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## SR 520 Pontoon Construction (Grass Creek) Mitigation Site
### USACE NWS-2008-151

<table>
<thead>
<tr>
<th>General Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USACE IP Number</strong></td>
</tr>
<tr>
<td><strong>Mitigation Location</strong></td>
</tr>
<tr>
<td><strong>LLID Number</strong></td>
</tr>
<tr>
<td><strong>Construction Date</strong></td>
</tr>
<tr>
<td><strong>Monitoring Period</strong></td>
</tr>
<tr>
<td><strong>Year of Monitoring</strong></td>
</tr>
<tr>
<td><strong>Area of Project Impact</strong></td>
</tr>
<tr>
<td><strong>Type of Mitigation</strong></td>
</tr>
<tr>
<td><strong>Planned Area of Mitigation</strong></td>
</tr>
</tbody>
</table>

1 Impact and mitigation acres from WSDOT (2010). An additional 46.01 acre of mitigation is available for use for other projects subject to future permits and approval by permitting agencies.
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Summary of Monitoring Results and Management Activities (2017)

<table>
<thead>
<tr>
<th>Performance Standards</th>
<th>2017 Results</th>
<th>Management Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal inundation at least 9.0 feet above sea level</td>
<td>Present</td>
<td></td>
</tr>
<tr>
<td>Wetland hydrology</td>
<td>Present</td>
<td></td>
</tr>
<tr>
<td>Cover of native wetland emergent species measured</td>
<td>Documented</td>
<td></td>
</tr>
<tr>
<td>50% cover native, wetland, woody species in the scrub-shrub and forested wetland</td>
<td>52% cover (CI_{80%} = 40-63%)</td>
<td>Weed control activity performed on 4/19, 5/3, and 7/27 in 2017</td>
</tr>
<tr>
<td>Less than 10% cover non-native species in the estuarine wetland</td>
<td>26% cover (CI_{80%} = 23-29%)</td>
<td></td>
</tr>
<tr>
<td>Less than 20% cover non-native species in the forested and scrub-shrub wetlands</td>
<td>5% cover (qualitative)</td>
<td></td>
</tr>
<tr>
<td>Less than 20% cover non-native species in the buffer</td>
<td>10% cover (qualitative)</td>
<td></td>
</tr>
<tr>
<td>No Class A noxious weeds, Japanese knotweed (Reynoutria japonica), or common reed (Phragmites australis) across the site</td>
<td>None observed</td>
<td></td>
</tr>
<tr>
<td>50% cover native woody species in the buffer</td>
<td>43% cover (CI_{80%} = 35-51%)</td>
<td></td>
</tr>
<tr>
<td>Cross-section of reconnected channels measured</td>
<td>Achieved (see Appendix 4)</td>
<td></td>
</tr>
</tbody>
</table>

Report Introduction

This report summarizes fifth-year (Year-5) monitoring activities at the 520 Grass Creek Mitigation Site. Included are a site description, the performance standards, an explanation of monitoring methods, and an evaluation of site development. Monitoring activities included vegetation surveys and photo-documentation on August 7-9, assessments of wetland hydrology on March 16, and channels measured on June 25 and October 9, in 2017. Photos of tidal inundation were taken on January 3, 2018.

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2 Estimated values are presented with their corresponding statistical confidence interval. For example, 52% cover (CI_{80%} = 40-63% cover) means we are 80% confident that the true cover value is between 40% and 63%.
What is the 520 Grass Creek Mitigation Site?

This 65.64-acre mitigation site (Figure 1) is a combination of preservation, restoration, re-habilitation, and enhanced wetlands adjacent to State Route (SR) 109 at the mouth of Grass Creek in the North Bay of Grays Harbor. This site was created to compensate for the loss of 1.10 acres of wetlands and 2.54 acres of other aquatic resources. The losses come as a result of the construction of a casting basin facility to accommodate simultaneous construction of multiple pontoons for the SR 520, I-5 to Medina: Bridge Replacement and HOV Project.

