	**0.4**
Deciduous Forest	**154.4**
Mixed Forest	**11.6**
Shrub	**28.2**
Grass	**46.2**
Medium Intensity Development	**72.7**
Low Intensity Development	**139.1**
High Intensity Development	**4.8**
Recently Cleared	**7.9**
Bare Ground/Asphalt/Concrete	**16.1**
Water	**0.0**
TOTAL	**481.4**

Walker	Embankment
Coniferous Forest	0
Deciduous Forest	6.1
Shrub	0.6
Grass	0.3
Low Intensity Development	9.8
Medium Intensity Development	5.8
High Intensity Development	0.4
Mixed Forest	0.3
Recently Cleared	0.0
Bare Ground/Asphalt/Concrete	0.4
Water	0.0
Total	**23.6**

Des Moines	Borrow 1	Borrow 3	Borrow 4	SASA	Sub-Total
Coniferous Forest	0.0	0.2	0.3	0.0	*0.4*
Deciduous Forest	40.0	12.9	20.0	20.2	*93.0*
Mixed Forest	1.9	2.4	0.3	0.2	*4.7*
Shrub	10.9	1.1	0.8	6.1	*18.9*
Grass	3.1	0.0	2.0	17.8	*23.0*
Medium Intensity Development	9.0	2.9	0.0	11.9	*23.7*
Low Intensity Development	24.5	0.2	6.6	34.3	*65.6*
High Intensity Development	0.0	0.0	0.0	2.0	*2.0*
Recently Cleared	0.0	0.0	5.7	0.0	*5.7*
Bare Ground/Asphalt/Concrete	0.0	0.0	0.0	9.3	*9.3*
Water	0.0	0.0	0.0	0.0	*0.0*
Total	**89.3**	**19.7**	**35.6**	**92.4**	*236.9*

Responses to Corps of Engineers' Questions – September 20, 2001

Item	Topic	Response
1, 8	Temporary Impacts to wetlands at Auburn Permanent wetland alterations at Auburn	The temporary impacts and alterations to wetlands at the Auburn mitigation site are mapped on Sheet 33 of 38 in the Public Notice – (October 25 2000). The impacts to the areas mapped are as follows: **Area 1:** The 1.55 acres of wetland are impacted from construction of the off-site temporary construction road. This road would cross reed-canary grass dominated and other and other emergent wetlands dominated by non-native grasses. The road could be in place for up to 50 months. The cross section of this road is shown on Sheet C8 of Appendix E of the NRMP. Sections 7.4.4.1 and 7.4.9.7 of the NRMP identify how the road will be removed and revegetated. **Area 2:** The 0.05 acres of wetland would be impacted from construction of the outlet channel that connects the wetland to adjacent ditch systems. Emergent wetlands dominated by non-native pasture grasses would be excavated and incorporated into the channel that drains the wetland. The bottom of the channel would contain wetland hydrology and be hydroseeded with emergent wetland grass species. The area of impact is also shown on Sheet C5 of Appendix E of the NRMP. The profile of the ditch, near the wetlands is shown on Sheet C8. The hydroseed mix for revegetation this area is given on Table 7.3-2. Of the NRMP. **Area 3:** Temporary impacts in this area (2.46 acres) result from on-site construction access roads and staging areas. These occur in emergent wetlands dominated by reed canary grass and other non-native grasses. The staging is necessary for the stock piling and mixing of topsoil, construction offices, vehicle parking, storage of plants, and other construction related activities. Much of this area would be restored to wetlands following about 30 months, but the portions used for to stage planting operations would be in place for up to 50 months. **Area 4, 5, 6, and 8** (4.06 acres): These areas of existing emergent wetland dominated by non-native pasture grasses would be excavated to create forest, shrub, and emergent wetlands. **Areas 7, 9, and 10** (0.12 acres) These areas would be permanently impacted by construction of permanent access roads to the site. The area is included in the permanent impacts of the project (see Table 3.1-3 of the NRMP).
2	Watershed Data	Approximate percent of Port owned property in the affected watersheds is as follows: Miller - 13.7% Walker - 14.5% Des Moines - 38.5% These areas are approximate, and do not include some land that is not subject to MPU improvements (north end properties, portions the golf course, property west of Des Moines Memorial Drive, or land in Green River basin).

Item	Topic	Response
3	Areas of wetland fill and excavation at Vacca Farm	Excavation of floodplain as part of mitigation would remove about 1.0 acre of peat soil. The mitigation at Vacca Farm and the Lora Lake would restore peat areas by removing inorganic fill and exposing buried peat. About 0.9 acres of buried peat would be exposed as part of grading the floodplain, and about 1 acre of buried peat would be exposed as part of restoring the shoreline of Lora Lake. I have attached a draft map illustrating this analysis. I believe that as significant as where the peat is or is not, is the ecological condition of the peat and the wetlands it supports. In this regard, the mitigation restores peat-forming processes to farmed areas that may currently experience an annual net loss of peat because oxidation rates exceed the annual contribution of plant biomass.
4	Changes in forest cover in the watersheds.	This information (also provided to Muffy last week) is attached. I have also attached copies of 1980 aerial photographs of the Borrow Site 1 and 3 that show the large amounts of residential development in the areas at that time.
5.	Impervious surface at the TRACON Facility	Approximately 4.7 acres of new impervious area is attributable to the TRACON project.
6	Miller Creek Riparian Wetlands	The designated riparian wetlands are listed in Table 3.1-4, and total about 3.41 acres. The remaining portions of Wetlands 18, 37, all wetlands in the Vacca Farm area, prior converted cropland in the Vacca Farm area and wetlands on the Nursery site are also riparian to Miller Creek. Excluding the nursery site and the new wetland areas around Lora Lake (data will be provided at a future date), the riparian wetlands in mitigation areas total 15.67 acres. All of the Miller Creek riparian wetlands on Port Property are included in mitigation projects. All of the riparian wetland acreage will be improved by the various activities described in the NRMP. Typically, these include removing existing homes, driveways, lawns, etc. from the wetlands and buffers and planting with native tree and shrub species.
7	Stormwater facilities	A table of the new stormwater facilities is attached. There are 5 vaults, 1 pond, and 2 pond/vault combination facilities in the Miller Creek basin. There is 1 pond in the Walker Creek basin. There are one pond and 4 vaults in the Des Moines Creek basin. Infiltration is used in 2 facilities in the Miller Creek basin. The potential for indirect impacts to Wetland 39 is identified and discussed in the Functional Assessment report (page 4-66 and 4-67). About 0.06 acres of potential indirect impact was identified. And modifications to the discharge orifices of Pond D have been made to supplement the ground water hydrology that would be expected to continue to support wetland hydrology. Finally, wetland monitoring is proposed, and if wetland hydrology sufficient to support the existing wetland vegetation and hydric soil conditions were not present, contingency actions would be implemented.

8	Auburn wetland modifications.	This issue is partially addressed in item 1 above. The 5.28 acres of wetland subjected to these long-term beneficial modifications refer to the emergent wetlands on the site that are graded to a new elevation and replaced with a new wetland type (shrub, forest, and emergent wetlands). Other wetlands (9.13 acres) are converted from emergent to forested wetlands without grading, but these too would be long term and beneficial changes to wetlands. The distinction between these actions was made simply to identify that grading and earthwork were to occur in portions of existing wetlands.
9	Impacts at mitigation sites	All wetlands subjected to the various mitigation activities (such as grading, planting, invasive species control, irrigation systems, soil amendments, etc.) are listed in Table 3.1-4 of the NRMP as being subjected to temporary impacts as a result of mitigation. Those that include placement of fill or substantial grading (18.85 acres) are separated from the minor enhancement activities (21.64 acres).
10	Restoration and enhancement in the Miller Creek Buffer	Removing lawns, residential development, driveways, farming, and all the other human disturbance factors from wetlands and buffers, coupled with the proposed revegetation with native plants is considered restoration. This work and the ecological lift it provides to wetlands, Miller Creek, wetland buffers, and stream buffers is substantial, and it restores key factors that drive ecosystem functions. The mitigation proposed by the Port reverses land uses and human activities that COE programs consider destructive. As a whole, this reversal is better characterized by the term "restoration" (meaning *to give back to a former or normal condition*) versus "enhancement" (meaning *to make greater; heighten, improve, augment*). The COE's criteria for wetland enhancement versus wetland restoration should not be used to diminish the ecological benefits to the 1.7 miles of creek and over 15 acres of wetland that are subject to this mitigation. I'm not aware of any COE published definitions that distinguish buffer restoration or stream restoration from buffer or stream enhancement, and I believe for these elements of the mitigation, the term "restoration" is also appropriate.
11	Stormwater models reliability	The model used to calculate stormwater impacts at the airport is HSPF, which is a continuous hydrologic simulation model. The model evaluates the movement of water in mass balance calculations (water enters the system from precipitation and exits as runoff, groundwater, evaporation or transpiration). All water is accounted for in the model. The model has been calibrated against actual flow data to determine how the input water (precipitation) is divided between the outflow components. King County and Ecology have approved the calibration, and it meets scientific standards for stormwater management. Model calibration focuses on matching various characteristics of the hydrograph with flow data. Experts using HSPF adjust model parameters to make the "best fit" of several flow components, such as hydrograph volume, peak flow magnitude, base flow, and peak flow recession. Thus, there is no "error margin", only a best fit allocation of the water mass balance. In the case of STIA, the calibration represents the professional expertise of hydrologists who reviewed and established the calibration parameters. Independent reviewers determined that these fall within typical and acceptable ranges given the specific local conditions. Stormwater modeling also compares existing runoff conditions with future

		runoff conditions. The relative differences between the existing conditions model simulation and the future conditions model simulation determines the amount of stormwater mitigation (such as peak flow or low flow) that is required. Since the relative difference generally drives the mitigation requirements, and the differences are dependent on the well-understood changes in a sub-basin (i.e. the changes in land use and impervious area) the relative differences are accurately modeled. Potential uncertainties remain unchanged. There are several conservative assumptions that have been made to determine appropriate mitigation for peak flow and low stream flow. The most significant of these is the assumption that all future impervious area at the airport, for purposes of peak flow mitigation, are assumed to be effective impervious area. This means that the total impervious area was assumed to generate runoff that drains to surface water and to contribute to peak flows; thus this water must be detained and released using stormwater facilities. In reality, much of the runoff from the runways will infiltrate into the soil surrounding the runway surface, therefore runoff from the new impervious surfaces is actually less than what is modeled to determine stormwater detention requirements. This provides a substantial safety factor in the sizing of most stormwater facilities. Also, with the peak flow retrofit requirements, modeling shows there is a reduction in peak flows.
12	Update of Tables	The tables have been changed to list Wetland A1 as 4.59 acres instead of 4.66 acres. Wetland A1a (0.007 acres) was formerly included in the total for Wetland A1, and it is now listed separately. These changes affect Table 2.1-1 in the NRMP and Table 1-2 in the Functional Assessment report.

Table 6-2. Summary of required detention facility volumes.

Watershed	Hydrologic Evaluation Point	Volume Required (acre-ft)	Type of Facility[a]	Comments
Miller Creek	NEPL	13.9[b]	Vault	In addition to existing 4 acre-ft
	CARGO	4.5	Vault	
	SDN2x + SDN4x	14.4	Vault	
	SDN3/3x	25.2	Vault	
	SDN1	5.5	Vault	
	SDN3A	Pond: 14.8 / Vault: 7.0	Pond/Vault	
	SDW1A	Pond: 25.5 / Vault: 7.4	Pond/Vault	Infiltration used
	SDW1B	53.6	Pond	Infiltration used
Total Miller Creek		**171.8**		
Walker Creek	**SDW2**	**10.9**	**Pond**	
Des Moines Creek	SASA Detention Facility	33.4[c]	Pond	
	Interconnecting taxiway (SDS3A)	5.4	Vault	
	Third Runway South (SDS7 and 6)	21.7	Vault	
	SDS3	88.0	Vault	
	SDS4	12.9	Vault	
Total Des Moines Creek		**161.4**		

[a] Types of facilities: Vault – enclosure with multiple orifice outlets on vertical riser with overflow spillway; Pond – open earth construction with netting or other means to provide wildlife deterrent.
[b] Volume needed to retrofit existing facility.
[c] Retrofit STIA area only.

