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TECHNICAL MEMORANDUM

DATE:	August 8, 2016
TO:	Ken Fetcho, OWEB
FROM:	Amy Merrill and Jody Lando
SUBJECT:	Phase 1 Analysis and Phase 2 Plans

Methods and results from Phase 1 field sampling as well as plans for the Phase 2 sampling effort are presented in this technical memorandum. The Phase 1 information and basis for the proposed Phase 2 plans were presented and discussed at the July 28, 2016 Advisory Group meeting. Based on input from the Advisory Group, Phase 2 plans were refined and presented herein.

1 PHASE 1 FIELD EFFORT AND METHODS

In this section, we provide an overview of our methods in selecting Phase 1 sites, present the distribution of the sites selected, and describe how well our field methods worked on the ground.

1.1 Number and Distribution of Sites Visited

Over 1200 CREP sites exist in the state of Oregon, and these sites were initially separated into six strata based upon ecoregion (east vs. west of the Cascades), contributing watershed area (<>200 km^2), and Conservation Practice (CP)—Forested Riparian Buffer (CP 22), Marginal Pastureland Riparian Buffer (CP 29), as described in the OWEB CREP effectiveness monitoring sampling design Technical Memo 1 to OWEB (Stillwater Sciences 2016a). The distribution of these sites in each stratum is presented in Figure 1.

For the Phase 1 sampling, we chose to sample two of the six strata in order to obtain sufficient sample size in the strata sampled to gain an understanding of the variation among treatment and control sites. The Phase 1 sampling included 5 days of sampling for two teams, each composed of two experienced field crew members. We anticipated each team completing two sites a day, for a total of 20 potential sites to be visited during Phase 1. Thus, two strata, each to include control and treatment sites, could yield a sample size of 10 per stratum or 5 per stratum and treatment. We chose strata 1: west, small, CP 22 and stratum 5: east, small, CP29 to capture the largest anticipated differences in the population: east vs. west and CP22 vs. CP29.

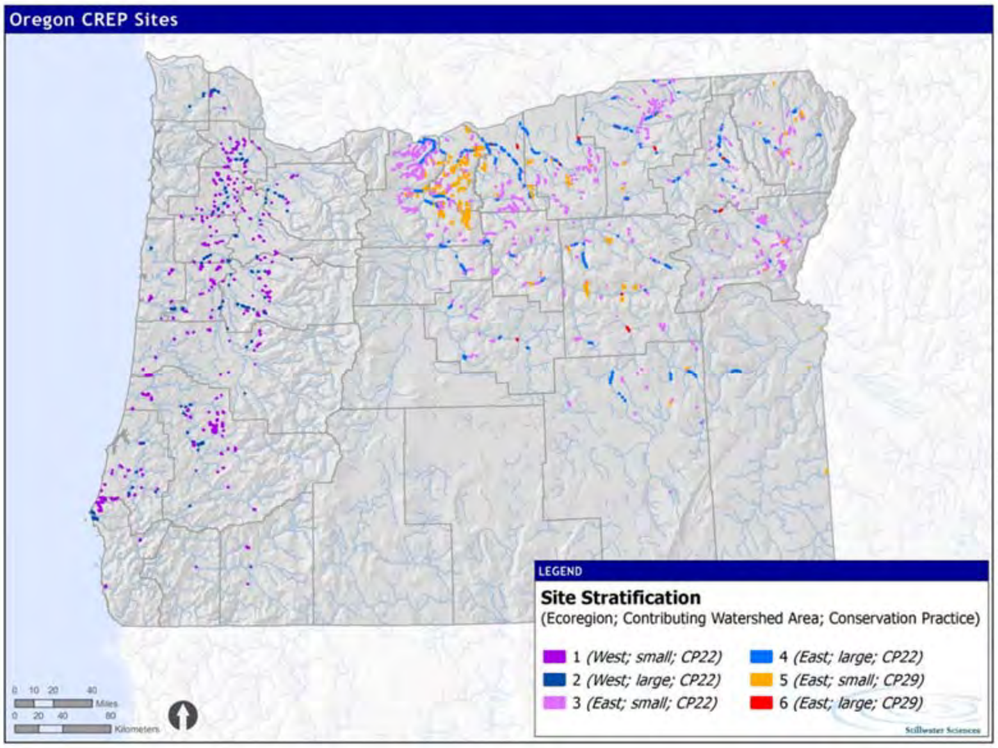

Figure 1. Distribution of CREP sites contracted in the past 10 years, colored-coded by the six strata described above.

