



WA State Dept. of Ecology - Washington Conservation Corps  
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# Impact Evaluation 2014–2015 Washington Conservation Corps Restoration Sites

Prepared October 2015 by:

The Watershed Company  
750 Sixth Street South  
Kirkland WA 98033  
(425) 822 – 5242  
watershedco.com

Prepared for:

Bridget Mason  
Washington Conservation Corps  
Washington State Department of Ecology  
PO Box 47600  
Olympia, WA 98504





**IMPACT EVALUATION 2014-2015**

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Bridget Mason  
Washington Conservation Corps  
Washington State Department of Ecology  
PO Box 47600, Olympia, WA 98504

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750 Sixth Street South  
Kirkland . WA 98033

p 425.822.5242  
f 425.827.8136  
watershedco.com

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**The Watershed Company Reference Number:**  
140829

**The Watershed Company Contact Person:**  
Nell Lund, PWS, Ecologist  
Sarah Sandstrom, Fisheries Biologist



# EXECUTIVE SUMMARY

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Washington Conservation Corps (WCC) focuses on design and implementation of environmental restoration projects, including wetland and riparian corridor enhancement and restoration. The program receives AmeriCorps funding for implementation of environmental and disaster services. To meet AmeriCorps funding requirements, the WCC is required to evaluate the success of grant-funded restoration projects with an independent statistical analysis. WCC contracted The Watershed Company (TWC) to develop methods and assess the efficacy of the WCC restoration activities over the course of one year (2014-2015).

The Evaluation Plan, developed by TWC in October 2014, was designed to assess changes in native cover and invasive cover via a Before-After, Control-Impact (BACI) statistical analysis. Performance standards were established for one growing season to provide additional quantitative measures for comparison. 23 restoration sites and 23 control sites were evaluated.

The statistical analysis indicates that restoration efforts achieved the goals of improving native cover and diversity and decreasing invasive cover (Table ES-1 below). Native cover increased by 9.6 percent at restoration sites compared to 0.4 percent at reference sites. Noxious weed coverage decreased by 15.6 percent at restoration sites compared to a decrease of 1.4 percent at reference sites. Both results were statistically significant. Native vegetation coverage is expected to continue to increase as planted vegetation grows; correspondingly, invasive coverage is expected to continue to decrease as native vegetation becomes established. The impact of initial restoration actions is statistically significant and demonstrate the WCC is using effective intervention techniques.

Table ES-1. BACI Analysis Results.

| Metric                   | Year-1 Result     |                 | Statistical Analysis |                         |
|--------------------------|-------------------|-----------------|----------------------|-------------------------|
|                          | Restoration Sites | Reference Sites | p-value              | Significant difference? |
| Native woody plant cover | 9.6% increase     | 0.4% increase   | 0.03                 | Yes                     |
| Noxious weed plant cover | 15.6% decrease    | 1.4% decrease   | 0.03                 | Yes                     |

To further analyze WCC/AmeriCorps restoration practices, additional quantitative measures were assessed. Performance standards were established to assess survival of installed native plants, native plant diversity, and invasive noxious weed cover. Performance standards are routinely applied to mitigation and restoration projects to measure achievement of project goals over the plant establishment period, typically 5 years. The Watershed Company monitors stream, wetland, and buffer mitigation sites in the region routinely. In our experience, achieving the performance standards for native plant survival, and maintaining invasive plant cover below the threshold, requires ongoing maintenance, particularly in the first two years. Performance standards are typically applied to mitigation or restoration projects over a 5-year

period. Since this study only covers one growing season, the utility of the performance standard review is limited.

Recorded survival was within the normal range for the first year following planting. Average survival was 72 percent, slightly lower than the 80 percent performance standard target. The unusually hot and dry summer of 2015 likely contributed to higher mortality than expected in normal rainfall years. Additionally, planting material at 9 of the sites included live stakes; a lower 50 percent survival is typical for live stakes in the first year. The diversity performance standard was likely achieved at all sites, but could only be confirmed at 16 of 23 sites due to reliance on transect data, rather than site-wide data. Although noxious weed cover decreased significantly at restoration sites, the invasive cover performance standard was achieved at 6 of 23 sites. It is common that sites with established monocultures of noxious weeds require more than one growing season following initial restoration actions to meet invasive species standards. For example, shading provided by dense planting of shrubs is one of the most effective measures for controlling reed canarygrass. This level of shading is expected to take several years to develop; therefore, the 10 sites that had pre-existing reed canarygrass monocultures are expected to see greater decreases in invasive plant cover in future years as shading from planted tree and shrub cover increases. Several opportunities for further investigation are identified, including multi-year assessment of restoration outcomes.

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# IMPACT EVALUATION 2014-2015

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## WASHINGTON CONSERVATION CORPS RESTORATION SITES

### 1 INTRODUCTION

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The Washington Conservation Corps (WCC) is an environmental service program that has provided opportunities for young adults to protect and restore our natural environment since 1983. Improving habitat for state and federally listed species, including anadromous fish, is a primary goal of the WCC. WCC projects include wetland and riparian corridor enhancement and restoration. The Washington State Department of Ecology (Ecology) administers the WCC program. Since 1994, WCC has been an AmeriCorps program.

To comply with AmeriCorps grant requirements and review its restoration practices, the Washington Conservation Corps (WCC) hired The Watershed Company to prepare an evaluation plan and provide an independent, quasi-experimental assessment of WCC restoration activities.

The Watershed Company is a Seattle area environmental consulting firm. The firm provides comprehensive services in critical areas assessment, restoration and mitigation design, environmental planning and permitting, landscape architecture, and water resources. It has been a leader in science-based design for natural resource mitigation and recovery in Washington State for over 30 years.

This evaluation assesses the outcomes of WCC restoration projects in riparian corridors within one year of planting. Outcomes evaluated include the change in native cover, change in invasive cover, survival, and species diversity.

### 2 GOALS AND PERFORMANCE STANDARDS

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Restoration site conditions are commonly measured against project goals and performance standards over a period of years as installed vegetation becomes established. Five to ten years are typical monitoring periods for stream, wetland, and buffer mitigation sites. Native plants tend to remain small in stature for the first two growing seasons as the root systems become established. When plants are in good

health, significant growth and increases in plant cover occur in the third growing season and beyond. Recognized ecosystem benefits from riparian restoration (e.g., stream shading, microclimate, wildlife habitat, large woody debris, and bank stabilization) are generally realized well after initial plant establishment.

This assessment took place over the initial growing season; therefore, the project goals focused on establishing native plant cover and reducing invasive species cover. Performance standards were also proposed to provide a quantitative measure for comparison. Performance standards for invasive cover typically apply to all years post-establishment; however, it is recognized that several years of site maintenance following planting may be required to meet the proposed invasive species standards.

