Section A
MASS WASTING

INTRODUCTION

This module summarizes the methods and results of a mass wasting assessment conducted on the Mendocino Redwood Company, LLC (MRC) ownership in the Mallo Pass Creek, Alder Creek, Brush Creek, and Schooner Gulch, the Southcoast Streams Watershed Analysis Unit (Southcoast Streams WAU). California Planning Watersheds included in the Southcoast Streams WAU include portions of Mallo Pass Creek, Lower Alder Creek, North Fork Alder Creek, Lower Brush Creek, Upper Brush Creek, and Point Arena Creeks Planning Watersheds. This assessment was completed by Elias J. Steinbuck, PG 7538, and is part of a watershed analysis initiated by MRC that utilizes modified methodology adapted from procedures outlined in the Standard Methodology for Conducting Watershed Analysis (Version 4.0, Washington Forest Practices Board).

The principle objectives of this assessment are to:
1) Identify the types of mass wasting processes active in the basin.
2) Identify the link between mass wasting and forest management related activities.
3) Identify where the mass wasting processes are concentrated.
4) Partition the ownership into zones of relative mass wasting potential based on the likelihood of future mass wasting and sediment delivery to stream channels.

Additionally, the role of mass wasting sediment input to watercourses is examined. This information combined with the results of the Surface and Point Source Erosion module is used to construct a sediment input summary for the Southcoast Streams WAU, contained in the Sediment Input Summary section of this watershed analysis.

The products of this report are: a landslide inventory map (Map A-1), a Terrain Stability Unit (TSU) map (Map A-2), and a mass wasting inventory database (Appendix A). The assembled information will enable forestland managers to make better forest management decisions to reduce management-induced risk of mass wasting. The mass wasting inventory will provide the information necessary to understand the spatial distribution, causal mechanisms, relative size, and timing of mass wasting processes active in the basin with reasonable confidence.

The Role of Mass Wasting in Watershed Dynamics

Mass wasting is a naturally occurring process, but can be accelerated by anthropogenic disturbances. Forest management practices can alter the natural frequency and magnitude of mass wasting events by changing the relative resisting and driving forces acting on a hillslope, altering soil and bedrock pore water pressures, and/or altering the effective cohesion of soil and bedrock (Sidle et.al., 1985). Increases in sediment yield due to mass wasting can disrupt the dynamic equilibrium of stream channels, resulting in a decline in the quality and quantity of amphibian and anadromous fish habitat, water quality, or stream ecology (Reeves et.al., 1995).

Mass wasting events are able to alter stream environments by increasing bed and suspended sediment loads, modifying the grain-size distribution of channel sediment, introducing woody debris, altering channel morphology by aggradation, damming and obstructing the channel, and in extreme cases scouring the channel to bedrock. Stream systems ultimately adjust to major alterations downstream, as well as upstream of individual mass wasting events, however, the consequences may last for a long while.

In the Pacific Northwest where anadromous fish are present, mass wasting can have both beneficial and adverse effects on salmonid habitat. Beneficial effects include formation of new spawning, rearing, and over-wintering habitat due to addition of coarse gravels to the channel. The introduction of woody debris and boulders from landslides can increase cover and improve pool to riffle ratios. Adverse effects include filling of pools and scouring of riffles, blockage of fish access, disturbing side-channel rearing areas, and siltation of spawning gravels (Reeves et.al., 1995). The magnitude of these effects are dependent on the frequency, location, and intensity of mass wasting events, as well as the sediment transporting capabilities of a particular stream. Beneficial and adverse effects typically occur simultaneously, and the relative relationship between the two will vary, even for individual events. Because of their greater stream powers, larger streams and rivers adjust to mass wasting perturbations faster than smaller streams.

BEDROCK STRUCTURE AND LITHOLOGY IN THE SOUTHCOAST STREAMS WAU

The geomorphology and geologic structure of the THP area is dominated by the northwest-southeast trending right-lateral San Andreas Fault Zone that lies approximately ¼ mile east of the Schooner Gulch assessment area and ½ mile west of the Mallo Pass and Alder Creek assessment areas. The San Andreas Fault juxtaposes Tertiary-Cretaceous Coastal Belt Franciscan sedimentary rocks to the east against German Rancho Formation, Gualala Formation, and Galloway-Schooner Gulch Formation sedimentary rocks, collectively referred to as the Gualala Block, to the west (Davenport, 1984a; --, 1984b.; --, 1984c.; Manson, 1984a., --, 1984b.).

The Coastal Belt Franciscan is characterized by predominately interbedded sandstone and shale exhibiting a relatively chaotic structure with shear zones, folds, and faults often juxtaposed with coherent sections of thin to massive sandstone and shale. Consistent with mass-flow type marine trench and trench-slope deposition, sedimentary structures are typically absent.

The sedimentary Gualala Block was formed in a marine environment and has subsequently been transported north along the San Andreas Fault Zone (SAFZ). German Rancho Formation rocks consist of consolidated, hard, coarse-grained sandstone interbedded with minor mudstone and conglomerate. The Anchor Bay Member of the Gualala Formation is characterized by consolidated silicified mudstone interbedded with sandstone. The Galloway-Schooner Gulch Formation is characterized by coarse grained massive sandstone.

All of these units are overlain by undifferentiated marine terrace deposits intermittently within the assessment area. Additionally, local alluvial deposits are present along the higher order channels within the Southcoast Streams WAU. Based on field reconnaissance, available geologic and hydrologic maps, and published literature, no regional indicators of adverse rock type, structure, or groundwater conditions were identified.

LANDSLIDE TYPES AND PROCESSES IN THE SOUTHCOAST STREAMS WAU

Landslide features are widespread over the Southcoast Streams WAU, owing to the relatively rapid down-cutting of the steep gradient creeks in response to global sea level fluctuations and regional uplift. The terminology used to describe landslides in this report closely follows the definitions of Cruden and Varnes (1996). This terminology is based on two nouns, the first describing the material that the landslide is composed of, and the second describing the type of movement. Landslides identified in the Southcoast Streams WAU are discussed in detail below. For the purposes of this report, landslides are categorically separated into rapidly moving shallow-seated landslides and slowly moving deep-seated landslides, an essential distinction for forest management purposes.

Shallow-Seated Landslides

Debris slides, debris flows, and debris torrents are terms used throughout Mendocino Redwood Company's ownership to identify shallow-seated landslide processes. The material composition of debris slides, flows, or torrents is considered to be mainly colluvial soil with a significant proportion of coarse material; 20 to 80 percent of the particles are larger than 2 mm (Cruden and Varnes, 1996). Shallow-seated slides generally move quickly downslope and commonly break apart during failure. Shallow-seated slides commonly occur along steep streamside slopes and in converging topography where colluvial materials accumulate and subsurface drainage concentrates. Susceptibility of a slope to fail by shallow-seated landslides is affected by slope steepness, saturation of soil, soil strength (friction angle and cohesion), and root strength (Selby, 1993). Due to the shallow depth and fact that debris slides, flows, or torrents involve the soil mantle, these are landslide types that can be significantly influenced by forest practices.

Debris slides are the most common landslide type observed in the Southcoast Streams WAU. The landslide mass typically fails along a surface of rupture or along relatively thin zones of intense shear strain located near the base of the soil profile. The landslide deposit commonly slides a distance beyond the toe of the surface of rupture and onto the ground surface below the failure; it generally does not slide more than the distance equal to the length of the failure scar. Landslides with deposits that traveled a longer distance below the failure scar would likely be defined as a debris flow or debris torrent. Debris slides commonly occur on steep planar slopes, convergent slopes, along forest roads and on steep slopes adjacent to watercourses. They usually fail by translational movement along an undulating or planar surface of failure. By definition debris slides do not continue downstream upon reaching a watercourse.

A debris flow is similar to a debris slide with the exception that the landslide mass continues to "flow" down the slope below the failure a considerable distance on top of the ground surface. A debris flow is characterized as a mobile, potentially very rapidly moving, slurry of soil, rock, vegetation, and water. High water content is needed for this process to occur. Debris flows generally occur on both steep, planar hillslopes and confined, convergent hillslopes. Often a failure will initiate as a debris slide, but will transform into a debris flow as its moves downslope.

Debris torrents have the greatest potential to destroy stream habitat and deliver large amounts of sediment. The main characteristic distinguishing a debris torrent is that the mass of failed soil and debris "torrents" downstream in a confined channel and erodes the bed and banks of the channel as it moves. As the debris torrent moves downslope and scours the channel, the liquefied landslide material generally increases in mass. Highly saturated soil or run-off in a channel is required for this process to occur. Debris torrents move rapidly and can potentially run down a channel for great distances. They typically initiate in headwall swales and torrent down intermittent watercourses. Often a failure will initiate as a debris slide, but will develop into a debris torrent upon reaching a channel. While actually a combination of two processes, these features were considered debris torrents.

Deep-Seated Landslides

Rockslides and earthflows are terms used throughout Mendocino Redwood Company's ownership to identify deep-seated landslide processes. The failure dates of the deep-seated landslides could not be estimated with any confidence, they are likely to be of varying age with some potentially being over several thousand years old. Many of the deep-seated landslides are considered "dormant", but the importance of identifying them lies in the fact that if reactivated, they have the potential to deliver large amounts of sediment and impair stream habitat.

Accelerated or episodic movement is likely to have occurred over time in response to seismic shaking or high rainfall events.

Rockslides are deep-seated landslides with movement involving a relatively intact mass of rock and overlying earth materials. The failure plane is below the colluvial layer and involves the underlying bedrock. Mode of rock sliding generally is not strictly rotational or translational, but involves some component of each. Rotational slides typically fail along a concave surface, while translational slides typically fail on a planar or undulating surface of rupture. Rockslides commonly create a flat, or back-tilted, bench below the crown of the scarp. A prominent bench is usually preserved over time and can be indicative of a rockslide. Rockslides fail in response to triggering mechanisms such as seismic shaking, adverse local structural geology, high rainfall, offloading or loading material on the slide, or channel incision (Wieczorek, 1996). The stream itself can be the cause of chronic movement, if it periodically undercuts the toe of a rockslide.

Earth flows are deep-seated landslides composed of fine-grained materials and soils derived from clay-bearing rocks. Earth flow materials typically consist of 80% or more of particles smaller than 2mm (Cruden and Varnes, 1996). Materials in an earth flow also commonly contain boulders, some very large, which move down slope in the clay matrix. Failure in earth flows is characterized by spatially differential rates of movement on discontinuous failure surfaces that are not preserved. The "flow" type of movement creates a landslide that can be very irregularly shaped. Some earth flow surfaces are dominantly grassland, while some are partially or completely forested. The areas of grassy vegetation are likely due to the inability of the unstable, clay-rich soils to support forest vegetation. The surface of an earth flow is characteristically hummocky with locally variable slope forms and relatively abundant gullies. The inherently weak materials within earth flows are not able to support steep slopes, therefore slope gradients are generally low to moderate. The rates of movement vary over time and can be accelerated by persistent high groundwater conditions. Timber harvesting can have the effect of increasing the amount of subsurface water, which can accelerate movement in an earth flow (Swanston et al, 1988).

Use of SHALSTAB by Mendocino Redwood Company for the Southcoast Streams WAU

MRC uses SHALSTAB—a coupled steady state runoff infinite slope stability model—to assist with the mapping of the hazard potential of shallow-seated landslides (Dietrich and Montgomery, 1998). William Dietrich of the University of California (Berkeley) and David Montgomery of the University of Washington (Seattle) have published a validation study of the SHALSTAB model. Generally, they found that the SHALSTAB model correctly distinguishes areas more prone to shallow landslide instability. In mass wasting studies conducted in seven basins in northern California, they concluded that a log (q/T) threshold of less than -2.8 identifies the portion of the basin within which on average 57% of the shallow landslides mapped from aerial photographs are found. However, they also found that the performance of SHALSTAB depends strongly on the quality of the topographic data. The best readily available topographic data (10-m grid data from digitized USGS 7.5' quad maps) do not represent the fine scale topography that dictates the convergence of subsurface flow and the locations where shallow landslides are likely to occur. In our watershed analysis, we assess mass wasting hazards apart from SHALSTAB as well, using aerial photographs and field reconnaissance. However, we still use SHALSTAB output as one tool to assist with the interpretation of the landscape into terrain stability units.

METHODS

Landslide Inventory

The mass wasting assessment relies on an inventory of mass wasting features collected through the use of aerial photographs and field observations. MRC owned photographs from 2004 (color, 1:12,000), 2000 (color, 1:12,000), 1987 (black-and-white, 1:12,000), and 1978 (color, 1:15,840) were analyzed, as were 1963 (black-and-white, 1:20,000), and 1952 (black-and-white, 1:20,000) photos on file at Howard Forest in Willits.

Data was collected regarding characteristics and measurements of the identified landslides. We acknowledge that some landslides may have been missed, particularly small ones that may be obscured by vegetation. A brief description of select parameters inventoried for each landslide observed in the field and during aerial photograph interpretation is presented in Figure A-1. A detailed discussion of these parameters follows.

Figure A-1. Description of Select Parameters used to Describe Mass Wasting in the Mass Wasting Inventory.

- Slide Identification: Each landslide is assigned a unique identification number, a two letter code (see below) that denotes which planning watershed (PWS) the slide is located, and a number which indicates the USGS designated map section number the slide is mapped in.
  Planning Watershed Codes:
    - CM – Mallo Pass Creek
    - CA – Lower Alder Creek
    - CN – North Fork Alder Creek
    - GW – Lower Brush Creek
    - GU – Upper Brush Creek
    - GP – Point Arena Creeks (Schooner Gulch, Moat Creek)
- TSU # – Terrain Stability Unit in which landslide is located.
- Landslide Type:
    - DS – debris slide
    - DF – debris flow
    - DT – debris torrent
    - RS – rockslide
    - EF – earthflow
- Certainty: The certainty of identification is recorded.
    - D – Definite
    - P – Probable
    - Q – Questionable
- Physical Characteristics: Includes average length, width, depth, and volume of individual slides. Length of torrent, if present, is recorded as a comment.
- Sediment Routing: Denotes the type of stream the sediment was routed into.
    - P – Perennial
    - I – Intermittent or Ephemeral
    - N – no sediment delivered
- Sediment Delivery: Quantification of the relative percentage of the landslide that delivered to the stream.
- Slope: Percent slope angle is recorded for all shallow-seated landslides observed in the field.