Figure 1  Site Sketch
Grass Creek Mitigation Site goals include restoring natural tidal influence, the rehabilitation of tidal channels and flats through the removal of portions of the dike, removal of a non-functioning tide gate, and the filling of agricultural drainage ditches. In addition, a 150-foot wide buffer now protects the functions of the rehabilitated wetland and channels. Appendix 2 includes site directions.
What are the performance standards for this site?

**Year 5**

**Performance Standard 1**
Estuarine areas will be evaluated annually (Years 1-10) during a high tide event predicted by NOAA to exceed 9.5 feet above sea level (based on NAVD88 datum). Photographs will also be taken at selected locations and representative dates to document tidal inundation to 9.0 feet or higher above sea level (based on NAVD88 datum). The 9.5 feet elevation is consistent with the elevation limits for salt-tolerant vegetation measured at the reference site on the opposite (south) bank of Grass Creek.

**Performance Standard 2**
The soils in palustrine wetlands at the Grass Creek Mitigation Site will be inundated or saturated within 12 inches of the surface for at least 12.5 percent of the growing season (41 consecutive days, as measured in the WETS table for Hoquiam FCWOS AP [USDA NRCS 2002]) in years when rainfall meets or exceeds the 30-year average.

**Performance Standard 3**
Cover of native wetland (facultative and wetter) emergent species will be measured in the estuarine zone and reported in the annual report. Native colonizing species will be included in this overall coverage.

**Performance Standard 4**
Aerial cover of native, wetland (facultative and wetter), woody species (both planted and volunteer) will be at least 50 percent in the scrub-shrub and forested communities of the rehabilitated and enhanced wetland.

**Performance Standard 5**
Non-native species will not cover more than 10 percent of the estuarine wetland areas or more than 20 percent of the palustrine and upland plant communities.

**Performance Standard 6**
Non-native species will not cover more than 10 percent of the estuarine wetland areas or more than 20 percent of the palustrine and upland plant communities.
Performance Standard 7
Non-native species will not cover more than 10 percent of the estuarine wetland areas or more than 20 percent of the palustrine and upland plant communities.

Performance Standard 8
Washington State and Grays Harbor County-listed Class A noxious weeds, Japanese knotweed, and common reed identified on the site will be eradicated.

Performance Standard 9
Aerial cover of native woody species (planted and volunteer) will be at least 50 percent in the buffer planting areas.

Performance Standard 10
Measurements will document the cross-section of reconnected channels at outlet to Grass Creek and at three locations upstream of each reconnected tidal channel outlet. If new tidal channels have formed, their cross-section will also be measured.

Appendix 1 shows the As-built Planting Plan (WSDOT 2011).
How were the performance standards evaluated?

Photographs were taken at selected locations and on representative dates to document tidal inundation to 9.0 feet or higher above sea level as well as at low tide (Performance Standard 1). WSDOT staff collected hydrology data using methods described in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987), *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (Version 2.0) (USACE 2010) (Performance Standard 2).

The figures and table below document the sampling methodology utilized for all the remaining performance standards (PS) as required by the mitigation plan. For additional details on the methods see the WSDOT Wetland Mitigation Site Monitoring Methods Paper (WSDOT 2008).

![Figure 2 Palustrine and Buffer Sampling Design (2017)](image1)

![Figure 3 Permanent Plot Sampling Design (2017)](image2)
**Placement of Baseline:** A 280-meter segmented baseline was placed along the environmental gradient in both the northern and southern portions of the palustrine wetland and buffer (Figure 2). One-hundred and twenty permanent plots were randomly distributed across four distinct elevation zones (Figure 3).

