

Woody Vegetation Performance Criteria for Wetland Mitigation Sites in Washington

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WSDOT proposes realistic woody vegetation performance criteria incorporating plant survival, density, and aerial cover at different stages of site development.

Rapid growth and a direct response to environmental change make trees and shrubs strong indicators of wetland health and condition (USEPA 2002). Both the rate and extent of woody species plant establishment may be important factors when evaluating the success of scrub-shrub and forest wetland mitigation sites (Hammer 1997). For these reasons, woody species performance criteria that require specific levels of plant growth and development are frequently included in wetland mitigation reports.

While measurements of woody species plant survival, density, and canopy cover are generally easy to quantify, writing meaningful and achievable performance criteria can be difficult (Ossinger 1999). The following discussion presents guidance that will help ensure woody species performance measures and performance standards are meaningful and achievable.

Performance Measure: First Year of Plant Establishment

To document early planting success, woody species survival surveys may provide a reasonable metric during the first year plant establishment period. Some mortality of planted trees and shrubs is expected during the first year. Survival targets should be set accordingly. For example, Washington State Department of Transportation (WSDOT) monitoring data suggest survival rates greater than 90 percent are frequently achieved on sites that receive regular and effective management (WSDOT 2001 through 2008). To ensure all areas of a mitigation site are successfully planted, performance measures may be combined with replanting contingencies.

Though plant survival may make sense as a performance measure in the first year, it is important to recognize plant mortality and natural colonization may confound survival estimates completed long after initial plant establishment. Plantings, for example, may die and disappear from sites, leaving no trace. Natural colonization may make it difficult to separate planted individuals from volunteer trees and shrubs. For these reasons, survival is not a dependable measure of planting success after the first year. Therefore, performance measures for plant survival are not recommended after the initial plant establishment period.

Performance Measures: One to Three Years after Planting

Plant density provides a reliable alternative to estimates of tree and shrub survival one to three years after planting. Targets can be set to achieve planting densities intended in the mitigation plan. For documenting temporal loss and natural recruitment in wetland tree and shrub plant communities, comparisons of plant density may be possible over several years.

In some specific situations, plant density has limitations as a metric. For example, density estimates in multiple-stemmed plant communities (e.g., willow thickets) may be unreliable where identification of individual plants is difficult. In addition, an inverse relationship may exist between stem density and plant size for some species. This often occurs as part of a natural and desirable thinning process. In these situations, other measurement techniques may be more appropriate (Bonham 1989).

Performance Measures and Standards: Five to Ten Years after Planting

Woody species cover is one of the most common measures of plant community growth and development because it is unbiased by either the size or distribution of individual plants (Floyd and Anderson 1987). Although it is a common metric, woody species cover is often difficult to measure with any reasonable level of accuracy and precision one to three years after initial plant establishment. Quantitative aerial cover estimates for immature trees and shrubs with few leaves are impracticable, and results generally lack value from a statistical, ecological, or management perspective (Elzinga *et al.* 2001).

WSDOT monitoring results support these conclusions and indicate growth of trees and shrubs is typically slow through the first several years of site development. On many sites, a growth surge does not occur until four to five years after planting. When plant growth is delayed, interim targets for woody species cover are not a strong indicator of eventual success. However, as a performance measure or performance standard five years after sites are planted, monitoring data indicate that woody cover is both a measurable and meaningful attribute (WSDOT 2001 through 2008). These data show that if targets are not set too high, aerial cover estimates for trees and shrubs provide a reasonable gauge of plant community development five to 10 years after initial plant establishment.

Benchmarks for Woody Species Cover in Wetlands

In scrub-shrub and forest wetland zones on mitigation sites in the lowlands of Puget Sound, WSDOT monitoring results suggest woody cover targets of 50 percent may be possible five years after planting is completed. Targets for wetland woody species cover should be lower for sites in southwest and eastern Washington. Though data from WSDOT mitigation sites in these regions are limited, a reasonable target might be 20 percent five years after planting (WSDOT 2001 through 2008). Appendix A provides a summary of these data.

Other studies support these findings and suggest standards that require high cover of woody species soon after initial plant establishment are unrealistic in most cases. In addition, efforts to achieve high cover of woody species in short timeframes may have unintended negative consequences. For example, Cassatt (1998) found high plant densities are required in the Puget Sound region to produce greater than 40 percent wetland woody species cover three years after planting. For large mitigation sites, high planting densities are expensive and may be a waste of plant material over the long term as individual trees and shrubs compete with one another five to ten years after planting. Celedonia (2002) found woody species cover targets of 80 percent could not be reliably achieved until eight years after planting for wetland trees and shrubs in the lowlands of Puget Sound. This study also suggests that high planting densities (greater or equal to 3,000 stems per acre) contribute to rapid establishment of canopy cover. However, the author cautions, high stem densities may inhibit development of other desirable features in the woody species plant community including plant maturity, emergence of a forest canopy, and vertical stratification.