Modeling conducted in 2000 presented a more comprehensive evaluation of the potential low stream flow impacts in Miller, Des Moines, and Walker Creeks from the planned STIA improvements. The *Low Streamflow Analysis for Seattle-Tacoma Master Plan Update* (Earth Tech 2000) contains detailed information and references for this work. This analysis was revised in 2001; results of the update are provided in the revised *Low Streamflow Analysis* report and therefore are not included in the SMP.

60 0 60 120
scale feet
CONTOUR INTERVAL = 1 FOOT

STATION 0+00 (MILLER CREEK DETENTION FACILITY OUTLET)

STA 1+24
N 22098
E 11120

CHANNEL CONNECTION AT NORTH END SEE ENLARGED PLAN, SHEET C5

APPROXIMATE TOE OF PROPOSED FILL SEE K&W DRAWINGS AND 1/C5

MILLER CREEK EXISTING ALIGNMENT

RELOCATED SANITARY SEWER, SEE SOUTH 154TH/156TH ST.

RELOCATED SOUTH 154TH/156TH ST.

CULVERT DRAIN PIPE SEE NOTE 10 SHEET C3

CHANNEL CONNECTION AT SOUTH END SEE ENLARGED PLAN, SHEET C5

EXISTING SEWER LINE SEE NOTE 7 SHEET C3

MILLER CREEK REALIGNMENT SEE PROFILE, SHEET C4

RELOCATE PP 40' MIN FROM CREEK ℄

PROPOSED SANITARY SEWER

INNER EDGES OF STREAM BANK

STA 13+36
N 21898
E 10518

RESTRICTED AREA SEE NOTE 9 SHEET C3

LOG WEIR 2

LOG WEIR 6

LORA LAKE BUFFER (25')

TYPICAL STREAM CHANNEL SECTION

PROJECT LIMITS

LORA LAKE EXISTING LAKE EL=264.4

EXISTING MONITORING WELL (TYP) SEE NOTE 8 SHEET C3

EXISTING OVERHEAD TRANSMISSION WIRES AND POLES (TYP) SEE NOTE 8 SHEET C3

LOG WEIR 4

FLOODPLAIN GRADING AREA

PROVIDE UNIFORM GRADE TO DRAIN

MATCH INVERT OF SWALE TO EXISTING DITCH INVERT

EXISTING SANITARY SEWER AND 20' EASEMENT

TESC BERM

10:1

CEMENT BULKHEAD (TO BE REMOVED)

TEST PIT #2 SEE SHEET C6

REMOVE AND DISPOSE EXISTING STORM DRAIN PIPING & BEDDING

TEMPORARY ACCESS ROAD SEE NOTE 4 SHEET C3

ADD MICROTOPOGRAPHIC FEATURES SEE SHEET 7.1

STORM DRAIN OUTLET SEE DETAIL 1/C7

EL 268

TEST PIT #10 SEE SHEET C6

N 21710
E 10255

STAGING AREA SEE NOTE 3 SHEET C3

1 Peat Removal Wetland Fill

2 Grading Exposes Buried Peat

3 Excavation Exposes Mineral Soil

RECONSTRUCT QUARRY SPALL PAD AT END OF PROJECT

GATE, SEE NOTE 12 SHEET C3

PROJECT SIGN, SEE NOTE 5 SHEET C3

STAGING AREA, SEE NOTE 3 SHEET C3

PROJECT LIMITS

DES MOINES MEMORIAL DRIVE

EXISTING STORM DRAIN TO REMAIN

ASPHALT ENTRANCE ROAD SEE NOTE 2 SHEET C3 AND DETAIL 2/C7

AR 026227

NOTE

SEE SHEET C3 FOR REFERENCE NOTES AND TABLE OF CONTROL POINTS.

AGENCY REVIEW
NOT FOR CONSTRUCTION

CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555

Parametrix, Inc.
5808 Lk. Washington Blvd. NE

REVISIONS

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

100051

Wetland/open water acreage*	Miller Creek	Walker Creek	Des Moines Creek
Current	113		87.7
With project			
Percent Change	-12.6%		-4.5%

Table 2. Potential changes to wetland/open water acreage as a result of propose projects at STIA.
*estimated via aerial photographs and not verified on the ground.

NOTE: I think we have provided Gail with the information needed for this table. She could update her values with wetlands on the site in Burien we discussed wetlands on the nursery site and new wetlands at Lora Lake Mac

Impervious surface	Miller Creek	Walker Creek	Des Moines Creek
Current acreage (1994)	950	92	993
With project acreage	1,056	97	1,116
Percent Change	11.1%	5.4%	12.4%
Current percentage (1994)	19.2%	16.3%	30.0%
With Project Percentage	21.4%	17.1%	33.7%
Percent Change	2.2%	0.8%	3.8%

Table 3. Potential changes to impervious surface as a result of proposed projects at STIA.
*estimated via aerial photographs and not verified on the ground.

Project	Possible wetland/ open water impacts (ac)*	Possible Increase in Impervious surface (ac)	Watershed
SR509/South Access Road	7.7 – 9.29 0	60.5 1.9	Des Moines Miller
Sound Transit Segment F	0.79	6.2-11.2	Des Moines
Regional Stormwater Detention Facility	11 2,000 linear feet		Des Moines
L-Shaped parcel in the ACDP	A 0.05 acre wetland is present on this site. There are no plans to alter it.	Unknown	Miller
EMT Conveyor Belt	2,800 sq ft eelgrass		Puget Sound
Outfall??	0	0	Puget Sound

Table 4. Preliminary aquatic resource impacts for possible future projects requiring a Corps Permit.
*Impacts include direct filling, grading, shading, and/or vegetation removal

Project	Possible Increase in Impervious Surface (ac)	Watershed
City Center Plan	0	Des Moines & Miller
South SeaTac Electrical Substation Upgrade	0	Des Moines
South Terminal Expansion	0	IWS
Upgrade Satellite Transit System	0 This is underground	IWS
IWS Lagoon #3	7.7	Des Moines
Portions of ACDP	?	Miller/Green River
AHFS	?2,500 sq ft	Des Moines
Part 150 Noise Compatibility Plan	Likely to remove impervious surface	Des Moines & Miller
North Electrical Substation	0	Miller
Water System	0	?Des Moines
ASDE	0	Miller
Temporary Airport Parking		
TRACON	4.7 acres	Miller

Table 5. Increase in Impervious Surface from projects not requiring a Corps permit.

[redacted]

ATTACHMENT B

Wetland acreage impacts by wetland function[31].

Wetland Function	Acres of Impact	Comments – *Rating Threshold*
Resident/ Anadromous Fish	8.6	Most wetlands rated for this function do not provide direct habitat for fish or aquatic organisms. These wetlands were rated at least low-moderate when at least indirect support of fish habitat through organic matter export, hydrologic functions, or other water quality functions would be expected.
Passerine Birds	14.9	Generally, areas providing nesting and foraging habitat for some birds were rated at least low-moderate. These ratings reflect the fact that even disturbed wetland areas in urban areas provide some habitat for birds when trees or shrubs are present in or near the wetlands.
Waterfowl	1.9	Wetlands that provide areas of forage (wetlands on the golf course and Vacca Farm) or emergent wetlands with nesting habitat were rated at least low-moderate.
Amphibians	9.8	When forest or shrub habitat occurred in wetlands or their buffers, they were rated at least low-moderate for this function.
Small Mammals	13.2	Generally, wetlands with shrub or forest cover provide some habitat to small mammals, and were rated at least low-moderate. These ratings reflect the fact that small disturbed wetland areas, even in urban environments are used by small mammal species.
Exports Organic Matter	10.9	Wetlands with surface water connections to streams or channels were generally rated at least low-moderate for this function.
Ground Water Exchange	13.0	Wetlands where groundwater discharges (perennial or seasonal) were observed were rated at least low-moderate for this function.
Flood Storage	4.6	Wetlands in floodplains or those formed in shallow depressions, were rated at least low to moderate for this function.
Nutrient/Sediment Trapping	16.3	Wetlands in floodplains, in shallow depressions, or on slopes where channelized inflow was absent, were rated at least low-moderate for this function.

[31] If functional assessment for a wetland was rated greater than low, the impact acreage is included in this table.

ATTACHMENT F

Comparison of mitigation projects to the Society of Wetland Scientist's Definition of Wetland Restoration.

SWS Criteria	Vacca Farm	Miller Creek Buffer	Tyee Golf Course	Auburn Wetland Mitigation
Reinstatement of driving ecological processes	Plant production processes are restored to the site. This production will drive wetland functions such as peat accumulation, organic matter export, and nutrient cycling processes.	Plant production processes will be restored in uplands and wetlands (see Vacca Farm). Stream enhancements and riparian restoration will restore habitat conditions and promote the retention and processing of organic matter by the creek ecosystem.	Plant production processes will be restored in uplands and wetlands (see Vacca Farm). Restoration of riparian areas will restore habitat and promote the retention and processing of organic matter by the creek ecosystem.	For wetland enhancement areas, plant production processes will be restored in uplands and wetlands (see Vacca Farm). In wetland creation areas, wetland hydrology will be established to support a variety of forest, shrub, and emergent pant communities and habitat which will promote a diverse ecological system.
Restoration Integrated into the landscape.	The restoration project is located within a 1.4 mile riparian corridor, and promotes an ecological connection between the wetlands located north of the airfield and Miller Creek.	The restoration restores landscape (wetland and riparian corridor) functions to Miller Creek. Removal of development on over 50 acres of land.	The restoration restores landscape (wetland and riparian corridor) functions to Des Moines Creek. Removal of golf course development on over 6.5 acres of land. The restoration is integrated into the larger (35 acre) Wetland 28 ecosystem.	The restoration establishes 65-acres integrated into the floodplain of the Green River.
Restores a persistent resilient system	Wetland buffers, the landscape setting, and restrictive covenants will assure long term protection and functioning of the restoration.	Same.	Same.	Same.
Results in historic wetland conditions	The historic floodplain and riparian conditions are restored.	The historic forest and shrub riparian wetlands are restored.	The historic floodplain and riparian conditions are restored.	Historic depression and riparian floodplain wetlands, once common in the Green River Valley are restored.
Performance standards based on objectives that measure structural and functional characteristics	A wide variety of performance standards based on desired structural and functional characteristics will be monitored as part of a 15-year adaptive management program.	A wide variety of performance standards based on desired structural and functional characteristics will be monitored as part of a 15-year adaptive management program.	A wide variety of performance standards based on desired structural and functional characteristics will be monitored as part of a 15-year adaptive management program.	A wide variety of performance standards based on desired structural and functional characteristics will be monitored as part of a 15-year adaptive management program.

ATTACHMENT G

Wetland acreage impacts and mitigation by wetland function.

Wetland Function	Impact	In-basin*		Auburn		Comment
		Site	Credit	Site	Credit	
Resident/ Anadromous Fish	8.6	70.54	25.79	-	-	In basin mitigation includes mitigation for direct impacts to Miller Creek and indirect impacts that may occur through alteration of riparian and hydrologically connected wetlands. For the Miller Creek enhancement areas, buffer averaging areas greater than 100-feet from Miller Creek were excluded from providing this function.
Passerine Birds	14.9	-	-	65.38	42.91	In-basin mitigation credit is not sought for this function due to potential wildlife management actions.
Waterfowl	1.9	-	-	6.80	6.80	In-basin mitigation credit is not sought for this function due to potential wildlife management actions.
Amphibians	9.8	78.72	27.46	65.38	42.91	The Lora Lake shoreline restoration, removing human uses, and native plant communities provided by the on-site mitigation will provide habitat for several species.
Small Mammals	13.2	78.72	27.46	65.38	42.91	Eliminating human uses, and native plant communities provided by the on-site mitigation will provide habitat for several species.
Exports Organic Matter	10.9	78.72	27.46	-	-	In-basin mitigation includes increasing production and quality of organic matter in wetlands and riparian areas. Maintenance actions that remove organic matter from wetlands, streams, and buffers will also be removed.
Ground Water Exchange	-	-	-	-	-	Impacts to this function, provided by slope and riparian wetlands (13.6 acres), are avoided by project design and by low flow augmentation.
Flood Storage	4.6	4.6	4.6	25	25	This function is mitigated in-basin by new flood storage at Vacca Farm and by stormwater detention facilities that are designed to maintain or decrease peak stream flows during flood events.
Nutrient/Sediment Trapping	16.3	78.72	27.46	65.38	42.91	In basin mitigation for this function is also provided by changes in land use that convert pollution generating land uses in mitigation areas to native vegetation, and by retrofitting existing pollution generating surfaces with BMPs for water quality treatment.

