

Writing Performance Measures and Performance Standards for Wetland Mitigation

WSDOT Updated 04/02/08

Performance measures and performance standards are critical components of any wetland mitigation report. These performance criteria describe measurable attributes that can be used to evaluate success in meeting the goals and objectives of a compensatory mitigation project (Ossinger 1999, Streever 1999). Performance measures and standards describe a desired state, threshold value, amount of change, or trend to be achieved for a particular population or habitat characteristic. In some cases, these performance criteria may set limits on the extent of undesirable change (Elzinga *et al.* 2001).

Performance measures and performance standards serve two distinct purposes. Performance measures are used to guide site management activities during the monitoring period. Performance standards are benchmarks measured during the final year of monitoring that are used to help evaluate compliance with regulatory requirements.

To be effective, performance measures and standards must be measurable, meaningful, and achievable (MacDonald *et al.* 1991). A direct connection must also be evident between these performance criteria and the goals and objectives of the mitigation project. Six elements are required for complete and clearly written measures and standards (Elzinga *et al.* 2001).

1. *Species or habitat indicator*: identifies what will be monitored
2. *Location*: mitigation site or planting zone
3. *Attribute*: aspect of the species or habitat indicator (e.g., size, density, cover)
4. *Action*: the verb of your objective
5. *Quantity or status*: measurable status or degree of change for the attribute
6. *Timeframe*: the time needed for management to prove itself

If one or more of these six elements is undocumented or unclear in the mitigation report or permit, clarification should be requested from authors of the report.

Example

Goal: To provide wildlife habitat at the Lost Creek wetland mitigation site.

Objective: Wildlife habitat functions will be improved by establishing native woody cover in the scrub-shrub wetland at the Lost Creek mitigation site.

Performance standard: After five years (2012) [*timeframe*], aerial cover [*attribute*] of native woody species [*species or habitat indicator*] will be [*action*] at least 50 percent [*quantity*] in the scrub-shrub wetland of the Lost Creek mitigation site [*location*].

Suggested Performance Measures and Performance Standards

Variability in site design and conditions make it challenging to establish a standard set of performance criteria. For this reason, numerical targets in the following sample performance measures and performance standards have been omitted. To make sure performance criteria are meaningful and achievable for a mitigation project, site-specific targets should be based on the following:

- details of the planting plan (e.g., patterns of plant distribution, planting density, and species mix),
- environmental characteristics of the mitigation site,
- landscape position and condition of surrounding habitats,
- area land use activities and anticipated level of disturbance,
- goals and objectives of the mitigation plan, and
- results from other mitigation or restoration projects in the area.

The following suggested performance criteria incorporate the six elements of a complete and clearly written performance measure or performance standard.

Wetland Hydrology

Performance Measure (all years)

In the intended wetland area, soils will be saturated to the surface, or standing water will be present within 12 inches of the surface for at least ____ consecutive weeks (____ percent) of the growing season in years when rainfall meets or exceeds the 30-year average at the Lost Creek mitigation site.

Performance Standard (final year of monitoring)

The wetland area at the Lost Creek mitigation site will be delineated using current methods to assure that the mitigation site contains ____ acres of wetland.

Native Plant Species in the Wetland

Performance Measure (Year-3)

Aerial cover of native, wetland (facultative and wetter) herbaceous plant species will be at least ____ percent in the emergent wetland at the Lost Creek mitigation site.

Performance Standard (final year of monitoring)

Aerial cover of native, wetland (facultative and wetter) herbaceous plant species will be at least ____ percent in the emergent wetland at the Lost Creek mitigation site.

Trees and Shrubs in the Wetland

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.

Trees and Shrubs in the Upland Buffer

Performance Measure (first year plant establishment period, only)

Planted woody species in the upland buffer at the Lost Creek mitigation site will achieve ____ 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 upland buffer at the Lost Creek mitigation site.

Performance Measure (Year-5)

Aerial cover of native woody species will be at least ____ percent in the upland buffer 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.

Performance Standard (final year of monitoring)

Aerial cover of native woody species will be at least ____ percent in the upland buffer at the Lost Creek mitigation site.

