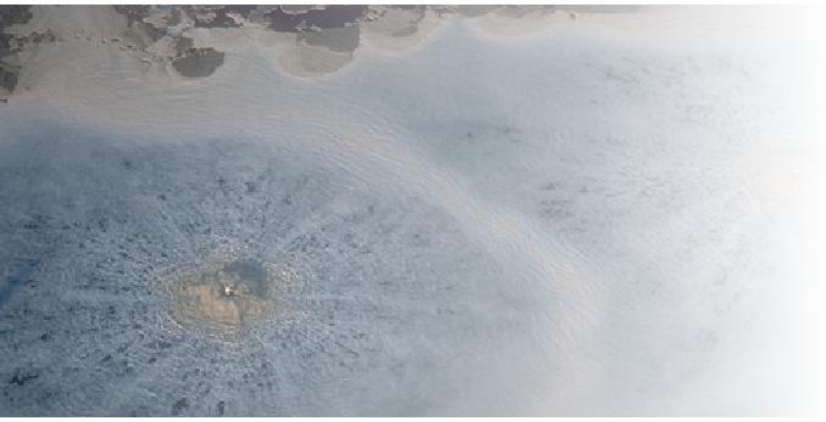

2011 (Year 4) Monitoring Report
Santosh Landfill
Wetland Mitigation Project
Scappoose, Oregon

Prepared for
Oregon Department of
Environmental Quality

December 7, 2011
15563-03/Task 2

HARTCROWSER

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2011 (YEAR 4) MONITORING REPORT
SANTOSH LANDFILL
WETLAND MITIGATION PROJECT
SCAPPOOSE, OREGON

1.0 INTRODUCTION

This Year 4 monitoring report documents the mitigation site conditions in 2009 at the Santosh Landfill in Scappoose, Oregon. The Santosh Landfill is currently being maintained by the Oregon Department of Environmental Quality (DEQ). The project area is located west of Hogan Ranch Road across from the Glacier Northwest facility, and is located in Section 31 of Township 4 North, Range 1 West in Scappoose, Oregon (Figure 1).

In this report, we summarize the site conditions for the wetland enhancement area and present results of the monitoring compared to the performance standards described in the approved mitigation plan. This monitoring report is being submitted to comply with permit conditions. We will complete future mitigation monitoring reports in Year 5. The monitoring schedule is presented in Table 1.

1.1 Background

In 2007, we completed repair of leachate seeps observed at three locations along the southern perimeter of the landfill. The repair work resulted in the filling of 0.04 acres or 1,900 square feet of wetland used as grazed pasture.

We identified a mitigation site located near the southwestern corner of the landfill as mitigation for the permanent wetland impacts. The mitigation site includes 0.13 acre (5,700 square feet) of wetland enhancement. The wetland mitigation plan was designed to replace the lost wetland area and provide additional wetland functions by enhancing the existing degraded wetland. The approved mitigation plan, which included grading, plantings, and fencing was implemented in 2007.

Prolonged inundation from November 2007 through a large portion of 2008 resulted in plant loss within the mitigation area. In November 2008, replacement plant stock was installed throughout the site and appeared to have been largely successful resulting in increased cover of native plants.

In 2011, the wetland mitigation area was significantly disturbed by livestock entering the area through a weak point in the fence. Livestock encroachment

resulted in damage to numerous plants and vegetation areas from trampling and browsing. The fence was promptly repaired and will be monitored to avoid future entry into the mitigation site by livestock using the adjacent grazed pasture.

This compensatory wetland monitoring report has been prepared to meet the permit requirements for the U.S. Army Corps of Engineers and the Oregon Department of State Lands (DSL) under wetland fill application number 38390-RF. We present the results of our Year 4 monitoring in Section 3.

1.2 Project Goals and Objectives

The project goals and objectives include providing mitigation for project impacts in the form of enhancement of the existing wetland complex adjacent to the Santosh Landfill to achieve "no net loss" of wetland functions and to increase wetland functions through the creation of more diverse habitat and plant communities. The project provides vegetation and hydrologic enhancements improving water quality, increasing flood storage, and enhancing the natural biological support functions of the wetland compared to pre-construction conditions.