## Goals

1. Improve habitat functions within subject segments of riparian corridors by:
  - a. Establishing a diverse assemblage of native plants at an appropriate density.
  - b. Reducing the presence of invasive plants.

## Performance Standards

The standards below are used to help assess the success of initial, Year 1, restoration efforts at each site.

1. Survival: Achieve an average of 80 percent survival of installed native trees and shrubs at each site.
2. Native plant diversity: Establish at least three native tree species, and four native shrub species. Native volunteer species may count towards this standard.
3. Invasive cover: Invasive cover standards vary by species and pre-existing site conditions.
  - a. Reed canarygrass (*Phalaris arundinacea*):
    - i. Small locally-dominant patches across site: No more than 20 percent cover in each restoration site.
    - ii. Pre-existing monoculture: A minimum 12-inch radius around installed plants must be kept clear of RCG. Cutting and mulch application are an acceptable alternative to uprooting the reed canarygrass.
  - b. Knotweed (*Polygonum spp.*): Eradicate from the restoration site.\*  
*\*Knotweed are robust perennials, which may not be eradicated from a site in a single year. Manual and/or chemical control may be repeated in the summer/fall of 2015 to meet this standard. If manual removal methods are used, all knotweed must be properly disposed of off-site.*
  - c. All other invasive noxious plants: No more than 10 percent cover by noxious weeds in the restoration area.

## 3 METHODS

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The sampling methodology was designed to enable a Before-After Control-Impact (BACI) analysis (Stewart-Oaten 1986, Stewart-Oaten et al. 1992, Underwood 1992, Stewart-Oaten 2003). A summary of methods is provided below. Refer to the 2014 Evaluation Plan for more information.

### 3.1 Sampling Sites

Twenty-three (23) randomly selected restoration sites were paired with 23 reference sites. Selected restoration sites were at least one-acre in size. Each reference site was similar to the pre-restoration conditions at its paired restoration site. To minimize variability due to patch size, reference sites were at least a quarter-acre in size.

### 3.2 Sampling Design

The sampling design included an assessment of pre-restoration site conditions (collected in fall/winter) and post-restoration site conditions (collected in spring/summer). As described above, sampling was conducted at both restoration and reference sites. This design allowed impacts from restoration actions to be differentiated from natural variability and stochastic events.

#### 3.2.1 Data Collection

##### Restoration Sites

###### *Before (pre-restoration site conditions)*

Pre-restoration site conditions were recorded at each site. Data collection included: a description of the dominant invasive plants at each site, existing native vegetation conditions, and visual cover estimates for native vegetation, total noxious vegetation, reed canarygrass, knotweed, and other weeds. Photo points were also established for before-after documentation.

To capture initial impact site conditions and document potential variability among sites, initial impact site data collection included site preparation and plant installation details. Variables such as invasive plant removal methods, soil amendments, bare-root or container plants, planting density, and irrigation, were recorded for review in the final evaluation.

Representative transects were established across each site. Those transects were used to record species and quantities of plants installed following a belt-transect approach. This data provided baseline plant counts for Year 1 plant survival estimates and native plant species diversity assessments. A survival evaluation was performed to track initial impacts of restoration activities. Photo points were established at transect ends.

*After (post-restoration site conditions)*

Post-restoration conditions were recorded immediately following the restoration action (fall/winter 2014) and one-growing season later (late summer 2015). Native and invasive plant cover estimates, plant health and vigor, and established photo points were recorded. The established belt-transects were resampled to conduct a representative survival count of installed plants at each site.

**Control (reference sites)**

Data collection at reference sites followed a similar protocol to restoration sites. Native and invasive cover estimates, plant health and vigor, and established photo-points were recorded once in winter 2014 and once in late summer 2015. Belt transects were not established at reference sites.

### **3.3 Statistical Analysis**

Data collected on native and invasive plant cover was analyzed using a 2-tailed t-test. The analysis tested the following null hypotheses:

1. Restoration actions did not affect native cover.
2. Restoration actions did not affect noxious weed cover.

Statistical significance was determined using an alpha of 0.05. The power to detect a 20 percent difference in cover, given a standard deviation of 20 percent was 0.89.

### **3.4 Quality Control**

Results were reviewed for completeness and accuracy. Accuracy was reviewed through a comparison of recorded data to photo points. Two restoration sites and three reference sites were omitted from statistical analysis due to missing data and inconsistencies between data and photo documentation. The number of sites meeting quality control thresholds and included for this analysis (21 restoration sites and 20 reference sites) exceeded the targeted statistical power of 0.8 and exceeded the initial target established in the evaluation plan (17 restoration and reference sites).

## **4 RESULTS**

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### **4.1 Summary of Restoration Sites and Actions**

WCC/AmeriCorps crews planted native vegetation at each of the 23 restoration sites. The timing of planting ranged from October 2014 to April 2015. Plant materials included bare-root plants (13 sites), potted plants (17 sites), and live-stakes (9 sites). A combination of bare-root, potted, and live-stake plantings were planted at 12 of the

restoration sites. Native vegetation protection methods (e.g., mulching, fabric sheeting, and tree protection) were employed at 16 of the 23 sites.

Noxious weeds were initially present at all but one of the restoration (impact) sites and two of the reference sites. Reed canarygrass was initially present at 17 of the reference sites and 17 of the impact sites. The initial cover of reed canarygrass varied widely across those sites (1-99 percent cover in the early, pre-restoration condition). Knotweed was initially present at two of the restoration sites and at six of the reference sites. Other noxious weeds observed include: Himalayan blackberry (*Rubus armeniacus*), evergreen blackberry (*R. laciniatus*), scotch broom (*Cytisus scoparius*), Canada thistle (*Cirsium arvense*), bull thistle (*C. vulgare*), tansy ragwort (*Senecio jacobaea*), English ivy (*Hedera helix*), and butterfly bush (*Buddleja davidii*).

WCC/AmeriCorps Crews employed some method of weed control at 19 of the restoration sites, including trimming (15 sites), hand removal (11 sites), grubbing (10 sites), and/or herbicide applications (12 sites). At several sites, multiple methods of weed control were employed. Weeds were transported off-site for disposal at 7 of the sites. Once a site was prepared and plants installed, further site maintenance was determined by the project sponsor.

## 4.2 Change in Cover

On average, native cover increased at restoration sites by 9.6 percent compared to reference sites where native cover increased by 0.4 percent on average (Figure 1). The increase in native cover at the restoration sites was significantly greater than at the reference sites ( $p = 0.03$ ).

The mean cover of noxious weeds decreased at restoration sites by 15.6 percent compared to reference sites, where mean noxious weed cover decreased by 1.4 percent (Figure 2). This difference was also statistically significant ( $p = 0.03$ ).