* Preservation of 23.55 acres near Borrow Area 3 is excluded from this table.

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5.2.5 Miller Creek Basin Trust Fund for Watershed Rehabilitation

To provide opportunities for additional restoration projects in the Miller Creek basin, the Port will establish a trust fund to support watershed rehabilitation projects. The trust fund will focus on portions of Miller Creek not owned by the Port, and where the Port is unable to independently implement stream enhancement projects. The Port will make these trust funds available and defer the selection of appropriate projects to other governmental agencies or interested groups. Restoration or enhancement projects supported by the trust fund are independent of the environmental review and permit process for Master Plan Update projects (e.g., CWA 404/401, HPA), and would not be covered by any permit conditions on Port Master Plan Update construction or mitigation projects.

5.2.5.1 Goal

The goal of this mitigation action is to provide a funding source to local agencies and groups to enhance instream or riparian habitat for salmonids and other aquatic organisms in the Miller Creek basin.

5.2.5.2 Description

The trust fund for watershed restoration will provide $150,000 for restoration projects in the Miller Creek basin. Potential projects eligible for funding by the trust fund are based on information provided in the Stream Survey Report for Miller Creek (Appendix F of the Final EIS for the Master Plan Update Projects [Port of Seattle 1997]). The projects identified in Table 5.2-18 are a preliminary list and are proposed to address habitat problems in Miller Creek identified in the stream survey. Examples of projects eligible for full or partial funding could include instream fisheries habitat improvements similar to those proposed for Miller Creek in this plan (see Figures 5.2-8 through 5.2-11), riparian buffer enhancement, removal of fish passage barriers, and removal of failed septic systems.

While specific projects are not selected, a suite of potential projects is identified with their respective goals, general performance standards, and general monitoring requirements. Additional planning and engineering of selected projects will result in specific project designs, performance standards, monitoring requirements, and contingency measures. Project proponents will be responsible for obtaining any federal, state, or local permits required to implement the projects.

The trust fund will have a sunset period of 5 years, with the 5-year period beginning once permits are issued for the Master Plan Update projects. If after a 5-year period trust fund projects are not designed and environmental permits sought,[1] the Port will use the money to implement projects in the Miller Creek basin that would provide water quality or aquatic habitat benefits. The projects to be implemented will be at the discretion of the Port, but with approval from Ecology and ACOE.

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[1] Project proponents will be responsible for obtaining all federal, state, and local permits required to implement habitat enhancement projects.

Table 5.2-18. Potential trust fund projects in the Miller Creek watershed.

Project	Goals	Description	Performance Standards	Monitoring
Pool Habitat Improvements (RM 2.0 to 3.3)	Increase high-flow refugia and over-wintering habitat for resident and anadromous fish species.	Modify stream channel to increase size, depth, and cover of existing pools. Create additional pools through placement of LWD complexes (4 to 6 logs each) in the stream channel.	Established pools and riffles will remain stable, or pool/riffle ratio shall remain within 10% of established value over 10 years.	Assess functions of pool/riffle complex annually at the end of the wet season to determine habitat quality of existing and created pools.
Streambank Stabilization (RM 2.0 to 3.3)	Increase quality spawning gravels and escape cover for juvenile salmonids and habitat for aquatic invertebrates by increasing stability of streambanks prone to slump and landslide activity.	Apply prescriptive stabilization designs to eroding banks, landslide areas, slumps, and debris jams that are major contributors to sediment loading.	Streambank stabilization projects shall remain intact for the 15-year monitoring period.	Assess stabilized streambanks annually at the end of the wet season, noting soil stability, evidence of sediment loading in the stream channel, and potential for sediment loading.
Streambank Re-vegetation (RM 2.0 to 3.3)	Decrease seasonal water temperature fluctuation through shading stream channel with native vegetation.	Install native riparian vegetation to provide overhead cover and shading of stream channel.	Installed plant materials shall have minimum 80% survival after 3 years, and shall provide a minimum of 80% cover of native species by year 10.	Assess installed plant materials and percent cover of non-native invasive vegetation species annually at the end of the growing season.

5.2.5.3 Eligibility

The Port or the designated administrator of the trust fund will consider requests for monies from the watershed trust fund to implement stream habitat enhancement projects. Requests must be made by King County, City of SeaTac, City of Des Moines, City of Burien, City of Normandy Park, special districts, tribal governments, non-profit organizations, or combinations of such governments through inter-local agreements. Organizations requesting funding must comply with general liability insurance requirements established by the Port.

Key criteria to be used to evaluate proposals to implement projects in Table 5.2-18, as well as other projects within the watershed, are:

- A demonstrated benefit to salmon or aquatic habitat without creating significant avian wildlife habitat within 10,000 ft of runways at STIA.
- Consistency with watershed management plans, or with prescriptions/recommendations identified using watershed analysis or stream assessment procedures.
- Clearly defined project goals, implementation plans, performance standards, and post-project monitoring.
- Preference for resolving underlying causes of problems rather than treating symptoms.
- Cost-effectiveness.

5.2.5.4 Implementation

The Miller Creek Basin Committee, the King County Watershed Coordinator, Puget Sound Restoration Fund, or other responsible entity will administer the fund. The administrator will establish eligible project criteria, set project cost limits, and set implementation and monitoring requirements. The Port will review and approve project goals, plans, performance standards, and monitoring requirements to enhance the ultimate success of the projects. The Port or the administrator at the Port's request, will provide status reports to the DOE and ACOE.

5.2.5.5 Site Protection

Site protection measures for enhancement projects will be coordinated with property owners and the fund administrator.

5.2.5.6 Monitoring and Contingency Plans

The fund administrator will review project design, implementation, and as-built plans to verify that intended benefits have been built. Contingency actions associated with establishment or operation of the fund will be reviewed with the Port, ACOE, Ecology, and the fund administrator.

Table 5.3-2. Final Performance Standards, Evaluation Approach, and Contingency Measures for the Tyee Valley Golf Course and Des Moines Creek Buffer Mitigation Projects.

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
1. Shrub and small trees planted at combined density of greater than 3,375 stems per acre	Survival of planted stock will be 100% at the end of year 1. Average survival of planted stock will be at least 80% during the first 3 monitoring years. Cover of native species will be at least 80% by monitoring year 15[b]. Cover of non-native invasive species will be no more than 10% by monitoring year 15[c].	Vegetation sampling (plots, transects, or plotless techniques) to estimate mortality, cover, density, and presence of invasive species.	If standards are not met: • Select species that are better adapted to existing hydrologic conditions. • Install additional plant material. • Install protective collars to reduce herbivore damage. • Control/reduce invasive plant species.
2. Plant native riparian tree and shrub plant species within the 100-ft buffer along Des Moines Creek.	Survival of planted stock will be 100% at the end of year 1. Average survival of planted stock will be at least 80% during the first 3 monitoring years. Tree density will be at least 280 individuals per acre and shrub density will be at least 2,100 individuals per acreduring monitoring years 3, 8, and 16. In years 3, 8, and 15, the number of plant species present will not decrease more than 10% from the number installed at baseline. Cover of native trees and shrubs will be at least 80% by monitoring year 15[a]. Cover of non-native invasive species will not exceed 10% during any monitoring year[b].	Vegetation sampling (see above).	See above.

[a] See Table 4.2-1 for interim cover targets (i.e., from year 3 to year 15).

[b] See Table 4.2-2 for list of invasive, non-native species to be monitored and controlled on the mitigation site.

5.3.2 Des Moines Creek Basin Trust Fund for Watershed Rehabilitation

To provide opportunities for additional restoration projects in the Des Moines Creek basin the Port will establish a trust fund to support watershed rehabilitation projects. The trust fund will focus on portions of Des Moines Creek not owned by the Port, and where the Port is unable to independently implement stream enhancement projects. The Port will make these trust funds available and defer the selection of appropriate projects to other governmental agencies or interested groups. Restoration or enhancement projects supported by the trust fund are independent of the environmental review and permit process for Master Plan Update projects (e.g., CWA 404/401, HPA), and would not be covered by any permit conditions on Port Master Plan Update construction or mitigation projects.

5.3.2.1 Goal

The goal of this mitigation action is to enhance instream or riparian habitat for salmonids and other aquatic organisms in Des Moines Creeks on land not owned by the Port.

5.3.2.2 Description

The trust fund for watershed restoration will provide $150,000 for restoration projects in the Des Moines Creek basin. Project information for potential projects eligible for funding by the trust fund is based on information provided in the Des Moines Creek Basin Plan (Des Moines Creek Basin Committee 1997) (Table 5.3-5). The trust fund will be established by the Port to fund watershed projects that result in direct habitat benefits to aquatic life in the streams or to remove documented water quality impacts.

Examples of projects eligible for full or partial funding include instream fisheries habitat improvements (e.g., see Figures 5.2-8 through 5.2-11), riparian buffer enhancement, removal of fish passage barriers, and removal of failed septic systems. Additional planning and engineering of selected projects would result in specific project designs, performance standards, monitoring requirements, and contingency measures. Project proponents will be responsible for obtaining federal, state, or local permits required to implement projects.

The trust fund will have a sunset clause of 5 years following issuance of Master Plan Update permits. If, after a 5-year period, projects are not designed and permits have not been sought,[2] the Port will use the money to implement those project(s) identified in the Des Moines Creek Basin Plan that provide water quality or aquatic habitat benefits. The project(s) to be implemented will be at the discretion of the Port, but with approval from Ecology and the ACOE.

5.3.2.3 Eligibility

The Port or a designated administrator will consider requests for monies from the watershed trust fund to implement stream habitat enhancement projects. Requests must be made by King County,

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[2] The project proponents will be responsible for obtaining federal, state, and local permits required to implement the projects.

the cities of SeaTac or Des Moines, tribal governments, non-profit organizations, or combinations of such governments through interlocal agreements (ILAs). Organizations requesting funding must comply with general liability insurance requirements established by the Port.

Key criteria to be used in evaluating proposals to implement projects in Table 5.3-5, as well as other projects within the watershed, include the following:

- A demonstrated benefit to salmon or aquatic habitat without creating significant avian wildlife habitat within 10,000 ft of runways at STIA
- Consistency with watershed management plans, or with prescriptions/recommendations identified using watershed analysis or stream assessment procedures
- Clearly defined project goals, implementation plans, performance standards, and post-project monitoring
- Preference for resolving underlying causes of problems rather than treating symptoms
- Cost-effectiveness

5.3.2.4 Implementation

The Des Moines Creek Basin Committee, the King County Watershed Coordinator, Puget Sound Restoration Fund, or other responsible entity will administer the fund. The administrator will establish eligible project criteria, application forms, project cost limits, implementation and monitoring requirements, etc. The Port will review and approve the project goals, plans, performance standards, and monitoring requirements to enhance the ultimate success of the projects. The Port, or the administrator at the Port's request, will provide status reports to the DOE and ACOE.

5.3.2.5 Site Protection

Site protection of enhancement projects will be coordinated with property owners and the fund administrator.

5.3.2.6 Monitoring and Contingency

The fund administrator will review project design, implementation, and as-built plans to verify that the project is built as intended. Contingency actions associated with establishment or operation of the fund will be reviewed with the Port, ACOE, Ecology, and the fund administrator.

Table 2.1-1. Summary of wetland and other Waters of the U.S. areas in the Seattle-Tacoma International Airport Master Plan Update Area.

