

EXECUTIVE SUMMARY

Watershed Analysis for Mendocino Redwood Company's Ownership in the Elk Creek Watershed

This report presents the results of a watershed analysis performed by Mendocino Redwood Company (MRC) on their ownership¹ in the Elk Creek watershed. The MRC ownership in the Elk Creek watershed is considered the Elk watershed analysis unit (WAU). This section presents a brief overview of results from the watershed analysis performed by MRC. More specific information is found in the individual modules of this report.

Elk Creek and its tributaries support populations of steelhead trout and coho salmon, which are listed as threatened and endangered fisheries, respectively, for the Central California Coast region. 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 Elk Creek watershed analysis was to perform resource assessments of mass wasting, surface and point source erosion (roads/skid trails), hydrology, fish habitat, amphibian distribution, riparian condition and stream channel condition. Mass wasting, riparian condition and surface and point source erosion modules address the hillslope hazards. The fish habitat, amphibian distribution, 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 399 shallow-seated landslides (debris slides, torrents, or flows) were identified and characterized in the Elk Creek WAU. A total of 68 deep-seated landslides (all rockslides) were mapped in the Elk Creek WAU. Of the 399 shallow-seated landslides in the Elk Creek WAU, 237 are determined to be road associated (includes roads, skid trails, or landings). This is approximately 60% of the total number of shallow-seated landslides. There were 6 debris torrents and 34 debris flows observed in the Elk Creek WAU. This is approximately 10% of the total shallow-seated landslides observed in the Elk Creek WAU. Approximately 27% (106/399) of the identified shallow-seated landslides were field verified. Of the 106 field observed shallow-seated landslides, 88% (93/106) were initiated on slopes of 70% gradient or higher.

¹ It must be emphasized that only the Mendocino Redwood Company ownership is analyzed.

A total of approximately 447,672 tons of mass wasting sediment delivery was estimated for the time period 1938-2004 in the Elk Creek WAU. This equates to approximately 305 tons/sq. mi./yr. Of the total estimated amount, 31% delivered from 1938-1947, 6% delivered from 1948-1964, 26% delivered from 1965-1967, 14% delivered from 1968-1978, 14% delivered from 1979-1987, 7% delivered from 1988-2000, and 2% delivered in the 2001-2004 time period. Road associated mass wasting (including roads, skid trails, and landings) was found to have contributed 191,744 tons (131 tons/sq. mi./yr) of sediment over the 67 years analyzed in the Elk Creek WAU. This represents approximately 43% of the total mass wasting inputs for the Elk Creek WAU for 1938-2004.

The landscape was partitioned into five Terrain Stability Units (TSU) representing general areas of similar geomorphology, landslide processes, and sediment delivery potential for shallow-seated landslides (Map A-2). The TSU with the largest estimated sediment delivery is TSU 3, which is estimated to deliver 29% of the total sediment input for the Elk Creek WAU. Combining all high hazard units (TSU 1, 2, 3, and 6) would yield 86% of the estimated non-road related sediment input of approximately 24% of the MRC owned acreage. Combining the moderate and low hazard units (TSU 4, 5, and 8) would yield 14% of the estimated non-road related sediment input off the remaining 76% of the property.

Surface and Point Erosion (Roads/Skid Trails)

It was determined that there are currently 131 miles of truck roads in the Elk WAU (skid trails not included). This represented an average road density of 7 miles of road per square mile. Approximately 50 miles of road contributes surface erosion to watercourses (defined as contributing road length). This represents approximately 38% of the total road length in the Elk WAU.

Roads in the Elk WAU are estimated to generate, on average, 232 tons/mi²/yr of sediment from road-associated surface and point source erosion (Table ES-1).

Table ES-1. Road Associated Surface and Point Source Erosion Estimates by Planning Watershed for the Elk WAU.

Planning Watershed	MRC Owned (sq mi)	Surface Erosion (tons/sq mi/yr)	Point Source Erosion (tons/sq mi/yr)	Total (surface +point source) (tons/sq mi/yr)
Upper Elk Creek	7.6	42	267	309
Lower Elk Creek	14.4	22	170	191
<i>Elk Creek WAU</i>	<i>22</i>	<i>29⁺</i>	<i>204⁺</i>	<i>232⁺</i>

⁺Area-weighted average

The future potential for point source erosion was evaluated in the Elk WAU. This potential erosion or controllable erosion was identified during the road inventory during 2005. A total of 17,876 cubic yards of controllable erosion (Table ES-2) is currently on the road network in the Elk WAU. Since 1998, when the company was formed, 26,900 cubic yards of erosion from the road network has been controlled. This represents an improvement of 60% of the total controllable erosion within the last 7 years.

Table ES-2. Controllable Erosion by Treatment Immediacy for the Elk WAU.