The cover of reed canarygrass decreased at restoration sites (-8.6 percent) more than at reference sites (-0.4 percent) (Figure 3); however, the difference between reference and restoration sites was not significant ( $p = 0.10$ ).

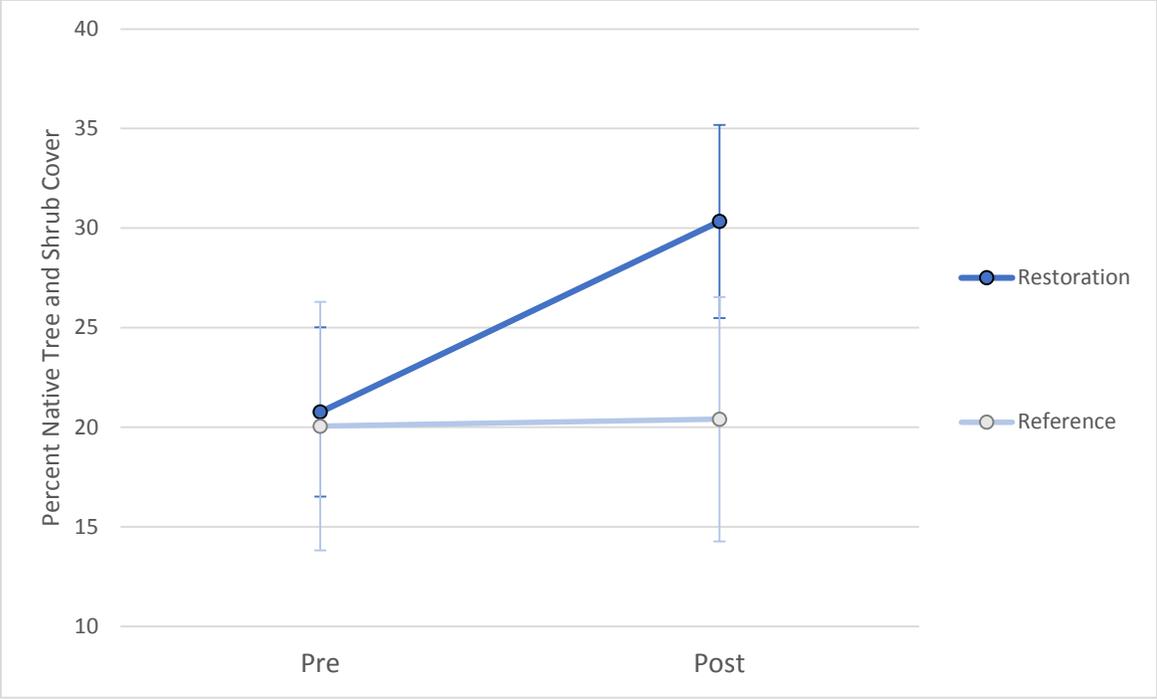


Figure 1. Mean percent native tree and shrub cover (+/- standard error) before and after at restoration and reference sites

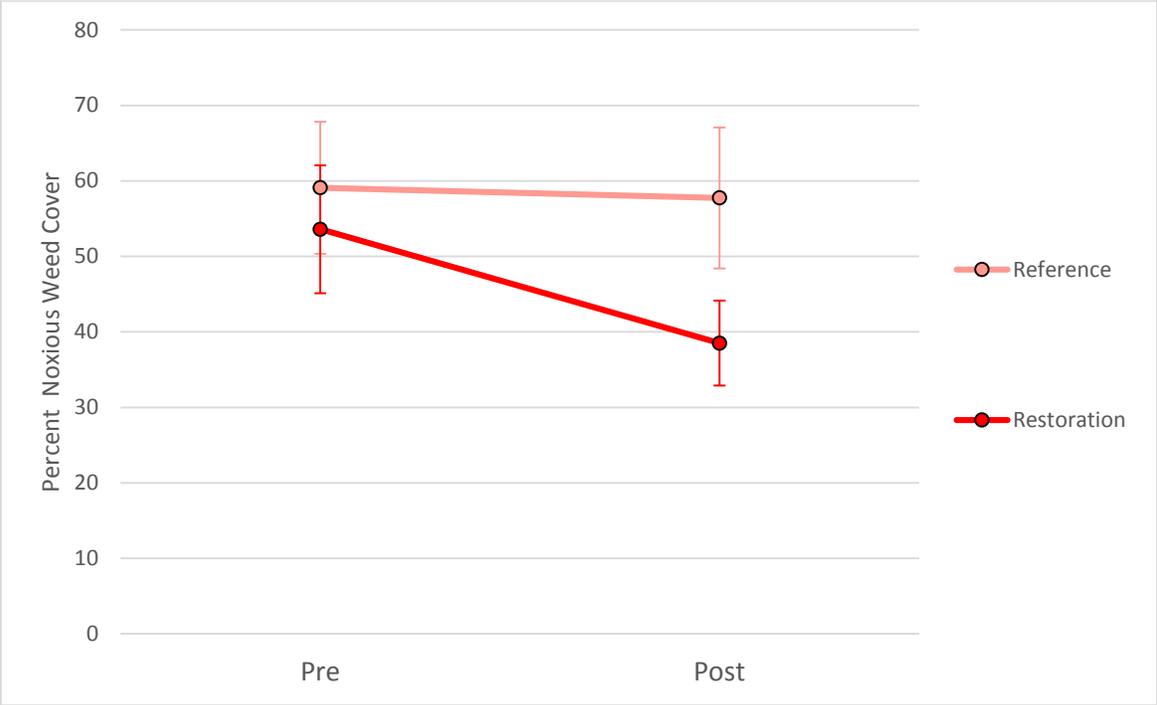


Figure 2. Mean percent noxious weed cover (+/- standard error) before and after at restoration and reference sites