Wetland [a]	Classification [b]	Area (Acres)	Drainage Basin
North Employee Parking Lot Area			
1	Forest	0.07	Miller
2	Forest	0.73	Miller
	Subtotal	0.80	
Runway Safety Area Extension			
3	Forest	0.56	Miller
4	Forest	5.00	Miller
5	Forest/Scrub-Shrub (70/30)	4.63	Miller
6	Scrub-Shrub	0.86	Miller
	Subtotal	11.05	
Third Runway Project Area			
North Airfield			
7[c]	Forest/Open Water/Emergent (30/50/20)	6.68	Miller
8	Scrub-Shrub/Emergent (80/20)	4.95	Miller
9	Forest/ Emergent (40/60)	2.83	Miller
10	Scrub-Shrub	0.31	Miller
11	Forest/Emergent (80/20)	0.50	Miller
12	Forest/Emergent (20/80)	0.21	Miller
13	Emergent	0.05	Miller
14	Forest	0.19	Miller
West Airfield			
15	Emergent	0.28	Miller
16	Emergent	0.05	Miller
17	Emergent	0.02	Miller
18	Forest/Scrub-Shrub/Emergent (50/20/30)	3.56	Miller
19	Forest	0.56	Miller
20	Scrub-Shrub/Emergent (90/10)	0.57	Miller
21	Forest	0.22	Miller
22	Scrub-Shrub/Emergent (90/10)	0.06	Miller
23	Emergent	0.77	Miller
24	Emergent	0.14	Miller
25	Forest	0.06	Miller
26	Emergent	0.02	Miller
W1	Emergent	0.10	Miller
W2	Forest/Emergent (20/80)	0.22	Miller
	Other Waters of the U.S.	0.02	Miller
Vacca Farm Site			
FW1	Farmed Wetland	0.03	Miller
FW2	Farmed Wetland	0.09	Miller

Table 2.1-1. Summary of wetland and other Waters of the U.S. areas in the Seattle-Tacoma International Airport Master Plan Update Area (continued).

Wetland [a]	Classification [b]	Area (Acres)	Drainage Basin
FW3	Farmed Wetland	0.59	Miller
FW5	Farmed Wetland	0.08	Miller
FW6	Farmed Wetland	0.07	Miller
FW8	Farmed Wetland	0.03	Miller
FW9	Farmed Wetland	0.01	Miller
FW10	Farmed Wetland	0.02	Miller
FW11	Farmed Wetland	0.11	Miller
A1a	Shrub	0.07	Miller
	Other Waters of the U.S.	0.02	Miller
West Acquisition Area			
35a-d	Forest/Emergent (40/60)	0.67	Miller
37a-f	Forest/Emergent (70/30)	5.73	Miller
39	Forest/Scrub-Shrub/Emergent (25/50/25)	0.90	Miller
40	Scrub-Shrub	0.03	Miller
41a and b	Emergent/Open Water (60/40)	0.44	Miller
44a and b	Forest/Scrub-Shrub (70/30)	3.08	Miller
A1	Forest/Scrub-Shrub/Emergent (15/15/70)	4.59	Miller
A2	Scrub-Shrub	0.05	Miller
A3	Scrub-Shrub	0.01	Miller
A4	Scrub-Shrub	0.03	Miller
A5	Emergent	0.03	Miller
A6	Forest	0.16	Miller
A7	Forest	0.30	Miller
A8	Forest/Scrub-Shrub (30/70)	0.38	Miller
A9	Scrub-Shrub	0.04	Miller
A10	Scrub-Shrub	0.01	Miller
A11	Scrub-Shrub	0.02	Miller
A12	Scrub-Shrub	0.11	Miller
A13	Forest	0.12	Miller
A14a and b	Forest/Scrub-Shrub/Emergent (50/25/25)	0.19	Miller
A15	Emergent	0.04	Miller
A16	Scrub-Shrub/Emergent (20/80)	0.09	Miller
A17	Forest/Scrub-Shrub/Emergent (10/20/70)	2.66	Miller
A18	Scrub-Shrub	0.01	Miller
A19	Emergent	0.04	Miller
Lora Lake	Open Water	3.06	Miller
	Other Waters of the U.S.	0.33	Miller
Riparian Wetlands			
R1	Emergent	0.17	Miller
R2	Scrub-Shrub/Emergent (70/30)	0.12	Miller
R3	Scrub-Shrub	0.02	Miller
R4	Emergent	0.11	Miller

Table 2.1-1. Summary of wetland and other Waters of the U.S. areas in the Seattle-Tacoma International Airport Master Plan Update Area (continued).

Wetland [a]	Classification [b]	Area (Acres)	Drainage Basin
R4b	Forest/Emergent (25/75)	0.11	Miller
R5	Emergent	0.05	Miller
R5b	Forest/Emergent (25/75)	0.07	Miller
R6	Forest/Emergent (25/75)	0.21	Miller
R6b	Emergent	0.09	Miller
R7	Forest/Emergent (25/75)	0.04	Miller
R7a	Emergent	0.04	Miller
R8	Scrub-Shrub/Emergent (40/60)	0.40	Miller
R9	Forest	0.38	Miller
R9a	Forest/Scrub-Shrub/Emergent (25/50/25)	0.74	Miller
R10	Scrub-Shrub	0.04	Miller
R11	Emergent	0.42	Miller
R12	Forest	0.03	Miller
R13	Emergent	0.12	Miller
R14a	Scrub-Shrub/Emergent (25/27)	0.13	Miller
R14b	Emergent	0.08	Miller
R15a	Forest/Scrub-Shrub/Emergent (25/65/10)	0.79	Miller
R15b	Forest/Emergent (25/75)	0.25	Miller
R17	Forest	0.31	Miller
	Subtotal	51.33	
Borrow Area 1			
32	Emergent	0.09	Des Moines
48	Forest/Emergent (20/80)	1.58	Des Moines
B1	Forest/Scrub-Shrub (30/70)	0.27	Des Moines
B4	Scrub-Shrub	0.07	Des Moines
B11	Emergent	0.18	Des Moines
B12[d]	Scrub-Shrub	0.63	Des Moines
B14	Scrub-Shrub/Emergent (70/30)	0.78	Des Moines
B15 a and b[d]	Scrub-Shrub	2.05	Des Moines
	Other Waters of U.S.	0.01	Des Moines
	Subtotal	5.66	
Borrow Area 3			
29	Forest	0.74	Des Moines
30	Forest/Scrub-Shrub (80/20)	0.88	Des Moines
B5	Forest/Scrub-Shrub (40/60)	0.08	Des Moines
B6	Forest/Scrub-Shrub (30/70)	0.55	Des Moines
B7	Forest/Scrub-Shrub (30/70)	0.03	Des Moines
B9	Forest	0.05	Des Moines
B10	Forest	0.02	Des Moines
	Subtotal	2.35	
South Aviation Support Area (SASA)/Tyee Valley Golf Course			
28[d]	Scrub-Shrub/Emergent/Open Water (50/30/20)	35.45	Des Moines

Table 2.1-1. Summary of wetland and other Waters of the U.S. areas in the Seattle-Tacoma International Airport Master Plan Update Area (continued).

Wetland [a]	Classification [b]	Area (Acres)	Drainage Basin
52	Forest/Scrub-Shrub/Emergent (80/20/20)	4.70	Des Moines
53	Forest	0.60	Des Moines
G1	Emergent	0.05	Des Moines
G2	Emergent	0.02	Des Moines
G3	Emergent	0.06	Des Moines
G4	Emergent	0.04	Des Moines
G5	Emergent	0.87	Des Moines
G6	Emergent	0.01	Des Moines
G7	Forest/Scrub-Shrub (30/70)	0.50	Des Moines
G8	Emergent	0.04	Des Moines
WH	Open Water	0.25	Des Moines
DMC	Forest/Scrub-Shrub/Emergent (15-15-70)	1.08	Des Moines
	Subtotal	43.67	
Industrial Waste System (IWS) Area			
IWS a and b	Forest	0.67	Des Moines
	Subtotal	0.67	
South Aviation Support Area Detention Pond			
E1	Forest	0.23	Des Moines
E2	Forest	0.04	Des Moines
E3	Forest	0.06	Des Moines
	Subtotal	**0.33**	Des Moines
TOTAL		**115.86**	

[a] Wetlands are labeled according to the following protocol:
- Wetlands with only numerical designations (e.g., Wetland 35 or Wetland 44) were described by Shapiro and Associates, Inc. (FAA 1995).
- Wetlands with an 'A' designation (e.g., Wetland A5 or A10) are wetlands occurring within the west acquisition area.
- Wetlands with an 'R' designation (e.g., Wetland R5 or R6) are riparian wetlands occurring within the west acquisition area.
- Wetlands with a 'W' designation (e.g., Wetland W1 or W2) are wetlands occurring within the west airfield area.
- Wetlands with a 'G' designation (e.g., Wetland G5 or G6) are wetlands occurring within the Tyee Valley Golf Course or the SASA areas.
- Wetlands with an 'E' designation (e.g., Wetland E1 or E2) are wetlands occurring within the SASA detention pond area.
- Wetlands with an 'IWS' designation (e.g., IWSa and IWSb) are wetlands occurring near the IWS lagoon.
- Wetlands with a 'B' designation (e.g., Wetland B5 or B10) are wetlands occurring within the borrow sites.
- Wetland numbers followed by a small case letter designate subsections of a larger wetland (i.e., Wetland 35a, or 35b) where constructed features (i.e., driveways) fragment a larger wetland.

[b] Numbers indicate approximate percentage of cover by respective wetland classes (Cowardin et al. 1979).

[c] Includes Lake Reba.

[d] Portions of the wetland area are estimated.

Table 4.1-2. Summary of compensatory mitigation (on and off site) for watershed, wetland, and stream impacts at Seattle-Tacoma International Airport.

Impact	Mitigation Action	Target Functions to Replace	Explanation and Key Attributes that Provide Target Functions
ON-SITE MITIGATION			
Permanent Impacts			
Approximately 980 linear ft of Miller Creek channel will be filled to accommodate third runway embankment and South 154th Street relocation.	Relocate approximately 1,080 ft of Miller Creek channel.	Fish and aquatic habitat Amphibian habitat Organic matter export	The channel design includes instream habitat features, including improved substrate conditions, LWD, channel diversity, and increased channel length. A buffer around the new channel will be vegetated with native trees and shrubs to provide shade and organic matter inputs to the stream.
Drainage channels will be filled near 12th Avenue South to accommodate the third runway embankment.	Create new permanent drainage channels.	Organic matter export functions Groundwater exchange functions	Approximately 1,290 ft of new permanent drainage channels will provide ecological functions by planting the channel margins with native vegetation to provide buffer functions. Functions include shade to control water temperatures and provide organic matter input. The channels will be designed to connect to the embankment drainage layer material to promote groundwater discharge. Connection to wetlands and Miller Creek will promote organic matter transport and export to the creek.
Approximately 8,500 cy of Miller Creek floodplain will be filled to accommodate third runway embankment and South 154th Street relocation.	Replace lost floodplain.	Flood storage	Approximately 9,600 cubic yards of soil will be excavated to suitable elevations that achieve storage of 5.94 acre-ft of floodwaters. Suitable grades and elevations will allow overbank and backwater flooding to occur in this floodplain.

Table 4.1-2. Summary of compensatory mitigation (on and off site) for watershed, wetland, and stream impacts at Seattle-Tacoma International Airport (continued).

Impact	Mitigation Action	Target Functions to Replace	Explanation and Key Attributes that Provide Target Functions
Approximately 18.37 acres of wetland will be filled during construction of the third runway embankment and other construction-related projects.	Restore about 9.0 acres of the Vacca Farm site to shrub-dominated wetlands.	Nutrient and sediment trapping functions Organic matter export Groundwater exchange Small mammal habitat Reduced waterfowl habitat	Plowed farmland will be stabilized with dense shrub and herbaceous plantings. Overbank and backwater flooding will occur to promote organic matter export. Subsurface drainage systems will be removed to promote natural groundwater discharge and flow patterns. Hummocks vegetated with dense native vegetation in wetlands and buffers will be provided as habitat for small mammals. This attribute will be augmented with LWD in wetlands and buffers. Large areas of emergent vegetation, open water, or long-term flooding that could promote waterfowl use will be avoided.
	Restore wetland buffer conditions (0.30 acre) around the north and west sides of Lora Lake.	Fish, amphibian, and aquatic habitat Organic matter export Reduce wildlife attractants	Converting lawn areas to riparian buffer communities will be established by planting with native wetland and upland shrub vegetation (refer to Table 5.1-1 in Section 5). Overhanging dense shrub vegetation will improve aquatic habitat, reduce waterfowl use of shoreline areas, and promote export of organic matter from shoreline to aquatic habitats. Removal of bulhead along the Lora Lake shoreline will improve shoreline habitat for amphibians, fish, and aquatic insects.
	Enhance approximately 10.25 acres of wetlands along Miller Creek	Nutrient and sediment trapping Small mammal habitat	Removing structures and restoring native wetland vegetation (Table 4.1-3) will enhance riparian and other wetlands. Areas of non-native vegetation will be removed and native trees and shrubs planted in the wetland.