- Age: Relative age of the observed slide is estimated.
  - N – new (<5 years old)
  - R – recent (5-10 years old)
  - O – old (>10 years old)
- Slope Form: Denotes morphology of the slope where the landslide originated
  - C – concave
  - D – divergent
  - P – planar
- Slide Location: Interpretation of the location where the landslide originated
  - H – Headwall Swale
  - S – Steep Streamside Slopes
  - I – Inner Gorge
  - N – Neither
- Road Association: Denotes the association of the landslide to land-use practices.
  - R – Road
  - S – Skid Trail
  - L – Landing
  - N – Neither
  - I – Indeterminate
- Contributing Area: Categorical description of the area interpreted to concentrate surface and/or subsurface flow to the point of failure for non-road related slide points.
  - S – Small, <0.5 acres
  - M – Medium, 0.5 – 3.0 acres
  - L – Large, >3.0 acres
- Aspect: Categorical description of the predominant cardinal direction the hillslope is facing for all slide points.
  - NE – Northeast, 0°-89°
  - NW – Northwest, 270°-359°
  - NE – Southeast aspect, 90°-179°
  - NE – Southwest aspect, 180°-269°
- Soil Type: County soil survey is used to attribute a soil type to each slide point. Soil types are grouped into similar grain size distributions based on the Unified Soil Classification System rating provided in the county survey.
  - C – Coarse, soils consisting of gravel-sand-silt mixture (GM-GC, USCS Class.)
  - F – Fine, soils consisting mainly of silt-clay (CL-ML, USCS Class.)
  - M – Mixed, soils with coarse and fine material (GC-CL)
- MRC Structure Class: 24 forest stand classes are used to describe the forest conditions across the MRC timberland. In this assessment this information is used to build a database of forest conditions upslope of recent (2001-2004 time period) non-road related failures. Structure classes are generated by classifying the following stand attributes:
  - Dominant Species
  - Dominant Diameter
  - Canopy Cover (%)
- Deep-seated landslides morphologic descriptions: toe, body, lateral scarps, and main scarp (see section below on Systematic Description of Deep-seated Landslide Features).

Landslides identified in the field and from aerial photograph observations are plotted on a landslide inventory map (Map A-1). All shallow-seated landslides are identified as a point plotted on the map at the interpreted head scarp of the failure. Deep-seated landslides are represented as a polygon representing the interpreted perimeter of the landslide body. Physical and geomorphic characteristics of all inventoried landslides are categorized in a database in Appendix A. Landslide dimensions and depths can be quite variable, therefore length, width, and depth values that are recorded are considered to be the average dimension of that feature. When converting landslide volumes to mass (tons), we assume a soil bulk density of 1.35 grams/cubic centimeter.

The certainty of landslide identification is assessed for each landslide. Three designations are used: definite, probable, and questionable. Definite means the landslide definitely exists. Probable means the landslide probably is there, but there is some doubt in the analyst's interpretation. Questionable means that the interpretation of the landslide identification may be inaccurate; the analyst has the least amount of confidence in the interpretation. Accuracy in identifying landslides on aerial photographs is dependent on the size of the slide, scale of the photographs, thickness of canopy, and logging history. Landslides mapped in areas recently logged or through a thin canopy are identified with the highest level of confidence. Characteristics of the particular aerial photographs used affects confidence in identifying landslides. For example, sun angle creates shadows which may obscure landslides, the print quality of some photo sets varies, and photographs taken at small scale makes identifying small landslides difficult. The landslide inventory results are considered a minimum estimate of sediment production. This is because landslides that were too small to identify on aerial photographs may have been missed, landslide surfaces could have reactivated in subsequent years and not been quantified, and secondary erosion by rills and gullies on slide surfaces is difficult to assess.

The technique employed to extrapolate a sediment volume delivery percentage to landslides not visited in the field relied on an average of those that were visited in the field. While this averaging technique is an oversimplification of actual on the ground sediment delivery measurements, it provides a means for estimating sediment delivery from the slides not visited in the field.

Landslides were classified based on the likelihood that a road associated land use practice was associated with the landslide. In this analysis, the effects of silvicultural techniques were not observed. The Southcoast Streams WAU has been managed, recently and historically, for timber production. Therefore, it was determined that the effect of silvicultural practices was too difficult to confidently assign to landslides. There have been too many different silvicultural activities over time for reasonable confidence in a landslide evaluation based on silviculture. The land use practices that were assigned to landslides were associations with roads, skid trails, or landings. It was assumed that a landslide adjacent to a road, skid trail, or landing was triggered either directly or indirectly by that land use practice. If a landslide appeared to be influenced by more than one land use practice, the more causative one was noted. If a cutslope failure did not cross the road prism, it was assumed that the failure would remain perched on the road, landing, or skid trail and would not deliver to a watercourse. Some surface erosion could result from a cutslope failure and is assumed to be addressed in the road surface erosion estimates (Surface and Fluvial Erosion Module).

Sediment Input from Shallow-Seated Landslides

The overall time period used for mass wasting interpretation and sediment budget analysis is sixty-seven years. Sediment input to stream channels by mass wasting is quantified for seven time periods (1942-1952, 1953-1963, 1964-1978, 1979-1987, 1988-2000, 2001-2004). The evaluation assumes that approximately the last 10 years of mass wasting can be observed in the aerial photograph. This is due to landslide surfaces revegetating quickly, making small mass wasting features older than about 10 years difficult to see. We acknowledge that we have likely missed an unknown quantity of small mass wasting events during the aerial photograph interpretation. However, we assume we have captured the majority of the larger mass wasting events in this analysis.

Sediment delivery estimates from mapped shallow-seated landslides were used to produce the total mass wasting sediment input. In order to extrapolate depth to the shallow-seated landslides not visited in the field, an average was taken from the measured depths of landslides visited in the field. Field measurements revealed a similar distribution of depths for management associated (which includes roads, skid trails, and landings), and non-management associated shallow-seated landslides. Therefore, the shallow-seated landslides not verified in the field were assigned the average depth from field verified landslides. In order to extrapolate sediment delivery percentage to landslides not verified in the field, an average was taken from the estimated delivery percentage of field verified landslides.

Delivery statistics were not calculated for deep-seated landslides, however, some of the sediment delivery from shallow-seated landslides is the result of conditions created by deep-seated landslides. For example, a deep-seated failure could result in a debris slide or torrent, which could deliver sediment. Furthermore, over-steepened scarps or toes of deep-seated landslides may have shallow failures associated with them. These types of sediment delivery from shallow-seated landslides associated with deep-seated landslides are accounted for in the delivery estimates.

Sediment Input from Deep-Seated Landslides

Large, active, deep-seated landslides can potentially deliver large volumes of sediment. Delivery generally occurs over long time periods compared to shallow-seated landslides, with movement delivering earth materials into the channel, resulting in an increased sediment load downstream of the failure. Actual delivery can occur by over-steepening of the toe of the slide and subsequent failure into the creek, or by the slide pushing out into the creek. It is very important not to confuse normal stream bank erosion at the toe of a slide as an indicator of movement of that slide. Before making such a connection, the slide surface should be carefully explored for evidence of significant movement, such as wide ground cracks. Sediment delivery could also occur in a catastrophic manner. In such a situation, large portions of the landslide essentially fail and move into the watercourse "instantaneously". These types of deep-seated failures are relatively rare on MRC property and usually occur in response to unusual storm events or seismic ground shaking.

Movement of deep-seated landslides has definitely resulted in some sediment delivery in the Southcoast Streams WAU. Quantification of the sediment delivery from deep-seated landslides was not determined in this watershed analysis. Factors such as rate of movement, or depth to the slide plane, are difficult to determine without subsurface geotechnical investigations that were not conducted in this analysis. Sediment delivery to watercourses from deep-seated landslides (landslides typically ≥10 feet thick) can occur by several processes. Such processes can include surface erosion and shallow-or deep-seated movement of a portion or all of the deep-seated landslide deposit.

The ground surface of a deep-seated landslide, like any other hillside surface, is subject to surface erosion processes such as rain drop impact, sheet wash (overland flow), and gully/rill erosion. Under these conditions the sediment delivery from surficial processes is assumed the same as adjacent hillside slopes not underlain by landslide deposits. The materials within the landslide are disturbed and can be arguably somewhat weaker. However, once a soil has developed, the fact that the slope is underlain by a deep-seated landslide should make little difference regarding sediment delivery generated by erosional processes that act at the ground surface. Although fresh, unprotected surfaces that develop in response to recent or active movement could become a source of sediment until the bare surface becomes covered with leaf litter, re-vegetated, or soils developed.

Clearly, movement of a portion or all of a deep-seated landslide can result in delivery of sediment to a watercourse. This determination is made by exploring for any evidence of movement. However, movement would need to be on slopes immediately adjacent to or in close proximity to a watercourse and of sufficient magnitude to push the toe of the slide into the watercourse. A deep-seated slide that toes out on a slope far from a creek or moves only a short distance downslope will generally deliver little to a watercourse. It is also important to realize that often only a portion of a deep-seated slide may become active, though the portion could be quite variable in size. Ground cracking at the head of a large, deep-seated landslide does not necessarily equate to immediate sediment delivery at the toe of the landslide. Movement of large deep-seated landslides can create void spaces within the slide mass. Though movement can be clearly indicated by the ground cracks, many times the toe may not respond or show indications of movement until some of the void space is “closed up”. This would be particularly true in the case of very large deep-seated landslides that exhibit ground cracks that are only a few inches to a couple of feet wide. Compared to the entire length of the slide, the amount of movement implied by the ground crack could be very small. This combined with the closing up or “bulking up” of the slide, would not generate much movement, if any, at the toe of the slide. Significant movement, represented by large wide ground cracks, would need to occur to result in significant movement and sediment delivery at the toe of the slide.

Systematic Description of Deep-seated Landslide Features

The characteristics of deep-seated landslides received less attention in the landslide inventory than shallow-seated landslides mainly due to the fact that subsurface analyses would have to be conducted to estimate attributes such as depth, volume, failure date, current activity, and sediment delivery. Subsurface investigation was beyond the scope of this report. Few of the mapped deep-seated landslides were observed to have recent movement associated with them, mainly due to oversteepening of the slope at the toe or scarp. Further assessment of deep-seated landslides will occur on a site-by-site basis in the Southcoast Streams WAU, likely during timber harvest plan preparation and review.

Deep-seated landslides were mainly interpreted by reconnaissance techniques (aerial photograph interpretation complemented by limited field observations). Reconnaissance mapping criteria consist of observations of four morphologic features of deep seated landslides – toe, internal morphology, lateral flanks, main scarp, and vegetation (after McCalpin 1984 as presented by Keaton and DeGraff, 1996, p. 186, Table 9-1). The mapping and classification criteria for each feature are presented in detail below.

Aerial photo interpretation of deep seated landslide features in the Southcoast Streams WAU suggests that the first three morphologic features above are the most useful for inferring the presence of deep-seated landslides. The presence of tension cracks and/or sharply defined and topographically offset scarps are probably a more accurate indicator of recent or active landslide movement. These features, however, are rarely visible on aerial photos.

Sets of five descriptions have been developed to classify each deep-seated landslide morphologic feature or vegetation influence. The five descriptions are ranked in descending order from characteristics more typical of active landslides to dormant to relict landslides. One description should characterize the feature most accurately. Nevertheless, some overlap between classifications is neither unusual nor unexpected. We recognize that some deep-seated landslides may lack evidence with respect to one or more of the observable features, but show strong evidence of another feature. If there is no expression of a particular geomorphic feature (e.g. lateral flanks), the classification of that feature is considered “undetermined”. If a deep-seated landslide is associated with other deep-seated landslides, it may also be classified as a landslide complex.

In addition to the classification criteria specific to the deep-seated landslide features, more general classification of the strength of the interpretation of the deep-seated landslide is conducted. Some landslides are obscured by vegetation to varying degrees, with areas that are clearly visible and areas that are poorly visible. In addition, weathering and erosion processes may also obscure geomorphic features over time. The quality of different aerial photograph sets varies and can sometimes make interpretations difficult. Owing to these circumstances, each inferred deep-seated landslide feature is classified according to the strength of the evidence as definite, probable or questionable as defined with respect to interpretation of shallow landslides.

At the project scale (THP development and planning), field observations of deep-seated landslide morphology and other indicators by qualified professionals are expected to be used to reduce uncertainty of interpretation inherent in reconnaissance mapping. Field criteria for mapping deep-seated landslides and assessment of activity are presented elsewhere.

