Aquatic and Riparian Conservation Strategy (ARCS)

USDA Forest Service

Pacific Northwest Region

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Section I: Introduction

Purpose of the ARCS

The Aquatic and Riparian Conservation Strategy (ARCS) is a Regional strategy designed to maintain and restore the ecological health of watersheds and aquatic and riparian ecosystems on National Forest System (NFS) lands in the Pacific Northwest Region (Region). Its goal is to develop networks of properly functioning watersheds that support populations of fish and other aquatic and riparian-dependent organisms across the Region. The Strategy focuses on maintenance and restoration of the dynamic ecological processes responsible for creating and sustaining habitats over broad landscapes, as opposed to individual project or small watershed scales (USDA and USDI 1994a and 1994b).

Background

The ARCS is a refinement of earlier strategies, including: the Aquatic Conservation Strategy (ACS) (USDA and USDI 1994a and 1994b), Interim Strategies for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and portions of California (PACFISH, USDA and USDI 1995), and the Inland Native Fish Strategy (INFISH, USDA Forest Service 1994c and 1995). Two independent assessments were completed to evaluate the utility and effectiveness of these earlier strategies (Reeves 2006, Heller and McCammon 2004). Both concluded that the basic approaches and associated management direction are sound, generally understood and implemented by Forest personnel, and have significantly changed the way aquatic resources are managed on NFS lands in the Pacific Northwest. Specifically, they found that the strategies have led to improved and proactive management of aquatic resources and these changes appear to be maintaining and restoring aquatic and riparian habitat conditions at the watershed and larger scales. In addition, Reeves (2006) noted that implementation of the ACS has resulted in positive changes in agency culture.

Scientific studies completed after these strategies were initiated (Naiman and Bilby 2000, Spence et al. 1996) continue to support their general framework and assumptions. In particular, this science reinforces previous understanding regarding the ecological importance of smaller, headwater streams and the need to protect streamside forests (Burnett and Miller 2007, National Research Council 2002). Evaluations of the strategies, as described above, indicate the need for and utility of a single, unified aquatic conservation strategy that incorporates new science (e.g., Hobbs and Huenneke 1992, Reeves et al. 1995) and addresses issues and clarifications identified during more than a decade of field-level implementation.

These needed refinements provide a primary basis for development of the current ARCS. They include better recognition that disturbance is integral to the resiliency of ecosystems, consideration of scale effects (spatial and temporal) on ecosystem processes, confirmation of the value and utility of watershed-scale analysis, the need for a monitoring component, and establishment of better linkages between management intent and direction in the strategy.

Intended Use of the ARCS

The ARCS is intended to provide the core set of desired conditions, suitability, objectives, and standards and guidelines for aquatic and riparian management in the Region. In revising Forest plans, each Forest should design the Forest plan direction according to this strategy. The ARCS itself is not Forest plan direction; it is a Regional strategy for incorporation into Forest plans or other administrative direction.

This document includes some sections in **bold** text. It is generally expected that plan components (e.g., desired conditions, suitable use determinations, standards and guidelines) displayed in **bold** will be included as worded. Other **bold** text (riparian management widths, for example) provides direction for plan content other than plan components. Any exceptions to plan components or other plan direction must be discussed with the Director of Resource Planning and Monitoring and the Director of Natural Resources.

Additionally, Forests should add specificity and local detail as needed to tailor management of watersheds and aquatic and riparian resources to local systems and conditions. It is anticipated that as each Forest works through its collaborative process, there will be plan components added to the set provided here that are Forest-specific and science-based.

Background text in this document is not intended for inclusion in Forest plans, instead it provides a basis and context for this strategy.

ARCS and Forest Plans

Application of the ARCS through Forest plans relies on a suite of five plan components to set goals (desired conditions), identify areas where certain activities are not generally appropriate (suitability of areas), provide a means of measuring progress toward achieving or maintaining desired conditions (objectives), and constrain activities (standards and guidelines) to ensure protection of physical and biological resources. While it is easy to focus on one plan component or another, all plan components work together to guide and constrain management for purposes of achieving desired conditions. These plan components are from the 2008 Planning Rule (36 CFR 219.7) and are further described in the Plan Wording Style Guide.

1. Desired conditions: the social, economic, and ecological attributes toward which management of the land and resources of the plan area is to be directed. Desired conditions are aspirations and are not commitments or final decisions approving projects and activities, and may be achievable only over a long time period.

2. Objectives: concise projections of measurable, time-specific, intended outcomes. The objectives for a plan are the means of measuring progress toward achieving or maintaining desired conditions. Like desired conditions, objectives are aspirations and are not commitments or final decisions approving projects and activities.

3. Standards and Guidelines:

- Guidelines: provide information and guidance for project and activity decision-making to help achieve desired conditions and objectives. Guidelines are not commitments or final decisions approving projects and activities
- Standards: a plan may include standards as a plan component. Standards are constraints upon project and activity decision-making and are explicitly identified in the plan as “standards”. Standards are established to help achieve the desired conditions and objectives of a plan and to comply with applicable laws, regulations, Executive orders, and agency directives. Changes to standards would require a plan amendment.

4. Suitability of Areas: Areas of each National Forest System unit are identified as generally suitable for various uses. An area may be identified as generally suitable for uses that are compatible with desired conditions and objectives for that area. An area may be identified as generally not suitable for uses that are not compatible with desired conditions and objectives for that area. Identification of an area as generally suitable or not suitable for a use is guidance for project and activity decision-making and not a commitment nor a final decision approving projects and activities. Uses of specific areas are approved through project and activity decision-making.

5. Special Areas: areas in the National Forest System designated because of their unique or special characteristics. Special areas such as botanical areas or significant caves may be designated by the responsible official in approving a plan, plan amendment, or plan revision. Such designations are not final decisions approving projects and activities. The plan may also recognize special areas designated by statute or through a separate administrative process in accord with NEPA requirements (219.4) and other applicable laws.

Other Forest Plan Elements: While not plan components as defined by the planning rule, many Forest plans will contain optional elements that are called *management areas* (some previous Forest plans used the roughly equivalent term *land allocations*). A management area can be either a mapped geographic area or a defined, but unmapped area on the Forest that is managed towards a specific theme. It is designated as a management area because this is a convenient way to describe and display the set of management direction that applies to this theme. The management direction will consist of Forest plan components as described above.

ARCS and Other Sources of Administrative Direction

While Forest plans are the chief vehicle for applying the ARCS, there are several ARCS elements that will be implemented through sources of management direction other than Forest plans.

Direction to implement mid-scale analysis of watersheds will reside in a Region 6 supplement to the Forest Service Manual (FSM). This direction will specify Regional policy for the completion, update, and revision of watershed analyses and the content of these analyses. Because this is direction regarding the process for conducting an analysis rather than direction for how NFS lands are managed, it is not appropriate Forest plan content. Instead, it is FS Manual or FS Handbook content.

Monitoring is an element of the ARCS that is addressed in several sources of direction. The Forest plans must describe the monitoring program for the plan area and the planning rule (Sec. 219.6(b)) contains some specific requirements. Additionally, there are some resource issues that operate at a broader scale than the National Forest and are best addressed through regional-scale, interagency monitoring programs and are shaped by administrative direction for those programs. This monitoring exists outside of Forest plans.

Expectations and Limitations of the ARCS

The ARCS is designed to provide a Regionally-consistent approach to maintain and restore the ecological health and processes of watersheds and aquatic and riparian ecosystems on NFS lands. It recognizes that periodic disturbances are often necessary to maintain ecological function. The goal of the strategy is to prevent degradation of riparian and aquatic ecosystems and to restore habitat and the ecological processes responsible for creating habitat over broad landscapes (USDA and USDI 1994b). It is not expected that all watersheds will be in good condition at any point in time, nor will any particular watershed be in a certain condition through time. Instead, if the ARCS is effective, the proportion of watersheds in good condition is expected to remain the same or increase over time (Reeves et al. 2006). The ARCS does not identify a particular desired or acceptable distribution of watershed condition.

The ARCS maintains the goal of the ACS, which is to develop networks of properly functioning watersheds that support populations of fish and other aquatic and riparian-dependent organisms across the National Forests in the Pacific Northwest Region. To accomplish all of the desired conditions will likely take several decades to possibly more than a century (USDA and USDI 1994b). Moreover, like the ACS, in the short term (10-20 years) the ARCS is intended to protect watersheds that currently have good habitat and fish populations (FEMAT 1993). The strategy is expected to improve the ecological condition of watersheds, but it will likely take an extended period time for the condition of most watersheds extensively degraded from past management activities to improve (FEMAT 1993).

The ARCS is expected to contribute to the recovery of Endangered Species Act (ESA)-listed fish, particularly anadromous salmon and trout[1] by increasing the quantity and quality of freshwater habitat (FEMAT 1993). By itself, however, it is not expected to prevent the listing of any species or distinct population segment, primarily because Federal land management agencies are responsible only for the habitat they manage. State agencies are responsible for populations on all lands and for the regulation of activities that affect populations and habitats on other ownerships. For listed salmon and trout, factors outside the responsibility of Federal land managers contribute to the status and trends of populations. These include changes in freshwater and estuarine habitats; harvest in commercial and recreational fisheries; management of dams; and the effects of hatchery practices and introductions (National Research Council 1996).

[1] Anadromous fish spend their early life in freshwater, move to the ocean to mature, and then return to freshwater to reproduce.

An additional factor beyond the scope of Federal land manager control is climate change. Nonetheless, Federal land managers have responsibility to address and be responsive to climate-related impacts. An adaptive management approach can be used to make adjustments in plan components as the local effects of climate change become apparent or as the ability to make accurate projections improves.

Section II: Scientific Basis

Aquatic and Riparian Ecosystems

Aquatic and riparian ecosystems in the Pacific Northwest are dynamic in space and time (Reeves et al. 1995). Ecologically healthy watersheds are maintained by natural disturbances that create spatial heterogeneity and temporal variability in the physical components of the system (Naiman et al. 1992a). Natural disturbances have resulted in a mosaic of habitat conditions over time and native fish populations have adapted to this dynamic environment (Naiman et al. 1995, Reeves et al. 1995). Aquatic and riparian ecosystems are most resilient[2] to the types of disturbances under which they have developed. Recovery from disturbance may take decades or longer, depending its magnitude and extent, but some improvements can be expected in 10 to 20 years (Reeves 2006).