Table 4.1-2. (continued). Summary of compensatory mitigation (on and off site) for watershed, wetland, and stream impacts at Seattle-Tacoma International Airport

Impact	Mitigation Action	Target Functions to Replace	Explanation and Key Attributes that Provide Target Functions
	Restore wetlands on the Tyee Valley Golf Course.	Nutrient and sediment trapping Organic matter export Reduce waterfowl habitat Small mammal habitat	Dense native shrub vegetation will be planted in Des Moines Creek floodplain and riparian areas (see Table 4.1-3). The wetland and riparian vegetation will promote increased export of organic matter to Des Moines Creek compared to the existing turf vegetation.[a] Shrub communities will reduce waterfowl use and improve habitat for small mammals.
Temporary Impacts			
Construction of temporary stormwater management ponds and other projects may temporarily impact up to 2.05 acres of wetland.	Restore forest and shrub communities to Wetland A17. Restore wetland areas after construction is complete.	Nutrient and sediment trapping Organic matter export Groundwater exchange Small mammal habitat	Restoration of wetlands that will be temporarily filled or disturbed will restore functions that previously existed on these sites. Restoration will include establishing pre-disturbance topography and planting the area with native shrub or forest vegetation. Integration of these areas with the replacement drainage channel mitigation and the embankment drainage layer will promote restoration of pre-existing hydrologic and water quality functions.
Indirect and Cumulative Impacts			
Filled wetlands near Miller Creek will reduce aquatic habitat value of the stream.	Establish and enhance buffers along Miller Creek.	Nutrient and sediment trapping Organic matter export Small mammal habitat	Conversion of residential landuses to vegetated stream buffers will promote nutrient and sediment trapping functions and reduce pollutant loading. Greater densities of riparian vegetation will increase shade, instream habitat, and organic matter export to Miller Creek. Riparian buffer vegetation will contribute to bank stabilization, sediment, and nutrient removal. It will also provide small mammal habitat (see Table 4.1-3).

Table 4.1-2. Summary of compensatory mitigation (on and off site) for watershed, wetland, and stream impacts at Seattle-Tacoma International Airport (continued).

Impact	Mitigation Action	Target Functions to Replace	Explanation and Key Attributes that Provide Target Functions
Additional development in the watersheds could result in additional cumulative impacts.	Participate in developing and implementing Miller Creek and Des Moines Creek basin plans.	Aquatic habitat Stream and/or watershed hydrology	These planning processes will identify effective, long-term solutions to restore additional fish habitat functions to Miller and Des Moines Creeks. Projects are anticipated to focus on restoring watershed hydrology through increased regional stormwater detention facilities and improved fish habitat through habitat restoration projects. The Port will contribute staffing resources and funds to support these efforts. The Port will work with other cooperating jurisdictions to plan and implement appropriate watershed restoration projects.
	Provide trust fund to watershed restoration projects.	Cumulative impacts to aquatic habitat	The Port will establish a trust fund to help promote aquatic habitat and other watershed restoration actions.
The runway fill or borrow area excavation may eliminate water sources that contribute to remaining wetlands downslope of the runway.	Design internal drainage and conveyance channels to promote and retain wetland hydrology and streamflow . Monitor wetlands adjacent to the third runway embankment and borrow areas to ensure wetland hydrology is maintained.	Groundwater exchange Organic matter export	Subsurface and surface replacement channels will continue to collect and distribute groundwater currently surfacing near 12th Avenue South to Miller Creek and associated wetlands. Surface drainage patterns and conveyance swales will be designed to collect and distribute groundwater seepage and surface runoff to wetlands downslope of the borrow areas.
OFF-SITE MITIGATION			
Permanent Impacts			
Approximately 18.37 acres of wetland wildlife (avian) habitat will be lost.	Replace high quality wetland and avian habitat functions off-site at an overall ratio of 2:1.	Passerine bird habitat Waterfowl habitat Small mammal habitat Flood storage	A variety of wetland classes and vegetation types on a large protected site will provide high quality habitat for a diverse array of birds and small mammals. Open water habitat (including vegetated aquatic beds) will support waterfowl and other bird species that require small ponds for forage or nesting. Waterfowl and other marsh birds will use flooded persistent and non-persistent emergent plant communities for forage and nesting. These communities will produce organic matter and aquatic insects that provide forage in open water areas.

Table 4.1-2. (continued). **Summary of compensatory mitigation (on and off site) for watershed, wetland, and stream impacts at Seattle-Tacoma International Airport**

Impact	Mitigation Action	Target Functions to Replace	Explanation and Key Attributes that Provide Target Functions
			Shrub wetland will fringe marsh communities and provide nesting and forage habitat for songbirds as well as export organic matter to emergent areas. Multi-storied forest communities will provide habitat to songbirds, raptors, and small mammals. A densely vegetated 100-ft-wide buffer will provide additional upland habitats and protect interior upland and wetland habitats from potential disturbances if off-site areas are developed. Microhabitat features-including LWD, vegetated hummocks, interspersion of vegetation types, and proximity to the Green River riparian corridor-will further enhance the area for wildlife. Excavation of portions of the site below an elevation of 45 ft and connection to the floodplain of the Green River by enhancing existing drainage channels will provide flood-storage functions.

Note: These enhancements will be coordinated with the Des Moines Creek Basin Committee's proposed RDF.

[a] Analyses of the ecological functions provided at each wetland mitigation site are found in Tables 4-13 to 4-16 in the *Wetland Functional Assessment and Impact Analysis* (Parametrix 2001b, in preparation). All mitigation areas (including, but not limited to, streams, wetlands, buffers, and floodplains) located within 10,000 ft of a runway shall be subject to the provisions of the Port's *Wildlife Hazard Management Plan* (USDA 2000) for the management of wildlife and wildlife attractant areas. On-site mitigation may provide replacement habitat functions for birds, but credit is not sought for this function, as management of birds pursuant to the WHMP may restrict this function.

Table 4.2-1. Riparian habitat buffer widths needed to protect riparian habitat functions (modified from Knutsen and Naef 1997).

Riparian Habitat Function	Buffer (Ft)	Literature Sources	Evaluation for Master Plan Update Mitigation
Water Temperature Control			
60-80% shading	35 to 125	Brazier et al. 1973	The 100 ft vegetated buffer would provide full shade of the narrow stream channels and thus provide water temperature control function. In limited areas where the buffer is reduced to 50 ft, full shading is also expected to occur because of the dense multi-layered planting approach. Since several buffer areas are currently disturbed, shading will increase over time, and is not currently optimal in all locations.
	35 to 120	Johnson and Ryba 1992	
	39	Corbett and Lynch 1985	
	49 to 100	Hewlett and Fortson 1982	
	59	Moring 1975	
50-100% shading	60 to 125	U.S. Forest Service et al. 1993	
	100	Lynch et al. 1985	
	100	Beschta et al. 1987	
	100	Johnson and Ryba 1992	
	100 to 141	Jones et al. 1988	
80% shading	151	Steinblums et al. 1984	
Large Woody Debris			
	100	Murphy and Koski 1989	The mitigation places a substantial amount of LWD in the stream at construction. The stream buffer mitigation will substantially improve recruitment of LWD over existing conditions. When trees in the buffer reach mature heights in 60 to 120 years, recruitment will be somewhat reduced (5 to 15%) from levels expected if buffers were 150 ft. Recruitment could be increased to natural levels (and accelerated over time) by placing any trees that have fallen outside the buffer within the buffer and by felling hazard trees inward toward the creek.
	103	Bottom et al. 1983	
	148	Harmon et al. 1986	
	150	McDade et al. 1990	
	150	Robison and Beschta 1990	
	165	Van Sickle and Gregory 1990	
	180	Thomas et al. 1993	
Filter Sediments			
75% sediment removal	100 to 125	Karr and Schlosser 1977	This function will occur as a result of the 100-ft average stream buffers. Where buffers are reduced to a minimum of 50 ft, the function will also be realized because there will be no areas of bare ground or erosion near the creeks. Permanent and temporary stormwater management facilities and other BMPs (which collect sediment from impervious and construction surfaces) provide this buffer function.
90% of sediment removal at 2% grade	100	Johnson and Ryba 1992	
Sediment removal	100	Erman et al. 1977, Moring et al. 1982, Lynch et al. 1985	
	200	Terrell and Perfetti 1989	
50% deposition	289	Gilliam and Skaggs 1988	
Effective control of non-channelized sediment flow	200 to 300	Belt et al. 1992	

Table 4.2-1. Riparian habitat buffer widths needed to protect riparian habitat functions (modified from Knutsen and Naef 1997) (continued).

Riparian Habitat Function	Buffer (Ft)	Literature Sources	Evaluation for Master Plan Update Mitigation
			Larger buffers to remove sediment are recommended for land use conditions that are not relevant to the Master Plan Update mitigation sites, such as agricultural, forestland, mining, or other land uses. Studies that identify buffer needs in excess of 100 ft have not considered TESC and extensive stormwater management facilities to control runoff.
Filter Pollutants			
Nutrient reduction	13	Doyle et al. 1977	The stream buffers are large enough to provide this function. They are generally not intended to do so because BMPs and the IWS route pollutants from pollution-generating surfaces through the stormwater management system for treatment. High levels of nutrient and chemical loading associated with agricultural land uses will not occur. The larger buffers recommended for removal of nutrients, fecal coliform, and pesticides from agricultural land uses are not relevant to the Master Plan Update mitigation sites.
Minimum	33	Petersen et al. 1992	
	49	Castelle et al. 1992	
	52	Jacobs and Gilliam 1985	
Nutrient removal using the multi-species riparian buffer strip system	66	Schultz et al. 1995	
Remove fecal coliforms	100 to 141	Jones et al. 1988	
	100	Grismer 1981	
	100	Lynch et al. 1985	
Nitrates removed to meet drinking water standards	100	Johnson and Ryba 1992	
Nutrient pollution in forested riparian areas	100	Terrell and Perfetti 1989	
Nutrient removal	118	Young et al. 1980	
Pesticides and animal waste	200	Terrell and Perfetti 1989	
Nutrient pollution in herbaceous or cropland riparian areas	600	Terrell and Perfetti 1989	
Erosion Control			
Bank erosion control	100	Raleigh et al. 1986	Full erosion control potential of the buffer will be realized. There are no high mass wasting areas present in the stream buffer. Specific mitigation is planned to improve bank stability and natural channel morphology.
High mass wasting area	125	Cederholm 1994	
Microclimate Influence			

Table 4.2-1. Riparian habitat buffer widths needed to protect riparian habitat functions (modified from Knutsen and Naef 1997) (continued).

Riparian Habitat Function	Buffer (Ft)	Literature Sources	Evaluation for Master Plan Update Mitigation
In forested ecosystem	200 to 399	Chen et al. 1990	These recommendations are made for old-growth forest ecosystems and are not relevant to urban conditions found in the Master Plan Update mitigation sites.
	525	Harris 1984, Franklin and Forman 1987	This function is lost from urban areas as there is no longer a forested ecosystem. However, the stream buffer mitigation will increase the microclimate influence of the buffer above existing baseline. It is unlikely any negative impact to aquatic or terrestrial organisms will result.
Aquatic Habitat			
Aquatic insects	100	Erman et al. 1977	This function will be fully realized where 100-ft buffers are present. In limited areas, the function may be sub-optimal due to 50-ft buffers. However, aquatic habitat conditions at the mitigation sites will improve above baseline due to the instream and buffer enhancement projects, and buffer averaging is included to mitigate reduced buffer widths.
Benthic invertebrates food supply	100	Erman et al. 1977	
Macroinvertebrate density	100	Newbold et al. 1980	
Macroinvertebrate diversity	100	Gregory et al. 1987	
Riparian invertebrates	100	Erman et al. 1977, Roby et al. 1977, Newbold et al. 1980	
Brook trout	100	Raleigh 1982	
Chinook salmon	100	Raleigh et al. 1986	
Cutthroat trout	100	Hickman and Raleigh 1982	
Rainbow trout	100	Raleigh et al. 1984	
Reptiles and amphibians	100	Rudolph and Dickson 1990	The stream buffers, enhanced riparian wetlands, buffer averaging areas, and riparian wetland buffers will provide suitable habitat for amphibian populations. Habitat conditions will exceed the baseline condition due to enhancement of the stream and buffer.
Instream Habitat			
Minimal maintenance of most functions	50 to 100	Johnson and Ryba 1992	
Mean buffers[a]			
Temperature Control (90 ft)		*Filter Sediments (138 ft)*	
Large Woody Debris (147 ft)		*Filter Pollutants (78 ft)*	
Instream Habitat (50-100 ft)			

[a] Where a range of values was reported in the literature, the median of that range was used to calculate a mean.

