Draft Guidance for
Vegetation Planning and Monitoring in
Western Oregon Wetlands and Riparian Areas:

Using Reference Sites to Help Plan and Evaluate Vegetation Performance of Mitigation Sites

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Acknowledgments

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Abstract

This document provides guidance on vegetation planning and monitoring protocols for western Oregon wetland and riparian areas. It is based on a presumption that reference sites can be used to help develop vegetation plans and performance standards for compensatory mitigation sites. The guidance recommends using relatively undisturbed reference sites that closely match the hydrogeomorphic and soil conditions of the corresponding proposed mitigation sites. By recommending consistent monitoring protocols and vegetation performance standards, it provides a means to evaluate the abilities of various mitigation implementation strategies (e.g. dike breaching, drain tile breaking, invasive plant removal, ditch filling, native vegetation planting, etc.) to meet the targeted design vegetation performance standards and to compare targeted vegetation outcomes against the actual outcomes. The data collected from compensatory mitigation projects that use the guidance should be useful in helping resource managers develop improved vegetation contingency plans, adaptive management strategies, performance standards, and implementation strategies for future mitigation projects. Iterative applications of this guidance should help increase the number and quality of compensatory mitigation vegetation successes in this area over time. A vegetation manager (VEMA) relational database is provided with the guidance to enable users to automatically record, calculate, and report vegetation performance. Provision of guidance such as this, which emphasizes vegetation, is not intended to diminish the importance of monitoring and assessing the performance of other key components of wetlands, such as water regime, soils, wildlife, and overall function.

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INTRODUCTION

Compensatory mitigation for loss of wetland and riparian habitat that is beneficial to fish and wildlife is a common requirement in environmental regulatory actions; such as Federal, State, and local government permits. Compensatory mitigation performance standards are routinely required as permit conditions and are subsequently monitored and used to help evaluate the success of compensatory mitigation sites (National Research Council 2001). The current rates of success for compensatory mitigation sites nationally and regionally are not encouraging (National Research Council 2001).

The U.S. Fish and Wildlife Service (Service) and other resource agencies commonly make recommendations and/or impose direct compensatory mitigation requirements, depending on the authorities under which an activity is permitted or licensed. Follow-up on monitoring, and subsequent enforcement of compensatory mitigation performance standards, has been underutilized. Both the scientific foundation and the administration of monitoring are lacking (National Research Council 2001). Compensatory mitigation monitoring and reporting are inconsistent both in terms of the methods required to collect monitoring data and the performance standards used to help gauge compensatory mitigation success (Devroy 2004).

Vegetation performance standards are routinely used to help evaluate compensatory wetland and riparian mitigation success. Regulatory agencies often recommend that mitigators use reference sites to help plan and evaluate compensatory mitigation site vegetation performance standards (Washington Department of Ecology et al 2004). However, there is very little technical guidance on how to do this. This guidance document is intended to help fill this technical gap. The guidance has three primary components: 1) vegetation monitoring protocols for reference and mitigation sites; 2) preliminary planting plans for compensatory mitigation sites, and 3) vegetation performance standards for compensatory mitigation sites. By recommending consistent vegetation monitoring protocols and performance standards, application of the guidance offers a standard means to help evaluate the abilities of various mitigation implementation strategies (e.g. dike breaching, drain tile breaking, invasive plant removal, ditch filling, native vegetation planting, etc.) to meet the targeted design vegetation performance standards. The vegetation data acquired through the application of the guidance will also be available for comparisons of targeted vegetation outcomes with the actual vegetation outcomes.

The performance standards and monitoring protocol in this guidance document were determined through a consensus agreement based on the best professional judgements of the members of the primary technical advisory committee and secondary advisors, including professional compensatory mitigation consultants in the private sector. They are based on their collective expertise and knowledge on Oregon vegetation ecology and vegetation field methods. To help facilitate this cooperative approach, a vegetation manager (VEMA) relational database has been developed and can be downloaded using a Northwest Habitat Institute FTP site link provided in Appendix V. This database should enable users to efficiently record, calculate, and share standardized vegetation performance reports.

VEMA is intended to: 1) provide a defensible and reliable vehicle for collecting vegetation data from reference sites for use in both designing preliminary planting plans and monitoring vegetation at mitigation sites, 2) aid in the consistency of the vegetation information collected from reference sites and mitigation sites, 3) provide comparable vegetation performance standards for evaluating the relative success of compensatory mitigation projects, and 4) ultimately keep a record of data that can be used to help resource and regulatory agencies steadily improve their ability to prescribe legally and ecologically defensible mitigation vegetation performance standards.

GENERAL GUIDANCE ON REFERENCE AND MITIGATION SITE SELECTION, CLASSIFICATION, AND STRATIFICATION

Reference Site Selection. Reference sites should be: 1) in the same watershed (5th or 4th Field Hydrologic Unit, in order of preference) as the proposed mitigation site, 2) relatively undisturbed, and 3) closely match the hydrogeomorphic and soil conditions of the corresponding proposed mitigation sites (Washington Department of Ecology et al 2004). Generally, reference sites should meet the performance standard thresholds recommended in this guidance.[1] This should help encourage the selection of reference sites that are relatively undisturbed as compared to the overall watershed in which they are located. [2]

In many urban and urbanizing watersheds, it may be very difficult or impossible to find suitable reference sites that meet the recommended performance standard thresholds. In those circumstances, one option would be to go outside the immediate watershed to find an adequate reference site. At a minimum, the selection of a suitable reference site should be made while considering the following factors: 1) proximity to the proposed mitigation site (generally the closer the better); and 2) the relative degree of alteration of the watershed under consideration. If an adequate reference site cannot be found; access to the only suitable reference site in the area is denied by landowners; or the distance to the next suitable reference site is impractical, the following is recommended:

1. Look for alternative vegetation data sets collected in the ecoregion of your mitigation site (e.g.,http://www.nativeseednetwork.org) and, for the habitats that are targeted. Substitute one or more of the available regional data sets for the data that would otherwise be collected at

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[1] In some watersheds it may not be possible to find a reference site that meets the performance thresholds recommended in this guidance. If the ambient conditions of a watershed are judged to significantly limit the ability of a given mitigation site to meet the recommended performance thresholds, lowering the thresholds through adaptive management may be the only viable option. Hopefully this option will be the exception and not the rule. Also, on a case-by-case basis, agencies may determine offsite mitigation is more advisable for impacts to resources in a given heavily disturbed watershed.

[2] Ideally native plant species lists, relative abundances, and performance thresholds derived for both reference site selection and mitigation site evaluation would be derived through iterative monitoring (using the performance criteria thresholds in this guidance as initial target goals) of the least disturbed sites in their respective watersheds.

reference sites and retain the use of the performance standards in this guidance to judge mitigation site success or failure.

For reference sites located on private land, it will be necessary to contact the landowner and ask for permission to visit their property to collect the reference data. In order to minimize refusals, it may be helpful to contact the land owner through a local watershed council or through other land owners who have cooperated with such efforts in the past. It may also be advisable to prepare a brief handout explaining the purpose and methods of monitoring reference sites as well as the special precautions that will be taken to help alleviate any misgivings a landowner may have about allowing their property to be used as a reference site (Adamus 2004).

The physical characteristics used to determine reference site/compensatory mitigation site matches include but are not limited to: elevation, slope aspect, soils, land form, and hydrology (Washington Department of Ecology et al 2004). The match determinations between reference sites and proposed mitigation sites should be made considering the *expected* conditions at the mitigation sites after all landform and hydrologic alterations are completed. Reference sites that are reasonably secure from development because of public ownership and/or that are protected through third party conservation easements are preferred.

For the purposes of this guidance, mitigation site designers should sample a minimum of one reference site habitat class for each habitat class targeted at the mitigation site. However, multiple reference sites for a single habitat class in the same watershed are encouraged. This would allow the collection of a vegetation data set that better reflects the range of variability of vegetation in the subject watershed. This data can then be used accordingly in the design of the mitigation site vegetation plan and performance standards (Adamus 2004).

For mitigation sites targeted to contain forested habitat, it may be advisable to select two or more reference sites at different stages of succession (Washington Department of Ecology et al 2004). The reference site representing the earlier successional sere would then be used for determining the initial species and stem densities for planting. A more mature reference site could be used as a template for supplemental planting once the mitigation site has acquired a canopy sufficient to protect more shade tolerant species (e.g., western red cedar, dogwood, vine maple, or western hemlock). Depending on stand density, partial thinning may be advisable at this time.

Reference Sites, Contingency Plans, and Adaptive Management. In addition to providing planting strategies and performance standards, reference sites can be used to help determine if a problem documented at a compensatory mitigation site is likely caused by on-site management factors (e.g., bark girdling by beavers) or a more regional environmental issue, such as a drought. In other words, if the same problem documented at the compensatory mitigation site is also documented at the reference site, it is more likely a regional issue and adaptive management is likely the best solution. If the problem is only found at the compensatory mitigation site, it is more likely a management issue that can be resolved using a contingency plan (e.g., replanting and establishing herbivory guards). Of course, deciding between adaptive management or a contingency plan is a judgment call and reference sites should be used as just one source of information to help make that decision.

Selection of Mitigation Sites. Where feasible, this guidance recommends strategically placing compensatory mitigation in areas that either expand the boundaries of existing reference sites or help connect fish and wildlife dispersal corridors between existing reference sites. Remote sensing imagery (e.g., aerial photographs) can be used in combination with local natural area inventories and ground recognizance to help locate potential compensatory mitigation sites.