Summary

WSDOT proposes the following approach for establishing interim performance measures and final-year performance standards for woody vegetation on WSDOT wetland mitigation projects:

- Woody species survival and density estimates may be used to document the success of site planting efforts in the first year plant establishment period.
- Survival estimates should not be used to document the success of woody species planting efforts after the first year plant establishment period.
- Woody species plant density may be used to guide site management activities one to three years after planting. Native woody plants naturally colonizing mitigation sites should be included in plant density estimates.
- Performance measures or performance standards for woody species cover should not be used until five years after initial site planting has been completed.
- For scrub-shrub and forest wetland-planting zones on mitigation sites in the lowlands of western Washington, a native woody species target of 50 percent aerial cover is often achievable five years after planting. For sites in southwest or eastern Washington, a target of 20 percent aerial cover may be reasonable.

Appendix B provides a list of suggested performance criteria for wetland woody vegetation.

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Appendix A

Woody Species Data Summary

Wetland Woody Cover

From 2000 through 2006, five years of required formal monitoring were completed for 48 WSDOT wetland mitigation sites. Quantitative estimates for wetland woody cover were calculated for 33 of these sites with cover standards in the fifth year (Figure 1). In Figure 1, cover values for sites located in the lowlands of Puget Sound are shaded in dark gray, and sites in southwest and eastern Washington are shaded in light gray.

Mean (\bar{x}) and median cover values were calculated for sites in the Puget Lowlands, and sites in southwest and eastern Washington (Figure 2). Data analysis suggests a reasonable target for wetland woody cover in the lowlands of Puget Sound is 50 percent after five years ($\bar{x} = 51\%$; $s = 18\%$). For sites in southwest or eastern Washington, year five cover targets should be lower. These data indicate a reasonable target for sites outside the Puget Lowlands may be 20 percent ($\bar{x} = 22\%$; $s = 12\%$).

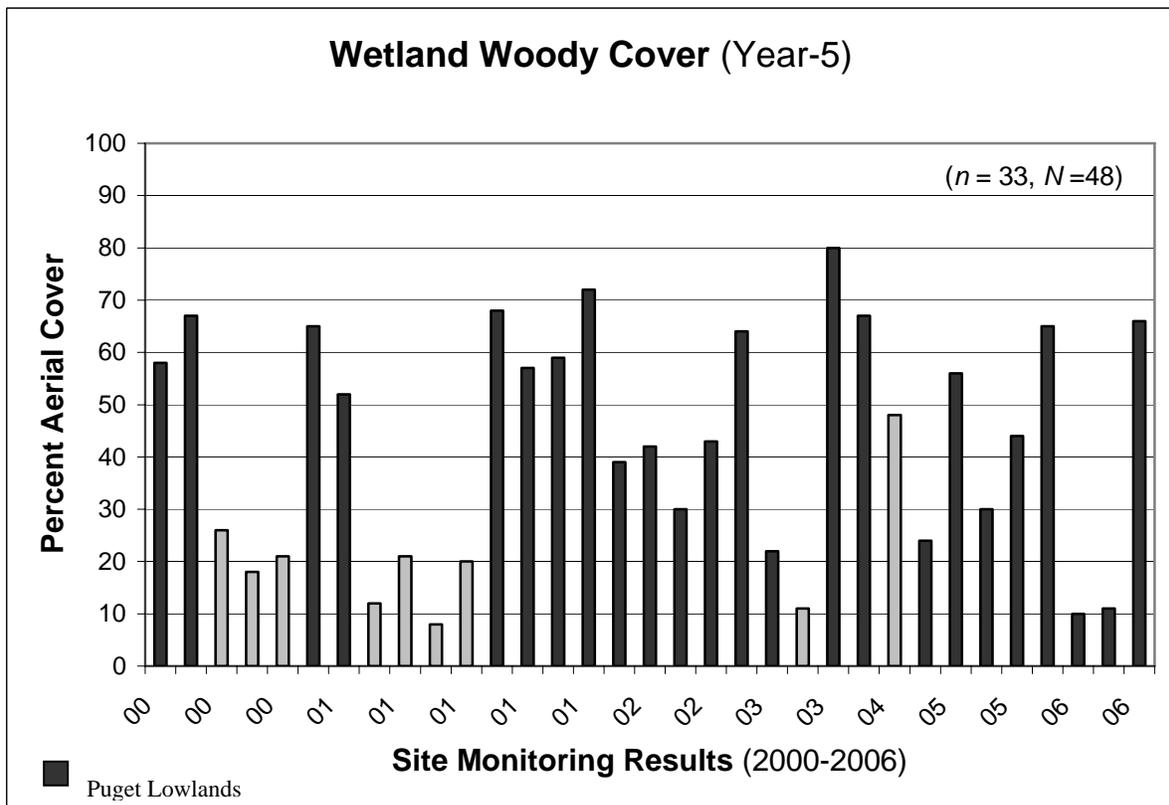


Figure 1: After five years, sites in the lowlands of Puget Sound typically achieve higher values for wetland woody cover than sites in southwest and eastern Washington.