Deep Seated Landslide Morphologic Classification Criteria:

I. Toe Activity

1. Steep streamside slopes with extensive unvegetated to sparsely vegetated debris slide scars. Debris slides occur on both sides of stream channel, but more prominently on side containing the deep-seated landslide. Stream channel in toe region may contain coarser sediment than adjacent channel. Stream channel may be pushed out by toe. Toe may be eroding, sharp topography/geomorphology.
2. Steep streamside slopes with few unvegetated to sparsely vegetated debris slide scars. Debris slides generally are distinguishable only on streamside slope containing the deep-seated landslide. Stream channel may be pushed out by toe. Sharp edges becoming subdued.
3. Steep streamside slopes that are predominantly vegetated with little to no debris slide activity. Topography/geomorphology subdued.
4. Gently sloping stream banks that are vegetated and lack debris slide activity. Topography/geomorphology very subdued.
5. Undetermined

II. Internal Morphology

1. Multiple, well defined scarps and associated angular benches. Some benches may be rotated against scarps so that their surfaces slope back into the hill causing ponded water, which can be identified by different vegetation than adjacent areas. Hummocky topography with ground cracks. Jack-strawed trees may be present. No drainage to chaotic drainage/disrupted drainage.
2. Hummocky topography with identifiable scarps and benches, but those features have been smoothed. Undrained to drained but somewhat subdued depressions may exist. Poorly established drainage.
3. Slight benches can be identified, but are subtle and not prominent. Undrained depressions have since been drained. Moderately developed drainage to established drainage but not strongly incised. Subdued depressions but are being filled.
4. Smooth topography. Body of slide typically appears to have failed as one large coherent mass, rather than broken and fragmented. Developed drainage well established, incised. Essentially only large undrained depressions preserved and would be very subdued. Could have standing water. May appear as amphitheater slope where slide deposit is mostly or all removed.
5. Undetermined

III. Lateral Flanks

1. Sharp, well defined. Debris slides on lateral scarps fail onto body of slide. Gullies/drainage may begin to form at boundary between lateral scarps and sides of slide deposit. Bare spots are common or partially unvegetated.
2. Sharp to somewhat subdued, rounded, essentially continuous, might have small breaks; gullies/drainage may be developing down lateral edges of slide body. May have debris slide activity, but less prominent. Few bare spots.
3. Smooth, subdued, but can be discontinuous and vegetated. Drainage may begin to develop along boundary between lateral scarp and slide body. Tributaries to drainage extend onto body of slide.
4. Subtle, well subdued to indistinguishable, discontinuous. Vegetation is identical to adjacent areas. Watercourses could be well incised, may have developed along boundary between lateral scarp and slide body. Tributaries to drainage developed on slide body.
5. Undetermined

IV. Main Scarp

1. Sharp, continuous geomorphic expression, usually arcuate break in slope with bare spots to unvegetated; often has debris slide activity.
2. Distinct, essentially continuous break in slope that may be smooth to slightly subdued in parts and sharp in others, apparent lack of debris slide activity. Bare spots may exist, but are few.
3. Smooth, subdued, less distinct break in slope with generally similar vegetation relative to adjacent areas. Bare spots are essentially non-existent.
4. Very subtle to subdued, well vegetated, can be discontinuous and deeply incised, dissected; feature may be indistinct.
5. Undetermined

V. Vegetation

1. Less dense vegetation than adjacent areas. Recent slide scarps and deposits leave many bare areas. Bare areas also due to lack of vegetative ability to root in unstable soils. Open canopy, may have jack-strawed trees; can have large openings.
2. Bare areas exist with some regrowth. Regrowth or successional patterns related to scarps and deposits. May have some openings in canopy or young broad-leaf vegetation with similar age.
3. Subtle differences from surrounding areas. Slightly less dense and different type vegetation. Essentially closed canopy; may have moderately aged to old trees.
4. Same size, type, and density as surrounding areas.
5. Undetermined

Terrain Stability Units

Terrain Stability Units (TSUs) are delineated by partitioning the landscape into zones characterized by similar geomorphic attributes, shallow-seated landslide potential, and sediment delivery to stream channels. A combination of aerial photograph interpretation, field investigation, and SHALSTAB output were utilized to delineate TSUs. The TSU designations for the Southcoast Streams WAU are only meant to be general characterizations of similar geomorphic and terrain characteristics related to shallow seated landslides. Deep-seated landslides are also shown on the TSU map (Map A-2). The deep-seated landslides have been included to provide land managers with supplemental information to guide evaluation of harvest planning and subsequent needs for geologic review. The landscape and geomorphic setting in the Southcoast Streams WAU is certainly more complex than generalized TSUs delineated for this evaluation. The TSUs are only meant to be a starting point for gauging the need for site-specific field assessments.

The delineation of each TSU described is based on landforms present, the mass wasting processes, sensitivity to forest practices, mass wasting hazard, delivery potential, and forest management related trigger mechanisms for shallow seated landslides. The landform section of the TSU description defines the terrain found within the TSU. The mass wasting process section is a summary of landslide types found in the TSU. Sensitivity to forest practice and mass wasting hazard is, in part, a subjective call by the analyst based on the relative landslide hazard and influence of forest practices. Delivery potential is based on proximity of TSU to watercourses and the likelihood of mass wasting in the unit to reach a watercourse. The hazard potential is based on a combination of the mass wasting hazard and delivery potential (Table A-1). The trigger mechanisms are a list of forest management practices that may have the potential to create mass wasting in the TSU.

Table A-1. Ratings for Potential Hazard of Delivery of Debris and Sediment to Streams by Mass Wasting (L= low hazard, M= moderate hazard, H = high hazard)(from Version 4.0, Washington Forest Practices Board, 1995).

		Mass Wasting Potential		
		Low	Moderate	High
Delivery Potential	Low	**L**	**L**	**M**
	Moderate	**L**	**M**	**H**
	High	**L**	**M**	**H**

RESULTS

Mass Wasting Inventory

A Landslide Inventory Data Sheet (Appendix A) was used to record attributes associated with each landslide. The spatial distribution and location of landslides is shown on Map A-1.

A total of 423 shallow-seated landslides (debris slides, torrents, or flows) were identified and characterized in the Southcoast Streams WAU. A total of 40 deep-seated landslides (rockslides and earthflows) were mapped in the Southcoast Streams WAU. A considerable effort was made to field verify as many landslides as possible to insure greater confidence in the results. Approximately 20% (82/423) of the identified shallow-seated landslides were field verified. From this level of field observations, extrapolation of landslide depth and sediment delivery is assumed to be performed with a reasonable level of confidence.

The temporal distribution of the 423 shallow-seated landslides observed in the Southcoast Streams WAU is listed in Table A-2. The distribution by landslide type is shown in Table A-3.

Table A-2. Shallow-Seated Landslide Summary for Southcoast Streams WAU by Time Periods.

Planning Watershed	1943 - 1952	1953 - 1963	1964 - 1978	1979 - 1987	1988 - 2000	2001 - 2004	1943 - 2004
Mallo Pass	19	35	40	31	7	1	133
Lower Alder	32	39	39	40	20	8	178
North Fork Alder	10	24	18	1	2	0	55
Lower Brush	1	4	0	0	1	0	6
Upper Brush	0	0	0	2	0	0	2
PA Creeks	7	9	13	10	6	4	49
Southcoast Streams WAU	69	111	110	84	36	13	**423**

Table A-3. Landslide Summary by Type and Planning Watershed for Southcoast Streams WAU.

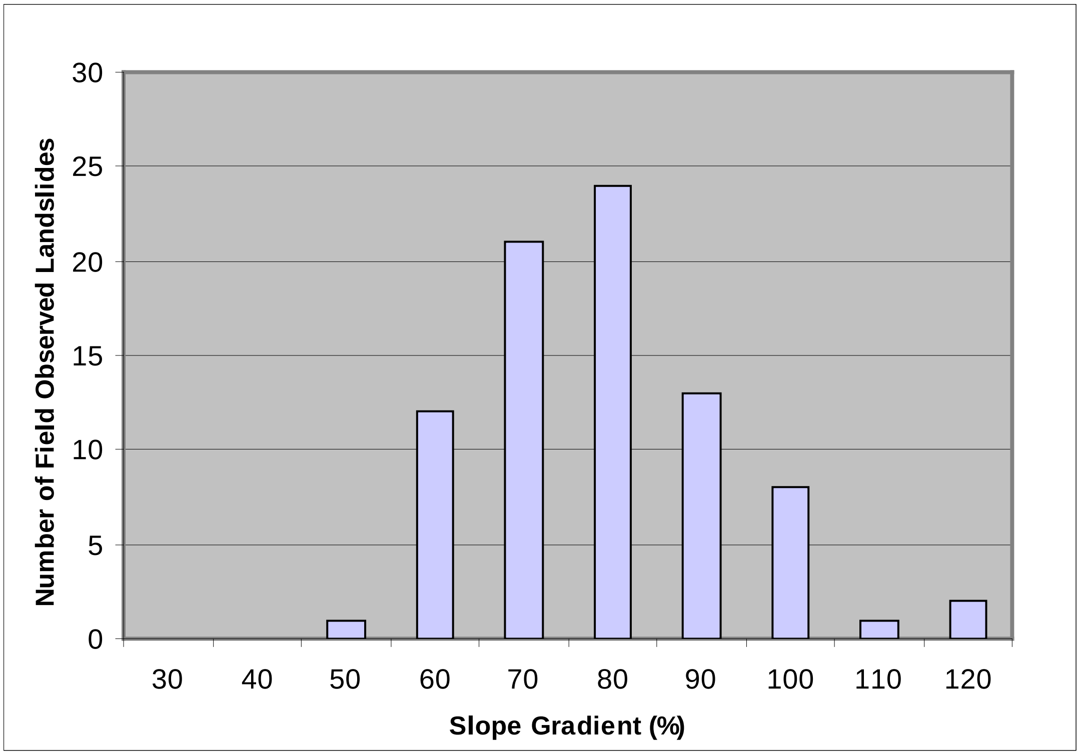
Planning Watershed	Debris Slides	Debris Flows	Debris Torrents	Rock-slides	Earth-flows	Total	Road[a] Assoc.
Mallo Pass	119	12	2	8	0	141	113
Lower Alder	161	13	4	22	0	200	115
North Fork Alder	54	1	0	6	0	61	40
Lower Brush	5	1	0	0	0	6	6
Upper Brush	2	0	0	0	0	2	2
PA Creeks	43	4	2	3	1	53	34
Southcoast Streams WAU	384	31	8	39	1	463	310

a – Includes roads, skid trails, and landings

The majority of the landslides observed in the Southcoast Streams WAU are debris slides. Of the 423 shallow-seated landslides in the Southcoast Streams WAU, 310 are determined to be road associated (includes roads, skid trails, or landings). This is approximately 73% of the total number of shallow-seated landslides. There were 39 debris torrents and flows observed in the Southcoast Streams WAU. This is approximately 9% of the total shallow-seated landslides observed in the Southcoast Streams WAU.

Of the 82 field observed shallow-seated landslides across the Southcoast Streams WAU, 84% (69/82) were initiated on slopes of 70% gradient or higher (Chart A-1).

Chart A-1. Slope Gradient Histogram for Shallow-Seated Landslides Occurring on MRC Ownership in the Southcoast Streams WAU.



A majority of inventoried landslides originated in convergent topography (294/423, or 70%) where subsurface water tends to concentrate, or on steep, planar topography (129/423, or 30%), where sub-surface water can be concentrated at the base of slopes, in localized topographic depressions, or by local geologic structure. No landslides originated in divergent topography where subsurface water is typically routed to the sides of ridges (Chart A-2).

A majority of the inventoried landslides were discovered along steep streamside slopes (230/423, or 54%), with fewer found in headwall swales (82/423, or 19%), and no inner gorge slopes observed. A significant portion (111/423, or 26%) of the inventoried landslides were observed on open slopes away from any steep streamside slopes, or headwall swales, however, a majority of these slides originated in fill material along the outside edge of roads and skid trails (Chart A-3). Such observations were, in part, the basis for the delineation of the WAU into Terrain Stability Units.

Chart A-2. Slope Morphology Summary for Shallow-Seated Landslides Occurring on MRC Ownership in the Southcoast Streams WAU.

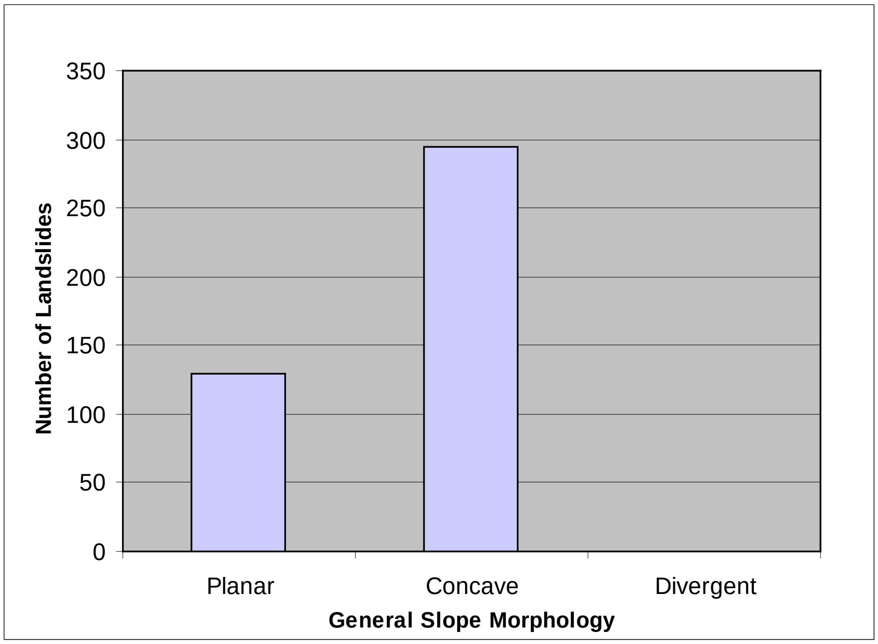
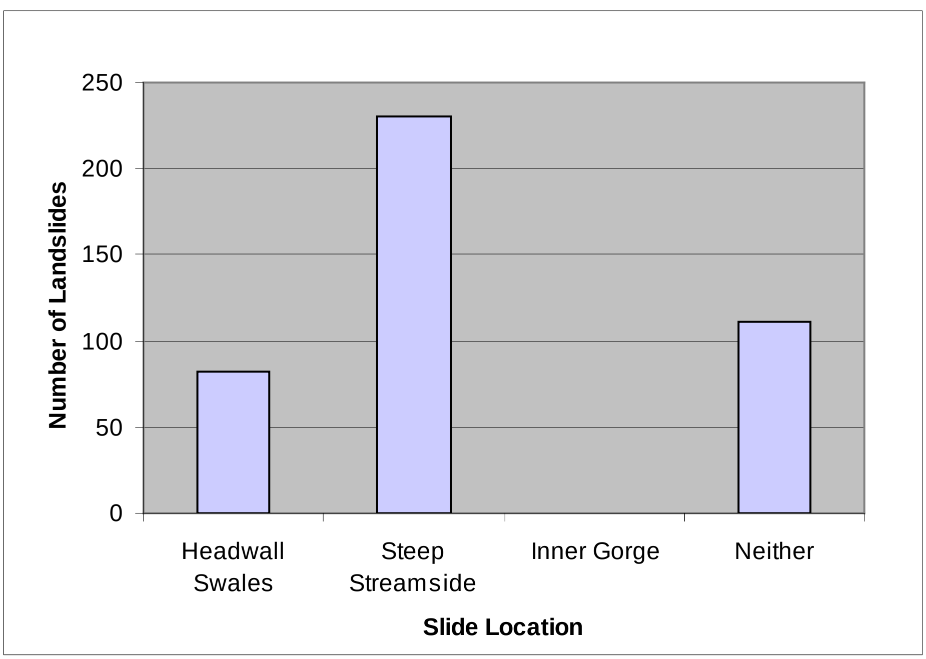


Chart A-3. Slide Location Summary for Shallow-Seated Landslides Occurring on MRC Ownership in the Southcoast Streams WAU.