The selection of mitigation sites will be dependent on a number of social, political, economic, and ecological factors. These factors may include but are not limited to the following:

1. Whether regulatory agencies are requiring on-site or off-site mitigation;
2. Distance from reference site (generally the closer the better);
3. Locations of adequate sources of hydrology;
4. Locations of areas relatively free of large pockets of nonnative invasive plants and nonnative predators (e.g., bullfrogs);
5. Locational opportunities to restore native fish and/or wildlife habitat;
6. Locational opportunities to reconnect fragmented habitat areas and provide historic fish and wildlife passage;
7. Locational opportunities to restore historically depleted habitat or threatened and endangered species; and
8. Locational opportunities to utilize mitigation sites prioritized in a watershed restoration plan, endangered species recovery plan, or a similar regional planning strategy.

Preliminary Planting Plans for Compensatory Mitigation Sites. This guidance is based on the presumption that one or more reference sites can be used to provide a preliminary vegetation planting plan for the corresponding mitigation site. This presumption is, contingent on the reference site occupying the same hydrogeomorphic class and a similar soil series as the proposed mitigation site. However, there are a significant number of plant and mitigation site related variables that affect the final selection of species and relative abundance of species for planting.

For woody species, it is relatively easy to count, by species, the number of live woody stems per acre documented at the reference site and then to prescribe, by species, that same stem density for planting at the compensatory mitigation site. Assuming moderate to good survival, the stem density planted can be immediately calculated and verified to exist on the ground for each of the species planted. Basically, for each native stem counted at the reference site, there is a stem planted at the mitigation site. However, a number of *other factors* need to be considered before establishing a final planting plan (e.g., locally available stock in sufficient quantities, condition of stock, suitable storage availability, budget, etc.).

Herbaceous species are generally even more problematic than woody species. First, herbaceous propagules used in mitigation planting plans are often in the form of seed. A number of factors, including but not limited to the following must be taken under consideration when developing a viable seed mix

(Packard and Mutel et al 1997): 1) existing site conditions; 2) vegetation goals; 3) grass-to-forb ratio; 4) seed quality; 5) seeding rates and seed size; 6). germination rates and reliability of each species; 7) species specific ecological behavior; 8) efficiency of seeding technique; 9) season of planting; 10) budget; and 11) seed availability. Asexual propagation is an alternative for many species (Packard and Mutel et al 1997) but these strategies also come with complications (e.g., restricted genetic diversity, labor intensive planting, and the vulnerability of injured plant structures to diseases).

Additionally, there is high variability in site preparation treatments depending largely on the existing mitigation site conditions and targeted design habitats. Seeding and weed control methods alone vary tremendously depending on site conditions and mitigation goals (Packard and Mutel et al 1997). The number and magnitude of complicating factors affecting our ability to define relationships between reference site data and a mitigation site planting plans for all the habitats in western Oregon are beyond the scope of this guidance.

So, is it feasible to use reference sites to help prescribe planting plans for compensatory mitigation sites? One potential body of work we can look to for assistance in answering this question are the publications associated with the restoration of tallgrass prairie, savanna, and woodlands of central North America. After years of effort, seed planting plans are now being generated for specific central North American prairie types, on specific soil conditions (Packard and Mutel et al 1997). Most importantly, these planting plans offer a means to help derive specific vegetation goals from prescribed seed mixes tested through many iterations of trial and error.

As sophisticated as these seed mixes are, each mitigation site planting is an experiment and, ultimately, the site will dictate species survival, abundance, and persistence over time. Compensatory mitigation is an on-going experiment for all parties involved and the collective knowledge on this subject in the Pacific Northwest is considerably less than our counterparts in the central United States and Canada (Pendergrass 2004).

We will likely nearly always be shy of taking a plant list directly from a reference site and transferring the list unchanged into a vegetation planting plan for a mitigation site; especially for the more complex wetland plant communities such as wetgrass prairie. However, in the interest of improving our chances in this direction over time, we should continue to try and use reference sites to help establish preliminary plant lists for compensatory mitigation sites. On a case-by-case basis, final lists will be compiled after sifting through the full litany of additional considerations, including but not necessarily limited to the following:

1. Existing mitigation site condition (e.g., soil moisture regime, existing weedy invasive species, existing seed bank, etc.);

2. Mitigation site preparation plan to meet target reference site condition (e.g., eradication of pasture grasses, ditch filling, excavation to water table, dike breaching, etc.);

3. Source, availability, quality, and quantity of plant materials;

4. Seeding and maintenance technologies available; and

5. Budget

Despite the formidable hurdles discussed above, this guidance recommends that every effort feasible be made to retain the fidelity of the preliminary reference site based planting goals. Hopefully, over time, and many iterations of trial and error, it will become increasingly easier to do so.

Reference and Mitigation Site Classification. Development/mitigation projects reviewed by resource and regulatory agencies are usually centered around aquatic environments. The aquatic environments most likely affected by development projects are wetlands, streams, rivers and their associated riparian areas. Largely following Cowardin et al 1979 and Adamus 2001, these aquatic environments are modified and classified in Table 1. While the performance standards and the monitoring protocols in this guidance focus on vegetation, there is an underlying presumption that hydrology, geomorphology, and soils play a critical role in the ability of plant species to establish themselves and persist over time and that they further affect the floral and structural characteristics of vegetation. Perhaps most importantly, there is a presumption that the underlying habitat elements associated with vegetation play a critical role in defining specific fish and wildlife habitat functions and the overall biological integrity of those functions (Johnson and O'Neil 2001).

Table 1. ***Habitat Systems and Classes in which Performance Standards and Monitoring Protocols are Applicable***
(modified Cowardin 1979 and Adamas 2001)

Habitat System	Vegetation Habitat Class	HGM Class	Soil Series
Estuarine	Forested Scrub-shrub Emergent	Tidal Fringe	NRCS Soil Survey
Riverine	Emergent Wetgrass Prairie	Riverine Flow Through (RFT) Riverine Impounded (RI)	NRCS Soil Survey
Palustrine	Forested Scrub-shrub Emergent Wetgrass Prairie	Slope Flats Depressional RFT, RI	NRCS Soil Survey
Upland Riparian	Forested Scrub-shrub Herbaceous	Slope Flats RFT	NRCS Soil Survey

Mitigation and Reference Site Habitat Class Stratification. In order to ensure we are collecting data about vegetation types in a way that is useful for documenting, calculating, and reporting vegetation performance (both within and between sites), we must physically stratify the vegetation by habitat class (see Table 1). In other words, for the purpose of ensuring correct sampling procedures and performance assessment, you should draw a boundary line around existing or targeted vegetation that is similar in character. For the purposes of this guidance, the polygons derived from stratifying habitat classes and/or vegetation types at reference sites are called sample units and the polygons derived from delineating target habitat classes and/or vegetation types at mitigation sites are called management units. Stratification is based on judgments of the similarity or "homogeneity" of the vegetation represented on the aerial photograph. These judgments are generally based on aerial photo signatures (e.g., texture, tone, shape, and color) in combination with field verification.

As stated above, there are a number of reasons to stratify habitat classes and/or vegetation types. For example, it wouldn't make sense to query a sample from an area that is targeted for a forested wetland using criteria that are solely intended to judge the performance of a wetgrass prairie. There are also different sampling strategies for an area targeted to become a forested wetland than an area targeted to become an emergent wetland. Of course the same considerations apply for existing vegetation types at reference sites.

It may occasionally be necessary to stratify a vegetation type or hydrologic condition within a habitat class. For example, if a given sample plot in a management unit indicates an upland plant community that is intended to be wetland or the significant presence of a nonnative invasive species, the area around the sample should be surveyed to verify the extent of the area the sample represents. For mitigation sites less than 100-acres, if the area is 0.25 acre or larger, it should be stratified into a separate sampling unit on the aerial photograph. For sites larger than 100-acres, the decision on the size a given area must be to require stratification should be made on a case-by-case basis. By stratifying these areas as separate units, managers can geographically focus the specific management options necessary to bring these areas into conformance with their performance standards. Such stratification can also be useful when calculating available credit for release at mitigation banks.

Three alternative approaches are offered for habitat class stratification for the purpose of vegetation sampling (Appendix I). The first approach (Low Tech) requires only general familiarity with aerial photograph interpretation and mapping skills with no specialized equipment needs. The second approach (Mod Tech) requires knowledge and experience with computer mapping software that is relatively inexpensive, easily accessible, and requires little specialized training. The third approach (High Tech) requires knowledge and skills with Geographic Information System computer software that is relatively expensive and requires a considerable amount of specialized training. All of these approaches can be used to provide an adequate map displaying the areal extent of the sample and management units from which vegetation data will be collected, as well as sample plot locations within units. The map products derived from using the more technical approaches are potentially progressively more interactive with the data. That is, as the approaches become more technically based, data access and manipulation opportunities through the map environment increase in diversity and flexibility, thereby allowing users more sophisticated tools for geographic accuracy, data analysis and reporting.

Under all of these approaches, habitat classes targeted for sampling at the mitigation and reference sites should be stratified at a large scale (1:1200 to 1:3600) using an aerial photograph (see Appendix I). Reference site stratification is based on the signatures of the actual vegetation displayed on the aerial photograph and verification through ground truthing while mitigation site stratification is based on the areas designated to become the targeted vegetation types delineated in the mitigation plan. [3]

The first iteration of vegetation mapping at a mitigation site should include the baseline condition before any of the site preparation activities are employed. After site preparation actions are completed (e.g. dike breaching, drain tile breaking, invasive plant removal, ditch filling, native vegetation planting, etc.), the aerial photo map should be updated to reflect the as-built condition. Mapping updates should be completed as needed at each iterative period of monitoring and inserted into the accompanying monitoring report. Each monitoring report should also contain the vegetation sampling data collected at the same fixed plots used for the as-built report. The map illustrating management units combined with the vegetation data should be used to track the progress of the mitigation site toward meeting its vegetation performance standards and habitat class target goals.

For mitigation site map stratification purposes, distinctions between shrub-scrub habitat and forested habitat will be based on potential height, not actual height. Both forest and scrub-shrub habitat units will be determined to be on a trajectory (trend) toward success provided that the live stem density performance standard is met. However, for tracking purposes, the date on which monitoring reveals the trees in the forested management unit have met or exceeded 6-meters (based on Cowardin 1979) , while maintaining the minimum live stem density performance standard, should be recorded. At this time there is no tree or shrub growth rate performance standard.