Woody Species Plant Diversity

Performance Measure (Year-5)

At least ____ native, facultative and wetter woody plant species will achieve a minimum ____ percent relative cover for each species in the scrub-shrub (and/or forested) wetland at the Lost Creek mitigation site.

Performance Standard (final year of monitoring)

At least ____ native, facultative and wetter woody plant species will achieve a minimum ____ percent relative cover for each species in the scrub-shrub (and/or forested) wetland at the Lost Creek mitigation site.

Invasive Species

Performance Measure (all years)²

County-listed Class-A noxious weeds and non-native blackberries (*Rubus armeniacus* and *R. laciniatus*), purple loosestrife (*Lythrum salicaria*), Scot's broom (*Cytisus scoparius*), thistles (*Cirsium arvense* and *C. vulgare*), and non-native knotweeds (*Polygonum cuspidatum*, *P. polystachyum*, *P. sachalinense*, and *P. bohemicum*) will not exceed ____ percent aerial cover at the Lost Creek mitigation site.

Performance Standard (final year of monitoring)

County-listed Class-A noxious weeds and non-native blackberries (*Rubus armeniacus* and *R. laciniatus*), purple loosestrife (*Lythrum salicaria*), Scot's broom (*Cytisus scoparius*), thistles (*Cirsium arvense* and *C. vulgare*), and non-native knotweeds (*Polygonum cuspidatum*, *P. polystachyum*, *P. sachalinense*, and *P. bohemicum*) will not exceed ____ percent aerial cover at the Lost Creek mitigation site.

Wildlife Habitat

Establishing meaningful and achievable performance measures and performance standards for wildlife can be difficult. Changes we observe in wildlife communities

² The list of invasive species in performance measures and standards should include those species that can be controlled with management. Species lists will vary based on site location, county-specific regulatory requirements, wetland type, and an assessment of threats from invasive species to the mitigation project.

may have more to do with activities off site and beyond our control, than changes that actually occur on our mitigation sites. How would we know for sure?

Frequently, attributes of the vegetative community (e.g., woody cover) are used as a surrogate for direct observations of wildlife. In this case, wildlife observations recorded from the site can be used to support and complement findings from vegetation surveys.

Snags, large woody debris, and brush or rock piles are often installed to improve wildlife habitat features on wetland mitigation sites. A simple count of habitat structures may be all that is necessary to document installation according to plan. Wildlife observations can be used to supplement these data and document wildlife use of habitat structures. The following provides an example performance standard.

Performance Standard (habitat structures) (Year-1)

Wildlife habitat structures including _____ snags and _____ large woody debris piles will be present at the Lost Creek mitigation site.

Benchmarks for Woody and Invasive Species Cover

Older mitigation sites may provide a useful reference to evaluate trends in development of wetland structure and function for newer mitigation projects (Azous *et al.* 1998). Monitoring data obtained from older mitigation sites can be used as a guide to establish reasonable performance criteria for compensatory mitigation. As an aid to developing performance targets, Appendix A summarizes woody and invasive species cover data collected from Washington State Department of Transportation (WSDOT) wetland mitigation sites across the state (WSDOT 2001 through 2007).

Glossary

Adaptive management – Adaptive management is the process of linking ecological management within a learning framework (Elzinga *et al.* 2001). Adaptive management is a process applied to a mitigation site to improve its outcome.

Aerial cover – Aerial cover is the percent of ground surface covered by vegetation of a particular species (or suite of species) when viewed from above (Elzinga *et al.* 2001). Aerial cover is expressed as a percentage. Estimates exclude overlapping cover of individual plants; therefore, values for aerial cover cannot be greater than 100 percent (Appendix B).

Areal cover – Areal cover estimates are made using the mapped boundary of a feature. Areal cover is expressed as a unit of area and not as a percent.

Cumulative cover – Cumulative cover is the sum of aerial cover estimates for all individuals in the target plant population (Brower *et al.* 1998). Cumulative cover may exceed 100 percent due to the layering of canopies of different species (Appendix B).

Invasive species – An invasive species is a plant that interferes with management objectives on a specific site at a specific point in time (Whitson 2001). For monitoring purposes, invasive species include those plants listed on the County Class-A Noxious Weed List and other species that may impede site development including non-native blackberries (*Rubus* species).