Terrain Stability Units

The landscape was partitioned into seven Terrain Stability Units representing general areas of similar geomorphology, landslide processes, and sediment delivery potential for shallow-seated landslides (Map A-2). The units are to be used by forest managers to assist in making decisions that will minimize future mass wasting sediment input to watercourses. The delineation for the TSUs was based on qualitative observations and interpretations from aerial photographs, field evaluation, and SHALSTAB output. Deep-seated landslides are also shown on the TSU map (Map A-2). The deep-seated landslides have been included to provide land managers with supplemental information to guide evaluation of harvest planning and subsequent needs for geologic review.

Shallow-seated landslide characteristics considered in determination of map units are size, frequency, delivery to watercourses, and spatial distribution. Hillslope characteristics considered are slope form (convergence, divergence, planar), slope gradient, relative magnitude of stream incision, and overall geomorphology. The range of slope gradients was determined from USGS 1:24,000 topographic maps and field observations. Hillslope and landslide morphology vary within each individual TSU and the boundaries are not exact. This evaluation is not intended to be a substitute for site-specific field assessments. Site-specific field assessments will still be required in TSUs and at deep-seated landslides or specific areas of some TSUs to assess the risk and likelihood of mass wasting impacts from a proposed management action. The TSUs are compiled on the entitled Terrain Stability Unit Map (Map A-2).

TSU Number: 1

Description: Inner Gorge or Steep Streamside Slopes adjacent to Low Gradient Watercourses

Materials: Shallow soils formed on weathered marine sedimentary rocks. Maybe composed of toe sediment of deep-seated landslide deposit.

Landform: Characterized by steep streamside slopes or inner gorge topography along low gradient watercourses (typically less than 6-7%). An inner gorge is a geomorphic feature created from down cutting of the stream, generally in response to tectonic uplift. Inner gorge slopes extend from either one or both sides of the stream channel to the first break in slope. Inner gorge slope gradients typically exceed 70%, although slopes with lower inclination are locally present. Inner gorge slopes commonly contain areas of multiple, coalescing shallow seated landslide scars of varying age. Steep streamside slopes are characterized by their lack of a prominent break in slope. Slopes are generally planar in form with slope gradients typically exceeding 70%. The upper extent of TSU 1 is variable. Where there is not a break in slope, the unit may extend 300 feet upslope (based on the range of lengths of landslides observed, 20-300 feet). Landslides in this unit generally deposit sediment directly into Class I and II streams. Small areas of incised terraces may be locally present.

Slope: Typically >70 %, (mean slope of observed mass wasting events is 85%, range is 65%-120%)

Total Area: 592 acres; 4% of the total WAU area.

MW Processes: 76 *road-associated landslides*

- 70 Debris slides
- 6 Debris flows
- 0 Debris torrents

26 *non-road associated landslides*

- 26 Debris slides
- 0 Debris flows
- 0 Debris torrents

Non Road-related Landslide Density: 0.04 landslides per acre for the past 62 years.

Forest Practices Sensitivity: High sensitivity to road construction due to proximity to watercourses, high sensitivity to harvesting and forest management practices due to steep slopes with localized colluvial or alluvial soil deposits adjacent to watercourses.

Mass Wasting Potential: High localized potential for landslides in both unmanaged and managed conditions.

Delivery Potential:	High
Delivery Criteria Used:	Steep slopes adjacent to stream channels, a majority of the observed landslides delivered sediment into streams.
Hazard-Potential Rating:	**High**

Forest Management Related Trigger Mechanisms:

- Sidecast fill material placed on steep slopes can initiate debris slides or flows in this unit.
- Concentrated drainage from roads onto unstable areas can initiate debris slides or flows in this unit.
- Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Sidecast fill material created from skid trail construction placed on steep slopes can initiate debris slides or flows in this unit.
- Concentrated drainage from skid trails onto unstable areas can initiate debris slides or flows in this unit.
- Cut-slope of skid trails can remove support of slope creating debris slides, torrents or flows in this unit.
- Cut-slope of skid trails can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Concentrated drainage from roads can increase groundwater, accelerating movement of rockslides or earth flows and over-steepening TSU 1 slopes.
- Removal of vegetation from these slopes can result in loss of evapotranspiration and thus increase pore water pressures that could initiate slope failure in this unit.
- Post timber harvest root decay of hardwood or non-redwood conifer species can be a contributing factor in the initiation of debris slides, torrents or flows in this unit.

Confidence: High confidence for susceptibility of landslides and sediment delivery in this unit. Moderate confidence in placement of the unit boundary. This unit is locally variable and exact boundaries are best determined during field observations. Within this unit there are likely areas of low gradient slopes that are less susceptible to mass wasting.

TSU Number: 2

Description: Inner gorge or Steep Streamside Slopes adjacent to high gradient intermittent or ephemeral watercourses.

Materials: Shallow soils formed from weathered marine sedimentary rocks with localized areas of thin to thick colluvial deposits.

Landforms: Characterized by steep streamside slopes or inner gorge topography along low gradient watercourses (typically greater than 6-7%). An inner gorge is a geomorphic feature created from down cutting of the stream, generally in response to tectonic uplift. Inner gorge slopes extend from either one or both sides of the stream channel to the first break in slope. Inner gorge slope gradients typically exceed 70%, although slopes with lower inclination are locally present. Inner gorge slopes commonly contain areas of multiple, coalescing shallow seated landslide scars of varying age. Steep streamside slopes are characterized by their lack of a prominent break in slope. Slopes are generally planar in form with slope gradients typically exceeding 70%. The upper extent of TSU 2 is variable. Where there is not a break in slope, the unit may extend 300 feet upslope (based on the range of lengths of landslides observed, 25-300 feet). Landslides in this unit generally deposit sediment directly into Class I and II streams.

Slope: Typically >70% (mean slope of observed mass wasting events is 68%, range is 60%-85%).

Total Area: 1,315 acres; 10% of total WAU area

MW Processes: 91 *road-associated landslides*

- 85 Debris slides
- 4 Debris flows
- 2 Debris torrents

32 *non-road associated landslides*

- 25 Debris slides
- 4 Debris flows
- 3 Debris torrent

Non Road-related Landslide Density: 0.02 landslides per acre for the past 62 years.

Forest Practices Sensitivity: High sensitivity to roads due to steep slopes adjacent to watercourses, high to moderate sensitivity to harvesting and forest management due to steep slopes next to watercourses. Localized areas of steeper and/or convergent slopes may have an even higher sensitivity to forest practices.

Mass Wasting Potential: High in both unmanaged and managed conditions due to the steep morphology of the slope.

Delivery Potential: High

Delivery Criteria Used: Steep slopes adjacent to stream channels, a majority of the observed landslides delivered sediment into streams.

Hazard-Potential Rating: **High**

Forest Management Related Trigger Mechanisms:

- Sidecast fill material placed on steep slopes can initiate debris slides, torrents or flows in this unit.
- Concentrated drainage from roads onto unstable areas can initiate debris slides, torrents or flows in this unit.
- Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Sidecast fill material created from skid trail construction placed on steep slopes can initiate debris slides, torrents or flows.
- Concentrated drainage from skid trails onto unstable areas can initiate debris slides, torrents or flows.
- Cut-slope of skid trails can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of skid trails can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Removal of vegetation from these slopes can result in loss of evapotranspiration and thus increase pore water pressures that could initiate slope failure in this unit.
- Post timber harvest root decay of hardwood or non-redwood conifer species can be a contributing factor in the initiation of debris slides, torrents or flows in this unit.

Confidence: High confidence for susceptibility of unit to landslides and sediment delivery. Moderate confidence in the placement of this unit. This unit is highly localized and exact boundaries are better determined from field observations. Within this unit there are likely areas of low gradient slopes that are less susceptible to mass wasting.

TSU Number:	3
Description:	Dissected and convergent topography
Materials:	Shallow soils formed from weathered marine sedimentary rocks with localized thin to thick colluvial deposits.
Landforms:	These areas have steep slopes (typically greater than 65%) that have been sculpted over geologic time by repeated debris slide events. The 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. MRC intends this unit to represent areas with a high hazard potential for shallow landsliding, while not constituting a continuous streamside unit (otherwise it would classify as TSU 1 or 2). The mapped unit may represent isolated individual “high hazard” areas or areas where there is a concentration of “high hazard” areas. Boundaries between higher hazard areas and other more stable areas (i.e. divergent and lower gradient slopes) within the unit should be keyed out as necessary based on field observation of landslide features.
Slope:	Typically >70%, (mean slope of observed mass wasting events is 78%, range is 65%-90%)
Total Area:	761 acres, 6% of the total WAU
MW Processes:	69 *road associated landslides* • 57 Debris slides • 9 Debris flows • 3 Debris torrents 33 *non-road associated landslides* • 32 Debris slides • 1 Debris flows • 0 Debris torrents
Non Road-related Landslide Density:	0.04 landslides per acre for the past 62 years.
Forest Practices Sensitivity:	Moderate to high sensitivity to road building, moderate to high sensitivity to harvesting and forest management practices due to moderate to steep slopes within this unit. Localized areas of steeper and/or convergent slopes have even higher sensitivity to forest practices.
Mass Wasting Potential:	High
Delivery Potential:	Moderate

Delivery Criteria Used: The converging topography directs mass wasting down slopes toward watercourses. Delivery potential may be high based on relatively high number of debris slides. Landslides in headwater swales often torrent or flow down watercourses. Approximately 80% of landslides in this unit delivered sediment.

Hazard-Potential Rating: **High**

Forest Management Related Trigger Mechanisms:

- Sidecast fill material placed on steep slopes can initiate debris slides, torrents or flows in this unit.
- Concentrated drainage from roads onto unstable areas can initiate debris slides, torrents or flows in this unit.
- Concentrated drainage from roads can increase groundwater, accelerating movement of rockslides or earth flows in this unit.
- Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Concentrated drainage from skid trails onto unstable areas can initiate debris slides, torrents or flows.
- Cut-slope of skid trails can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of skid trails can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Sidecast fill material created from skid trail construction placed on steep slopes can initiate debris slides, torrents or flows.
- Removal of vegetation from these slopes can result in loss of evapotranspiration and thus increase pore water pressures that could initiate slope failure in this unit.
- Post timber harvest root decay of hardwood or non-redwood conifer species can be a contributing factor in the initiation of debris slides, torrents or flows in this unit.

Confidence: Moderate confidence in placement of unit. This unit is locally variable and exact boundaries are best determined from field observations. Some areas within this unit could have higher susceptibility to landslides and higher delivery rates due to localized areas of steep slopes, weak earth materials, and/or adverse ground water conditions.

TSU Number:	4
Description:	Non-dissected topography
Materials:	Shallow to moderately deep soils formed from weathered marine sedimentary rocks.
Landforms:	Moderate to moderately steep hillslopes with planar, divergent, or broadly convergent slope forms with isolated areas of steep topography or strongly convergent slope forms. TSU 4 is generally a midslope region of lesser slope gradient and more variable slope form than TSU 3.
Slope:	Typically 40% - 65%, (mean slope of observed mass wasting events is 76%, range is 50% - 110%)
Total Area:	9829 acres, 73% of the total WAU
MW Processes:	74 *road-associated landslides* • 69 Debris slides • 5 Debris flows • 0 Debris torrents 21 *non-road associated landslides* • 19 Debris slides • 2 Debris flows • 0 Debris torrent
Non Road-related Landslide Density:	0.002 landslides per acre for the past 62 years.
Forest Practices Sensitivity:	Moderate sensitivity to road building, moderate to low sensitivity to harvesting and forest management practices due to moderate slope gradients and non-converging topography within this unit. Localized areas of steeper slopes have higher sensitivity to forest practices.
Mass Wasting Potential:	Moderate
Delivery Potential:	High
Delivery Criteria Used:	This unit constitutes a majority of the WAU, which accounts for it having the highest number of landslides. This unit has a low non-road related landslide density, and therefore has a moderate mass wasting hazard. Although landslides in this unit are localized, when landslides occur, the landslide has a high potential to deliver. Approximately 90% of the landslides in this unit delivered sediment. This unit has a moderate sensitivity to road building due to low road landslide density.

Hazard-Potential Rating: **Moderate**

Forest Management Related Trigger Mechanisms:

- Sidecast fill material placed on steep slopes can initiate debris slides, torrents or flows in this unit.
- Concentrated drainage from roads onto unstable areas can initiate debris slides, torrents or flows in this unit.
- Concentrated drainage from roads can increase groundwater, accelerating movement of rockslides or earth flows in this unit.
- Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Concentrated drainage from skid trails onto unstable areas can initiate debris slides, torrents or flows.
- Cut-slope of skid trails can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of skid trails can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Sidecast fill material created from skid trail construction placed on steep slopes can initiate debris slides, torrents or flows.
- Removal of vegetation from these slopes can result in loss of evapotranspiration and thus increase pore water pressures that could initiate slope failure in this unit.
- Post timber harvest root decay of hardwood or non-redwood conifer species can be a contributing factor in the initiation of debris slides, torrents or flows in this unit.

Confidence: High confidence in placement of unit, however, this unit is locally variable and exact boundaries are best determined from field observations. Some areas within this unit could have higher susceptibility to landslides and higher delivery rates due to localized areas of steep slopes, weak earth materials, and/or adverse ground water conditions.

