Aquatic Restoration Strategy

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USDA Forest Service
Pacific Northwest Region

Pacific Northwest Region
Aquatic Restoration Strategy

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Summary

Regional Aquatic Restoration Strategy

The Strategy is to improve watershed and aquatic/riparian habitat conditions at a Regional scale. This is accomplished using a combination of "Passive" and "Active" restoration. Passive restoration is the broad-scale, "natural" recovery/restoration of aquatic ecosystems. It involves resource support, coordination, analysis and planning/ design activities designed to maintain or improve habitat conditions while implementing a variety of other resource programs. Active restoration involves active intervention (integrated project activities) which is specifically designed to influence processes needed for watershed and aquatic/ riparian habitat restoration. It is focused and applied on a more limited scale (priority watersheds) than Passive restoration. The Strategy relies on an increasing variety of close, working partnerships (internal and external), and interdisciplinary skills which provide both operational and technical capacity for aquatic restoration. The Strategy serves to link Passive and Active restoration activities and provides guidance for implementation of the Regional Priority on Aquatic Restoration. It is a way of organizing and focusing resources to improve aquatic/riparian habitat and watershed conditions Region-wide. It is designed to be a "living document" which will receive review and revision based on performance, accomplishment, new opportunities etc.

The Strategy consists of three main sections:

Goals, Objectives and Actions - this section identifies major Goals (outcomes) and expected Regional accomplishments at mid (five years) and near term (1-2 years) time frames. It establishes priority actions to guide progress over the next 18-24 months. Primary responsibility for the implementation of each action is identified. This Section is also a key link with the new Performance Accomplishment Tracking budget system.

Program Framework – this is the foundation for the Aquatic Restoration Program. It presents the working philosophy and the primary Program elements needed for implementation of the Strategy. The Framework is specific enough to establish a comprehensive, integrated restoration "game plan" for the Region which will enhance team work, coordination and overall consistency of the Program. It is general enough to facilitate Forest and District level innovation based on local needs, opportunities and political realities.

Restoration Components – these are groups of activities used to implement various program elements. They include things like resource support activities, aquatic and riparian resource assessment, coordination and cooperation with State and Federal Salmon and Watershed Recovery programs, technical support to the field for active restoration projects, etc. A number of "Regional Commitments" are restoration components. This section shows how these are linked to other activities to aid in the effective and efficient implementation of the Aquatic Restoration Strategy.

R6 Aquatic Restoration Strategy
Vision, Goals, Objectives

REGIONAL VISION

"The Pacific NW Region is a leader in aquatic resource management and restoration. Program accomplishments are of the highest quality and result from a highly skilled, energetic workforce working as a team with a wide range of partners. Program activities are clearly linked to agency and resource priorities. They are integrated and strategically organized to provide timely and effective results."

REGIONAL GOALS

- Accelerate improvement of watershed and riparian/aquatic habitat conditions by-
    - Promoting broad-scale maintenance/recovery of watershed and habitat conditions- "Passive" Restoration. (This is primarily accomplished through coordinated support to project design/implementation for the full range of other resource programs.)
    - Completing restoration of priority watersheds- "Active" Restoration.

- Increase availability of resources (partnerships, funding and skills) to maximize implementation of the program.

REGIONAL FIVE YEAR OBJECTIVES (FY05-10)

- Increase the completion of priority restoration for whole watersheds by > 25% (Regional totals increase from 2.0 to 2.5 per year.)
- Maintain >90% implementation efficiency for Forest Plan ACS "Standards and Guides" while meeting resource targets and producing high-quality plans.
- Maintain or increase the quality and diversity of high quality partnerships, while increasing total partnership number by >10% and leveraged funding by >50%.
- Maintain or increase the technical/operational capacity for completion of aquatic restoration across the Region.
- Complete full linkage to "new" budget process for FY 2006 Program.

Framework: Region 6 Aquatic Restoration Strategy

GOALS

- **Accelerate improvement of watershed and riparian/aquatic habitat conditions by-**
  - **Promoting broad-scale passive restoration. (This is primarily accomplished through coordinated support to project design/implementation for a full range of other resource programs.)**
  - **Completing active restoration of all high priority watersheds.**
- **Increase the availability of funding and efficient use of skills utilizing a variety of tools and a diverse network of action partners.**

FRAMEWORK FOR ACTION

1. Philosophy- Achieve maximum improvement in aquatic resource/ watershed condition at a Region-wide scale. This is accomplished using passive restoration (maintenance of watershed and aquatic habitat conditions through application of Plan standards and Guidelines and coordination with other activities) on a broad scale and active restoration (active intervention to restore selected processes) applied strategically at a local, more focused scale.

Protect- Maintenance of healthy habitat is the foundation for effective restoration. First priority is to curtail causes of resource damage. Prevention of damage is the most effective tool, allowing "natural" recovery (Passive Restoration) using ecological processes. Conservation/ maintenance of aquatic habitat conditions requires timely, high-quality involvement/ support to other resource programs and comprehensive resource information to support analysis needs. Availability of an adequate core of technical skills/experience and timely coordination with regulatory agencies/ interested parties is critical. Standards and guidelines in Forest Plans and policy direction provide guidance for conduct of activities. It is also important to have solid linkages to other plans (Oregon and Washington Salmon/Watershed Recovery Plans, fish species and water quality recovery plans, etc.) and strong working relationships with other stakeholder/landowners.