Naiman et al. (1992b) describe different disturbance regimes based on the frequency and magnitude of disturbance and its location in a watershed (e.g., headwaters, middle, or lower reaches). Under natural disturbance regimes, a landscape would have watersheds exhibiting a range of conditions because of the asynchronous nature of large and infrequent disturbance events. More recent studies describe stream systems as complex, branching networks rather than linear systems, providing a better understanding of the ecological processes that link riparian and aquatic and headwater and downstream ecosystems (Benda et al. 2004, Fisher 1997). These perspectives imply that aquatic ecosystems are not steady state. Rather, streams are invariably dynamic, and conditions vary in space and time because of periodic events such as wildfire, large storms and subsequent floods, hillslope failures, landslides, debris flows, and channel migration. An important implication is that streams and aquatic ecosystems are linked to the dynamics of both the riparian and upland communities and the watershed and physical processes that shape them.

Small streams[3] serve as critical source areas for high quality water. Because the spatial extent of headwater streams makes up a major portion of the total catchment area (Sidle et al. 2000, Meyer and Wallace 2001), these and adjacent upland ecosystems are important sources of sediment, water, nutrients, energy, and organic matter for downstream systems (Furniss et al. 2005, Gomi et al. 2002, Meyer et al. 2003, Wipfli et al. 2007). These relationships are illustrated in Figure 1.

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[2] Resiliency of an ecosystem is the degree to which the system can be disturbed and recover to a state where processes and interactions function as before (Holling 1973, Reeves et al. 1995).

[3] Small streams are also called headwater, intermittent, ephemeral, seasonal, low-order, and upper network streams (after Furniss et al. 2005).

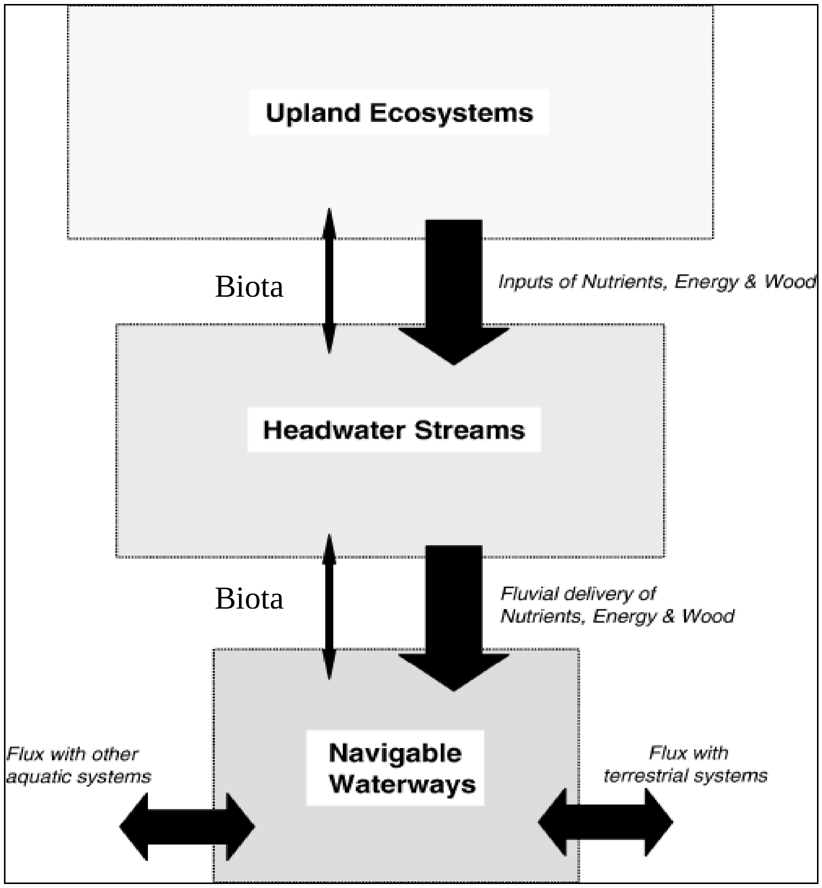

Figure 1. Natural Connectivity Model. Headwater streams are sources of energy and serve as conduits for fish, amphibians and other biota, nutrients, energy, and wood, linking upland ecosystems with larger navigable waters downstream (modified from Wipfli et al. 2007).

Riparian ecosystems are among the most diverse, dynamic and complex biophysical habitats on the landscape. They have many interfaces, edges, or ecotones and possess a relatively high diversity of resources. Riparian zones control energy and material flux, are sites of biological and physical interaction at the terrestrial/aquatic interface, support unique vegetation assemblages, provide critical habitats for rare and threatened species, and are refuges and source areas for a wide variety of species (Kaufman et al. 2001). Riparian zones also play a critical role in connectivity of watersheds by providing dispersal and travel habitat and corridors across the landscape for both terrestrial and riparian-dependent species. The functions of living and dead vegetation in riparian zones include regulating bank erosion, providing an adequate and continuous supply of coarse woody debris to streams, and providing shade and microclimate protection. Most vertebrates (53% of wildlife species occurring in Oregon and Washington) use riparian zones for at least part of their activities (Kaufman et al. 2001). Moreover, approximately 26 and 30 percent of flora in Oregon and Washington, respectively, are facultative or obligate wetland species (USDA Natural Resource Conservation Service 2006, FEMAT 1993). These species play a critical role in the productivity, resiliency, and function of riparian zones.

Ecosystem Management

Management and conservation strategies (Holling and Meffe 1996, Dale et al. 2000), including those involving aquatic organisms (National Research Council 1996, Independent Multidisciplinary Scientific Team 1999), require consideration of large spatial and temporal extents and the conservation of biophysical processes rather than just individual biological and physical elements. In the case of many legally listed fish, this necessitates a transition from the current focus on relatively small spatial extents with little or no consideration of temporal dimensions, to larger spatial extents (ecosystems and landscapes) over longer (i.e., 10 – 100 years) time periods (Reeves et al. 1995, Poff et al. 1997, Naiman and Latterell 2005). Williams et al. (1989), for example, found that no fish species listed under the ESA was ever recovered after listing and attributed this failure to the general focus of recovery efforts on habitat attributes rather than on restoration and conservation of ecosystems.

Factors to be considered in developing ecosystem management plans and policies include the frequency, magnitude, extent, duration (Pickett and White 1985, Hobbs and Huenneke 1992), and context of interacting disturbance regimes (including legacy effects) in managed ecosystems (Hobbs and Huenneke 1992, Reeves et al. 1995, Lindenmayer and Franklin 2002). The resilience of an ecosystem can be reduced if any of these factors are modified. Reduced resilience can lead to a decrease in the range of conditions that an ecosystem can experience, extirpation of some species, increases in species favored by available habitats, and an invasion of exotic species (Lugo et al. 1999, Levin 1974, Harrison and Quinn 1989, Hansen and Urban 1992). The effects of land management on the ecosystem depend on how closely the management disturbance regime resembles the natural disturbance regime with regard to these factors.

The focus of the ARCS on ecological processes and dynamics is well supported in the scientific literature. Ecosystems constantly change through time. They are not steady state, and periodic disturbance is necessary to maintain the long-term productivity and integrity of an ecosystem (Lugo et al. 1999). Based on recognition of ecosystem dynamics, a key focus of ecosystem management and the ARCS is maintaining or restoring ecological processes and resilience as opposed to attempting to maintain a desired set of static conditions through time (Dale et al. 2000). Ecosystem management also strives to maintain a variety of ecological states or patches in a desired spatial and temporal distribution (Gosz et al. 1999, Concannon et al. 1999).

Ehrenfeld (1992) supports these perspectives, noting that conditions in many ecological communities are in flux because of disturbance. This makes it difficult to determine a normal state. Applying fixed standards developed for ecological conditions at small spatial extents with the expectation of achieving constant conditions over large areas is likely to compromise or decrease the long-term productivity of ecosystems and can create false or unrealistic expectations about the outcomes of policies or regulations (Holling and Meffe 1996, Bisson et al. 1997, Caraher et al. 1999, Dale et al. 2000, Poole et al. 2003).

A variety of sources, including interested citizens, interest groups, scientific review and evaluation groups (e.g., the Independent Multidisciplinary Scientific Team 1999, National Research Council 1996), regulatory agencies, and policy- and decision makers have called for developing policies and practices to manage the freshwater habitats of at-risk fish at ecosystem and landscape extents. The ARCS responds to this need and the failure of previous conservation strategies by focusing on larger, varied spatial extents and longer timeframes.

Specifically, the ARCS combines “coarse filter” (ecosystem diversity) and “fine filter” (species diversity) approaches to the management, conservation and restoration of aquatic and riparian ecosystems over a continuum of spatial scales (Groves 2003, Poiani et al. 2000). Since inception of a coarse/fine filter concept for conserving biological diversity (TNC 1982), there has been an evolution in its interpretation and application. Originally, reserves were viewed as an efficient coarse filter approach to conserving biodiversity by protecting 85-90 percent of all plant and animal species. The complementary fine filter approach focused on conserving individual rare or specialized species that “slip” through the coarse filter and are not necessarily protected in reserves (Noss 1987, Hunter 1991).

The coarse filter has recently evolved to a concept of conserving species diversity by providing adequate representation (distribution and abundance) of ecological land units, considering the historical range of variability based upon an understanding of the natural disturbance regimes (Haufler et al. 1996). This coarse filter approach does not necessarily prescribe reserves, but rather recognizes ecological processes and provides for a dynamic distribution of ecological units across the landscape over time. Individual species (species of concern, species of interest, focal species) fine-filter assessments are conducted to evaluate whether a sufficient amount and distribution of habitat is provided under the coarse filter strategy (see Reiss et al. 2008). Thus, a coarse filter strategy has been viewed both as a reserve system and as an approach to managing dynamic landscapes considering natural disturbance regimes. The ARCS incorporates both of these components. The intent is to ensure that proposed management activities help to move areas toward desired conditions at multiple scales.