TSU Number:	5
Description:	Low relief topography
Material:	Moderately deep to deep soils, derived from weathered marine sedimentary rocks.
Landforms:	Characterized by low gradient slopes generally less than 40%, although in some places slopes may be steeper. This unit occurs on ridge crests, low gradient side slopes, and well-developed terraces. Shallow-seated landslides seldom occur and usually do not deliver sediment to stream channels.
Slope:	Typically <40% (based on field observations)
Total Area:	570 acres, 4% of WAU area
MW Processes:	0 *road-associated landslides* • 0 Debris slides • 0 Debris flows • 0 Debris torrents 1 *non-road associated landslides* • 1 Debris slides • 0 Debris flows • 0 Debris torrent
Non Road-related Landslide Density:	0.001 landslides per acre for the past 62 years.
Forest Practices Sensitivity:	Low sensitivity to road building and forest management practices due to low gradient slopes
Mass Wasting Potential:	Low
Delivery Potential:	Low
Delivery Criteria Used:	Sediment delivery in this unit is low.
Hazard-Potential Rating:	**Low**
Forest Management Related Trigger Mechanisms:	•Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit.

- Concentrated drainage from roads and skid trails can initiate or accelerate gully erosion, which can increase the potential for mass wasting processes.

Confidence: High confidence in placement of unit in areas of obviously stable topography. High confidence in mass wasting potential and sediment delivery potential ratings.

TSU Number:	8
Description:	Ohlson Ranch Formation
Materials:	Fine-grained, relatively cohesionless, sandy material.
Landforms:	Boundaries of this unit correspond to the mapped outcrops of the Ohlson Ranch Formation (Manson, 1984). Slopes are characterized by relatively low gradient slopes found along broad wave cut ridge-tops. Ground surfaces in this unit contain areas of vegetation similar to the surrounding forest. Rills and gullies are common in this unit, particularly where roads and skid trails concentrate water for any significant distance.
Slope:	Typically <30%
Total Area:	382 acres; 8% of the total WAU.
MW Processes:	0 *landslides*
Non Road-related Landslide Density:	0 landslides per acre for past 67 years.
Forest Practices Sensitivity:	High sensitivity to roads and skid trails, low sensitivity to harvesting of trees. However, slopes underlain by this unit are not steep and therefore usually harvested using ground based yarding where skid trails
Mass Wasting Potential:	Low
Delivery Potential:	Moderate
Delivery Criteria Used:	All mapped exposures of the Ohlson Ranch Formation, and overlying residual soils, typically occur on low gradient ridge-tops where run-off is generated through subsurface processes. However, where first order ephemeral watercourses originate in these deposits, and connectivity exists to higher order tributaries, the potential for surface erosion and sediment delivery is relatively high if roads and/or skid trails are not properly constructed and/or drained after operations.
Hazard Potential Rating:	**Low**
Forest Management Related Trigger Mechanisms:	•Concentrated drainage from roads and skid trails can initiate or accelerate gully erosion, which can increase the potential for sediment delivery.

Confidence: High confidence in placement of unit in areas of obviously erodible cohesionless sandy earth materials. High confidence in mass wasting potential and sediment delivery potential ratings.

Sediment Input from Mass Wasting

Sediment delivery was estimated for shallow-seated landslides in the Southcoast Streams WAU. Depth values were estimated to facilitate approximation of mass for the landslides not observed in the field. In order to extrapolate depth to the shallow-seated landslides not visited in the field, an average was taken from the measured depths of landslides visited in the field. The mean depth of all shallow-seated landslides interpreted as being unrelated to road systems was 5 feet. The mean depth of all shallow seated landslides interpreted as being associated with road systems was 4 feet. Due to the relative lack of debris flows and torrents, no effort was made to differentiate landslide depths among different shallow landslide types. The mean depths were assigned to all landslides not verified in the field.

The mean sediment delivery percentage assigned to shallow landslides determined to deliver sediment, but not field verified, is 40%. Of the 423 shallow-seated landslides mapped in this watershed analysis, 396 of the landslides delivered some amount of sediment (Table A-4).

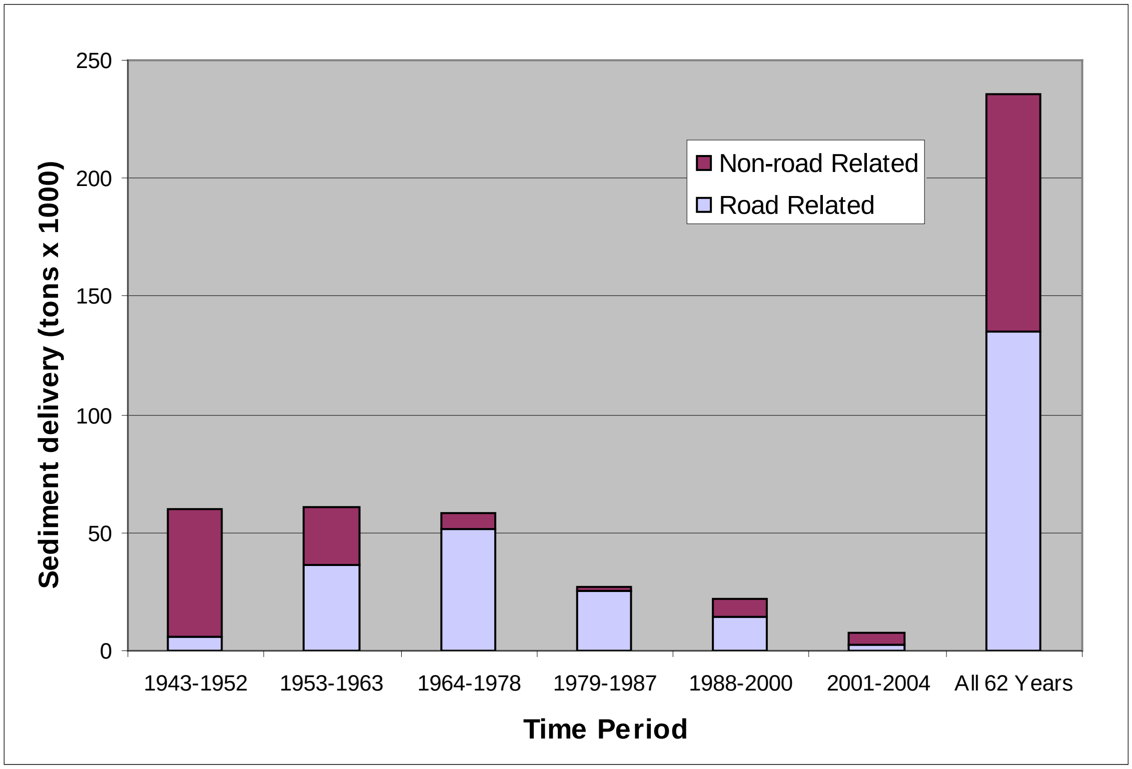
Table A-4. Total Shallow-Seated Landslides Mapped for each PWS in Southcoast Streams WAU.

Planning Watershed	Total Landslides	Landslides with Sediment Delivery	Landslides with No Sediment Delivery
Mallo Pass Cr.	133	124	9
Lower Alder Cr.	178	165	13
North Fork Alder Cr.	55	54	1
Lower Brush Cr.	6	6	0
Upper Brush Cr.	2	2	0
Point Arena Creeks	49	45	4
Southcoast Streams WAU	**423**	**396**	**27**
Percentage	100%	94%	6%

Sediment input to stream channels by mass wasting is quantified for six time periods (1943-1952, 1953-1963, 1964-1978, 1979-1987, 1988-2000, 2001-2004). The dates for each of the time periods are based on the date of aerial photographs used to interpret landslides (1952, 1963, 1978, 1987, 2000, and 2004) and field observations (2011). The available aerial photography did not correspond exactly to ten year time periods for mass wasting assessment, however the time periods and the aerial photographs analyzed approximate decadal intervals and bracket major disturbance events (e.g. intensive tractor logging in the 1960's and 1970's). These time periods allow for a general evaluation of the relative magnitude of sediment delivery rate estimates across the Southcoast Streams WAU.

A total of approximately 235,529 tons of mass wasting sediment delivery was estimated for the time period 1943-2004 in the Southcoast Streams WAU. This equates to approximately 176 tons/sq. mi./yr. Of the total estimated amount, 25% delivered from 1943-1952, 25% delivered from 1953-1963, 25% delivered from 1964-1978, 12% delivered from 1979-1987, 10% delivered from 1988-2000, and 3% delivered in the 2001-2004 time period (Chart A-4).

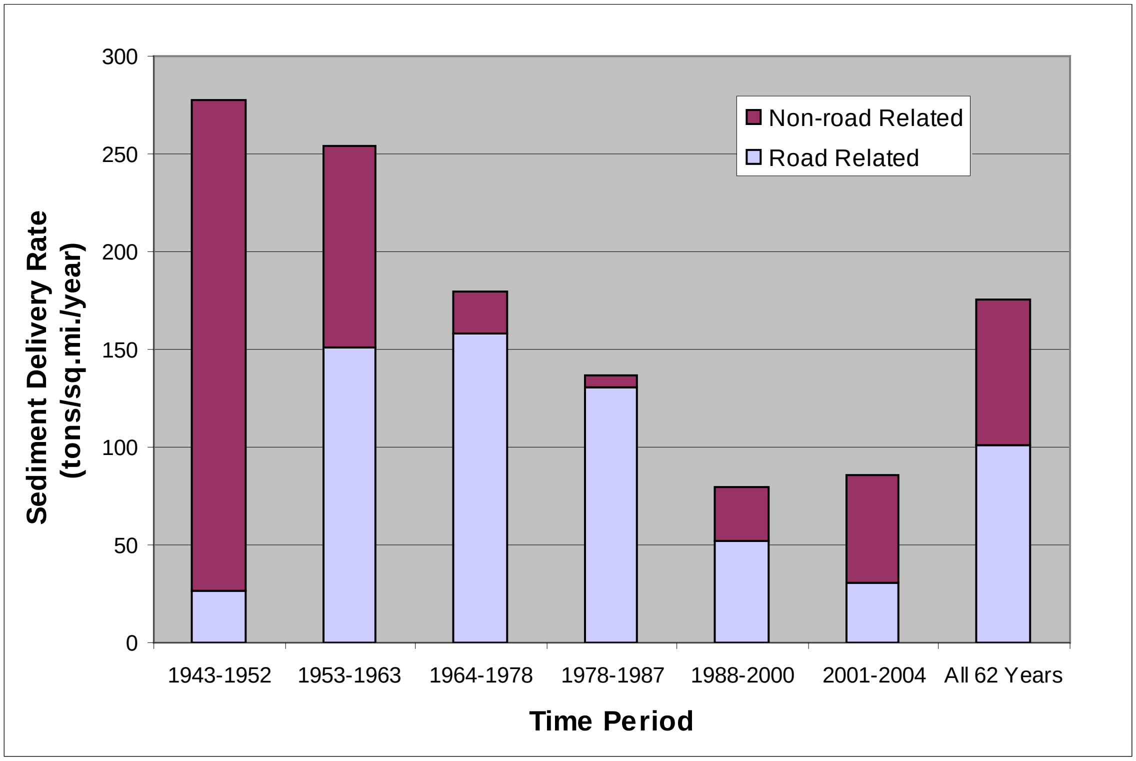
Chart A-4. Sediment Delivery Estimates by Time Period for Shallow-Seated Landslides on MRC Ownership in the Southcoast Streams WAU.



Relatively large amounts of sediment delivered from 1953-1978 is partly the result of intensive road building and ground based yarding on relatively steep slopes. Road and skid trail construction during this era of forest management included the practice of sidecasting excavated fill material, at times onto steep slopes. Additionally, according to local rainfall data, the 1974 storm event produced the wettest days on record at numerous precipitation stations on the northwest coast (Goodridge, 1997). Numerous studies reveal there is a pronounced effect of pore water pressure changes on factor of safety for shallow-seated landslides (Sidle et al., 1985).

The sediment delivery estimates were normalized by time (years) and area (square miles) for the purposes of relative comparison between time intervals and planning watershed. The resulting sediment delivery rates in the Southcoast Streams WAU change dramatically over the time period investigated (Chart A-5).

Chart A-5. Mass Wasting Sediment Delivery Rate (tons/sq.mi./year) from Shallow-Seated Landslides on MRC Ownership in the Southcoast Streams WAU.



Road associated mass wasting (including roads, skid trails, and landings) was found to have contributed 135,370 tons (101 tons/sq. mi./yr) of sediment over the 62 years analyzed in the Southcoast Streams WAU (Table A-5). This represents approximately 57% of the total mass wasting inputs for the Southcoast Streams WAU for 1943-2004. The road related sediment delivery rates vary widely over the time periods analyzed. A review of the aerial photo record reveals a majority of Southcoast Streams WAU had been intensively tractor yarded in the 1960's and 1970's.

Table A-5. Road Associated Sediment Delivery (tons) for Shallow-Seated Landslides in the Southcoast Streams WAU by Planning Watershed.

Planning Watershed	Road Associated Mass Wasting Sediment Delivery (tons)	Percent of Total Sediment Delivery From Planning Watershed
Mallo Pass Creek	52,363	72%
Lower Alder Creek	46,459	44%
North Fork Alder Creek	18,560	62%
Lower Brush Creek	1,836	100%

Upper Brush Creek	500	100%
Point Arena Creeks	15,652	59%
Southcoast Streams WAU	**135,370**	**57%**

A categorical description of the land area interpreted to concentrate surface and/or subsurface flow to the point of failure for non-road related shallow-seated failures was conducted. Road related failures were excluded because of the many other variables that influence road failures (e.g. thickness of fill, construction techniques, concentrated road run-off, etc.). In this analysis, categories of contributing area included small areas (<0.5 acres), medium sized areas (0.5-3.0 acres) and large areas (>3.0 acres). Areas were determined by a combination of air photo and GIS analysis and indicate a majority of the sediment delivery is occurring from slides where the contributing area is between 0.5 and 3.0 acres in size (Table A-6).

Table A-6. Sediment Delivery (tons) from Landslides for MRC Ownership in the Southcoast Streams WAU by Contributing Area.

Planning Watershed	Small Area <0.5 acres	Medium Area 0.5-3.0 acres	Large Area >3.0 acres
Mallo Pass Creek	5,690	2,446	11,920
Lower Alder Creek	17,333	19,635	21,115
North Fork Alder Creek	7,040	3,770	480
Lower Brush Creek	0	0	0
Upper Brush Creek	0	0	0
Point Arena Creeks	1,940	3,360	4,680
Southcoast Streams WAU	**32,003**	**29,211**	**38,195**

Intuitively, a majority of the sediment delivery is occurring from large contributing areas where pore pressure increases in response to precipitation events would be most significant.

