

## SECTION H

### CASUAL MECHANISMS AND PRESCRIPTIONS

#### INTRODUCTION

The following Causal Mechanism Reports and Prescriptions were specifically prepared for use in the Navarro Watershed Analysis Units (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 Navarro 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.

The land management prescriptions presented here are the protections that Mendocino Redwood Company will pursue to provide protection of aquatic resources. In addition to these prescriptions Mendocino Redwood Company will build and maintain all of its roads at high design standards such as presented in the Handbook for Forest and Ranch Roads (Weaver and Hagans, 1994).

The causal mechanism reports present the situations where watershed conditions have a likelihood of affecting a vulnerable resource. By addressing each of these situations with an appropriate prescription the situations that could impact sensitive resources will either be removed or their impact significantly lessened. This is to attempt to provide protection to watershed values from receiving significant or cumulative impacts from future management actions.

Monitoring will be conducted in the Navarro WAU to ensure that these prescriptions are providing necessary protection to aquatic resources (see Section I, Navarro WAU Monitoring Plan). This monitoring is part of an adaptive management approach that tests the hypothesized protections the prescriptions are developed to meet. If it is found that the prescriptions are not providing the appropriate protections, then they will be updated and improved.

#### CAUSAL MECHANISMS AND PRESCRIPTION REPORTS

Each Causal Mechanism Report and Prescription has specific headings to provide background on the watershed situation and prescription. The following is the description of these headings.

*Resource Sensitive Area:* the area or topic encompassed by the prescription.

*Input Variable and Process:* this briefly states what is the source variable or input to a vulnerable resource.

*Situation Sentence:* presents the situation that will be addressed by the prescription.

*Prescriptions:* specific land management actions or recommendation for the proposed causal mechanism.

## Causal Mechanism Report and Prescription #1

**Resource Sensitive Area:** Mass Wasting Map Unit (MWMU) 1

**Input Variable(s):** Coarse and fine sediment from mass wasting and bank erosion.

### **Situation Sentence:**

Small shallow seated landslides and bank erosion are common within the over-steepened slopes of the MWMU 1 topography. The immediate proximity of watercourses to landslides of this MWMU 1 provides direct delivery of fine and coarse sediment. Marginal to deficient salmonid rearing habitat due to high coarse sediment levels is common in the Navarro WAU. Fine sediment inputs can reduce spawning habitat quality. Fine sediment can also create higher than natural turbidity during storm flows potentially affecting fish physiology, reduce feeding or in the worst cases increase mortality.

### **Prescriptions:**

#### *MWMU 1 Road placement, construction, and management:*

- New road construction in MWMU 1 will not occur unless it is the only access available. If new road construction must occur it will only be to gain entry in and out of MWMU 1 and construction developed with the approval of a California Registered Geologist. The exception is when the road is the best alternative.
- Seasonal roads (roads subjected to annual use) in MWMU 1, including newly constructed roads and re-opened existing roads, will have the surface armored with rock.
- Temporary roads (roads only used periodically, every few years or decades) in MWMU 1 will be storm-proofed (such as suggested in Weaver and Hagans, 1994) prior to the winter period and the surface stabilized with grass seed, mulch, or other cover product.
- Any road that is within MWMU 1 will not have winter period heavy truck or log hauling traffic unless armored with a rock surface.
- The slopes of the inner gorge or the first 50 feet, whichever is longer, will be an equipment exclusion zone (EEZ) except for designated crossings and existing truck roads.

#### *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% overstory canopy<sup>1</sup>.
- The area directly adjacent to the break in slope of the inner gorge will retain those trees with a root mass that maintains the stability of that slope break.
- Trees within 10 feet of the bankfull channel will be retained, except for redwood clumps. At least 50% of a redwood clump must be retained with emphasis on leaving the trees most likely to deliver to the stream in this 10 foot zone.

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<sup>1</sup> Only trees greater than 30 feet in height count towards canopy measurement.

## Causal Mechanism Report and Prescription #2

**Resource Sensitive Area:** Mass Wasting Map Unit (MWMU) 2

**Input Variable(s):** Coarse and fine sediment from mass wasting and bank erosion.

### **Situation Sentence:**

The incised topography adjacent to watercourses of MWMU 2 has high risk for shallow seated landslide sediment delivery and bank erosion. The landslides in MWMU 2 are typically associated with destabilization of the toe of a watercourse's steep side slopes. Landslides or soil failures could be aggravated by soil disturbance by heavy equipment, road building or removal of ground stabilizing vegetation. The immediate proximity of watercourses to these soil failures provides direct delivery of fine and coarse sediment. Marginal to deficient rearing habitat due to high coarse sediment levels occurs in the Navarro WAU. Fine sediment inputs can reduce spawning habitat quality. Fine sediment can also create higher than natural turbidity during storm flows potentially affecting fish physiology, reduce feeding or in the worst cases increase mortality.