Location	Controllable Erosion Treatment Immediacy (yd ³)			
	High	Moderate	Low	None
Culverts	2155	210	10245	0
Crossings	0	30	3009	2
Landings	0	590	1036	0
Erosion Features	0	10	241	0
Road slides	80	50	218	0
Total	2235	890	14749	2

The Elk WAU was evaluated for skid trail sediment delivery from the 1940s to 2000. The greatest sediment delivery from skid trails occurred during the 1960s and the 1970s (roughly 170 tons/mi²/yr) with the majority of activity occurring in the Lower Elk Creek planning watershed.

Hydrology

Using the peak flow record from the Navarro River (near Navarro) 1951-2005, the flood of record was in December 1956 (64,500 cfs) and is considered to be a little more than a 50 year event. This suggests that the Elk WAU has been subjected to stressful hydrologic conditions, possibly creating a greater incidence of landslides, road failures or surface erosion.

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 Elk WAU due to low instream LWD 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 Elk WAU is moderate to low. The majority of the LWD in Elk consists of older redwood logs.

The Elk WAU generally has favorable stream shade conditions as demonstrated by the stream shade ratings. The Lower Elk Creek planning watershed was rated on-target for stream shading. It is anticipated that over time with policies promoting stream shade these ratings will improve. There are no “deficient” stream shade quality ratings in the Elk WAU due to the fact that greater than 70% of each segment observed had greater than 70% canopy.

Stream temperatures in the Elk WAU are above the range preferred by steelhead trout and coho salmon. Instantaneous maximum temperatures recorded at all sites typically do not exceed the maximum lethal ranges for coho salmon (23C^o) and steelhead trout (26C^o) but maximum weekly average temperatures (MWAT) were above the desirable level of 15C^o.

Stream Channel Condition

Baseline information on the stream channels of the Elk WAU was collected and reported (see Module E 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-3). Long term channel monitoring observations have been collected on one

monitoring segment in the Elk WAU in 2004. The results for these observations are presented in the Stream Channel Condition module.

Table ES-3. Stream Geomorphic Units and Sensitivities for the Elk WAU.

Stream Geomorphic Unit	Channel Sensitivity		
	Coarse Sediment	Fine Sediment	LWD
Geomorphic Unit I. Confined Low Gradient Channels.	Moderate	Moderate	High
Geomorphic Unit II. Low Gradient Confined to Moderately Confined Transport Channels.	Moderate	Moderate	High
Geomorphic Unit III. Moderate Gradient Confined Transport Channels	Moderate	Moderate	Moderate
Geomorphic Unit IV. High Gradient Transport Channels.	Low	Low	Low

Fish Habitat Assessment

The anadromous fish species inhabiting the Elk WAU are steelhead trout (*Oncorhynchus mykiss*) and coho salmon (*Oncorhynchus kisutch*). Other fish and amphibian species include three-spine stickleback (*Gasterosteus aculeatus*), prickly sculpin (*Cottus asper*), coastrange sculpin (*C. aleuticus*), Pacific lamprey (*Lampetra tridentata*), Pacific giant salamander (*Dicamptodon tenebrosus*), tailed frog (*Ascaphus truei*), red-legged frogs (*Rana aurora*), yellow-legged frogs (*Rana boylei*), southern torrent salamander (*Rhyacotriton variegatus*), and tarichid newts (*Taricha spp*).

Habitat typing data indicated that spawning habitat was generally fair throughout most of the Elk WAU. However, substrate sampling indicated gravels with lower than desirable permeability levels. Reduction of erosion rates should increase the quality of spawning gravel in the Elk WAU. Throughout most of the Elk WAU, summer rearing and over-wintering habitat were rated as fair. Land management activities that promote woody debris recruitment and sediment reduction should directly increase the quality of rearing habitat in the Elk WAU.

Amphibian Distribution

The amphibian species detected in the Elk WAU represent two of the four species having geographical ranges in the area. The two detected amphibious ‘Species of Special Concern’ (as designated by the State of California) are tailed frogs (*Ascaphus truei*) and southern torrent salamanders (*Rhyacotriton variegatus*). Aquatic habitat types have remained functional in the Elk WAU to support these species which have been extirpated both locally and regionally. Insufficient breeding habitat for the other ‘Species of Special Concern’ red-legged frogs (*Rana aurora*) and foothill yellow-legged frogs (*Rana boylei*) may explain their absence in the Elk WAU. To date, the results of MRC’s amphibian distribution studies have only detected one other watershed within MRC’s ownership where all four ‘concern species’ were present (Albion River).