From the full set of 1,282 CREP sites, strata 1 and 5 include 324 and 133 sites (Figure 2).

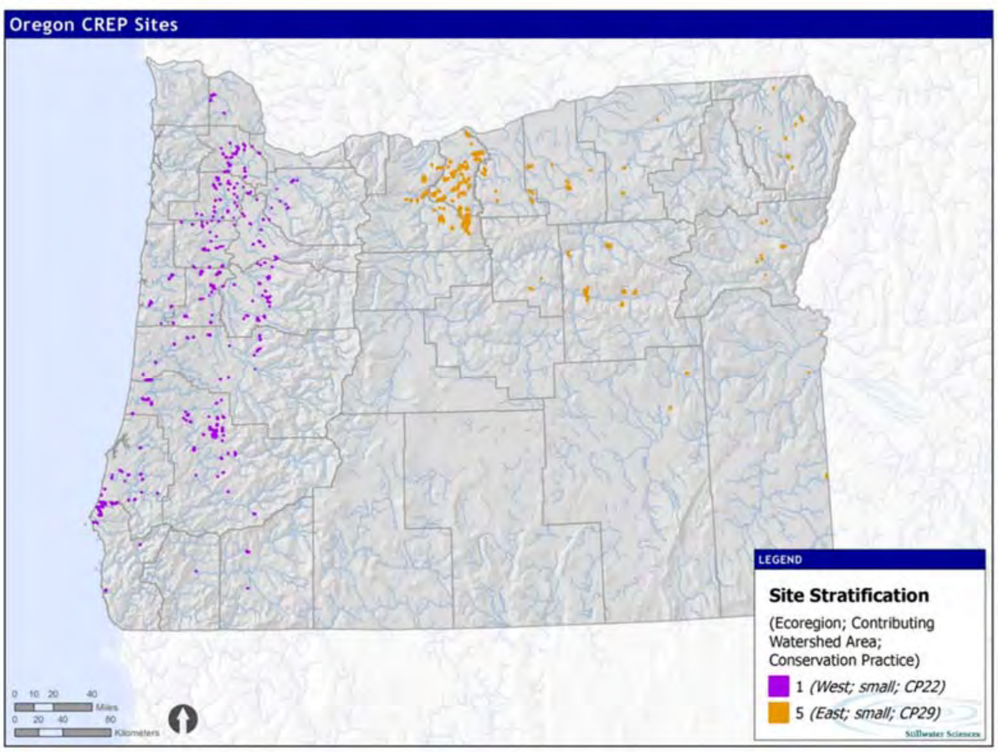

Figure 2. Sites in stratum 1 and stratum 5 only.

From these original 324 sites from stratum 1, we requested additional information from the CREP technicians on 79 sites, drawn randomly from the full set of stratum 1, and received information on 76 of those sites. From the original 133 sites in stratum 5, we requested information on 80 randomly drawn sites and received additional information on a little over half (Table 1).

We screened the sites on which we received additional data by the following criteria:

- Age of contract at least 7 years
- no catastrophic event (e.g., wildfire, flood) had occurred within recent past,
- maps/planting plan available with specific locations for management actions,
- contract not expired,
- not an ECREP site,
- minimum buffer length
- landowner likely to give permission for survey teams to access site,
- a potential control site was identified

This second screening resulted in 20 candidate sites for stratum 1 and 8 candidate sites for stratum 5 (Table 1).

Table 1. Site selection process for Phase 1.

Stratum	Initial information request	Information received	Post screening candidates	Sites sampled (treatment and control)
1: west, small, CP 22	79	76	20	6 and 4
5: east, small, CP 29	80	43	8	4 and 4

The large difference between strata 1 and 5 in sites for which information was received from CREP technicians could be due to either or both the lower number of CREP technicians in the east side counties and/or the greater reluctance for east side landowners to accommodate surveyors on their property. Just prior to field sampling, several of the final candidate sites on both sides dropped out due to various reasons, such as plans to log other parts of the property during the site visit, need for ATV or similar to access area, and re-assessment of the proposed control site.