Section III: Elements of the ARCS

The ARCS combines ecosystem and landscape[4] perspectives to forge a management strategy that is intended to be applied over broad heterogeneous areas. It is comprised of five elements: riparian management areas, key watersheds, watershed analysis, watershed restoration, and monitoring (Figure 2). Each of these is described below in further detail. Interaction of all five elements at the watershed or landscape scale provides the basis for watershed, aquatic, and riparian ecosystem management and restoration. These components work together and complement each other to achieve the goal of a distribution of watershed conditions that are resilient to natural disturbance and that maintain, restore and enhance habitat for inland and anadromous fish, other aquatic organisms, and a variety of wildlife and other riparian dependent resources (FSM 2526) on NFS lands in the Pacific Northwest Region. They will not achieve desired results if implemented alone or in limited combination (FEMAT 1993). As such, they are designed to be applied in an integrated manner.

4 A landscape is a collection of biophysical elements and ecosystem types that occupy relatively large (10^5-10^7 acres) contiguous areas (Hunter 1996, Concannon et al. 1999).

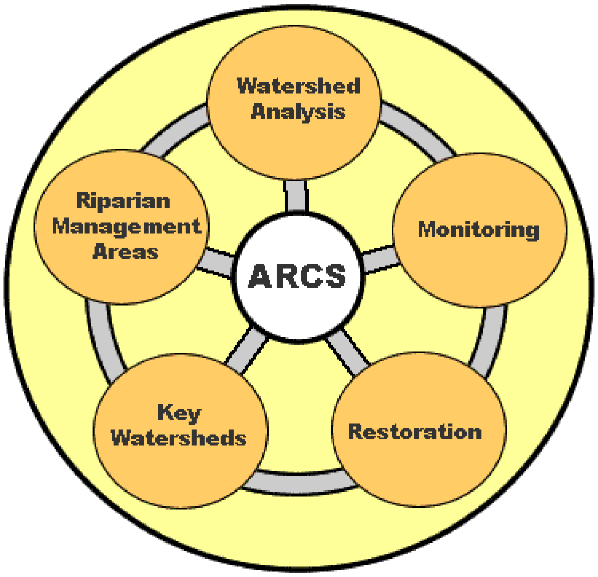

Figure 2. The five primary elements of the ARCS are intended to work together and complement one another to provide for the maintenance and restoration of aquatic and riparian ecosystems and dependent resources.

1. Riparian Management Areas (RMAs): RMAs are management areas. They include lands along permanently-flowing streams, ponds, lakes, wetlands, seeps, springs, intermittent streams, and unstable sites that may influence these areas where management activities are designed to maintain, restore or enhance the ecological health of aquatic and riparian ecosystems and dependent resources. These areas function at the ecosystem level (coarse filter) to represent and maintain the full range of riparian and aquatic ecological diversity. RMAs are portions of watersheds where aquatic and riparian-dependent resources receive primary emphasis and where special management direction applies.

2. Key Watersheds: Key watersheds are a network of watersheds selected to serve as strongholds for important aquatic resources or having the potential to do so. They are areas crucial to threatened or endangered fish and aquatic species of concern and/or interest, and/or areas that provide high quality water important for maintenance of downstream populations. Management emphasizes minimizing risk and maximizing restoration or retention of ecological health. Because the key watershed selection process is based on the habitat requirements of "focal species", it addresses the species level diversity (fine filter) by conserving and/or restoring critical biophysical processes and riparian and aquatic ecological diversity.

3. Mid-scale Analysis of Watersheds: An R6 FSM Supplement (under development) will detail the procedures for conducting analysis that evaluates geomorphic and ecological processes operating in specific watersheds. This analysis evaluates the condition and trend of watersheds, riparian zones and aquatic ecosystems, connectivity of the watershed for terrestrial flora and fauna species (e.g. spotted owls), and provides the context for management. Watershed analysis provides a basis for development of watershed-scale restoration strategies and is a key basis for defining desired conditions, management objectives and monitoring.

4. Watershed Restoration: Watershed restoration is an integrated set of actions and treatments designed to facilitate the recovery of watershed functions and related physical, biological and chemical processes to promote recovery of riparian and aquatic ecosystem structure and function. Restoration includes a mix of passive and active management activities.

5. Monitoring: Monitoring is a strategic assessment of the implementation and effectiveness of management activities and the ecological trends toward desired conditions.

Section IV: Desired Conditions and Applicable Scales

The ARCS is designed to contribute to the sustainability of aquatic and riparian ecosystems and species. Thus, the ARCS is intended to maintain and restore the ecological health of watersheds and to retain the ability of riparian and aquatic ecosystems to recovery from natural disturbances. To provide for resilient, productive and persistent natural systems, it is important for management to conserve natural processes that constrain or influence the structure and variability in landscapes; conserve the natural variation or diversity; and account for the influence of scale by identifying and conserving patterns and key processes at multiple spatial and temporal scales (Rieman et al. 2006).

Stream habitats are heterogeneous and dynamic in longitudinal (headwaters to larger rivers), lateral (stream, floodplain, riparian area interactions) and vertical (stream channel-hyporheic interactions) dimensions (Stanford and Ward 1992). Stream and riparian habitats also vary in time in relationship to disturbance (Reeves et al 1995). Different physical processes may affect aquatic habitat at different spatial and temporal scales. Figure 3 displays the relative frequencies and scales of selected disturbances that may affect stream channels and watersheds, producing spatially and temporally variable habitats. For example, disturbance from storms, debris flows and/or fires are typically more frequent and occur at smaller spatial scales than climate change and tectonic processes. The probability that a particular location will be affected by disturbance at a particular time may be low, but it increases with increasing spatial scale.

The scale of biological response to disturbance will vary depending upon spatial requirements (home range, territory size, migratory patterns) and temporal constraints (e.g. generation time, migration time) of different species (Rieman et al 2006). Similarly, the relationship between recovery time and the relative sensitivity to disturbance will vary depending on the relative scale of various habitat and stream features (Figure 4). For example, individual sites have a relatively high sensitivity to disturbance but have relatively short recovery periods. Conversely, watersheds have a relatively low sensitivity to an individual disturbance, but have a relatively long recovery period. Aquatic and riparian ecosystems management needs to account for processes interacting at multiple scales to establish the context for aquatic resource conservation (Fausch et al. 2002).

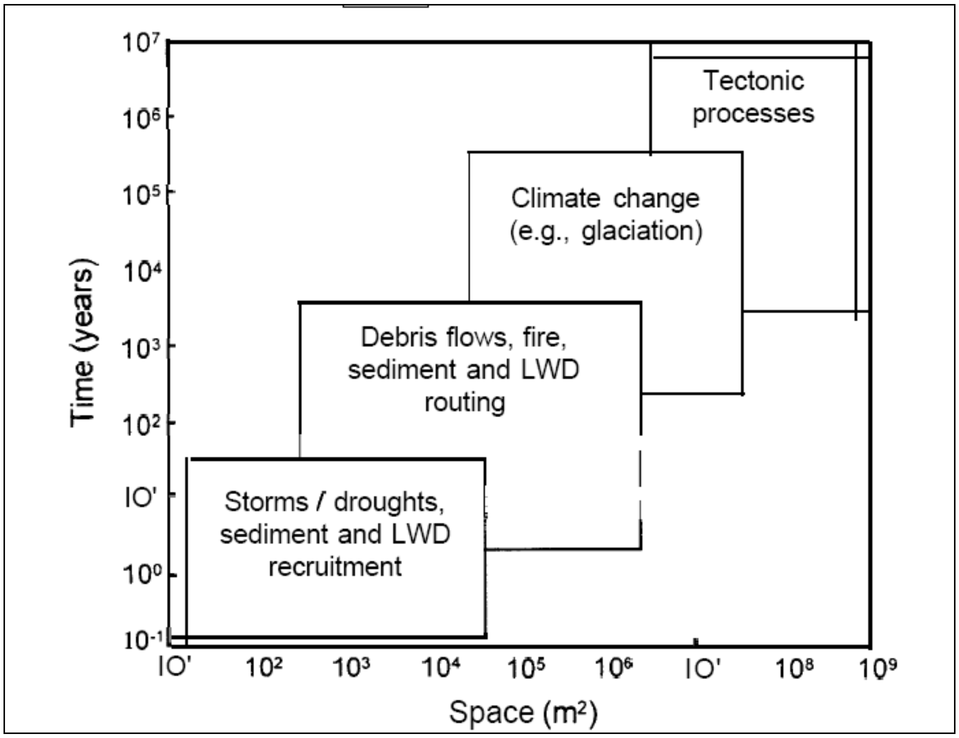

Figure 3. Influences on stream channels at a range of spatial and temporal scales (Montgomery and Buffington 1998).

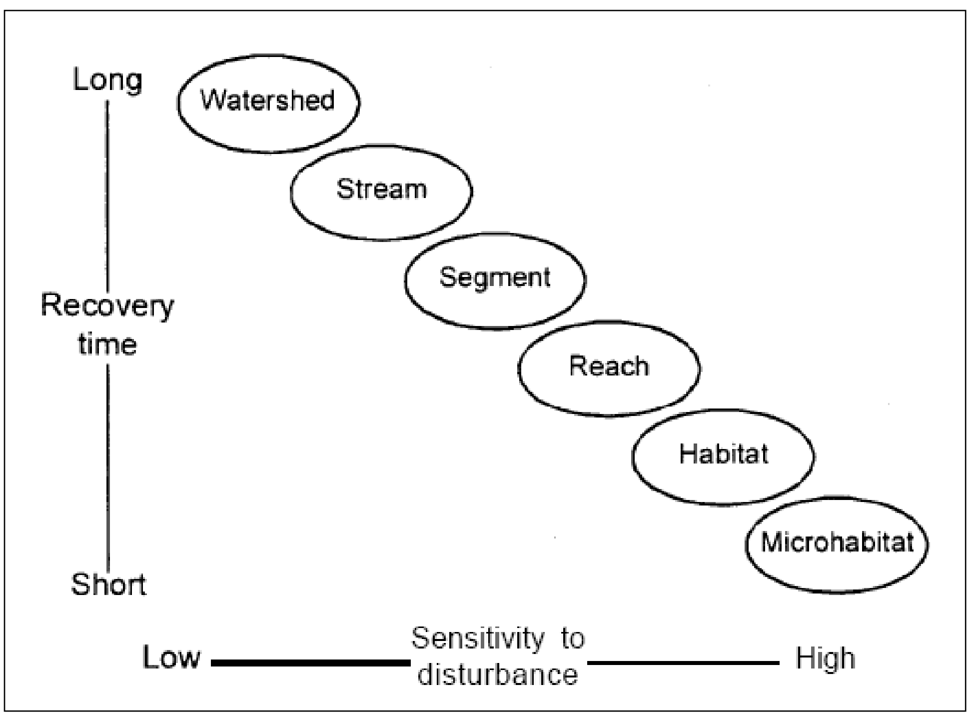

Figure 4. Relationship between recovery time and sensitivity to disturbance for different spatial scales (Frissell et al. 1986, Naiman 1998, Naiman et al. 1992b).