Restore- Active Restoration complements Passive Restoration. Prevention of damage (storm-proofing) is first priority. Strategic focus of activities on priority areas (areas where basic integrity and processes are still adequately functioning- functioning but "at risk.") is essential. Identify and address root causes (altered processes) responsible for impaired function/quality of riparian/aquatic systems. Address whole watersheds. Use treatments which anticipate and use natural disturbance to accomplish restoration. Watershed scale restoration is an interdisciplinary effort and requires close coordination between multiple resource programs, watershed councils, adjacent landowners, other stakeholders and partners. FS participation increasingly aids in the planning and design of treatment prescriptions on non-federal lands but critical to achieving restoration objectives at the watershed scale. Coordination and partnerships are essential for whole watershed restoration and will be emphasized at all levels.

2. Leadership

"Buy in" and engagement from Line results in knowledge of the restoration program, establishment of expectations (goals/objectives), and support for an integrated program of work. "Champions" for restoration are identified and given authority to lead (program and project development, partner development and maintenance, information sharing etc.). Incentives/ accountability for program activities and results are clearly established and used. Accomplishments and effort are rewarded and celebrated.

3. Technical and Operational Resources

A solid cadre of skills (both technical and operational) is the foundation of an effective and innovative restoration program. Core skills are field-based and integrated into the full suite of Forest program activities. Teams of Master Performers are used to fill special needs/ skill gaps for complex issues/projects. Interdisciplinary and integrated approaches are used to achieve best results. Maintenance and expansion of skills are emphasized using OJT and formal training tools. Certification is used to ensure appropriate skills are used for complex projects and to acknowledge mastery of requisite skills. Operational skills and expertise are recognized as essential to the program. Use of multi-discipline COR's for project implementation is emphasized.

4. Support to Other Resource Programs

Highest priority for investment/allocation of funds and skills is to ensure effective maintenance of aquatic resource conditions while supporting other resource programs. The relative level of cores skills available to aid in Environmental Assessment, Consultation and development of comprehensive project plans should be commensurate with the extent/ magnitude /quality (potential) of aquatic resources and the magnitude/diversity and complexity of programs and resource issues.

5. Financial Resources and Partnerships

Second priority is to leverage scarce resources and to allocate them with an emphasis on priority treatment areas (basins, sub-basins and watersheds). Leveraging at the Regional scale will help extend the amount of "seed money" available to support project development. Leveraging at the field level will generally focus on more local partners and the implementation of projects. Given the diverse array of treatments, FS funding for restoration will require integrated treatments and will involve multiple BLI'S. Use of new tools, which may generate resources for restoration (Stewardship Contracts, PAYCO, etc) and linkage to other programs whose implementation can help achieve restoration objectives, will be encouraged on all units. Broad networks of partners will provide support, linkage to the community and will allow access of additional funding sources not readily accessible to the FS.

6. Project development

Multi-scale analysis (sub basin and watershed analysis) will provide a context for restoration and establish a strategic framework, including priorities, timing location etc. for watershed-scale restoration activities. There will be strong emphasis on addressing restoration of whole watersheds and on the use of interdisciplinary skills in all analysis and project planning. Comprehensive resource information will support this analysis and planning. Project plans will identify specific project resource objectives and expected results. These will establish the foundation for post project monitoring and evaluation. Coordination with other plans and activities is critical. Forest Service interdisciplinary skills will often aid Watershed Councils in assessments and in development of project plans and designs. There will be a strong emphasis to create multi-year groups of projects for implementation (5-Year Watershed Restoration schedules).

7. Project Implementation

A wide range of tools will be used in project implementation. Use of Service Contracts will become more common for certain project types. Units will develop a cadre of multi-discipline, watershed restoration COR's to improve efficiency of project implementation. Development of a pool of local contractors, skilled in restoration work, will be emphasized.

7. Quality Control/ Assurance

The development and maintenance of the high level of technical and operational skills will be emphasized. Certification for certain project types (in-stream work) will be explored. Use of Master Performer Teams (Regional Design Assistance Team, Fish Passage Design Assistance Team) will be expanded to increase the amount of design review in addition to technical assistance/on-the-job training functions. Implementation monitoring will be emphasized on most projects.

8. Monitoring and Evaluation

Implementation monitoring will occur on most projects. Effectiveness monitoring will occur for most priority watershed programs. Watershed analysis/ project planning will provide a foundation for monitoring plans. A mechanism for summary and reporting of annual M/E findings will be developed. Increased use of interagency protocols and involvement in PNAMP will occur.

9. Reporting

There will be increased emphasis on use of M/E and accomplishment reporting to gauge program delivery and effectiveness. Reporting will provide a key role in accountability and recognition. There will be continued use of IRDA as the primary Regional reporting tool for restoration activity accomplishments. NRIS reporting will be a major source of information for reporting by FY 2006. There will be increased use of information to develop reports and briefings to describe program accomplishments and opportunities.

Aquatic Restoration

Framework for Action

Philosophy	Leadership	Technical Resources	Financial Resources	Project Development	Project Implementation	QA / QC	Monitoring Evaluation	Reporting

Regional Commitments

Components: R6 Aquatic Restoration Strategy

Regional Aquatic Strategy direction emphasizes landscape scale protection and restoration of aquatic/riparian ecosystems. This is accomplished through the use of broad-scale habitat management (Passive Restoration) to protect and maintain aquatic/riparian resources and the development/implementation of strategically-focused activities to speed recovery of degraded systems (Active Restoration). The ACS provides the general framework for this by use of 6 primary elements. Riparian Reserves/RHCA's, Key Watersheds/Special Emphasis Watersheds and Standards and Guidelines generally focus to provide for protection/passive restoration. Active Restoration guidance is a separate component and provides general strategic direction. Watershed analysis provides context, and Monitoring/Evaluation provides feedback, for both passive and active management activities. A variety of support components are needed for effective implementation. These include:

Skill Base (Passive and Active Restoration)

Ready availability of a technically and operationally competent skill base is the first of 2 elements that provide the foundation for Aquatic Restoration. These skills interact with other disciplines to provide interpretation and analysis to support other resource programs and to develop, plan and implement active restoration prescriptions. They are also key in coordination with other agencies, Tribes and interest groups, developing and administering cooperative restoration efforts. Often they design, implement and interpret monitoring and evaluation information. High levels of team work, communication and technical skills are necessary for effective implementation of the ACS. On average, roughly 50-60% of salary costs are provided through support to an array of Programs (timber, hazardous fuels, road maintenance, deferred maintenance, range management etc). The remaining 40-50% of salary costs is provided through Aquatic Program funds to coordinate, plan and implement restoration activities.