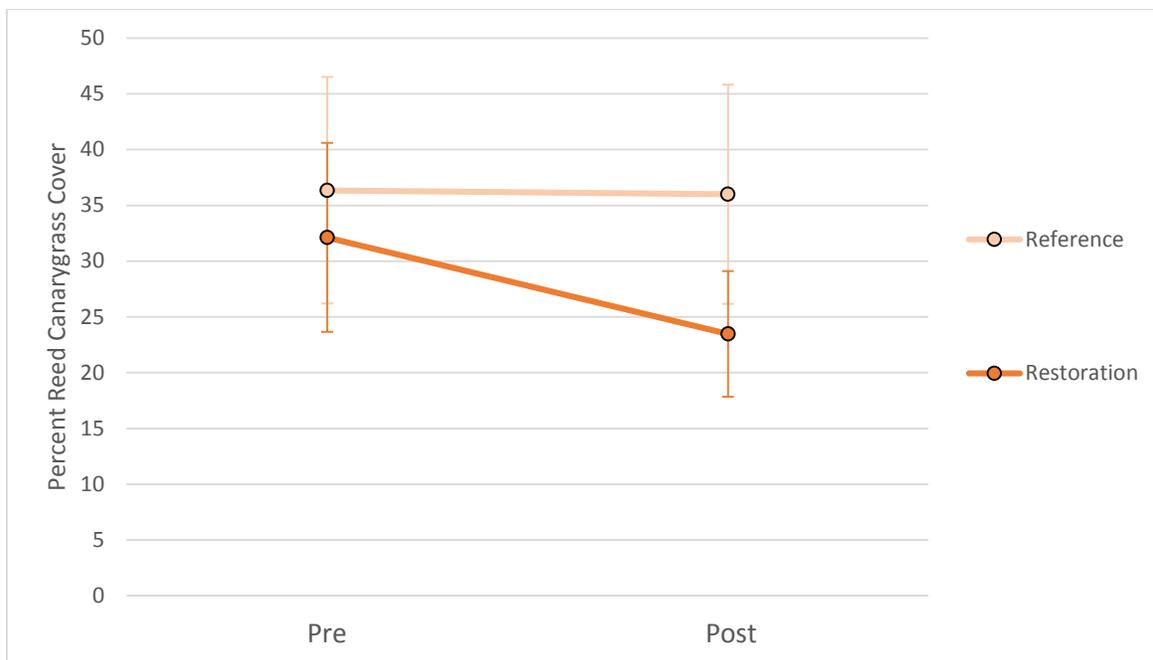


Figure 3. Mean percent reed canarygrass cover (+/- standard error) before and after at restoration and reference sites

### 4.3 Performance Standards Assessment

Performance standards are typically applied to mitigation or restoration projects over a 5-year period. Since this study only covers one growing season, the utility of the performance standard review is limited. The results among sites for achieving Year 1 performance standards were varied (Table 1). Detailed tables are provided in Appendix B.

Average survival across all sites was slightly below the 80 percent target; 9 of 23 sites met the 80 percent survival standard. Average plant survival is high at 72 percent.

An average of 4 trees and 7 shrubs were established per site. The diversity standard was definitively met based on transect data alone at 16 of 23 sites. In addition, based on supplemental plant lists, this standard was likely met at all 23 sites.

Only one of the 10 restoration sites that had a pre-existing reed canarygrass monoculture appeared to have mulched rings and cleared vegetation surrounding the native plantings. The invasive cover performance standard for sites without pre-existing reed canarygrass monocultures was met at 5 of 13 sites, and met both the zero tolerance standard for knotweed and the overall performance standard of less than 10 percent cover by noxious weeds. See discussion notes on why this standard may not have been feasible in a single-year assessment.

Table 1. Performance Standards Summary

| Performance Standard                           | Summary  |
|--|--|
| PS-1. 80% Survival                             | 9 of 23 sites meet. Average: 72%.  |
| PS-2. Diversity (3+ trees; 4+ shrubs)          | Per transect data, 16 of 23 sites meet. *Presumed to meet at most or all of sites. |
| PS-3. Invasive cover (preexisting monoculture) | 1 of 10 sites meet all requirements.   |
| PS-3. Invasive cover (all others)              | 5 of 13 sites meet all requirements.   |

## 5 DISCUSSION

The WCC restoration projects successfully achieved the goals of establishing a diverse assemblage of native plants and reducing the presence of invasive plants. A statistical analysis confirmed that restoration actions significantly increased native cover and reduced the cover of noxious weeds. Based on transect data, a diverse assemblage of native trees and shrubs was also established.

Reed canarygrass also decreased after restoration efforts compared to reference sites, although results were not statistically significant. One effective method of reed canarygrass control is to establish shade through dense cover of native plantings (Kim et al. 2006); therefore, sites employing this approach may not experience a significant reduction in reed canarygrass until several years after initial restoration activities. The ten sites that had pre-existing reed canarygrass monocultures are expected to see greater decreases in future years as shading from planted tree and shrub cover increases.

Based on belt transect data and invasive cover class estimates, performance standards were not uniformly met at each site. However, it is important to note that Year 1 performance standards are typically guidelines in multi-year evaluations that provide opportunities to improve over a greater time period than a single year. It should be noted that WCC/AmeriCorps crews typically implement supplemental plantings (as is common at most environmental restoration sites) to meet long-term biodiversity, native/invasive coverage, and survival standards.

Plant survival may have been lower in 2015 compared to most years because of record heat and dry conditions, with 85 percent of Washington State experiencing drought ([www.governor.wa.gov](http://www.governor.wa.gov)). These conditions can stress new plantings and tend to lower survival rates, particularly if regular irrigation is not otherwise provided. In spite of drought conditions, plant survival was relatively high at 72 percent on average. During the plant establishment period, survival standards are typically met through replanting.

Planting efforts increased the diversity of native vegetation at the restoration sites. While most sites (16 out of 23) met the diversity standard for three native trees and four native shrubs based on transect data, this standard was met at more sites based on a

review of the original planting lists. However, based on the original planting lists, at least two of the sites, such as the Joyce or Oshea sites, could not have achieved diversity standards without volunteer native plant species becoming established because fewer than three trees or four shrub species were planted. At these sites, native forest and/or shrubs were present prior to restoration, and we expect that increasing native diversity was a secondary goal to increasing overall native cover.

Invasive noxious plant cover did significantly decrease at all sites, even if not all sites met the established performance standards for Year 1. Invasive noxious weed plant cover thresholds in the established performance standards are typically achieved through ongoing site maintenance, performed at least twice annually. Success in reducing invasive species cover over the plant establishment period is tied to the level of maintenance that sites receive. Project sponsors are typically responsible for scheduling site maintenance over the course of the growing season, and the scheduling of such maintenance varies among sponsors. This introduces variability in the success of restoration actions in Year 1 and beyond.

Cover thresholds for invasive plants, as stated in the performance standards, reflect best management practices for noxious weed species, particularly reed canarygrass and knotweed. Establishing plants within a reed canarygrass monoculture is commonly achieved by reducing competition within the dripline of newly installed plants, rather than attempting to reduce reed canarygrass coverage site-wide. Reed canarygrass growth is suppressed by shade, which installed native plants provide over time. Knotweed is a robust perennial that spreads vegetatively, often from root and stem fragments conveyed along streams. Along waterways, a watershed approach is necessary to eradicate knotweed. It is typical to require eradication of knotweed from mitigation and restoration sites during the plant establishment period. However, it is recognized that this can only be achieved through active site maintenance and may not be sustained in the long-term.