Allen and Hoekstra (1992) suggest that to understand ecological processes it is necessary to assess three scales of ecosystem organization concurrently: (1) the scale in question; (2) the scale below that provides mechanisms (dominant processes); and (3) the scale above that gives broader context, role or relative significance. The relationship between the finest spatial or temporal resolution studied or of interest (grain) and the size of the study area or study duration (extent) determines the scale of processes that can be understood (Wiens 1989).

The general desired conditions for the ARCS apply at landscape or watershed level (scale), not at a particular site. The national hydrologic unit code (HUC) is the basis for defining the scales at which desired conditions apply. The three watershed scales most relevant to implementation of the Forest plan are: subbasin (4th field HUC), watershed (5th field HUC), and subwatershed (6th field HUC). Individual project assessments often use data collected at finer scales such as the subwatershed, drainage, valley segment, site, stream reach or scale (Figure 5).

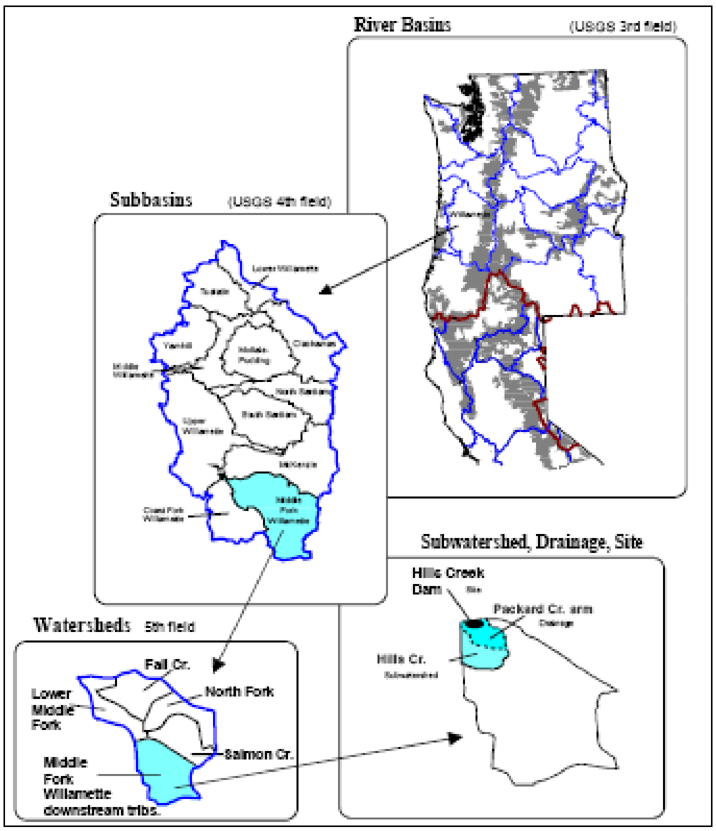

Figure 5. A hierarchy of spatial scales and terms for managing watersheds and aquatic and riparian resources.

Desired conditions are generally to be applied at the watershed-scale but some are more appropriate at the subbasin or subwatershed scale. Aquatic populations can be nested in a manner consistent with the watershed-scale definitions. Bull trout core populations (Whitsell et al. 2004) and anadromous fish populations for example have been generally identified at the subbasin level (4th field HUC) (http://www.nwfsc.noaa.gov/trt/trt_viability.cfm). Bull trout local populations and anadromous fish major and minor spawning areas are generally located within watersheds (5th field HUC) or subwatersheds (6th field HUC).

The desired conditions for all National Forest System lands are described below. The scale(s) at which these generally apply to Forest planning and project planning are identified after each desired condition.

National Forest System lands administered by the XXXXX National Forest contribute to:

DC-1. The distribution, diversity, and complexity of watershed and landscape-scale features, including natural disturbance regimes, of the aquatic and riparian ecosystems to which species, populations and communities are uniquely adapted. Subbasin scale for both Forest planning and project planning.

DC-2. Spatial connectivity within or between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact habitat refugia. These network connections provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic, riparian-dependent, and many upland species of plants and animals. For Forest planning, spatial connectivity is between watersheds at the subbasin scale. For project planning, spatial connectivity is between subwatersheds at the watershed scale.

DC-3. Habitat and ecological conditions capable of supporting self-sustaining populations of native and desired non-native, riparian-dependent plant and animal species. Subbasin scale for Forest planning; watershed or subwatershed scale for project planning.

DC-4. The physical integrity of the aquatic system, and riparian habitat, including shorelines, banks, and bottom configurations. Watershed scale for Forest planning; subwatershed scale for project planning.

DC-5. Water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality is within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities. Watershed scale for both Forest planning and project planning.

DC-6. The sediment regime within the natural range of variability. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport. Watershed scale for both Forest planning and project planning.

DC-7. In-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows are retained. Watershed scale for both Forest planning and project planning.

DC-8. The timing, variability, and duration of floodplain inundation that is within the natural range of variability. Watershed scale for both Forest planning and project planning.

DC-9. The timing, variability, and water table elevation in wetlands, seeps and springs is within the natural range of variability. Subwatershed scale for both Forest planning and project planning.

DC-10. The species composition and structural diversity of native plant communities in riparian management areas including wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris and fine particulate organic matter sufficient to sustain physical complexity and stability. Watershed scale for Forest planning; subwatershed scale for project planning.

DC-11. Native assemblages of riparian dependent plants and animals free of persistent non-native species. Watershed scale for both Forest and project planning.

Section V: ARCS Elements in Detail

ARCS Element 1. Riparian Management Areas (RMAs)

Background

All Forest plans will include riparian management areas, although the locations may not be mapped until project level planning. RMAs are management areas and include portions of watersheds where aquatic and riparian-dependent resources receive primary emphasis and where special management direction applies. RMAs are designated for all permanently flowing streams, lakes, wetlands, seeps, springs and intermittent streams, and unstable sites that may influence these areas. RMAs are used to maintain and restore the riparian structure and function of intermittent and perennial streams, confer benefits to riparian-dependent plant and animal species, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, and provide for greater connectivity within and between watersheds for both riparian and upland species.

Management of RMAs emphasizes aquatic and riparian dependent species. RMAs are used as the primary framework (coarse filter) that provides for ecosystem diversity by conserving biophysical processes at the landscape and watershed scales. RMAs provide travel and dispersal corridors for many riparian dependent animals and plants and provide connectivity between geographically significant areas for these species. Management activities within RMAs maintain or enhance existing functional conditions or restore degraded conditions for aquatic and riparian dependent species.

RMAs generally parallel the stream network and include areas necessary for maintaining hydrologic, geomorphic, and ecologic processes that influence riparian and aquatic systems. Unstable and potentially unstable areas in headwater areas and along streams are primary source areas for coarse wood, fine and coarse particulate organic matter and sediment. RMAs occur at the margins of standing and flowing water, intermittent stream channels and ephemeral ponds, springs, and wetlands.

Management of RMAs focuses on ecological processes and conditions within and contributing to the value of these areas. Management activities should contribute to moving toward or meeting or maintaining desired conditions.

RMA Widths

***Fish-bearing streams* - RMAs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest. It is expected that RMA widths along fish-bearing streams will not be less than described here.**

***Permanently flowing non-fish-bearing streams* - RMAs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.**

***Constructed ponds and reservoirs, and wetlands greater than 1 acre* – RMAs consist of the body of water or wetland and: the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of the wetland greater than 1 acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.**

***Lakes and natural ponds* - RMAs consist of the body of water and: the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest.**

***Seasonally flowing or intermittent streams, wetlands, seeps and springs less than 1 acre, and unstable and potentially unstable areas* - This category applies to features with high variability in size and site-specific characteristics. At a minimum, the RMAs should include:**

- **The extent of unstable and potentially unstable areas (including earthflows).**
- **The stream channel and extend to the top of the inner gorge.**
- **The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, extending from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest. A site-potential tree height is the average maximum height of the tallest dominant trees for a given site class.**

- **Intermittent streams are defined as any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria. Including intermittent streams, springs, and wetlands within RMAs is important for full implementation of the ARCS. Accurate identification of these features is critical to the correct implementation of the strategy and protection of the intermittent stream and wetland functions and processes. Identification of these features is difficult at times due to the lack of surface water or wet soils during dry periods. Fish-bearing intermittent streams are distinguished from non-fish-bearing intermittent streams by the presence of any species of fish for any duration. Many intermittent streams may be used as spawning and rearing streams, refuge areas during flood events in larger rivers and streams or travel routes for fish emigrating from lakes. In these instances, the guidelines for fish-bearing streams would apply to those sections of the intermittent stream used by the fish.**

Suitability

RMAs are generally unsuitable for:

- **scheduled timber production**
- **new leasable minerals extraction**
- **new surface occupancy for oil, gas, and geothermal exploration and development**
- **salable mineral activities such as sand and gravel extraction.**
- **waste and disposal areas**
- **new facilities, except as needed for resource protection or those that inherently must be in RMA's**
- **new designated motorized use areas**

Desired Conditions

1. **Riparian management areas within any given watershed reflect a natural composition of native flora and fauna and a distribution of physical, chemical, and biological conditions appropriate to natural disturbance regimes affecting the area.**