The main project goals include: 1) enhancing the degraded wetland through installation of native vegetation, 2) creating a permanently inundated area, and 3) providing wildlife habitat. We identified performance criteria and established standards for each criterion to evaluate the success of the wetland mitigation in the approved Compensatory Wetland Mitigation Plan (Hart Crowser 2007). The three performance criteria and their standards for this wetland enhancement project include:

- Total areal cover of native plants: 70 to 80 percent in Year 4 to a minimum of 80 percent in Year 5;
- Survival of installed plants: 80 percent in Year 4 and each subsequent year; and
- Total areal cover of invasive species: less than 20 percent each year.

In 2010, DEQ submitted a request to DSL to alleviate the hydrology monitoring requirements at the project site given the status of the area as wetland and continued observation of inundation and saturation (primary hydrology indicators) during the early part of the growing season. While no response was received, hydrology monitoring at the site has ceased and is considered to be met based on the year 1 through 3 hydrology monitoring results. This monitoring report describes the project's progress in achieving the goals and

objectives outlined in the approved mitigation plan as well as the above performance standards to measure the project's success over time.

2.0 MONITORING LOCATIONS AND METHODS

The DSL requires a minimum 5-year monitoring period for mitigation activities (OAR 141-085-0151(3)). Mitigation site monitoring includes quantitative and qualitative data collection to measure the success of the proposed mitigation.

2.1 Vegetation Monitoring Transects

The wetland enhancement plant communities were sampled along three permanent vegetation transects that provide coverage of the forested, scrub/shrub, and emergent plant communities. A tape measure was extended along each vegetation transect to locate the sample plots. Transect lengths measured 90 feet for transects T1 and T3, and 57 feet for transect T2 (Figure 2). Within each transect, we established 5 permanent quadrants. We used the sample plot locations from Year 1 in order to monitor and compare progress along each transect. Sample plots for herbs were measured using a 0.25-square meter rectangular quadrant, and sample plots for trees and shrubs were measured using a 1-meter circular quadrant. We used the cattle exclusion fencing as a base point for each transect location to ensure the same locations are monitored each year.

We visually evaluated the wetland enhancement plantings along each transect to determine the rate of survival, health, and vigor. Plants were recorded as live, stressed, or dead/dying. Plant survival was calculated by dividing the number of installed living plants by the number of initially installed plants.

We visually estimated the percent cover of individual plant species present within each quadrant. Data collection consisted of species composition and percent cover, total percent plant cover, percent cover of volunteer plants, and percent cover of invasive species. Species coverage values were summed to determine the total areal coverage in each quadrant.

2.2 Photo Points

We established two photo points (P1 and P2) within the mitigation area. We used the cattle exclusion fencing as a base point and permanent location for the photo points (Figure 2).

3.0 RESULTS

Conditions at the Santosh Landfill mitigation site show that the mitigation has improved since Year 1 and mitigation activities were successful on many levels in Year 3. However, cattle entry into the mitigation area in 2011 resulted in significant plant losses and damage at the site. In general, the wetland mitigation area has met one out of three performance criteria (areal cover of invasive weeds) set forth in the mitigation plan for Year 4.

3.1 Vegetation Monitoring

A field visit was completed on September 8, 2011, to document vegetation conditions at the mitigation site. Areal cover provided by native plants was estimated using a sample plot method. Three transects (T1, T2, and T3) were evaluated in the wetland mitigation area (Figure 2). In addition, five sample plots along each transect were evaluated to estimate the cover of native and non-native trees, shrubs, and herbaceous vegetation.

The site contains a variety of wetland plant communities including forested, scrub/shrub, and emergent areas. We describe plant survival and provide general observations in each of these three communities below followed by a summary of the site's overall performance.

