EXECUTIVE SUMMARY

Watershed Analysis for Mendocino Redwood Company's Ownership in the Gualala River Watershed

This report presents the results of a watershed analysis performed by Mendocino Redwood Company (MRC) on their ownership in the Gualala River watershed. The MRC ownership in the Gualala River watershed is considered the Gualala watershed analysis unit[1] (WAU). This section presents a brief overview of the watershed and the watershed analysis process followed by MRC. More specific information is found in the individual modules of this report.

The Gualala River is on the 303(d) list as sediment impaired and a total maximum daily load (TMDL) has been developed for sediment reduction in the river (EPA, 2001). The Gualala River and its tributaries support populations of coho salmon and steelhead trout (only steelhead present within MRC lands), two fisheries of concern in northern California. For this reason MRC conducted a watershed analysis to assist in their efforts to reduce non-point source pollution, evaluate current and past land management practices and establish a baseline for monitoring of watershed conditions over time. The watershed analysis will also be used to identify needs for site-specific management planning and restoration in the watershed to reduce impacts to aquatic resources and potentially to improve fish and aquatic habitat conditions.

MRC's approach to the Gualala River watershed analysis was to perform resource assessments of mass wasting, surface and point source erosion (roads/skid trails), hydrology, fish habitat, riparian condition and stream channel condition. Mass wasting, riparian condition, and surface and point source erosion modules address the hillslope hazards. The fish habitat and stream channel condition modules address the vulnerability of aquatic resources. Prescriptions are developed to address the issues and processes identified in the watershed analysis. Finally, monitoring is suggested to determine the efficacy of the prescriptions to protect sensitive aquatic resources. The monitoring will provide the feedback for MRC's adaptive management approach to resource conservation.

RESULTS

Mass Wasting

A total of 160 shallow-seated landslides (debris slides, torrents, or flows) were identified and characterized in the Gualala WAU. A total of 34 deep-seated landslides (rock slides or earth flows) were mapped in the Gualala WAU. Of the 174 shallow-seated landslides in the Gualala WAU, 71 are determined to be road-associated. This is approximately 41% of the total number of shallow-seated landslides.

A total of 180,000 tons of mass wasting sediment delivery was estimated for the time period 1971-2000 in the Gualala WAU, equivalent to a per unit watershed area rate of 480 tons/sq. mi./yr. Of the total estimated amount, 73,000 tons (40% of total) occurred from 1971-1980, 51,500 tons (29% of total)

[1] The WAU is only MRC lands in the watershed.

occurred from 1981-1987, and 55,500 tons (31% of total) occurred in the 1988-2000 time period (Table ES-1).

For the Haupt Creek, Tobacco Creek, and Annapolis Falls Creek planning watersheds, sediment input from mass wasting was highest during the 1971-1980 period (Table ES-1). For the Flat Ridge Creek planning watershed, no mass wasting sediment input was observed within the 1981-1987 time period (no landslides were observed from aerial photos in the period). The highest overall sediment input from mass wasting occurred in the Tobacco Creek planning watershed. The higher sediment delivery appears to be due to a few very large landslides that contributed a high amount of sediment in the planning watershed. In particular, the highest sediment delivery estimate is for the Tobacco Creek planning watershed from 1971-1980, which is mainly attributed to a single very large debris slide.

Table ES-1. Mass Wasting Sediment Input by Planning Watershed for Gualala WAU. Data are Reported in Tons of Sediment Delivered.

