Section 4

Monitoring Riparian Restoration

This section provides a general overview of the riparian management monitoring programs. Annual reporting to the Federal Services will document implementation (compliance) monitoring of the riparian strategy, as is the case with the implementation of other conservation strategies established in the state trust lands HCP. The specifics of reporting will be agreed upon by DNR and the Services and will likely include: the acreage of Riparian Management Zones to be treated by each management scenario, the planning units in which the activities are to occur, the stream type of adjacent riparian areas, as well as other statistics. DNR riparian forest effectiveness monitoring will be conducted in accordance with detailed scientific guidelines outlined in Riparian Silviculture (Wilhere and Bigley 2001a and 2001b) and Instream Conditions and Trends Effectiveness Monitoring (Pollock et al. 2001). Each specifies monitoring priorities, design, parameters to monitor, evaluation of results, and period of monitoring. Additional guidance may be developed for sediment and unstable slope monitoring.

Riparian restoration is a long-term goal that requires the manager to have a vision for the forest, and tailor treatments to the site's existing conditions and ecological potential.

Monitoring the effectiveness of these restorative actions requires measuring the response of vegetation to the treatments in the riparian areas, as well as measuring the physical and biological responses of stream channels and fish habitat. Several guidelines have been published recently for determining which parameters to monitor, and the appropriate methods for monitoring instream parameters such as water quality (MacDonald et al. 1991; Bauer and Ralph 1999; Kauffman et al. 1999). However, some aspects of monitoring design for restoration of riparian areas have not been well developed, and consistent criteria are lacking for determining the success of riparian restoration efforts. In particular, there has been little analysis of riparian silvicultural treatments on forest conditions, or on how associated changes affect instream habitat (Beechie et al. 2000; Pollock et al. 2001; Pollock et al. 2005).

DNR's Need for Riparian Effectiveness Monitoring

The trust lands HCP conservation strategies have been developed with the best available information. In many cases, however, the information has been less than complete. The

riparian forest strategies are intended to strike an acceptable compromise between ecological and economic values, and the center or locus of compromise is often surrounded by uncertainty. Both the RMZs and the silvicultural prescriptions for riparian forests are working hypotheses based on extensive experience in thinning upland forests, and initial results from the Olympic Experimental State Forest.

HCP riparian effectiveness monitoring for riparian silviculture has been designed to test sets of hypotheses (Wilhere and Bigley 2001b). These hypotheses comprise the principal assumptions about the form and function of watershed and riparian processes that are most likely to be affected by forest management activities, and that relate directly to attaining resource objectives addressed by monitoring. The testing of these hypotheses constitutes a major portion of DNR's riparian management monitoring program. The results will be used in DNR's adaptive management process to make necessary adjustments to activities that will better create the riparian desired future condition.

Riparian Silviculture Effectiveness Monitoring

Effectiveness monitoring for riparian silviculture is a means through which DNR will acquire the data needed to develop effective and cost-efficient silvicultural systems to conscientiously proceed with riparian forest management. Effectiveness monitoring (as defined in the HCP 1997, V. 2) will help DNR determine whether implementation of the riparian conservation strategies results in the anticipated habitat conditions. The definition focuses on habitat conditions but ignores cost-efficient management. However, conscientious stewardship of trust assets demands that effectiveness monitoring address both. Therefore, the purposes of effectiveness monitoring are to:

1. Determine whether DNR's management actions are effectively achieving desired habitat conditions; and
2. Identify and either improve or eliminate those actions that are not cost effective.

Detailed monitoring plans to meet their objectives have been prepared (Wilhere and Bigley 2001b).

Riparian Silviculture Risks in Relation to Monitoring

There is a moderate level of uncertainty when undertaking silvicultural operations in a riparian forest (Wilhere and Bigley 2001a and 2001b). Three types of risk are associated with riparian forest restoration. First, there is a risk of actually retarding rather than advancing community succession. For instance, removing an alder overstory could cause a profusion of understory plants, such as salmonberry, that would prevent the growth of conifer seedlings. Second, silvicultural treatment could temporarily increase the risk of forest destruction by windstorm or flood. This too could retard the rate of forest restoration. Third, thinning a conifer stand risks an undesired effect of creating a riparian forest that is too stable (Beechie et al. 2000). Thinning is done to reduce tree mortality and enhance tree vigor, so thinning could conceivably decrease rates of large woody debris delivery into streams for several decades. Any of the three risks described above could delay or prevent attainment of the RDFC. Effectiveness monitoring will help address questions related to each of these risks.