Ultimately, 18 sites were visited during the week of June 12-17, 2016, as summarized in Table 2 and Figure 3. For stratum 1, these included 2 treatments and controls from Yamhill County, 1 treatment from Benton County, and 3 treatments and 2 controls from Polk County. For stratum 5, these included 3 treatments and 3 controls from Wasco County and 1 treatment and 1 control from Morrow County.

Table 2. Phase 1 sites visited June 13-17, 2016.

Stratum	Ecoregion	Contributing watershed area	Conservation practice	No. Treatments sites visited	No. Control sites visited
1	West	Small	22	6	4
5	East	Small	29	4	4
Total				**10**	**8**

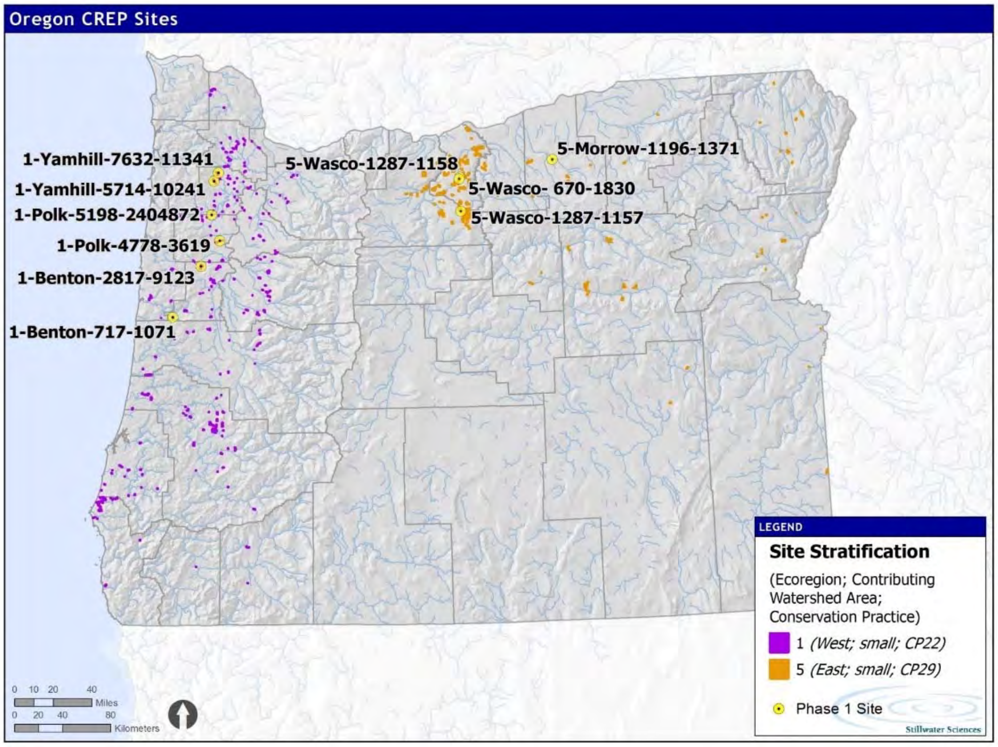

Figure 3. Phase 1 treatment sites sampled; control sites are located in very close proximity to treatment sites.

1.2 Data Collection Methods

One of the important goals of the Phase 1 sampling effort was to correct inefficiencies in the data collection process early in the field sampling effort. In this section, we report on successes and challenges met in application of the field methods detailed in the OWEB CREP Effectiveness Monitoring Field Methods and Analyses Technical Memo (subsequently referred to as TM2, Stillwater Sciences 2016b). Not including the important goal of gaining insight on among statistical variability described in the next section, other goals in completing Phase 1 of the sampling were six-fold:

- Half day of training for two crews
- Two sites per day per team for 5 days
- Sample 1 control site per treatment
- Field metrics make sense
- Field methods are efficient and repeatable
- Data management smooth and efficient

Two of these goals, training field crews for ½ day at the onset of the field effort, and ensuring that the field metrics made sense in the field, were achieved without further refinement. For the remaining four, we propose slight variations in our approach in Phase 2 in order to increase quality and efficiency in sampling. These are described below.