Partnerships (Passive and Active Restoration)

Partnerships are the second essential element of restoration program delivery. Increasingly, FS funds are used for planning/design of restoration projects, and implementation is funded through state, county, or foundation grant programs. Program outputs are more than doubled through cooperative work and external funding: FS funding for restoration is typically matched by external funding, with projects leveraging 2-3 partner dollars for every FS dollar invested. FS funding to match that of partners comes from Regional Commitments (CCS and Aquatic Restoration) and regular program dollars in Fisheries, Watershed, Engineering, Vegetation Management, etc.

Support to Resource Programs (Passive Restoration)

Includes technical input and support to a variety of resource programs (Healthy Forest Initiative, National Fire Plan, Recreation Management, Transportation system management, Range Management, Wilderness and Wild and Scenic River management, etc). Support actions by aquatic resource personnel assist in planning, design and implementation of most activities in these programs, helping to ensure that ACS standards and guidelines are accomplished. Funding is provided as part of project costs, based on the primary purpose of the activity.

Coordination and Planning (Passive and Active Restoration)

Coordination and development of broad-scale plans sets the general direction for resource management. Often FS participation in plan development led by other agencies (ESA Fish Recovery, Water Quality Recovery/TMDL, CRB Sub-basin Restoration, Oregon and Washington Salmon and Watershed Recovery, etc) is critical to better integrate management activities at the watershed, and larger, scales. Coordination and integrated planning provide for more effective resource management and should aid in setting a strategic framework for management that defines agency roles and activities. ESA Fish Recovery Planning Coordination is an RF Commitment, and allows detailing of highly skilled personnel to work with interagency planning teams at the Provincial scale. Other coordination with States, Tribes, partner Federal agencies, watershed councils etc, is generally provided from Aquatic Program funds.

Aquatic Inventory (Passive and Active restoration): ***Regional Commitment***

AI provides watershed scale characterization of physical and biological components of aquatic and riparian habitat. This information is quantitative and allows the description and condition analysis of these resources. The information is central to the completion/update/revision of watershed and sub basin analyses and is also used to support consultation and project planning. Aquatic Inventory is funded through a Regional Commitment, facilitating/guiding multi-Forest work organization and promoting more strategic implementation using scarce resources.

Watershed and Sub Basin Analysis (Passive and Active Restoration)

Mid-scale analysis sets the context for resource management at the watershed/sub basin scales. Information from these analyses helps to locate, schedule and design a variety of resource activities. It is critical to set baseline conditions for consultation and to provide an initial diagnosis of watershed and aquatic conditions. This diagnosis leads to development of active restoration strategies and encourages linkage with other program activities at this scale. Mid-scale analysis is managed by Strategic Planning and is funded primarily through NFIM funds.

Community Outreach, Involvement and Education (Passive and Active Restoration)

Public understanding and appreciation of aquatic resources and resource management programs are fundamental to success of the Restoration Program. Agency investment to improve resource conditions through both passive and active restoration can quickly be lost through damage caused by inappropriate recreational use or development near riparian areas (on and off NFS lands). Public support for resource management activities and community participation in restoration programs stems from their knowledge, involvement, and trust built through communication (education/interpretive efforts) and cooperative protection/restoration activities. The development of whole watershed approaches, across ownership boundaries, is promoted through these efforts. These are largely Fish and Wildlife "Nature-watch" activities: the largest and most successful are funded through Competitive Challenge Cost Share (Regional Commitment), and the balance through Forest Fish and Wildlife funded activities.

Leveraged Funding/Area Restoration Leaders (Active Restoration): ***Regional Commitment***

The "Aquatic Restoration Strategy" (ARS) project will pilot creation of a multi-partner fund to focus support and speed development of restoration in priority watersheds. This cooperative restoration fund is a key element in implementation of the ARS. The underlying goal is to match or exceed the FS investment share, significantly expanding resources for project planning/development in priority watersheds. Multi-program FS funding ($260K) is matched with funds from Agencies (BLM, EPA, BPA, etc.) and major Regional partners (Oregon Trout, Trout Unlimited, National Fish and Wildlife Foundation, National Forest Foundation etc) to create 'seed money' for the most urgently needed activities. This funding will promote Forests' ability to attract additional local leveraging (partners and funds).

The most effective restoration programs currently operating in the Region have one factor in common: a "sparkplug" to help develop plans, recruit partners, obtain/organize resources and implement/monitor work. Six priority subbasins have been initially selected for restoration emphasis, and partial funding is provided for a highly skilled leader in each subbasin to guide whole watershed restoration. These leaders will coalesce partners to identify a single highest priority watershed, then develop and implement an efficient, short-term action plan aimed at promoting rapid recovery of key aquatic processes and functions.