For the foreseeable future, the greatest uncertainties of riparian silviculture will be those associated with forest restoration. When the conservation strategy moves into the multiple-resource phase, new types of risks will emerge. These risks will be assessed and monitoring priorities re-examined when DNR is ready to enter the multiple-resource phase.

Questions Addressed by Riparian Silviculture Monitoring

To be highly cost-efficient, monitoring must address specific questions. A monitoring plan explicitly addressing questions is much more likely to yield useful information (Wilhere and Bigley 2001b). The most general question for effectiveness monitoring is 'Does the management of HCP riparian zones maintain or restore riparian forests?' Relative to the key functions for Riparian Management Zones, the question is 'Do HCP RMZs provide a quantity and quality of instream large woody debris that approximates those provided by unmanaged riparian ecosystems?' These questions encompass more specific questions about details of riparian forest ecology, riparian silviculture, and large woody debris recruitment processes. The key questions are:

- Which silvicultural prescriptions are most effective for restoring riparian forest structure?
- How does RMZ forest stand structure influence its function (i.e., supply adequate quantities of large woody debris, shade, nutrients, sediment filtering, etc.)?
- What is the rate of woody debris delivery from different types of RMZs?
- What is the structure and species composition of DNR-managed RMZs, and how do these compare to unmanaged riparian forests over time?

An active monitoring approach will be implemented as described in Wilhere and Bigley (2001a; 2001b) and Figure 6. Active monitoring design requires an untreated control area, before and after measurements, and carefully controlled treatments so that true replicates of treatments can be produced. Silvicultural prescriptions applied to the riparian buffer can be considered working hypotheses to be tested through effectiveness monitoring.

Variables chosen for monitoring will reflect information needed to answer questions about riparian silviculture and riparian forest ecology, especially those pertaining to large woody debris recruitment into and across streams. Monitoring will concentrate on variables that describe forest characteristics—structure and species composition—because these attributes are directly affected by silviculture, and they are only weakly affected by processes outside of the area. Some monitoring of large woody debris will be conducted, and the variables selected for monitoring are those that should minimize the effects of remote processes such as instream large woody debris transport from upstream.

Relationship of Monitoring to HCP Research

Questions about riparian ecosystem functions would best be answered through carefully designed research. This research needs to be compatible with effectiveness monitoring (i.e., controlled treatments with an untreated reference). However, because of the number of variables that must be measured in order to measure

functions, it may not be possible to address more subtle information such as the maintenance of microclimate, delivery of detrital nutrients, and delivery of small wood debris (less than 3 inches in diameter). Functions that can be cost-effectively addressed at all of the effectiveness monitoring sites are the recruitment of large woody debris and snags. The monitoring design (Wilhere and Bigley 2001b) specifies that additions to these riparian restoration prescriptions will be tested to demonstrate their utility and provide options for future management decisions.

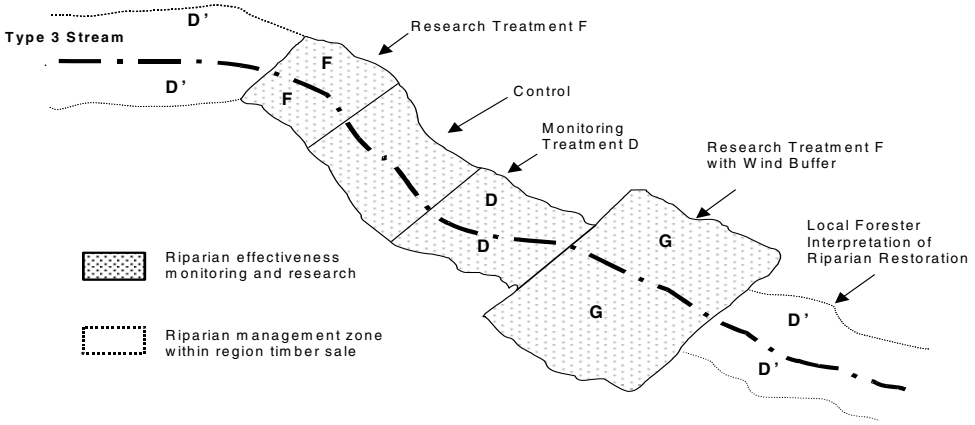

Figure 6. Configuration of riparian silviculture effectiveness monitoring and research plots.

Monitoring of Instream Conditions and Trends

Monitoring of restoration emphasizes stand development, species diversity, wind firmness and development of forest understory vegetation.