Management (site management activity) – A site management activity is an operation carried out to remedy a specific situation (e.g., weed control, replanting).

Relative cover – Relative cover of a plant species (or suite of species) is the proportion of the target species coverage compared to that of all species in the plant community combined (Brower *et al.* 1998). The sum of the relative cover estimates for all species from the plant community will equal 100 percent (Appendix B).

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Appendix A

Woody and Invasive Species Cover Data Summaries

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 ($\bar{x} = 22\%$; $s = 12\%$).

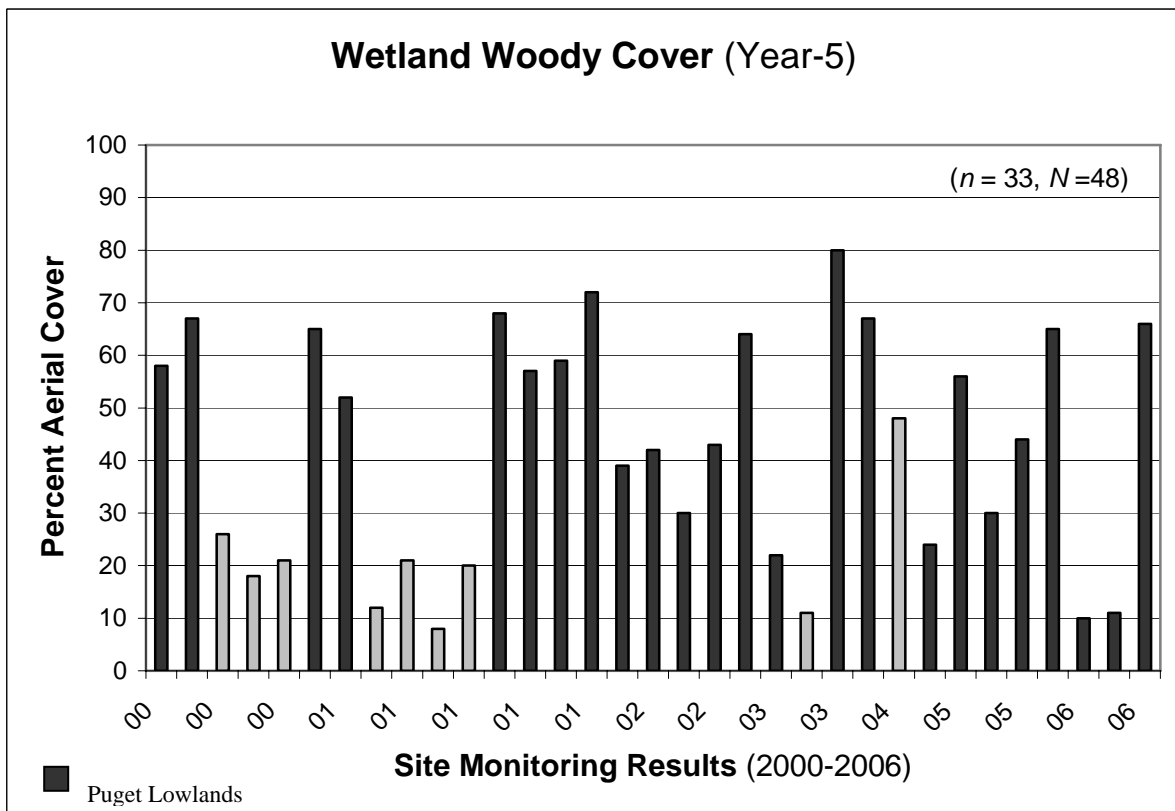


Figure 1: After five years, sites in the lowlands of Puget Sound typically achieve higher values for wetland woody cover than sites in southwest and eastern Washington.