SPECIFIC GUIDANCE ON USING REFERENCE SITES FOR DETERMINING PLANTING PLANS AND PERFORMANCE STANDARDS AT COMPENSATORY MITIGATION SITES

Using this guidance, the vegetation data collected at the selected reference site can to a limited extent be used to help develop the preliminary planting plan at the compensatory mitigation site. The data provide the basis for developing a mitigation site preliminary plant species list and to help estimate the relative amounts of plant materials (e.g., pounds of seed, number of plugs, number of stems, etc.) required for each species intended for planting. At the discretion of the resource and regulatory agencies, the person or organization responsible for implementing the mitigation action may choose to not plant all or portions of their mitigation site; under the presumption that natural plant colonization and succession will eventually allow the site to meet its targeted vegetation goals. However, except for cases where unforeseen circumstances persuade resource and regulatory agencies to allow an adaptive management option, no mitigation site should be considered successful until the date at which the applicable performance standards prescribed below are met. Ideally, these performance standards should continue to be met for the full period of time monitoring is required.

In addition to helping the regulated public meet their legal obligations, the data generated through the application of this guidance are intended to become part of an on-going reference site/mitigation site vegetation manager (VEMA) relational database (Appendix V). This database is also accessible to scientists and resource managers interested in using the data to better analyze the causal elements behind mitigation successes and failures. Any such analyses should, in turn, be provided to resource

[3] It is likely the vegetation management unit boundaries established on the mitigation plans will change over time as natural succession processes interact with management strategies. Maps should be updated accordingly.

managers and subsequently used to update, revise, and augment this guidance. Over time, this process should serve to help improve the quality and number of compensatory mitigation site successes.

The following performance standards and monitoring methods are provided to aid in the implementation of this guidance. We strongly suggest that users of the guidance follow the performance standards and monitoring methods below as closely as possible. If local site conditions or any other circumstances require deviation from the performance standards or the monitoring methods, we recommend that users document both the reason for the deviation and carefully outline the alternative performance standard(s) and/or monitoring method(s) used. This will allow reviewers of the monitoring reports to better interpret their content and conclusions.

Primary Performance Standard (Emergent/Herbaceous Habitat Class). Monitoring indicates (see Appendix V): 1) a minimum of 55% of the relative plant cover (including substrate) is comprised of native species; 2) </= 15% relative plant cover are non-native invasive species, and 3) moisture index </= 3.0.

> **Secondary Performance Standard (Willamette Valley Wetgrass Prairie).** Monitoring indicates (see Appendix V): 1) at least 10 wetgrass prairie species listed in are present, 2) Tufted hairgrass *(Deschampsia cespitosa)* is represented by 25% or greater relative plant cover, 3) at least 50% of the relative plant cover (including substrate) is comprised of native species; 4) no more than 15% of the relative plant cover is comprised of non-native invasive species; 5) the prairie's moisture index is between 2.0 and 3.0; and 6) no more than 5% relative plant cover is by shrubs or trees.
>
> Other Willamette Valley wetgrass prairie plant associations have been described that do not meet the criteria listed above (Christy et al 2004). For the purposes of this guidance, emergent wetland plant associations that are not consistent with the secondary performance standard above are considered emergent wetlands; even if they are considered prairies in other classifications. As this guidance is applied to areas containing these divergent but related plant associations, it may be appropriate to then reconsider them as unique prairie types and to tailor specific performance standards appropriate for their unique flora and structure. The newly recognized prairie types should then be reclassified as wet prairie and adopted into the guidance.

Primary Performance Standard (Forest Habitat Class). For forested habitat classes: Monitoring indicates at least 80% of the aggregate species live stem density as compared to the reference site (natural recruitment of native species stems can be considered in this calculation). Less than 5% of the relative live stem count should be non-native species and moisture index </= 3.0.

Primary Performance Standard (Scrub-shrub Habitat Class/Layer). For scrub-shrub habitat classes or scrub-shrub habitat layers underneath a forested habitat canopy: Monitoring indicates at least 80% of the aggregate species live stem density as compared to the number of stems planted.[4] Less than 5% of the relative live stem count should be non-native species and 3) moisture index </= 3.0.

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[4] Because of the difficulty associated with counting high stem densities in many scrub-shrub stands and the potentially prohibitive cost of planting at those densities, this performance standard reflects the more commonly used best professional judgment approach to prescribe planting densities and performance. Reference sites can still be used to help determine species selection and relative abundances.

Office Methods for Reference Site Field Preparation. To prepare for the field portion of the reference site data collection, the sampling team will:

1. Use a recent large scale (1:1200 - 1:3600) air photo (Figure 1) to stratify habitat classes (see Appendix I) intended for sampling (sample and management units). Depending on the location, there are a number of sources of air photo imagery (e.g., WAC Inc. in Eugene, Corps of Engineers Photogrammetry Section in Portland, and local municipalities and Councils of Government (COGs). Orthophotographs are preferable. Digital orthophotos for every county in the United States are available as free downloads from the following United States Department of Agriculture website but must be viewed with a GIS or other image processing software:

http://datagateway.nrcs.usda.gov/

Table 2. Sample Unit and Sampling Grid Code

Grid Feature	Code	Sample Code
Sample Unit	Number	1
Baseline	Capital Letter	A
Transect	Number	1
Plot	Small Letter	a

Figure 1. Stratification of Sample Units on Aerial Photographs

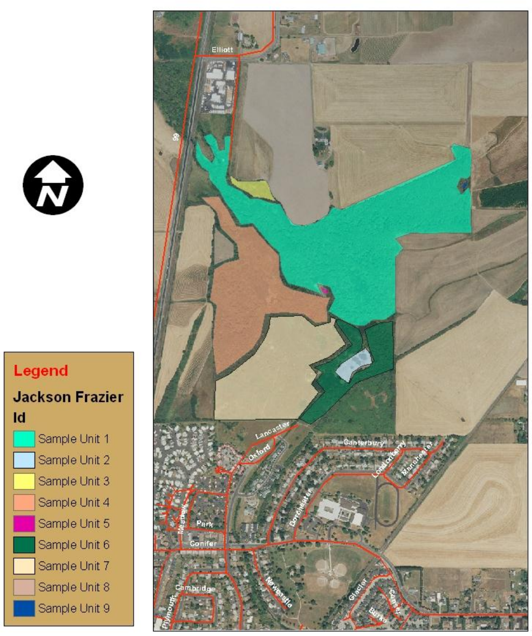
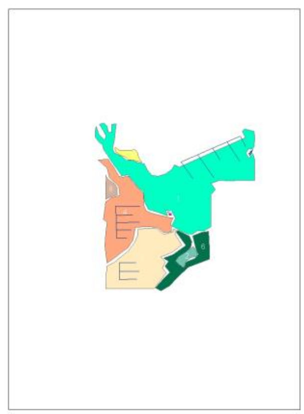


Figure 2. Display of Sample Grids in Sample Units



2. Use a hierarchical standard sample unit and sample grid code for identifying and locating samples on the air photograph (see Table 2 and Figure 2). If it becomes necessary to subdivide a sample unit in the field because of unexpected habitat heterogeneity, small letters will be used to distinguish the subdivided units (e.g., Sample 1 is subdivided into 1a and 1b).

3. Draw a representative layout of the sample grid on the air photo. The orientation of the grid and the lengths of the baselines and transects will be variable depending on the configuration of the sample unit. However, a few general rules should be applied:

   a. While baselines and portions of transects can be located outside the sample units, all sample plots must be in the sample unit.

b. To help ensure samples are representative of their sample unit, a systematic method of sampling from a random point is recommended (see Figure 3) for both the baselines and the transects. From the randomly selected point(s), all other points along the baselines (transect line starts) and transects (sample plots) will be measured at equal intervals (Elzinga et al 1998). The method of randomly selecting the distance to the first transect start or the first sample plot is discretionary but should be documented in the monitoring report.

It should be noted here that *this is not intended to be a statistically representative sampling strategy. It is intended to provide a reasonable representation of the reference site flora and stand character with a minimum number of samples.*

c. The distances between transect start points along the baseline should be far enough to ensure that the last point will be near the opposite end of the baseline. Transects should usually be perpendicular to the baselines.

d. A minimum of 5-points (transect starts) will be marked along the baselines in sample units that contain trees and shrubs and a minimum of three points (transect starts) will be marked along the baselines in sample units that contain open herbaceous and emergent vegetation. The locations of these points and the subsequent positions of the sample plots should be identified and coded accordingly on the air photo.

Figure 3: *Display of Systematic Sampling from a Random Point*

e. Deviations from the guidelines above rules may be necessary for many sample units. For example, a long narrow linear sample unit may be most efficiently sampled with one long transect line or a series of shorter transect lines. When a deviation to the standard grid is deemed necessary, document the revised grid pattern selected on the air photo and provide a description in the monitoring report.

f. Additional sample units and sample grids are discretionary.

g. The most convenient routes to access the intended starting points for each baseline should be identified on the air photo. It is recognized that it may not be possible to use the baseline and transect grid system in every case because of site limitations (e.g., impenetrable thickets, intersections with deep water, etc.).

Reference Site Field Methods. Once in the field and near the desired sample unit boundary, if the baseline starting point is not easily observed at the point of entry to the sample unit, the sampling team should mark the point of entry with a rebar stake[5] and record the GPS coordinates (waypoint) at that location.