1.2.1 Site Selection and Site Access

Maintaining a pace of two sites per day for each of the two field crews was hampered when several of the proposed control sites were found to no longer be feasible based on closer inspection. For example, one control site was located along a major channel while the proposed paired treatment site was on an adjacent but small tributary; another was found to be planted by the landowner, outside of the CREP program; and another was no longer accessible due to changes in landowner plans. We plan several means for addressing this situation during Phase 2: more fully screen the proposed control sites via Google earth at least three weeks prior to initiation of field sampling; prepare multiple additional sites per stratum that are ready to access and sample if others fall through; and maintain key staff in the office during the Phase 2 field effort to act as a liaison between field crew and CREP technicians, landowners, and the other field crew. This ‘mothership’ approach was used in Phase 1 and proved to be an effective means of supporting field crew that encounter any number of unexpected problems (e.g., flat tire) efficiently.

1.2.2 Field Measurements

Field crew were trained and successfully implemented the field methods detailed in TM1 (Stillwater Sciences 2016b). At each site, the field crew first walked the treatment area and found representative locations for setting up the sample reach. The sample reach length was established as 16 times average bankfull width. Along the sample reach, field crews established 5 transects, located 4 average bankfull widths apart. At each transect, a series of measurements were made on channel canopy cover, vegetation cover by wood vs. herbaceous plant types, by vertical layer, and for weed and bare ground cover. Field crews also measured bank erosion along the sample reach. Vegetation planting plots (2.33 m diameter) were established and sampled for vegetation cover by wood vs. herbaceous plant types, weed and bare ground cover, at random distances from the outer edge of each transect (Figure 4). There were no problems locating representative reaches or setting up and sampling these transects or the vegetation plots.

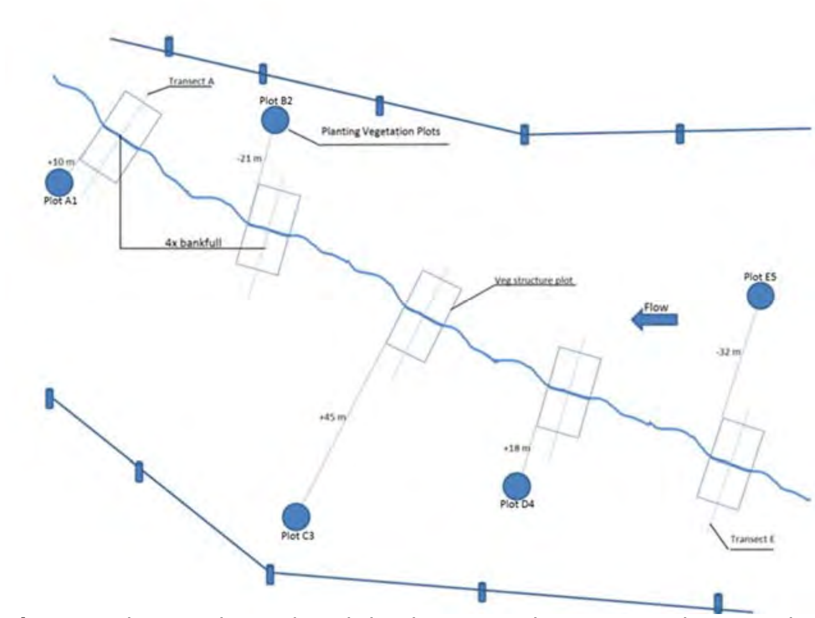

Figure 4. Site sample reach and riparian vegetation structure (squares along river) and riparian vegetation planting (blue circles) for Phase 1 field sampling.

While we found that the field methods detailed in TM2 (Stillwater Sciences 2016b) were feasible and resulted in high consistency among users, we were initially concerned about the wide percent cover bins detailed in the Protocol for monitoring effectiveness of riparian planting projects, MC-3 (Crawford 2011). The initial percent cover bins were:

0-absent: 0%,
1-sparse: <10%,
2-moderate: 10%-20%,
3-heavy: 40%-75%,
4-very heavy: >75%.

In order to test whether or not we were losing valuable information by using these wide bins rather than the +1 % precision allowed with a simple numeric rather than categorical input, both data sets were collected. We used a Pearson's correlation coefficient to compare the site means and standard errors of the two versions of each metric (continuous vs categorical), together with the slope of the regression lines. The comparison results are provided in Table 3 and show the means and standard errors are strongly correlated in most cases. As such, tests and analyses using the categorical variates (percent cover categories) should be as sensitive as using continuous variates (single digit values). Based upon these findings, we determined to use the broader percent cover categories since there were no significant differences, at a site scale, between the single digit values vs. the much broader percent cover categories.