Table 4.2-2. Performance standards for vegetation cover (minimum percent) by vegetation zone and monitoring year.

	Vegetation Zone				
			Emergent		
Monitoring Year	Forest[a]	Shrub[a]	Hydroseed	Planted	Invasive Species
0	-	-	0	0	<10
1	-	-	50	10	<10
2	-	-	60	20	<10
3	10	10	70	30	<10
5	25	40	80	50	<10
7	40	65	80	70	<10
10	80	80	80	80	<10
12	80	80	80	80	<10
15	80	80	80	80	<10

[a] Vegetation cover will not be monitored in forest and shrub plant communities during monitoring year 0, 1, or 2. During these years, plant survival performance will be monitored and at year 3, survival must be 80 percent of the original numbers planted.

Table 4.2-3. Invasive plant species that will be monitored and controlled on the mitigation sites.

Scientific Name	Common Name
Convolvulus sepium	Hedge bindweed
Cytisus scoparius	Scotch Broom
Lythrum salicaria	Purple loosestrife
Phalaris arundinacea	Reed canarygrass
Polygonum cuspidatum	Japanese knotweed
Polygonum sachalinense	Sachaline
Rubus discolor	Himalayan blackberry
Rubus lacinatus	Evergreen blackberry

Table 5.1-7. Final performance standards, evaluation approaches, and contingency measures for mitigation projects at Vacca Farm.

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
I. Relocation of Miller Creek (relocated portion of stream (1080 ft) on Vacca Farm)			
1. The channel cross section will provide an average dry season base flow velocity that is greater than the silt transport velocity (0.7 ft/sec).	Average flow velocities will exceed 0.7 ft/sec at flows of 0.5 cfs or greater.	Measurements of stream velocity.	Alter velocities in low-flow channel using woody debris or boulders. Narrow portions of channel using LWD, boulders, or gravel bars to increase velocity.
2. Design a natural channel with stable gravel bottom in riffle sections suitable for spawning of cutthroat trout.	Substrates will contain less than 20% fine sediments (i.e., sand or smaller) in riffle sections.	Riffle areas will be delineated as part of the as built plans. A volumetric assessment of substrate (using McNeil cores or bulk samples) will be performed to document substrate conditions.	If fine sediments are present, evaluate sources; if sources are on Port property, implement stabilization measures to control or eliminate fine sediments. Alter velocities in low-flow channel using woody debris or boulders to adjust channel width.
3. Channel flow velocity is less than the gravel movement velocity (4 ft/sec) at the 100-year flow (175 cfs)..	Bed material size will not change compared to as-built conditions.	A volumetric assessment of substrate (using McNeil cores or bulk samples) will be used to document substrate conditions. Channel surveys will be performed to evaluate the presence of scouring or erosion.	Adjust width of channel, replace spawning gravels, and/or repair any eroded channel banks with bioengineering or additional streambank plantings.
4. Flows greater than the annual peak flow will overtop the channel and inundate the adjacent floodplain restoration.	Flows greater than the annual peak (40 cfs) will overtop the streambanks and flow into the floodplain.	Measure water elevations in the stream channel and floodplain and relate to streamflow and as built topography (e.g., floodplain elevation and berm height).	Adjust bank height, channel morphology, or roughness to alter amounts of overbank flow. Regrade channel banks if necessary.
5. Provide instream habitat features such as deflectors and overhanging logs as needed to maximize available habitat.	A minimum of 20 instream habitat features (e.g., LWD, overhanging logs, deflector logs, or root wads) will be present during monitoring years 3, 8, and 15. (LWD is woody material greater than 10 cm in diameter and 2 m in length (Cederholm et al. 1997).	Measure abundance, sizes, and location of LWD in the new channel.	If losses of LWD occur, evaluate factors contributing to reduction in LWD (e.g., high flows) and address. Add LWD to channel as necessary.

Table 5.1-7.Final performance standards, evaluation approaches, and contingency measures for mitigation projects at Vacca Farm (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
6. Provide approximately 3.0 acres of vegetated buffer on the east side of the channel. Establish native vegetation along channel banks and the riparian zone of the new channel.	Establish 3.0 acres of native shrub/forested riparian zone and upland buffers with an average tree density of at least 280 stems/acre and shrub density of at least 2,100 individuals per acre in monitoring years 3, 8, and 15. At Year 1, survival of planted stock will be 100%. Average survival of planted trees and shrubs in the first 3 monitoring years shall be at least 80%; cover of native species will be 80% by year 15[b]. Cover of non-native invasive[c] species will be no greater than 10% during any monitoring year. In monitoring years 3, 8, and 15, the numbers of plant species in the mitigation area shall not decline by more than 10 % from the number originally planted.	Vegetation sampling (plots, transects, or plotless techniques) to measure stem density plant cover, count live and dead plants, and measure cover of non-native invasive species.	Install additional plants if necessary. Identify substitute native species that are adapted to site conditions. Eliminate or reduce the abundance of non-native invasive species. Install protective collars to reduce herbivore damage.
7. Densely plant woody vegetation along the new channel to cover open water and reduce use of the area by waterfowl.	Canopy cover extending over the low flow channel will be 80 percent by the end of the monitoring period[d].	Vegetation sampling to determine tree and shrub cover over the portion of the channel below the ordinary high water mark (OHWM).	Add additional plants if areas of exposed stream channel are present.
II. Wetland Enhancement and Restoration on Vacca Farm			
1.[a] Provide for approximately 5.94 acre-ft of flood storage on Vacca Farm to compensate for approximately 5.24 acre-ft filled for the embankment. Excavate drainage swales to provide positive drainage from the floodplain and prevent standing water during non-flood periods.	Provide 5.9 acre-ft of flood storage to compensate for 5.2 acre-ft filled for the embankment. The floodplain area will slope toward drainage swales that connect to Miller Creek.	Record drawings and hydrologic monitoring to verify necessary flood storage is present	Regrade area if not excavated to specifications. Modify design of swales to improve drainage conditions if necessary.
2. Use excavated material from grading	Topographic features (mounds,	Determine density from	Construct additional features if project has not been

Table 5.1-7.Final performance standards, evaluation approaches, and contingency measures for mitigation projects at Vacca Farm (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
the floodplain to create topographic variation in the floodplain.	ridges)[c] will be constructed at a density of 4 per acre. Dimensions of these features will range between 4 and 8 ft wide; 8 and 16 ft long, and 1 and 2 ft high.	record survey.	built to specifications.
3. Plant native trees, shrubs and herbaceous (see Table 5.1-11, Table 5.1-12) species in these areas at tree densities of greater than 280 trees per acre (trees include willow species) and shrub densities of greater than 2,100 per acre. Intersperse scattered native conifers in this area.	At year 1, survival of planted stock will be 100%. Shrub and tree survival will average at least 80% in the first 3 monitoring years. In monitoring years 3, 8, and 15, at least 280 trees per acre (including willow species) and 2,100 shrubs/acre will remain. Percent cover of native species will be at least 80% by year 15[b]. In newly planted areas, non-native invasive[c] species cover will be no more than 10% in all monitoring years. In monitoring years 3, 8, and 15, the numbers of plant species in the mitigation area shall not decline by more than 10 % from the number originally planted.	Vegetation sampling (plots, transects, or plotless techniques) measure vegetation cover and diversity.	If standards are not met: • Select species that are better adapted to existing hydrologic conditions. • Install additional plant material. • Install protective collars to reduce herbivore damage. • Control/reduce non-native invasive species.
4. Plant the floodplain with native trees, shrubs, and grasses to deter water fowl.	Percent cover of native herbaceous species will be at least 80% by year 15[b].	Vegetation sampling (plots, transects, or plotless techniques) to estimate canopy cover.	See above.

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Table 5.1-7.Final performance standards, evaluation approaches, and contingency measures for mitigation projects at Vacca Farm (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
5. Enhance existing forested wetland south of Lora Lake with native shrubs to provide a diverse understory. Total density of native shrubs will be at least 1,700 individuals per acre.	At Year 1, survival of planted stock will be 100%. Average survival of planted stock will be at least 80% in the first 3 monitoring years. In monitoring years 3, 8, and 15, shrub density will be at least 1,700 shrubs per acre. In areas where existing wetland is being enhanced, percent cover of non-native invasive[c] species in the understory will be no more than 10% during any monitoring year. In years 3, 8, and 15, the number of plant species present will not decrease by more than 10% from the number installed at baseline.	Vegetation sampling (plots, transects, or plotless techniques) to estimate canopy cover.	See above.
III. Lora Lake Buffer Enhancement			
1. Plant a 25-ft buffer around Lora Lake with native trees and shrubs. Plant native tree species at densities of greater than 280 per acre (total of at least 168 trees). Plant native shrub species at densities of greater than 2,100 (total of at least 1,260) per acre.	At Year 1 survival of planted stock will be 100%. Average survival of planted stock will be at least 80% in the first 3 monitoring years. During monitoring years 3, 8, and 15, at least 168 trees and 1,260 shrubs will be present in the buffer. Percent cover of native species will be at least 80% by year 15[b]. In years 3, 8, and 15, plant diversity will not decrease by more than 10% from the number and type of plants installed at baseline. Non-native invasive[c] species cover will be no more than 10% by year 15 in newly planted areas.	Vegetation sampling (plots, transects, or plotless techniques), as described above.	Contingency measures for vegetation performance standards are described above.

Table 5.1-7.Final performance standards, evaluation approaches, and contingency measures for mitigation projects at Vacca Farm (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
2. Concrete bulkhead will be removed and shoreline graded to a stable slope configuration.	Record drawings and photo documentation verify that the concrete bulkhead has been removed. New shoreline of Lora Lake will have a slope of 3:1 or gentler.	Record drawings to verify removal and bulkheads and slope of shoreline.	Remove all structures and bulkhead areas to be consistent with design. Re-grade as necessary to be consistent with design.

[a] Compliance with this performance standard will be determined from the as-built drawing, and will generally not require ongoing monitoring.

[b] See Table 4.2-1 for interim cover targets (i.e., from year 3 to year 15).

[c] See Table 4.2-2 for list of invasive, non-native species to be monitored and controlled on the mitigation site.

[d] During the first few growing seasons following establishment of the new channel, shade will be provided over the channel with the use of nursery shade cloth to shade out about 75% of the ambient solar radiation. Interim cover standards for vegetation (i.e. for monitoring years 1-14) are provided in Table 4.2-1)

[e] See Appendix A for design details.

[f] Normal rainfall will be based on the definition for 'most years' given in the USACE 1987 Manual (i.e. annual precipitation in a normal year must be the same as or greater than precipitation in 5 years out of 10) or the average precipitation for a time period plus or minus 1 standard deviation of the mean.

Table 5.2-3. Final performance standards, evaluation approach, and contingency measures for wetland and buffer enhancement along Miller Creek.

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
1. Riparian buffer areas that are cleared or disturbed during demolition will be planted with native forested and shrub vegetation (these are shaded in Appendix B, Sheets L1 through L5.1). Plant native tree species at densities of greater than 280 per acre. Plant native shrub species at densities of greater than 2,100 per acre.	Plant survival will be 100% following year 1. Average survival of planted stock will be at least 80% during the first 3 monitoring years., Tree density will be at least 280 stems/acre; shrub density will be at least 2,100 individuals per acre in monitoring years 3, 8, and 15. During monitoring years 3, 8, and 15, plant diversity will not decrease by more than 10% from the number of plant species installed at baseline. Cover of native species will be at least 80% at monitoring year 15[a]. Cover of non-native, invasive[b] species in cleared and planted areas will not exceed 10% in any monitoring year(see Appendix B, Sheets L1 through L5.1 for locations where this standard will apply).	Vegetation sampling (plots, transects, or plotless techniques) to estimate native species cover, density, and mortality, and invasive species cover.	If standards are not met: • Select species that are better adapted to existing hydrologic conditions. • Install additional plant material. • Install protective collars to reduce herbivore damage. • Control/reduce non-native invasive species.
2. Lawn and other areas dominated by non-native plant species, will be enhanced by planting native forested vegetation.	Plant survival will be 100% following year 1. Average survival of planted stock will be at least 80% during the first 3 monitoring years.Tree density will be at least 280 stems/acre; shrub density will be at least 2,100 individuals per acre in monitoring years 3, 8, and 15. In monitoring years 3, 8, and 15, plant diversity will not decrease by more than 10% from the number of plant species installed at baseline. Cover of native species will be at least 80% at monitoring year 15[a]. Cover of non-native, invasive[b] species in cleared and planted areas will not exceed	See above.	See above.