### **Prescriptions:**

#### *MWMU 2 Road construction, placement or management:*

- Alternatives to road construction or road use, such as cable yarding, helicopter yarding or alternative road placement, will be pursued in MWMU 2.
- New road construction in MWMU 2 will not occur unless it is the only access available. If new road construction must occur it will only be to gain entry in and out of MWMU 2 and construction developed with the approval of California Registered Geologist. The exception is when the road is the best alternative.
- The slopes of the inner gorge or the first 50 feet, whichever is longer, will be an equipment exclusion zone (EEZ) except for designated crossings and existing truck roads.

#### *MWMU 2 Timber Harvest:*

- MWMU 2 will receive no harvest on inner gorge slopes unless approved by a California Registered Geologist. On other areas (non-inner gorge slopes) within MWMU 2 in addition to the riparian protections set as company policy timber harvest must retain a minimum of 50% overstory canopy (see footnote 1, page H-2) dispersed evenly across the slopes.
- Trees within 10 feet of the bankfull channel will be retained, except for redwood clumps. At least 50% of a redwood clump must be retained with emphasis on leaving the trees most likely to deliver to the stream in this 10 foot zone.

**Causal Mechanism Report and Prescription #3**

**Resource Sensitive Area:** Mass Wasting Map Unit (MWMU) 3

**Input Variable(s):** Coarse and fine sediment from mass wasting.

**Situation Sentence:**

Steep and/or convergent slopes of MWMU 3 can have shallow seated landslides associated with them. These landslides can travel moderate distances across hillslopes to reach streams or draws where sediment delivery and sometimes debris torrents or flows occur. When sediment delivery occurs with these landslides, sediments will travel down the watercourses and are delivered to river and stream channels. If the frequency and amount of shallow seated landslides are increased from management actions in MWMU 3 this can contribute to poor rearing habitat, downstream aggradation or high turbidity.

**Prescriptions:**

Forester will utilize available resources for identification of unstable areas or areas with predicted slope instability. These include Map A-1 of Mass Wasting Assessment for the Navarro WAU, Division of Mines and Geology landslide maps (if available), or past Timber Harvest Plans.

Forester will walk the ground of this unit prior to prescribing operations. If upon field review the unit is confirmed to meet the definition of MWMU 3 and a significant risk of sediment delivery is identified the following guidelines apply:

- No road or landing construction activity will occur in areas identified in the field as having a significant likelihood of sediment delivery to a watercourse from mass wasting unless a site-specific assessment is conducted and operations approved by a California Registered Geologist.
- Harvest operations must retain at least 50% of the overstory canopy (see footnote 1, page H-2) unless a site-specific assessment is conducted and operations approved by a California Registered Geologist.

**Causal Mechanism Report and Prescription #4**

**Resource Sensitive Area:** Rockslides

**Input Variable(s):** Coarse and fine sediment from mass wasting.

**Situation Sentence:**

Rockslides are deep-seated landslides within the Navarro WAU. These features can be active, dormant or have sections of the landslide active with sections of the landslide dormant. Increases in sub-surface water from loss of evapo-transpiration or concentrated water from road drainage can activate or accelerate movement and sediment delivery from these features. The increased sediment delivery could contribute to adverse fish habitat by pool filling, increased channel scour, fine sediments smothering spawning gravel and loss of stream channel complexity.

**Prescriptions:**

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.

**Causal Mechanism Report and Prescription #5**

**Resource Sensitive Area:** Roads in Little North Fork Navarro, John Smith Creek, Ray Gulch, Hendy Woods, Rancheria Creek and Upper Navarro River Planning Watersheds

**Input Variable(s):** Coarse and fine sediment from surface and point source erosion.

**Situation Sentence:**

The roads within the Little North Fork Navarro and John Smith Creek planning watersheds are observed to have high past sediment inputs. These two planning watersheds are also important areas for salmonid spawning and rearing, particularly coho salmon. The roads within the Ray Gulch, Hendy Woods, and Upper Navarro River planning watersheds are also observed to have high past road associated sediment inputs.

**Prescriptions:**

John Smith Creek, Ray Gulch, Upper Navarro, Little North Fork Navarro River, Rancheria Creek and Hendy Woods planning watersheds had the highest rates of road associated erosion. In all of these cases the roads in the planning watersheds had a high amount of point source erosion. This probably indicates older legacy roads that are having a high amount of culvert or landing failures or inappropriate drainage creating gully erosion. These planning watersheds with a high rate of erosion should be considered priorities for erosion control work when considering work in a watershed context (i.e. “buttoning-up the entire watershed”).