Overall, data were collected per the evaluation plan. As discussed in the methods, data from a few sites were not included as a result of incomplete data or results that were not consistent with observed conditions based on photo documentation. Consistency in data collection could be improved through more training before each round of sampling, possibly with a consultant present to answer questions. A reference plant guide could be helpful to increase consistency in identification of existing vegetation. Additionally, photo documentation of volunteer species or other observations, such as evidence of deer browse, could be helpful in interpreting results.

Results from this evaluation indicate that the WCC utilizes intervention strategies that are consistent with proven techniques practiced throughout the region. This evaluation provides strong evidence that the restoration activities were successful in meeting the goals of increasing the cover and diversity of native vegetation and reducing invasive species cover. The sites showed high survival rates overall, despite record dry

conditions, which have contributed to higher than normal mortality among restoration sites in the region (based on observations from ongoing multi-year monitoring at dozens of sites conducted by The Watershed Company). Sites that fell short of performance standards for invasive cover are expected to experience continued reduction in noxious weed cover in future years as a result of continued maintenance and shading from native plants.

Suggestions for continuing to improve and sustain success at restoration sites include, where feasible: 1) the use of potted plants instead of bare-root; 2) scheduled maintenance plan with host-site sponsors; 3) early fall installation for better chance of precipitation; and 4) irrigation during the first two to three years after plant installation; especially in dry areas and during drought years.

## 5.1 Opportunities for Further Investigation

Table 2 highlights study options and areas identified for further investigation of WCC restoration performance and assessment in future years. Suggestions include a multi-year analysis, or study designs focused on specific noxious weed species or restoration methods.

Table 2. Opportunities for additional investigation

| Variable            | Description  | Suggested Action   |
|---------------------|--|--|
| Study timespan      | Single-year approach yields limited results.   | Conduct a multi-year study that assesses habitat improvement over a longer period of time. Sites used in this study could be re-evaluated over several years. The occurrence or lack of maintenance activities could introduce variability in the success of restoration sites. Similar maintenance across sites would be helpful to isolate the effects of restoration actions. |
|                     |  |  |
| Restoration methods | A variety of planting, native protection, and invasive control methods were employed in this study. This study was not designed to compare the success of different methods. | Conduct a study with a balanced design to assess the effectiveness of specific methods of interest (e.g., bare-root versus potted, trimming versus mulch).   |

| Variable | Description | Suggested Action  |
|----------|-------------|---|
|          |             | This analysis could also include a relative cost-savings evaluation that compares the time invested in the restoration action to the restoration outcome on a per-area basis. |

## 5.2 Summary

In conclusion, restoration activities conducted by the WCC crews in 2014-2015 successfully met the goals of increasing native vegetation cover and diversity and reducing invasive cover. A range of results were observed among the sampled sites. Further investigation over a longer time period would help to quantify the value and sustainability of ecological benefits the program provides. Additional study of the relationship between specific restoration techniques and outcomes could help to maximize the benefits of restoration activities.

# 6 REFERENCES

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**APPENDIX A**

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WCC Field Data Sheets (blank)



**WCC Supervisor:** \_\_\_\_\_

\*Please note site name, supervisor, and sampling date at the top of each data sheet.

**Control Site Name:** \_\_\_\_\_

Approximate Size of Control Site (acres): \_\_\_\_\_

Location (address, cross-streets):

**Impact (Restoration) Site Name:** \_\_\_\_\_

Approximate Size of Impact Site (acres): \_\_\_\_\_

Location (address, cross-streets):

## Equipment needed:

- Stakes (avg. of 10-20 per each impact site)
- Mallet
- High visibility flagging
- 100-foot transect tape
- Permanent marker
- Camera phone
- Data sheets
- Pencil
- Site Map / Aerial Photo (attach to data sheets)
- Visual Cover Classes – Octave Scale reference sheet

## Performance Standards

The standards below will be used to judge the success of initial, Year 1, restoration efforts at each site.

1. Survival: Achieve an average of 80 percent survival of installed native trees and shrubs at each site.
2. Native plant diversity: Establish at least three native tree species, and four native shrub species. Native volunteer species may count towards this standard.
3. Invasive cover: Invasive cover standards vary by species and pre-existing site conditions.
  - a. Reed canarygrass (RCG):
    - i. Small locally-dominant patches across site: No more than 20 percent cover in each restoration site.
    - ii. Pre-existing monoculture: A minimum 12 inch radius around installed plants must be kept clear of RCG. Cutting and mulch application are an acceptable alternative to uprooting the RCG.
  - b. Knotweed: Eradicate from the restoration site.\*

*\*Knotweed are robust perennials, which may not be eradicated from a site in a single year. Manual and/or chemical control may be repeated in the summer/fall of 2015 to meet this standard. All knotweed must be properly disposed of off-site.*
  - c. All other invasive noxious plants: No more than 10 percent cover by noxious weeds in the restoration area.

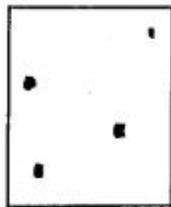
# Visual Cover Classes - Octave Scale

| Cover Class | Percent Cover Range |
|-------------|---------------------|
| 0           | 0                   |
| 1           | 0 - < 0.5           |
| 2           | 0.5 - < 1           |
| 3           | 1 - < 2             |
| 4           | 2 - < 4             |
| 5           | 4 - < 8             |
| 6           | 8 - < 16            |
| 7           | 16 - < 32           |
| 8           | 32 - < 64           |
| 9           | 64 - 100            |

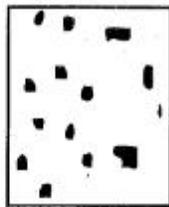
Visual charts for estimating percentages are provided below as a reference. (The breakdown does not exactly match the Octave Scale cover class values.)

Charts for Estimating Proportions of Mottles and Coarse Fragments

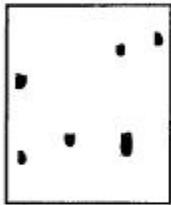
Charts for Estimating Percentage



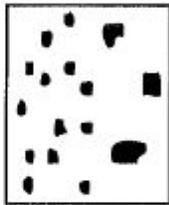
1%



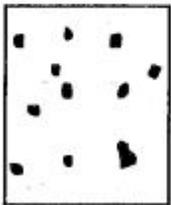
5%



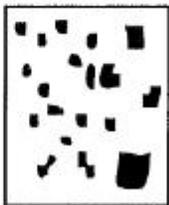
2%



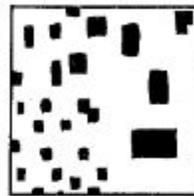
7%



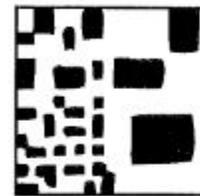
3%



10%



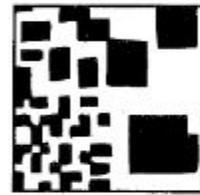
15%



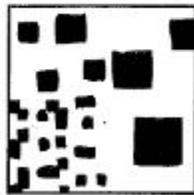
30%



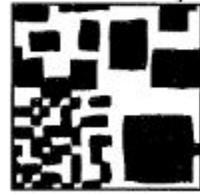
20%



40%



25%



50%

(Each fourth of any one square has the same amount of black)