Table 5.2-3. Final performance standards, evaluation approach, and contingency measures for wetland and buffer enhancement along Miller Creek (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
	10% in any monitoring year.		
3. Densely plant the portion of the buffer adjacent to Miller Creek with native trees and shrubs where applicable to provide future sources of LWD to the stream.	Density of trees in buffer is at least 280 stems/acre during monitoring years 3, 8, and 15.	See above.	See above.
5. Install fencing and signs to designate the buffer area as a protected mitigation site.	Signs and/or fencing will clearly mark the buffer edge as a protected mitigation site (see Appendix ___ for fencing specifications).	Check signs and fencing during annual monitoring visits	Repair and/or re-install damaged or missing signs.

[a] See Table 4.2-1 for interim cover targets (i.e., from year 3 to year 15).

[b] See Table 4.2-2 for list of invasive, non-native species to be monitored and controlled on the mitigation site.

Table 5.2-8. Final performance standards, evaluation approach, and contingency measures for instream habitat enhancements in Miller Creek.

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
1. Add LWD to the creek channel.	During all monitoring years, number of LWD features in stream remains stable or increases compared to baseline (as-built) conditions (LWD is woody material greater than 10 cm in diameter and 2 m in length).	Record survey and visual inspection of channel	Add LWD to create additional channel complexity.
	During all monitoring years, number and density of habitat features (e.g., pools, riffles, bars, and undercut banks) remain stable or increase compared to baseline (as-built) conditions.	Record survey and visual inspections. Measure density and number of habitat features	Add LWD to create additional channel complexity and promote formation of pools and riffles.
2. Stabilize areas of erosion by using native vegetation and LWD.	Cover of streambank vegetation in enhancement will meet performance standards for cover provided in Table 4.2-1.	Site inspections and record drawings.	Repair damaged bank if necessary. Stabilize banks with additional LWD, live stakes, or seeding.
	Bank stabilizing LWD, as shown on record drawings, remains in place.		
3. Add gravel to degraded reaches where natural recruitment is limited.	During all monitoring years, substrate is predominantly gravel (>50 percent) on bars and benches, as defined in as-built conditions..	Assess substrate composition with pebble counts. Visual inspection	Evaluate source of sediment and remove/control. Add channel features (e.g., large wood and boulders) to reduce bedload movement.

Table 5.2-12. Final performance standards, evaluation approach, and contingency measures for replacement drainage channels.

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
1[a]. Construct the replacement channel to convey the 100-year, 24-hour design storm, and seepage water collected by the embankment drain layer and adjacent areas.	Channel depths will be a minimum of 2 ft deep with side slopes of 3:1 or gentler with log and rock weirs to protect channel banks.	Monitor stability by examining for scour, bank erosion, etc. once per year and following storm events greater the and the ten year storm.	Enlarge channel if conveyance is inadequate.
2. Direct water in drainage channels to discharge points in or adjacent to riparian wetlands along Miller Creek (Wetlands A13, 18, 37a, 39, 44a, R9).	Flowing water will be present in Segment B and Segment C from December to June in years of normal[b] rainfall. Groundwater in wetlands with predominantly organic soils (Portions of Wetland 18, 37a, R14a, A14b, and 44a) will be within 10 inches of the soil surface at least between March and mid-June in years of normal[b] rainfall. Other wetlands with predominantly mineral soils will have soils saturated in the upper part to mid-April in years of normal[b] rainfall. Wetland indicator status (WIS) of the dominant non-invasive plant species will not differ from pre-project conditions during or at the end of the monitoring period. . Each vegetation strata (trees, shrubs, and emergents) shall be assessed separately, and have separarte conclusions. Statistically valid sampling procedures will be employed to monitor these potential changes, in all areas where there is a potential to change the post construction hydrology (downslope of the embankment and the borrow sites). WIS status of the vegetation will be calculated as in the 1987 USACE wetland delineation manual.	Measurements of channel baseflow by installing weirs that allow quantity of water flowing through channels to be determined. Map organic and inorganic soils; characterize wetland vegetation. Monitor duration and depth to water table in wetlands to determine if wetland hydrology persists. The data will be related to the wetland indicator status of dominant wetland plants, the information on vegetation tolerance of various hydrologic regimes, and the intensity of reducing soil conditions (i.e., iron reduction creating mottled and gleyed soil colors, or organic matter accumulation). This	Modify discharge points from channel to wetlands to meet performance standards. Divert treated stormwater from upslope stormwater ponds to drainage channels. Improve drainage paths to convey water to wetlands. Remove obstructions and/or enlarge channels as needed. Reconfigure drainage channels to maintain flows (i.e., longer drainage channels to collect more water for distribution to wetlands). If wetlands are found to be drier than under pre-project conditions: Divert treated stormwater from upslope stormwater ponds to drainage channels (the source of this stormwater could be from biofiltration swales, filter strips, etc. treating runoff from the perimeter road). Reconfigure discharge (i.e., location, size, and number of discharge points that distribute water to wetlands from drainage channels). If these wetlands are wetter than under pre-project conditions: A portion of the water in the drainage

Table 5.2-12. Final performance standards, evaluation approach, and contingency measures for replacement drainage channels (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
		analysis will be used to determine whether the post-construction hydrology observed through monitoring can reasonably be expected to maintain the wetland soils and vegetation currently present in the wetlands.	channels will be directed to Water W rather than into the wetlands.
3. Plant native shrubs at greater than 2,100 individuals per acre and native trees at greater than 280 trees per acre along channel banks.	Shrub density will be at least 2,100 individuals per acre. Tree density will be at least 280 stems per acre. At Year 1, survival of planted stock will be 100%. Average tree and shrub survival will be at least 80% during the first 3 monitoring years. Average canopy cover of native species will be at least 80% by monitoring year 15.[d] By the end of year 3, plant diversity in each stratum will not decrease by more than 10% from the number and type of plants installed at baseline. Cover of non-native invasive[e] species will be no more than 10% by monitoring year 15.	Vegetation sampling (plots, transects, or plotless techniques) to estimate cover, density, mortality, and invasive species.	If standards are not met: Select species that are better adapted to existing hydrologic conditions. Install additional plant material. Install protective collars to reduce herbivore damage. Control/reduce non-native invasive species.

[a] Indicates a key design standard to be determined from the as-built condition. These standards typically do not require ongoing monitoring.

[b] Normal rainfall will be based on the definition for 'most years' given in the USACE 1987 Manual (i.e. annual precipitation in a normal year must be the same as or greater than precipitation in 5 years out of 10) or the average precipitation for a time period plus or minus 1 standard deviation of the mean.

[c] Pre-project vegetation and soil conditions are documented in the Wetland Delineation Report (Parametrix 2000).

[d] See Table 4.2-1 for interim cover targets (i.e., from year 3 to year 15).

[e] See Table 4.2-2 for a list of invasive, non-native species to be monitored and controlled on the mitigation site.

Table 5.2-16. Final performance standards, evaluation measures, and contingency measures for restoration of temporary wetland impacts.

Design Criteria	Performance Standard	Evaluation Methods	Contingency Measures
1. Grade disturbed areas to pre-construction elevations. and hydrologic conditions..	Pre-disturbance wetland topography is restored.	Comparison of pre- and post-construction topography.	Regrade if necessary.
	Wetland areas will meet wetland criteria (hydrophytic vegetation, hydric soils, hydrology) following restoration (see Table 5.2.12).	Monitor the depth to and the duration of soil saturation (see Table 5.2.12).	Regrade if necessary. Use water collected by drainage channels to supplement wetland hydrology.
2. Restore impacted areas with native forest vegetation. Emergent wetland communities will be replanted with forest vegetation to increase wetland functions and reduce potential use by waterfowl.	In revegetated areas, survival will be 100% at the end of year 1; average survival of planted stock will be at least 80% during the first 3 monitoring years. Cover of native species will be at least 80% by the end of the 15-year monitoring period[a].	Vegetation sampling (plots, transects, or plotless techniques) to estimate mortality, cover, density, and presence of invasive species.	If standards are not met: Select species that are better adapted to existing hydrologic conditions. Install additional plant material. Install protective collars to reduce herbivore damage.
	Cover of non-native invasive[b] species will be no more than 10% during any monitoring year.		Control/reduce non-native invasive species.
	In monitoring years 3, 8, and 15re-vegetated wetlands will have a tree density of at least 280 per acre and a shrub density of at least 2,100 individuals per acre.		
	In monitoring years 3, 8, and 15, plant diversity will not decrease by more than 10% from the number of plant species installed at baseline.		
3. Disturbed ground within 50 ft of the wetlands will be hydroseeded or otherwise stabilized to prevent erosion impacts to the wetland.	Vegetation cover within 50 ft of wetlands will exceed 80 percent within 1 year following restoration.	Measure plant cover using standard vegetation sampling techniques.	Install erosion control fabric. Install additional hydroseed or plants in upland areas.

[a] See Table 4.2-1 for interim cover targets (i.e., from year 3 to year 15).

[b] See Table 4.2-2 for list of invasive, non-native species to be monitored and controlled on the mitigation site.

Table 5.3-5. Summary of potential trust fund projects in the Des Moines Creek watershed (projects are as described in the Des Moines Creek Basin Plan, 1997).

Project	Goals	Description	Performance Standards	Monitoring	Cost Estimate[a]
Habitat Improvements					
Ravine reach[b] (RM 1.0-1.85)	Stabilize steep channel. Provide channel geometry that responds positively to predicted flows.	Construct 20 rock weirs throughout the reach.	Rock weirs remain secure/intact for 10 years.	Assess function and any movement of rock weirs once a year at end of wet season.	$50,000
Treatment plant[b] (RM 0.4-1.0)	Provide pool habitat. Increase channel complexity. Reduce the risk of bank failure adjacent to sewer line access road by diverting high-velocity flows away from road.	Place 4 LWD complexes (4 to 6 logs each) on outside bends and/or channel spanning; install 15 small rock deflectors, each spanning 40% of channel (half immediately upstream of LWD complexes, half in high-velocity areas diverting flow from bank); place 5 small groups (3 to 5 rocks per group) of fish and turning rocks.	LWD complexes, rock deflectors, fish and turning rocks remain secure/intact for 10 years.	Assess functions of LWD complex, rock deflectors, fish and turning rocks; document shifting or accumulation of debris once a year at end of wet season.	$130,000
Park reach[b] (RM 0.0-0.4)	Increase pool habitat. Increase channel complexity.	Place 1 LWD complex (4 to 6 logs) on outside bend and/or channel spanning; install four small rock deflectors each spanning 40% of channel (half immediately upstream of LWD complexes, half in high-velocity areas diverting flow from bank); install 1 small group (3 to 5 rocks) of fish and turning rocks.	LWD complexes, rock deflectors, fish and turning rocks remain secure/intact for 10 years.	Assess function of LWD complexes, rock deflectors, fish and turning rocks; document shifting or accumulation of debris once a year at end of wet season.	$50,000
Wetland reach (RM 1.85-2.15)	Maintain/enhance natural flood storage function of wetland system.	Add woody debris to stream and/or buffer.	Installed habitat features remain secure/intact instream channel for 10 years.	Assess functions of installed habitat features; document shifting or accumulation of debris once a year at end of wet season.	$10,000
Septic systems[b]	Reduce fecal coliform levels and improve other water quality parameters in Des Moines Creek.	Identify houses within areas not connected to sanitary sewer. Connect problem septic systems to sewer lines.	Identified houses are connected to sewers and septic systems are decommissioned.	As-built monitoring to verify completion.	$ 150,000

[a] This cost estimate reflects 1997 dollars.
[b] Identified as "regional high priority" in the basin plan.

