ADDENDUM TO REDDINGTON LEVEE SETBACK

HABITAT MONITORING PLAN

GREEN RIVER, RM 28.2 TO 29.5

Corps Reference Number NWS-2010-1183

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Summary
King County proposes modifications to the Reddington Levee Setback Planting Plan. These changes result in a gain of 0.29 acres of planted area and 2,878 additional plants. The proposed changes leave an area unplanted to facilitate a plant recruitment study, reduce the risk of plantings being affected by a future project, increase the planting area overall by planting areas closer to the water, and tighten the plant spacing in a few areas. The changes are summarized below, and if approved, the attached planting plan will replace the previous plan. Two study proposals are also attached. The goal of planting studies is to improve our planting and maintenance practices in the future. Each study plan has an adaptive management section that explains how King County would work to meet the previously agreed-upon permit conditions if plant survival and cover were to fall below intermediate performance standards.

- Two study sites have been established. The first study, in Area “A”, is a natural recruitment study which complements an identical study being conducted on the Cedar River. The second study will be established in a subsection of Area “C” and will compare hand watering, drip irrigation and control plots. Draft study designs are attached.

- Part of Planting Area “A” has been eliminated to allow for future construction of the planned levee extension and a patch of existing vegetation spanning small parts of Areas “D” and “E” has been removed from the planting areas. Part of Area “A” has also been reserved for the natural recruitment study and will not be planted unless natural recruitment is not successful (see the adaptive management section of the attached natural recruitment study proposal). Planting areas “C”, “G” and “H” have been expanded to improve future riparian conditions and reduce the potential need for invasive species establishment and control. The net change in planting area from all of these changes is a gain of 0.29 acres. The overall shift in planting areas has put more of the planting closer to the water.

- Shrub densities in parts of Areas “D”, “E” and “F” (under the powerlines) have been increased from an average plant spacing of 7 feet to 6 feet; this is to make up for not having trees under the powerlines per the BPA easement (See Note 2 on Page L7). The spacing of the irrigation study area in Planting Area C has been increased from 7 feet to 4.5 feet to meet study objectives.

- Some species were added and some plant mixes were altered. Most plant quantities were rounded to the nearest 10 plants to facilitate plant management.

- The total number of plants on both the left and right banks, including willow and cottonwood stakes, has been increased from 15,580 to 18,458.
Reddington Plant Recruitment Study

The purpose of this study is to determine recruitment rate of native woody plant species in riparian areas following disturbance. The experiment will be located within Planting Zone A which is a large field used as a staging area during levee setback project construction. One half acre within Planting Zone A will be left unplanted. Permanent plots will be established here to monitor natural recruitment of native and invasive species over a five year period. In addition, 15 plots will be sampled in the exact same way within the planted area of Zone A to determine weed frequency, percent cover, and recruitment rate.

Study Design:
4 treatments, 15 replicates, 4m x 4m plots, 1 meter between each plot and around perimeter.

Treatments:
1. Control
2. Weed
3. Water
4. Weed and Water

Weeding will use chemical control (Roundup Pro or Roundup Pro Max), handheld sprayer. Apply once in May to control rosettes, once in August so the herbicide is translocated to roots. Watering will occur for two years, 2x/month in the dry months. Only water woody seedlings, not weeds

Response variables:
1. Frequency of weeds (Y/N)
2. Percent cover of all plants (visual estimate within 4x4m plot)
3. Recruitment rate (seedling count for woody species)

Monitoring Plan:
- Year 1 (2014): Late summer/early fall – one growing season after study is initiated
- Year 3 (2016): Late summer/early fall – three growing seasons after study is initiated
- Year 5 (2018): Late summer/early fall – five growing seasons after study is initiated

Adaptive Management:
If, in year 5, 40% cover of native woody species is not observed in at least 75% of test plots, the study area will be planted with native trees and shrubs to achieve the originally proposed spacing (trees at 12 feet on center and shrubs at 7 feet on center) and to increase the likelihood of reaching Year 10 percent cover targets (75%).
Reddington Irrigation Study

Problem Statement
King County’s levee and revetment projects typically include revegetation of new or disturbed sites with native trees and shrubs. Installation and maintenance of these sites includes planting, mulching, weeding and watering. King County has used both hand watering and drip irrigation on its levee and revetment projects, but has never attempted to determine which method is most effective. More recently it has been suggested that not watering and over-planting to allow for losses may be more cost effective than planting fewer plants and doing intensive watering. Of particular concern is the effectiveness and relative cost of hand watering on levee and revetment slopes where water may run off before it can infiltrate into the plant’s root zone. The purpose of this study is to compare the relative benefits of hand watering, drip irrigation and not watering.