Planning Watershed	1971-1980	1981-1987	1988-2000
Haupt Creek	9,000	6,000	2,000
Tobacco Creek	42,000	27,000	3,000
Annapolis Falls Creek	19,000	11,000	11,000
Flat Ridge Creek	3,000	0	27,000
Doty Creek	*	1500	4,500
Robinson Creek	*	6000	8,000
Total	73,000	51,500	55,500

*- Aerial photography not available

The landscape was partitioned into five Mass Wasting Map Units (MWMU) representing general areas of similar geomorphology, landslide processes, and sediment delivery potential for shallow-seated landslides (Map A-2). The mass wasting map unit with the highest sediment delivery is MWMU 1, inner gorge topography along low gradient watercourses; which is estimated to deliver 62% of the total sediment input for the Gualala WAU. Combining all streamside units (MWMU 1 and 2) would yield 65% of the total sediment input. MWMU 3 (steep dissected topography) and MWMU 4 (moderate gradient slopes) are estimated to both have delivered similar amounts 17% each. MWMU 4 is not appreciably lower than MWMU 3 for proportion of total sediment delivery however it does encompass almost four times more area. In addition, the majority of the MWMU 4 landslides are road associated, indicating that silvicultural hazards in this unit are low. No sediment delivery was observed in MWMU 5.

Surface and Point Erosion (Roads/Skid Trails)

It was determined that there are 99 miles of truck roads in the Gualala WAU (skid trails not included) this represented an average road density of 8.0 miles of road per square mile (Table ES-2). Road length, road surface area and contributing road area are highest in the Annapolis planning watershed (Table ES-2). Compared to Annapolis, the total amount of contributing road area is lower in the Flat Ridge Creek planning watershed, but proportionately Flat Ridge contributes a greater percent of road area on MRC land in the watershed.

Table ES-2. Road Surface Areas, Contributing Road Surface Areas, Road Lengths and Road Densities for the Gualala River WAU.

Planning Watershed	Road Surface Area (ac)	Road Contributing Area (ac)	Road Contributing Area/MRC Owned (%)	Road Length (miles)	Road Density (mi/sq mi)
Annapolis	90.3	4.7	0.15	46.6	9.4
Flat Ridge Creek	20.5	2.5	0.28	10.6	7.7
Haupt Creek	20.6	0.4	0.07	10.6	11.1
Tobacco Creek	46.9	3.1	0.13	24.2	6.6
Doty/ Robinson Creeks	13.1	0.4	0.04	6.8	4.6
Gualala River WAU Total	***191.5***	***11.1***	***0.14***	***98.7***	***8.0***

Roads within MRC's ownership of the Gualala River WAU are estimated to generate, on average, 400 tons/mi^2/yr of sediment from road-associated surface and point source erosion. Tobacco Creek and Flat Ridge Creek contribute the highest rate of sediment delivery, 800 and 500 tons/mi^2/yr respectively. The Annapolis planning watershed has a sediment delivery rate of 200 tons/mi^2/yr. Road erosion is approximately equally split between surface and point source erosion contributions.

Table ES-3. Road Associated Surface and Point Source Erosion Estimates by Planning Watershed for the Gualala River WAU (rounded to nearest 100 tons).

Planning Watershed	Total Road Assoc. Erosion (tons/yr)	MRC Owned Acres	Road Assoc. Erosion Rate (tons/mi^2/yr)	Surface Erosion Rate (tons/mi^2/yr)	Point source Erosion Rate (tons/mi^2/yr)
Annapolis	900	3154	200	100	100
Flat Ridge Creek	700	883	500	400	100
Haupt Creek	100	614	200	100	100
Tobacco Creek	2800	2335	800	200	600
Doty/Robinson Creeks	500	945	300	100	300
Gualala River WAU totals	**5000**	**7931**	**400**	**200**	**200**

A few high treatment immediacy point source erosion sites were identified in the Gualala River WAU. The road site numbers and road numbers are found on Map B-1. The road number, site number, amount controllable erosion and description of the site are in Table B-5 of the Surface and Point Source Erosion Module.

In the Gualala WAU skid trial yarding during the 1950s and 1960s produced a high level of sediment delivery. The sediment delivery estimated from skid trails in Annapolis, Tobacco Creek and Haupt Creek is by far the highest in the 1950s. Flat Ridge Creek had fairly high levels of sediment delivery during the 1950s, 1970s and 1980s. Of all four planning watersheds, Annapolis generally had the greatest skid trail sediment delivery rates. In the late 1970s and 1980s a change in skid trail design likewise changed sediment delivery rates. The Herringbone design abandoned the low-slope trail designs of earlier times and placed the trails along ridges and branched out down the slopes. This produced a significant drop in skid trail sediment delivery after this time period in the Gualala WAU.