Table 3. Statistical comparison using Pearsons correlation coefficient and slope of the regression line to compare categorical vs. continuous data.

Metric	mean		standard error	
	correlation coefficient	slope	correlation coefficient	slope
canopy total	0.99	0.96	0.97	0.94
understory herbaceous	0.99	1.14	0.88	0.91
understory wood	0.99	1.13	0.95	0.99
ground herbaceous	0.98	1.02	0.44	0.61
ground wood	0.98	1.08	0.90	0.92
all herbaceous	0.77	0.80	0.67	0.72
all wood	0.93	1.12	0.92	0.97
all herbaceous weed	0.86	1.07	0.93	1.54
all woody weed	0.95	1.11	0.87	1.11
all bare	0.91	0.72	0.92	0.95

Finally, we used field electronic data recorders (iPads) to enter field data directly into tailored data entry forms. This was very efficient in some ways; however, several points were identified where changes in the data entry sequencing could importantly improve the efficiency and accuracy of the field methods. Our partners, Sitka Technology Group, who developed the iPad based data entry system, will make changes in the electronic datasheet format to support more field efficient sequencing in data input and flexibility in using non-iPad cameras in the field. Finally, the iPads will be adjusted to accommodate adding new sites in the field by including 'blank' datasheets.

1.2.3 Field Observations

Several observations from the field are worth considering at this point in the monitoring assessment. We visited 4 treatment sites east of the Cascades in both Wasco and Morrow counties. Remarkably, there were no obvious visible differences between the treatment areas and the untreated controls (Figures 5a and 5b). For the sites visited, there was also no water in any of the channels during the June sites surveys. Moreover, channel structure was subtle, with the expression of 'banks' being discontinuous unvegetated areas along a linear low area of topography. There was little evidence of the bank itself, let along bank erosion (Figure 6).

Figure 5a. Treatment site in Wasco County.

Figure 5b. Control site in Wasco County.

Figure 6. Many sites on east of the Cascades lacked well defined channels.

In contrast, we observed large variation among the sites sampled west of the Cascades. Differences in the density and vertical structural complexity of riparian vegetation were large, as were differences in the growth of plant trees and shrubs on the terrace and floodplain beyond the channel edge (Figures 7a and 7b). Some sites were grazed and had signs of high herbivory rates, while others were not; some had high weed cover, while others did not.

Figure 7a. Site in Polk County west of the Cascades.

Figure 7b. Site in Yamhill County west of the Cascades.

2 DESIGN AND POWER ANALYSIS: PHASE 2 RECOMMENDATIONS

An important aspect of the Phase 1 monitoring was to evaluate aspects of the study design that might require refinement. Stratification was one such component. Stratification according to location (east/west) and conservation practice (CP 22/29) worked well given the variation in measured site conditions and the number of candidate monitoring sites.

Table 4. Number of sites per stratum, by ecoregion, contributing watershed area, and conservation practice (source Table 2 from Technical Memorandum 1).

Stratum No.	Ecoregion	Contributing watershed area	Conservation practice	No. of Sites (tracts)
1	west	small	22	324
2		large	22	116
3	east	small	22	479
4		large	22	216
5		small	29	133
6		large	29	14
Total	**-**	**-**	**-**	**1,282**

However, the stratification by contributing watershed area (large/small) was less successful. Although it was not sampled during Phase 1, strata 6 (East, large CP) only has 14 potential monitoring sites (Table 4 above) which is unlikely to result in a sufficient sample size based on our experience in Strata 1 and 5. Furthermore, although we expect conditions to be different in large vs. small contributing watershed areas, the only proposed metric likely to reflect that difference is canopy cover at midchannel and it is not a measurement that can safely be collected on the large rivers. So, although there may be a difference in sites with large vs. small contributing watershed areas, it is not one our sampling is likely to reflect. As a result, we advise shifting the contributing watershed area from a stratification to a covariate. Doing so has the benefit of increasing sample sizes for other strata while retaining the ability to analyze potential differences in large vs. small rivers.

