United States Department of Agriculture | Forest Service | Klamath National Forest | 1312 Fairlane Road
Yreka, CA 96097-9549
(530) 842-6131
TDD (530) 841-4573

File Code: 2510

Date: May 11, 2001

RWQCB
REGION 1

MAY 14 2001

☐ LAM ____ ☐ CRJ ____ ☑ MATT
☐ RLT ____ ☐ SAW ____ ☐ KAD ____
☐ FCR ____ ☐ RSC ____ ☐ ____

North Coast Regional Water Quality Control Board
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403
ATTN: Matt St. John

Dear Mr. St. John:

The Klamath, Mendocino, Shasta-Trinity, and Six Rivers National Forests have worked with NCRWQCB staff for many years. We reviewed your March 12, 2001 letter soliciting information regarding Impaired Water Bodies (303d list) and submit the attached for your consideration.

The National Forests of California, including the four listed above, recently completed a Reconnaissance Level Watershed Condition Assessment. That assessment (copy of process paper enclosed) is the product of professional staff work by journey level hydrologists, geologists, soils scientists, and fishery biologists familiar with the watersheds of Northern California. The assessment process evaluated watershed condition in the context of *potential* adverse effects (risk, hazard, threat) quantitatively and *expressed* adverse effects qualitatively. Hazards assessed quantitatively are linked to road systems, surface erosion, and mass wasting. Qualitative features assessed include floodplain connectivity, water quality impairments, flow regime, riparian condition, stream channel stability, and native aquatic fauna integrity.

We believe this information and the assessment map product can be useful to the NCRWQCB staff as they prepare recommendations on the state of the current 303d list of impaired water bodies. The map product is based upon a large data table that captures results of the assessment of indicators. The enclosed map displays those watersheds that currently exhibit high degrees of physical and biotic integrity and appear stable. We do not believe areas displayed as "watersheds in good condition" should be considered as "impaired" water bodies.

We think it would be productive for our staff to meet with you and review this information in detail necessary for complete understanding of the process and results. Please contact Jack West (jrwest@fs.fed.us; 530-841-4419) at the Klamath NF who can arrange for appropriate Forest Service specialists to meet with you and discuss this information. We appreciate the opportunity to continue working cooperatively with the NCRWQCB on this important task.

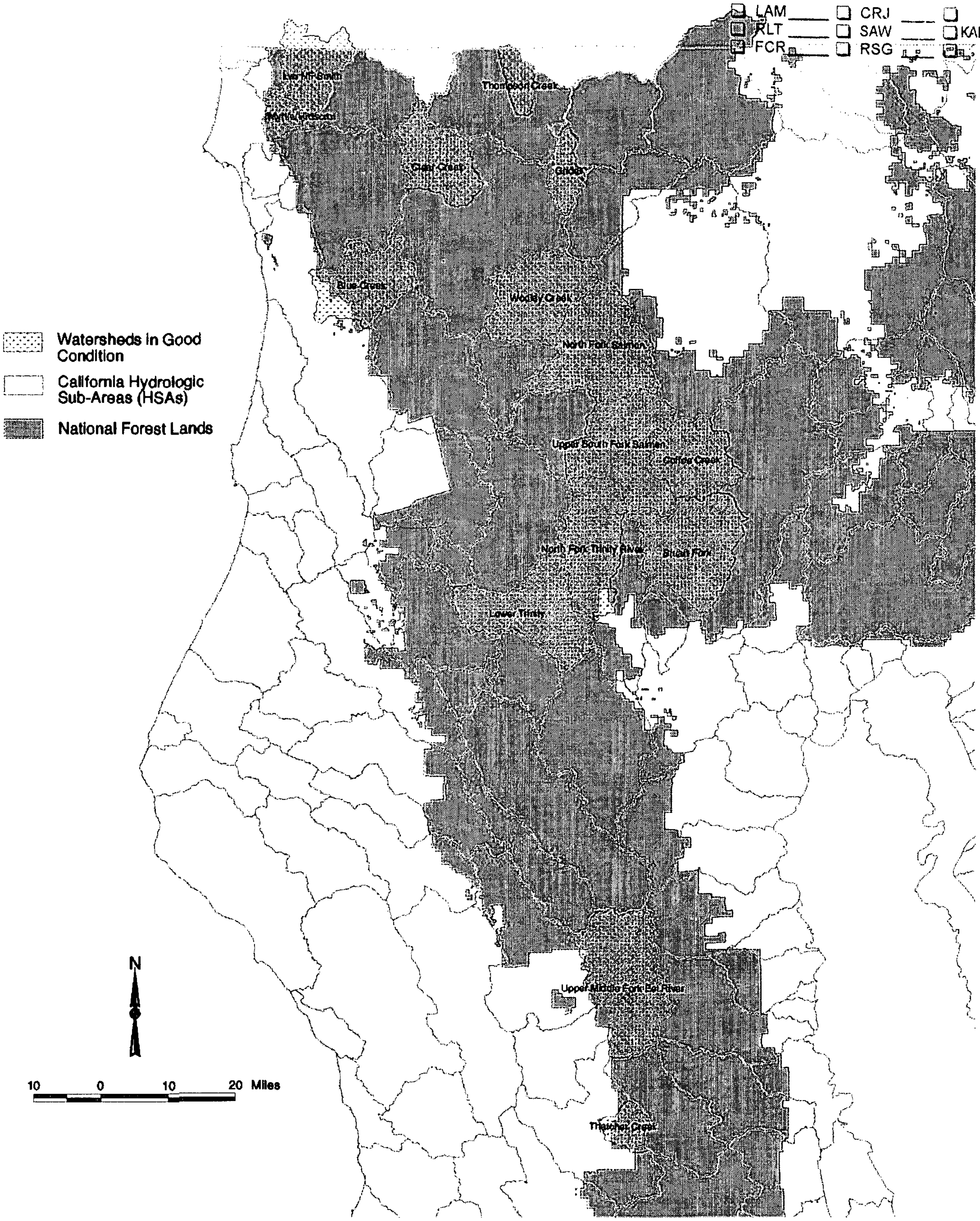
Sincerely,

Margaret J. Boland

MARGARET J. BOLAND
Forest Supervisor
for Northern California Board of Directors

Enclosures

Unimpaired Watersheds on National Forest Lands in Northwest California



Analysis Watershed Name	Hydrologic Subarea (HSA)	HSA Acres	Analy Wshd Acres	Percent of HSA*
Lwr NF Smith	1103.4	43,210	60,685	140%
Thompson Creek	1105.32	153,358	23,183	15%
Myrtle/Hrdscrbl	1103.3	102,094	17,787	17%
Clear Creek	1105.31	339,465	71,307	21%
Grider	1105.33	127,112	27,640	22%
Blue Creek	1105.11	318,253	80,326	25%
Wooley Creek	1105.22	95,096	95,175	100%
North Fork Salmon	1105.23	130,362	130,391	100%
Upper South Fork Salmon	1105.24	185,705	118,952	64%
Coffee Creek	1106.4	459,948	74,378	16%
North Fork Trinity River	1106.15	176,703	97,398	55%
Stuart Fork	1106.4	459,948	123,741	27%
Lower Trinity	1106.13	134,747	114,813	85%
Upper Middle Fork Eel River	1111.74	131,480	131,118	100%
Thatcher Creek	1111.71	164,158	23,032	14%

*proportion of the HSA that is within the analysis watershed. If the two do not match, it is most commonly because the HSA is larger than the analysis watershed. The one exception is the Lwr NF Smith which includes parts of Oregon while the corresponding HSA does not.

Rating Watershed Condition: Reconnaissance Level Assessment for the National Forests of the Pacific Southwest Region

USDA Forest Service, Pacific Southwest Region
June, 2000

Background

A principal function of the USDA Forest Service is to ensure the long-term integrity of watersheds and aquatic systems on lands the agency manages. In California, a considerable proportion of the State's surface waters have their origins on National Forest System (NFS) lands. With so much of California's water coming from National Forests, maintenance of healthy forest watersheds is critical to the State's economic and environmental well being. In addition, these lands provide much of the high quality aquatic and riparian habitat remaining in the state, habitat crucial to native terrestrial, riparian, and aquatic species.