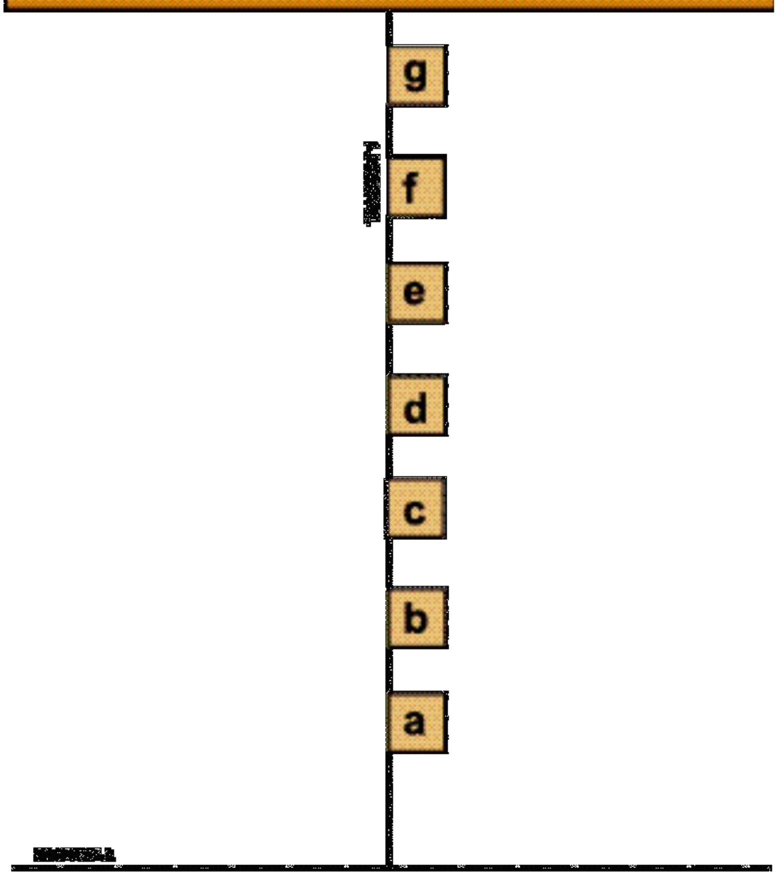
ESTABLISHING THE BASELINE.

Using a compass and the air photo prepared in the office, the sampling team will then walk to the area where the mapped starting point of the sample unit's baseline is located. The sampling team will mark that point in the field with a rebar stake and record the GPS coordinates (waypoint) for that location.

Table 3. ***Vegetation Cover Class Parameters*** (Kuchler 1966)

Percent Cover	Cover Class	Cover Class Mid Point (%)
75-100	5	88
50-75	4	63
25-50	3	38
5-25	2	15
<5	1	3

Figure 4: ***Sample Plot Orientatation on Transects in Open/Emergent Herbaceous Habitat Class***



If any unanticipated field circumstances (e.g., impenetrable blackberries) require that the baseline start at a point substantially different than that marked on the air photo in the office, the necessary adjustments should be made on the air photo, and marked using the GPS unit, to reflect the true positions. The

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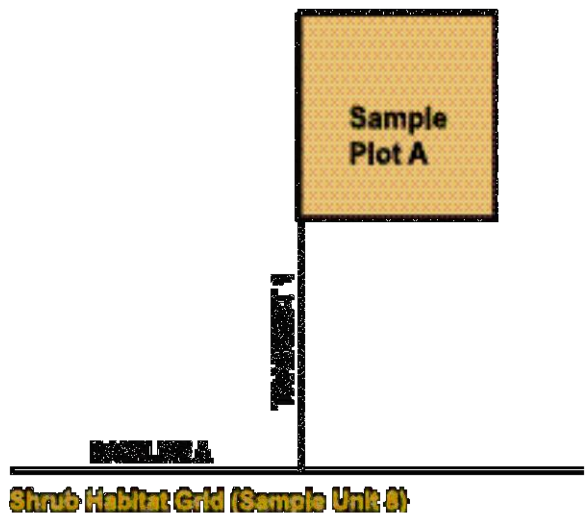
[5] If rebar stakes are used to mark sampling grids and/or plots in areas that are managed in a way that requires equipment such as tractors to have site access, it may be advisable to collect a GPS waypoint at the point locations, hammer the rebar flush with the soil, and then , during the next sampling site visit, to use the GPS to find the general locations of the points and a then a metal detector to find the precise locations.

sample team will then field mark the baseline using the air photo and a compass while laying out a field measuring tape. The first transect start point along each base line will be selected randomly. The remaining transect start positions will be spaced equidistantly along the baseline and spaced to cover the entire sample unit. Each interval of each transect start position will be marked in the field with a flag or stake and its location will be recorded on a GPS unit. The length of the baselines should generally reflect the size of the sample units being sampled.

ESTABLISHING THE TRANSECTS AND SAMPLE PLOTS AND COLLECTING FIELD DATA

Emergent/Herbaceous Habitat Class. There will be three transect lines established with a minimum of 10 sample plots per transect (additional transect lines and plots are discretionary). After the position of the first sample point is randomly selected on a transect, the remaining sample positions will be spaced at equal distances along the right side of the transect line (facing away from the baseline). The bottom left-hand corner of each 1-square meter sample plot will be placed on the corresponding sample point on the transect line (see Figure 4).

Figure 5: *Sample Plot Orientation on Transects in Scrub-Shrub Habitat Class*



The field team will designate a field team data recorder and the remaining members of the team will become data collectors who will report the data to the recorder. The entire field team will always remain on the left side of the transect line to avoid disturbing the samples. The data collectors can use Table 3 to help make percent cover class mid-point determinations for each species in each sample and the data recorder will place the data in the field data sheet provided in Appendix II and/or in the vegetation manager (VEMA) relational database linked to Appendix V. [6] The recorder can also use VEMA directly or a printout of its Plant table [7]to help determine whether a species is native, nonnative noninvasive, or nonnative invasive. The vegetation manager relational database linked to Appendix V can be used to collect and document the data as well as to help make the mitigation site performance specifications.

Willamette Valley Wetgrass Prairie Habitat Class. The same methods used above for the emergent/ herbaceous habitat class will be used for the Willamette Valley Wetgrass Prairie Habitat Class. However, additional data (Table 5) will need to be recorded and tallied: 1. number of prairie cohorts, 2. plant species moisture indexes, 3. relative percent cover of Tufted hairgrass *(Deschampsia cespitosa)*, and 4. relative percent cover by trees and shrubs. The vegetation manager (VEMA) relational database

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[6] Depending on the weather and/or availability of a laptop computer, VEMA data entries may need to take place in the office.
[7] The tables in the data file for VEMA are currently accessible by opening the VEMAData.mdb file and selecting the "Unhide" option under the window dropdown menu.

linked to Appendix V can be used to collect and document the data as well as to help make the mitigation site performance specifications.

Scrub-shrub Habitat Class. In Scrub-shrub Habitat Classes, there will be one sample plot measuring 10-foot square established on each of 5 transect lines (additional transect lines and plots are discretionary). As with the baseline, the selection of the distance to the sampling point shall be random. The sample plot will be placed on the right side of the transect line (facing away from the baseline) and the bottom left-hand corner of the plot will be placed on the sampling point (see Figure 5).

The field team will designate a field team data recorder and the remaining members of the team will become data collectors who will report the data to the recorder. The field team data collectors will count the number of stems (at ground level) for each shrub species in each 10-foot square sample plot and report the data to the recorder who will fill out the on the field data sheet provided in Appendix II.

Forest Habitat Class. In forest habitat classes, there will be one circular plot measuring 30-foot diameter established on each transect line. As with the baseline, the selection of the distance to the sample point shall be random. The sample point shall also be the center of the circle plot (see Figure 6).

The field team will designate a field team data recorder and the remaining members of the team will become data collectors who will report the data to the recorder. The field team data collectors will count the number of stems (at ground level) for each tree species in each 30-foot diameter circle sample plot and report the data to the recorder who will fill out the field data sheet provided in Appendix II. The recorder can also use VEMA directly or a printout of its Plant table to help determine whether a species is native, nonnative noninvasive, or nonnative invasive. The vegetation manager relational database linked to Appendix V can be used to collect and document the data as well as to help make the mitigation site performance specifications.

Layered Habitat Class. Some samples will have multiple vegetation layers (e.g., a forest overstory, a scrub-shrub understory, and/or an herbaceous understory). If there is a scrub-shrub understory in a Forest Habitat Unit, the 10 x 10- foot (100-square-foot) Scrub-shrub sample plots will be placed within the respective 30-foot diameter circles.