A categorical description of the slope aspect for all shallow-seated failures was conducted. Despite the other variables that influence road related failures, as mentioned above, road related failures were included in this analysis. In this analysis slope aspect is determined as an absolute azimuth in the GIS and then categorically described as NE (0°-89°), SE (90°-179°), SW (180°-269°), or NW (270°-359°). Results are presented below (Table A-7).

Table A-7. Sediment Delivery (tons) from Landslides for MRC Ownership in the Southcoast Streams WAU by Slope Aspect.

Planning Watershed	NE	NW	SE	SW
Mallo Pass Creek	12,452	16,604	16,352	27,010
Lower Alder Creek	15,025	11,567	25,964	51,986
North Fork Alder Creek	2,622	3,124	7,528	16,576
Lower Brush Creek	300	0	512	1,024
Upper Brush Creek	500	0	0	0
Point Arena Creeks	3,940	4,157	3,006	15,279
Southcoast Streams WAU	**34,839**	**35,452**	**53,362**	**111,875**

A majority (69%) of the sediment delivery is occurring on slopes with a predominately south facing aspect. This may be attributed to the south to north direction that rain falls when storm events occur over in the area, resulting in increased pore water pressure increases on south facing slopes.

The distribution of shallow-seated landslides by soil type was analyzed to investigate the relationship between sediment delivery and soil type. The Mendocino County Soil Survey (Rittiman and Thorson, 2001) data includes a classification (USCS, Unified Soil Classification System) that describes the general properties of the soil. Criteria for mapping soil types and classifying them based on the USCS are presented elsewhere. Results are presented below (Table A-8).

Table A-8. Sediment Delivery from Landslides for MRC Ownership in the Southcoast Streams WAU by Soil Type.

Planning Watershed	CL-ML[a]	SM[b]	GM[c]	GC-GM[d]
Mallo Pass Creek	48,349	0	0	24,070
Lower Alder Creek	81,697	0	0	22,845
North Fork Alder Creek	14,620	0	6,130	9,100
Lower Brush Creek	300	0	0	1,536
Upper Brush Creek	0	0	0	500
Point Arena Creeks	22,381	4,001	0	0
Southcoast Streams WAU	**167,347**	**4,001**	**6,130**	**58,051**

[a] CL-ML - predominately fine grained sands, silts, and clays
[b] SM - predominately silty sand
[c] GM - predominately silty gravels
[d] GC-GM - predominately silty and clayey gravels

Results of this analysis reveal a majority of the sediment delivery is occurring from fine grained sand silts and clays, however, fine grained soils also make up a majority of the soils mapped in the Southcoast Streams WAU.

Historically, research on the influence of timber harvesting on slope stability has focused on clear-cutting, or even-aged management, where hydrologic changes are most pronounced. The effect of partial harvest, or uneven-aged management, on slope stability is less well known. This data should not be misinterpreted as present forest conditions on MRC lands have resulted in a majority of the ownership being in a state of partial harvest. The purpose of this analysis is to begin to generate a long term dataset on the relationship between forest conditions and landslide occurrence. Updates to this watershed analysis over time will build upon this dataset with the intention of identifying any emerging trends in the relationship between forest conditions and sediment delivery from partial harvesting.

The effect that forest stand conditions can have on sediment delivery from shallow-seated landsliding is investigated by attributing recent (2001-2004) non-road related failures with a forest inventory variable titled “structure class.” Stands with similar forest attributes (dominant diameter, dominant vegetation, and canopy density) are described by their structure class as a tool for MRC to assess habitat conditions property wide. Generally, in this process vegetation strata are delineated based on an air photo interpretation of individual similar stands, subsequent field sampling generates empirical information on tree species, diameter, and canopy, and similar strata are grouped together to generate structure classes for habitat description purposes. The findings are summarized below (Table A-9).

Table A-9. Forest Stand Attributes for Recent Non-Road Related Landslides on MRC Ownership in the Southcoast Streams WAU.

Slide ID	Structure Class	Dominant Veg.	Dominant Diameter	Canopy Closure
701	17	Conifer	<16”	40%-60%
703	12	Conifer/Hardwoods	16-24”	>60%
704	22	Conifer	16-24”	>60%
706	18	Conifer	16-24”	40%-60%
707	22	Conifer	16-24”	>60%
711	12	Conifer/Hardwoods	16-24”	>60%
712	1	Mixed Hardwoods	<8”	20%-40%

Sediment Input by Terrain Stability Unit

Total mass wasting sediment delivery for the Southcoast Streams WAU was separated into respective Terrain Stability Units. Sediment delivery statistics for each TSU are summarized in Table A-10.

Table A-10. Total Sediment Delivery (in tons) by TSU in the Southcoast Streams WAU (tons)

Sediment Delivery (tons)	TSU					
	1	2	3	4	5	8
Road Related	39,268	32,432	32,171	31,498	0	0
% of road related	29%	24%	24%	23%	0%	0%
Non-Road Related	26,246	23,333	33,168	17,413	0	0
% of non-road related	26%	23%	33%	17%	0%	0%
Total	***65,514***	***55,765***	***65,339***	***48,911***	***0***	***0***
% of total delivery	28%	24%	28%	21%	0%	0%
Acres	592	1,315	761	9,829	570	382
% of WAU area	4%	10%	6%	73%	4%	3%
Ratio- delivery %/area %	6.3	2.4	4.9	0.3	0.0	0.0

The TSU’s with the largest estimated sediment delivery are TSU 1 and 3, which cumulatively are estimated to deliver 56% of the total sediment input for the Southcoast Streams WAU. Combining all high hazard units (TSU 1, 2, and 3) would yield 82% of the estimated non-road related sediment input on approximately 20% of the MRC owned acreage. Combining the moderate and low hazard units (TSU 4, and 5) would yield 17% of the estimated non-road related sediment input off the remaining 80% of the property. One measure of the intensity of mass wasting processes in a given TSU is the amount of sediment produced divided by the area in the TSU. The last row in Table A-10 expresses landslide intensity as the ratio of the percentage of total sediment delivered by the percentage of watershed area in the TSU. A ratio of 1.0 would indicate that the map unit is producing a proportion of the sediment delivery equal to the proportion of the map unit area within the WAU. Values of this ratio greater than 1.0 indicate high landslide rates in a relatively concentrated area. The TSUs with the largest ratios were units 1, 2, and 3, with ratios of 6.3, 2.4, and 4.9, respectively. The smallest ratios are found in units 4, 5, and 8; 0.3, 0.0, and 0.0 respectively. The ratios suggest that the delineation of the high hazard Terrain Stability Units has captured the majority of the estimated sediment delivery from mass wasting over the past 62 years in the Southcoast Streams WAU.

CONCLUSIONS

In forest environments of the California Coast Range, mass wasting is a common, natural occurrence. In the Southcoast Streams WAU this is due to steep slopes, the condition of weathered and intensely sheared and fractured marine sedimentary rocks, seismic activity, locally thick colluvial soils, a history of timber harvest practices, and the occurrence of high intensity rainfall events. Mass wasting events are episodic and many landslides may happen in a short time frame. Mass wasting features of variable age and stability are observed throughout the Southcoast Streams WAU. A majority of the landslides visited in the field during this assessment occurred on slopes greater than 70%. Seeps and springs were evident in the evacuated cavity at many sites. Particular caution should be exercised when conducting any type of forest management activity in areas with convergent or locally steep topography.

Mass wasting sediment input is estimated to be at least 176 tons/sq.mi./yr. over the 1943-2004 time period for the entire Southcoast Streams WAU. However, approximately 73% of the shallow-seated landslides inventoried in the Southcoast Streams WAU are road associated (includes roads, skid trails, and landings). Road associated mass wasting represented 57% of the estimated sediment delivery, or at least 101 tons/sq. mi./yr of sediment over the 62 years analyzed. Road construction is thus a significant factor in the cause of shallow-seated mass wasting events. Improved road construction practices combined with design upgrades of old roads can reduce anthropogenic sediment input rates and mass wasting hazards.

The steep streamside areas of TSU 1, 2, and 3 contribute the highest amount of the sediment per unit area in the watershed. In the moderate and low hazard units of TSU 4 and 5, a large amount of road associated landslides are occurring, suggesting the need to make improvements on roads within the Southcoast Streams WAU.

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Coastal Rockport Mass Wasting Inventory
Appendix A

Watershed:	Southcoast Streams							Shallow-seated landslides																	Deep-seated landslides							Mass Wasting Inventory Sheet Mendocino Redwood Company, LLC
Unique ID#	PWS	T & R Sec. #	Air Photo year	Air Photo frame	Landslide Type DS DF DT EF RS	TSU 1 2 3 4 5 6	Certainty D P Q	Length feet	Size Width feet	Depth feet	Slide Vol. yd^3	Sed. Routing P I N	Dom. Aspect NE SE NW SW	Sed. Del. Ratio 25 50 75 100 (%)	Sed. Delivery yd^3	Sed. Delivery tons	Slope (field) (%)	Age N R O	Slope Form C D P	Slide Loc. H S I N	Road Assoc. R S L N I	Contrib. Area S M L	Soil Type USCS	Struc. Class 1 to 24	Toe Activity 1 2 3 4 5	Body Morph. 1 2 3 4 5	Lat. Scarps 1 2 3 4 5	Main Scarps 1 2 3 4 5	DS Veg. 1 2 3 4	Complex Y N	Field Obs. Y N	Comments
1	GP	27	1952	15K-143	DS	2	P	80	40	5	593	P	SW	40	237	320		N	C	S	N	L	CL-ML	22								
2	GP	27	1952	15K-143	DS	1	Q	40	40	5	296	P	SE	40	119	160		N	P	S	N	L	CL-ML	22								
3	GP	27	1952	15K-113	DS	5	D	80	80	5	1185	N	SW	0	0	0		N	P	N	N	M	SM	21								
4	GP	35	1952	15K-113	DS	1	D	80	40	5	593	I	SW	40	237	320		N	C	H	N	M	SM	10								
5	GP	35	1952	15K-113	DS	3	D	80	80	5	1185	I	SW	40	474	640		N	C	H	N	M	CL-ML	10								
6	GP	35	1952	15K-113	DS	3	P	160	80	5	2370	I	SW	40	948	1280		N	C	H	N	L	CL-ML	9								
7	GP	36	1952	15K-113	DS	4	P	80	40	5	593	I	SW	40	237	320		N	C	H	N	L	CL-ML	22								
8	CM	33	1952	15K-133	DS	3	D	160	160	5	4741	I	NW	40	1896	2560		R	C	S	N	L	CL-ML	10								
9	CM	33	1952	15K-133	DS	4	P	80	40	5	593	P	SW	50	296	400	85	N	C	S	N	L	CL-ML	10							Y	
10	CM	33	1952	15K-133	DS	4	D	80	40	5	593	P	SW	40	237	320		N	C	S	N	S	CL-ML	10								
11	CM	33	1952	15K-133	DS	2	D	80	40	5	593	P	SW	40	237	320		N	C	S	N	L	CL-ML	10								
12	CM	28	1952	15K-133	DS	3	P	80	80	5	1185	I	SW	40	474	640		N	C	H	N	M	GC-GM	22								
13	CM	28	1952	15K-133	DS	2	D	40	40	5	296	I	SW	40	119	160		N	C	H	N	M	GC-GM	22								
14	CM	33	1952	15K-133	DS	1	D	40	40	6	356	P	SW	50	178	240	65	N	C	S	N	M	CL-ML	10							Y	
15	CM	33	1952	15K-133	DS	3	D	80	40	5	593	I	SE	40	237	320		N	C	H	N	L	GC-GM	10								
16	CM	28	1952	15K-132	DS	3	D	160	80	5	2370	I	SW	40	948	1280		N	C	H	N	L	GC-GM	10								
17	CM	32	1952	15K-155	DS	3	D	160	80	5	2370	I	SW	40	948	1280		N	P	S	N	S	CL-ML	10								
18	CM	29	1952	15K-156	DS	3	P	80	80	5	1185	I	SE	40	474	640		N	C	H	N	S	CL-ML	17								
19	CM	29	1952	15K-156	DS	3	P	80	80	5	1185	I	SW	40	474	640		N	C	H	N	L	CL-ML	13								
20	CM	32	1952	15K-156	DS	2	D	80	40	5	593	I	NE	40	237	320		N	C	S	N	S	CL-ML	18								
21	CM	32	1952	15K-156	DS	4	D	160	240	6	8533	P	SE	25	2133	2880	110	R	P	S	N	S	CL-ML	13							Y	
22	CM	34	1952	15K-133	DS	4	P	240	160	5	7111	I	NW	40	2844	3840		R	C	H	N	L	CL-ML	17								
23	CM	34	1952	15K-133	DS	4	D	160	160	5	4741	I	NW	40	1896	2560		N	C	H	N	L	GC-GM	13								
24	CM	4	1952	15K-134	DS	2	P	160	80	4	1896	P	SE	40	759	1024		N	C	S	S		GC-GM	22								
25	CM	4	1952	15K-134	DS	3	D	80	160	4	1896	P	SW	40	759	1024		N	C	S	S		GC-GM	22								
26	CM	4	1952	15K-134	DS	3	D	160	160	4	3793	P	SW	40	1517	2048		N	C	S	S		GC-GM	22								
27	CA	9	1952	15K-134	DS	3	P	80	80	4	948	I	SE	40	379	512		N	C	H	S		CL-ML	22								
28	CA	9	1952	15K-134	DS	3	D	80	80	4	948	I	SE	75	711	960	90	N	C	S	N	M	CL-ML	22							Y	
29	CA	9	1952	15K-134	DS	1	D	160	80	12	5689	P	SW	50	2844	3840	100	N	C	S	N	S	CL-ML	13							Y	
30	CA	17	1952	15K-134	DS	1	D	160	80	5	2370	P	SE	75	1778	2400	75	N	C	S	N	L	CL-ML	10							Y	
31	CA	16	1952	15K-134	DS	1	D	160	80	8	3793	P	SW	75	2844	3840	85	N	C	S	N	L	CL-ML	10							Y	
32	CA	10	1952	15K-134	DS	2	P	80	40	5	593	I	NE	40	237	320		R	C	S	N	S	CL-ML	22								
33	CA	9	1952	15K-134	DS	1	D	160	80	5	2370	P	NW	40	948	1280		N	C	S	N	L	CL-ML	10								
34	CA	16	1952	15K-134	DS	2	D	80	40	5	593	I	SW	40	237	320		N	C	H	N	M	CL-ML	21								
35	CA	16	1952	15K-134	DS	2	D	80	160	5	2370	I	SW	40	948	1280		N	P	S	N	S	CL-ML	10								
36	GW	22	1952	15K-134	DS	3	D	80	80	4	948	I	SW	40	379	512		N	C	H	S		GC-GM	22								
37	CA	3	1952	6K-197	DS	4	D	80	80	5	1185	I	SE	40	474	640		N	C	H	N	M	CL-ML	7								
38	CA	2	1952	6K-197	DS	3	D	80	80	5	1185	I	SW	40	474	640		N	C	H	N	M	GC-GM	13								
39	CA	2	1952	6K-197	DS	4	D	80	40	5	593	I	SW	40	237	320		N	C	H	N	L	GC-GM	21								
40	CA	2	1952	6K-197	DS	3	D	160	80	5	2370	I	SW	40	948	1280		R	C	H	N	M	GC-GM	10								
41	CA	1	1952	6K-197	DS	3	D	80	40	5	593	I	SE	40	237	320		N	C	H	N	L	GC-GM	7								
42	CA	1	1952	6K-197	DS	3	D	80	40	5	593	I	SW	40	237	320		N	C	H	N	M	GC-GM	7								
43	CA	1	1952	6K-197	DS	3	D	80	40	5	593	I	SW	40	237	320		N	C	H	N	S	GC-GM	10								
44	CA	1	1952	6K-197	DS	3	D	80	40	4	474	I	NW	40	190	256		N	C	H	S		GC-GM	7								
45	CA	10	1952	6K-198	DT	2	D	160	80	5	2370	P	NE	40	948	1280		N	C	H	N	S	CL-ML	22								500 foot torrent track
46	CA	10	1952	6K-198	DS	3	D	80	80	5	1185	P	NE	40	474	640		N	C	S	N	S	CL-ML	22								
47	CA	10	1952	6K-198	DS	1	D	80	40	5	593	P	NE	40	237	320		N	C	S	N	L	CL-ML	22								
48	CA	15	1952	6K-198	DS	2	D	80	80	5	1185	P	NE	40	474	640		N	C	S	N	L	CL-ML	22								
49	CA	15	1952	6K-198	DS	2	D	80	80	5	1185	P	NE	40	474	640		N	C	S	N	M	CL-ML	22								
50	CA	15	1952	6K-198	DS	2	D	80	80	5	1185	P	SE	40	474	640		N	C	S	N	M	CL-ML	22								
51	CA	15	1952	6K-198	DS	3	D	80	40	4	474	P	SW	40	190	256		N	C	S	S		CL-ML	12								
52	CA	11	1952	6K-198	DT	2	D	80	80	5	1185	P	SE	40	474	640		N	C	S	N	S	CL-ML	22								on DSL 500 foot torrent track
53	CA	11	1952	6K-198	DS	1	D	80	80	5	1185	P	SE	40	474	640		N	C	S	N	L	CL-ML	22								on DSL
54	CA	11	1952	6K-198	DS	1	D	80	80	5	1185	P	SE	40	474	640		N	C	S	N	S	CL-ML	22								on DSL
55	CA	2	1952	6K-198	DS	3	P	80	80	5	1185	P	SW	40	474	640		O	C	S	N	M	GC-GM	10								
56	CA	13	1952	6K-198	DS	2	D	160	80	5	2370	P	NE	40	948	1280		N	C	S	N	M	CL-ML	21								
57	CA	13	1952	6K-198	DS	3	P	80	40	5	593	P	SW	40	237	320		N	C	S	N	M	GC-GM	21								
58	CA	12	1952	6K-198	DS	3	D	80	40	5	593	I	SE	40	237	320		N	C	H	N	S	GC-GM	10								
59	CA	15	1952	6K-199	DS	3	P	80	40	5	593	P	NE	40	237	320		N	C	S	N	S	CL-ML	22								on toe of DSL
63	CN	15	1952	7K-178	DS	3	D	160	80	5	2370	I	SE	40	948	1280		N	C	H	N	S	CL-ML	10								
64	CN	15	1952	7K-178	DS	3	P	160	160	5	4741	I	SE	40	1896	2560		N	C	H	N	S	CL-ML	10								
65	CN	15	1952	7K-178	DS	2	D	40	40	5	296	P	SE	40	119	160		N	P	S	N	M	GC-GM	18								
66	CN	15	1952	7K-178	DS	3	D	80	40	5	593	P	NW	40	237	320		N	C	S	N	S	GC-GM	5								
67	CN	15	1952	7K-178	DS	2	P	40	80	5	593	P	SE	40	237	320		N	C	S	N	M	GC-GM	22								
68	CN	15	1952	7K-178	DS	2	D	40	40	5	296	P	SW	40	119	160		N	P	S	N	M	GC-GM	12								