<table>
<thead>
<tr>
<th>Attribute</th>
<th>PS 3</th>
<th>PS 4</th>
<th>PS 5</th>
<th>PS 6</th>
<th>PS 7</th>
<th>PS 8</th>
<th>PS 9</th>
<th>PS 10</th>
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</thead>
<tbody>
<tr>
<td>Cover</td>
<td>Cover</td>
<td>Cover</td>
<td>Cover</td>
<td>Cover</td>
<td>Cover</td>
<td>Presence/Absence</td>
<td>Cover</td>
<td>Width</td>
</tr>
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<td>Target population</td>
<td>Native herbaceous species</td>
<td>Native woody species</td>
<td>Non-native species</td>
<td>Non-native species</td>
<td>Non-native species</td>
<td>Noxious weeds</td>
<td>Native woody species</td>
<td>Channel cross-sections</td>
</tr>
<tr>
<td>Zone</td>
<td>Estuarine</td>
<td>PFO/PSS</td>
<td>Estuarine</td>
<td>PFO/PSS</td>
<td>Buffer</td>
<td>Entire site</td>
<td>Buffer</td>
<td>Estuarine</td>
</tr>
<tr>
<td>Sample method</td>
<td>Daubenmire</td>
<td>Line-intercept</td>
<td>Daubenmire</td>
<td>Qualitative</td>
<td>Qualitative</td>
<td>Qualitative</td>
<td>Line-intercept</td>
<td>Total station instrument and survey rod</td>
</tr>
<tr>
<td>SU length</td>
<td>1 m</td>
<td>15 m</td>
<td>1 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15 m</td>
</tr>
<tr>
<td>SU width</td>
<td>0.5 m</td>
<td>0.5 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total # of SU</td>
<td>116 (four not found)</td>
<td>116 (four not found)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>46</td>
</tr>
</tbody>
</table>
How is the site developing?

This site is developing well and continues to transition from freshwater to saltwater/brackish conditions. The removal of the earthen dike and the non-functioning tide gate has helped to restore the natural hydrology/tidal exchange and floodplain connectivity. High tides regularly inundate the tidal channels and mudflats with subsequent draining during the receding tide. The natural recruitment of salt tolerant emergent species continues around the newly connected tidal channels.

Cover of non-native species in the estuarine wetland is still above the performance standard threshold, however cover is lower than in past years. Estimated reed canarygrass cover values have decreased from 33 percent in 2013, to 17 percent in 2015, to 14 percent in 2017. Invasive cover within the palustrine wetland and buffer remains low.

Native cover in the buffer is slightly below the performance standard target. Regular saltwater inundation in much of this area is making the further development of the woody species difficult.

Coyote scat and tracks, garter snakes, field mice, and six species of birds were observed on-site at the time of monitoring.
Results for Performance Standard 1
(Tidal inundation at least 9.0 feet above sea level):

Photos to document tidal inundation were taken on January 3, 2018 during a NOAA predicted 11.19 feet above sea level tide. See Appendix 2 for selected photos. High tides regularly inundate the tidal channels and mudflats (Photo 1).

Results for Performance Standard 2
(Wetland Hydrology):

Nearly the entire site was saturated to the surface and had large areas of inundation on both hydrology visits (March 16 and 30) in 2017 (Photo 2). This zone is also inundated by high tides.
Results for Performance Standard 3
(Cover of native facultative and wetter emergent species in the estuarine wetland):

Total cover of native facultative and wetter emergent species in the estuarine wetland is qualitatively estimated at 70 percent. Thirteen native facultative and wetter species were observed in the estuarine zone (Photo 3). See Appendix 3, Table 2 for cover estimates of individual species obtained from the permanent vegetation plots.

Results for Performance Standard 4
(50% cover native facultative and wetter woody species in the forested and scrub-shrub wetlands):

Cover of native facultative and wetter woody species in the forested and scrub-shrub wetland is estimated at 52% (CI80% = 40-63%) (Photo 4). This exceeds the performance standard target. Dominant species include Hooker's willow (Salix hookeriana) and Sitka spruce (Picea sitchensis).

Results for Performance Standard 5
(Less than 10% cover non-native species in the estuarine wetland):

Total cover of non-native species in the estuarine wetland is qualitatively estimated at 25 percent. This exceeds the performance standard threshold. See Appendix 3, Table 3 for cover estimates of individual species obtained from the permanent vegetation plots.
Results for Performance Standard 6
(Less than 20% cover non-native species in the palustrine wetland):

Cover of non-native species in the palustrine wetland is qualitatively estimated at five percent. This is below the performance standard threshold. Reed canarygrass (*Phalaris arundinacea*) was the predominant species. Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), and Himalayan blackberry (*Rubus armeniacus*) were present in small quantities.