Figure 6: *Sample Plot Orientation on Transects in Forest Habitat Class*

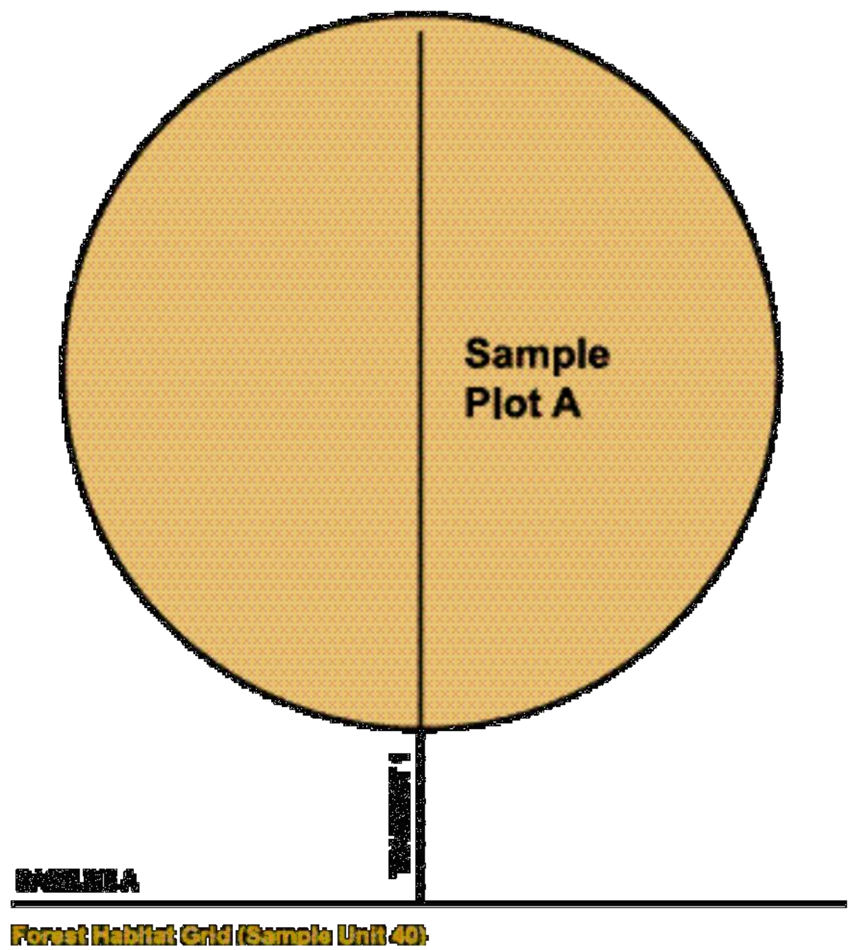
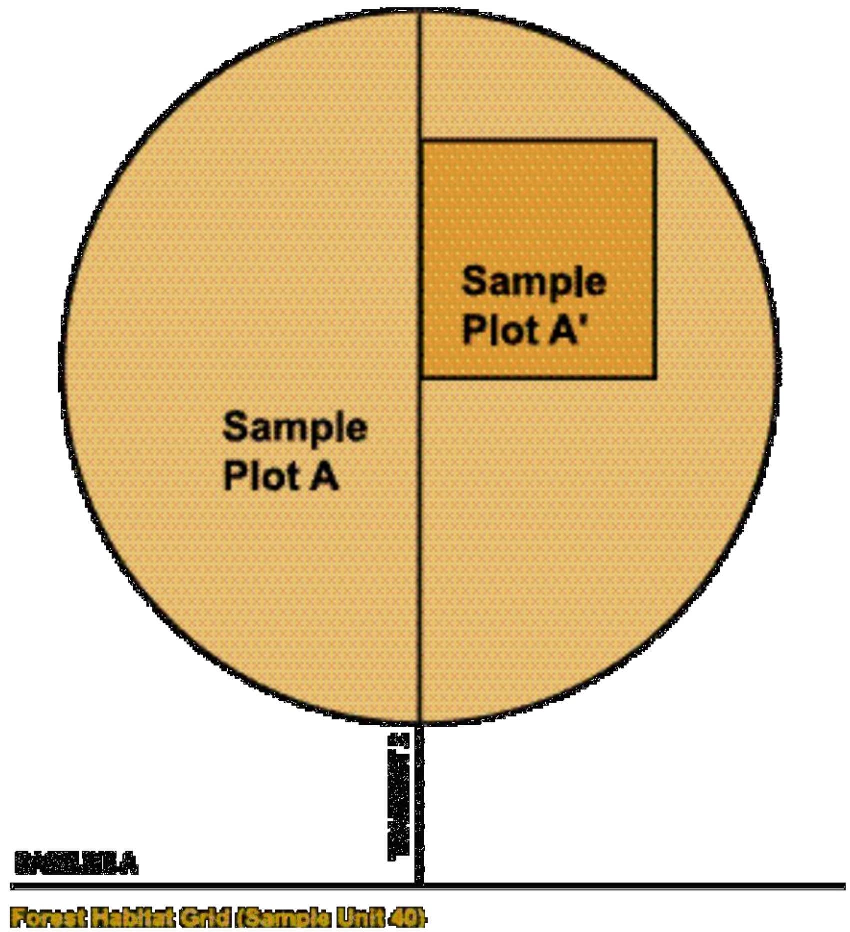


Figure 7: *Sample Plot Orientation on Transects in Layered Habitat Class*



The bottom left corner of each Scrub shrub sample plot will meet the center point of the circle it occupies (Figure 7). The percent cover of understory herbaceous vegetation in Layered sample units will be estimated using the boundaries of the largest sample plot. The field team will designate a field team data recorder and the remaining members of the team will become data collectors who will report the data to the recorder. The field team data collectors will estimate the percent cover mid-points for each herbaceous species and count the number of stems for each tree and shrub species in each sample plot and report the data to the recorder who will fill out the field data sheet provided in Appendix II. The recorder can also use VEMA directly or a printout of its Plant table to help determine whether a species is native, nonnative noninvasive, or nonnative invasive. The vegetation manager relational database linked to Appendix V can be used to collect and document the data as well as to help make the mitigation site performance specifications.

Manually Calculating Vegetation Performance. While we recommend entering all the data into the vegetation manager (VEMA) relational database downloadable through a link in Appendix V to automatically make the necessary calculations and display:

1. Reference site stand conditions (e.g., stem densities of woody species and relative percent cover of herbaceous species) to aid in formulating the preliminary mitigation site planting plan; and

2. Report summaries indicating whether mitigation site(s) meet their performance standard(s).

Recommendations on manual calculations using the field data are provided below:

Emergent/Herbaceous Habitat Class. The following procedure will be used for the determination of relative dominance by native, nonnative non-invasive, and nonnative invasive plant species:

1. For each transect in the Habitat Class sample unit, develop a table (see Table 4) that displays the following calculations:

   a. Determine percent cover of native, nonnative noninvasive, nonnative invasive species, and substrate by sample plot;

Table 4. *Example Use of Reference Site to Help Determine Preliminary Mitigation Site Planting Goal and Final Performance Standards (Emergent/Herbaceous Habitat Class)*

	PERCENT COVER		MEAN PERCENT COVER			
Species	**Sample 1**	**Sample 2**	**Native Invasive**	**Nonnative Soil**	**Bare**	**All**
Bare Soil	0	3			1.5	1.5
Caob	88	63	75.5			75.5
Scmi	38	15	26.5			26.5
Phar*	3	3		3.0		3.0
Total Mean Cover:			102	3.0	1.5	106.5
Relative Mean Cover:			95.8	2.8	1.4	100

[illegible]
[illegible]

*[illegible]

b. Determine mean percent cover of native, nonnative, nonnative invasive species, and substrate for transect;

c. Sum mean percent cover for all species present and substrate;

d. Sum mean percent cover for all native species present;

e. Sum mean percent cover for all nonnative noninvasive species

f. Sum mean percent cover for all nonnative invasive species

2. Divide each of the sums derived in calculations 1(d), 1(e), and 1(f) by the sum derived in calculation 1(c) to derive the relative mean percent cover for native species, nonnative noninvasive species, and nonnative invasive species sampled in the transect.

3. Repeat steps 1 and 2 for each transect.

4. Sum the total relative percent mean covers (native, nonnative noninvasive, nonnative invasive) for each transect tallied in Step 3.

5. Divide each of the sums derived in step 4 by the number of transects to derive the relative percent cover for native species, nonnative noninvasive species, and nonnative invasive species in the Habitat Class represented by the sample unit.

The above calculations are displayed in Table 4 for a simplified hypothetical sample unit. As you can see from the table, this sample unit would meet its performance standards because greater than 55% of the relative plant cover is by native species and less than 15% relative plant cover is by nonnative invasive species.

Willamette Valley Wetgrass Prairie Habitat Class. The same methods used above for the emergent/ herbaceous habitat class will be used for the Willamette Valley Wetgrass Prairie Habitat Class. However, additional data (Table 5) will need to be recorded and tallied: 1. number of prairie cohorts, 2. plant species weighted moisture indexes, 3. relative percent cover of Tufted hairgrass (*Deschampsia cespitosa*), and 4. relative percent cover by trees and shrubs.

A site must meet the following criteria to meet the Willamette Valley wetgrass prairie performance standards: 1. at least 50% of the relative cover by native species, 2. less than 15% relative plant cover is by nonnative invasive species, 3. at least 25% relative plant cover is by Tufted hairgrass (*Deschampsia cespitosa*), 4. at least 10 wetgrass prairie prairie cohort species are present on the site, 5. the site moisture tolerance index is between 2.0 and 3.0, and 6. less than 5% relative plant cover is by trees and/or shrubs.

Scrub-shrub Habitat Class. The following procedure will be used to determine species densities to plant at the mitigation site and the minimum stem density the mitigation site is required to have in order to meet its performance standard (see Table 6):

1. By species, add the number of live stems in each plot and divide by the number of plots to derive the mean number of stems per plot;

2. By species, divide the mean number of live stems per plot by the area of each plot (100-square feet) to derive the mean stem density (stems/square foot);

3. By species, multiply the mean stem density (stems/square foot) by the number of square feet in an acre (43,560) to derive mean number of stems per acre. The derived live stem density per species per acre can be used to prescribe the density at which to plant each respective species at the compensatory mitigation site.

4. Add the mean live stems per acre per species derived in step 3 to derive the total live stems per acre for all species.

5. Multiply total live stems per acre derived in step 4 by 0.80 to derive the minimum shrub density performance standard for the mitigation site.

Forest Habitat Class. The following procedure will be used to determine species densities to plant at the mitigation site and the minimum tree stem density the mitigation site is required to have in order to meet its performance standard (see Table 6):

1. By species, add the number of live stems in each plot and divide by the number of plots to derive the mean number of live stems per plot;

2. By species, divide the mean number of live stems per plot by the area of each plot (about 707-square feet) to derive the mean live stem density (stems/square foot);

3. By species, multiply the mean live stem density (stems/square foot) by the number of square feet in an acre (43,560) to derive mean number of live stems per acre. This derived mean live stem

density per species per acre can be used to prescribe the density at which to plant each respective species at the compensatory mitigation site.

4. Add the mean live stems per acre per species derived in step 3 to derive the total live stems per acre for all species.