In addition to refining the sampling design stratification, Phase 1 monitoring provided information on variability within and among sites. Figures 8 and 9 show the results for 2 of the 18 metrics and illustrate the wide range of results within and between sites.

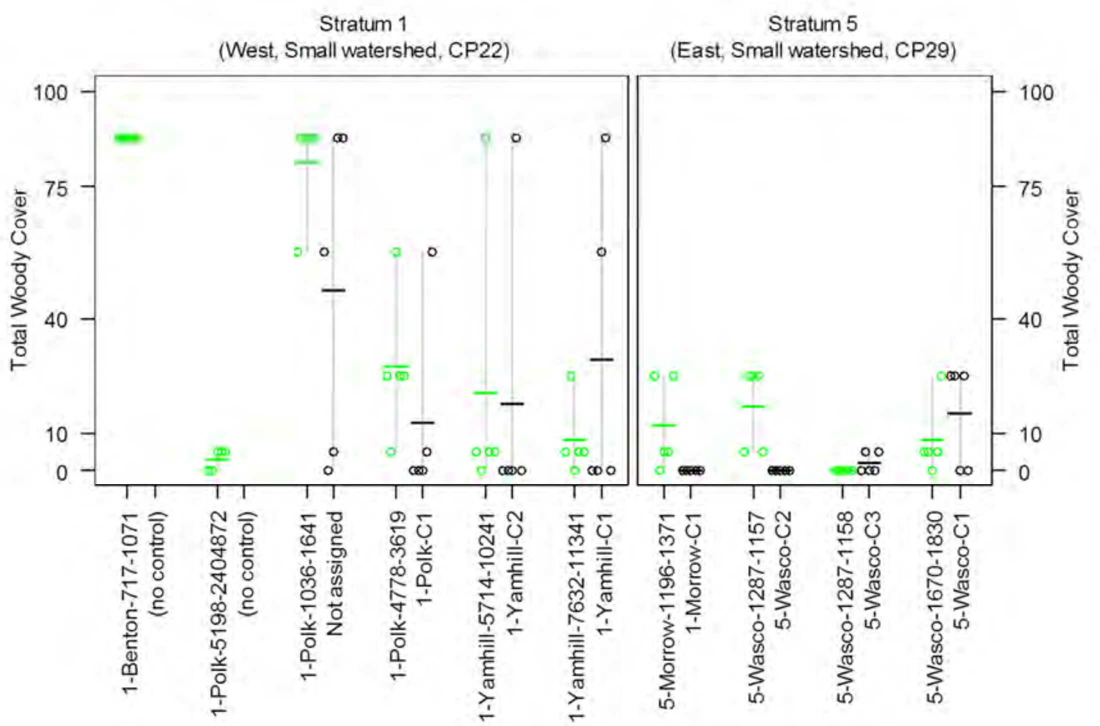

Figure 8. The range of data for Total Woody Cover in Stratum 1 and 5. Circles reflect the midpoint of the interval within the five potential categories (0, <10%, 10-40%, 40-75%, >75%). Green circles are colored coded for treatment sites and black circles for control sites. The small horizontal bars are the mean value with either a treatment or control site for the range of data.