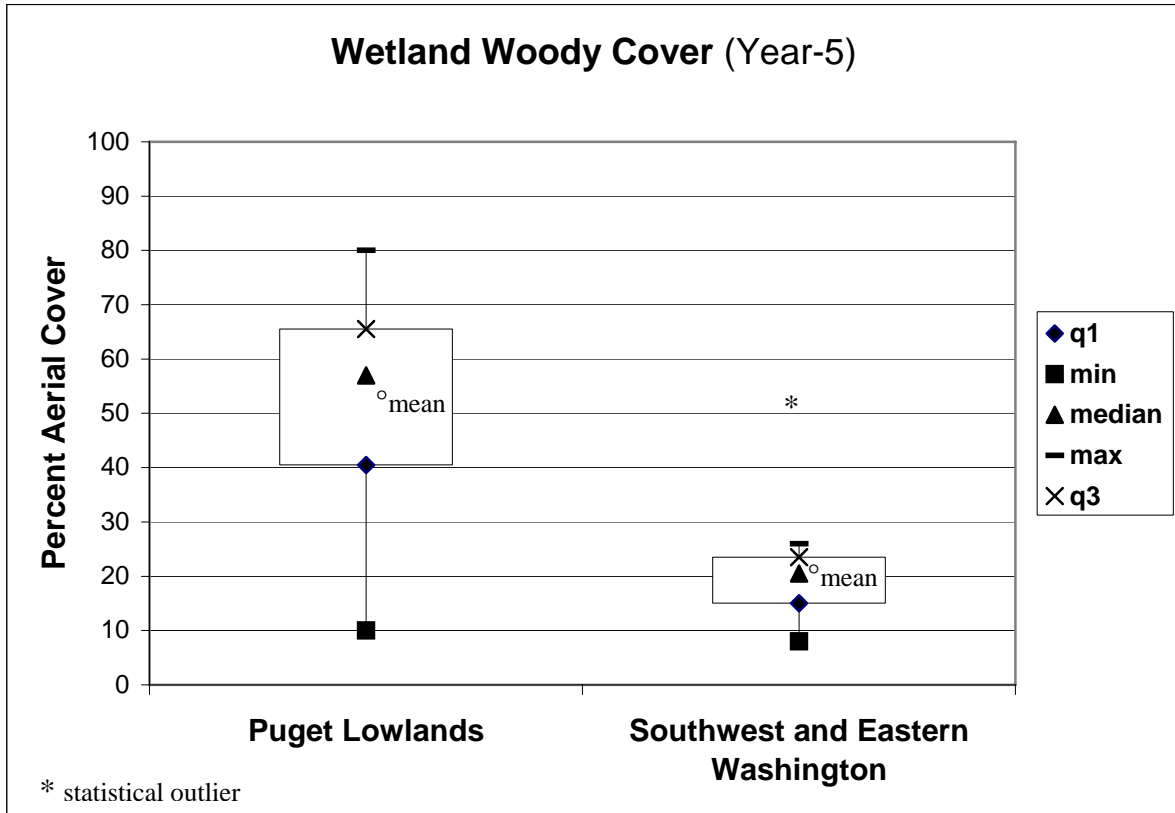


Figure 2: Data analysis suggests year five targets for wetland woody cover should be lower in areas away from the lowlands of Puget Sound.

Upland Woody Cover

From 2000 through 2006, quantitative aerial cover estimates were calculated for 16 of 48 WSDOT mitigation sites with standards for upland woody cover in the fifth year (Figure 3). All sites in this sample were located in the lowlands of Puget Sound. During this same period, no quantitative aerial cover data for upland woody species were collected from sites in southwest or eastern Washington.

Mean and median cover values for woody species in upland zones were calculated for sites in this data set (Figure 4). Although the sample size is small ($n = 16$ sites), data analysis suggests a reasonable target for upland woody cover in the lowlands of Puget Sound may be 40 percent after five years of site development ($\bar{x} = 44\%$; $s = 20\%$).

Though data are not currently available for sites in southwest and eastern Washington, WSDOT monitoring experience suggests targets for upland woody cover should be much lower for sites in these regions. Furthermore, experience indicates targets for upland woody cover should, in general, be lower than targets for wetland woody cover on these same sites. After five years of site development, upland woody cover targets of less than 20 percent might be reasonable for sites in southwest and eastern Washington based on this experience.