Results for Performance Standard 7
(Less than 20% cover non-native species in the buffer):

Cover of non-native species in the buffer is qualitatively estimated at 10 percent. This is below the performance standard threshold. Reed canarygrass (*Phalaris arundinacea*) was the predominant species. Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), and Himalayan blackberry (*Rubus armeniacus*) were present.

Results for Performance Standard 8
(No Class A noxious weeds, Japanese knotweed, or common reed across the site):

No Class A noxious weeds, Japanese knotweed, or common reed were observed at the time of monitoring.

Results for Performance Standard 9
(50% cover native woody species in the buffer):

Cover of native woody species in the buffer is estimated at 43% (CI80%= 35-51%). Dominant species include Hooker's willow, red alder (*Alnus rubra*), and salmonberry (*Rubus spectabilis*). This is slightly below the performance stand target.

Results for Performance Standard 10
(Cross-section of reconnected channels measured):

See Appendix 4 for Tidal Channel Monitoring report.

**What is planned for this site?**

Routine weed control will continue in 2018.
Appendix 1 – As-Built Planting Plan
(from WSDOT 2011)
Appendix 2 – Photo Points
The photographs below were taken from permanent photo-points on January 3, 2018 and document current site development.
The photographs below were taken from permanent photo-points on January 3, 2018 and document current site development.

**Photo Point 2d**

**Photo Point 3a**

**Photo Point 3b**

**Photo Point 4a**
The photographs below were taken from permanent photo-points on January 3, 2018 and document current site development.

Photo Point 4b

Photo Point 4c

Photo Point 5a

Photo Point 5b
The photographs below were taken from permanent photo-points on January 3, 2018 and document current site development.

**Photo Point 5c**

**Photo Point 6**

**Photo Point 7a**

**Photo Point 7b**
The photographs below were taken from permanent photo-points on January 3, 2018 and document current site development.

Photo Point 8a

Photo Point 8b
**Driving Directions:**
From US 101 North, take SR 8 West and then continue on US 12 West. Continue on East Wishkah Street. Turn right onto South Alder Street, to a slight left onto Sumner Avenue, to a right onto Levee Street. Turn left onto SR 109 for approximately 10 minutes. The site is on the east side of SR 109. Look for parking pads.
## Appendix 3 – Data Tables

### Table 1. Hydrology Observations

<table>
<thead>
<tr>
<th>Date</th>
<th>Surface Observations</th>
<th>Well ID #</th>
<th>Water Level (inches below soil surface unless otherwise noted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 16, 2017</td>
<td>All of the intended areas are saturated to the surface with pockets and some large areas of inundation.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>March 30, 2017</td>
<td>All of the intended areas are saturated to the surface with pockets and some large areas of inundation.</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 2. Cover of native facultative wet and wetter species in the estuarine wetland

<table>
<thead>
<tr>
<th>Species</th>
<th>Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>inland saltgrass (<em>Distichlis spicata</em>)</td>
<td>23.9%</td>
</tr>
<tr>
<td>Baltic rush (<em>Juncus balticus</em>)</td>
<td>13.6%</td>
</tr>
<tr>
<td>silverweed cinquefoil (<em>Potentilla anserina</em>)</td>
<td>9.1%</td>
</tr>
<tr>
<td>spear saltbush (<em>Atriplex patula</em>)</td>
<td>8.5%</td>
</tr>
<tr>
<td>meadow barley (<em>Hordeum brachyantherum</em>)</td>
<td>6.1%</td>
</tr>
<tr>
<td>tufted hairgrass (<em>Deschampsia caespitosa</em>)</td>
<td>1.9%</td>
</tr>
<tr>
<td>pickleweed (<em>Salicornia depressa</em>)</td>
<td>1.5%</td>
</tr>
<tr>
<td>Lyngbye's sedge (<em>Carex lyngbyei</em>)</td>
<td>1.2%</td>
</tr>
<tr>
<td>seacoast bulrush (<em>Schoenoplectus maritimus</em>)</td>
<td>1.0%</td>
</tr>
<tr>
<td>pickleweed (<em>Salicornia virginica</em>)</td>
<td>0.9%</td>
</tr>
<tr>
<td>soft rush (<em>Juncus effusus</em>)</td>
<td>0.5%</td>
</tr>
<tr>
<td>three-ribbed arrowgrass (<em>Triglochin striata</em>)</td>
<td>0.2%</td>
</tr>
<tr>
<td>common yarrow (<em>Achillea milfolium</em>)</td>
<td>0.2%</td>
</tr>
</tbody>
</table>
Table 3. Cover of non-native species in the estuarine wetland

