EXECUTIVE SUMMARY

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

This report presents the results of a watershed analysis performed by Mendocino Redwood Company (MRC) on their ownership[1] in the Cottaneva Creek watershed. The MRC ownership in the Cottaneva Creek watershed is considered the Cottaneva 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.

Cottaneva 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 Cottaneva 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 164 shallow-seated landslides (debris slides, torrents, or flows) were identified and characterized in the Cottaneva Creek WAU. A total of 26 deep-seated landslides (all rockslides) were mapped in the Cottaneva Creek WAU. Of the 164 shallow-seated landslides in the Cottaneva Creek WAU, 111 are determined to be road associated (includes roads, skid trails, or landings). This is approximately 68% of the total number of shallow-seated landslides. There were 0 debris torrents and 27 debris flows observed in the Cottaneva Creek WAU. This is approximately 16% of the total shallow-seated landslides observed in the Cottaneva Creek WAU. Of the 63 field observed shallow-seated landslides, 100 % were initiated on slopes of 65% gradient or higher.

A total of approximately 235,800 tons of mass wasting sediment delivery was estimated for the time period 1943-2000 in the Cottaneva Creek WAU. This equates to approximately 321 tons/sq. mi./yr. Of

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

the total estimated amount, 22% delivered from 1943-1952, 9% delivered from 1953-1963, 26% from 1964-1978, 38% from 1979-1990, and 5% delivered in the 1991-2000 time period. Road associated mass wasting (including roads, skid trails, and landings) was found to have contributed 112,700 tons (153 tons/sq. mi./yr) of sediment over the 58 years analyzed in the Cottaneva Creek WAU. This represents approximately 48% of the total mass wasting inputs for the Cottaneva Creek WAU for 1943-2000.

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 1, which is estimated to deliver 47% of the total sediment inputs for the Cottaneva Creek WAU. This is mainly due to the large slide in Rockport Creek which delivered a disproportionately large mass of sediment. Combining all high hazard units (TSU 1, 2, and 3) would yield 92% of the estimated non-road related sediment input off approximately 18% of the MRC owned acreage. Combining the moderate and low hazard units (TSU 4 and 5) would yield 8% of the estimated non-road related sediment input off the remaining 82% of the property.

Surface and Point Erosion (Roads/Skid Trails)

It was determined that there are currently 106 miles of truck roads in the Cottaneva WAU (skid trails not included). This represented an average road density of 8.5 miles of road per square mile. Approximately 15 miles of road contributes surface erosion to watercourses (defined as contributing road length). This represents approximately 14% of the total road length in the Cottaneva WAU.

Roads in the Cottaneva WAU are estimated to generate, on average, 887 tons/mi^2/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 Cottaneva 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)
Cottaneva Creek	12.4[a]	341	546	887

[a]Sum of property ownership within the Cottaneva Creek Planning Watershed

The future potential for point source erosion was evaluated in the Cottaneva WAU. This potential erosion or controllable erosion was identified during the road inventory during 2004. A total of 27,300 cubic yards of controllable erosion (Table ES-2) is currently on the road network in the Cottaneva WAU. Since 1998, when the company was formed, 4,330 cubic yards of erosion from the road network has been controlled. This represents an improvement of 14% of the total controllable erosion within the last 5 years.

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

Location	Controllable Erosion Treatment Immediacy (yd^3)			
	High	**Moderate**	**Low**	**Undetermined**
Culverts	6351	1081	10325	0
Crossings	0	130	5696	0
Landings	0	500	1112	0
Erosion Features	0	0	1085	0
Road slides	0	0	1020	0
Total	***6351***	***1711***	***19238***	***0***

The Cottaneva WAU was evaluated for skid trail sediment delivery from the 1940s to 2000. The greatest sediment delivery from skid trails occurred during the 1940s, 1960s and then in the 1970s (all were roughly 70 tons of sediment per square mile per year). The 1950s represented the lowest sediment delivery (10 tons of sediment per square mile per year).

Hydrology

Using the peak flow record from the South Fork Eel River at Leggett 1965-2003, the flood of record was in December 1964 (78,700 cfs) and is considered to be almost a 100 year event (Table C-1). The recent time period, from the 1990's onward, has seen several large stream flow events though none of these events have been higher than a five year return interval. This suggests that the Cottaneva 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 Cottaneva 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 Cottaneva WAU is moderate to low. The majority of the LWD in Cottaneva consists of older redwood logs.

The Cottaneva WAU generally has less-than favorable stream shade conditions as demonstrated by the stream shade ratings. All of the larger streams rated have a "marginal" stream shade rating. 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 Cottaneva WAU due to the fact that greater than 70% of each segment observed had greater than 70% canopy.

Stream temperatures in the Cottaneva WAU are well within a 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 ($26C^o$) and maximum weekly average temperatures (MWAT) were near the desirable level of $15C^o$, even though canopy levels are rated as marginal.

Stream Channel Condition

Baseline information on the stream channels of the Cottaneva 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 Cottaneva 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 Cottaneva WAU.

	Channel Sensitivity		
Stream Geomorphic Unit	**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 Cottaneva WAU are steelhead trout (*Oncorhynchus mykiss)* and coho salmon (*Oncorhynchus kisutch*). Other species include three-spine stickleback *(Gasterosteus aculeatus),* prickly sculpin *(Cottus asper),* coastrange sculpin *(C. aleuticus),* California roach *(Lavinia symmetricus).*

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

Amphibian Distribution

The amphibian species detected in the Cottaneva 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 Cottaneva 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 boylii*) may explain their absence in the Cottaneva 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 Cottaneva are at an acceptable level for steelhead and coho, but canopy conditions could be improved. Currently MRC has made good strides toward controlling road sediment in Cottaneva, but treatment of controllable erosion sites is yet to be evaluated since the initial road inventory of Cottaneva was also

conducted in 2004. Long-term monitoring data in Cottaneva is in it's infancy since 2004 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.

Land Management Prescriptions

The following prescriptions were specifically prepared for use in the Cottaneva 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 Cottaneva 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% canopy[2] 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 collivial 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 alternative[3].

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 trails[4].

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 Cottaneva 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 Cottaneva Creek have been identified as potential candidates for decommissioning. These segments include roads 47-CC (South Fork Cottaneva near Kimball Creek), 47-PH-005 (south of Honky Tonk picnic area) and 47-G4 (Middle Fork Cottaneva). A detailed field

[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.

evaluation of these segments will be required in order to determine whether or not decommissioning is appropriate.

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 Cottaneva 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 Cottaneva WAU. The monitoring suggested in this plan is monitoring that MRC does across all its lands including the Cottaneva WAU. However, other monitoring efforts not mentioned here may be conducted by MRC in the Cottaneva 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 Cottaneva 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 Cottaneva 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 Cottaneva WAU over time.

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