The Forest Service's Natural Resource Agenda for the 21st Century emphasizes the agency's commitment to protection of healthy watersheds and restoration of those that are degraded. Chief Dombeck has called watershed restoration and maintenance the "oldest and highest calling of the Forest Service", and announced it would be the over-riding priority of forest planning and management. In addition, the President's Clean Water Action Plan directed federal agencies to develop a unified policy that provides a framework to ensure that federal land and resource management activities demonstrate water quality stewardship and ensure the health of aquatic ecosystems on federal lands. This policy will ensure a watershed approach to federal land and resource management that emphasizes assessing the function and condition of watersheds, incorporating watershed goals in planning, enhancing pollution prevention, monitoring and restoring watersheds, recognizing waters of exceptional value, and expanding collaboration with other agencies, states, tribes, and communities. This policy will address consistency and compliance with state and tribal programs as required by federal laws, including the Clean Water Act, Safe Drinking Water Act, and the Coastal Zone Management Act.

In order to address the goal of healthy watersheds there is a need to complete assessments of watershed conditions. This information needs to be obtained for all NFS watersheds in California in a timely manner, be consistent throughout the Pacific Southwest Region and be reproducible and credible.

Project Description and Purpose

For this project, *Watershed Condition* is defined by the aggregate expression of the physical and biological processes of a watershed relative to natural and human disturbance. While watershed processes are fundamentally similar among most watersheds, they work within the unique physical and biological characteristics, which define hydrologic units including geology, topography, climate, and biology.

Watershed analysis, as described in the *Federal Guide for Watershed Analysis (USDA 1995),* provides the ideal analytical framework for describing watershed processes and conditions at the watershed scale (5^{th} or 6^{th} field). A ``reconnaissance-level" assessment of all NFS watersheds in California has been initiated. This procedure is intended to be hierarchically compatible with the process outlined in the *Federal Guide for Watershed Analysis (USDA 1995).* The reconnaissance-level assessment will provide the Forest Service an overall perspective of watershed conditions across Region 5 in the near-term, while encouraging progressive analyses of watersheds using the Federal framework. Analyses of watershed conditions at both resolutions (the reconnaissance level and more detailed Federal Guide approach) are intended to be incremental.

The purpose of this project is to obtain a reconnaissance-level characterization of the condition of NFS 5^{th} field (62.5 - 390 square mile or 40,000-250,000 acres) watersheds in California. The watershed assessment process includes the following tasks: (1) delineate assessment watersheds at approximately the 5th field scale for NFS lands; (2) develop a characterization protocol and classification procedure; (3) acquire and interpret reconnaissance level information sufficient to place watersheds into one of three condition categories; and (4) compile tabular and map products displaying watershed conditions.

Much of the preliminary work required for completing the assessments is complete. Assessment watersheds are delineated at approximately the 5th field scale for NFS lands. The characterization protocol and classification procedure is developed and ready for use. Reconnaissance level data (tabular data and map products) displaying information used for quantitative portions of the evaluations are compiled.

Tasks that remain to complete the reconnaissance level assessments are to bring together individuals that are familiar with the assessment watersheds to interpret and summarize known information sufficient to place watersheds into one of three condition categories, and to compile tabular ratings and produce map products displaying watershed conditions.

<u>Intended Goals and Uses of Watershed Condition Assessment</u>

-- Establish a systematic process for determining Watershed Condition that can be applied consistently across the Pacific Southwest Region.

-- Strengthen effectiveness of Region 5 programs to maintain or restore healthy watersheds and aquatic ecosystems in California.

-- Foster multi-scale ecosystem based approaches to management of aquatic resources.

-- Enable coordinated and priority-based approach for allocation of resources to conduct monitoring, inventory, and restoration of watersheds and aquatic biota.

-- Enhance coordination with external agencies and partners in watershed management, species recovery efforts, and regulatory compliance.

-- Improve internal dialog among disciplines to focus and integrate annual programs of work to efficiently maintain and restore ecosystems.

-- Establish a ``barometer" of ecosystem health for the Region through a composite characterization of watershed conditions at the reconnaissance scale.

Project Outputs and Timelines

(1) Development of a seamless map coverage of 5th field watersheds administered by USFS for Region 5 to at least 1:100,000 scale, preferably 1:24,000 scale of resolution. The delineation was accomplished following interagency standards (USDA-NRCS 1995) (Completed June 1999).

(2) Development of a draft Regional protocol for characterization of watershed condition into 3 classes (Completed September 1999).

(3) Internal/external review and revision of Regional watershed condition protocol (November 1999 – May 2000).

(4) Testing and evaluation of professional judgment indicators (Completed February - March 2000).

(5) Compilation of seamless GIS coverages for evaluation of quantitative indicators by watershed, and map production to illustrate quantitative assessment watershed indicators by class for Region 5 (December 1999 – May 2000).

(6) Evaluation of data representing quantitative indicators, and assignment of condition classes (February – June 2000).

(7) Forest teams evaluate watershed conditions using R-5 Watershed Condition Rating Process (April – August 2000).

(8) Compilation of Region 5 database and map products to illustrate assessment watershed conditions (April - September 2000).

(9) Dissemination of results for Region 5, including database (October – November 2000).

Identification of Watershed Areas for Assessment

The choice of geographic-scale for analysis was an important and intensely debated topic. Given the broad-scale objectives of this project and the desire for compatibility with existing (and future *Watershed Analyses),* 5^{th} field watersheds (as defined in NRCS National Instruction No. 170-304) provided the foundation upon which assessment areas are identified. The 5^{th} field watersheds, as defined are between 40,000 and 250,000 acres. Most 5^{th} field watersheds define the geographic boundaries for analysis, however further sub-delineation of these units is permitted on a limited basis to:

- Minimize heterogeneous conditions; and
- Consolidate portions of land under federal administration.

Division of 5^{th} field watersheds is limited to one sub-delineation, must follow hydrologic boundaries, and the resulting assessment watershed will not be significantly smaller than the defined size range for 5^{th} field watersheds. Watersheds that contain only a small portion of National Forest land may be excluded from analysis.

Forests will evaluate approximately 450 assessment watersheds. Forests are encouraged to work collaboratively with partners in watersheds with mixed ownership in evaluating watershed conditions. Evaluation teams are to evaluate conditions within the extent of the defined assessment watersheds regardless of ownership. Watershed conditions illustrated in map form will be displayed on Federal lands only.

Description of the Watershed Condition Assessment Process

The assessment process involves three steps: (1) evaluate condition indicators; (2) determine preliminary watershed conditions by integrating all nine indicators; and (3) determine final watershed conditions by applying professional judgment "reality check".

<u>Step 1: Evaluation of Condition Indicators</u>

Diagnostic environmental indicators were chosen to evaluate the integrity of major ecosystem processes with the intent of characterizing the condition of individual watersheds (Table 1). Many interrelationships exist between the indicators selected. **Table 2** provides a straightforward approach for tracking the linkage of individual indicators to key physical and biological processes influencing watershed. Descriptions of these indicators, including the criteria used to discern between condition classes are incorporated in Appendix A. In some cases, several diagnostic measures were combined and represented by a single indicator (i.e., indicator # 1). The natural sensitivity of watersheds to human caused disturbance is factored into indicators where applicable, (see indicator descriptions) and not treated as a separate analysis step.

Table 1. List of Watershed Condition Indicators and Information type.

Watershed Condition Indicator	Information Type
(1) Road Hazard Potential	Quantitative Assessment
(2) Surface Erosion	Quantitative Assessment
(3) Mass Wasting	Quantitative Assessment
(4) Floodplain Connectivity	Professional Judgment
(5) Water Quality	Professional Judgment
(6) Water Quantity/Flow Regime	Professional Judgment
(7) Stream Corridor Vegetation	Professional Judgment
(8) Stream Channel Condition	Professional Judgment
(9) Native Aquatic Faunal Integrity	Professional Judgment

The proposed watershed condition assessment procedure incorporates a suite of nine indicators. Three relate to potential adverse effects (risk, hazard, threat) and rely upon quantitative analysis (Table 1: 1-3). The remaining six relate to expressed adverse effects and are derived through professional judgment (Table 1: 4-9). Consistent evaluation of conditions measured by professional judgment is a challenge. The proposed process uses categorically defined condition classes (high, med, low) for each of the professional judgment indicators. Use of defined classes should minimize bias among evaluators. Training and involvement in the evaluation process by the regional watershed condition assessment support team will be undertaken to help assure consistency. In addition, evaluation of watershed conditions by multiple independent specialists on a sample of watersheds will also be conducted to ensure professional judgment indicators are providing consistent outcomes.