During our site visit evidence of livestock encroachment in the mitigation area was observed. A weak point in the fence allowed cattle to enter the area and resulted in significant losses to trees, shrubs, and herbaceous vegetation. Numerous individual plants were trampled and/or heavily browsed. Additionally, the ground surface and associated herbaceous vegetation were disturbed or altogether eliminated. The fence was promptly repaired and will be closely monitored in the future to avoid future livestock entry into the mitigation area.

The vegetation monitoring results are compared to the performance standards in Table 2. A summary of vegetation survival is provided in Table 3 and a summary of sample plot monitoring results in Table 4. Data sheets are presented in Appendix A. Photographs of site conditions during our monitoring visit are shown in Appendix B.

3.1.1 Forested Zone

Given the heavy browsing on the remaining trees and shrubs in the mitigation area, it was difficult to identify many of the installed willows (*Salix* sp.) to a

species level. Therefore, willows have been grouped together under shrubs for Year 4 monitoring purposes.

Trees identified in the forested zone included Oregon ash (*Fraxinus latifolia*) and black cottonwood (*Populus balsamifera*). Survival of Oregon ash remained at 30 percent with the live trees in Year 3 appearing stressed or dying in Year 4 (Table 3). Black cottonwood survival dropped from 60 percent to 0, a notable reduction in tree survival due to livestock encroachment.

In general, the forested zone is performing at a very low level. We anticipate that vegetation within this zone will become re-established over time with the installation of additional plantings and maintenance of the cattle exclusion fence.

3.1.2 Scrub/Shrub Zone

Shrubs installed in the scrub/shrub zone included Hooker's willow (*Salix hookeriana*), Scouler's willow (*S. scouleriana*), Columbia River willow (*S. fluviatilis*), Sitka willow (*S. sitchensis*), Pacific willow (*S. lasiandra*; previously identified under the tree zone), hardhack (*Spiraea douglasii*), and swamp rose (*Rosa pisocarpa*). Survival of installed shrubs ranged from 0 to 84 percent (Table 3). Hardhack performed the best within this zone and had a survival rate of 84 percent. All species of willow had a survival rate of around 50 percent, a considerable reduction from the Year 3 monitoring results. Swamp rose appeared to be heavily impacted by grazing and no live plants were found during our field visit. The majority of the shrubs appeared stressed, dying, or dead.

In general, the scrub/shrub zone is performing at a low to moderate level. We anticipate that vegetation within this zone will re-establish by increasing native plant stock and coverage.

Our evaluation of plant survival is based on the quantity of live trees and shrubs in the mitigation area. The total percent survival of installed trees and shrubs is approximately 50 percent.

The total native plant areal cover criterion includes trees and shrubs as well as emergent and grass species at the site. The average percent cover of trees and shrubs in the mitigation area is approximately 11 percent. This tree and shrub percent coverage reflects a 50 percent reduction in cover since 2010 due to livestock encroachment. The total combined areal cover of native plants is discussed in the Emergent Zone and Vegetation Summary sections (3.2.3 and 3.2.6) of this report.

3.1.3 Emergent Zone

Emergent and grass species were evaluated based on percent coverage in the established monitoring transects. We documented the average cover of native emergents and grasses to be approximately 12 percent along the wetland monitoring transects. Livestock encroachment resulted in a greater than 50 percent reduction in cover provided by emergent vegetation due to trampling of the ground surface which left ruts and exposed bare ground. The most common emergent species was creeping spikerush (*Eleocharis palustris*). In addition, pointed rush (*Juncus oxymeris*) and hardstem bulrush (*Scirpus acutus*) were observed at the site. Areas that supported these emergent species ranged from heavily disturbed to relatively intact. We also documented the percent cover of seeded grass species in the mitigation area. Native grass species were included in our evaluation of emergent and herbaceous vegetation. The most common grass species included water foxtail (*Alopecurus geniculatus*). The grass species were also impacted by livestock encroachment and are likely to re-colonize the area.