Hydrology

Using the peak flow record from 1950-1970, the flood of record is 1955 (55,000 cfs) calculated to be greater than a 25 year event for the South Fork Gualala River. The second highest peak flow occurred in the 1965 water year, specifically December 1964. This is similar to most of the stream flow stations in the Mendocino and Sonoma County areas. Although this is a brief period of record, it suggests that the Gualala River has been subjected to similar storms and magnitude as other watersheds of the area. The high occurrence of these extreme storms suggests that the Gualala River WAU has been subjected to stressful hydrologic conditions and can be assumed to be a major contributor to the erosion and mass wasting delivered to the watercourses in the WAU.

Riparian Function

The riparian function assessment is divided into two groups: 1) the potential of the riparian stand to recruit large woody debris (LWD) to the stream channel along with the level of concern about current LWD conditions in the stream, and 2) a canopy closure and stream temperature assessment.
Our analysis showed a need for large woody debris in most of the channel segments of the Gualala WAU due to past stream clearing, historic harvest and low riparian recruitment potentials. Channel segments with LWD levels that are well below targets will need to be a priority for future recruitment and restoration work. Riparian LWD recruitment potential in the Gualala WAU is moderate to low. Currently, the majority of the streams have a deficient LWD quality rating, with the remainder being marginal. None of the major streams in the Gualala WAU received an on target LWD quality rating.

Stream temperatures in the Gualala WAU are on the high end of tolerance for salmonids. Instantaneous maximum temperature recorded in Fuller Creek and the Wheatfield Fork is higher than the preferred temperature range for salmonids. Temperature values for Annapolis Falls Creek and Crocker Creek are at the high end for coho salmon, but within a reasonable range tolerated by steelhead. Canopy cover over the stream is low in a few tributaries in the Gualala WAU. Currently several stream segments have deficient stream shade quality ratings, with several being marginal and only one segment being on target. Improvement in stream canopy closure should result in lowering of stream water temperatures.

Stream Channel Condition

Baseline information on the stream channels of the Gualala WAU was collected and reported (see Stream Channel Condition module). Individual channel segments were categorized into geomorphic units using the baseline stream channel information, topography the channel segments are found in, position in the drainage network, and gradient/confinement classes. Four stream geomorphic units were established to represent the range of channel conditions and sensitivities to input factors of coarse and fine sediment and LWD (Table ES-4).

Table ES-4. Stream Geomorphic Units and Sensitivities for the Gualala WAU.

	Channel Sensitivity		
Stream Geomorphic Unit	**Coarse Sediment**	**Fine Sediment**	**LWD**
Geomorphic Unit I. Low Gradient, Confined Channel of the Wheatfield Fork, Gualala River.	Moderate	Moderate	Low
Geomorphic Unit II. Confined and Moderately Confined Low Gradient Channel Segments.	High	Moderate	High
Geomorphic Unit III. Moderate Gradient Confined Transport Segments.	Moderate	Low	Moderate
Geomorphic Unit IV. High Gradient Transport Segments.	Low	Low	Moderate

Fish Habitat Assessment

The fish species currently inhabiting the Gualala River WAU are steelhead trout (*Oncorhynchus mykiss*), sculpin (*Cottus spp.*), threespine stickleback (*Gasterosteus aculeatus*), California roach (*Lavinia symmetricus*), and Pacific lamprey (*Lampetra tridentata*). In 1973, the spawning population of coho in the Gualala River watershed was estimated at 4,000 fish (Bureau of Reclamation, 1973). Hatchery fish have been planted extensively in the basin; however it appears that coho are not currently present within the Gualala WAU.