Quantitatively evaluated indicators rely principally upon corporate spatial data (i.e., GIS), which is of uniform resolution across Forest Service administered lands. These indicators have the potential for high consistency and reasonable accuracy at the 1:24,000 scale. These corporate data sets provide an *index* of conditions and should not be considered the actual quantification of conditions. Landscapes with better resolution data (updated local field mapping of road or stream features based on imagery or at scales better than 1:24,000) can be used to refine available corporate information to better reflect actual conditions.

Step 1 involves evaluation of each of the nine indicators and will be done for all 5th field watersheds in California that are administered dominantly (i.e., >50%) by the Forest Service. *Professional judgment indicators* require local resource specialists to match their knowledge of existing watershed conditions to categories for each indicator. Local resource specialists include hydrologists, geologists, soil scientists, and biologists familiar with the target watersheds.

Table 2. Watershed Condition Processes, Linkages, and Indicators.

Ecosystem Processes		Stressors		Responses	
General Processes	**Key Processes**	**Natural Influences**	**Human Influences**	**Indicators**	**Source**
Hydrologic Regime	Water Storage and Yield	Precipitation, flood, drought, rain on snow, thunderstorms	Diversion, roads, logging, fire, grazing, recreation	Road proximity to streams, crossings, steepness, slope position	Indicator (1)
			Diversion, impoundment	Hydrologic record, number and effects of diversions and dams	Indicator (6)
Sediment Regime	Surface Erosion	Climate, soil erodibility (texture, slope gradient)	Disturbance to soil cover: roads, harvest, grazing, mining, fire, dams, recreation, agriculture	Roads by soil type and slope gradient	Indicator (2)
	Landsliding	Rock type, degree of fracture & weathering, slope, climate, soil, landform, seismicity	Disturbance to soil or bedrock: roads, mining, harvest, dams, fire	Roads by bedrock type and slope gradient	Indicator (3)
Channel Structural Dynamics	Sediment & Wood Transport and Routing	Scouring, deposition, wood interactions	Dredging, filling, roads, harvest	Floodplain connectivity	Indicator (4)
				Channel Stability	Indicator (8)
Energy Exchange Chemical/Nutrient Dynamics	Heat Transfer	Insulation, shading, climate	Harvest, grazing, recreation	Water quality records	Indicator (5)
	Chemical & Nutrient Cycling	Organic, wood input and erosion	Harvest, recreation, mining	Water Quality	Indicator (5)
Vegetative Succession, Growth, Mortality	Wood, Forage, Browse and Cover Production	Fire, insects, pathogens, wildlife, blow down, flood	Disturbance to vegetation: harvest, grazing, recreation	Riparian Vegetation (cover, composition, structure, PFC, exotics) Vegetation seral stage, fuel class	Indicator (7)
Aquatic Riparian Faunal Ecology	Reproduction, Survival, Competition	Flood, drought, food and habitat availability	Forest and fishery management, grazing, recreation, mining, impoundments, diversions, exotics	Presence or absence of native aquatic/riparian species	Indicator (9)

Preliminary evaluation of quantitative indicators will be done by province under guidance of the regional watershed condition assessment support team. Numeric references will be reassessed after pooling data from completed analyses. Condition classes for quantitative indicators will be refined during this step.

Step 2: Preliminary Determination of Condition

The nine diagnostic indicators are expected to yield a **preliminary** assessment of the condition for each watershed. In **Step 2**, these indicators are integrated through a consistent, repeatable, and understandable process. Upon completion of this step, each watershed will be **provisionally** classified into one of three condition categories (I-III) with the following descriptions:

Category I -- *Watersheds that are currently exhibiting high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and exhibit a stable drainage network. Physical and biological conditions suggest that aquatic and riparian systems are predominantly functional in terms of supporting dependent species and beneficial uses of water. The risks of management induced disturbance have not been expressed or resulted in significant alteration of geomorphic, hydrologic, and biotic processes.*

Category II -- *Watersheds that are currently exhibiting moderate geomorphic, hydrologic, and biotic integrity relative to its natural potential condition and portions of these watersheds exhibit an unstable drainage network. Physical and biological conditions suggest that aquatic and riparian systems are at risk in being able to support dependent species and retain beneficial uses of water. The risks of management induced disturbance are variable and effects have partially been expressed or have resulted in localized alteration of geomorphic, hydrologic, and biotic processes.*

Category III -- *Watersheds that are currently exhibiting low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and a majority of the drainage network is unstable. Physical and biological conditions suggest that riparian and aquatic systems do not support dependent species nor beneficial uses of water. The risks of management induced disturbance are high; they have been fully expressed and/or have resulted in deterioration of geomorphic, hydrologic, and/or biotic processes.*

Description of the Integration Process -- This approach stratifies the 9 indicators into two groups: (a) indicators that dominantly reflect the *hazard* of impairment to watershed condition (i.e., disturbance prone to accelerate future sediment delivery to streams); and (b) those that largely reflect the *expression* of watershed condition (i.e., existing water quality). Each of the 9 indicators is equally weighted, with the rating aggregated within each of the two groups. In other words, indicators # 1-3 are combined to derive a cumulative *hazard condition indicator* rating and indicators # 4-9 are combined to derive a cumulative *expression condition indicator* rating. Within each of the two groups, the process of combining each of the individual indicators employs ranking, followed by dividing the entire pool into 3^{rds}. They are then integrated using a matrix of *hazard* versus *expression* to derive the composite condition classification (Figure 1). For example, if aggregate ranking of indicators of hazard is **low** (i.e., there is a low threat of impairment due to modification of the hydrologic and sediment regime) and aggregate ranking of indicators of expression is **properly functioning** (i.e., impairment is minimal or has not been expressed in the watershed) this would yield a **category I** watershed condition.

		Expression Condition Indicators (ECI) $\Sigma\ indc_4+indc_5+indc_6+indc_7+indc_8+indc_9$ -- = ECI rating ranked and divided into 3rds		
		Impaired (rating = 3)	Functioning At-Risk (rating = 2)	Properly Functioning (rating = 1)
Hazard Condition Indicators (HCI)	High Hazard (rating = 3)	category III	category III	category II
Each indicator ranked & divided into 3rds	Mod Hazard (rating = 2)	category III	category II	category I
$\Sigma\ indc_1+indc_2+indc_3$ ------------------ 3 = HCI rating	Low Hazard (rating = 1)	category III	category II	category I

Figure 1. Illustration of hazard/expression matrix for use in preliminary identification of watershed condition categories

Step 3: Determination of Final Condition Class

Synthesis and final interpretation of results occurs in **Step 3**. This step is performed by interdisciplinary dialog between local specialists, interagency resource counterparts, and the regional watershed condition assessment support team. The objective of this step is to validate or refine preliminary conditions identified in step 2, leading to a final condition classification. The final identification of condition categories for NFS watersheds in California might look like the example map illustrated in Figure 2. Information, not captured by the indicators, which would likely have a significant influence on shifting the first approximation findings between condition categories, should be evaluated. Assumptions underlying the various indicators should also be considered with respect to observations within individual and grouped watersheds. For example, are watershed sensitivity criteria (i.e., stream, bedrock, soil, slope classes) yielding results consistent with local observations? In addition, does any ecological process dominantly influence the overall conditions in a particular watershed? If so, are the results of the integration process in Step 2 consistent with local observations?

The proposed watershed condition assessment procedure relies strongly upon the involvement of professionals, knowledgeable in the physical, biological and ecological status of Forest watersheds. However, changes or modifications of results from Step 2 will require compelling and convincing evidence, including multi-disciplinary corroboration and documentation. The intent of this requirement is to meet the goals of assuring results are consistent, repeatable, and rigorous. It is likely, however, that multi-disciplinary evaluation of watersheds in Step 3 will result in modifications of Step 2 findings.