The presence of a variety of native and non-native (naturalized) plant species were noted as dominating portions of the mitigation area. The dominant species included common purslane (*Portulaca oleracea*) and waterpepper (*Polygonum hydropiper*). These species are also present within the adjacent wetland areas. We will continue to monitor these species within the mitigation area.

The total average areal cover of native plants (trees, shrubs, emergents, and grasses) in the mitigation area was approximately 22 percent (Table 4).

3.1.4 Open Water Zone

The open water portion of the mitigation area was visually evaluated for aquatic and emergent plant species. A variety of emergent plants and grasses described above were observed colonizing the edge of the open water area in areas that remained relatively undisturbed by livestock encroachment.

3.1.5 Invasive Plants

Invasive plant species were observed in the wetland mitigation area. In past years, small patches of reed canarygrass (*Phalaris arundinacea*) were noted at the site, particularly in the southern corner adjacent to the gate. The southern corner currently contains a significant amount of reed canarygrass (approximately 70 percent cover). However, the remainder of the site contains limited areas (less than 15 percent cover with the majority of the site containing 0 to 3 percent cover) of reed canarygrass and other invasive plants species

(Table 4). In fall 2011, a geotextile fabric was placed along the perimeter of the site adjacent to the mitigation area to reduce reed canarygrass encroachment through shading. Efforts to control reed canarygrass at the site will continue and we anticipate that regular maintenance of the area will maintain coverage of invasive plants below the required 20 percent performance criterion.

Areas containing bare ground and sparse vegetation were observed throughout the wetland mitigation area and were primarily attributed to cattle entering the area. We anticipate that these areas will re-colonize with emergent and grass species over time.

3.1.6 Vegetation Summary

The results of vegetation inspection within the mitigation area are summarized below:

- Total areal cover of native plants was 22 percent, and does not meet the Year 4 goal of 70 to 80 percent;
- Survival of installed plants was 50 percent, and does not meet the Year 4 goal of 80 percent; and
- Total areal cover of invasive species was less than 7 percent and meets the annual goal of 20 percent.

We anticipate that the mitigation area will re-colonize with native vegetation over time through replanting efforts and maintenance of the cattle exclusion fencing.

3.3 Cattle Exclusion Fencing

The cattle exclusion fence around the wetland mitigation area did not effectively exclude cattle from the site. Several loose wires were observed along the fence lines and resulted in cattle entry into the mitigation area. A significant amount of damage occurred to native vegetation as a result of cattle entry, and we noted the presence of large patches of disturbed soil and bare ground created by cattle movement and dung accumulation. The DEQ was alerted and the fence has been repaired. We recommend examining the fence on a monthly basis as well as during annual maintenance activities to ensure that it remains in good condition and effectively excludes cattle from the mitigation site.

3.4 Wildlife Observations

Wildlife observations were also recorded during late summer site visits. Species observed within the mitigation site within emergent and open water areas included a variety of ducks, bullfrog (*Rana catesbeiana*), garter snake (*Thamnophis sirtalis*), and Pacific chorus frog (*Pseudacris regilla*). Bullfrog and Pacific chorus frog are common species found throughout the adjacent wetland area. In addition, great blue heron (*Ardea herodias*), red-tailed hawk (*Buteo jamaicensis*), common robin (*Turdus migratorius*), flicker (*Colaptes* sp.), swallow (*Hirundo* sp.), Canada goose (*Branta canadensis*), and a variety of other birds were observed within the larger wetland complex adjacent to the mitigation area.

4.0 MAINTENANCE AND CONTINGENCY RECOMMENDATIONS

We recommend replacement of dead or heavily damaged trees and shrubs to compensate for losses as a result of livestock entry at the site. In addition, regular maintenance of the mitigation area should resume including weeding, invasive species control, and routine inspections of the fence.

We will continue to monitor and vegetation within the enhancement area in 2012 (Year 5).

5.0 REFERENCES

Hart Crowser, Inc., 2007. Compensatory Wetland Mitigation Plan for the Santosh Landfill. Beaverton, Oregon.