Synthesis

The habitat quality ratings and sediment input summaries show that large woody debris and road associated sediment have the most significant need for improvement. Stream temperature conditions in Elk are also not at a desirable level for steelhead and coho, but canopy conditions are favorable. Currently MRC has made good strides toward controlling road sediment in Elk, but treatment of controllable erosion sites is yet to be evaluated since the initial road inventory of Elk was also conducted in 2005. Long-term monitoring data in Upper Elk is in it’s infancy since 2005 was the first year that this

type of monitoring was conducted, but initial data suggests that large woody debris levels are low and fine sediment deposition levels are acceptable. Conditions in Lower Elk have not improved substantially since the original survey completed in 2000. These segments will be monitored at least every 10 years to track any changes in conditions.

Land Management Prescriptions

The following prescriptions were specifically prepared for use in the Elk 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 Elk 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

Terrain stability unit 1 – Inner gorge or steep streamside slopes adjacent to low gradient watercourses

Where there is inner gorge within TSU 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.

TSU 1 Road construction:

- No new road or landing construction unless field reviewed and approved by a California Professional Geologist.

TSU 1 Existing Roads:

- Roads or landings shall be maintained at the design standards that lower risk of mass wasting sediment delivery. Existing roads and landings within TSU 1 should be considered for abandonment if no longer needed.

TSU 1 Tractor Yarding:

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

TSU 1 Skid Trail Construction or Reconstruction:

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

TSU 1 Timber Harvest:

- TSU 1 will receive no harvest on inner gorge slopes unless approved by a California Professional Geologist. On steep streamside slopes within TSU 1, in addition to the riparian protections set as company policy, timber harvest must retain a minimum of 50% canopy² dispersed evenly across the slopes.

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

Terrain stability unit 2 – Inner gorge or steep streamside slopes adjacent to moderate to high gradient watercourses

Where there is inner gorge within TSU 2 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.

TSU 2 Road construction:

- If inner gorge topography, no new road or landing construction unless field reviewed and approved by a California Professional Geologist. If steep streamside slope 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.

TSU 2 Existing Roads:

- Roads or landings shall be maintained at the design standards that lower risk of mass wasting sediment delivery. Existing roads and landings within TSU 2 should be considered for abandonment if no longer needed.

TSU 2 Tractor Yarding:

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

TSU 2 Skid Trail Construction or Reconstruction:

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

TSU 2 Timber Harvest:

- No harvest on inner gorge slopes unless approved by a California Professional Geologist. On steep streamside slopes within TSU 2, in addition to the riparian protections set as company policy, timber harvest must retain a minimum of 50% canopy (see footnote 2) dispersed evenly across the slopes.

Terrain stability unit 3 – Steep dissected terrain

This area is characterized primarily by 1) steep convergent and dissected topography located within steep gradient colluvial hollows or headwall swales and small high gradient watercourses, and 2) locally steep planar slopes where there is strong evidence of past landsliding. Please see the mass wasting module for the full definition.

TSU 3 Road construction:

- No new road construction across TSU 3 unless field reviewed and approved by a California Professional Geologist unless it is the best road alternative³.

TSU 3 Existing Roads:

- Roads or landings shall be maintained at the design standards that lower risk of mass wasting sediment delivery. Existing roads and landings within TSU 3 should be considered for abandonment if no longer needed.

³ Best road alternative – the placement has a lower potential for sediment production and greater cost effectiveness.

TSU 3 Tractor Yarding:

- Equipment limited to existing roads or stable trails⁴.

TSU 3 Skid Trail Construction or Reconstruction:

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

TSU 3 Timber Harvest:

- Retain 50% canopy (see footnote 2, page v) 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 Professional 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 Professional Geologist.

Roads*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.

High and moderate treatment immediacy sites for roads in the Elk 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.

The moderate treatment immediacy controllable erosion sites will be the next highest priority (relative to the high treatment immediacy sites) for erosion control, upgrade, or modifications to existing design. The moderate treatment immediacy sites will typically be addressed when in close proximity to high treatment immediacy sites.

Potential Road Work

Three road segments in Elk Creek have been identified as potential candidates for decommissioning. These segments include roads 47-CC (South Fork Elk near Kimball Creek), 47-PH-005 (south of Honky Tonk picnic area) and 47-G4 (Middle Fork Elk). A detailed field evaluation of these segments will be required in order to determine whether or not decommissioning is appropriate.

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.

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.

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.

Monitoring

Aquatic resources monitoring will be conducted in the Elk 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 Elk WAU. The monitoring suggested in this plan is monitoring that MRC does across all its lands including the Elk WAU. However, other monitoring efforts not mentioned here may be conducted by MRC in the Elk 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 Elk 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 Elk 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. Table ES-4 summarizes some of the monitoring to be conducted in the Elk WAU over time.

Table ES-4. Monitoring Matrix for Mendocino Redwood Company Lands Including the Elk 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 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 Elk 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 Elk 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.