Master Performer Teams (Active Restoration): ***Regional Commitment***

Technical support teams have been organized to assist Forests in addressing some of the most complicated and expensive restoration challenges: fish passage at road stream crossings, and stream channel/wetland reconstruction. These teams provide 3 essential functions: 1) State-of-the-art input/guidance to help produce high quality, efficient solutions to complex restoration problems, 2) On-the-job training and mentoring for Forest workforce (tech transfer); 3) Quality control/assurance (identifying potential

shortfalls or risks prior to implementation). The teams, in existence for 2 years, have been very well utilized (the Stream Team has supported over 35 projects to date, and the Culvert Team has supported over 25 projects on 11 Forests.) They enjoy a solid base of support from aquatic program personnel, line and staff. These teams are funded as a Regional Commitment.

OR/WA Water/Salmon Liaisons (Active Restoration): ***Regional Commitment***

The Region is committed to support implementation of State Salmon and Water Quality Recovery Plans. Close coordination is necessary to ensure complementary efforts in planning, implementing and monitoring restoration work. The liaison positions, created five years ago, have greatly improved State/Federal program linkages and understanding between State and Federal program leaders. The liaisons have significantly increased efficiency in planning/implementation through streamlining of project consultation and permitting processes. These positions have also directly benefited the Region, assisting Forests in obtaining approximately $1.5-2 MM in external funding annually for project implementation. Positions provide service to all Forests and are funded by a Regional Commitment

Pacific Northwest Region, Forest Service
Basin-scale Restoration Prioritization Process

Pacific Northwest Region
U.S.D.A. Forest Service

Dave Heller, Regional Fish Program Leader
Bruce McCammon, Regional Hydrologist
Jeff Uebel, Regional Habitat Biologist

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I. General Background

A prioritization process to identify geographic emphasis areas for restoration work has been developed by the Pacific Northwest Region, Forest Service. It provides an ecological basis for priority setting. The Regional process consists of three "modules" displaying priorities for aquatic, terrestrial and community/social environments. The modules are designed to operate independently or be combined to produce an integrated priority ranking for basins. These modules have been initially applied at the basin scale (3rd level hydrologic unit or HUC), to provide information for broad-scale strategic planning. It is anticipated that the general approach and criteria used in the modules will be used at other spatial scales (4th, 5th and even 6th field HUC's) as a basis for developing a consistent, nested strategy for restoration work at all levels in the Pacific NW Region. Increasingly more detailed local data would be used as watershed size decreases. Basic concepts guiding development of the three modules has emphasized analysis of whole basins (not just Federal lands), as well as rating areas in the best relative condition as the highest priority for restoration.

II. Aquatic Module Approach

The aquatic module considers resource condition, watershed sensitivity, and management-related risk factors in establishing priorities. It addresses ecological needs of at-risk fish stocks, watershed condition and water quality. The underlying approach in developing the model is to utilize quantitative information, using the best data consistently available across the two-state area (Oregon and Washington).

The model utilizes the same general methodology developed in the interagency (IIT) Interim Watershed Restoration Strategy, for Biological Opinions in the PACFISH/INFISH areas (May 2000). Please refer to this document for details on derivation of the model. It is included as Appendix A. This Regional model incorporates additional variables for reflecting water quality improvement needs. It also uses some different information than was used in the IIT Restoration Strategy analysis, in an effort to utilize uniform data sets available for the entire two-state area.

III. Model Development and Framework

The model construction incorporates three primary categories for analysis: 1) Aquatic Resource Condition; 2) Watershed Sensitivity; and 3) Management Intensity. The paradigm of risk reduction in the "best" basins first drives the weighting of the model components from 4 for aquatic resource condition to 1 for watershed integrity. These weights were assigned based on the modelers' belief of their relative importance. The model is intended to select for basins with a

higher proportion of watersheds in a “fully functioning” or “functioning at risk” condition. Among basins with similar condition ratings, the most “sensitive” are rated highest for treatment, and then among similar groupings, the basins with the greatest amount of risk factors are rated highest.

Each of the categories is represented by a series of criteria/indicators. These are both physical and biological for each of the categories. Basins are scored for each indicator and the indicator ratings are ranked to normalize. In an Excel spreadsheet, each indicator ranking is then weighted by multiplying it’s relative importance within the category by the reliability of the data – high-3, medium 2, and low-1. This results in a possible range of weights for each indicator, ranging from 1-9. The weighted indicator scores within each category for each basin are summed and averaged to produce a weighted average score for the category. The weighted average score for each category is then multiplied by the category weight. The scores for each of the categories are then totaled for each basin. The general logic track followed for model development follows (refer also to Table I):

1. Aquatic Resource Condition: With a weighting of 4, this category is weighted as the most important category in the model. It represents basin condition under existing management regimes. It also infers the potential for detectable response in resources of concern (fish populations, water quality, etc.) to restoration work. It is intended to select for basins with the highest proportion of sub basins/watersheds in “functioning” or “functioning at risk” condition. The category uses both physical and biological criteria/indicators.

- Physical Indicators
    - Current condition/potential for response: Water quality impaired stream segments
    - Future status: Land-use (amount of protected/reserved lands)
- Biological Indicators
    - General condition: Native biodiversity
    - Condition/potential for response: Healthy fish stocks

2. Basin Sensitivity: This category has a weighting of 2. It characterizes the inherent relative sensitivity of the watershed to disturbance using selected risk factors (see #3 below).

- Physical Indicators
    - Surface erosion risk
    - Mass failure risk
- Biological Indicator
    - Federally Listed T& E species

3. Management Intensity: This category measures the degree of human impact on the landscape, and is a measure of potential to affect significant change in resource conditions through restoration work. Human-caused disturbance such as road building and consumptive water use are considered risk factors. This is the lowest weighted category and is intended to help sort basins after each basins' condition and sensitivity are factored together.