Hart Crowser, Inc., 2008. As-Built Report for the Santosh Landfill Compensatory Wetland Mitigation Project. Beaverton, Oregon.

Hart Crowser, Inc., 2010. 2010 (Year 3) Monitoring Report for the Santosh Landfill Compensatory Wetland Mitigation Project. Beaverton, Oregon.

Table 1 – Schedule for Annual Monitoring
Santosh Landfill Wetland Mitigation
Scappoose, Oregon

Monitoring Element	Year				
	2008 (Year 1)	2009 (Year 2)	2010 (Year 3)	2011 (Year 4)	2012 (Year 5)
Hydrology Monitoring (Midspring)	✓	✓	✓	N/A	○
Vegetation Monitoring (Late Summer)	✓	✓	✓	✓	○
Annual Monitoring Report (by December 31)	✓	✓	✓	✓	○

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✓ - completed to date
○ - scheduled for completion

Table 2 – Summary of Year 4 Monitoring Results
Compared with Performance Standards
Santosh Landfill Wetland Mitigation
Scappoose, Oregon

Criterion	Performance Standard (Year 4)	Results Summary	Performance Standard Met?
Total areal cover of native plants in percent	70 to 80	22.1	No
Survival of installed plants in percent	80	50	No
Total areal cover of invasive weeds in percent	0 to 20	6.5	Yes
Hydrology	Permanent inundation in open water area 0 to 20 percent cover of invasive plants	N/A	N/A

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Table 3 – Summary of Year 4 Vegetation Survival Monitoring Results
Santosh Landfill Wetland Mitigation
Scappoose, Oregon

Survival of Installed Native Trees and Shrubs						
Species	**Live**	**Stressed or Dying**	**Dead**	**Total Quantity Survived**	**Total Quantity Installed**	**Survival Rate (percent)**
Oregon ash (*Fraxinus latifolia*)	---	3	---	3	10	**30**
willow (*Salix lasiandra*, *S. hookeriana*, *S. fluviatilis*, *S. sitchensis*, *S. scouleriana*)	44	40	---	84	179	**47**
Black cottonwood *(Populus balsamifera*)	---	---	---	0	10	**0**
Swamp rose (*Rosa pisocarpa*)	---	---	---	0	11	**0**
Hardhack (*Spiraea douglasii*)	40	2	---	42	50	**84**
Total	**84**	**45**	**---**	**129**	**260**	**50**

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Table 4 – Summary of Year 4 Vegetation Monitoring Results
Santosh Landfill Wetland Mitigation
Scappoose, Oregon

Sample Plot Data in Average Percent Cover				
	Wetland Monitoring Transects			
	T1	T2	T3	Total Average
Native Plants (trees, shrubs, emergents and grasses)	37	19.2	10.2	**22.1**
Other Native and Non-Native Plants (volunteers)	42.2	22.8	23.8	**29.6**
Invasive Weeds[a]	18.2	1	0.2	**6.5**