Watershed:		Southcoast Streams						Shallow-seated landslides																	Deep-seated landslides							Mass Wasting Inventory Sheet
																																Mendocino Redwood Company, LLC
Unique	PWS	T & R	Air Photo	Air Photo	Landslide	TSU	Certainty		Size		Slide	Sed.	Dom.	Sed. Del.	Sed.	Sed.	Slope	Age	Slope	Slide	Road	Contrib.	Soil	Struc.	Toe	Body	Lat.	Main	DS	Complex	Field	
ID#		Sec. #	year	frame	Type			Length	Width	Depth	Vol.	Routing	Aspect	Ratio	Delivery	Delivery	(field)		Form	Loc.	Assoc.	Area	Type	Class	Activity	Morph.	Scarps	Scarps	Veg.		Obs.	Comments
					DS DF DT	1 2 3	D P Q	feet	feet	feet	yd^3	P I N	NE SE	25 50 75	yd^3	tons	(%)	N R O	C D P	H S I N	R S L	S M L	USCS	1 to	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3 4	Y N	Y N	
					EF RS	4 5 6							NW SW	100 (%)							N I			24	4 5	4 5	4 5	4 5				
69	CN	22	1952	7K-178	DS	4	D	40	40	5	296	P	NW	40	119	160		N	P	S	N	S	GC-GM	10								
70	CN	24	1952	8K-17	DS	4	D	80	40	5	593	I	SW	40	237	320		N	C	H	N	S	CL-ML	10								
71	CN	25	1952	8K-17	DS	4	D	40	40	5	296	I	SW	40	119	160		N	C	H	N	S	CL-ML	22								
72	CN	25	1952	8K-17	DS	3	D	80	40	5	593	I	SW	40	237	320		N	C	H	N	S	CL-ML	22								
100	GP	34	1963	6-90	DT	3	D	80	40	4	474	P	SW	40	190	256		N	C	H	S		SM	10								1000' torrent track
101	GP	34	1963	6-90	DS	1	P	120	80	4	1422	P	NW	50	711	960	75	N	P	S	N		CL-ML	22							Y	
102	GP	26	1963	6-90	DS	4	P	80	60	4	711	N	SW	0	0	0	65	N	C	N	R		CL-ML	21							Y	
103	GP	27	1963	6-90	DS	1	Q	120	80	4	1422	P	NW	40	569	768		N	C	S	S		CL-ML	22								
104	GP	26	1963	17-49	DT	2	D	80	60	5	889	I	SE	50	444	600	60	N	C	H	R		SM	22							Y	500' torrent track
105	GP	26	1963	17-49	DS	4	P	80	60	4	711	P	SW	40	284	384		N	C	S	R		CL-ML	21								
106	GP	35	1963	17-49	DS	2	Q	60	40	5	444	P	NE	40	178	240		N	C	S	N		CL-ML	22								
107	GP	17	1963	17-93	DS	2	D	40	40	5	296	I	NW	40	119	160		N	C	S	N	S	CL-ML	22								
108	GP	17	1963	17-93	DS	2	D	80	60	5	889	P	NW	40	356	480		N	P	S	N	S	CL-ML	22								
109	CA	17	1963	17-100	DS	1	D	40	40	4	237	N	SE	0	0	0		N	C	H	R		CL-ML	10								
110	CA	17	1963	17-100	DS	1	D	40	20	2	59	P	SW	25	15	20	70	N	C	S	R		CL-ML	10							Y	
111	CA	17	1963	17-100	DF	4	D	80	40	2	237	P	SW	25	59	80	70	N	C	S	R		CL-ML	10							Y	240' runout
112	CA	17	1963	17-100	DS	2	D	160	80	4	1896	P	NE	40	759	1024		N	P	S	S		CL-ML	1								
113	CA	17	1963	17-100	DS	1	D	40	40	2	119	P	SW	50	59	80	85	N	P	N	R		CL-ML	10							Y	
114	CA	16	1963	17-100	DS	4	D	120	60	4	1067	P	NE	40	427	576		N	P	S	S		CL-ML	10								
115	CM	4	1963	17-101	DF	2	P	40	40	4	237	I	SW	40	95	128		N	C	H	S		GC-GM	13								200' runout
116	CM	4	1963	17-101	DS	4	P	120	60	4	1067	I	SW	40	427	576		N	C	S	S		GC-GM	13								
117	CM	32	1963	17-102	DS	4	D	40	40	4	237	P	SW	25	59	80	75	N	P	S	R		CL-ML	10							Y	on DSL toe slopes
118	CM	32	1963	17-102	DS	4	D	60	40	4	356	P	SE	25	89	120	65	N	P	S	L		CL-ML	10							Y	
119	CM	32	1963	17-102	DS	1	D	40	60	4	356	P	SW	100	356	480	70	N	P	S	R		CL-ML	10							Y	
120	CM	32	1963	17-102	DS	1	D	60	60	4	533	P	SW	40	213	288		N	C	H	S		CL-ML	21								
121	CM	32	1963	17-102	DS	2	D	80	60	4	711	P	NE	40	284	384		N	C	S	S		CL-ML	10								
122	CM	32	1963	17-102	DS	2	D	60	80	4	711	I	NE	40	284	384		N	C	N	S		CL-ML	21								
123	CM	32	1963	17-102	DF	1	D	40	40	5	296	P	NE	50	148	200	80	N	C	S	S		CL-ML	22							Y	240' runout
124	CM	32	1963	17-102	DS	1	D	160	160	4	3793	P	NE	100	3793	5120	100	N	C	S	S		CL-ML	21							Y	
125	CM	33	1963	17-102	DF	1	D	60	60	3	400	P	NE	75	300	405	100	N	C	S	S		CL-ML	21							Y	400' runout
126	CM	33	1963	17-102	DF	1	D	120	160	4	2844	P	NE	25	711	960	90	N	C	S	S		CL-ML	17							Y	400' runout
127	CM	33	1963	6-103	DS	1	D	60	80	4	711	P	SW	75	533	720	65	N	C	S	R		CL-ML	10							Y	
128	CM	33	1963	6-103	DS	4	D	60	80	4	711	I	SE	25	178	240	90	N	P	S	S		CL-ML	17							Y	
129	CM	33	1963	6-103	DS	1	D	80	80	3	711	I	SE	50	356	480	80	N	P	S	S		CL-ML	17							Y	
130	CM	4	1963	6-103	DF	4	Q	60	40	4	356	I	NW	40	142	192		N	C	H	R		CL-ML	13								500' runout
131	CM	4	1963	6-103	DS	4	D	80	60	4	711	N	NE	0	0	0		N	C	N	R		GC-GM	10								
132	CM	4	1963	6-103	DS	3	D	80	60	4	711	I	NE	40	284	384		N	C	N	R		GC-GM	10								
133	CM	4	1963	6-103	DS	2	D	60	40	4	356	I	SE	40	142	192		N	P	S	S		GC-GM	21								
134	CM	3	1963	6-103	DS	3	P	60	40	4	356	I	SW	40	142	192		N	C	H	S		GC-GM	10								
135	CM	3	1963	6-103	DS	2	D	80	60	4	711	I	SW	40	284	384		N	P	N	S		GC-GM	17								
136	CM	3	1963	6-103	DF	3	D	60	60	4	533	I	SW	40	213	288		N	C	H	S		GC-GM	15								800' runout
137	CM	3	1963	6-103	DF	3	D	60	60	4	533	I	SW	40	213	288		N	C	H	S		GC-GM	15								800' runout
138	CM	34	1963	6-103	DS	2	D	40	60	4	356	I	SW	40	142	192		N	P	S	S		GC-GM	17								on DSL toe
139	CM	34	1963	6-103	DS	2	D	40	60	4	356	I	SW	40	142	192		N	P	N	S		GC-GM	15								on DSL toe
140	CM	34	1963	6-103	DS	3	D	80	80	4	948	I	SE	40	379	512		N	C	H	S		GC-GM	17								
141	CM	33	1963	6-103	DS	1	D	40	80	4	474	I	SE	40	190	256		N	P	S	R		CL-ML	10								
142	CM	33	1963	6-103	DS	3	D	40	60	4	356	I	SE	40	142	192		N	P	S	R		CL-ML	13								
143	CM	33	1963	6-103	DS	4	D	40	80	4	474	N	SE	0	0	0		N	C	N	S		GC-GM	13								
144	CM	34	1963	6-103	DS	3	D	60	60	4	533	I	SE	40	213	288		N	C	H	S		GC-GM	17								
145	CM	28	1963	6-103	DF	2	Q	40	40	4	237	I	SE	40	95	128		N	C	N	S		GC-GM	17								400' runout
146	CM	28	1963	6-103	DS	4	P	60	80	4	711	I	SW	40	284	384		N	C	S	S		GC-GM	13								
147	CM	28	1963	6-103	DS	2	D	60	60	4	533	I	SW	40	213	288		N	C	H	S		GC-GM	22								
148	CA	10	1963	6-100	DF	2	D	240	160	5	7111	I	SW	40	2844	3840		N	C	N	N	M	CL-ML	22								on DSL 1400' runout
149	CA	4	1963	6-100	DS	4	D	60	60	4	533	I	SE	40	213	288		N	C	N	S		CL-ML	22								
150	CA	9	1963	6-100	DS	4	D	60	40	4	356	I	NE	40	142	192		N	C	N	S		CL-ML	22								
151	CA	9	1963	6-100	DS	4	D	60	80	4	711	I	SW	40	284	384		N	C	N	S		CL-ML	12								
152	CA	9	1963	6-100	DF	4	D	40	40	4	237	I	SE	40	95	128		N	P	S	R		CL-ML	21								200' runout
153	CA	9	1963	6-100	DS	1	D	40	40	4	237	P	SE	40	95	128		N	P	S	S		CL-ML	21								
154	CA	9	1963	6-100	DF	1	D	80	60	4	711	P	SE	40	284	384		N	C	H	R		CL-ML	24								1200' runout
155	CA	16	1963	6-99	DS	4	D	60	120	4	1067	I	NE	40	427	576		N	C	H	S		CL-ML	10								
156	GW	15	1963	6-99	DS	3	P	60	40	4	356	I	SE	40	142	192		N	C	H	S		GC-GM	10								
157	GW	15	1963	6-99	DS	3	P	80	80	4	948	I	SW	40	379	512		N	C	N	S		GC-GM	22								
158	GW	22	1963	6-98	DF	3	D	60	40	4	356	I	SE	40	142	192		N	C	H	S		GC-GM	10								240' runout
159	GW	22	1963	6-98	DS	4	D	40	40	4	237	I	SE	40	95	128		N	C	S	S		GC-GM	10								
160	CA	14	1963	17-56	DS	2	D	80	40	4	474	I	NE	40	190	256		N	P	S	S		CL-ML	18								