- Terrestrial/Watershed Indicator- Road density
- Aquatic Indicator (channel condition)- Consumptive water use

TABLE I: Aquatic Model Construction

1. Aquatic Resource Condition

Indicator	Score->	Rank (1-9) X	Indicator Weight*=	Weighted Rank
303d segments	___	___	3	___
Key watershed %	___	___	9	___
Wild/Parks %	___	___	9	___
Healthy Stocks	___	___	6	___
Biodiversity	___	___	6	___

Condition Category = $\frac{\text{Sum Indicator Weighted Ranks}}{\text{Sum of Indicator Weights (33)}}$ X 4 (Category Score Weight*)

2. Basin Sensitivity

Indicator	Score->	Rank (1-9) X	Indicator Weight*=	Weighted Rank
Surf. Erosion risk	___	___	4	___
Mass failure risk	___	___	4	___
T&E species	___	___	3	___

Sensitivity Category= $\frac{\text{Sum Indicator Weighted Ranks}}{\text{Sum of Indicator Weights (11)}}$ X 2 (Category Score Weight*)

3. **Management Intensity (Risk)**

Indicator	Score->Rank (1-9)	X	Indicator Weight*	=Weighted Rank
Road Density	___	___	3	___
Water Use	___	___	3	___

Risk Category = Sum Indicator Weighted Ranks X 1 (Category Score) / Sum of Indicator Weights (6) Weight*)

Total Basin Score = Condition+Sensitivity+Risk Scores

*Weighting assignment:

Category Weighting- relative importance based on restoration philosophy

Indicator Weighting- importance in category times the reliability of the data

IV. Criteria description/derivation

An attempt was made to use the most robust, ecologically representative, and direct measure for each indicator. In many cases, it was difficult to find complete data sets derived in a consistent fashion that covered both states for preferred indicators. Therefore a different, less directly related indicator was sometimes used. Indicators utilized include:

Water Quality/Physical Criteria

1. Number of currently listed 303(d) segments in the basin.

   303(d) listed segments identify those water-bodies that are currently not meeting water quality standards and, therefore, are not providing for beneficial uses. Data was taken from an EPA source. No attempt to validate the listings was made. The data is for total number of segments and does not represent miles of "impaired" segments.

2. Irrigation water use

   Measures water withdrawal without return flow to streams in million gallons/day. 1998 water use values were taken from published USGS data.

3. Surface erosion risk

   Potential for surface erosion was estimated for each basin. A professional panel was convened to qualitatively assign a Very High, High, Moderate, or Low rating to each of Omernick's eco-regions (level IV). A GIS query was made to intersect the basin and eco-region maps with a resultant data table showing acres of

each eco-region in each basin. A final rating for each basin was determined based on the relative real extent of each erosion class within a basin.

4. Mass failure risk
   Derived in the same fashion as Surface Erosion, above.

5. Road density
   Percent of basin with transportation network greater than or equal to 2 miles per sq. mile. A "moving windows" approach was applied to a GIS layer that contains transportation maps for all ownerships in both Oregon and Washington. The result of the analysis is a tabulation of acres of density classes by ownership by basin. The table, in concert with the spatial arrangement of the densities, provides a good representation of the variability of roads within each basin. Ownership was ignored in the model input. The total area for road networks with density greater than or equal to 2 miles per square mile was totaled for use in the model.

Land-use "Condition" Indicators

Two general classes of land-uses were identified as likely to maintain or improve watershed conditions over time:

1. Wilderness and National parks
   Highly protected lands with relatively limited current and future amounts of human caused disturbance. The percent of each basin's acreage in these lands was calculated.

2. Key Watersheds
   These are high quality and readily restorable watersheds with high biological fish recovery and/or water quality values. They are the focus areas for protection and restoration efforts on FS and BLM lands. The percent of each basin's acreage allocated to Key watersheds (Northwest Forest Plan, Tier I/Tier II) and/or A1/A2 watersheds (ICBEMP) was calculated.

Biological/Fish criteria

The three biological criteria utilized include:

1. Healthy stocks – number/status of healthy anadromous fish stocks.
   Some agencies and interest groups have proposed these stocks as a logical focal point for protection/restoration efforts. The rationale for this index recognizes healthy stocks as indicators of functional habitats. They also infer a relative lack of other significant impacts

acting on the populations, which suggests good potential for response from further habitat restoration.

The number of species represented by a healthy stock in each basin was taken from Huntington, et al. (1994), Healthy Native Stocks of Anadromous Salmonids in the Pacific Northwest and California. Basins shown with a "Healthy Level 1" stock (greater than 2/3 potential productivity for the river system) were given two points; basins with only a "Healthy Level 2" stock (10-66% of potential productivity) were given one point. Points for each species were summed to give a total basin score. No attempt was made to verify the information from the source document. (There is no comprehensive information on relative status of resident fish populations available for the two-state area.)

2. Threatened and Endangered Species- number of federal threatened and endangered fish species in each basin.

   Each listed species is given one point. These are totaled for each basin. Distribution of fish species listed as Endangered or Threatened (or proposed for listing) were taken from Listing Status Maps (see www.nwr.noaa). The rationale for the criterion is to reflect the relative risk for loss of fish species, as well as to recognize potential benefits from restoration work to help recover listed species.

3. Biodiversity- number/basin of native salmonid plus rare endemic non-salmonid fish species.

   Each native salmonid species and each Regionally listed sensitive non-salmonid species was given one point and totaled for each basin. Due to the current lack of consistent, complete information on aquatic biodiversity in the watersheds across Oregon and Washington, the modeling effort utilized two of the more complete data sets available: The number of native salmonid species in each basin and the Pacific NW Region FS Sensitive Species list (which incorporates species listed by both States and Natural Heritage databases). It was assumed that the diversity of these native species still present in these basins could function as an indicator of aquatic community status, and also reflect the additive benefits for watershed restoration to multiple species. Sources for data were StreamNet GIS maps, USFWS Distinct Population Segment maps, and NOAA Coastal Listing Status Map (see www.nwr.noaa.gov/1salmon/salmesa/cuttesum .htm.) Efforts are underway in both Oregon and Washington to compile general aquatic biodiversity information. When this is available, the model can be updated with more representative criteria.