Objectives
1. Determine the effect of three irrigation treatments (hand water, drip irrigate and no water) on plant survival for the purpose of informing future vegetation plans.
2. Meet regulatory requirements related to revegetation on the project
3. Recycle drip irrigation materials salvaged from previous projects

Study Location and Description
The study site will be within the Reddington Levee Setback project on the Green river in Auburn Washington. This project was constructed in 2013 and resulted in the reduction of an existing levee and construction of a new levee in a location set back from river. The project extends from River Mile 28.5 to 29.5. The study will be conducted on a 720 foot long levee segment which runs roughly north-south and is bordered to the east (riverward side) by a wooded wetland and to the west by the levee and a residential community of manufactured homes. The existing steep sided slope landward of the river and wetland was cleared and reworked to install the new setback levee and associated engineered logjams. The new levee face was planted with willow rows/lifts; two lifts near the bottom of the slope and one lift was planted mid slope. The upper slope (above the top willow lift) will be maintained as grass. The area between the willow lifts (approximately 18 to 20 feet in width) will be revegetated with native shrub species. The area between the willow lifts will be the study site.

Study Design
The study will be set up using 4 replicates containing 3 plots of each of the 3 treatments to equal a total of 36 plots. Plot sizes will be 20 feet long by 15 feet deep. The twenty foot dimension will run parallel to the levee. These plot sizes maximize the ability to use recycled materials and still meeting study objectives. The three treatments to be used are: drip irrigation, hand water or no water. Treatments will be assigned in a repeating pattern along the length of the study area. Each plot will be planted with 10 red twig dogwoods and 10 snowberries. In addition, three locations will be prepared in each plot and marked with a stake (unplanted) for evaluation of the distribution of both irrigation and natural rainfall. All plant material will be one gallon stock from the same nursery and installed in winter of 2013/14
during two consecutive days. All plants will be mulched using cardboard and approximately four inches of wood mulch to suppress weeds and conserve soil moisture. The primary metrics will be the total cost of installing and maintaining the plants and the percent survival of each species within each plot.

Analysis
All time and labor hours and material costs associated with the installation and maintenance of the plots will be documented throughout the study and plant survival data for each plot will be collected in late September 2014. Possible outcomes that will be evaluated include:

- Difference in survival between the two treatments and control.
- Difference in cost per plant installed and maintained between the two treatments and control.
- Difference in cost per plant still living at the end of the study period.
- Difference in water distribution in the soil column between the unused planting sites in each treatment.

Limitations
- The site is less exposed than most Green River Levee sites; therefore irrigation may be less critical to the plants in the study area than plants on other levee repair projects.
- If the summer is unusually wet, plants will be less sensitive to differences in irrigation practices.
- Watering protocols will be more tightly controlled than in typical practice and will not capture the variation in watering quality that would be observed less rigid watering programs.
- The study area is between rows of willow stake plantings which will begin to shade the study area within the first few years, thereby reducing the criticality of water to plant survival and changing the fundamental conditions of the site. It is anticipated that the study will be terminated after either the first or second year of irrigation.

Adaptive Management
- The planting in the study area is denser than that of the rest of the Reddington Project area; however, if after year two, plant mortality has reduced the average spacing to below the project-wide density of 6′, additional plants will be needed.
- If, after the first year, one treatment is found to be more cost effective than the other two treatments, and no further data are needed, the entire study area will be treated using the best treatment.
Revised Planting Plan
MATCHLINE - SEE SHEET

SEC. 32, TWN. 22, R. 5 SW, W.M.
SEC. 5, TWN. 21, R. 5 NW, W.M.
SEC. 6, TWN. 21, R. 5 NE, W.M.
SEC. 31, TWN. 22, R. 5 SE, W.M.