# Control (Reference Site- **Before**) Fall/Winter 2014

**Photo Points:** *Photo points (PP) should capture general site conditions. One or two photos are recommended for each control site.*

- Photo point(s) established (marked with a stake and/or flagging)
- Photo point locations sketched or recorded (Lat./Long.)

| Photo Point Number* | Photo Point Description | Latitude | Longitude |
|---------------------|-------------------------|----------|-----------|
|                     |                         |          |           |
|                     |                         |          |           |
|                     |                         |          |           |

\*Naming convention: site #-PP#-(insert brief descriptor); for example, *site1-PP1-SouthCornerFacingEast*. To keep track photos on your phone, you may want to have someone stand in the photo displaying the photo number.

**Circle noxious weed plant species onsite:**

- |                      |                    |                    |                     |
|----------------------|--------------------|--------------------|---------------------|
| Himalayan blackberry | Knotweed           | Tansy Ragwort      | Reed canarygrass    |
| Evergreen blackberry | Canada thistle     | Bull thistle       | Purple star thistle |
| Oriental clematis    | Policeman’s helmet | Butterfly bush     | English Ivy         |
| Scotch broom         | Spanish broom      | Poison hemlock     | Garden loosestrife  |
| Yellow archangel     | Yellow flag iris   | Purple loosestrife |                     |

Other: \_\_\_\_\_

**Dominant noxious weed species:** \_\_\_\_\_

**Weeds of concern (not noxious):** Climbing nightshade      Jewelweed      English holly      English laurel  
 Bindweed (morning glory)      other: \_\_\_\_\_

**Existing Native Plant Conditions:**

Forest canopy present?      Yes      No  
 If yes, is the forest deciduous, coniferous, or mixed? \_\_\_\_\_  
 Native shrubs present?      Yes      No

**Visual cover class estimates:**      See Visual Cover Classes – Octave Scale

*If leaves have dropped, assume leafed-out condition for your cover class estimates. All cover class estimates are site-wide averages. Referencing an aerial photo is recommended when making site-wide cover class estimates.*

| Plant species / community                                  | Visual % cover estimate | Cover Class |
|--|-------------------------|-------------|
| Native tree, shrub, and shrub-like plant (e.g. sword fern) |                         |             |
| Reed canarygrass (RCG)                                     |                         |             |
| Knotweed   |                         |             |
| Other noxious weeds, excluding RCG and knotweed            |                         |             |

# Impact Site (Pre-Restoration)

Fall/Winter 2014

**Photo Points:** *Photo points (PP) should capture general site conditions. One or two photos are recommended for each impact site prior to site preparation.*

- Photo point(s) established (marked with a stake and/or flagging)
- Photo point locations sketched or recorded (Lat./Long.)

| Photo Point Number* | Photo Point Description | Latitude | Longitude |
|---------------------|-------------------------|----------|-----------|
|                     |                         |          |           |
|                     |                         |          |           |
|                     |                         |          |           |

\*Naming convention: site #-PP#-(insert brief descriptor); for example, *site1-PP1-SouthCornerFacingEast*. To keep track photos on your phone, you may want to have someone stand in the photo displaying the photo number.

**Circle noxious weed plant species onsite:**

- |                      |                    |                    |                     |
|----------------------|--------------------|--------------------|---------------------|
| Himalayan blackberry | Knotweed           | Tansy Ragwort      | Reed canarygrass    |
| Evergreen blackberry | Canada thistle     | Bull thistle       | Purple star thistle |
| Oriental clematis    | Policeman’s helmet | Butterfly bush     | English Ivy         |
| Scotch broom         | Spanish broom      | Poison hemlock     | Garden loosestrife  |
| Yellow archangel     | Yellow flag iris   | Purple loosestrife |                     |

Other: \_\_\_\_\_

**Dominant noxious weed species:** \_\_\_\_\_

**Weeds of concern (not noxious):** Climbing nightshade      Jewelweed      English holly      English laurel  
 Bindweed (morning glory)      other: \_\_\_\_\_

**Existing Native Plant Conditions:**

- Forest canopy present?      Yes      No  
 If yes, is the forest deciduous, coniferous, or mixed? \_\_\_\_\_  
 Native shrubs present?      Yes      No

**Visual cover class estimates:**      **See Visual Cover Classes – Octave Scale**

*If leaves have dropped, assume leafed-out condition for your cover class estimates. All cover class estimates are site-wide averages. Referencing an aerial photo is recommended when making site-wide cover class estimates.*

| Plant species / community                                  | Visual % cover estimate | Cover Class |
|--|-------------------------|-------------|
| Native tree, shrub, and shrub-like plant (e.g. sword fern) |                         |             |
| Reed canarygrass (RCG)                                     |                         |             |
| Knotweed   |                         |             |
| Other noxious weeds, excluding RCG and knotweed            |                         |             |

Site Name: \_\_\_\_\_ WCC Supervisor: \_\_\_\_\_ Sampling Date: \_\_\_\_\_

# Impact Site (Site Preparation)

Fall/Winter 2014

*Please document your site clearing and any soil preparation ahead of planting.*

## Site Preparation

### Clearing

**Invasive plant removal methods (circle all that apply):**

Weed-whacker      Hand-removal      Grub out roots      Herbicide application

Other/Notes: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Noxious weed disposal (circle one):**      on-site      off-site

Notes: \_\_\_\_\_

\_\_\_\_\_

### Soils

**Soil amendments (circle one):**      Yes      No

**If yes, circle all applicable actions:**

Incorporate compost site-wide      Amend soil in planting pits with compost

Import topsoil

**If amendments were done, indicate depths:** \_\_\_\_\_

Other/Notes: \_\_\_\_\_

\_\_\_\_\_

Site Name: \_\_\_\_\_ WCC Supervisor: \_\_\_\_\_ Sampling Date: \_\_\_\_\_

# Impact Site (Site Installation)

Fall/Winter 2014

## Plant Installation

**Total # of plants installed:** trees: \_\_\_\_\_ shrubs: \_\_\_\_\_

**Plant materials (circle all that apply):**      bare-root      container pot      stakes

Notes: \_\_\_\_\_

### Plant size:

**If bare-root, average height:** trees: \_\_\_\_\_ shrubs: \_\_\_\_\_

**If container pots, gallon-size:** trees: \_\_\_\_\_ shrubs: \_\_\_\_\_

**Plant health:** Any signs of disease or stress? If yes, describe. \_\_\_\_\_

**Spacing:** Trees: \_\_\_\_\_ ft on-center    Shrubs: \_\_\_\_\_ ft on-center    Stakes: \_\_\_\_\_ ft on-center

**Mulch:** Were the installed planted mulched?      Yes      No

If yes, mulch rings?    Radius? \_\_\_\_\_ And thickness? \_\_\_\_\_

OR sheet-mulch application? Depth/thickness? \_\_\_\_\_

**Ground Fabric:** Yes    No

If yes, type used:    continuous    pre-cut squares    strips    other: \_\_\_\_\_