<table>
<thead>
<tr>
<th>Species</th>
<th>Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>reed canarygrass (<em>Phalaris arundinacea</em>)</td>
<td>13.5%</td>
</tr>
<tr>
<td>creeping bentgrass (<em>Agrostis stolonifera</em>)</td>
<td>6.8%</td>
</tr>
<tr>
<td>bird’s-foot trefoil (<em>Lotus corniculatus</em>)</td>
<td>3.1%</td>
</tr>
<tr>
<td>common brassbuttons (<em>Cotula coronopifolia</em>)</td>
<td>0.9%</td>
</tr>
<tr>
<td>common velvetgrass (<em>Holcus lanatus</em>)</td>
<td>0.5%</td>
</tr>
<tr>
<td>meadow foxtail (<em>Alopecurus pratensis</em>)</td>
<td>0.3%</td>
</tr>
<tr>
<td>tall fescue (<em>Schedonorus arundinaceus</em>)</td>
<td>0.1%</td>
</tr>
</tbody>
</table>
Appendix 4 – Tidal Channel Monitoring
1.0 Introduction
The Grass Creek mitigation site lies between SR 109 and Grass Creek in Grays Harbor County. Mitigation completed on this site, for the SR520 Pontoon project, has restored tidal influence on the site and in the tidal channels that drain the site. This memo describes the results of data collection from 2017 on the tidal channels that were reconnected to Grass Creek following project completion in 2012.

2.0 Methods
Channel cross-section locations were determined based on the anticipated channel changes. Channels B, C, D, D’, and E were surveyed. Channels with smaller drainage areas received more closely spaced cross-sections, and these were closer to Grass Creek. Channels with larger drainage areas received more widely spaced cross-sections, farther from Grass Creek. On all channels surveyed, one cross-section was located at the former position of the berm. Upstream limits of longitudinal profiles were determined based on the anticipated upstream migration of channel changes during the monitoring period. The longitudinal profiles’ downstream limit was the farthest downstream location feasible to survey on foot from the bank. In all cases, the longitudinal profile did not reach the confluence with Grass Creek, due to water depth and steep unstable banks.

We made a separate, initial field trip to locate cross-section and profile monuments. Many of the original wooden hubs and some of the rebar could not be relocated. The location was approximated as closely as possible to the original location, using aerial photographs and GPS units. Fortunately, at least one monument (either right bank or left bank) was found for each cross-section, enabling reasonably accurate re-construction of the channel cross-sections where needed. The end of each cross section was marked with a rebar hammered into about 4 inches above the ground, with a lathe hammered in next to it. Flagging and spray paint were added to the lathe for easier recovery during the next monitoring trip.
3.0 Results & Discussion

The locations of the cross-sections and longitudinal profiles are shown in Figure 1. The cross-sections and longitudinal profiles are shown in Figures 2 through 11. Channels C, D, and D’ exhibit headcutting already. These channels are incising near where they cross the former dike. We expect that they will rapidly move upstream. A headcut is an abrupt change in slope of channel, often vertical. Headcuts are inherently unstable and tend to migrate upstream, hence the term “headcutting.” These channels are incising near where they cross the former dike. We expect that they will rapidly move upstream, though we do not know how far, as it is dependent on many factors, including vegetation and cohesive strength of the underlying strata.

Channel B is the longest channel within the site. A longitudinal profile of about 800 feet was surveyed. Channel B is different than the other tidal channels in that it has a project-created mudflat at the confluence with Grass Creek. This tends to spread out flows and decrease the shear stress across the channel bottom. Compared to 2013, there was significant widening and lowering of the channel, particularly at XS1 and XS2 (Figures 2-5). The longitudinal profile showed some unexpected variation in profile, with erosion in the highest elevation reach, essentially no change in the middle, and erosion at the downstream end (Figure 6). We speculate that the upstream erosion is due to mobilization of organic materials by the increased tidal flux. The downstream erosion was expected, and at XS1, the network of estuary channels is becoming established (Figure 7). We anticipate significant expansion of these channels in the next few years.