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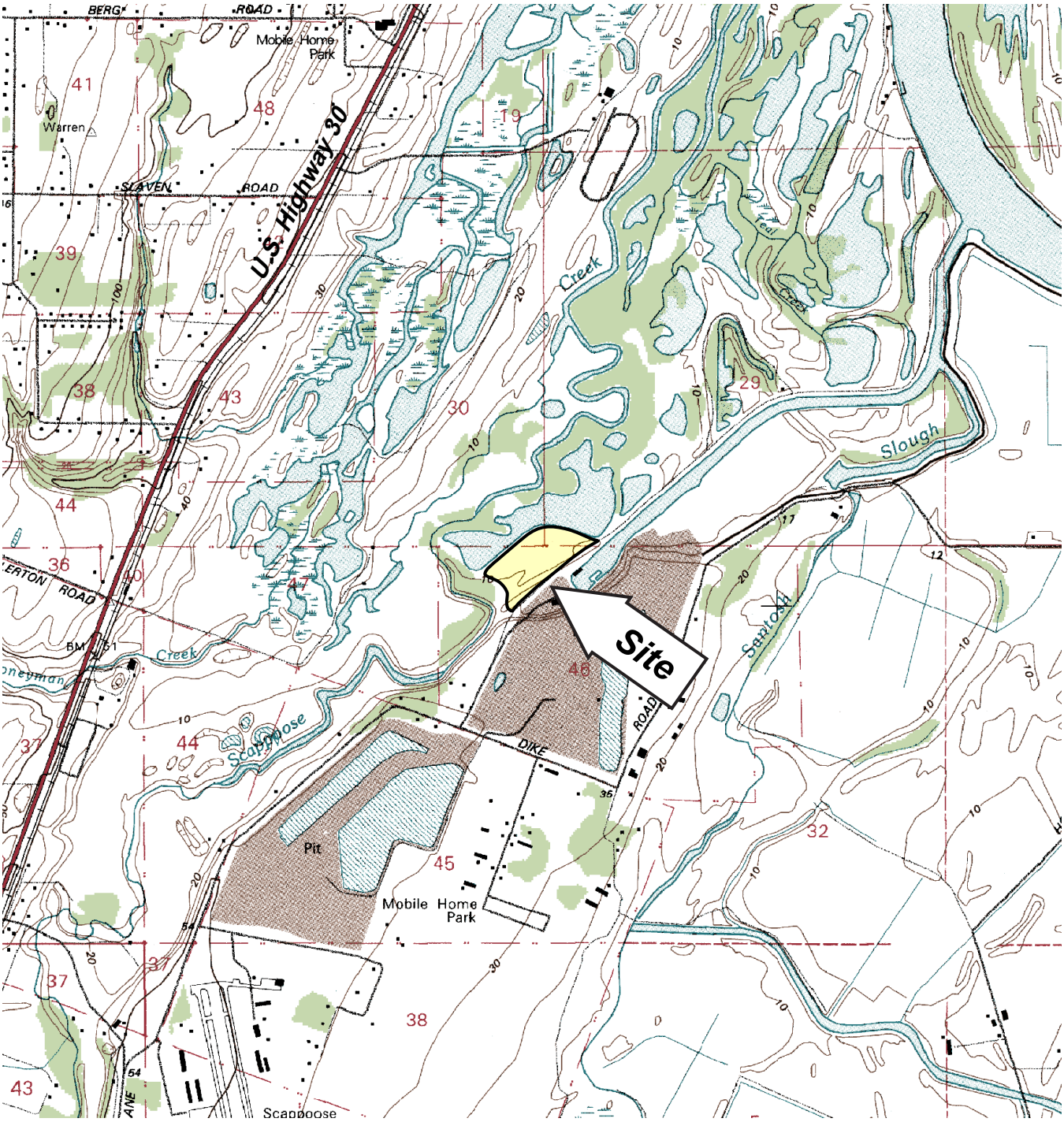
[a] Invasive weeds may include Himalayan blackberry, reed canarygrass, and bittersweet nightshade.



0 2,000 4,000

Scale in Feet

N

Santosh Landfill Scappoose, Oregon	
Site Location Map	
15563-03/Task 2	12/11
HARTCROWSER	Figure **1**

Note: Base map prepared from the USGS 7.5-minute quadrangle of St. Helens, Oregon, dated 1990.