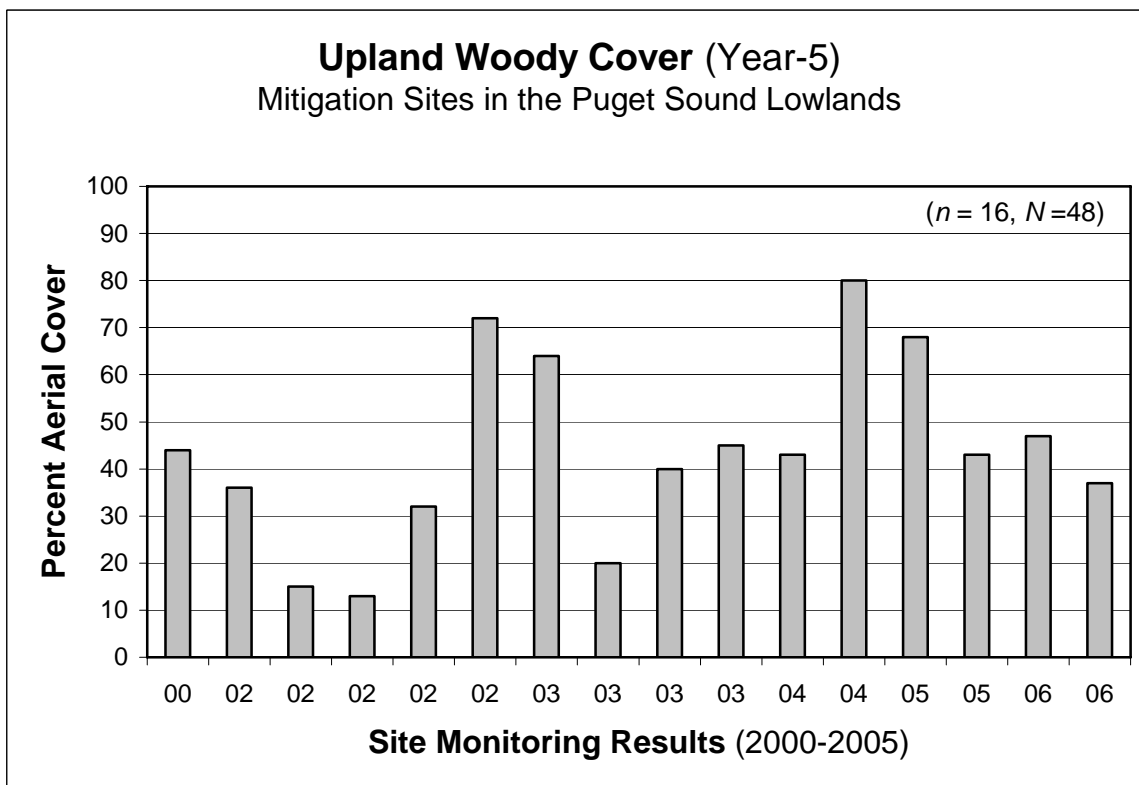


Figure 3: Quantitative estimates were calculated for 16 mitigation sites in the Puget Sound Lowlands with year five cover standards for upland woody cover.