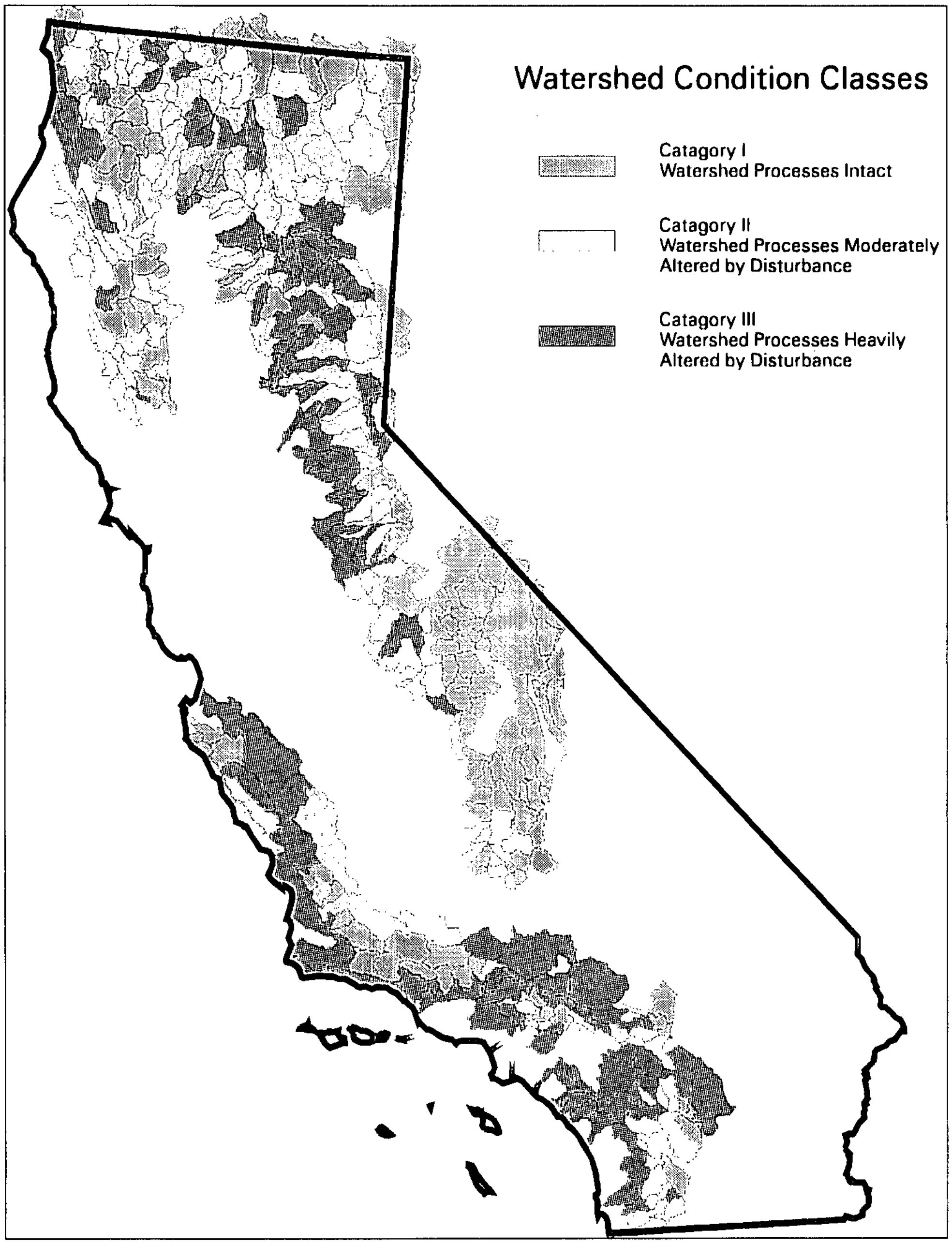


Figure 2. Example illustrating what a final condition classification of Forest Service watersheds might look like.

Data Quality Assurance and Quality Control

A primary objective of the watershed rating process is to produce consistent results across the region; therefore, mechanisms to guide and review consistency of assessments are essential. Quality assurance and quality control measures are built into the watershed condition assessment procedure and include:

(1) development and utilization of a standardized rating methodology;

(2) documentation of data sources, assumptions and other factors used by teams to support their ratings;

(3) interdisciplinary development (Delphi approach) and validation of each composite watershed rating.

Additional procedural measures provide post-assessment consistency and quality review at various steps in the watershed assessment process:

- **Forest replicated assessments (optional).** Forests with adequate staffing to conduct replicate evaluations will be encouraged to convene a second, independent interdisciplinary team to provide a replicate rating of at least one watershed during each rating cycle. Results from replicate ratings will be assessed at the regional scale to provide information on the consistency of the rating procedures.

- **Province review of ratings.** This will include review of composite and individual criteria ratings for all watersheds, by a team composed of representatives from each National Forest within each province. This step will also serve to improve consistency of ratings between forests.

- **Regional review of results.** It is envisioned that this step may be undertaken in cooperation with key regulatory agencies or partners, and will involve a broad scale evaluation to detect anomalies or inconsistencies between forests or provinces.

Spatial and Scale Considerations with Indicators

The assessment procedure evaluates Watershed Condition for hydrologic units derived from the Regional 5th field watershed layer. This layer contains watersheds of various sizes, and areas that may not necessarily constitute a functional hydrologic unit (for instance the unit may be composed of the downstream half of a large watershed, or a composite of several "face" drainages to a river or large stream). In such instances, and in cases where watersheds approach the upper extent of the 5th field watershed size (200 square miles), special circumstances will arise which complicate characterization of individual condition indicators. These circumstances may include watersheds with heterogeneous conditions, extreme indicator measures diluted by area, and/or receiving waters that are not indicative of the assessment watershed conditions.

Teams employing the Watershed Condition Assessment will need to reconcile the variation in condition within watersheds with the need to arrive at a single rating for the watershed for each attribute. Describing and documenting the logic used to arrive at the overall rating is key. Such descriptions will be very valuable to those undertaking subsequent assessments of the same watershed, and will provide a richer and more accurate picture of conditions within the watershed than the simple, overall rating. At a minimum, evaluation teams should complete the tracking form provided in **Appendix C** to assist in documenting logic used in the condition rating.

Providing the logic track does not solve the problem of consistency of approach when the assessment is applied region wide. To increase the consistency of evaluations at the regional scale, the following discussion and suggestions are provided.

First, remember that the unit of the evaluation is the watershed. The fifth field watersheds selected as the unit of measure for this assessment range in size from as small as 20 to as large as 200 square miles. As the size of the watershed increases, differences in the condition attributes (at hydrologically or ecologically important scales) are more likely to occur. The first consideration in applying the condition attributes to such heterogeneous situations is to gauge how the differences at the smaller scale affect condition and function of the watershed as a whole.

In making this determination keep in mind how the smaller components of the watershed (which may vary in their condition) contribute to the function and condition of the larger watershed. Not all parts of a watershed are equal in terms of their characteristics and function. Second, consider how smaller parts of the watershed (presumably in different condition) contribute to the processes and functions of concern at the larger watershed scale.

To illustrate these two considerations, the following hypothetical situations are provided. In the first example, two watersheds of equal size, each comprised of five smaller (say, 6^{th} field) watersheds, each have a single hydroelectric dam. In the first case, the dam is located on one of the 6^{th} field channels, in the second case; the dam is located on the main stem, at the downstream extent of the watershed. Both dams significantly moderate the flow regime in the channel downstream of the structure. Both are barriers to fish migration, both have altered the biological communities upstream and downstream of the dams for some distance. Given the need to assess flow regime at the larger watershed scale, the 2nd case would result in an impaired rating, while the 1st case would not. The reason is that in the 2nd case, the flow regime of the entire 5^{th} field watershed is seriously impacted. Note that even in this relatively simple case there could be confounding factors. If the 6^{th} field watershed with the hydroelectric development in the first case contained the only habitat for an aquatic species for example, or changed the chemical composition in the main stem significantly, condition factors related to aquatic species and water quality might be rated as less than properly functioning.

Having just one of the five sub-watersheds with dams in the first example simplifies the analysis. More difficult would be if 2 or 3 of the 6^{th} field watersheds were so impacted. Rating this case would depend on several factors. These include:

- To what extent downstream are the effects of the diversions felt?
- What is the effect of the diversions on the main stem channel at the downstream extent of the watershed?
- What affect does placement of the facilities have on "special" characteristics of the larger watershed (parts of the watershed that produce the coldest water, highest flows, support rare species or habitats)?