V. Sensitivity Testing

In initial tests of early versions of the model, weighting of the indicators differed from that shown above. Weighting was adjusted for several indicators to provide better balance within the model. Computing weighted average scores for each category also helped to balance the indicators. Subsequent sensitivity testing has shown that results from the present version of the model do not change significantly with small changes to weighting in any of the indicators or categories.

VII. Results

Values for the indicators in each basin, and the resulting total model scores are displayed in Table II. The basin total scores are shown in Table III. Basins ranking 30 or more were rated as having "high" ecological priority for restoration. These basins include: Puget Sound, Lower Columbia, Washington Coastal, Southern Oregon Coastal, Northern Oregon Coast, Lower Snake and John Day. Basins ranking 23-29 were rated moderate, and include Willamette, Klamath, Upper Columbia, Northern California Coastal, Deschutes, Middle Columbia, Clearwater, and Yakima. Basins ranking 22 and below rated low, including Pend Oreille, Middle Snake-Powder, Spokane, Oregon Closed Basins, Middle Snake-Boise, Upper Sacramento and Black Rock Basin.

TABLE II: Basin Criteria and Category Scores

Resource Condition

	Basin Name	303(d)		Key WS		NP/ wild		healthy stk		biodiv.		Wtd. Rank
160402	Black Rock Basin	9	27	0	0	0	0	0	0	0	0	**1**
170102	Pend Oreille	9	27	4	38	0	1	0	0	3	20	**3**
170103	Spokane	9	27	1	12	0	0	0	0	2	15	**2**
170200	Upper Columbia	7	21	3	29	3	26	5	27	7	44	**4**
170300	Yakima	7	21	4	38	3	24	0	0	5	29	**3**
170501	Middle Snake-Boise	8	25	2	20	0	1	0	0	2	10	**2**
170502	Middle Snake-Powder	8	25	4	35	0	0	0	0	1	5	**2**
170601	Lower Snake	7	21	5	43	4	35	0	0	5	29	**4**
170603	Clearwater	9	27	7	67	0	0	0	0	4	25	**4**
170701	Middle Columbia	7	21	2	17	0	4	2	14	6	34	**3**
170702	John Day	6	19	9	81	1	13	2	14	4	25	**5**
170703	Deschutes	8	23	3	31	2	14	0	0	4	25	**3**
170800	Lower Columbia	7	21	5	42	5	44	3	20	7	39	**5**
170900	Willamette	7	22	5	41	3	23	0	0	6	34	**4**
171001	Washington Coastal	7	22	2	15	4	39	9	54	8	49	**5**
171002	Northern OR Coastal	7	22	4	37	0	3	5	27	5	29	**4**
171003	Southern OR Coastal	2	7	6	55	2	19	6	34	5	29	**4**
171100	Puget Sound	0	0	5	43	9	81	7	41	9	54	**7**
171200	OR Closed Basins	8	23	1	12	0	0	0	0	6	34	**2**
180101	Northern Calif. Coastal	9	27	5	48	0	0	1	7	2	15	**3**
180102	Klamath	8	25	7	61	1	12	0	0	7	44	**4**
180200	Upper Sacramento	9	27	1	10	0	0	0	0	0	0	**1**
	importance	1		3		3		2		2		
	data reliability	3		3		3		3		3		
	criteria wt.	3		9		9		6		6	33	

Risk

	Basin Name	roads		water use		Wtd. Rank
160402	Black Rock Basin	0	0	9	27	**5**
170102	Pend Oreille	0	1	9	27	**5**
170103	Spokane	3	9	9	26	**6**
170200	Upper Columbia	4	13	0	0	**2**
170300	Yakima	5	16	4	11	**4**
170501	Middle Snake-Boise	1	2	7	20	**4**
170502	Middle Snake-Powder	3	9	7	22	**5**
170601	Lower Snake	3	9	7	20	**5**
170603	Clearwater	0	0	9	27	**5**
170701	Middle Columbia	4	12	5	14	**4**
170702	John Day	4	12	8	25	**6**
170703	Deschutes	5	15	7	21	**6**
170800	Lower Columbia	6	18	9	26	**7**
170900	Willamette	8	23	6	18	**7**
171001	Washington Coastal	5	16	9	27	**7**
171002	Northern Oregon Coastal	9	27	9	27	**9**
171003	Southern Oregon Coastal	6	19	8	23	**7**
171100	Puget Sound	5	14	9	26	**7**
171200	Oregon Closed Basins	3	9	6	17	**4**
180101	Northern California Coastal	0	0	9	27	**5**
180102	Klamath	2	6	7	21	**5**
180200	Upper Sacramento	0	1	8	25	**4**
	importance	1		1		
	data reliability	3		3		
	criteria wt.	3		3	6	