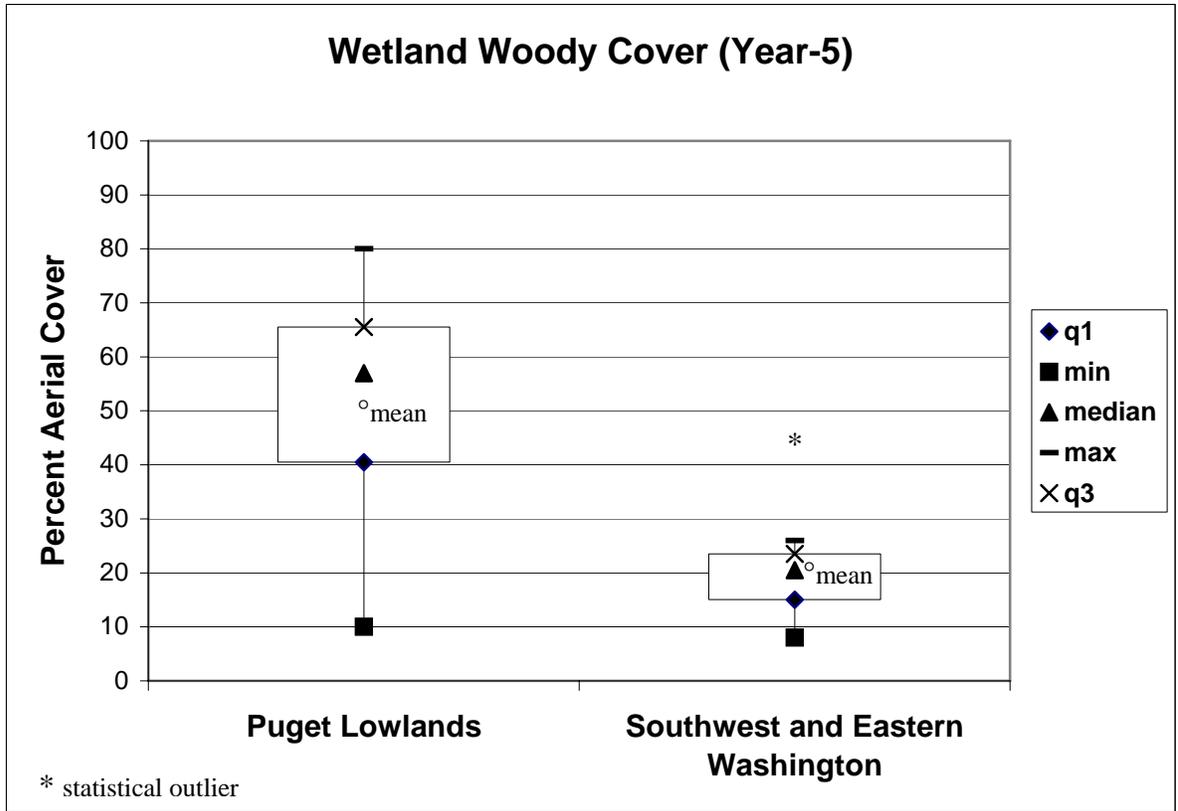


Figure 2: Data analysis suggests year five targets for wetland woody cover should be lower in areas away from the lowlands of Puget Sound.

Appendix B

Performance Criteria for Wetland Woody Vegetation

Performance Criteria for Wetland Woody Vegetation

The following performance measures and performance standard provide a means to track woody vegetation plant establishment through a typical five or ten year monitoring period. To make sure performance criteria are meaningful and achievable, site-specific targets for survival, density, or cover should be based on details of the planting plan (e.g., plant distribution, density, and species mix), mitigation goals and objectives, and results from other restoration projects in the mitigation site area.

Performance Measure (first year plant establishment period, only)

Planted woody species in the scrub-shrub (and/or forested) wetland at the Lost Creek mitigation site will achieve at least ___ percent survival one year after the site is planted. If all dead woody plantings are replaced, the performance measure will be met.

Performance Measure (Year-1 and Year-3)

Native woody species (planted and volunteer) will achieve an average density of at least ___ plants per ___ in the scrub-shrub (and/or forested) wetland at the Lost Creek mitigation site.

Note: Density should be expressed as the number of plants per unit area.¹

Performance Measure (Year-5)

Aerial cover of native woody species will be at least ___ percent in the scrub-shrub (and/or forested) wetland at the Lost Creek mitigation site.

Performance Standard (final year of monitoring)

Aerial cover of native woody species will be at least ___ percent in the scrub-shrub (and/or forested) wetland at the Lost Creek mitigation site.

¹ For example, if plantings are five feet on center there will be an average four plants per 100 square feet with square spacing, or five plants per 100 square feet with triangular spacing.