In practice, considering the variation within 5th field watersheds will often be more difficult than in the above examples. Hydroelectric facilities are used as an example of variation in a watershed that is otherwise uniform. Teams conducting the evaluations will have to consider the relative importance and influence of a variety of natural (geological, biological, etc.) and anthropogenic (range management, roads, urbanization, etc.) factors on condition of the watershed.

Limitations and Qualifications

Caution must be exercised when using any indicator. Indicators alone cannot answer questions, and can be misleading or misused. Indicators should be chosen, applied, and interpreted only in the context of an understanding of how they individually and jointly affect watershed processes. A process understanding should first be achieved, and then well thought-out hypotheses should be formed about mechanisms of impact. Then, indicators and watershed condition data can be compared to test the hypotheses and add spatial and quantitative relevance. The results must be interpreted in the context of other dominant watershed processes, with a keen eye to recognizing inherent limitations and assumptions.

Testing Indicators -- The use of an indicator implies the existence of certain cause and effect relationships. Usually, this association is based on correlative studies between some variable (the indicator) and the response variable of interest. The true set of environmental variables that produce the response are often complex, unmeasured, or unknown. The ability of an indicator to correctly predict a response depends on the quality of the correlative study and works best when applied within the exact set of conditions under which it was developed. When an indicator is used for a different purpose than intended, or subjected to a different set of conditions, the result can be misleading or incorrect.

Before using an indicator or collection of indicators to draw conclusions about the effects of roads or other human disturbance on watersheds, the relationship of the indicator to actual effects should be tested. That is, actual data on roads or other human disturbance performance should be related to the candidate indicator to determine if it is sensitive to and predictive of the effect of interest. Still, simply because there is a good correlation between the indicator and the observed effect does not imply that the measured indicator is the cause of the effect; it is only correlated to the response. For example, there may be a good correlation between road density and stream sediment levels. Closer examination suggests the causative mechanism is not the density of roads, but the amount of compaction, drainage rerouting, unstable fills, and other sources of erosion. In this case, simply reducing road density without paying close attention to also reducing the sources of sediment will not produce the expected result of reducing sediment.

Remember to keep in mind that the process proposed in this paper is intended to provide an initial region-wide reconnaissance-level (first approximation) evaluation of watershed conditions on Forest Service lands. It is **not** intended to be comprehensive examination of ecological conditions, **nor** provide the level of detail expected from a specific watershed analysis or assessment *(USDA/USDI 1998 & USDA 1995)*. Use of this process could; however, lead to a broadening of our understanding of processes in natural systems. Be aware of the assumptions and limitations of current hypotheses when interpreting data based upon these indicators. The use of a simple 3-class system (high, med, low), which integrates nine condition indicators, provides a systematic means of classifying and comparing watersheds. Of necessity, it generalizes complex systems and users must be cognizant of this limitation.

Applications of Condition Assessment

While this assessment process is focused principally upon describing watershed conditions, it is readily applicable for a variety of applications, including priority setting. Priorities may be set for a variety of reasons such as focusing acquisition of additional information, investments in restoration, resource protection, and long-term condition monitoring. The following example illustrates how watershed condition information might be used to set priorities, such as for restoration (Figure 3).

Watershed Condition	+	Values	+	Opportunity	=	Priority
category I	+	-T&E species - domestic water source - urban interface - key watershed	+	- active CRMP - infrastructure - coop funds	=	high priority

Figure 3. Utility of watershed condition in priority setting.

In another application, the condition categories should also be useful at the scoping phase of the current Regional process for cumulative watershed effects assessment. The categorical condition assessment offers information useful at the 5th field scale for scoping the risk to beneficial uses of water and as surrogates for land use history and watershed sensitivity.

References Cited

Montgomery, D.R., and J.M. Buffington. 1993. Channel Classification, prediction of channel response, and assessment of channel condition. University of Washington, Seattle, Washington. 84 pp.

U.S. Department of Agriculture (USDA). 1999. Roads Analysis: Informing Decisions about Managing the National Forest Transportation System. Misc. Rep. FS-643. Washington, D.C.: U.S. Department of Agriculture Forest Service. 222p.

U.S. Department of Agriculture (USDA). 1995. A federal guide for watershed analysis, version 2.2. Portland, Oregon. 26 pp.

U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). 1995. National Instruction No. 170-304, Mapping and digitizing watershed and subwatershed hydrologic unit boundaries. Washington, DC.

U.S. Department of Interior. 1993. TR 1737-9 Process for assessing proper functioning condition. Bureau of Land Management, Washington, DC. 52 pp.

U.S. Department of Interior (USDI-BLM) and U.S. Department of Agriculture (USDA-FS & NRCS). 1998. TR 1737-15. A User Guide to Assessing Proper Functioning Condition and Supporting Science for Lotic Areas. BLM. Denver, CO. 126 pp.

U.S. Department of Agriculture (USDA), U.S. Department of Interior (USDI). 1998. A Framework for Analyzing the Hydrologic Condition of Watersheds. BLM Tech Note 405. Denver, CO. 37 pp.

Glossary of Terms

Beneficial uses -- Uses identified in the associated Regional Water Quality Control Board Basin Plan(s) for the watershed being evaluated. State law defines beneficial uses to include (and not be limited to): "domestic, municipal, agricultural and industrial supply, power generation, recreation, aesthetic enjoyment, navigation, preservation and enhancement of fish, wildlife and other aquatic resources or preserves"(Water Code Section 13050(f)).

Indicator Beneficial Use - the key use(s) requiring protection within the watershed being evaluated or the use(s) most responsive to being affected by management actions.

Functioning At-Risk -- Riparian-wetland areas that are in functional condition but an existing soil, water, or vegetation attribute makes them susceptible to degradation (USDI /USDA 1998).

Hydrologically Connected -- Any road segment that, during a 'design' runoff event, has a continuous surface flow path between any part of the road prism and a natural stream channel (any declivity in the land that exhibits a defined channel and evidence of scour and deposition) is a hydrologically connected road segment. This process uses proximity of roads to streams as a surrogate for identifying hydrologically connected roads to streams.

Hydrologic Regime -- The timing, magnitude, duration, and spatial distribution of peak, high, and low flow runoff within a watershed.

Nonfunctional -- Riparian-wetland areas that are not providing adequate vegetation, landform, or woody debris to dissipate stream energy associated with high flows such as a 25-year flood (USDI /USDA 1998).

Professional Judgment -- Intuitive conclusions and predictions that are dependent upon an analyst's training, interpretation of facts, information, observations; and personal knowledge of the watershed being analyzed.

Native Fauna -- Any faunal species endemic to a watershed.

Natural Potential Condition -- Physical and biological conditions that would be expected in the absence of anthropological disturbance based on site potential and inherent natural process.

Proper Functioning Condition -- Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows such as a 25-year flood (USDI /USDA 1998).

Response reaches -- Low gradient (generally <3%) transport limited channels in which significant morphologic adjustment occurs in response to increased sediment supply (Montgomery and Buffington 1993). Response channels generally correspond to Rosgen C, D, E, and F channel types.

Sediment Regime -- The timing, volume, rate, and character of sediment input, storage, and transport within a watershed.

Stream corridor -- All streams including the adjacent land that has vegetation that has the potential to directly contribute woody debris to a stream course or meadow system.

Source reaches -- Steep gradient (generally >30%) transport limited (due to limited flow) sediment storage sites that are subject to intermittent scour from debris flows (colluvial) (Montgomery and Buffington 1993).

Stable Drainage Network -- Channel systems free of scour/deposition and bank failures within their range of natural variability.

Transport reaches -- Moderate to high gradient (generally 3-30%) morphologically resilient. supply limited channels that rapidly convey increased sediment inputs (Montgomery and Buffington 1993).

Watershed -- Lands enclosed by a single continuous (True) hydrologic-surface drainage divide or grouping of adjacent similar hydrologically unique (Composite) lands. This process utilizes approximating a 5th-level hydrologic unit (20-200 square miles) in size.

Watershed Condition -- the aggregate expression of the physical and biological processes of a watershed related to natural and human disturbances.

APPENDIX A

Watershed Condition Classes for Individual Indicators

Appendix A defines three condition classes (high, medium, low) for each of the nine indicators. These condition classes are referenced to natural potential conditions. It also contains definitions and the rule set to use in determining conditions. The nine indicators are:

Quantitative Indicators

(1) Road Hazard Potential

This indicator addresses the potential for an altered hydrologic regime (changes in runoff response) and stream diversions associated with roads. Condition class is determined by examining the slope position, slope gradient, proximity to stream channels, number of stream crossings, and density of the road system.