Sensitivity

	Basin Name	sfc eros.		mass fail		T&E		Wtd. Rank
160402	Black Rock Basin	2	8	2	8	0	0	**1**
170102	Pend Oreille	5	20	2	8	1	3	**3**
170103	Spokane	5	20	2	8	1	3	**3**
170200	Upper Columbia	5	20	2	8	3	9	**3**
170300	Yakima	5	20	2	8	3	9	**3**
170501	Middle Snake-Boise	5	20	2	8	1	3	**3**
170502	Middle Snake-Powder	5	20	2	8	1	3	**3**
170601	Lower Snake	8	32	2	8	4	12	**5**
170603	Clearwater	5	20	2	8	3	9	**3**
170701	Middle Columbia	5	20	2	8	4	12	**4**
170702	John Day	8	32	2	8	2	6	**4**
170703	Deschutes	5	20	2	8	1	3	**3**
170800	Lower Columbia	2	8	5	20	5	15	**4**
170900	Willamette	2	8	2	8	6	18	**3**
171001	Washington Coastal	2	8	2	8	2	6	**2**
171002	Northern Oregon Coastal	2	8	6	24	1	3	**3**
171003	Southern Oregon Coastal	5	20	6	24	2	6	**5**
171100	Puget Sound	2	8	2	8	3	9	**2**
171200	Oregon Closed Basins	2	8	2	8	1	3	**2**
180101	Northern California Coastal	9	36	5	20	1	3	**5**
180102	Klamath	2	8	2	8	5	15	**3**
180200	Upper Sacramento	5	20	2	8	0	0	**3**
	importance	2		2		1		
	data reliability	2		2		3		
	criteria wt.	4		4	6	3	**11**	

Model output

		4	1	2	
		Cond.	Risk	Sens.	**total**
160402	Black Rock Basin	3	5	3	**11**
170102	Pend Oreille	10	5	6	**21**
170103	Spokane	7	6	6	**18**
170200	Upper Columbia	18	2	7	**27**
170300	Yakima	14	4	7	**25**
170501	Middle Snake-Boise	7	4	6	**16**
170502	Middle Snake-Powder	8	5	6	**19**
170601	Lower Snake	16	5	9	**30**
170603	Clearwater	14	5	7	**26**
170701	Middle Columbia	11	4	7	**23**
170702	John Day	18	6	8	**33**
170703	Deschutes	11	6	6	**23**
170800	Lower Columbia	20	7	8	**35**
170900	Willamette	15	7	6	**28**
171001	Washington Coastal	22	7	4	**33**
171002	Northern Oregon Coastal	14	9	6	**30**
171003	Southern Oregon Coastal	17	7	9	**34**
171100	Puget Sound	26	7	5	**38**
171200	Oregon Closed Basins	8	4	3	**16**
180101	Northern California Coastal	12	5	11	**27**
180102	Klamath	17	5	6	**27**
180200	Upper Sacramento	4	4	5	**14**

TABLE III: Total Basin Scores, Aquatic Restoration Priority Model

		Cond.	Risk	Sens.	**total**
160402	Black Rock Basin	3	5	3	**11**
170102	Pend Oreille	10	5	6	**21**
170103	Spokane	7	6	6	**18**
170200	Upper Columbia	18	2	7	**27**
170300	Yakima	14	4	7	**25**
170501	Middle Snake-Boise	7	4	6	**16**
170502	Middle Snake-Powder	8	5	6	**19**
170601	Lower Snake	16	5	9	**30**
170603	Clearwater	14	5	7	**26**
170701	Middle Columbia	11	4	7	**23**
170702	John Day	18	6	8	**33**
170703	Deschutes	11	6	6	**23**
170800	Lower Columbia	20	7	8	**35**
170900	Willamette	15	7	6	**28**
171001	Washington Coastal	22	7	4	**33**
171002	Northern Oregon Coastal	14	9	6	**30**
171003	Southern Oregon Coastal	17	7	9	**34**
171100	Puget Sound	26	7	5	**38**
171200	Oregon Closed Basins	8	4	3	**16**
180101	Northern California Coastal	12	5	11	**27**
180102	Klamath	17	5	6	**27**
180200	Upper Sacramento	4	4	5	**14**