2. **Key riparian processes and conditions, including slope stability and associated vegetative root strength, wood delivery to streams and within the RMAs, input of leaf and organic matter to aquatic and terrestrial systems, solar shading, microclimate, and water quality, are operating consistently with local disturbance regimes.**

Objectives

Forests should develop objectives to move toward or maintain desired conditions. These objectives should address conditions in RMAs that pose substantial risk and consequence at the watershed scale to maintenance or attainment of desired conditions (e.g., facilities, developed and dispersed recreation, grazing and livestock facilities, mining, roads, and vegetative conditions). Forest objectives to address these conditions should be achievable within the life of the plan (e.g., 10 -15 years). Forest objectives should complement those developed for key watersheds and restoration. **Forests should identify objectives to relocate or restore roads, trails, other facilities, or damage caused by dispersed use that pose a substantial risk to the integrity of aquatic and other riparian dependent resources.**

Standards and Guidelines

Standards and guidelines for riparian management areas are technical and scientific specifications to be used in the design and constraint of projects and activities in RMAs. Both standards and guidelines are intended to assure that management activities that disturb or modify land, water or vegetation in RMAs will only occur if the activities maintain, restore or enhance riparian dependent resources when viewed at the watershed or larger scale over time. They help assure that the relevant processes for which RMAs are established are assessed to avoid watershed scale effects and minimize effects to aquatic and riparian resources at the site scale. Examples of riparian functions or processes to consider in project/site level planning include (but are not limited to): root strength, large wood delivery to streams and riparian areas, leaf and other particulate matter input, shade and riparian microclimate, nutrient cycling, sediment filtration, and provision of wildlife habitat (FEMAT V 26-29).

Standards are mandatory constraints on activities that must be followed in projects and activities unless special site specific circumstances justify a plan amendment. Guidelines are constraints on activities that are widely and generally appropriate, but project decisions may identify situations where exceptions are appropriate.

General Riparian Area Management

Guideline RA-1.

- **When RMAs are properly functioning[5], project activities should maintain those conditions.**
- **When RMAs are not properly functioning, and to the degree that project activities would drive or contribute to improper function, project activities should improve those conditions.**
- **Project activities in RMAs should not result in long-term degradation to aquatic and riparian conditions at the watershed scale. Limited short term or site-scale effects from activities in RMAs may be acceptable when they support, or do not diminish, long-term benefits to aquatic and riparian resources.**

Standard RA-2. Apply herbicides, insecticides, piscicides and other toxicants, and other chemicals only to maintain, protect, or enhance aquatic and riparian resources or to restore native plan communities.

Guideline RA-3. Generally retain, on site, trees needed to maintain, protect, or enhance aquatic and riparian resources that are felled for safety.

Guideline RA-4. Water drafting sites should be located and managed to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat.

Standard RA-5. Pumps shall be screened at drafting sites to prevent entrainment of fish and shall have one-way valves to prevent back-flow into streams.

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[5] Assessment of properly functioning or fully functioning condition is a concept originally developed by the BLM to assess the natural habitat forming processes of riparian and wetland areas (Pritchard et al. 1993). Ecosystems at any temporal or spatial scale are in a properly functioning condition when they are dynamic and resilient to perturbations to structure, composition and processes of their biological and physical components (USDA Forest Service 1998). Primary elements typically include hydrologic characteristics, physical structure/form, vegetative characteristics, water quality and aquatic/riparian biological community characteristics. The general methodology provides an integrated measure of condition and can be used at a variety of scales from individual reaches to watersheds. The basic approach is used to assess a wide range of process-based, riparian and aquatic conditions. The current R6 process to assess watershed condition, which uses the Ecosystem Management Decision Support (EMDS) model, and the R4 PFC Rapid Assessment Process are examples of this technique, used at the sub-watershed and watershed scales. This general methodology has also been used for salmonid systems by the NMFS (1996) and as a tool in salmon conservation and recovery planning (e.g., Ecosystem Diagnosis and Treatment Model (EDT) described by Lestelle et al. 2004).

Timber Management

Guideline TM-1. Timber harvest and thinning should occur in RMAs only as necessary to maintain, restore or enhance conditions that are needed to support aquatic and riparian dependent resources.

Standard TM-2. Fuelwood cutting shall not be authorized in the active floodplain[6] or within primary source areas for large woody debris.

Guideline TM-3. New landings, designated skid trails, staging or decking should not occur in RMAs, unless there are no alternatives, in which case they should:

- **be of minimum size,**
- **be located outside the active floodplain, and**
- **minimize effects to large wood, bank integrity, temperature and sediment levels.**

Guideline TM-4. Yarding activities should achieve full suspension over the active channel[7].

Road Management

Guideline RF-1. Generally avoid new road construction in RMAs except where necessary for stream crossings.

Standard RF-2. Avoid side-casting (placement of unconsolidated earthen waste materials resulting from road construction or maintenance) in RMAs.

Standard RF-3. Avoid placing fill material on organic debris in RMAs.

Standard RF-4. Minimize or avoid disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow when constructing or reconstructing roads or landings either inside or outside of RMAs.

Guideline RF-5. Wetlands and unstable areas should be avoided when reconstructing existing roads or constructing new roads and landings. Minimize impacts where avoidance is not practical.

Standard RF-6. New or replaced permanent stream crossings will accommodate at least the 100-year flood, including associated bedload and debris.

Standard RF-7 Where physically feasible, construction or reconstruction of stream crossings will avoid diversion of streamflow out of the channel and down the road in the event of crossing failure.

Standard RF-8. In fish bearing streams, construction or reconstruction of stream crossings will provide and maintain passage for all fish species and all life stages of fish.

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[6] Active floodplain is the area bordering a stream that is inundated by flows at a surface elevation defined by two-times the maximum bankfull depth (i.e., bankfull depth measured at thalweg).

[7] Active channel is the bank full width of flowing perennial or intermittant streams.

Guideline RF-9. Construction or reconstruction of stream crossings should allow passage for other riparian dependent species where connectivity has been identified as an issue.

Guideline RF-10. Fish passage barriers should be retained where they serve to restrict access by undesirable non-native species and are consistent with restoration of habitat for native species.

Guideline RF-11. Generally minimize hydrologic connectivity and delivery from roads. This includes roads inside and outside of RMAs.

Guideline RF-12. Road drainage should be routed away from potentially unstable channels, fills, and hillslopes. This applies both inside and outside of RMAs.

Guideline RF-13. Protect fish habitat and water quality when withdrawing water for administrative purposes.

Grazing Management

Standard GM-1. New livestock handling, management or watering facilities shall be located outside of RMAs, except for those that inherently must be located in an RMA and those needed for resource protection.

Guideline GM-2. Within green-line vegetation area adjacent to all watercourses[8]:

- **do not exceed 20% streambank alteration;**
- **do not exceed 40% utilization of mean annual vegetative production on woody vegetation;**
- **maintain at least 4-6 inches or do not exceed 40% utilization of mean annual vegetative production on herbaceous vegetation[9]**

Guideline GM-3 During allotment management planning consider removal of existing livestock handling or management facilities from RMAs.

Guideline GM-4. Livestock trailing, bedding, loading, and other handling activities should be avoided in RMAs.

Guideline GM-5. Generally avoid trampling of Federally listed threatened or endangered fish redds by livestock.

[8] National Forests can modify the numeric values in these guidelines to more effectively achieve desired conditions. Rationale for these changes should be documented.

[9] Sampling and assessment of these parameters is intended to portray the general condition of banks and riparian vegetation along an individual stream reach within each pasture. It is assumed that there will be some variability in conditions within the reach, including occasional, limited area of concentrated animal use, such as water gaps or crossings.

Recreation Management

Guideline RM-1. Generally avoid placing new facilities or infrastructure within expected long term channel migration zone. Where activities inherently must occur in RMAs (e.g. road stream crossings, boat ramps, docks, interpretive trails), locate them to minimize impacts on riparian dependent resource conditions (e.g., within geologically stable areas, avoiding major spawning sites)

Guideline RM-2. Consider removing or relocating existing recreation facilities which are causing unacceptable impacts in RMAs.

Minerals Management

Guideline MM-1. Adverse effects to aquatic and other riparian dependant resources from mineral operations should be minimized or avoided. For operations in a riparian management area ensure operators take all practicable measures to maintain, protect, and rehabilitate water quality, and habitat for fish and wildlife and other riparian dependent resources which may be affected by the operations.

Guideline MM-2. Structures and support facilities should be located outside RMAs. Where no alternative to citing facilities in RMAs exists, locate them in a way to minimize adverse effects to aquatic and other riparian dependant resources. Existing roads should be maintained to minimize damage to aquatic and riparian dependent resources in the RMAs.

Standard MM-3. Locate mine waste with the potential to generate hazardous material (per CERCLA) outside of RMAs. If no reasonable alternative to locating these facilities in RMAs exists, then locate and design the waste facilities using best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials.

Guideline MM-4. Where possible, adjust the operating plans for existing activities to minimize adverse effects to aquatic and riparian dependent resources in the RMAs.

Fire/Fuels Management

Guideline FM-1. Temporary fire facilities (e.g. incident bases, camps, wheelbases, staging areas, helispots and other centers) for incident activities should be located outside RMAs. When no practical alternative exists, all appropriate measures to maintain, restore, or enhance aquatic and riparian dependent resources should be used.

Guideline FM-2. Aerial application of chemical retardant, foam, or other fire chemicals and petroleum should be avoided within 300 feet of waterways.

Guideline FM-3. Water drafting sites should be located and managed to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat.

Standard FM-4. Pumps shall be screened at drafting sites to prevent entrainment of native and desired non-native fish and shall have one-way valves to prevent back-flow into streams.

Standard FM-5. Portable pump set-ups shall include containment provisions for fuel spills and fuel containers shall have appropriate containment provisions. Vehicles should be parked in locations that avoid entry of spilled fuel into streams.

Guideline FM-6. Generally locate and configure fire lines to minimize sediment delivery, creation of new stream channels and unauthorized roads and trails.

Standard FM-7. Use Minimum Impact Suppression Tactics (MIST) during fire suppression activities in RMAs (NWCG 2006)

Standard FM-8. To minimize soil damage when chipping fuels within RMAs, limit chip bed depths on dry soils to 7.5 cm. or less (Busse et al. 2005).