(2) Surface Erosion

This indicator addresses the potential for an altered sediment regime associated with surface erosion accelerated by disturbances such as roads and timber harvest. Condition class is determined by examining the density of roads on erodible soils.

(3) Mass Wasting

This indicator addresses the potential for altered sediment regime associated with mass wasting accelerated by disturbances such as roads and timber harvest. Condition class is determined by examining the density of roads on unstable geologic rock units.

Professional Judgement Indicators

(4) Floodplain Connectivity

This indicator addresses the expressed alteration of floodplain connectivity. Condition class is determined by evaluating the extent to which the natural floodplain remains connected during high flows.

(5) Water Quality *(temperature, DO, pH, conductivity, turbidity, nutrient, and chemical)*

This indicator addresses the expressed alteration of water quality. Condition class is determined by evaluating the geographic extent and length of time during which the water quality is impaired relative to beneficial uses.

(6) Water Quantity/Flow Regime *(magnitude, frequency, and duration)*

This indicator addresses the expressed alteration of magnitude, duration, or timing of annual extreme flows. Condition class is determined by evaluating the departure from the potential natural hydrograph.

(7) Stream Corridor Vegetation

This indicator addresses the proper functioning condition of the riparian vegetation. Condition class is determined by the proportion of the stream corridor vegetation which is not in proper functioning condition, and the proportion of streamside vegetation which has been disturbed.

(8) Stream Channel Condition

This indicator addresses the stability of the stream channel system. Condition class is determined by assessing the proportion of the stream network which exhibits signs of instability. Separate determinations of instability are made for confined and unconfined channels.

(9) Native Aquatic Faunal Integrity

This indicator addresses the distribution, structure, and density of native and introduced aquatic fauna. Condition class is determined by assessing the geographic distribution, species mix, and numbers of native aquatic species, as well as the presence or absence of exotic species, and their effects on the ecosystem.

(1) Road Hazard Potential -- (Quantitative Indicator)

Rating	Definition
High Hazard	The density and distribution of roads within the watershed indicate there is a higher probability that the hydrologic regime (timing, magnitude, duration, and spatial distribution of runoff flows) is substantially altered. Conditions are characterized by the presence of higher road densities (a) on slope classes >45%, (b) in middle and lower slope positions, (c) within 100 meters of stream channel, and (d) higher density of road/stream intersects.
Moderate Hazard	The density and distribution of roads within the watershed indicate there is a moderate probability that the hydrologic regime is substantially altered. Conditions are characterized by the presence of moderate road densities (a) on slope classes >45%, (b) in middle and lower slope positions, (c) within 100 meters of stream channel, and (d) moderate density of road/stream intersects.
Low Hazard	The density and distribution of roads within the watershed indicate the hydrologic regime is substantially intact and unaltered. Conditions are characterized by the presence of lower road densities (a) on slope classes >45%, (b) in middle and lower slope positions, (c) within 100 meters of stream channel, and (d) low density of road/stream intersects.

Definitions:

Hydrologically Connected: Any road segment that, during a 'design' runoff event, has a continuous surface flow path between any part of the road prism and a natural stream channel (any declivity in the land that exhibits a defined channel and evidence of scour and deposition) is a hydrologically connected road segment. This process uses proximity of roads to streams as a surrogate for identifying hydrologically connected roads to streams.

Hydrologic Regime: The timing, magnitude, duration, and spatial distribution of peak, high, and low flow runoff within a watershed.

Rule Set:

The descriptive references for condition classes given above represent a provisional system for roads indicators used in watershed characterization. Actual condition classes must be derived empirically rather than theoretically. Initially, condition classes will be derived by ranking of watershed data three equal classes (high, moderate, low). We expect to re-examine the thresholds used to determine condition classes based upon the distribution of values as datasets for these indicators become available across R5.

Recommended References:

A detailed description to the analytical procedure used to evaluate road hazard potential, including the criteria defining hydrologic sensitivity and disturbance integration, can be found with the *analysis package* for each R-5 Province.

USDA. 1999. Roads Analysis: Informing Decisions about Managing the National Forest Transportation System.

*(2) **Surface Erosion*** -- (Quantitative Indicator)

Rating	Definition
High Hazard	Significant alteration of the natural sediment regime associated with surface erosion is likely or evident. Conditions are characterized by the presence of higher road densities and associated disturbance to soil and vegetation on soils highly sensitive to accelerated erosion (high - very high Erosion Hazard Ratings).
Moderate Hazard	Moderate alteration of the natural sediment regime associated with surface erosion is likely or evident. Overall disturbance is variable, with low to moderate road densities and associated disturbance to soil and vegetation on soils highly sensitive to accelerated erosion (high - very high Erosion Hazard Ratings).
Low Hazard	Minor or no alteration of the natural sediment regime associated with surface erosion is likely or evident. Overall disturbance is low and are characterized by the presence of low road densities and associated disturbance to soil and vegetation on soils highly sensitive to accelerated erosion (high - very high Erosion Hazard Ratings).

Definitions:

Sediment Regime: The timing, volume, rate, and character of sediment input, storage, and transport within a watershed.

Rule Set:

The qualitative descriptions given above represent a provisional system for roads indicators used for watershed condition determinations. Actual classes must be derived empirically rather than theoretically. Initially, condition classes will be derived by ranking of watershed data three equal classes (high, moderate, low). We expect to re-examine the thresholds used to determine condition classes based upon the distribution of values as datasets for these indicators become available across R5.

Recommended References:

A detailed description to the analytical procedure used to evaluate surface erosion, including the criteria defining soil type sensitivity and disturbance integration, can be found with the *analysis package* for each R-5 Province.

(3) Mass Wasting -- (Quantitative Indicator)

Rating	Definition
High Hazard	Watersheds characterized by the presence of a large number of roads on unstable geologic types. This results in a situation where it is very likely that the timing, geographic distribution, and magnitude (total volume) of natural landsliding have been significantly altered.
Moderate Hazard	Watersheds characterized by the presence of a moderate number of roads on unstable geologic types. This results in a situation where there is a moderate risk that the timing, geographic distribution, and magnitude (total volume) of natural landsliding have been significantly altered.
Low Hazard	Watersheds characterized by the presence of very few, if any, roads on unstable geologic types. This results in a situation where the natural sediment regime is likely to be intact, and it is very unlikely that roads have, or will, significantly modify the timing, geographic distribution, and magnitude (total volume) of natural landsliding in the watershed.

Definitions:

Sediment Regime: The timing, volume, rate, and character of sediment input, storage, and transport within a watershed.

Rule Set:

The qualitative descriptions given above represent a provisional system for roads indicators used for watershed condition determinations. Actual classes must be derived empirically rather than theoretically. . Initially, condition classes will be derived by ranking of watershed data three equal classes (high, moderate, low). We expect to re-examine the thresholds used to determine condition classes based upon the distribution of values as datasets for these indicators become available across R5.

Recommended References:

A detailed description to the analytical procedure used to evaluate mass wasting, including the criteria defining geologic type sensitivity and disturbance integration, can be found with the *analysis package* for each R-5 Province.

(4) Floodplain Connectivity -- (Professional Judgment Indicator)

Rating	Definition
Impaired	Few (<50%) response channels in the watershed display floodplain connectivity. The distribution of response channels with connectivity is far less than that found in reference watersheds of similar size and geology. There is little to no evidence that flows exceeding bankfull have contact with the floodplain.
Functioning At-risk	Only some (50-80%) response reaches or parts of response reaches (as compared with the distribution found in reference watersheds of similar size and geology) have inundation of historic floodplains by bankfull flows. Flows of greater magnitude than bankfull may reach the floodplain. Bankfull flows typically are inundating recently formed floodplains (since 1849) that are present within incised channels. This "new" floodplain is not yet capable of spreading all flood flows.
Properly Functioning	Greater than (80%) response reaches and parts of response reaches within the watershed demonstrate floodplain connectivity. Inundation of floodplains by flows greater than bankfull occurs throughout most of the reach(s). The distribution of response channel with connectivity is very close to that found in reference watersheds of similar size and geology.

Definitions:

Floodplain Connectivity: In channels with existing or historic floodplains, the ability of flows greater than bankfull to encounter the floodplain. Floodplain connectivity may be lost through construction of levees, or through downcutting of channels because of overgrazing, or increased flow or sediment.