**Tree protection:**    Yes    No

If yes, type?      Plastic rings    tree shelters    other: \_\_\_\_\_

### Irrigation:

Were installed plants watered immediately following installation?      Yes    No

Is WCC involved in site irrigation?      Yes    No

Was a temporary irrigation system installed?      Yes    No

Is a water-truck scheduled to irrigate the site during the dry season?      Yes    No

Other/Notes: \_\_\_\_\_





















# Control (Reference Site - **After**) Summer 2015

**Photo Points:** *Photo points (PP) should capture general site conditions. Photo points should be from the same position as Before sampling. One or two photos are recommended for each control site.*

Photo point locations sketched or recorded (Lat./Long.)

| Photo Point Name* | Latitude | Longitude |
|-------------------|----------|-----------|
|                   |          |           |
|                   |          |           |
|                   |          |           |

\*Naming convention: site #-PP#-(insert brief descriptor); for example, *site1-PP1-SouthCornerFacingEast*

**Circle noxious weed plant species onsite:**

- |                      |                    |                    |                     |
|----------------------|--------------------|--------------------|---------------------|
| Himalayan blackberry | Knotweed           | Tansy Ragwort      | Reed canarygrass    |
| Evergreen blackberry | Canada thistle     | Bull thistle       | Purple star thistle |
| Oriental clematis    | Policeman’s helmet | Butterfly bush     | English Ivy         |
| Scotch broom         | Spanish broom      | Poison hemlock     | Garden loosestrife  |
| Yellow archangel     | Yellow flag iris   | Purple loosestrife |                     |
- Other: \_\_\_\_\_

**Dominant noxious weed species:** \_\_\_\_\_

**Weeds of concern (not noxious):** Climbing nightshade      Jewelweed      English holly      English laurel  
 Bindweed (morning glory)      other: \_\_\_\_\_

**Existing Native Plant Conditions:**

Forest canopy present?      Yes      No  
 If yes, is the forest deciduous, coniferous, or mixed? \_\_\_\_\_  
 Native shrubs present?      Yes      No

**Visual cover class estimates:**      **See Visual Cover Classes – Octave Scale**

*If leaves have dropped, assume leafed-out condition for your cover class estimates. **All cover class estimates are site-wide averages.** Referencing an aerial photo is recommended when making site-wide cover class estimates.*

| Plant species / community                                  | Visual % cover estimate | Cover Class |
|--|-------------------------|-------------|
| Native tree, shrub, and shrub-like plant (e.g. sword fern) |                         |             |
| Reed canarygrass (RCG)                                     |                         |             |
| Knotweed   |                         |             |
| Other noxious weeds, excluding RCG and knotweed            |                         |             |

# Impact Site (Post-Restoration)

Summer 2015

**\*Be sure to also complete the post-restoration tallies on the Plant Count worksheets**

**Circle noxious weed plant species onsite:**

- |                      |                    |                    |                     |
|----------------------|--------------------|--------------------|---------------------|
| Himalayan blackberry | Knotweed           | Tansy Ragwort      | Reed canarygrass    |
| Evergreen blackberry | Canada thistle     | Bull thistle       | Purple star thistle |
| Oriental clematis    | Policeman’s helmet | Butterfly bush     | English Ivy         |
| Scotch broom         | Spanish broom      | Poison hemlock     | Garden loosestrife  |
| Yellow archangel     | Yellow flag iris   | Purple loosestrife |                     |

Other: \_\_\_\_\_

**Dominant noxious weed species:** \_\_\_\_\_

**Weeds of concern (not noxious):** Climbing nightshade      Jewelweed      English holly      English laurel  
 Bindweed (morning glory)      other: \_\_\_\_\_

**Visual cover class estimates:**      **See Visual Cover Classes – Octave Scale**

*If leaves have dropped, assume leafed-out condition for your cover class estimates. All cover class estimates are site-wide averages. Referencing an aerial photo is recommended when making site-wide cover class estimates.*

| Plant species / community  | Visual % cover estimate | Cover Class |
|--|-------------------------|-------------|
| Native tree, shrub, and shrub-like plant (e.g. sword fern)<br><i>(including any pre-existing canopy)</i>   |                         |             |
| Native tree, shrub, and shrub-like plant (e.g. sword fern)<br><i>(installed plants only)</i><br>*5-10% cover is normal after just one growing season |                         |             |
| Reed canarygrass (RCG)   |                         |             |
| Knotweed   |                         |             |
| Other noxious weeds, excluding RCG and knotweed  |                         |             |

**APPENDIX B**

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WCC Field Data Summary Tables



Table 1. Performance Standards Summary

| Performance Standard                           | Summary  |
|--|--|
| PS-1. 80% Survival                             | 9 of 23 sites meet. Average: 72%.  |
| PS-2. Diversity (3+ trees; 4+ shrubs)          | Per transect data, 16 of 23 sites meet. *Presumed to meet at most or all of sites. |
| PS-3. Invasive cover (preexisting monoculture) | 1 of 10 sites meet all requirements.   |
| PS-3. Invasive cover (all others)              | 5 of 12 sites meet all requirements.   |

Table 2. Survival of plantings over one growing season, combining transect data per site.