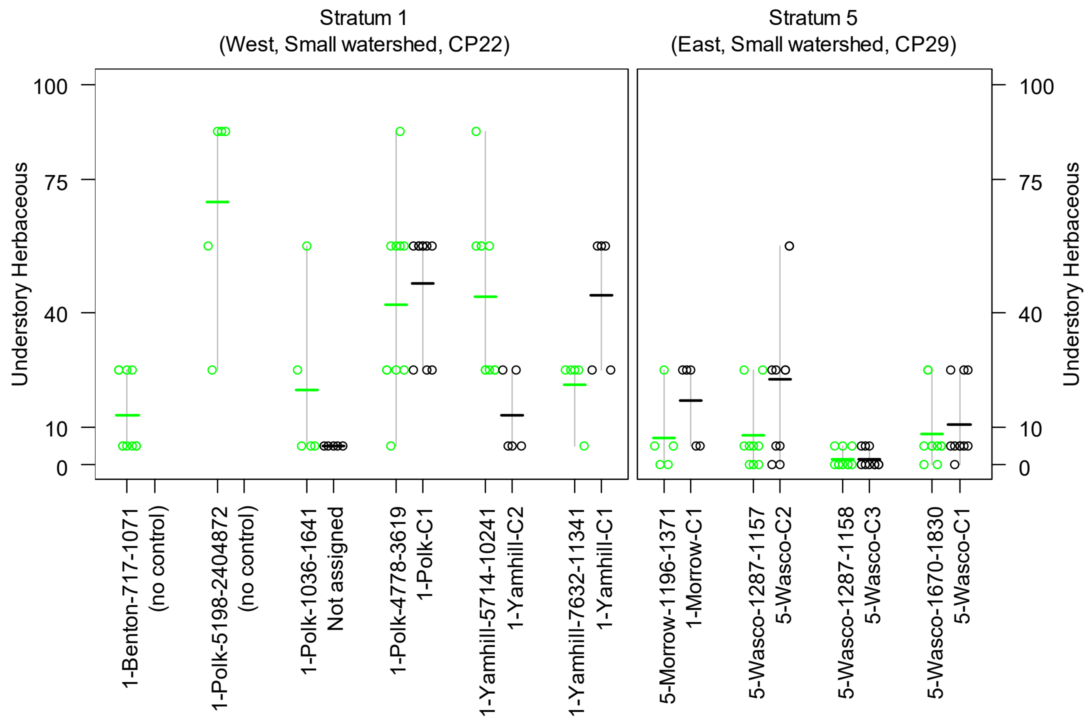

Figure 9. The range of data for Understory Herbaceous Cover in Stratum 1 and 5. Circles reflect the midpoint of the interval within the five potential categories (0, <10%, 10-40%, 40-75%, >75%). Green circles are colored coded for treatment sites and black circles for control sites. The small horizontal bars are the mean value with either a treatment or control site for the range of data.

The variability measured in each metric was used to conduct a statistical power analysis and identify the appropriate number of samples needed to detect a difference between treatment and control for each stratum. Treatment and control sites were combined to increase the analytical sample size and the following commonly applied statistical targets were selected: 95% confidence, 80% power and delta (effect size) = 20 (for percent data with five categories) and delta = 1 (for index data with a range of 1-5). The results are presented Tables 5-8 below:

Table 5. Power analysis results for Riparian Planting metrics.

Cover Percent from Category				
Metric	**Stratum**	**standard deviation**	**mean**	**Samples needed to detect: *delta = 20***
Total Herbaceous Cover	1	27.5	54.7	**13**
	5	13.5	65.4	**5**
Total Woody Cover	1	29.7	33.5	**15**
	5	7.2	6.8	**3**
Total Herbaceous Weed Cover	1	7.5	6.9	**3**
	5	2.4	1.9	
Total Woody Weed Cover	1	11.4	8.8	**4**
	5	0.0	0.0	
Total Bare Ground	1	9.7	6.6	**3**
	5	13.3	22.4	**4**

Table 6. Power analysis results for Riparian Structure metrics.

Cover Percent from Category				
Metric	**Stratum**	**standard deviation**	**mean**	**Samples needed to detect: *delta* = 20**
Canopy Cover Total	1	21.2	17.1	**8**
	5	0.0	0.0	
Understory Herbaceous	1	20.4	31.9	**8**
	5	7.2	9.5	**3**
Understory Woody Plants	1	27.8	40.7	**13**
	5	4.3	3.7	**2**
Ground Cover Herbaceous	1	27.1	54.3	**13**
	5	7.2	65.2	**3**
Ground Cover Woody Plants	1	22.2	39.1	**9**
	5	10.3	12.5	**3**
Total Herbaceous Cover	1	25.6	38.4	**12**
	5	17.0	63.8	**6**
Total Woody Cover	1	27.0	38.5	**13**
	5	9.6	7.8	**3**
Total Herbaceous Weed Cover	1	4.9	5.0	**2**
	5	3.3	3.7	**2**
Total Woody Weed Cover	1	14.2	12.0	**5**
	5	0.0	0.0	
Total Bare Ground Cover	1	2.6	2.4	**2**
	5	9.1	15.4	**3**

Table 7. Power analysis results for Canopy Cover metrics.