Response Channels: Low gradient (generally <3%) transport limited channels in which significant morphologic adjustment occurs in response to increased sediment supply (Montgomery and Buffington 1993). Response channels generally correspond to Rosgen C, D, E, and F channel types.

Rule Set:

This criterion applies only in watersheds that have "response" channel reaches. For this determination, channels lower in the watershed are the focus, and receive greater consideration than those in the headwaters. Consider the length of response channel in the watershed, and estimate (or derive from field survey or other data sources) the amount of channel that has maintained floodplain connectivity.

(5) Water Quality *(temperature, DO, pH, conductivity, turbidity, nutrient, chemical)* -- (Professional Judgment Indicator)

Rating	Definition
Low Water Quality	Significant annual impairment of indicator beneficial use(s) within the watershed (greater than 20% of the surface waters, greater than 60 days) due to physical, biological or chemical impacts.
Altered Water Quality	Minor, less than year around impairment of beneficial use(s) within a watershed (less than 20% of the surface waters, less than 60 days in aggregate) due to physical, biological, or chemical impacts.
High Water Quality	Minimal to no impairment of beneficial use(s) in the watershed (less than 20% of the surface waters at any time) due to physical, biological or chemical impacts.

Definitions:

Beneficial uses -- Uses identified in the associated Regional Water Quality Control Board Basin Plan(s) for the watershed being evaluated. State law defines beneficial uses to include (and not be limited to): "domestic, municipal, agricultural and industrial supply, power generation, recreation, aesthetic enjoyment, navigation, preservation and enhancement of fish, wildlife and other aquatic resources or preserves"(Water Code Section 13050(f)).

Indicator Beneficial Use - The key use(s) requiring protection within the watershed being evaluated, or the use(s) most responsive to being affected by management actions.

Rule Set:

1. Consider monitoring and/or inventory information available (internal or external)
2. Consider chronic water quality deterioration as well as instantaneous impacts in light of overall sustained impact to beneficial uses i.e. both could be irreversible/ irretrievable but are not always so.
3. Consider both human actions and natural event "re-sets" e.g. floods/ landslides in contributing to existing water quality. Cause/source of deterioration should be documented, but not used as a determinant in rating water quality. Do not consider wildfire effects as they are addressed in the "Surface Erosion & Mass Wasting indicators.
4. Consider mainstream systems as indicative of whole drainage system water quality i.e. the composite representative of the watershed.

***(6) Water Quantity/Flow Regime** (magnitude, frequency, duration)* -- (Professional Judgment Indicator)

Rating	Definition
Altered	The magnitude, duration, and/or timing of annual extreme flows (low and/or high) significantly depart from a natural (unaltered by anthropogenic actions) hydrograph. Commonly the timing and the rate of change in flows do not correlate with expected seasonal changes. The magnitude, frequency, and/or duration of either high or low flow pulses are impairing aquatic habitat *availability* and/or are resulting in changes to channel morphology and streamside vegetation.
Partially Altered	A departure from a natural hydrograph occurs during periods other than extreme flows (lows and/or highs) peaks and base flows are maintained. The timing, rate of change and/or duration of mid-range discharges may impair aquatic habitat *availability*.
Unaltered	Hydrograph has no alteration from natural conditions. Flows support availability of aquatic habitat

Rule Set:

Relate existing conditions to historic conditions, site potential, and reference conditions. Document characteristics used to formulate rating.

Items to consider:

Percentage of watershed affected by urbanization/developments/wildfire /dams/diversions/vegetation management/disease and insects
Location of specific characteristics within the 5th field watershed (headwater tributaries vs. main stem)
Degree of influence each characteristic plays on overall watershed condition.

Recommended References:

R5, SCI protocol for streambank stability definitions.
R5, SCI database, and reports for comparison of values as well as reference reach measurements.
Rosgen Geomorphic Classification System. 1996. See channel typing and ranges of expected measurements within each channel type.
The Nature Conservancy. 1997. Indicators of hydrologic alteration. Users manual with Smythe Scientific Software.
USDA/USDI. 1998. A Framework for Analyzing the Hydrologic Condition of Watersheds.

(7) Stream Corridor Vegetation -- (Professional Judgment Indicator). Apply the following indicator using professional knowledge of existing and potential stream corridor vegetation, including vegetation classification based on ecological province, elevation zone, and stream valley segment type, and riparian vegetation. Apply the evaluation to vegetation species that occur within the stream corridor, regardless of whether vegetation is considered "true riparian".

Rating	Definition
Impaired	A large percent of the stream corridor (>25%) vegetation attributes are not in proper functioning condition. Greater than 10% of stream corridor areas within the watershed has experienced disturbance that has resulted in adverse effects to riparian vegetation composition, cover, and/or structure. Due to disturbance such as recreation, timber harvest, and wildfire there is a lack of stream corridor vegetation cover and/or density. The lateral extent of the stream corridor vegetation is undersized in relation to stream channel width. Stream corridor vegetation is not providing protection to aquatic and riparian habitats from high stream flows. In systems that would contain large wood as an ecosystem component, it is lacking, and is not providing for favorable riparian or aquatic habitat conditions including bank stabilization, pool formation, and microclimate.
Functioning At-risk	Disturbance partially compromises proper functioning condition of vegetation attributes in stream corridor areas. 10-25% of the stream corridor area vegetation within the watershed is not in proper functioning condition. There is moderate disturbance (5-10% of streamside or aquatic adjacent area impacted) within the watershed that has resulted in adverse effects to stream corridor vegetation composition, cover, and/or structure. Stream corridor vegetation provides protection to riparian and aquatic habitats during high water flow events throughout most of the riparian area, however, some stream segments exhibit evidence of accelerated erosion due to disturbance.
Properly Functioning	Vegetation is in proper functioning condition throughout the stream corridor. Less than 10% of the stream corridor area vegetation attributes are not in proper functioning condition. There is limited disturbance to no disturbance (< 5% of streamside or aquatic adjacent habitats are disturbed) within the watershed that has resulted in adverse effects to stream corridor vegetation composition, cover, and structure. Stream corridor vegetation provides protection to riparian and aquatic habitats during high water flow events. In aquatic and riparian systems that evolved with large wood, large wood is present and continuing to be recruited into the system.

Definition:

Proper Functioning Condition: Riparian-wetland health (functioning condition), an important component of watershed condition, refers to the ecological status of vegetation, geomorphic, and hydrologic development, along with the degree of structural integrity exhibited by the riparian-wetland area (Riparian Area Management, Process for Assessing Proper Functioning Condition, BLM 1993, TR 1737-9).

Stream corridor: All streams including the adjacent land that has vegetation that has the potential to directly contribute woody debris to a stream course or meadow system.

Rule Set: (Refer to: A User Guide to Assessing Proper Functioning condition and the supporting science for Lotic Areas, BLM 1998, TR 1737-15, pgs. 35-46.). Use the following riparian vegetation attribute questions to guide your evaluation of the existing condition of riparian vegetation in the watershed:

1. Is there diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)?
2. Is there diverse composition of riparian-wetland vegetation (for maintenance/recovery)?
3. Are species present that indicate maintenance of riparian-wetland soil moisture characteristics?
4. Is streambank vegetation comprised of those plants of plant communities that have root masses capable of withstanding high stream flow events?
5. Do riparian-wetland plants exhibit high vigor?
6. Is adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows?
7. Are plant communities and adequate source of coarse and/or large woody material (for maintenance/recovery)?