| Supervisor | Site                    | Spring 2015 (# plantings) | Summer 2015 (# plantings) | Survival   | Meets PS-1? |
|------------|-------------------------|---------------------------|---------------------------|------------|-------------|
| Baran      | Black Lake Meadows      | 42                        | 37                        | 88%        | Yes         |
| French     | Oshae                   | 131                       | 123                       | 94%        | Yes         |
| Gould      | Hursch                  | 189                       | 198                       | 105%       | Yes         |
| Gould      | Upper Carlson           | 149                       | 144                       | 97%        | Yes         |
| Mensching  | Tang                    | 449                       | 550                       | 89%        | Yes         |
| Shirk      | Riverstead              | 106                       | 90                        | 85%        | Yes         |
| Tomt       | Baxter Phase 2          | 144                       | 122                       | 85%        | Yes         |
| Turner     | Nakashima               | 206                       | 188                       | 91%        | Yes         |
| Williams   | Hylebos                 | 53                        | 44                        | 83%        | Yes         |
| Arthur     | Larchmont               | 47                        | 21                        | 45%        | No          |
| Baran      | Smith Ranch             | 41                        | 30                        | 73%        | No          |
| Buitrago   | Reddington              | 43                        | 19                        | 44%        | No          |
| Frankowski | Millenium               | 172                       | 105                       | 61%        | No          |
| French     | Joyce                   | 39                        | 23                        | 59%        | No          |
| Gould      | Foothill                | 166                       | 116                       | 70%        | No          |
| Johnson    | First Creek             | 194                       | 126                       | 65%        | No          |
| Kellogg    | Vaughn Bay              | 99                        | 76                        | 77%        | No          |
| Mensching  | Soos Creek              | 261                       | 205                       | 79%        | No          |
| Mensching  | Mourey                  | 124                       | 84                        | 68%        | No          |
| Shirk      | Maleng                  | 124                       | 95                        | 77%        | No          |
| Skaar      | Uy North                | 82                        | 45                        | 55%        | No          |
| Stevens    | Mills                   | 379                       | 99                        | 26%        | No          |
| Voelker    | Eaton, Subach, Jensen   | 97                        | 65                        | 67%        | No          |
| <b>WCC</b> | <b>Weighted Average</b> |                           |                           | <b>72%</b> | <b>No</b>   |

Table 3. Tree and Shrub Species Diversity

| Supervisor | Site                  | Spring 2015 |        | Summer 2015 |        | Meets PS-2? |
|------------|-----------------------|-------------|--------|-------------|--------|-------------|
|            |                       | Trees       | Shrubs | Trees       | Shrubs |             |
| Baran      | Smith Ranch           | 4           | 4      | 3           | 4      | Yes         |
| Frankowski | Millennium            | 9           | 13     | 9           | 17     | Yes         |
| Gould      | Hursch                | 5           | 13     | 5           | 13     | Yes         |
| Gould      | Foothill              | 7           | 13     | 7           | 11     | Yes         |
| Kellogg    | Vaughn Bay            | 4           | 6      | 3           | 6      | Yes         |
| Mensching  | Mourey                | 5           | 6      | 5           | 6      | Yes         |
| Mensching  | Soos Creek            | 3           | 6      | 3           | 6      | Yes         |
| Mensching  | Tang                  | 6           | 7      | 6           | 7      | Yes         |
| Shirk      | Maleng                | 5           | 5      | 5           | 5      | Yes         |
| Shirk      | Riverstead            | 7           | 8      | 7           | 8      | Yes         |
| Skaar      | Uy North              | 5           | 7      | 5           | 6      | Yes         |
| Stevens    | Mills                 | 6           | 11     | 6           | 10     | Yes         |
| Tomt       | Baxter Phase 2        | 7           | 14     | 6           | 13     | Yes         |
| Turner     | Nakashima             | 4           | 4      | 4           | 4      | Yes         |
| Voelker    | Eaton, Subach, Jensen | 4           | 5      | 4           | 5      | Yes         |
| Williams   | Hylebos               | 4           | 8      | 3           | 8      | Yes         |
| Arthur     | Larchmont             | 2           | 7      | 1           | 8      | Unclear*    |
| Baran      | Black Lake Meadows    | 1           | 0      | 1           | 0      | Unclear*    |
| Buitrago   | Reddington            | 5           | 6      | 1           | 5      | Unclear*    |
| French     | Joyce                 | 2           | 3      | 1           | 3      | Unclear*    |
| French     | Oshae                 | 2           | 11     | 2           | 11     | Unclear*    |
| Gould      | Upper Carlson         | 4           | 3      | 4           | 3      | Unclear*    |
| Johnson    | First Creek           | 2           | 7      | 1           | 7      | Unclear*    |

\* Since diversity was not evaluated site-wide and just along limited transects, it is unclear if there are planted species not evaluated along transects that may count towards the site-wide diversity performance standard.

Table 4. Invasive cover, Summer 2015

| Crew Leader | Site                  | RCG* cover | Knotweed cover | Other noxious weed cover | Total noxious weed cover | Meets PS-3? |
|-------------|-----------------------|------------|----------------|--------------------------|--------------------------|-------------|
| Gould       | Foothills             | 72**       | 0              | 5                        | 77                       | Yes**       |
| Baran       | Smith Ranch           | 0          | 0              | 1                        | 1                        | Yes         |
| Kellogg     | Vaughn                | 0          | 0              | 3                        | 3                        | Yes         |
| Mensching   | Tang                  | 1          | 0              | 1                        | 2                        | Yes         |
| Skaar       | Uy North              | 4          | 0              | 0                        | 4                        | Yes         |
| Stevens     | Mills                 | 0          | 0              | 0                        | 0                        | Yes         |
| Mensching   | Mourey                | 2          | 0.1            | 5                        | 7.1                      | No***       |
| Arthur      | Larchmont             | 6          | 0.75           | 48                       | 54.75                    | No          |
| Baran       | Black Lake Meadows    | 10         | 0              | 10                       | 20                       | No          |
| Buitrago    | Reddington            | 3          | 0.5            | 7                        | 10.5                     | No          |
| Frankowski  | Millennium            | 60         | 0              | 0.5                      | 60.5                     | No          |
| French      | Oshae                 | 70         | 0              | 0                        | 70                       | No          |
| French      | Joyce                 | 52         | 0              | 3                        | 55                       | No          |
| Gould       | Upper Carlson Levee   | 1          | 1              | 20                       | 22                       | No          |
| Gould       | Hursch                | 0          | 10             | 1                        | 11                       | No          |
| Johnson     | First Creek           | 7          | 0              | 20                       | 27                       | No          |
| Mensching   | Soos Creek            | 25         | 0              | 20                       | 45                       | No          |
| Shirk       | Maleng Rd             | 20         | 0              | 65                       | 85                       | No          |
| Shirk       | Riverstead            | 50         | 0              | 0                        | 50                       | No          |
| Tomt        | Baxter Phase 2        | 0          | 0              | 75                       | 75                       | No          |
| Turner      | Nakashima             | 40         | 0              | 0                        | 40                       | No          |
| Voelker     | Eaton, Subach, Jensen | 30         | 0              | 12                       | 42                       | No          |
| Williams    | Hylebos               | 40         | 1              | 20                       | 61                       | No          |

\* RCG = reed canarygrass

\*\*PS-3.ii for sites with pre-existing RCG monoculture satisfied; verified with pictures

\*\*\*Performance standard not met due to presence of knotweed. All other invasive cover parameters were met.