NOTES:

1. DO NOT PLANT NATURAL RECRUITMENT AREA.
2. PLANT THIMBLEBERRY AND ROSE ALONG WEST EDGE OF PLANTING AREA.
3. DO NOT PLANT 2-GALLON STOCK IN AREA "A".

A. Fallow Field
147,892 sqft

Trees

<table>
<thead>
<tr>
<th>Species</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottonwood (Stakes)</td>
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</tr>
<tr>
<td>Alder</td>
<td>280</td>
</tr>
<tr>
<td>Western Red Cedar</td>
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</tr>
<tr>
<td>Douglas Fir</td>
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Shrubs

<table>
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</thead>
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<td>Red Twig Dogwood</td>
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<tr>
<td>Tall Oregon Grape</td>
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<tr>
<td>Thimbleberry</td>
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<td>Baldhip Rose</td>
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</tr>
<tr>
<td>Shrub Totals</td>
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</table>

Water and Land Resources Division
\dnrp.kingcounty.lcl\wlrsc\CIP\Share\CADD\1-RIVERS CAD SUPPORT\Reddington Levee_RD_Util\DWG SETBACK\RED-SB_L PLANT.dwg, L5, 11/20/2013 12:00:56 PM, kkitamura, 1:2
**C1. Irrigation Study**

- **Trees**
  - Species: Cottonwood (Stakes)
  - Number: 538

- **Shrubs**
  - Species: Dogwood
  - Number: 360
  - Species: Snowberry
  - Number: 360

**C2. Wetland ELJs**

- **Trees**
  - Species: Alder
  - Number: 70
  - Species: Oregon Ash
  - Number: 100
  - Species: Cottonwood Stakes
  - Number: 180

- **Shrubs**
  - Species: Black Twinberry
  - Number: 270
  - Species: Cluster Rose
  - Number: 130
  - Species: Dogwood
  - Number: 220
  - Species: Salmonberry
  - Number: 200
  - Species: Thimbleberry
  - Number: 200

**NOTES:**

1. **PLANTING AREA "C1" MAY BE PLANTED AFTER FIRST SIGNIFICANT HIGH FLOWS.**
2. **START PLANTING AREA "C2" 6 FEET VERTICAL BELOW TOP OF LEVEE. DO NOT PLANT TREES ON LEVEE SLOPE.**
3. **AREA "C1" IS IRRIGATION STUDY AREA.**
### Lowered Levee

**Area:** 46,140 sqft

- **Trees:** 46
  - Species: Alder, Douglas Fir, Cottonwood
  - Species: Western Red Cedar, Bigleaf Maple
  - Species: Alder, Western Red Cedar
  - Species: Alder, Bigleaf Maple

- **Species:** Alder, Douglas Fir, Cottonwood
- **Number:** 70
- **Spacing:** 12'
- **Shrubs:** 44
  - Species: Red Twig Dogwood
  - Species: Snowberry

- **Species:** Alder, Western Red Cedar
- **Number:** 60
- **Spacing:** 7'
- **Shrubs:** 370

### Powerline Area

**Area:** 124,419 sqft

- **Trees:**
  - Species: Alder
  - Species: Cottonwood
  - Species: Bigleaf Maple
  - Species: Western Red Cedar
  - Species: Oregon Ash
  - Species: Western Crabapple
  - Species: Black Hawthorn

- **Species:** Alder, Western Red Cedar
- **Number:** 130
- **Spacing:** 12'
- **Shrubs:**
  - Species: Red Twig Dogwood
  - Species: Snowberry

- **Species:** Alder, Western Red Cedar
- **Number:** 60
- **Spacing:** 7'
- **Shrubs:**
  - Species: Red Twig Dogwood

### Downstream Barbs

**Area:** 93,000 sqft

- **Trees:**
  - Species: Alder
  - Species: Cottonwood
  - Species: Bigleaf Maple
  - Species: Western Red Cedar
  - Species: Oregon Ash
  - Species: Western Crabapple
  - Species: Black Hawthorn