Channel G includes a pond that was likely created when the dike was built. In 2013, the headcut was currently about 40 feet downstream from the pond outlet (see Figure 8). The headcut has reached the lower end of where the pond used to be, and has begun to establish tributary channels within the muck that was at the bottom of the pond (Figure 9). The cross-sections spanning the former pond contain low flat areas that connect the lowest surveyable points on the banks. Similar to Channel B, Channel G shows widening and down cutting of the channel, in every cross-section (Figures 8-12). The longitudinal profile showed substantial migration of the headcut, with deepening of the channel of up to 3.5 feet compared to 2013 (Figure 13).

Channel C is relatively short. The longitudinal profile was surveyed from the mouth to where the channel becomes diffuse, about 300 feet and ending in a series of connected, brackish, depressions. This channel also showed some change, but only about a foot of incision (Figures 14-18). We found there to be some inconsistencies in the survey data, and the probably range of error of +/- 0.5 feet. However, some consistent trends were observed: the thalweg of the channel experienced the most change, up to 1.3 feet, while the sides of the channel in each cross-section had lowered in elevation. This change in elevation was greater toward the center of the channel and less toward the end. We
speculate that some of the connate water in the wetland areas adjacent to Channel C has been allowed to drain into the channel. The pore space formerly occupied by water may now be compressing, no longer supported by the water. The pattern of elevation change would be consistent with this kind of process.

Channel D is similar to Channel C. The cross-sections mostly exhibit a narrowly incised “inner” channel, except at cross-section 4, where the flow gets wider and more nebulous (Figures 19-22). Since 2013, the thalweg experienced mild incision, of about -.5 to 1.1 feet, with the greatest change in the lower cross-sections (1-2). This pattern was expected as material is eroded from the channel bottom, and the erosive power is greater at the downstream end. A longitudinal profile of about 300 feet was surveyed (Figure 23). The longitudinal profile showed headcut migration but also some deposition since 2013, both in the lower end of the profile.

Channel E has the deepest profile, being located entirely below 2 feet NAVD88. Only three cross-sections were surveyed (Figures 24-27). Due to the deep incision of the channel, the longitudinal profile was not surveyed separately in 2013. Rather, we established the profile using the low points (thalweg shots) in the three cross-sections that were surveyed. However, in 2017, we visited the channel at low tide and were able to collect more points along the thalweg, particularly at the downstream end (Figure 26). Comparison with 2013 shows an overall decrease in thalweg elevation. Significant erosion of a muck organic layer may have occurred since the tide gate and berm were removed. Being a very deep channel, the shear stresses from tidal flow would be more significant than in the other monitored tidal channels, so it would not be surprising to have more erosion.
Figure 1. Cross-section and long profile location map.
Figure 2. Channel BS1 Cross-sections

Figure 3. Channel B XS2 Cross-sections
Figure 4. Channel B XS3

Figure 5. Channel B XS4
Figure 6. Channel B Longitudinal Profile.

Figure 7. Photo of tributary channel development at XS1, Channel B.
Figure 8. Channel G XS1.

Figure 9. Estuary channel development in former pond, Channel G.
Figure 10. Channel G XS2.

Figure 11. Channel G XS3.
Figure 12. Channel G XS4

Figure 13. Channel G Longitudinal Profile.
Figure 14. Channel C XS1.

Figure 15. Channel C XS2.
Figure 16. Channel C XS3.

Figure 17. Channel C XS4.
Figure 18. Channel C Longitudinal Profile.

Figure 19. Channel D XS1.
Figure 20. Channel D XS2.

Figure 21. Channel D XS3.
Figure 22. Channel D XS4.

Figure 23. Channel D Longitudinal Profile.
Figure 24. Channel E XS1.

Figure 25. Channel E XS2.
Figure 26. Channel E XS3.

Figure 27. Channel E Long Profile.
APPENDIX Site Photos
Literature Cited