Lands and Special Uses, including Hydropower

Standard LH-1. Authorizations for all new and existing special uses including, but not limited to water diversion or transmission facilities (e.g, pipelines, ditches), energy transmission lines, roads, hydroelectric and other surface water development proposals, shall result in the re-establishment, restoration, or mitigation of habitat conditions and ecological processes identified as being essential for the maintenance or improvement of habitat conditions for fish, water and other riparian dependent species and resources. These processes include in-stream flow regimes, physical and biological connectivity, water quality, and integrity and complexity of riparian and aquatic habitat.

Standard LH-2. Locate new support facilities outside of RMAs. Support facilities include any facilities or improvements (e.g., workshops, housing, switchyards, staging areas, transmission lines) not directly integral to the production of hydroelectric power or necessary for the implementation of prescribed protection, mitigation or enhancement measures.

Guideline LH-3. If existing support facilities are located within the RMAs, they should be operated and maintained to restore or enhance aquatic and riparian dependent resources. At time of permit reissuance, consider removing support facilities, where practical.

ARCS Element 2. Key Watersheds

Background

Key watersheds are areas to be identified for each plan area that either provide, or are expected to provide, high quality habitat that will serve as source areas for specific threatened or endangered fish species, fish species of concern, and fish species of interest, and/or provide high quality water important to these populations downstream and/or their habitats. Key watersheds contribute to broad scale, ecosystem diversity by providing high quality habitat for other aquatic and riparian dependent species as well as to conserve or restore critical elements of riparian and aquatic habitat necessary for fish species habitat diversity (the species diversity, fine-filter strategy). A network of key watersheds, managed to serve as refugia, is crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. Refugia include areas of high quality habitat as well as areas of degraded habitat that have high potential to develop into productive habitat. In the short term, they provide centers of fully functioning, high quality, aquatic and riparian habitat and a starting point for longer term expansion of such habitats. Key watershed networks should complement and support fish and water quality recovery plans. While key watersheds were designed primarily to provide high quality habitat for fish species, other aquatic or riparian and upland species also benefit from the key watershed network. Management direction for habitat is intended to provide within key watersheds the highest relative level of protection and accepts the lowest relative level of risk from activities threatening their integrity and resiliency.

Research supports managing priority watersheds more conservatively in terms of future risk and restoration. Conservation of metapopulations requires numerous patches of suitable habitat over time and the potential for dispersal among the patches (Harrison 1994). Where there is a currently an insufficient number of patches of high quality habitat, it is important to protect existing high quality patches in the near term (Frissell 1997). Minimizing or eliminating external threats increases the likelihood of persistence of these patches (Carroll and Meffe 1997). These areas will serve as sources of individuals to colonize new patches as they develop favorable habitat. Development of future patches of favorable habitat requires the protection or restoration of critical ecological processes that create favorable habitat over time (Carroll and Meffe 1997).

Key watersheds complement the management direction provided by other ARCS elements. They provide a network of refugia at the ESU (Evolutionary Significant Unit), Recovery Unit, or population scale. The network is designed to provide species level conservation and restoration of habitat conditions to retain strong/anchor populations of fish species of interest and species of concern in the short term, and contribute to recovery in the long term. The relative contribution to long term conservation and recovery provided by the key watershed network will vary depending on species, habitat and life history requirements and the quality and extent of habitat provided on NFS lands. Key watersheds with high quality conditions will serve as anchors for the potential, near-term recovery of depressed stocks. Those of lower quality habitat with high potential for restoration are expected to become future sources of high quality habitat with the implementation of a comprehensive restoration program (see Watershed Restoration). The location of key watersheds relative to one another is also important. Key watersheds should be positioned so they form the centers of broadly connected networks of high quality watersheds and restore currently fragmented habitats and core fish populations.

Designating Key Watersheds

Key watershed networks will be established at the ESU/Recovery unit scale for specific threatened or endangered fish species, fish species of concern, and fish species of interest, and/or areas that provide high quality water important to these fish populations and/or their habitats downstream, in order of relative priority (FSH 1909.12 definition). In identifying key watersheds it is important to consider what types of environmental gradients to represent, with the key assumption that environmental variation is a useful surrogate for ecosystem and species diversity and sustainability. A second consideration in key watershed network design is predicting whether species or ecosystem types will persist (Pickett 1978 and Thompson; Groves 2003). Third, it's important to validate physical surrogates for biodiversity with actual data on biological diversity (Pressey 2004). The selection of physical attributes and the temporal and spatial scales at which they are analyzed is also important. Different species will respond to the same environmental gradients in different ways. Distance between watersheds will have important influences on how well biodiversity is represented (e.g., Oliver et al. 2004; Figure 5). In other words, areas that are closer together in space will have similar biological diversity.

The protocol for identification and selection of key watershed networks is provided by Reiss et al. (2008). Forests shall use this process for identification and selection of key watersheds. Key watersheds are positioned such that over time they can form the centers of a broadly connected network of high quality watersheds that reduces the currently fragmented condition of many habitats for threatened or endangered fish species, fish species of concern, fish species of interest, or areas that provide high quality water important to these fish populations or their habitats downstream. The networks are expected to remain relatively unchanged for the life of the Forest plan. Adjustments may be necessary based on substantial, new information (e.g. populations and trends, life history characteristics and needs, distribution and use/non use of habitats) or new listings of species.

Desired Conditions in Key Watersheds

1. **Networks of watersheds with good habitat and functionally intact ecosystems contribute to and enhance conservation and recovery of specific threatened or endangered fish species, fish species of concern, and fish species of interest, and high water quality and quantity. The networks contribute to short-term conservation and long-term recovery at the ESU /Recovery Unit or other appropriate population scale.**
2. **Roads in key watersheds do not present substantial risk to aquatic resources.**
3. **Key watersheds have high watershed integrity and provide resilient aquatic and riparian ecosystems.**

More detailed desired conditions for individual or groups of key watersheds should be developed using information from watershed analyses and other broad scale assessments. These will provide direction directly responsive to local watershed conditions and to complement goals of specific recovery plans for fish and water quality to reach desired conditions sooner or to a greater extent.

Developing Objectives for Key Watersheds:

Key watersheds should be the highest priority for active, aquatic and riparian restoration. As part of plan revision, each Forest will identify which key watersheds are priorities for active restoration during the life of the plan. Restoration objectives will be prepared for key watersheds identified as high priority by the Forest plan. These objectives will complement programmatic objectives contained in the Regional Aquatic Restoration Strategy (USDA Forest Service, 2005). They will identify priority treatment activities (e.g. improved fish passage, instream habitat improvement, riparian/floodplain vegetation treatments, road stabilization and/or decommissioning), the extent of treatment areas (miles, acres) and timing for completion within individual key watersheds, and blocking up of federal ownership within key watersheds. The objectives should specifically contribute to the maintenance or restoration of desired conditions for each watershed. Source information for development of objectives include watershed analyses and/or plans for the recovery of fish, water or other riparian dependent plant and animal species. Integration and coordination with other Forest Service resource management programs, state and Federal agencies, tribal governments, local communities, land owners and partners is strongly encouraged.

More detailed objectives for individual or groups of key watersheds should be developed using information and findings from watershed analysis and other broad scale assessments and plans. These will provide direction directly responsive to local watershed conditions and to complement goals of specific recovery plans for fish and water quality.

Standards

Standard KW-1. There shall be no net increase in the mileage of Forest roads, in any key watershed unless doing so results in a reduction in road-related risk to watershed condition. No net increase means that for each mile of new road constructed, at least one mile of road must be decommissioned to hydrologically stable, self maintaining conditions. Priority should be given to roads that pose the greatest relative ecological risks to riparian and aquatic ecosystems.

Standard KW-2. Hydroelectric and other water development authorizations shall include requirements for in-stream flows and habitat conditions that maintain or restore native fish and other desired aquatic species populations, riparian dependent resources, favorable channel conditions, and aquatic connectivity.

Standard KW-3. New hydroelectric facilities and water developments shall not be located in a key watershed unless it can be demonstrated they have minimal risks and/or no adverse effects to fish and water resources for which the key watershed was established.

ARCS Element 3. Mid-Scale Analysis of Watersheds

Background

Mid-scale analysis of watersheds is an important element of the ARCS. Direction for development and use of mid-scale watershed analyses will be contained in a future R-6 supplement to the Forest Service Directives System (FSM and FSH).

Mid-scale or watershed analysis provides context for management activities and is a systematic analytical procedure for characterizing watershed physical and ecological processes. Use of information from watershed analyses will help managers meet specific management and social objectives. Watershed analysis can be helpful in considering the role RMAs play in connectivity and habitat.

Watershed analysis serves as the basis for determining restoration needs and developing project-specific proposals. It is an analytical (not a decision making) process and must involve individuals from appropriate disciplines. Results from watershed analysis support decisions for management activities. For example, watershed analysis may help in defining objectives for management within RMAs, developing restoration strategies and priorities, identifying the most useful indicators for diagnosing existing and potential conditions, and providing a context for multi-scale monitoring programs.

Watershed analysis identifies and analyzes dominant ecological and geomorphic characteristics and processes influencing riparian and aquatic ecosystems within a watershed. Decision makers use results from watershed analysis to diagnose the condition and trend of watershed and riparian-dependent resources and determine appropriate activities to attain Forest Plan desired conditions.

The interaction of multiple processes operating at multiple spatial and temporal scales may be challenging to analyze and incorporate into a relevant management strategy. Understanding the relationships among multiple spatial scales is necessary, however, to fully assess the effects of management policies and activities on watershed, riparian, and aquatic ecosystems in the future. The goal is to conduct an assessment that addresses current conditions, considers the larger context, takes a historic look to assess past trajectories of ecosystems and natural histories, and projects future potential threats and expectations.

Watershed analysis is integral to gaining understanding of a complex array of biophysical processes and the existing range of watershed conditions, and is essential to support broad-scale restoration and monitoring programs across the Region.