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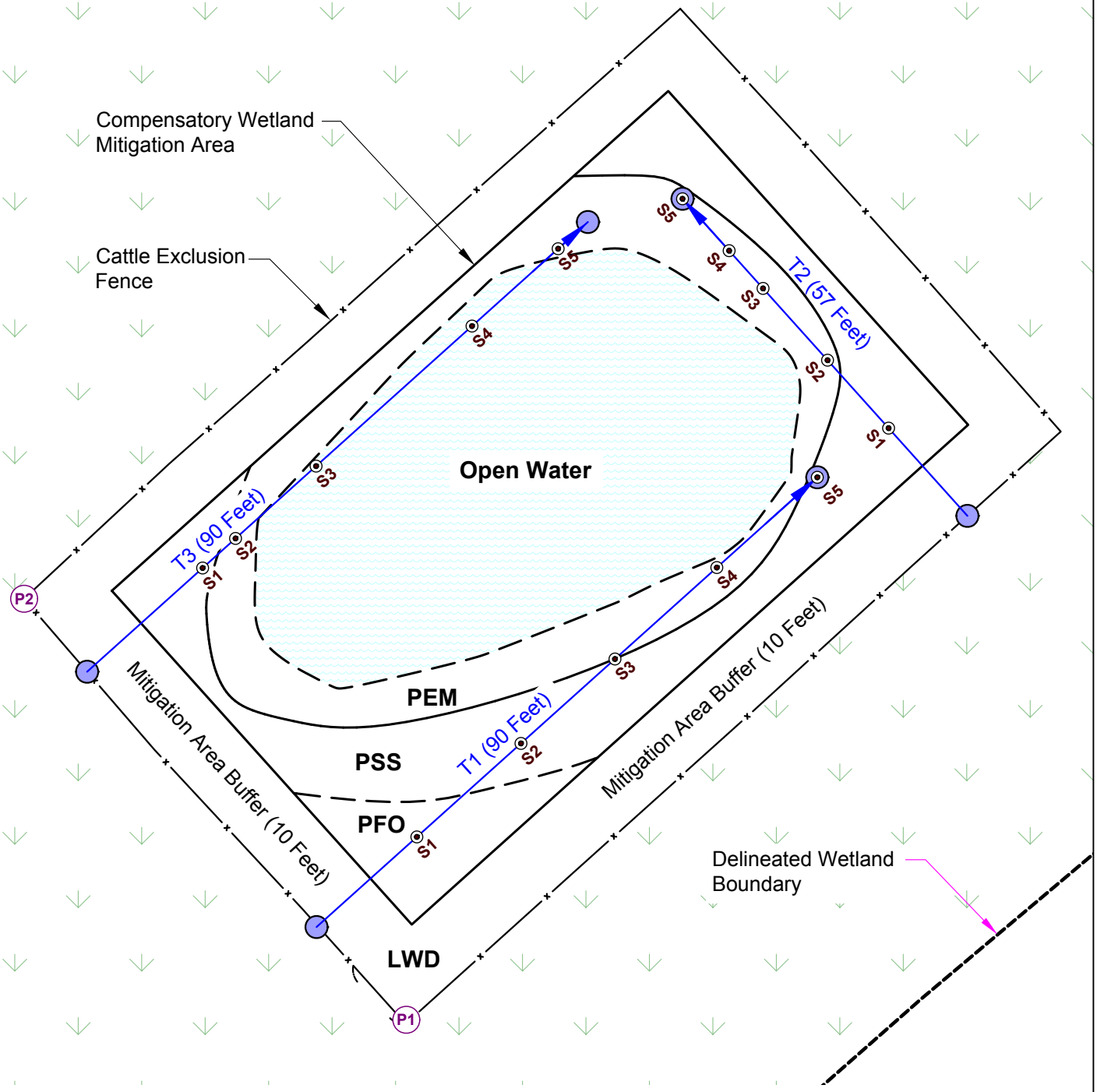

PFO Palustrine Forested

PSS Palustrine Scrub/Shrub

PEM Palustrine Emergent

LWD Large Woody Debris

P2 Photo Point Location and Number

Transect Location and Direction (Sample Plot Locations are Listed in Appendix A)

S1 Sample Plot Location

N

0 20 40

Scale in Feet

Santosh Landfill
Scappoose, Oregon

Wetland Monitoring Plan

15563-03/Task 2 12/11

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Figure
2

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APPENDIX A
VEGETATION MONITORING DATA SHEET

Appendix A - Vegetation Monitoring Data Sheets
Santosh Landfill Wetland Mitigation
Scappoose, Oregon