Habitat typing data indicated that spawning, rearing and over-wintering habitat was fair throughout most of the Gualala WAU. Throughout most of the Gualala WAU, habitat is limited by a lack of large woody debris and embedded spawning gravels from sediment. Land management activities that promote woody debris recruitment and reduce erosion should directly increase the quality of habitat in the Gualala WAU.

Sediment Input Summary

The average estimated sediment input for the past thirty years for the Gualala WAU is 900 tons/square mile/year. The inputs in the Gualala WAU over the last 30 years have come from mass wasting (54%), surface and point source erosion (40%) and to a lesser extent skid trail erosion (6%). The greatest amount of sediment inputs is estimated to be from the Tobacco Creek and Flat Ridge Creek planning watersheds.

Road associated erosion is the dominant sediment contributing process in the Gualala WAU. The road associated mass wasting, surface and point source erosion combined accounts for 57% of the estimated sediment inputs in the Gualala WAU. Mass wasting from roads and hillslopes combined accounts for 54% of the sediment inputs in the Gualala WAU.

Land Management Prescriptions

The following prescriptions were specifically prepared for use in the Gualala WAU. These prescriptions are meant to help address issues to aid in the stewardship of aquatic resources of the Mendocino Redwood Company ownership in the Gualala WAU. The prescriptions are meant to be used in addition to the current California Forest Practice Rules and company policies. At the time of the publication of this watershed analysis MRC's forest management policies are governed by interim guidelines prior to the issuance of a Habitat Conservation Plan and Natural Community Conservation Plan (HCP/NCCP). Once the HCP/NCCP is approved, the conservation strategies set forth in these documents will become the company policies. A prescription is only presented if it deviates from or adds clarification to these policies.

Mass Wasting

Mass wasting map unit 1 – Inner gorge or steep streamside slopes adjacent to low gradient watercourses

MWMU 1 Road construction:

- If inner gorge topography, no new road or landing construction unless field reviewed and approved by a California Registered Geologist. If not inner gorge topography, road construction shall be minimized. If road construction must occur, the road must utilize the highest design standards to lower risk of mass wasting sediment delivery.

MWMU 1 Existing Roads:

- Existing roads and landings shall be abandoned when no longer needed. If abandoning is not feasible, then roads or landings shall be maintained at the design standards that lower risk of mass wasting sediment delivery.

MWMU 1 Tractor Yarding:

- Equipment exclusion zones on inner gorge slopes. Equipment exclusion zones on non-inner gorge slopes except for existing roads or where alternative yarding method creates potential for greater sediment delivery.

MWMU 1 Skid Trail Construction or Reconstruction:

- No new tractor trail construction on inner gorge slopes, no new tractor trail construction or reconstruction on non-inner gorge slopes unless field reviewed and approved by a California Registered Geologist.

MWMU 1 timber harvest:

- MWMU 1 will receive no harvest on inner gorge slopes unless approved by a California Registered Geologist. On other areas (non-inner gorge slopes) within MWMU 1, in addition to the riparian protections set as company policy, timber harvest must retain a minimum of 50% overstory canopy dispersed evenly across the slopes.
    - The MWMU 1 protections will extend from the edge of the watercourse transition line up to the break in slope of the inner gorge and 25 feet of additional slope distance after the break in slope of the inner gorge.
    - For those areas that do not have well defined inner gorge topography in MWMU 1 timber harvest must retain 50% canopy[2].

Mass wasting map unit 2 – Inner gorge or steep streamside slopes adjacent to moderate to high gradient watercourses

MWMU 2 Road construction:

- If inner gorge topography, no new road or landing construction unless field reviewed and approved by a California Registered Geologist. If not inner gorge topography, road construction shall be minimized. If road construction must occur, the road must utilize the highest design standards to lower risk of mass wasting sediment delivery.

MWMU 2 Existing Roads:

- Existing roads and landings shall be abandoned when no longer needed. If abandoning is not feasible, then roads or landings shall be maintained at the design standards that lower risk of mass wasting sediment delivery.