**Causal Mechanism Report and Prescription #6**

**Resource Sensitive Area:** High and Moderate Erosion Hazard Roads

**Input Variable(s):** Coarse and fine sediment from surface and point source erosion.

**Situation Sentence:**

The erosion hazard ratings suggest the likelihood and amount of future sediment delivery to be delivered from a road. The high erosion hazard roads would be considered the greatest risk, with the moderate erosion hazard roads next.

These roads commonly have areas of long undrained road lengths that increase the amount of fine sediment delivery. Many of these roads are directly adjacent to watercourses. Water drainage off these roads can increase or cause point source erosion contributing both fine and coarse sediment deliveries to watercourses. If the frequency and amount of erosion is increased from management actions this can contribute to poor rearing habitat, high turbidity or decreased spawning habitat quality.

**Prescriptions:**

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.

**Causal Mechanism Report and Prescription #7**

**Resource Sensitive Area:** Masonite Road (M Road)

**Input Variable(s):** Coarse and fine sediment from surface and point source erosion and mass wasting.

***Situation Sentence:***

The Masonite road was found to be a significant sediment producer in the Navarro WAU. The road was estimated to produce 20% of the past sediment inputs and represents 25% of the controllable erosion in the Navarro WAU. The Masonite road is in close proximity to sections of the North and South Branches of the North Fork Navarro River. These sections provide spawning and rearing habitat for coho salmon and steelhead trout.

***Prescriptions:***

A management plan has been developed for the Masonite road, across all watersheds (not just the Navarro WAU). The plan presents a prioritization of where road restoration work should occur and a timeline and process for that restoration.



**Causal Mechanism Report and Prescription #8**

**Resource Sensitive Area:** High and moderate treatment immediacy sites for roads in the Navarro WAU.

**Input Variable(s):** Sedimentation from surface and point source erosion.

**Situation Sentence:**

Individual culverts, bridges, landings and road erosion sites were inventoried and ranked based on their priority for treatment and relative degree of likelihood of sediment delivery. All have a significant concern for a large discrete input of coarse and fine sediment to watercourses. In the Navarro WAU 276 controllable erosion sites have high treatment immediacy and 466 controllable erosion sites have moderate treatment immediacy. If the frequency and amount of erosion is increased from management actions this can contribute to poor rearing habitat, or degradation of spawning habitat quality.

**Prescriptions:**

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.

It is recommended that road site corrections attempt to follow the order of treatment immediacy as presented in Appendix B.

**Causal Mechanism Report and Prescription #9**

**Resource Sensitive Area:** Diversion potential sites along roads in the Navarro WAU.

**Input Variable(s):** Coarse and fine sediment from point source erosion.

**Situation Sentence:**

When roads cross watercourses the resulting crossing structure (culvert or bridge) has a potential to fail. When the crossing fails the watercourse has potential to either stay within the “natural” channel or be diverted away from the channel. Typically a diversion away from a “natural” channel in a failed crossing is due to low areas adjacent to the crossing that allows water to be routed either down the road surface or through fill material. This potential for diversion of water if a crossing failed can be a secondary erosion process that can create significant sediment inputs, sometimes greater than the actual crossing failure itself. This water diversion potential is an important concern to correct on roads. Currently there are 610 culverts or crossings in the Navarro WAU that have a diversion potential. If the frequency and amount of erosion is increased from management actions this can contribute to poor rearing habitat, downstream aggradation or high turbidity.

**Prescriptions:**

These diversion potential sites will be a high priority for correction. 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. It is very likely that these sites will be addressed when in close proximity to high treatment immediacy sites.

It is recommended that road site corrections attempt to follow the order these diversion potential sites are presented in Appendix B.

**Causal Mechanism Report and Prescription #10**

**Resource Sensitive Area:** Undersized culverts in the Navarro WAU.

**Input Variable(s):** Sedimentation from surface and point source erosion.  
Water quality; turbidity from fine sediment.

**Situation Sentence:**

Culverts must pass not only water beneath roads but the sediment and debris that is transported down the watercourses. If a culvert is not properly sized for the water, sediment and debris that must be conveyed through it can plug or be over topped. This can cause water to flow over road fill material creating point source erosion of the road or potentially having the fill material at the crossing completely fail. In the Navarro WAU 260 culverts were determined (remotely) to not be able to pass the 50-year flood. Additional 16 culverts were determined not to be able to pass the 100-year flood.

**Prescriptions:**

The 260 culverts that will not pass the 50 year flood will be visited in the field and a determination will be made if the culverts are indeed under-sized (identification of under-sized culverts was done by an office-based evaluation that could be inaccurate). If after field review the culverts are found to be under-sized it will be a high priority for replacement to a watercourse crossing structure that will pass the 100-year flood.