5. Multiply total stems per acre derived in step 4 by 0.80 to derive the minimum tree density performance standard for the mitigation site.

Table 5. ***Example Use of Reference Site to Help Determine a Preliminary Mitigation Site Planting Goal and Performance Standards***
(Willamette Valley Wet Prairie Habitat Class)

Percent Cover				Wet Prairie Statistics			
Species	**Sample1**	**Sample 2**	**Mean Cover**	**Rel. % Cover**	**Number Prairie Cohorts**	**Moisture Tolerance**	**Weight Moist. Tolerance**
Bare Soil	0	3	1.5	.65		NA	
Dece	88	63	75.5	32.75		2.0	151.00
Agex	38	15	26.5	11.49	1	2.0	53.00
Bode	3	38	20.5	8.89	1	2.5	51.25
Cale	3	3	3.0	1.30	1	2.0	6.00
Café	3	3	3.0	1.30	1	2.0	6.00
Cade	3	15	9.0	3.90	1	1.0	9.00
Caun	3	3	3.0	1.30	1	2.0	6.00
Hobr	38	38	38.0	16.49	1	2.5	95.00
Grin	15	38	26.5	11.50	1	2.0	53.00
Juen	3	3	3.0	1.30	1	2.0	6.00
Juox	3	3	3.0	1.30	1	1.5	4.50
Brmi *	15	15	15.0	6.50	0	3.0	45.00
Ronu *	3	3	3.0	1.30	0	3.0	9.00

Total Mean Cover:	230.5
Mean Percent Cover Tufted Hairgrass	75.5
Mean Percent Cover Shrubs (Ronu)	3.0
Total Number Prairie Cohorts:	10
Total Weighted Moisture Tolerance	494.75

Meets Performance Standards:

1. >25% mean relative cover Tufted Hairgrass:	True	(32.75%)
2. At Least 10 Wetgrass Prairie Cohorts:	True	(10)
3. Moisture Tolerance Between 2 and 3:	True	(494.75/230.5 = 2.15)
4. < 5% mean relative cover trees or shrubs:	True	(1% Rosa nutkana)

* These species would not be included in the Mitigation Site Planting Goal

Table 6. *Example Use of Reference Site to Help Determine Preliminary Mitigation Site Planting Goal and Performance Standards* (Forested Habitat Class)*

Number of Stems Per 706 Square Foot Sample Unit			Mean Number of Stems	Mean Stem Density	
				Sq. Foot	Acre
Species	Sample 1	Sample 2			
Frla	6	7	6.5	.009	392.0
Potr	1	0	0.5	.0007	30.5
Crdo	1	2	1.5	.002	87.0
Total Stems Per Acre:	509.5				
Mean Live Stem Density Planting Goal and Performance Standard:	509.5 stems per acre (to be planted) x .80 = 407.6 stems per acre (Performance Standard)				

*This same method can be applied to the Scrub-shrub Habitat Class as long as the differences in sample plot sizes are adjusted accordingly.

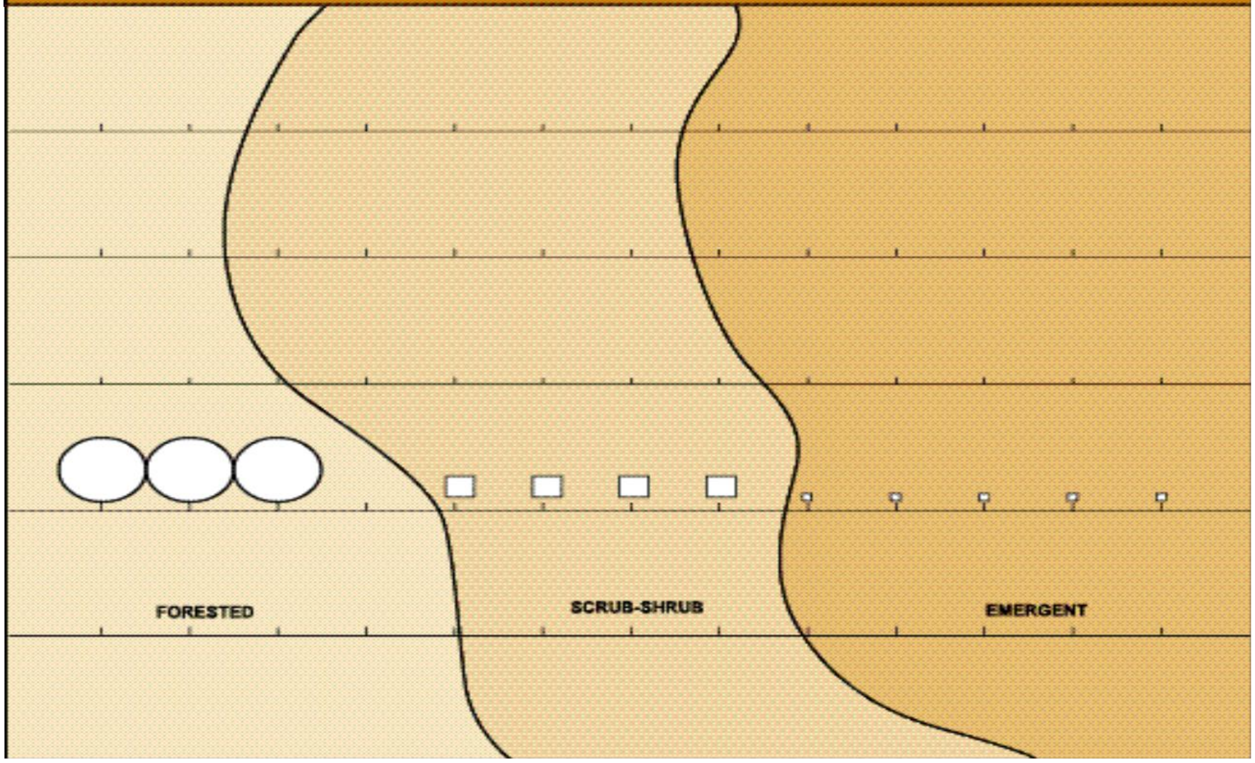
SAMPLING COMPENSATORY MITIGATION SITES

Once a compensatory mitigation site has been established under this guidance, it will be necessary to set up a sampling strategy designed to collect the same type of data collected at the corresponding reference site(s). We recommend using the same plot sizes used for the reference site(s). However, depending on the size and complexity of the mitigation site, a larger number of samples will generally be needed at the mitigation site than the number collected at the reference site. That is because the sampling goal at the mitigation site is different than at the reference site.

The sampling goal at the reference site is to collect the minimum number of samples needed to roughly characterize the flora and stand characteristics of the reference site. The sampling goal at the mitigation site is to determine, over the entire area of the mitigation site, whether the site has met its vegetation performance standards or, if not, if it is on a trajectory towards meeting those performance standards. This goal requires a more representative sampling strategy and, hence, generally a higher number of samples.

Forest Habitat Class Unit. A 30-acre forest vegetation management unit would require about 92 sample plots (3 plots per acre) if each plot were approximately 707-square feet (roughly the area of a 30-foot diameter circle). Reduction of the sample numbers may be appropriate based on site circumstances (e.g., a fairly evenly distributed ash stand). Decisions to reduce sample numbers should be made on a case-by-case basis and be in conformance with all regulatory requirements.

Figure 8: *Mitigation Site Vegetation Sample Grids*

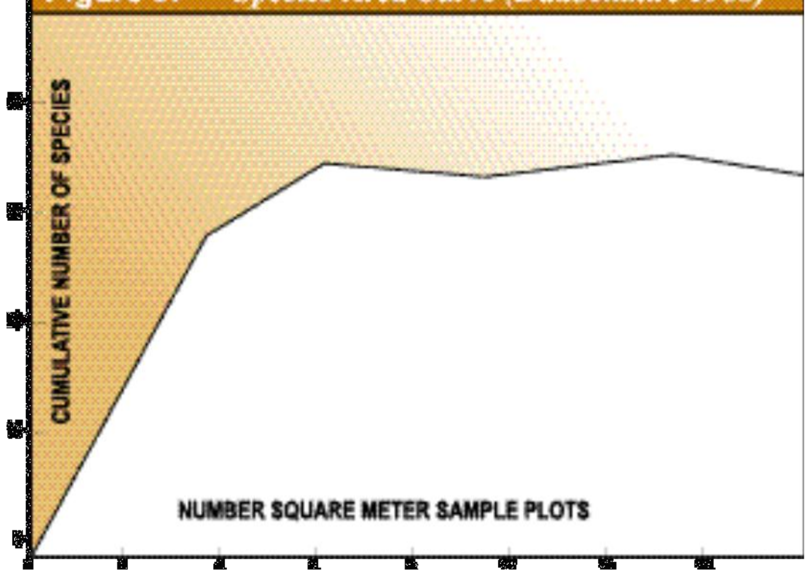


Scrub-shrub Habitat Class Unit. A 30-acre scrub-shrub vegetation management unit would require about 653 sample plots (22 per acre) if each plot were 100-square feet (the area of a 10-foot square). Reduction of the sample numbers may be appropriate based on site circumstances (e.g., a fairly evenly distributed stand of Spirea). Decisions to reduce sample numbers should be made on a case-by-case basis and be in conformance with all regulatory requirements.

Emergent/Herbaceous Habitat Classes Unit. The following steps should generally be followed to determine the minimum number of plots required using a species/area curve method (Daubenmire 1968):

1. Plot a graph (Figure 9) with the vertical axis (y) representing the cumulative number of species and the horizontal axis (x) representing the number of sample plots used;
2. Establish a preliminary transect within the appropriate habitat class unit following the transect and sample design in Figure 4;
3. Plot the number of new species counted in each respective sample plot on the graph established in step 1;

Figure 9: *Species-Area Curve (Daubenmire 1968)*



4. Continue step 3 for several plots after the species/area curve plotted begins to flatten;

5. Plot the x/y coordinate that best represents the sample number where an insignificant number of new species are being counted and use that sample number for the habitat class unit being sampled.