Canopy Density				
Metric	**Stratum**	**standard deviation**	**mean**	**Samples needed to detect: *delta* = 20**
Left- and Right-Bank Readings	1	3.9	10.5	**3**
	5	0.0	0.0	
Mean of Stream-Center Readings	1	5.4	7.4	**4**
	5	0.0	0.0	

Table 8. Power analysis results for Erosion metrics.

Category index				
Metric	**Stratum**	**standard deviation**	**mean**	**Samples needed to detect: *delta* = 1**
Erosion Category	1	0.79	3.23	**5**
	5	0.95	3.41	**7**

The estimated sample sizes (samples needed to detect) are based on estimated standard deviations, which are random variables. As such, random chance dictates that some estimates will be too large and some too small. Therefore, we advise relying on the average sample size for all metrics in Stratum 1 (7.5 sites for either treatment or control. A total of 15 for the strata) and the average sample size calculated for all metrics in Stratum 5 (3.5 sites for either treatment or control. A total of 7 for the strata).

Based on the power analysis results, we recommend the following sample sizes:

Stratum 1 – 15 sites total with a preferred allocation of 10 treatment and 5 control sites assuming the control sites can be paired with more than one treatment site.
Stratum 3 – 15 sites total with a preferred allocation of 10 treatment and 5 control sites assuming the control sites can be paired with more than one treatment site. The selected sample size is indirectly informed on Phase 1 analysis.
Stratum 5 – 10 sites with 5 treatment and 5 control sites. A smaller size is appropriate for this stratum based on the power analysis, but we increased the sample size from 3.5 to 5 to reduce the likelihood of spurious results at such a low sample size.

3 PLANS FOR PHASE 2 SAMPLING AND PROJECT COMPLETION

Based upon our findings from Phase 1, we will shift the contributing area variable from a stratifying variable to a co-variate. In doing this, we will have three populated strata for the program:

Table 9. Strata remaining with number of treatment sites surveyed in Phase 1 and planned for surveying in Phase 2.

Stratum	Ecoregion	Conser vation Practice	Phase 1 - completed		Phase 2 – to be completed	
			Treatments	Controls	Treatments	Controls
1	West of Cascades	CP 22	6	4	4	1
3	East of Cascades	CP 22	0	0	10	5
5	East of Cascades	CP 29	4	4	1	1
	TOTAL		10	8	15	7

To randomly select the 22 Phase 2 sites, the Stillwater Team will use the existing data file of CREP sites for which CREP technicians have gathered and reported information. These will be screened for the six key attributes used for strata 1 and 5 in Phase 1.

- Age of contract at least 7 years
- no catastrophic event (e.g., wildfire, flood) had occurred within recent past,
- maps/planting plan available with specific locations for management actions,
- contract not expired,
- not an ECREP site,
- minimum buffer length
- landowner likely to give permission for survey teams to access site,
- a potential control site was identified

We are targeting 22 more sites, including approximately 15 treatments sites distributed among the three strata as outlined in Table 9 above. However, we will gather all the necessary information and coordination with landowners for 8 additional sites that we can have as ‘back ups’ in case unforeseen issues arise with any of the targeted treatment sites. Similarly, we will prepare at least five more control sites than are needed, so that at least 12 potential control sites are prepared for the treatments. These will be reviewed using Google Earth imagery and information on land ownership (county parcel data) to inform access potential.

Landowners of this final set of sites will be contacted to confirm and schedule site access. Sitka Technology will finalize electronic datasheet refinements in early to mid-August and add site information to the iPads, including information for at least 13 additional treatment and control ‘back up’ sites. The Phase 2 field effort will take place in late August or early September.

Data analysis and the first draft of the final report will be available to the Advisory Group for review in November. Edits and comments will be received in mid-December and the final draft will be submitted by the end of January 2017.

4 LITERATURE CITED

Crawford, B. A. 2011a. Protocol for monitoring effectiveness of riparian planting projects, MC-3. Washington Salmon Recovery Funding Board.

Stillwater Sciences. 2016a. OWEB CREP effectiveness monitoring sampling design. Prepared by Stillwater Sciences, Portland, Oregon for the Oregon Watershed Enhancement Board.

Stillwater Sciences. 2016b. OWEB CREP effectiveness monitoring field methods and analyses. Prepared by Stillwater Sciences, Portland, Oregon for the Oregon Watershed Enhancement Board, Salem, Oregon.