DNR has been working cooperatively to develop and implement the concepts in the HCP Salmon Habitat Conditions and Trends Monitoring (Pollock et al. 2001). Effectiveness monitoring for these conditions and trends was prepared collaboratively by the Northwest Fisheries Science Center's Environmental Conservation Division Watershed Processes Program, and DNR. This monitoring will describe changes in salmon habitat resulting from riparian conservation strategy activities. This will include instream habitat changes relating to adjacent riparian forest conditions.

The instream conditions and trends monitoring uses general habitat requirements for anadromous salmonid species and the current scientific literature to select quantifiable parameters and develop a statistically rigorous monitoring design. Several recent efforts, (e.g., Poole et al. 1997, Bauer and Ralph 1999) have provided valuable summaries of available information and interpretation of those data. In addition, several research groups (e.g., Oregon Department of Fish and Wildlife, U.S. Forest Service) currently are conducting similar assessments.

Instream conditions and trend monitoring is being conducted in close collaboration with DNR to ensure that the Salmon Habitat Conditions and Trends monitoring guidance is consistent with other riparian effectiveness monitoring modules required by DNR's HCP and management objectives.

Hypotheses for Riparian Effectiveness Monitoring

It is assumed that improvements to instream habitat will occur as deciduous and young conifer forests within riparian ecosystems develop into older conifer forests. This is a predicted outcome of the HCP, which suggests that instream habitat will improve as riparian forests become older. It is assumed that the two primary means by which older forests will improve instream habitat are: the provision of additional shade, and organic material—particularly large woody debris. The shade should lower stream temperatures, while the instream large woody debris should create more pool habitat.

The monitoring guidelines propose specific hypotheses linking instream conditions to upslope management activities. Observed trends in instream conditions may result from changes in upslope management (i.e., road and unstable slope management), thus in order to make broader interpretations, instream monitoring efforts will necessarily have to be linked to monitoring modules. In order to build a capacity for integrating and facilitating a more rapid connection between DNR's various monitoring modules, specific hypotheses are suggested to link road and unstable slope management strategies to improvements in instream conditions.

Implementation and Adaptive Management

DNR has made a commitment through this Riparian Forest Restoration Strategy to a wide range of actions to actively promote the development of structurally complex forests to benefit the habitat of aquatic- and riparian-dependent species (see Appendix 6 for a summary of those commitments). The Department also has committed to a training and implementation schedule that will ensure that managers are well trained and have continued support as they implement this strategy (see Appendix 7).

DNR recognizes that the science and understanding underlying the monitoring and evaluation of riparian restoration efforts are rapidly evolving (Pollock et al. 2005). DNR anticipates that the understanding will change over the life of the trust land HCP regarding watershed processes, natural disturbance rates and patterns, riparian forest functions, and the effects of management practices on aquatic and riparian systems. As this new information is acquired, DNR will learn how to better and more efficiently modify forest management activities, and to mitigate the effects of the activities on protected species and aquatic resources. It is the intention of DNR that restoration activities (i.e., thinning and hardwood conversion activities) will be applied annually to no more than approximately one percent of the Westside Riparian Management Zones (excluding the OESF).

Initial Implementation of the Riparian Forest Restoration Strategy

To address concerns and questions still remaining regarding the proposed Riparian Forest Restoration Strategy in the very short-term, the first three years will be an initial Implementation Period for effective riparian restoration. By December 2009, DNR will

produce a compliance monitoring report that will include at least the following information:

- Total acreage of Type I, II, and III riparian thinnings and hardwood treatments,
- Riparian silvicultural prescriptions outlining the residual RD and trees per acre,
- Stream type associated with riparian prescriptions,
- Untreated riparian acres due to site conditions (wetlands, unstable slopes, etc.), and
- Riparian restoration activity acreages treated by HCP planning unit.

At this time, the Riparian Forest Restoration Strategy Technical Review Committee will re-convene to address issues pertinent to the implementation of the strategy and determine if refinements are necessary.

For the foreseeable future, the main management objective for riparian forests will be restoration. This period is called the "restoration phase" of the HCP Riparian Conservation Strategy.

Currently, DNR believes that silviculture can be an effective tool for accomplishing this objective. Eventually, most riparian forests should attain a structure and species composition that is considered restored. At that time, economic objectives for riparian silviculture will be appropriate. Management for the simultaneous objectives of fish and wildlife habitats and forest commodities hold considerable appeal for the schools and other state beneficiaries who depend on DNR-managed state trust land for revenue. Future silvicultural systems may be effective tools for accomplishing these multiple objectives, called the "multiple-resource phase" of the conservation strategy.