ARCS Element 4. Watershed Restoration

Background

Watershed restoration to benefit aquatic and riparian dependent resources is an integral element of the ARCS. Restoration, in concert with other ARCS elements, contributes to riparian and aquatic habitat and species diversity at the watershed scale. A primary purpose of restoration is to provide watershed, riparian and aquatic habitat conditions that contribute to the maintenance and recovery of species diversity. Restoration is accomplished by removing major impediments to the integrity of otherwise fully-functioning watersheds and by accelerating the recovery of physical, biological and/or chemical processes where natural recovery rates extend beyond resource needs and management objectives. Restoring the health and resiliency of selected watersheds will help ensure that the network of key watersheds remains well represented and distributed over time.

Effective restoration at the watershed scale is a complex undertaking. Restoration programs require: diagnosing watershed conditions and processes; identifying primary disturbance regimes (past, present and future); and the ability to locate, design and implement integrated treatments to achieve the desired, watershed-scale response. As a result, using watershed analysis and adaptive management with comprehensive monitoring programs to provide timely feedback, is essential.

The goal of restoration is to provide for ecologically healthy watershed, riparian and aquatic ecosystems. The phrase "ecologically healthy" refers to functions affecting biodiversity, productivity, biochemical and evolutionary processes that are adapted to the climate and geologic conditions in a given region (Karr et al 1986; Karr 1991 cited in Naiman et al 1992a). Watershed restoration is designed to facilitate the recovery of watershed functions and related physical, biological and chemical processes to promote recovery of riparian and aquatic composition, structure and ecosystem function. The Regional Aquatic Restoration Strategy (USDA Forest Service 2005) provides a framework for the organization and implementation of restoration activities for the Pacific Northwest Region.

Watershed restoration is expected to be a catalyst for initiating ecological recovery (FEMAT 1993). Restoration efforts will be comprehensive, addressing both protection of existing functioning aspects of a watershed and restoration of degraded or compromised aspects. It may not be possible to restore every watershed and some restoration actions may only have limited success because of an extensive level of degradation. The effectiveness of restoration efforts is not likely to be extensive or immediately visible for some time. At the watershed scale, it may take an extended period (decades or longer) to observe the full effects of treatments. Even longer timeframes may be necessary to see changes at the regional scale.

Watershed restoration programs combine "passive" and "active" approaches. Passive restoration relies on maintaining the resiliency of riparian and aquatic ecosystems to absorb or recover from disturbance and is effective at the landscape scale. Active restoration focuses on re-establishment or modification of specific ecosystem processes. Active restoration is generally applied using integrated treatments (e.g., fish passage, road decommissioning/stabilization, riparian and upslope vegetation treatment, instream habitat improvement) which are strategically applied to multiple sites within a watershed. In cases where the full recovery of watershed functions and processes is not possible (e.g., mixed ownerships, major dams/diversions for hydropower or irrigation, roads or other developments that influence large and/or important portions of the floodplain or stream channel), mitigation treatments may be needed. These should incorporate design features which benefit aquatic and riparian dependent resources.

Active restoration should be prioritized to emphasize the protection and/or retention of existing high quality habitat and naturally functioning ecosystems. This is accomplished by identifying and treating major risk factors (e.g., unstable roads or poorly located and/or drained roads, certain invasive plants and animals, major obstructions to physical and biological connectivity) which threaten the integrity and are likely to adversely influence existing conditions. Identification, prioritization and integrated treatment of watersheds with limited loss of function and condition are also a priority. These watersheds will likely serve as the next generation of refugia for fish and provide future quality water. Their selection should consider the extent of habitat degradation and the degree to which their natural diversity and ecological processes are retained (Reeves et al. 1995). Active restoration programs should consider and complement recovery plans for fish, water quality and other riparian dependent species. Watershed analyses will be critical to identify key ecological processes influencing watershed condition and function and will be important in identifying specific protection and or treatment objectives.

Key watersheds are the highest overall priority for protection and restoration of watershed conditions, aquatic and riparian dependent species habitat and water quality. In some cases areas providing habitat for a particular species may be important for restoration in a non-key watershed.

Watershed-scale restoration is an interdisciplinary effort requiring close coordination and working partnerships among multiple resource programs, other agencies, tribal governments, watershed councils, adjacent landowners, other stakeholders and partners. Interdisciplinary skills provide both operational and technical capacity for implementing comprehensive watershed restoration programs. Coordination and partnerships are essential to effectively address community and watershed-scale restoration needs and opportunities. Coordination also enhances skill and funding sources needed to sustain multi-year programs.

Objectives

Each Forest will establish specific, aquatic restoration objectives for those watersheds which are determined to be a priority for treatment during the life of the Plan. Restoration objectives should be developed for key watersheds in order to make progress toward plan desired conditions. Forest plan objectives should identify:

- **priority for restoration treatments (e.g. improved fish passage, in-stream habitat improvement, wetland restoration, riparian/floodplain vegetation treatments, road stabilization and/or decommissioning) and their general location.**
- **the general scope/magnitude of the treatment areas (e.g. miles, acres, sites).**

In developing objectives, highest priorities for restoration generally include the removal of major risk factors to the integrity/resiliency of watersheds and riparian and aquatic ecosystems and the re-establishment of physical and biological connectivity of the aquatic and riparian ecosystems.

Restoration should be designed and implemented at the watershed scale. Treatment objectives and activities on NFS lands should be coordinated with other resource programs and with restoration on other ownerships.

Guidelines

Guideline RE-1. Watershed restoration projects should be designed to maximize the use of natural ecological processes as a tool in meeting and maintaining restoration objectives.

Guideline RE-2. Watershed restoration projects should be designed to minimize the need for long-term maintenance.

ARCS Element 5. Monitoring

Implementation monitoring

The responsible official must have a structured approach to assure that plan components are implemented as intended as a part of the Forest plan monitoring program.

Status and trend of watershed condition

The Forest plan monitoring program must include monitoring the status and trend of watershed condition. This monitoring will be accomplished either by rerunning the EMDS models developed for the aquatic sustainability analysis or using other models with concurrence of the Regional Office. The location, intensity and frequency of status and trend monitoring will be determined by the responsible official. Areas to consider as high priority for status and trend monitoring include key watersheds and municipal watersheds.

Section V: Risks and Uncertainties

As with any strategy designed to protect and restore ecosystems, it is uncertain whether the ARCS will achieve its goals. There are risks that it may not. These risks and uncertainties stem from several key factors. First, we have incomplete knowledge of these highly complex systems. These knowledge gaps mean that the ARCS may be missing key components. Moreover, the effectiveness of some existing components of the strategy has not been fully demonstrated. For instance, there are few examples of successful restoration at the scales of interest (i.e., typically watershed or subbasin, over long-timeframes). Besides risks and uncertainties associated with the composition of the ARCS, full implementation of the strategy is not guaranteed. For example, implementation is strongly dependent on budgets and a robust, highly-skilled workforce with access to extensive resource information. However, skills and capacity in the Region have declined substantially in the past 15 years and future declines are possible. Another key source of risk and uncertainty is the fact that the ARCS pertains only to National Forest System lands in the Pacific Northwest Region. It does not apply to dam and hatchery operations off national forests or activities on other federal lands and state and private lands. These activities will have a large influence on the maintenance and recovery of aquatic ecosystems in the Pacific Northwest. Lastly, climate change and invasive species substantially increase risks and uncertainty associated with aquatic ecosystems. These have emerged and have become increasingly important in recent years and are therefore described in further detail.

Climate Change

A recent review of the effects of climate change on salmon (ISAB 2007) identified the following probable consequences along the Pacific coast in coming years and decades: (1) higher temperatures will result in more precipitation falling as rain rather than snow; (2) snowpacks will diminish and seasonal stream flow patterns will be altered; (3) peak river flows will likely increase; (4) summer low flows will be lower; and (5) water temperatures will continue to rise. Not all of these anticipated trends are necessarily harmful to aquatic habitats, and many are dwarfed by other anthropogenic factors, but they have major implications for native fishes and aquatic ecosystems.

Climate change scenarios predict an increase in large flood events, wildfires, and forest pathogen outbreaks. All of these have some potential to actually improve habitat complexity in some areas as a result of floodplain reconnection and large wood recruitment. Many effects of climate warming, however, will have negative habitat consequences for aquatic organisms. A higher frequency of severe floods will probably result in increased egg mortality due to gravel scour. Winter snowpacks will likely retreat and run off earlier in the spring (Mote et al. 2003a and 2003b), potentially impacting species whose migration to the ocean is timed to coincide with plankton blooms (Pearcy 1997). Summer base flows will probably be lower and the network of perennially flowing streams in a drainage system is likely to shrink during the summer dry period, forcing fish into smaller wetted channels and less diverse habitats (Battin et al. 2006). Warmer water temperatures would increase physiological stresses and lower growth rates. Summer peak temperatures may approach or exceed lethal levels for salmon and trout (Crozier and Zabel 2006, Crozier et al. 2008). Higher temperatures will also favor species that are better adapted to warmer water, including potential predators and competitors (Reeves et al. 1987).

Climate change will likely force shifts in the distribution of fish populations affecting their ability to cope with natural disturbances, particularly drought (Battin et al. 2006). Streams located high in watersheds that historically provided some of the best habitat may no longer be accessible to migratory fishes if snowpack is reduced, thus limiting available rearing areas and access to thermal refugia in summer. Even moderate climate-induced changes may significantly increase the risk of extirpating local populations of Chinook salmon (Crozier et al. 2008). Climate-related factors such as temperature and streamflow could affect habitat in different ways and at different scales depending on local site characteristics. Therefore a diversity of conditions is needed for population stability (Crozier and Zabel 2006).

Existing well-connected, high-elevation habitats on public lands will be important to supporting salmon survival and recovery as the climate continues to warm (Martin and Glick 2008). Maintaining and restoring these areas is a fundamental objective of the ARCS. The strategy incorporates numerous adaptation actions relevant to climate change. These include maintaining instream flows by limiting water withdrawals, reducing flood peaks by enhancing floodplain connectivity and disconnecting roads from streams, reconnecting isolated habitats by removing anthropogenic barriers, managing riparian forests to provide shade and other functions, and improving waters where aquatic habitats and water quality have been degraded. Actual impacts to aquatic ecosystems will be highly dependent on the degree to which these adaptation actions are implemented now and in the future. Without them, aquatic habitats are likely to become increasingly isolated, simplified, and less likely to recover after significant disturbance events.