MWMU 2 Tractor Yarding:

- Equipment exclusion zones on inner gorge slopes. Equipment exclusion zones on non-inner gorge slopes except for existing roads or where alternative yarding method creates potential for greater sediment delivery.

[2] Only trees greater than 30 feet in height count towards canopy measurement.

MWMU 2 Skid Trail Construction or Reconstruction:

- No new tractor trail construction on inner gorge slopes, no new tractor trail construction or reconstruction on non-inner gorge slopes unless field reviewed and approved by a California Registered Geologist.

MWMU 2 Timber Harvest:

- No harvest on inner gorge slopes unless approved by a California Registered Geologist. On other areas (non-inner gorge slopes) within MWMU 1, in addition to the riparian protections set as company policy, timber harvest must retain a minimum of 50% canopy (see footnote 1, page H-2) dispersed evenly across the slopes.
    - The MWMU 1 protections will extend from the edge of the watercourse transition line up to the break in slope of the inner gorge and 25 feet of additional slope distance after the break in slope of the inner gorge.
    - For those areas that do not have well defined inner gorge topography in MWMU 1 timber harvest must retain 50% canopy.

Mass wasting map unit 3 – Steep dissected terrain

MWMU 3 Road construction:

- No new road construction across MWMU 3 unless field reviewed and approved by a California Registered Geologist unless it is the best road alternative[3].

MWMU 3 Existing Roads:

- Existing roads and landings shall be abandoned when no longer needed. If abandoning is not feasible, then roads or landings shall be maintained at the design standards that lower risk of mass wasting sediment delivery.

MWMU 3 Tractor Yarding:

- Equipment limited to existing roads or stable trails[4].

MWMU 3 Skid Trail Construction or Reconstruction:

- No new tractor trail construction or reconstruction unless field reviewed and approved by a California Registered Geologist.

MWMU 3 Timber Harvest:

- Retain 50% canopy with trees dispersed evenly across slope. Tree retention shall be emphasized in the axis of headwall swales. Deviations from this default must be field reviewed and approved by a California Registered Geologist.

Rockslides

No harvest or new road construction will occur on active portions of rockslides with a risk for sediment delivery unless approved by a California Registered Geologist.

[3] Best road alternative – the placement has a lower potential for sediment production and greater cost effectiveness.
[4] Stable trail – skid trail that has >85% of trail's tread intact, fill cracks or settling can have occurred provided the trail is still 85% intact and can have corrective action such that the trail presents little risk of future sediment delivery after use. Cut bank slumps can occur on stable trails, however, the slump cannot be removed if it buttresses failure of upslope soils, soils from slump must be either removed or retained in trail prism if trail is used.

Roads

The road segments adjacent to Crocker Creek (97-MS; 97-MS-012) and Fuller Creek downstream of Sullivan Creek (97-FC) will be examined for future harvest needs. If it is determined the roads are not needed for future harvest activity they will be decommissioned.

If the roads are determined to be needed for future harvest activity these road segments will be a high priority for erosion control work and maintenance. Rocking of the road surface should be considered on high use segments.

High and Moderate Erosion Hazard Roads

The roads with a high erosion hazard rating should be given special attention for maintenance or erosion control. These roads should be considered high priority roads for rock surface, improved and increased road drainage relief, design upgrades or decommissioning.

The moderate erosion hazard roads should be given similar attention, but not as high a priority as the high erosion hazard roads.

Known high treatment immediacy sites for roads in the Gualala WAU

The high treatment immediacy controllable erosion sites will be the highest priority for erosion control, upgrade, or modifications to existing design. These sites will be scheduled for repair based on operational considerations of harvest scheduling, proximity and availability of equipment, magnitude of the problem, and accessibility to the site.

Riparian

Large woody debris recruitment

The company policies for streamside stand retention are considered to be appropriate at this time for LWD recruitment. Monitoring of LWD recruitment will be done to determine if this is correct.