- **Species:** Alder, Cottonwood
- **Number:** 130
- **Spacing:** 12'
- **Shrubs:**
  - Species: Red Twig Dogwood

- **Species:** Alder, Western Red Cedar
- **Number:** 60
- **Spacing:** 7'
- **Shrubs:**
  - Species: Red Twig Dogwood

### Wetland

**Area:** 34,273 sqft

- **Trees:**
  - Species: Alder
  - Species: Western Red Cedar

- **Species:** Alder
- **Number:** 10
- **Spacing:** 12'
- **Shrubs:**
  - Species: Red Twig Dogwood

- **Species:** Alder
- **Number:** 10
- **Spacing:** 7'
- **Shrubs:**
  - Species: Red Twig Dogwood

### Planting Plan Notes:

- **NOTES:**
  - Yellow stakes 1-2 inches diameter by 6 feet long.
  - *Plant only shrubs under power line row. All vine maple for areas "D" and "E" 6 feet under power lines. Average spacing of shrubs and vine maple under power lines to be 6 feet.
  - Start planting areas "C" and "D" 6 feet vertical below top of levee.
  - Willow and Oregon ash in planting areas "C" will be used primarily between bars.
  - Planting area "C" may be planted after first significant high flows.
**H. Upstream Barbs**

88,554 sqft

**Trees**

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<tbody>
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<tr>
<td>Cottonwood</td>
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<td>120</td>
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<td>Douglass Fir</td>
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**Shrubs**

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<tbody>
<tr>
<td>Red Twig Dogwood</td>
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</tr>
<tr>
<td>Snowberry</td>
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<td>Black Twinberry</td>
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<td>Thimbleberry</td>
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<td>Baldhip Rose</td>
<td>200</td>
</tr>
<tr>
<td>Mock Orange</td>
<td>30</td>
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<tr>
<td>Tall Oregon Grape</td>
<td>80</td>
</tr>
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<td>Ocean Spray</td>
<td>150</td>
</tr>
<tr>
<td>Shrub Totals</td>
<td>1,810</td>
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</tbody>
</table>

**NOTES:**

1. ALL WILLOW STAKES 1-2 INCHES DIAMETER BY 8 FEET LONG.
2. START PLANTING AREAS "G" AND "H" 6 FEET VERTICAL BELOW TOP OF LEVEE.
3. WILLOW AND OREGON ASH IN PLANTING AREAS "G" WILL BE USED PRIMARILY BETWEEN BARBS.
4. PLANTING AREA "H" MAY BE PLANTED AFTER FIRST SIGNIFICANT HIGH FLOWS.
NOTES:
1. PLANT ASH LOWEST ON SLOPE, ALDER MIDDLE SLOPE, AND
   FIR AND MAPLE MIDDLE TO UPPERSLOPE
2. PLANT ONLY WILLOWS UNDER SPA EXCAVATION IN
   SECTION 7. DO NOT PLANT PACIFIC WILLOW.

J. Isaac Evans Main Planting
101,107 sqft

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J. Isaac Evans Main Planting
101,107 sqft

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Water and Land Resources Division

I. Auburn Golf Revetment
46,069 sqft

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<table>
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Shrubs
6'

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<tbody>
<tr>
<td>Willow Stakes</td>
<td>75</td>
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</table>

Tree Totals
460

Shrub Totals
75
### R. Isaac Evans Buffer Planting
- **Area:** 7,140 sqft
- **Trees:** 16'
- **Spacing:**
  - **Species:** Western Red Cedar
    - **Number:** 20
  - **Species:** Douglas Fir
    - **Number:** 10

### L. Isaac Evans Lawn Planting
- **Area:** 5,000 sqft
- **Trees:** 10'
- **Spacing:**
  - **Species:** Western Red Cedar
    - **Number:** 10
  - **Species:** Douglas Fir
    - **Number:** 10
  - **Species:** Bigleaf Maple
    - **Number:** 10

**Tree Totals:**
- **R. Isaac Evans Buffer Planting:** 30
- **L. Isaac Evans Lawn Planting:** 30