Invasive Species

Climate change effects will be compounded by those associated with aquatic and terrestrial invasive species, which are likely to worsen in the future. For example, in some large coastal rivers, non-native species have come to dominate fish assemblages and have largely replaced native fishes within the rivers' food web. Relatively little is known of the effects of invasive riparian plants on the water quality, nutrient cycling, and the physical habitat of streams and lakes. The magnitude of these effects will depend on the effectiveness of invasive aquatic species control programs. This is influenced by the effectiveness of prevention and eradication efforts, the reinvasion rate of invasives after control actions are taken, and the speed with which native species reoccupy habitats previously dominated by the non-native species. Effective control will also depend heavily on successful public awareness programs to prevent spread of new aquatic invasives on both public and adjacent private lands.

These risks and uncertainties do not suggest there is a need to change the basic structure and components of the ARCS. Instead, they reinforce and amplify the need for this type of strategy. They may also influence the details of how the ARCS is implemented at subbasin, watershed, and site scales.

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Section VII: Glossary

Anchor population*:* population stronghold, source for supplementing or refounding smaller, more vulnerable surrounding populations.

Active floodplain: Active floodplain is defined as the area bordering a stream that is inundated by flows at a surface elevation defined by two times the maximum bankfull depth (measured at the thalweg).

Active Restoration: The deliberate activities related to restoration. As an example, this might include seeding native grasses and planting native scrubs and trees.

Aquatic (and riparian) health: Aquatic and riparian habitats that support animal and plant communities that can adapt to environmental changes and follow natural evolutionary and biogeographic processes. Healthy aquatic and riparian systems are resilient and recover rapidly from natural and human disturbance. They are stable and sustainable, in that they maintain their organization and autonomy over time and are resilient to stress. In a healthy aquatic/riparian system there is a high degree of connectivity from headwaters to downstream reaches, from streams to floodplains, and from subsurface to surface. Floods can spread into floodplains, and fish and wildlife populations can move freely throughout the watershed. Healthy aquatic and riparian ecosystems also maintain long-term soil productivity. Mineral and energy cycles continue without loss of efficiency. (www.icbemp.gov/) [section 1 page 5]

Aquatic ecosystem: Any body of water, such as a stream, lake or estuary, and all organisms and nonliving components within it, functioning as a natural system. FEMAT glossary

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act (1980).

Channel migration zone: "Channel migration zone (CMZ)" means the area along a river within which the channel(s) can be reasonably predicted to migrate over time as a result of natural and normally occurring hydrological and related processes when considered with the characteristics of the river and its surroundings. CMZs are those areas with a high probability of being subject to channel movement based on the historic record, geologic character and evidence of past migration. It should also be recognized that past action is not a perfect predictor of the future and that human and natural changes may alter migration patterns. Consideration should be given to such changes that may have occurred and their effect on future migration patterns.

Coarse filter management: Land management that addresses the needs of all associated species, communities, environments and ecological processes in a land area. (see fine filter management.) *(FS People's Glossary of Eco Mgmt Terms)*

Connectivity: The arrangement of habitats that allows organisms and ecological processes to move across the landscape; patches of similar habitats are either close together or linked by corridors of appropriate vegetation. The opposite of fragmentation. (www.icbemp.gov/) [pg 33]

Connectivity (of habitats) : a) A measure of the extent to which conditions among late-successional and old-growth forest areas provide habitat for breeding, feeding, dispersal, and movement of late-successional old-growth associated wildlife and fish species. Also See Late-Successional/Old-Growth Forest. *(FEMAT, IX-7)*

Decommission: To remove those elements of a road that reroute hillslope drainage and present slope stability hazards. Another term for this is "hydrologic obliteration." FEMAT glossary

Ecological health: - The state of and ecosystem in which processes and functions are adequate to maintain diversity of biotic communities commensurate with those initially found there. FEMAT glossary

Ecosystem health: A condition where the parts and functions of an ecosystem are sustained over time and where the system's capacity for self-repair is maintained, such that goals for uses, values, and services of the ecosystem are met. (www.icbemp.gov)

Evolutionary Significant Unit (ESU): a group of salmon or trout populations that is a distinct population segment. Scientists established two criteria for ESUs: 1) the population must show substantial reproductive isolation; and 2) there must be an important component of the evolutionary legacy of the species as a whole.

Facultative Bacteria: Bacteria that can live under aerobic or anaerobic conditions (EPA glossary).

Fine filter management: Management that focuses on the welfare of a single or only a few species rather than the broader habitat or ecosystem (see coarse filter management). *(FS People's Glossary of Eco Mgmt Terms)*

Forest road or trail: A road or trail wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization (Title 36, Code of Federal Regulations, Part 212—Administration of the Forest Transportation System, section 212.1.)

Fresh Water: Water that generally contains less than 1,000 milligrams-per-liter of dissolved solids (EPA glossary).

Herbicide: A chemical pesticide designed to control or destroy plants, weeds, or grasses. (EPA glossary)

Hyporheic zone: The hyporheic zone is a region beneath and lateral to a stream bed, where there is mixing of shallow groundwater and surface water. The flow dynamics and behavior in this zone (termed hyporheic flow) is recognized to be important for surface water/groundwater interactions, as well as fish spawning, among other processes.

INFISH: Interim Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (Forest Service). (www.icbemp.gov/)

Insecticide: A pesticide compound specifically used to kill or prevent the growth of insects. (EPA glossary)

Leasable minerals: Minerals that may be leased to private interests by the federal government. Includes oil, gas, geothermal resources, and coal. FEMAT glossary

Meta-population: A population comprising local populations that are linked by migrants, allowing for recolonization of unoccupied habitat patches after local extinction events. FEMAT glossary

Mitigation: Mitigation Measures - Modifications of actions taken to:

- avoid impacts by not taking a certain action or parts of an action;
- minimize impacts by limiting the degree or magnitude of the action and its implementation;
- rectify impacts by repairing, rehabilitating, or restoring the affected environment;
- reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or,
- compensate for impacts by replacing or providing substitute resources or environments.

Obligate species: A plant or animal that occurs only in a narrowly defined habitat such as tree cavity, rock cave, or wet meadow. FEMAT glossary

PACFISH: Interim Strategies for Managing Pacific Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California. (www.icbemp.gov/)

Passive Restoration: Allowing a site to self-restore through natural processes

Pesticide: Substances or mixture there of intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant. (EPA glossary)

Recovery unit: A management sub-unit of a federal ESA listed entity , geographically or otherwise identifiable, that is essential to the recovery of the entire listed entity; conserves genetic or demographic robustness, important life history stages, or other feature for long-term sustainability of the entire listed entity. Recovery criteria for the listed entity should address each identified recovery unit, and every recovery unit must be recovered before the species can be delisted.

Refugia: Locations and habitats that support populations of organisms that are limited to small fragments of their previous geographic range (i.e., endemic populations). FEMAT glossary

Resilience: The ability of an ecosystem to maintain diversity, integrity, and ecological processes following a disturbance. *(FS People's Glossary of Eco Mgmt Terms) REO Information Center-Definitions*

Resiliency: The degree to which the system can be disturbed and recover to a state where processes and interaction function as before (Holling 1973 in Reeves et al 1995).

Resilient, resilience, resiliency: (1) The ability of a system to respond to disturbances. Resiliency is one of the properties that enable the system to persist in many different states or successional stages. (2) In human communities, refers to the ability of a community to respond to externally induced changes such as larger economic or social forces. (www.icbemp.gov)

Riparian-dependent resources: (see 2526.05 - Definitions) Riparian-Dependent Resources. Resources that owe their existence to the riparian area.

Riparian ecosystem: An ecosystem that is a transition between terrestrial and aquatic ecosystems; includes streams, lakes, wet areas, and adjacent vegetation communities and their associated soils which have free water at or near the surface; an ecosystem whose components are directly or indirectly attributed to the influence of water (www.icbemp.gov)

Riparian Habitat: Areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands.

Salable minerals: High volume, low value mineral resources including common varieties of rock, clay, decorative stone, sand, and gravel. FEMAT glossary

Site potential: A measure of resource availability based on interactions among soils, climate, hydrology, and vegetation. Site potential represents the highest ecological status an area can attain given no political, social, or economic constraints. It defines the capability of an area, its potential, and how it functions. (www.icbemp.gov/)

Site-potential tree: A tree that has attained the average maximum height possible given site conditions where it occurs. FEMAT glossary

Site potential tree height (SPTH): The average maximum height of the tallest trees (200 years or older) for a given site class. http://www.icbemp.gov/

Spatial: Related to or having the nature of spacehttp://www.icbemp.gov/

Temporal: Related to time. http://www.icbemp.gov/

Unstable and potentially unstable lands: The unstable land component includes lands that are prone to mass failure under natural conditions (unroaded, unharvested), and where human activities such as road construction and timber harvest are likely to increase landslide distribution in time and space, to the point where this change is likely to modify natural geomorphic and hydrologic processes (such as the delivery of sediment and wood to channels), which in turn will affect aquatic ecosystems including streams, seeps, wetlands, and marshes. (www.icbemp.gov/)

Watercourse: A watercourse is any flowing body of water. These include rivers, streams, and brooks.

Watershed: The entire region drained by a waterway (or into a lake or reservoir). More specifically, a watershed is an area of land above a given point on a stream that contributes water to the streamflow at that point.

Watersheds:

a) The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake. *(FEMAT, IX-39)*

b) Any area of land that drains to a common point. A watershed is smaller than a river basin or subbasin, but it is larger than a drainage or site. The term generally describes areas that result from the first subdivision of a subbasin, often referred to as a "fifth-field watershed." *(Ecosystem Analysis at the Watershed Scale v 2.2, p. 25)*

c) The entire region drained by a waterway (or into a lake or reservoir). More specifically, a watershed is an area of land above a given point on a stream that contributes water to the stream flow at that point. *(FS People's Glossary of Eco Mgmt Terms)*

Wetlands:

Section 404 of the Clean Water Act. The term wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

National Wetland Inventory (Fish and Wildlife Service) has broadly defined both vegetated and nonvegetated wetlands as follows: Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands should have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.