A credible policy of multiple-resource management in riparian ecosystems must be based on valid scientific information, and effectiveness monitoring is one means of acquiring such information.

Implementation Period Commitments

The following non-standard localized activities described below will apply during the Implementation Period of this strategy (until January 1, 2009), and will require joint concurrence between the DNR trust lands HCP Implementation Manager and Federal Services (NOAA Fisheries and USFWS). After January 1, 2009, decisions will then be made regarding further implementation of these activities and the future need for interagency approval processes.

If DNR determines this approach is needed, it will coordinate with the Federal Services on a joint concurrence letter between the three agencies. The Services will have 60 working days to respond back to DNR, either with signing the concurrence letter, or notifying DNR otherwise.

Site-specific riparian activities that require joint concurrence between DNR and Federal Services:

1. Type II and Type III thinning to a RD 30.
2. Specific forest practice activities for salvage logging in riparian areas.
3. Conducting more than two commercial silvicultural restoration treatments within the same portion of the riparian area during the 70- to 100-year term of the HCP.
4. Conducting a Type III thinning in stands greater than 70 years of age. This approach to thinning older stands will be reviewed by the Technical Review Committee at the end of the three-year initial Implementation Period.
5. Specific non-timber resource activities (see non-timber section).

Changes to the stream typing methodology or the Riparian Forest Restoration Strategy also will require concurrence between the three agencies. However, the level of analysis and discussions between the agencies for these changes would be expected to be more comprehensive and systematic than addressing the site-specific issues addressed above.

Adaptive Management

The threshold for initiating adaptive management discussions will be tied either to the rejection or the acceptance of one or more of the testable hypotheses associated with a particular resource objective (Wilhere and Bigley 2001b). In cases in which the monitoring program establishes that the resource objectives are not being achieved (or conversely, that the existing prescriptions could be relaxed and still achieve the desired outcomes), discussion will be initiated with the Federal Services to address possible cause and effect relationships that could be responsible for the monitoring observations.

Adaptive management changes consistent with the restoration goal will be made to this Riparian Forest Restoration Strategy when implementation and/or effectiveness monitoring indicate that the objectives outlined in the RFRS and the HCP Riparian Conservation Strategy are not being met. It is anticipated that applied research led by DNR and others could result in innovations that will increase the Department's ability to implement the strategy with higher efficiency and less potential of short-term adverse habitat impacts. Adaptive management areas of interest for the Riparian Forest Restoration Strategy are listed in Table 6. These areas will be added to the research priorities in the HCP research and adaptive management plan (Bigley and Wilhere, 2001). Other subjects and their priority may be added or changed by mutual agreement. Changes to this Riparian Forest Restoration Strategy may be made by written agreement between the appropriate agency representatives.

The riparian forest affords the opportunity for long-term management of structural legacy trees, such as this snag that offers foraging for primary excavators such as woodpeckers.

Considering that active riparian management on DNR-managed state trust lands has not taken place to date, adaptive management that addresses refinements to management activities allowed in the Riparian Management Zones within the first decade of the HCP does not apply. DNR agrees that using the adaptive management process as outlined in the HCP's Implementation Agreement, management activities allowed within the RMZs will be refined during the entire term of the Habitat Conservation Plan.

Table 6. Summary of adaptive management subjects for the Riparian Forest Restoration Strategy.

Subject area	Priority
▪ Evaluate the need for increased site-specificity of thinning targets and prescriptions	1
▪ Evaluate windthrow associated with different thinning levels and site types	1
▪ Evaluate potential impacts of salvage operations on riparian function and plan for future salvage contingencies	1
▪ Evaluate Large Woody Debris recruitment rates within RMZ's associated with active restoration vs. natural self-thinning	1
▪ Evaluate the economics of hardwood thinning and conversion to conifer-dominated stands	2
▪ Evaluate the feasibility and value of thinning beyond the RDFC desired riparian condition	2
▪ Evaluate options for management of Large Woody Debris recruitment including the tipping of live trees	2
▪ Evaluate on a Watershed Administrative Unit scale the influence that the rate and extent of riparian restoration may have on stand development and possible negative short-term impacts on stream habitat.	2
▪ Evaluate options for snag creation and long-term management	2
▪ Evaluate the role of canopy gaps in providing riparian function	2