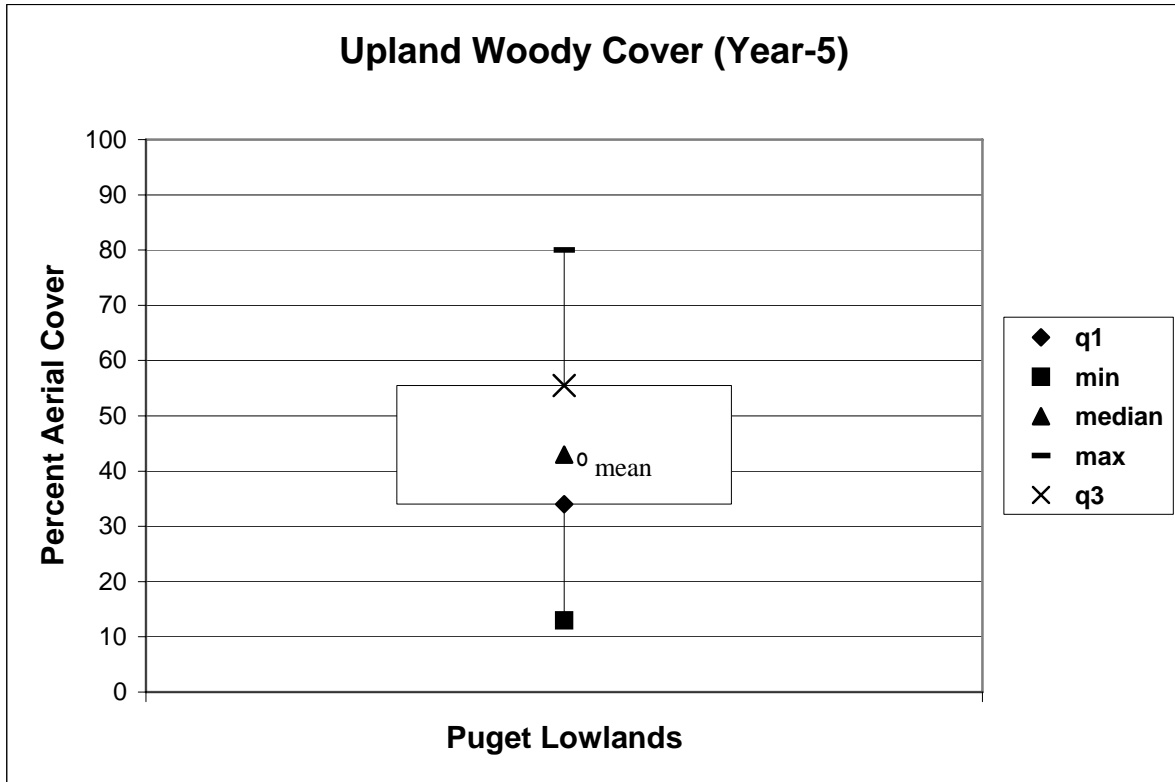


Figure 4: Although data are limited to just 16 sites, analysis suggests a reasonable target for upland woody cover might be 40 percent after five years of site development for sites in the Puget Sound Lowlands.

Invasive Species Cover

Quantitative invasive species cover estimates were calculated for 38 of 48 WSDOT mitigation sites at the end of their required, formal monitoring period. Data suggest an aerial cover target of 20 percent may be reasonable and achievable in most cases (Figure 5). In addition, data collected from these same sites indicate invasive species cover levels of 20 percent do not, in general, prevent mitigation projects from meeting other site goals, objectives, and success standards (Bergdolt *et al.* 2004, WSDOT 2001 through 2007).