Site: Santosh Landfill — Investigator: C. Abercrombie
Project Number: 15563-03/Task 2 — Date: 9/8/2011
Transects: 1 and 3 (90 feet); 2 (57 feet)
Sample Plots: 5 per transect
Sample Plot Size: 0.25 square meters rectangular quadrat - herbs, 1 meter circular quadrat - trees/shrubs

Plant Species		Estimated Percent Cover for Sample Plots at Each Transect														
		T1					T2					T3				
Scientific Name	**Common Name**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Trees and shrubs (native)																
Fraxinus latifolia	Oregon ash															
Populus balsamifera	black cottonwood															
Rosa pisocarpa	swamp rose															
Salix sp.*	willow	40	25	4	1		3	8	2	1	6	2				
Spiraea douglasii	hardhack		12	20	5		20	5		3						
Total Percent Cover per Sample Plot (Native Trees and Shrubs)		40	37	24	6	0	23	13	2	4	6	2	0	0	0	0
Emergents (native)																
Agrostis exarata	spike bentgrass															
Alopecurus geniculatus	water foxtail		2	3	20								2	20	7	
Carex sp.	sedge sp.															
Eleocharis palustris	creeping spikerush	2	5			30	15	20	2	8		1	7	2	8	2
Hordeum brachyantherum	meadow barley															
Juncus oxymeris	pointed rush	5	8			3										
Scirpus acutus	hardstem bulrush									3						
Scirpus sp.	bulrush sp.															
Total Cover per Sample Plot (Native Emergents)		7	15	3	20	33	15	20	2	11	0	1	9	22	15	2
Invasive Weeds																
Phalaris arundinacea	reed canarygrass	70	3	15		3	5					1				
Total Cover per Sample Plot (Invasive Weeds)		70	3	15	0	3	5	0	0	0	0	1	0	0	0	0
Other native and non-native plants																
Aster sp.	aster															
Lotus crassifolius	deervetch	2	30	35	10	10	10	3					3			
Mentha arvensis	field mint															
Plantago sp.	plantain															
Polygonum hydropiper	waterpepper		2	5		8	3	12	25	17	35	2	20	15	15	30
Portulaca oleracea	common purslane					35		2								
Moss								2							30	2
Unidentified grasses/herbs		1	3		60	10	5					2				
Bare ground			40	25			65		50	75	60	90	60			25
Total Cover per Sample Plot (Native and Non-native plants)		3	35	40	70	63	18	19	25	17	35	4	23	15	45	32

Average Percent Cover in Sample Plots (Native Trees and Shrubs)

T1	21.4
T2	9.6
T3	0.4
Transect Average	10.5

Average Percent Cover in Sample Plots (Native Emergents)

T1	15.6
T2	9.6
T3	9.8
Transect Average	11.7

Total Percent Cover of Native Plants (Trees, Shrubs, Emergents and Grasses)

T1	37
T2	19.2
T3	10.2
Total Cover	22.1

Average Percent Cover in Sample Plots (Invasive Weeds)

T1	18.2
T2	1
T3	0.2
Transect Average	6.5

Average Percent Cover in Sample Plots (Other Native and Non-native Plants)

T1	42.2
T2	22.8
T3	23.8
Transect Average	29.6

Sample Plot Locations (distance in feet from the beginning of the transect)

	T1	**T2**	**T3**
S1	17	15	18
S2	35	27	25
S3	51	39	39
S4	68	45	66
S5	87	57	81

* Due to heavy grazing of vegetation, a species level determination could not be made.

APPENDIX B
PHOTOGRAPHS

Photograph 1 – Forested and scrub/shrub plantings were impacted by grazing in the mitigation area at monitoring Transect T2 (view looking northwest).

Photograph 2 – Forested and emergent planting areas were impacted by grazing which resulted in plant loss (taken from Photo Point P1, view looking north).

Photograph 3 – The primarily emergent plant community along the edge of the open water was heavily impacted by grazing from Photo Point P2 (view looking northeast).

Photograph 4 – An overview of the mitigation site from Photo Point P2 (view looking east).