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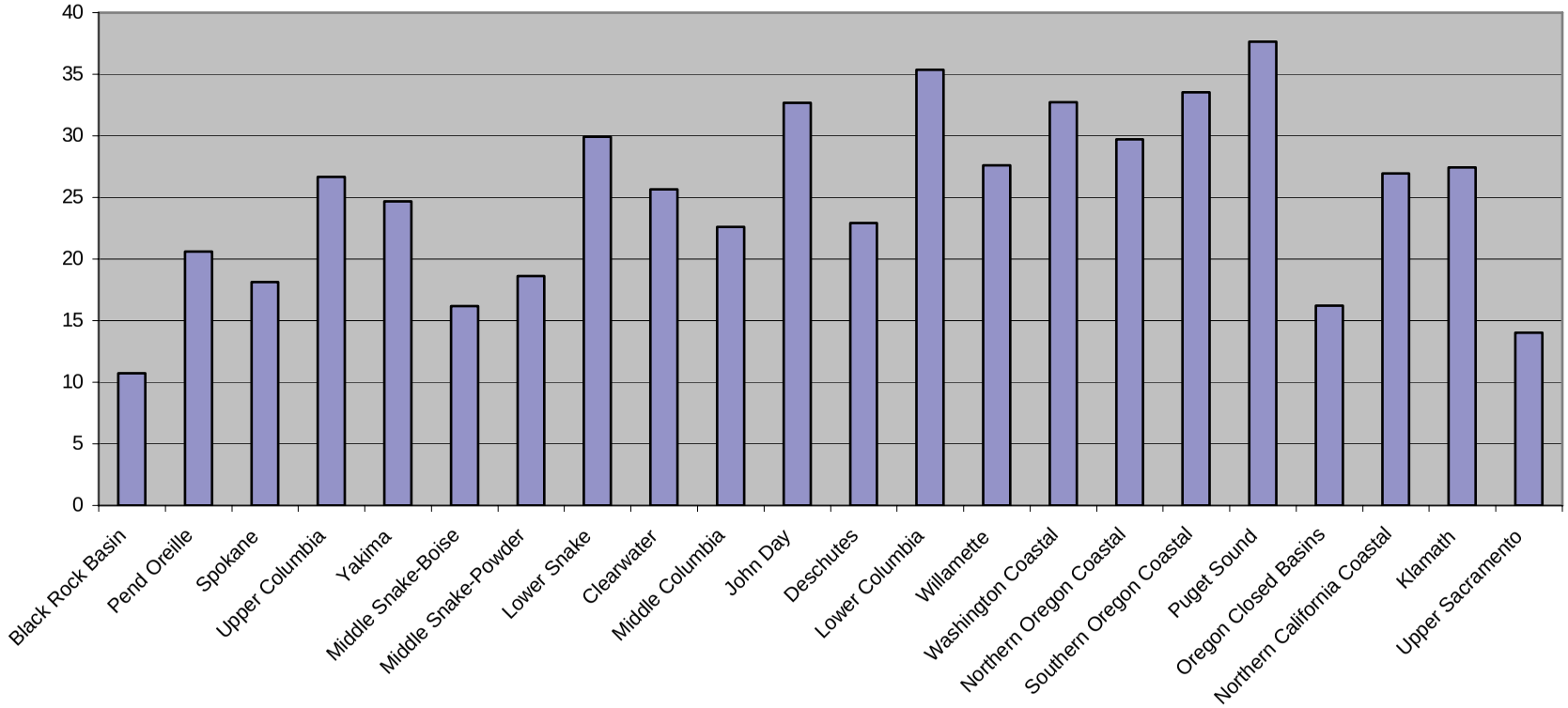
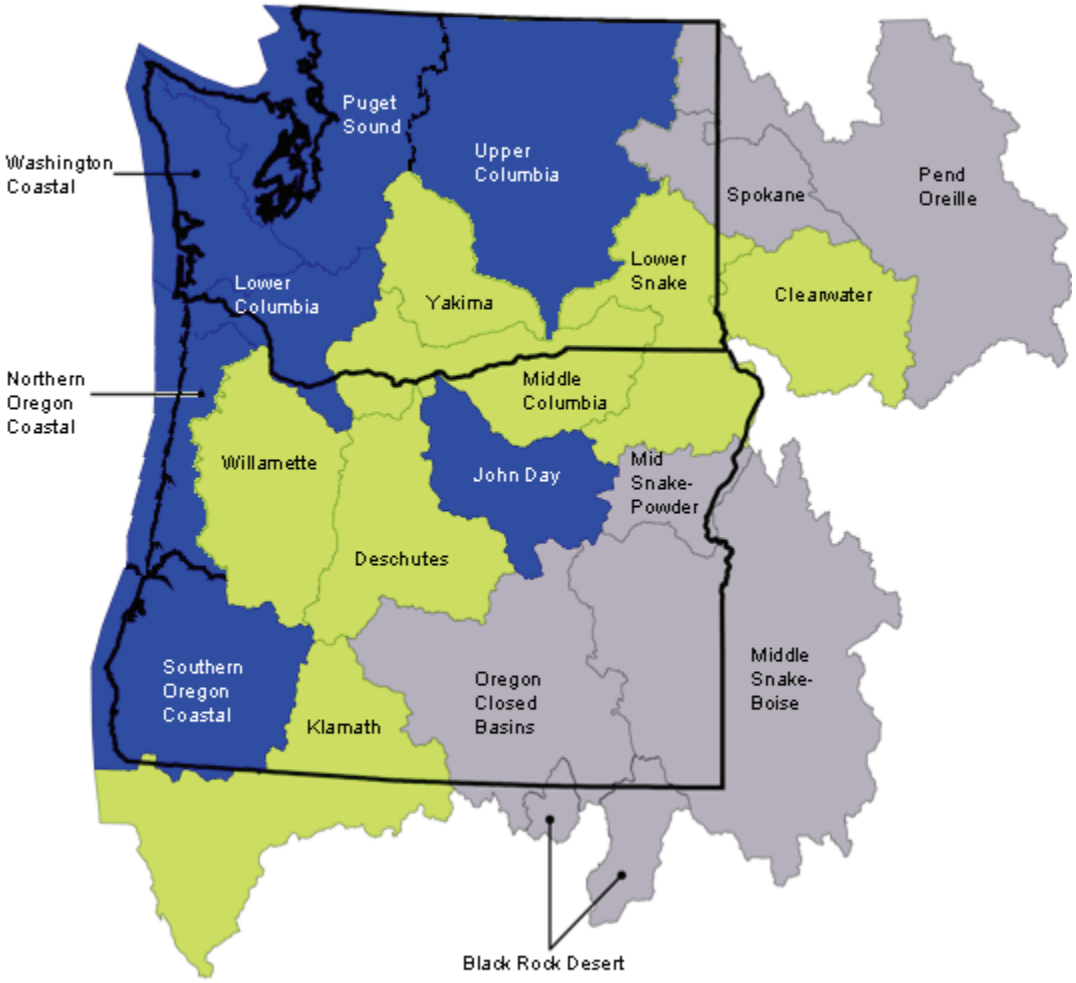


Table IV. TOTAL BASIN SCORES, Aquatic Restoration Priority Model

USFS Aquatic Restoration Priority Basins



Legend: Dark (blue) = highest Priority for Restoration
Medium (green)= moderate
Light (gray) = Low

Ecological Ranking Criteria

Resource Condition

- 303(d) Waterbodies
- Key-A1/A2 watershed
- National Parks, Wilderness
- Healthy Fish stocks
- Biodiversity

Risk

- Road Density
- Consumptive water use
- TES fish

Inherent Sensitivity

- Surface erosion
- Landslide potential