Table 5.3-6. Final Performance Standards, Evaluation Approach, and Contingency Measures for Monitoring Borrow Area Wetlands.

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
Maintain wetland hydrology by redirecting surface water runoff to the wetlands near Borrow Area 1.	Soils in wetlands near Borrow Area 1 (Wetlands 48 and B15) will be saturated to the surface from December to April in years of normal[a] rainfall.	Shallow groundwater monitoring wells.	Minor regrading to direct surface water runoff to wetlands
Maintain wetland hydrology by directing groundwater seepage and surface water runoff via an interceptor swale to wetlands in and near Borrow Area 3.	Wetland 30 will have shallow standing water up to 24 inches deep during the breeding season for resident amphibians (i.e., December through April).	Shallow groundwater monitoring wells.	Adjust length and discharge points of interceptor swale system
	Wetland 29 will have soils saturated to the surface from December through April in years of normal[a] rainfall.	Shallow groundwater monitoring wells.	Adjust length and discharge points of interceptor swale system
Wetland vegetation will remain in wetlands adjacent to and downslope of borrow areas 1, 3, and 4.	Wetland indicator status (WIS) of the dominant non-invasive plant species will not differ from pre-project conditions during or at the end of the monitoring period. Each vegetation strata (trees, shrubs, and emergents) shall be assessed separately, and have separarte conclusions. Statistically valid sampling procedures will be employed to monitor these potential changes, in all areas where there is a potential to change the post construction hydrology (downslope of the embankment and the borrow sites). WIS status of the vegetation will be calculated as in the 1987 USACE wetland delineation manual.	Vegetation sampling to determine plant cover, dominance, and presence of invasive species.	For Borrow are 3, alter distribution of water from the interceptor swale For other wetlands, review grading and drainage patterns of borrow sites. Regrade to provide additional water to wetlands of concern.

[a] Normal rainfall will be based on the definition for 'most years' given in the USACE 1987 Manual (i.e. annual precipitation in a normal year must be the same as or greater than precipitation in 5 years out of 10) or the average precipitation for a time period plus or minus 1 standard deviation of the mean.

Table 7.7-1. Final performance standards, evaluation approach, and contingency measures for the Auburn wetland mitigation project.

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
Excavated Areas (East and West Basins)			
1. Use a perched water table to establish wetlands at the approximate final grades of: <u>East Basin</u> 41 ft to 38 ft in emergent wetlands 42 ft to 41 ft in shrub wetlands 45 ft to 42 ft in forested wetlands Below 38 ft in open-water wetland <u>West Basin:</u> 42 ft to 44 ft in emergent wetlands 44 ft to 47 ft in shrub wetlands 47 ft to 49 ft in forested wetlands Below 42 ft in open-water wetland	Wetland areas will meet the following hydrology[a] criteria: In forested areas, soils will be saturated within the upper 12 inches for a minimum of 2 weeks during the growing season[b] In shrub areas, soils will be saturated within the upper 6 inches for a minimum of 6 weeks during the March-November period. In emergent zones, soils will be saturated to the soil surface for 6 months, including at least the period of March through June.	Measure hydrology using ground water monitoring wells, soil pits, and staff gages.	Modify surface drainage features or control elevations of drainage channels. Minor regrading if necessary.
2. Plant five forested wetland plant associations that are similar in composition to naturally occurring plant associations. Use native[c] deciduous and evergreen species such as black cottonwood, Oregon ash, red alder, western redcedar, and Sitka spruce. Forest communities will have a native shrub understory with species such as salmonberry, twinberry, red-osier dogwood, red elderberry, willows, and vine maple.	Forest wetlands will cover at least 36 acres of the mitigation site. Upland forest habitat will be established on at least 15 acres of the mitigation site.	Measured using record surveys, vegetation monitoring, and mapping. Verify areas available for vegetation zones on completion of grading and prior to planting.	Replant as necessary to achieve desired vegetation. Adjust planting areas to match as-built grades and planned vegetation zones.

Table 7.7-1.Final performance standards, evaluation approach, and contingency measures for the Auburn wetland mitigation project (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
3. Plant native tree species at densities greater than 280 trees per acre. Plant native shrub species in forested communities at densities greater than 1,800 plants per acre.	Forest wetlands will have at least 80% cover[d] of native species by monitoring year 15. Forest wetlands will have no more than 10% cover of non-native invasive[e] species during any monitoring year. At the end of Year 1, survival of planted stock will be 100%. Average survival of planted stock will be at least 80% in the first 3 monitoring years. In monitoring years 3, 8, and 15, forested areas will have multiple strata, tree density will be at least 280 trees per acre in forested wetland areas and shrub density will be at least 1,800 individual plants per acre in areas of the forested wetland that are planted with shrubs (i.e., over 25% to 50% of the area). Plant diversity in each stratum will not decrease by more than 10% from the number plant species installed at baseline.	Verify using record surveys and vegetation monitoring. Vegetation sampling (plots, transects, or plotless techniques) to determine plant mortality, density, cover, and presence of invasive species. Vegetation analysis will employ statistically valid sampling and analysis procedures.	Replant as necessary to meet required density. If standards are not met: Select species that are better adapted to existing hydrologic conditions. Install additional plant material. Install protective collars to reduce herbivore damage. Control/reduce non-native invasive species. Implement integrated weed management plan, which may include test plots to evaluate potential control methods, mechanical removal, manual controls (i.e., chopping, digging), mowing, mulching, biological control, and/or herbicides.

Table 7.7-1.Final performance standards, evaluation approach, and contingency measures for the Auburn wetland mitigation project (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
4. Plant an association of native shrub wetland species that is similar in composition to naturally occurring shrub wetlands, including species such as Pacific willow, Hooker's willow, Sitka willow, red-osier dogwood, and twinberry.	Shrub wetlands will cover at least 6.0 acres of the mitigation site. Species composition in the shrub wetland will include at least a 5% cover of each native species planted in monitoring years 3, 8, and 15. At the end of Year 1, survival of planted stock will be 100%. Average survival of planted stock will be at least 80% during the first 3 monitoring years. In monitoring years 3, 8, and 15, shrub density will be at least 2,100 plants per acre in shrub wetland areas. Cover of native species will be at least 80% by monitoring year 15[d]. Shrub areas will have no more than 10% cover of non-native invasive[e] species during any monitoring year. In monitoring years 3, 8, and 15, plant diversity in each stratum will not decrease by more than 10% from the number and type of plants installed at baseline.	See above.	See above.
5. Plant an association of native emergent wetland species similar in composition to naturally occurring emergent wetlands. Use native species that are suited to seasonally and/or permanently flooded conditions, such as water parsley, hardstem bulrush, and common spike rush.	Emergent wetlands and open-water habitat will cover at least 6.8 acres of the mitigation site. Native emergent wetland species will contribute at least 90% of plant cover in areas planted with emergent species by monitoring year 15[d]. During any monitoring year, no more than 10 percent cover by *Typha latifolia* will be present.	See above.	See above.

Table 7.7-1.Final performance standards, evaluation approach, and contingency measures for the Auburn wetland mitigation project (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
6. Plant native emergent species in approximately 0.05-acre monotypic patches.	Species composition in the emergent wetland will include at least a 5% cover of each native species planted. Emergent areas will have no more than 10% cover of non-native invasive[e] species during any monitoring year. By the end of year 3, plant diversity in each stratum will not decrease by more than 10% from the number and type of plants installed at baseline.	See above.	See above.
7. Provide year-round shallow water with patches of emergent vegetation as feeding habitat for dabbling duck species.	Permanently flooded wetlands (at least 0.59 acres) will have shallow-water habitat (<12 inches deep during the June to September period) in 20% of their area. Open water, shallow aquatic bed areas will cover at least 0.59 acres.	Hydrologic monitoring and vegetation surveys.	Replant or minor regrading as necessary.
8. Provide ponded water areas for waterfowl resting habitat.	Ponded water at least 26 inches deep will occur in open areas of at least 1 acre from December through May.	Hydrologic monitoring.	Minor regrading as necessary.
9. Plant forested wetland adjacent to shrub, emergent, and open-water habitats.	Forested vegetation with trees at densities of 280 stems per acre will occur within 50 ft of the edge of flooded emergent wetland areas for at least 200 linear ft	Vegetation monitoring, site mapping.	Replant as necessary.
10. LWD (stumps and logs of native species) placed throughout the forested wetland to provide year-round cover for small mammals. Low hummocks constructed in the shrub wetland areas to provide non-saturated soils for burrowing small mammals.	LWD placed at densities of 50 pieces per acre (approximately 25 ft on-center). LWD pieces will be at least 6 ft in length and at least 1 ft in diameter at the narrowest part; 25% of the LWD will be greater than 10 ft long and greater than 2 ft in diameter at the narrowest end. Root wads will be at least 4 ft long and 1 ft in	As-built surveys for wood placement and topography. As-built surveys to verify grades; vegetation surveys. Wildlife surveys.	Supplement with more wood as necessary.

Table 7.7-1.Final performance standards, evaluation approach, and contingency measures for the Auburn wetland mitigation project (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
	diameter at the stump end. Shrub hummocks (with a minimum area of 150 ft^2 at elevation 43 ft) at least 4 per acre in the shrub zone.		
11. Provide attachment substrate for breeding amphibian species in areas of ponded water.	At least 50% of live and dead stems in ponded emergent wetland areas will be species with stem diameters less than 0.25 inch.	Vegetation surveys.	Replant as necessary.
Existing Wetland			
12. Enhance habitat functions of existing wetland.	Plant sections of the existing wetland with native trees and shrubs at densities of at least 2,100 individual plants per acre for shrubs and at least 280 stems per acre for native trees. At the end of Year 1, survival of planted stock will be 100%. Average survival of planted stock in the enhanced wetland will be at least 80% during the first 3 monitoring years. Cover of native species in the enhanced wetland will be at least 80% by monitoring year 15[d]. Cover of non-native invasive[e] species will be no more than 10% in any monitoring year. In monitoring years 3, 8, and 15, plant diversity in each stratum will not decrease by more than 10% from the number of plant species installed at baseline.	Vegetation sampling (plots, transects, or plotless techniques) to determine plant mortality, density, cover, and presence of invasive species.	If standards are not met: Select species that are better adapted to existing hydrologic conditions. Install additional plant material. Install protective collars to reduce herbivore damage. Control/reduce non-native invasive species. Implement integrated weed management plan, which may include test plots to evaluate potential control methods, use of mechanical removal, manual controls (i.e., chopping, digging), mowing, mulching, biological control, and/or herbicides

Table 7.7-1.Final performance standards, evaluation approach, and contingency measures for the Auburn wetland mitigation project (continued).

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
Buffers			
13. Establish a 100-ft-wide forested buffer around the perimeter of the mitigation site. The buffer will be densely planted with native trees and shrubs to provide site protection and discourage access to the site by people or domestic animals.	At the end of Year 1, survival of planted stock will be 100%. Average survival of planted stock in the buffer will be at least 80% during the first 3 monitoring years. Cover of native species in the buffer will be at least 80% by monitoring year 15[d]. Cover of non-native invasive[e] species will be no more than 10% during any monitoring year. During years 3, 8, and 15, plant diversity in each stratum will not decrease by more than 10% from the number plant species installed at baseline.	See above.	See above.

[a] All hydrologic criteria (water depths, soil saturation, etc.) must be met during years of normal rainfall. Normal rainfall will be based on the definition for 'most years' given in the USACE 1987 Manual (i.e. annual precipitation in a normal year must be the same as or greater than precipitation in 5 years out of 10) or the average precipitation for a time period plus or minus 1 standard deviation of the mean.

[b] Growing season as defined by the NRCS: portion of year when soil temperatures at 19.7 inches below soil surface are higher than biological zero (i.e., 5°C. From King County Soil Survey, this period is assumed to begin March 1 and is between 190 to 220 days in portions of the County near Puget Sound.

[c] Native species are those defined as native to the Pacific Northwest per Hitchcock and Cronquist, 1973.

[d] See Table 4.2-1 for interim percent cover targets for the mitigation site (i.e., between years 1 and 15).

[e] See Table 4.2-2 for list of non-native invasive species to be monitored and controlled on the mitigation site.