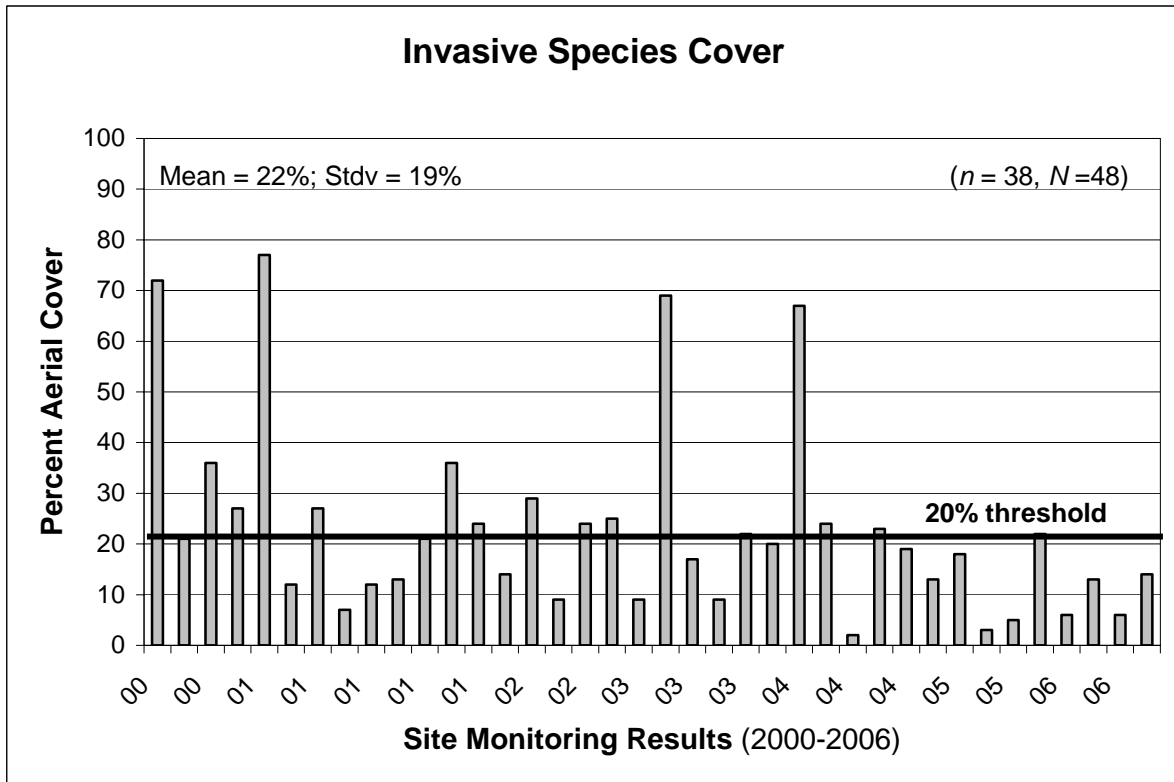


Figure 5: Invasive species cover estimates were calculated for 38 mitigation sites at the end of their required, formal monitoring period. Data suggest an aerial cover target of 20 percent may be achievable in most cases.

Several factors should be considered when setting targets for invasive species cover. These factors include:

- level of invasive species cover on the preconstruction mitigation site,
- presence of invasive species in areas surrounding the mitigation site,
- types of invasive species present, and
- present and future land use activities in the area.

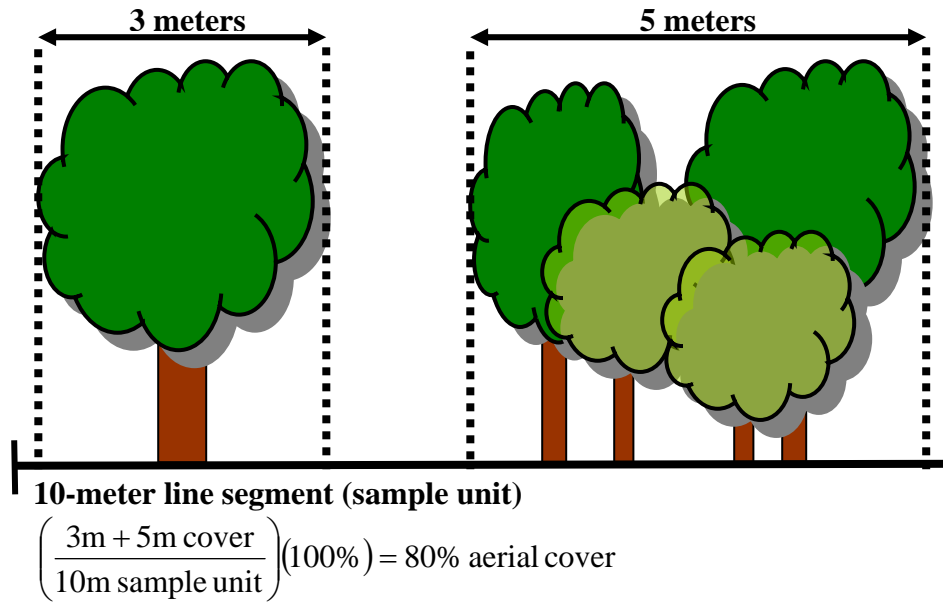
Research indicates mitigation sites that are actively managed are more successful (Johnson *et al.* 2000, National Research Council 2001). An aggressive weed control program should be implemented through the early years of site development.