In the interim MRC will promote attempts to place LWD in stream channels to provide habitat structure. The stream locations with high instream LWD demand should be considered the highest priority for LWD placement. The moderate instream LWD demand segments would be next.

When planning for instream LWD placement the following major streams in the Gualala WAU are recommended for a higher level of consideration, due to instream LWD demands and coho salmon habitat improvement:

- Fuller Creek
- Haupt Creek
- Annapolis Falls Creek

Stream Shade

The company policies for promoting streamside canopy and riparian management are considered to be appropriate at this time to improve stream canopy. Monitoring of stream temperatures and canopy will be done to determine if this is correct.

The 3 stream reaches with unnaturally low canopy, the lower reach of Fuller Creek, the lower reach of Haupt Creek, and an upper reach of Tobacco Creek will have the following considerations for canopy improvement:

- Tree planting along the river for restoration of riparian vegetation should be emphasized.
- Restoration harvest within the AMZ will not remove trees providing effective shade.
- Stream temperatures will be monitored to determine if temperatures are lowering as canopy grows in over time.

Monitoring

Aquatic resources monitoring will be conducted in the Gualala WAU. This monitoring is to assist Mendocino Redwood Company to assess impacts to aquatic resources associated with past or future timber harvest and related forest management activities in the Gualala WAU. The monitoring suggested in this plan is monitoring that MRC conducts across all its lands including the Gualala WAU. However, other monitoring efforts not mentioned here may be conducted by MRC in the Gualala WAU. Currently a comprehensive monitoring plan is being developed for the MRC lands. Once that plan is finalized it will supercede the monitoring presented here.

Monitoring Plan Goals:

- Test the efficacy of the Gualala WAU prescriptions to address impacts to aquatic resources from timber harvest and related forest management activities.
- To assess long term channel conditions. Are current and future forest management practices inhibiting, neutralizing or promoting stream channel conditions for aquatic habitat?

A monitoring report will be produced each year that monitoring is conducted in the Gualala WAU. The report will cover the monitoring and analysis that has occurred up to that year; if no monitoring is conducted in a given year than no report will be produced. The goal will be to have a report completed by February of the year following the monitoring. Table ES-5 summarizes some of the monitoring to be conducted in the Gualala WAU over time.

Table ES-5. Monitoring Matrix for Mendocino Redwood Company Lands Including the Gualala Watershed Analysis Unit.

Monitoring Objectives	**Reasoning, Comments**	**Technique**
1. Determine effectiveness of measures to reduce management created mass wasting.	Management created mass wasting is significant contributor of sediment delivery.	Evaluation of mass wasting following a large storm event or after approximately 20 years.
2. Determine effectiveness of erosion control practices on high and moderate surface erosion hazard roads and landings.	Roads provide sediment delivery in the Gualala WAU.	Evaluation of watercourse crossings, landings, and road lengths for erosion evaluation.
3. Determine in-stream large woody debris amounts over time.	Large woody debris is needed for stream channel and aquatic habitat improvement in the Gualala WAU.	Stream LWD inventories and mapping of LWD designation areas in select stream reaches and long term channel monitoring sites.
4. Determine if stream temperatures are staying within properly functioning range for salmonids.	Stream temperature can be a limiting factor for salmonid growth and survival.	Stream temperature probes and assessment conducted in strategic locations.
5. Determine if fine sediment in stream channels is creating effects deleterious to salmonid reproduction.	Many forest practices can produce high fine sediment amounts. Need to ensure fine sediments are not impacting salmonid reproduction.	Permeability measurements on select stream reaches (bulk gravel samples if necessary).
6. Determine long-term channel morphology changes from coarse sediments.	Channel morphology can be altered from sediment increases, possibly affecting aquatic habitat.	Thalweg profiles and cross section surveys on select stream reaches.
7. Determine presence and absence of fish species in Class I watercourses.	Management practices and resource protections can affect distribution of aquatic organisms.	Electro-fishing and snorkeling observations at select locations to determine species composition and presence.