Since homogeneity in the environment typically decreases rapidly with increasing area, it is important to correlate specific plant communities with specific soil and microclimate conditions (Daubenmire 1969). This consideration is important both from the standpoint of planting species suitable to a particular location within a compensatory mitigation site and in determining the adequate sample number necessary to evaluate the performance of the vegetation planted. In order to document change over time, all sample plots at the mitigation site should be established as permanent plots (clearly marked in the field) and mapped to scale in a manner that they can be easily located during each future iteration of monitoring. Also, the coordinates of each transect starting point should be determined on a GPS unit and logged on the field data collection sheets and/or the vegetation manager (VEMA) relational database (Appendix V).

The above sample number recommendations for the different habitat class units are provided as guidelines. Depending on the complexity of the area being sampled, more or fewer samples may be warranted. However, a decision to use fewer sample numbers should be accompanied by an explanation of the specific circumstances that were considered when making that decision.

SUMMARY AND CONCLUSION

This document provides guidance on vegetation planning and monitoring protocols for western Oregon wetland and riparian areas. It is based on a presumption that reference sites can be used to help develop preliminary vegetation planting plans and performance standards for compensatory mitigation sites. The guidance recommends using relatively undisturbed reference sites that closely match the hydrogeomorphic and soil conditions of the corresponding proposed mitigation sites.

By recommending consistent monitoring protocols and vegetation performance standards, the guidance provides a means to evaluate the abilities of various mitigation implementation strategies (e.g. dike breaching, drain tile breaking, invasive plant removal, ditch filling, native vegetation planting, etc.) to meet the targeted design vegetation performance standards and to compare targeted vegetation outcomes against the actual outcomes. The data collected from compensatory mitigation projects that use this guidance should be useful in helping resource managers develop improved vegetation contingency plans, adaptive management strategies, performance standards, and implementation strategies for future mitigation projects. With iterative applications of this guidance, compensatory mitigation vegetation success should increase substantially in this area over time. A vegetation manager relational database linked to Appendix V can be used to record, calculate, and report vegetation performance based on the field data collected in sample and management units. It can also be used to set iterative performance thresholds for gauging a given site's vegetation success.

While the fundamental goal of this guidance is to provide a means to ultimately increase the success of compensatory mitigation actions, it is limited in terms of the contribution it can make toward this end. It provides a reference site based framework for establishing mitigation goals, performance standards, and follow-up monitoring. If consistently applied, over time, it should help facilitate the collection of highresolution vegetation data for a significant number of sites regionally scattered (with a probable bias toward urban areas). However, even after a prolonged period of application, it will not have contributed to the collection of data necessary to calculate the full range of vegetation variability by ecoregion and subwatershed.

Future wetland and riparian mitigation successes are highly contingent on the use of regionally collected vegetation data. Fortunately, there are a number of ecoregion and watershed scale vegetation data collection efforts currently underway (e.g., west Eugene wetlands, the Native Seed Network, the Willamette Valley and Oregon Coast wetland and riparian hydrogeomorphic guidebooks, Columbia River Estuary Long-term Monitoring Program, etc.). If a cooperative relationship can be established that would allow the users of this guidance to share their data with those working at the regional levels, the benefits would very likely trickle down to all mitigation practitioners. Of course, if adopted, this cooperative approach would require a concerted effort by all the parties in the network to work toward the following goals:

1. Consistent data collection methods and measures; and

2. A shared GIS based automated system for data storage and access.

If this guidance plays any part in helping achieve these goals, it will have served the intended purpose of the author. Finally, Provision of guidance such as this, which emphasizes vegetation, is not intended to diminish the importance of monitoring and assessing the performance of other key components of wetlands, such as water regime, soils, wildlife, and overall function.

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Appendix I.
Guidelines on How to Stratify an Aerial Photograph

Low Tech

1. Secure a recent aerial photograph that displays the area of concern. The photograph should generally be displayed at a scale no smaller than 1-inch equals 300 feet;
2. Overlay pre-cut clear plastic acetate sheet over the aerial photograph or mount on poster board and laminate;
3. Use a permanent Sharpie pen (the ink can be erased from the plastic by using a wetted pencil eraser) to delineate the boundaries of sample units on the aerial photograph;
4. Use the aerial photo signatures (e.g., texture, tone, shape, and color) to determine sample unit boundary locations and to label sample unit habitat types;
5. Number polygons; and
6. Field check sample unit polygons and make any necessary boundary and habitat classification adjustments as needed.

Mod Tech

1. Open Terrain Navigator Pro Software and load Maptech 2.0 Professional USGS Topographic Series CD for the area that contains the site you wish to stratify;
2. Zoon to scale at which aerial imagery are automatically downloaded (generally 1:12,000 or larger);
3. Choose a zoom level (e.g., 2:1) that allows you the best view of the aerial photo signature;
4. Per the guidance in step 4 under Low Tech, use the distance tool to draw a line around each of the habitat classes or vegetation types you wish to stratify;
5. Right click each polygon immediately after you close the line and choose convert to Track;
6. Use the edit option to give the track a full name and a GPS name and fill in any comments you wish to record about the habitat class;
7. Use the label tool to label the habitat class polygons; and
8. Select the print option to organize your map layout and to print the aerial photo with polygon and annotation layers.

Appendix I.

Guidelines on How to Stratify an Aerial Photograph (Cont)

High Tech

1. Open ArcMap in ArcGIS 9.1 or 9.2 software;

2. Add raster file containing orthophotograph imagery for the county that contains the site you wish to stratify;

3. Left click windows Start, select Explore, and navigate it to a folder you wish to place the shapefile for the polygons you will create during the sample/management unit stratification process for the habitat classes;

4. Create a subfolder specifically to contain the sample or management unit polygons you will create;

5. Close windows directory and go back to ArcMap with the added raster image;

6. Open ArcToolbox and select the Search tab at the bottom of the directory;

7. Type the words “create feature class” and select the “Search” button;

8. Double left click “Create Feature Class” after it populates the toolbox window;

9. A “Create Feature Class” form will display on your computer screen;

10. Under Output Location, navigate to the shapefile folder you created in step 4 above;

11. Type the name you wish to give your shapefile under Output Feature Class (be sure geometry type selected is polygon);

12. Select OK and wait for the feature class to be created and to show up in the table of contents;

13. Close ArcMap and Open ArcCatalog;

14. Navigate to the shapefile you have just created and select properties;

15. Click the X/Y Coordinates tab and click the Select a predefined coordinate system;

16. Choose Geographic Coordinate System (e.g., North America, North American Datum 1983.prj,), select Add, and then OK ;

17. Close ArcCatalog and Open ArcMap;

18. Click Editor down arrow to open drop down box and select “start editing.”

Appendix I.

Guidelines on How to Stratify an Aerial Photograph (Cont)

19. Make sure the task widow on the editor tool bar contains “start new feature” and the target window on the editor toolbar contains the name of your shapefile;

20. Zoom to a scale appropriate to stratify the sample or management units and select the “sketch tool” to the right of the editor down arrow;

21. Right click to place vertices as you use your mouse to sketch around the habitat classes you wish to stratify. Double click to close each sketch and to create a polygon representing the sample or management unit;

22. After all the polygons are complete, under the editor dropdown box, click “save your edits” and then click “stop editing.”

23. Right click on the feature class you are editing in the table of contents and select “Open Attribute Table;”

24. Click the options button at the bottom of the table and click “Add Field;”

25. Name the Field Sample Units and Select Float under “Type” then close the Attribute Table;

26. Click start editing and reopen the Attribute Table;

27. Click the records under the Field you just added and place a number to represent the sample or management unit that record is associated with;

28. After you have placed the numbers of each sample or management unit in the appropriate record, click save your edits and stop editing;

29. Right click properties and select “Symbology;”

30. Select the drop down arrow next to the Value Field window and select the Field you just added and edited;

31. At the bottom of the Symbol and Value window, select the “Add All Values” button and then Click each Label and change it to reflect the label you want to give the polygon it represents (e.g., Sample Unit 1, Sample Unit 2 . . . .) and then click OK;

32. At the bottom of the ArcMap window hit the Map Layout icon and insert title, north arrow, legend, scale, etc as desired.

33. Save your map (mxd file) to a selected folder and select Export Map under the File button on your toolbar. Use dropdown arrow under “Save as Type” and select the file type you wish to export the map to (e.g., pdf, jpg, emf). Close ArcMap.

Appendix II.
Field Data Collection Form

Vegetation Manager Data Base Field Sampling Form

Date: __________________ Site Name: ___________________ Surveyor: ____________________ Ecoregion: __________________________ HUC: ___________________________
State: __________________________ County: _______________________T R S: ________________________________ Assoc. Stream _________________________ RM ________

Sample Unit: **Reference Unit / Management Unit**

Lat. ________________________________ Long.___________________________________ HGM Class/Sub-class: ________________________________
Cowardin System: ____ Cowardin Class/Modifier:________________________________
Existing Habitat Type: ____ Targeted Habitat Type: ______________________________
Soil Series: ____

Baseline:

Number ___________ Bearing ____Start Lat./Long. ____________________________
End Lat./Long. ____ Length ____________________________

Transect:

Number ___________ Bearing ____ Start Lat/Long. ____________________________
End Lat/Long. ____ Length ____________________________

Transect Number	Sample Plot Number	Plot Size	Plant Species/Exposed Substrate	Moisture Index	T S H FE ES	Percent Cover	Stem Count	N NN I	Grass	Forb	Woody	Prairie Cohort	GPS Way-point

T = Tree; S = Shrub; H = Herb; FE = Floating Emergent; ES = Exposed Substrate: (Br = Bedrock, Co = Cobble, Gr = Gravel, Sa = Sand, Si = Silt, Cl = Clay, Li = Litter, Du = Duff, Th = Thatch, Pe = Peat, Mu = Muck); N = Native; NN = Nonnative; I = Nonnative Invasive.