The 16 culverts that will not pass the 100 year flood will be visited in the field and a determination will be made if the culverts are indeed under-sized for this sized flood event (identification of under-sized culverts was done by an office-based evaluation that could be inaccurate). If after field review the culverts are found to be under-sized for the 100 year flood it will be a moderate priority for replacement to a watercourse crossing structure that will pass the 100-year flood. Typically the upgrade will occur once the culvert has reached the end of its operational life.

The field review will consist of determining the cross section area of the bankfull channel and comparing it the cross sectional area of the culvert in question. A rule of thumb is that to pass the 100 year flood the culvert opening area needs to be 3 times as large as the bankfull channel cross section area (Cafferata, Spittler, and Wopat, 2000).

**Causal Mechanism Report and Prescription #11**

**Resource Sensitive Area:** Fish passage barriers from culverts in the Navarro WAU.

**Input Variable(s):** Barrier to fish migration.

**Situation Sentence:**

Culverts must pass not only water beneath roads but the sediment and debris that is transported down the watercourses and the fish migrating through the stream. If a culvert is not properly sized for the water it must pass or has too a steep grade or a high drop at the outlet it can be a barrier for fish migration. There are 3 culverts currently identified as complete barriers to upstream fish migration. These are on the Masonite road at Bridge Creek, Camp Creek and an unnamed tributary to the North Branch North Fork Navarro River just downstream of John Smith Creek. Removal of these barriers can make available additional stream lengths for spawning, rearing and over-wintering habitat.

**Prescriptions:**

The 3 known culverts should be removed. In the case of Bridge Creek and Camp Creek a bridge should be built at the watercourse crossing. The unnamed tributary below John Smith Creek will be evaluated for appropriate watercourse crossing design for fish passage. All of these crossings should be a high priority for fish passage improvement.

Other fish migration barriers likely exist and need to be investigated over time.

**Causal Mechanism Report and Prescription #12**

**Resource Sensitive Area:** Aquatic Management Zone

**Input Variable(s):** Large woody debris recruitment

**Situation Sentence:**

Large woody debris (LWD) is an important component of stream habitat. Large woody debris provides sediment storage in channels, creates areas of scour for pool creation, provides cover for fish habitat and adds channel roughness for habitat complexity. Historic forest management practices did not require watercourse protection measures like current California Forest Practice Rules mandate. Historic removal of LWD from the Navarro River WAU has created a deficient of LWD available for fish habitat and stream channel diversity. Historic harvesting practices have removed many of the large conifer trees which provide the current and future large woody debris recruitment needed in these areas.

This watershed analysis has presented, by stream segment, the instream LWD demand based on riparian stand recruitment potential and instream LWD conditions. The majority of streams in the Navarro WAU have a high LWD demand, suggesting lack of LWD and short term LWD recruitment potential

**Prescriptions:**

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 Navarro WAU are recommended for a higher level of consideration, due to instream LWD demands and coho salmon habitat improvement:

- Little North Fork Navarro River
- John Smith Creek
- South Branch North Fork Navarro River
- Flynn Creek
- Marsh Gulch
- Murray Gulch

**Causal Mechanism Report and Prescription #13**

**Resource Sensitive Area:** Canopy closure over Class I and II watercourses

**Input Variable(s):** Canopy closure and stream temperature

**Situation Sentence:**

Stream temperatures in the Navarro River WAU range from deficient to rearing salmonids to within preferred range. The range of stream temperatures in the Navarro WAU reflects a range of environmental conditions. A few areas of the Navarro WAU do have stream canopy conditions below what would naturally be expected in those locations. High water temperature can be deleterious and even fatal to many fish and aquatic species and warrant concern. Therefore, promoting appropriate stream canopy cover is important. Areas that are unnaturally low in canopy should be targeted for restoration and concern given to management activities that do not promote increased canopy. Two areas within the Navarro WAU have stream canopy that appear to be unnaturally low. These are the North Branch North Fork Navarro from approximately John Smith Creek downstream to the crossing at highway 128, and the South Branch North Fork Navarro from Malcom's bridge downstream to the confluence with the North Branch.

**Prescriptions:**

The company policies for streamside canopy and riparian management are considered to be appropriate at this time.

The 2 river reaches with unnaturally low canopy, the North Branch North Fork Navarro from approximately John Smith Creek downstream to the crossing at highway 128, and the South Branch North Fork Navarro from Malcom's bridge downstream to the confluence with the North Branch 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.

**Literature Cited**

Cafferata, P., Spittler, T., and M. Wopat. 2000. Sizing watercourse crossings for the 100-year flood flows. Draft California Forestry Note. California Department of Forestry, Sacramento, CA.

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