(8) Stream Channel Condition -- (Professional Judgment Indicator)

Rating	Definition
Impaired	Response reaches: Vegetative bank protection is sparse, shallow rooted, and largely maintained in an early seral stage, not reflecting the sites potential. Channel width to depth ratios have increased from historic conditions (generally greater than 25). The size and extent of gullied sections of channel are currently increasing or have increased recently. Braiding is common. Transport reaches: Twenty percent or more of the stream system displays some form of instability and/or vulnerability. Instability is observed during most years, with marked increases following large flow events. Degradation and/or aggradation are evident due to unstable streambed and banks. Streambanks show recent erosion along more than 50% of the channel. Stream substrate displays widespread mobilization with most particle sizes unsorted. Source reaches: Debris torrents occur frequently, they are commonly linked to anthropogenic disturbances and occur at rates several times greater than in comparable reference areas.
Functioning At-risk	Response reaches: Where site capability exists streamside vegetation is patchy. Where riparian vegetation is present channel width to depth and vertical stability are maintained. Reaches generally exhibit width to depth ratios greater than 15. Braiding is present, but not common. Transport reaches: Some reaches of channel instability exist with other sections vulnerable. Freshly mobilized substrate is evident with fine sediment deposition common in many pools and some spawning areas; overall, average grain size distribution is larger and better sorted than streams in low condition. Source reaches: Debris torrents that occur are occasionally tied to anthropogenic disturbances, however they also occur as part of the natural evolution of the landscape and are linked to geologic character and natural processes.
Properly Functioning	Response reaches: Streambanks are stable with a low vulnerability to become unstable. There are few signs of instability such as bare and exposed banks, cracking, or bank collapse. Streambank erosion occurs only on outside bends. Channels are vertically stable, with isolated locations of aggradation or degradation. Where site capability exists the streamside vegetation is vigorous, deep rooted, and diverse in age, structure, and composition. Channel widths to depth ratios match the sites potential. Braiding is uncommon. Transport reaches: Instances of channel instability are rare (<10%) and if observed occur primarily after large flow events. Freshly mobilized, well sorted substrates are over the head of bars or in pool tails. Source reaches: Debris torrents are infrequent yet do occur as part of the natural evolution of the landscape and are linked to geologic character and natural processes.

Definitions:

Response reaches -- Low gradient (generally <3%) transport limited channels in which significant morphologic adjustment occurs in response to increased sediment supply (Montgomery and Buffington 1993).
Transport reaches -- Moderate to high gradient (generally 3-30%) morphologically resilient. Supply limited channels that rapidly convey increased sediment inputs (Montgomery and Buffington 1993).
Source reaches -- Steep gradient (generally >30%) transport limited (due to limited flow) sediment storage sites that are subject to intermittent scour due to debris flows (colluvial) (Montgomery and Buffington 1993).

Rule Set: Relate existing conditions to historic conditions, site potential, and reference conditions. Document characteristics used to formulate rating. Consider floods and fires regardless of cause. Consider perennial and intermittent streams.

Items to Consider: Location of specific characteristics within the 5th field watershed.
Degree of influence each characteristic plays on overall watershed condition.

Available References: R5, SCI Protocol -Streambank stability definitions.
R5, SCI database and reports. Compare values of existing conditions to reference reach measurements.
Channel Classification, Prediction of Channel Response, and Assessment of Channel Condition (D. Montgomery and J. Buffington 1993).
Applied River Morphology (D. Rosgen 1996) Compare values of existing conditions to expected measurements by channel type.

(9) Native Aquatic Faunal Integrity -- (Professional Judgment Indicator)

Rating	Definition
Low Integrity	Native aquatic fauna are uncommon or absent within the watershed. Native aquatic fauna occur in less than half of their historic habitat within the watershed. Existing populations of native aquatic fauna exhibit significant simplification in species assemblage, trophic shifts, and/or are smaller than desired and possibly decreasing. Presence of exotic aquatic species indicates altered or impaired habitat conditions.
Altered	Native aquatic fauna are present in more than half of their historic habitat within the watershed. Species assemblage may exhibit minor alteration due to habitat impairment. Habitat conditions have the potential to support healthy and stable populations of native aquatic fauna. Presence of exotic aquatic species indicates altered or impaired habitat conditions.
High Integrity	Native aquatic fauna are present in most (>80%) of their historic habitat within the watershed. Existing habitat conditions are or have the potential to support healthy populations of native aquatic fauna. Species assemblage is consistent with historic potential. Presence of exotic aquatic species is not an indicator of altered or impaired habitat conditions.

Definitions:

Native Fauna -- Any faunal species endemic to a watershed.

Rule Set:

Avoid focus on single species.

Native aquatic Faunal Integrity is to be used as an indicator of habitat condition. For this reason presence of exotic aquatic species are used as an indicator of altered or impaired habitat conditions. Although exotic species can significantly affect native aquatic faunal integrity, intra-species interactions are not considered for this assessment of watershed condition. For this assessment consider if the presence of exotic species indicates poor habitat quality. For example, you note the presence of bluegill in an area that historically supported native rainbow trout, you find in your records that water temperatures and flow conditions are now favoring bluegill and are not providing suitable habitat conditions for trout. Your conclusion is that the habitat is in poor condition and presence of bluegill is an indicator of this condition.

In another example, consider a pond that historically supported California red-legged frogs but currently has bullfrogs. If the pond conditions are good and the pond has the potential to support California red-legged frogs if the bullfrogs were removed then the habitat is probably in good condition and the presence of bullfrogs is not an indicator of poor watershed or habitat conditions.

APPENDIX C

Region 5 Watershed Condition Assessment Worksheet

R5 Watershed Condition Assessment Worksheet			
Assessment Watershed Name			
Watershed Identifier			
Date of Evaluation			
Forest Contact		Forest	
Evaluation Team Members/Skills			

Quantitative Indicators	GIS Generated Rating	Professional Judgment Rating	Preferred Interdisciplinary Rating	Justification if Differs from GIS Generated Rating
Hydrology				
Soils				
Geology				

Professional Judgment Indicators	Professional Judgment Rating	Qualifier	1 = ranking based on infrequent or limited field observation 2 = frequent/long-term field observations, no/little data 3 = frequent/long-term field observations, data supported 4 = syntheses based upon formal Watershed Analysis Comment field:
Floodplain Conn.			
Water Quality			
Water Quantity			
Stream Corridor Vegetation			
Channel Stability			
Aquatic Integrity			

Integrated Condition Rating			
Provisional Condition Matrix	Professional Judgment Rating	Preferred Interdisciplinary Rating	Justification if Differs from GIS Generated Rating

Please use reverse side for additional comments/justification

R5 Watershed Condition Assessment Worksheet

% Designated Wilderness (circle 1)	0-25	26-50	51-75	76-100
Primary land uses (circle up to 3)	Harvest, grazing, wildfire, recreation, dams, mining, other_______			
Primary Watershed Impacts (list)				
Supports a Municipal Water Supply (Y / N)				
Are Primary Watershed Impacts Reversible using contemporary techniques?				

Additional Comments:

APPENDIX D

Regional Watershed Condition Support Team

A team of watershed and fisheries specialists was formed to coordinate development and application of the procedure for characterization of Region 5 NFS watersheds into condition classes. Their responsibilities include: development of the draft watershed condition assessment protocol, communicating the objectives of this project to internal and external partners, and guiding the reconnaissance survey of watersheds by Forest specialists. **The regional watershed condition process was prepared by the following Forest Service staff specialists:**

John Rector (co-leader)	Regional Hydrologist, Pacific Southwest Region, Vallejo, California.
Alan Olson (co-leader)	Forest Fisheries Biologist, Klamath National Forest, Yreka, California.
Polly Hays	Hydrologist, Pacific Southwest Region, Vallejo, California.
Mike Furniss	Forest Hydrologist, Six Rivers National Forest, Eureka, California.
Ken Roby	Zone Hydrologist, Lassen-Plumas National Forests, Quincy, California
Christine Mai	Forest Hydrologist, Eldorado National Forest, Placerville, California.
Ann Carlson	Forest Fisheries Biologist, Tahoe National Forest, Nevada City, California.
Earle Franks	Forest Hydrologist, Sierra National Forest, Clovis, California.
Jim O'Hare	Zone Soil Scientist, Angeles National Forest, Arcadia, California.
Sara Chubb	Forest Fisheries Biologist, Los Padres National Forest, Goleta, California.
Juan de la Fuente	Forest Geologist, Klamath National Forest, Yreka, California.
Tom Laurent	Forest Soil Scientist, Klamath National Forest, Yreka, California.
Don Elder	Geologist, Klamath National Forest, Yreka, California.
Richard Vandewater	GIS Specialist, Klamath National Forest, Yreka, California.
Mark Reichert	Hydrologist, Klamath National Forest, Yreka, California.

Additional project consultants include: Jerry DeGraff, Alan Smart, Neil Berg, Mark Smith, Abel Jasso, Ed Rose, Allen King, Anne Boyd, Alan Gallegos, Randy Sharp, Jim Demaagd, Gilbert Garcia, Fred Levitan, Vern McClean, Grdon Keller, and Leah McDougal.