Appendix B

Vegetative Cover Definitions and Illustrations

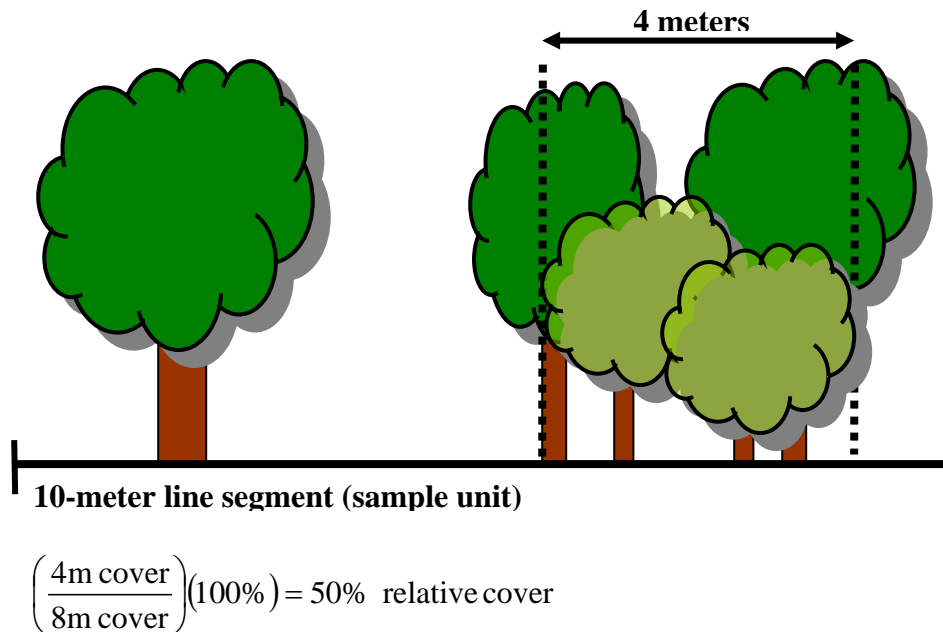
Aerial Cover

Aerial cover is the percent of ground surface covered by vegetation of a particular species (or suite of species) when viewed from above. Aerial cover cannot be greater than 100 percent.



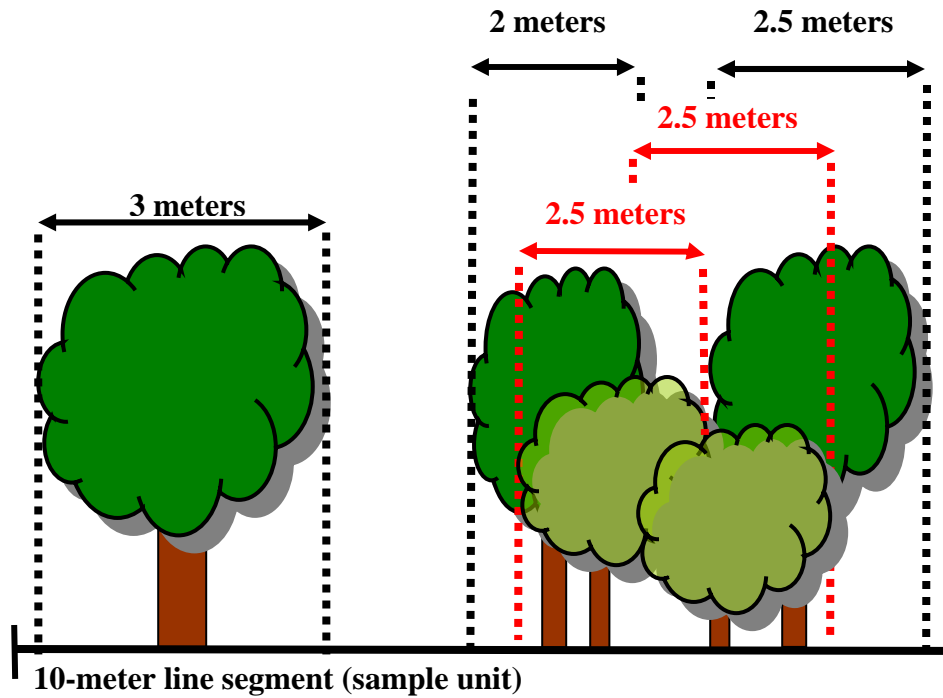
Relative Cover

Relative cover of a plant (or suite of species) is the proportion of the target species coverage compared to that of all species in the plant community combined.



Cumulative Cover

Cumulative cover is the sum of aerial cover estimates for all individuals in the target plant population. Cumulative cover may exceed 100 percent due to canopy layering.



$$\left(\frac{3\text{m} + 2\text{m} + 2.5\text{m} + 2.5\text{m} + 2.5\text{m cover}}{10\text{m sample unit}} \right) (100\%) = 125\% \text{ cumulative cover}$$