Percent Cover Classes: 1: 0 – 5 (3); 2: 5 – 25 (15); 3: 25 – 50 (38); 4: 50 – 75 (63); 5: 75 – 100 (88).

Appendix III.
Office and Field Equipment Lists

1. Aerial photograph/plastic cover;
2. Rebar stakes (for marking baseline, transect, and sample locations);
3. Write-in-the-rain field data sheets;
4. Two 300-foot measuring tapes;
5. 2 one-meter square plot frames;
6. 1 camera;
7. One GPS unit;
8. 1 box of plastic plant collection bags;
9. A compass; and
10. A random number generator.

Appendix IV.

Guidelines on Calculating Site Level Moisture Tolerance Indexes

1. Assign each of the plants in the sample plot a number based on the U.S. Fish and Wildlife Service National List of Plant Species that Occur in Wetlands: Northwest (Region 9) wetland indicator status (e.g.1 = obligate, 2 =FACW, 3 = FAC, 4 = FACU, and 5 = UPL).

2. Determine percent cover for each species and then sum the percent cover for each species in a sample;

3. Multiply the percent cover of each species by its respective moisture tolerance index to derive a weighted percent cover for each species;

Sample Plot: a

	Step 1		Step 2	Step 3
Sample	Cover Class	Moisture Index	Sum Cov. Class	Sum Weighted Cov Class
[illegible]	[illegible]	1	[illegible]	[illegible]
Caob	33	1	33	33
[illegible]	[illegible]	1	[illegible]	[illegible]
Mear	63	3	63	189
SUM			[illegible]	[illegible]

Step 4: Sample Plot Average Moisture Index (SPMI) [illegible]

Step 5. Transect Average Moisture Index (TMI)

Sample Plot:	a	b	c	d	e	f	g	h	i	j	TMI
Transect 1 SPMI:	2	2.5	[illegible]	2	[illegible]	3	[illegible]	2	[illegible]	3	[illegible]
Transect 2 SPMI:	2.2	2	1.9	2.3	1.8	2.6	2.9	2.2	1.7	2.8	2.24
Transect 3 SPMI	[illegible]	2.1	1.7	[illegible]	2.2	[illegible]	2.2	2	[illegible]	2.4	[illegible]

Step 6. Site Average Moisture Index (SMI) [illegible]

4. Sum the weighted percent cover for each species in the same sample;

5. Divide the sum in step 4 by the sum derived in step 2 to derive sample plot average moisture index (SPMI);

6. Average sample plot moisture indexes in the transect to derive transect average moisture index (TMI); and

7. Average transect moisture indexes to derive site average moisture index (SMI).

Appendix V.
Vegetation Manager (VEMA) Relational Database

Click here to download the database.

ftp://nwhi.org

Login: vema
Password: vema

To download it onto your computer, create a file named "VEMA" on your C drive (C:\VEMA), drag the zip file from the FTP site directly into your VEMA folder and use winzip to "extract to here." There will be four folders: Help, Images, Logs, Reference; a text file; and two mdb files: VEMA.mdb and VEMAData.mdb. You access the database through the VEMA.mdb (applications file).

NOTE: All the data you enter in the applications file is stored separately in tables in the VEMAData.mdb (data file). You can send a copy of this datafile to any other user of VEMA and they can then "point" their applications file at it and generate vegetation performance reports related to their customized queries of the data. Or you can export your reports to excel files, word docs, etc. and file those reports in your windows directory and/or attach them to e-mails or CDs and send them to others.

Once you open the applications file you will be in a form called: "About VEMA." At the top left corner of your screen above your toolbar but below the title of the database in black letters there is a dropdown list box titled: VEMA: Sites; Site Visits; About; Exit. Click the dropdown list and choose "Sites." That is where you begin entering the data necessary to set up your Site, Site Visit and vegetation data entry. There is also a Help link you can use to further explain and assist you in your use of the database.

The next goals are to: 1. convert VEMA into a geodatabase, 2. enable it to be used on mobile data collection/GIS-GPS devices for direct field data entry, and 3. develop a common protocol for an internet based system for data access and sharing.

Appendix VI
Glossary

Biological Integrity. A habitat condition that is characterized primarily by native species and native plant communities; and/or a habitat condition that is characterized by a structure that provides opportunities for the multiple life-cycle requirements of a diverse or abundant native fauna; and/or a habitat condition that is characterized by a structure that provides opportunities for the life-cycle requirements of a specialized fauna that is currently rare or federally listed as threatened and endangered.

Compensatory Mitigation. The restoration, enhancement, or creation of habitat to compensate for the unavoidable loss of habitat.

Emergent Wetland Habitat Class. An area dominated by herbaceous vegetation with an overall site moisture index less than 3.

Forested Habitat Class. An area dominated by woody vegetation equal or greater than six meters (about 20-feet) in height (Cowardin et al 1979).

Habitat Class. A classification of biotic and abiotic attributes in a defined area. It is used to compare similar and to contrast distinct animal and plant assemblages. There is variation both within and among habitat classes. Habitat classes experience cyclic variations in environmental conditions daily, seasonally, and through historic and geologic time. Habitat classes may also experience successional or catastrophic changes.

Habitat System. The complex of habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors (Cowardin et al 1979).

Non-native Invasive Plant Species. Non-native plants that have demonstrated consistent trends toward invading and dominating or totally replacing native plant communities over a relatively short period of time after they initially become established. Invasive species include but are not limited to: Purple loostrife; Reed cannarygrass; Japanese knotweed; Yellow iris; Eurasion water millfoil; and Himalayan blackberry.

Open Emergent/Open Herbaceous Habitat Class. Herbaceous vegetation with no tree or shrub overstory.

Sample Unit. A habitat class delineated on an air photograph and numbered for sampling purposes.

Scrub-shrub Habitat Class. An area dominated by woody vegetation less than six meters (about 20-feet) in height (Cowardin et al 1979).

Substrate. Bare ground, including both mineral and organic soil, a wide variety of soil and rock partical sizes, and/or a wide variety of organic debris types.

Willamette Valley Wetgrass Prairie. Wet prairie grassland with a tufted hairgrass (Deschampsia cespitosa) component and other grasses and forbs. The underlying soils are typically saturated to the surface during the early part of the growing season and gradually dry out during the summer with a moisture index between 2 and 3.

Appendix VII.
Selecting and Substituting Plant Species and Plant Genotypes

We recommend mitigation site designers develop planting plans using the same native species and genotypes (collectively referred to as plant materials) documented at the reference site for planting the mitigation site. It is usually preferable to salvage the desired plant materials from existing vegetated areas on or near the proposed compensatory mitigation site. However, this option may be partially or completely unavailable. If that is the case, native plant nurseries can be used. Many nurseries keep track of the geographic origins of their stock. Also, if the order for plant materials can be placed far enough in advance of the development action(s), some nurseries will gather the ordered plant materials, propagate them, and hold them until the plant materials ordered are needed.

Giving deference to best professional judgment, we generally recommend against substituting for species documented at the reference site with species that are not present at the reference site because of suitable plant material unavailability. If one or more species documented at the reference site is unavailable, we recommend filling the gap with species that are documented at the reference site and are obtainable. For example, if there are 300 alder, 100 Oregon ash, and 10 cottonwood per acre at the reference site, and cottonwood are unavailable, we would recommend planting 110 Oregon ash or alder per acre at the mitigation site instead of substituting another "selected" species for the cottonwood. Diversity goals should be considered within the context of the landscape. It may be inappropriate to try and obtain high species diversity at the project level at many mitigation sites.

Appendix VIII.
Securing Aerial Photographs for Sampling

Acquisition of Planimetrically Correct Aerial Photographs. Aerial photographs are commercially available for most areas in Oregon and flights are run almost every year. Enlarging the centers of small scale aerial photographs in areas that are relatively low relief topographically, typically results in photographs that are, within acceptable parameters, planimetrically correct. For many urban areas, orthographic photos are readily available from local and regional planning authorities.

Digital orthophotos for every county in the United States can be downloaded from the following United States Department of Agriculture web site but are only viewable with a GIS or other image processing software:

http://datagateway.nrcs.usda.gov/

Plotting Sample Points on Aerial Photographs Downloaded From the Internet. A precision lightweight global positioning system receiver (PLGR+96) can be used to electronically collect and map sample points (waypoints) in the field (accuracy is about +/- 25-feet in open fields):

1. The field marked sample points (waypoints) are recorded on the GPS unit (setup for a North American 1983 datum using a universal transverse mercator (UTM) coordinate system for UTM Zone 10 and Zone Designator T.). Be sure to collect waypoints in the same datum and projection that you will use to map the locations.

2. The waypoints (sample points) are then downloaded from the unit and entered as individual markers in the Terrain Navigator Pro mapping software program.

3. Download the digital orthographic quads (1:12000) from the vendor(s internet site and layer the individual markers (sample points) on the base orthographic quads (photographs) in the Terrain Navigator Pro mapping software program.

4. Re-scale the quads to an appropriate scale to view the individual markers (sample points).

5. Print the selected orthographic quad (photograph) section in a large output format using a HP Design Jet 1055CM Plus plotter or it(s equivalent.

Waypoints can also be exported from Terrain Pro Navigator Software as a shapefile to a folder in your windows directory. From there, the shapefile can then be added to ArcMap using ArcGIS software and projected onto digital orthopotos along with other GIS layers.

Appendix IX.
Additional Data Needs

1. Vegetation height class;
2. Numeric plant salinity tolerance index;
3. Sequential ground photographs of the compensatory mitigation action taken from permanent photo stations;
4. Sequential aerial photographs of the compensatory mitigation site;
5. Shallow ground water well data or peizometer data;
6. Surface water staff gauge data; and
7. Wildlife use behavior by habitat class.