Watershed: Southcoast Streams								Shallow-seated landslides																	Deep-seated landslides							Mass Wasting Inventory Sheet Mendocino Redwood Company, LLC
Unique ID#	PWS	T & R Sec. #	Air Photo year	Air Photo frame	Landslide Type	TSU	Certainty	Size Length	Width	Depth	Slide Vol.	Sed. Routing	Dom. Aspect	Sed. Del. Ratio	Sed. Delivery	Sed. Delivery	Slope (field)	Age	Slope Form	Slide Loc.	Road Assoc.	Contrib. Area	Soil Type	Struc. Class	Toe Activity	Body Morph.	Lat. Scarps	Main Scarps	DS Veg.	Complex	Field Obs.	Comments
					DS DF DT EF RS	1 2 3 4 5 6	D P Q	feet	feet	feet	yd^3	P I N	NE SE NW SW	25 50 75 100 (%)	yd^3	tons	(%)	N R O	C D P	H S I N	R S L N I	S M L	USCS	1 to 24	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
161	CA	13	1963	17-56	DS	3	D	60	60	4	533	N	SW	0	0	0		N	C	H	S		CL-ML	13								on DSL crown
162	CA	13	1963	17-56	DS	2	D	160	160	5	4741	I	SW	40	1896	2560		N	P	S	N	S	CL-ML	13								on DSL toe
163	CA	13	1963	17-56	DS	4	D	60	40	5	444	I	SW	40	178	240		N	C	S	N	S	GC-GM	12								
164	CA	13	1963	17-56	DF	2	D	60	40	5	444	I	SW	40	178	240		N	C	S	N	M	GC-GM	21								400' runout
165	CA	13	1963	17-56	DS	3	D	160	240	5	7111	I	SW	40	2844	3840		N	P	S	N	M	GC-GM	21								
166	CA	12	1963	17-56	DF	2	D	40	40	4	237	I	SW	40	95	128		N	C	N	S		GC-GM	22								240' runout
167	CA	11	1963	17-56	DS	1	D	160	240	5	7111	P	SW	40	2844	3840		N	P	S	N	L	CL-ML	22								on DSL toe
168	CA	11	1963	17-56	DS	1	D	80	40	5	593	P	NW	40	237	320		N	C	S	N	L	CL-ML	22								
169	CA	11	1963	17-56	DS	2	D	60	60	4	533	P	SW	40	213	288		N	C	S	S		GC-GM	22								
170	CA	11	1963	17-56	DS	1	D	60	40	5	444	P	SE	40	178	240		N	P	S	N	L	CL-ML	22								on DSL toe
171	CA	11	1963	17-56	DS	1	D	80	60	5	889	P	SE	40	356	480		N	P	S	N	L	CL-ML	22								on DSL toe
172	CA	10	1963	17-56	DF	4	D	60	60	5	667	P	SW	40	267	360		N	C	H	N	M	CL-ML	10								400' runout
173	CA	15	1963	17-56	DS	2	D	60	40	5	444	I	NE	40	178	240		N	C	S	N	L	CL-ML	22								
174	CA	10	1963	17-56	DS	2	D	60	60	5	667	I	NE	40	267	360		N	C	S	N	L	CL-ML	22								
175	CA	2	1963	17-58	DF	3	D	60	60	5	667	I	SE	40	267	360		N	C	H	N	S	CL-ML	13								
176	CA	31	1963	4-83	DS	3	D	80	60	4	711	I	SW	40	284	384		N	C	H	S		GC-GM	10								
177	CA	6	1963	4-83	DS	3	D	40	40	4	237	I	NW	40	95	128		N	C	S	S		GC-GM	21								
178	CN	5	1963	4-83	DS	4	D	160	160	4	3793	I	SW	40	1517	2048		N	C	H	S		CL-ML	22								
179	CN	5	1963	4-83	DS	3	D	60	40	4	356	I	SW	40	142	192		N	C	S	S		CL-ML	5								
180	CN	5	1963	4-83	DS	3	D	60	60	4	533	I	SW	40	213	288		N	C	S	S		GC-GM	5								
181	CA	6	1963	4-83	DS	4	D	80	60	5	889	I	SE	40	356	480		N	P	S	N	S	GC-GM	21								on DSL toe
182	CA	6	1963	4-83	DS	4	D	80	60	4	711	I	SE	40	284	384		N	C	S	S		GC-GM	22								on DSL toe
183	CA	12	1963	4-83	DS	4	D	60	80	4	711	P	SE	40	284	384		N	P	S	S		GC-GM	10								
184	CA	12	1963	4-83	DS	4	D	80	80	4	948	I	NE	40	379	512		N	P	N	S		GC-GM	22								on DSL lateral scarp
185	CA	12	1963	4-83	DS	3	D	80	80	4	948	I	SE	40	379	512		N	C	N	S		GC-GM	22								on DSL lateral scarp
186	CN	9	1963	17-32	DS	1	D	80	80	4	948	P	NE	40	379	512		N	C	S	S		GM	5								
187	CN	9	1963	17-32	DS	3	D	80	60	4	711	P	SE	40	284	384		N	C	S	S		GM	12								
188	CN	9	1963	17-32	DS	4	D	60	60	4	533	P	SW	40	213	288		N	C	S	S		GM	5								
189	CN	9	1963	17-32	DS	1	D	160	60	4	1422	P	SE	40	569	768		N	P	S	S		GM	5								
190	CN	15	1963	8-162	DS	1	D	40	40	4	237	P	SW	40	95	128		N	P	S	S		GM	12								
191	CN	16	1963	8-162	DS	2	D	80	60	4	711	I	SE	40	284	384		N	C	H	S		GC-GM	5								
192	CN	15	1963	8-162	DF	2	D	120	60	4	1067	I	SW	40	427	576		N	C	H	S		GC-GM	13								480' runout
193	CN	15	1963	8-162	DS	3	D	240	120	5	5333	I	SW	40	2133	2880		N	C	S	N	M	CL-ML	1								
194	CN	22	1963	8-162	DS	3	D	60	80	5	889	I	SE	40	356	480		N	C	S	N	L	CL-ML	10								
195	CN	23	1963	8-162	DS	2	D	60	60	4	533	I	NW	40	213	288		N	P	S	S		GC-GM	22								
196	CN	23	1963	8-162	DS	2	D	60	60	4	533	I	SW	40	213	288		N	P	S	S		GC-GM	10								
197	CN	27	1963	8-160	DS	3	D	60	40	4	356	I	SW	40	142	192		N	C	N	S		GC-GM	18								
198	CN	27	1963	8-160	DS	2	D	60	60	4	533	I	SW	40	213	288		N	C	N	S		GC-GM	18								
199	CN	27	1963	8-160	DS	2	D	40	40	4	237	I	NW	40	95	128		N	C	N	S		GC-GM	18								
200	CN	27	1963	8-160	DS	3	D	160	120	5	3556	P	SW	40	1422	1920		R	P	S	N	S	CL-ML	1								irregular slopes
201	CN	26	1963	8-160	DS	4	D	60	60	4	533	P	SE	40	213	288		N	P	S	S		GC-GM	22								
202	CN	26	1963	8-160	DS	4	D	80	60	4	711	I	NE	40	284	384		N	C	N	R		GC-GM	12								
203	CN	26	1963	8-160	DS	2	D	40	40	4	237	I	NW	40	95	128		N	C	S	S		GC-GM	22								
204	CN	26	1963	8-160	DS	2	D	60	40	4	356	I	SE	40	142	192		N	P	S	S		GC-GM	22								
205	CN	26	1963	8-160	DS	3	P	40	60	4	356	I	SE	40	142	192		N	C	S	S		GC-GM	12								
206	CN	25	1963	8-160	DS	4	D	60	80	4	711	I	NW	40	284	384		N	P	N	R		GC-GM	22								Mtn View Rd cutslope failure
207	CM	32	1963	17-102	DS	3	D	80	60	4	711	P	SE	40	284	384		N	C	N	S		CL-ML	22								
208	CA	17	1963	field obs.	DS	1	D	100	60	3	667	P	SW	75	500	675	85	O	P	S	R		CL-ML	10							Y	
209	CA	17	1963	field obs.	DS	1	D	85	150	4	1889	P	SW	50	944	1275	80	O	P	S	R		CL-ML	10							Y	
210	CM	33	1963	field obs.	DS	1	D	80	120	4	1422	P	SW	25	356	480	70	O	P	S	R		CL-ML	10							Y	
300	GP	28	1978	3-3	DS	2	Q	130	100	5	2407	I	NE	40	963	1300		N	C	N	N	S	SM	21								
301	GP	34	1978	3-3	DS	1	D	65	65	4	626	P	SE	40	250	338		N	P	S	S		CL-ML	22								
302	GP	27	1978	3-3	DS	2	D	65	65	4	626	I	SW	40	250	338		N	C	N	S		CL-ML	22								
303	GP	34	1978	3-3	DS	1	D	65	65	4	626	P	SW	40	250	338		N	P	S	S		CL-ML	22								
304	GP	34	1978	3-3	DS	1	D	100	65	4	963	P	SE	40	385	520		N	P	S	S		CL-ML	22								
305	GP	34	1978	3-3	DS	4	P	65	130	3	939	P	NW	75	704	951	80	R	P	S	R		CL-ML	22							Y	
306	GP	34	1978	3-3	DS	3	D	200	65	5	2407	I	NE	40	963	1300		R	C	H	N	M	CL-ML	21								
307	GP	27	1978	3-3	DS	2	P	65	65	4	626	I	SE	40	250	338		N	C	N	R		CL-ML	22								
308	GP	27	1978	3-3	DS	2	D	65	65	4	626	I	NW	40	250	338		N	P	S	S		CL-ML	22								
309	GP	35	1978	4-3	DS	2	D	65	65	4	626	P	SW	40	250	338		N	C	N	S		CL-ML	22								
310	GP	35	1978	4-3	DS	2	D	100	65	4	963	P	SW	40	385	520		N	C	N	S		CL-ML	22								
311	GP	26	1978	4-3	DF	4	D	260	100	4	3852	P	SW	50	1926	2600	65	N	C	N	N	L	CL-ML	10							Y	on DSL
312	GP	26	1978	4-3	DF	2	D	100	65	5	1204	I	SE	40	481	650		N	C	H	N	M	SM	13								400' runout
313	CA	17	1978	2-5	DS	4	D	100	130	4	1926	N	SW	0	0	0	90	N	C	N	R		CL-ML	10							Y	cutslope failure
314	CA	17	1978	2-5	DS	1	D	65	65	5	782	P	NW	25	196	264	100	N	C	N	S		CL-ML	10							Y	

Watershed: Southcoast Streams

Shallow-seated landslides | **Deep-seated landslides**

Mass Wasting Inventory Sheet
Mendocino Redwood Company, LLC

Unique ID#	PWS	T & R Sec. #	Air Photo year	Air Photo frame	Landslide Type DS DF DT EF RS	TSU 1 2 3 4 5 6	Certainty D P Q	Length feet	Size Width feet	Depth feet	Slide Vol. yd^3	Sed. Routing P I N	Dom. Aspect NE SE NW SW	Sed. Del. Ratio 25 50 75 100 (%)	Sed. Delivery yd^3	Sed. Delivery tons	Slope (field) (%)	Age N R O	Slope Form C D P	Slide Loc. H S I N	Road Assoc. R S L N I	Contrib. Area S M L	Soil Type USCS	Struc. Class 1 to 24	Toe Activity 1 2 3 4 5	Body Morph. 1 2 3 4 5	Lat. Scarps 1 2 3 4 5	Main Scarps 1 2 3 4 5	DS Veg. 1 2 3 4	Complex Y N	Field Obs. Y N	Comments
315	CA	17	1978	2-5	DS	1	D	65	65	4	626	P	NW	25	156	211	90	N	C	N	S		CL-ML	10							Y	
316	CA	16	1978	2-5	DS	1	D	65	100	4	963	P	NW	40	385	520		N	P	S	S		CL-ML	12								
317	CA	16	1978	2-5	DF	3	D	65	65	4	626	P	NW	40	250	338		N	C	N	R		CL-ML	10								600' runout
318	CA	16	1978	2-5	DS	1	D	100	65	4	963	P	NW	40	385	520		N	P	S	S		CL-ML	12								
319	CA	16	1978	2-5	DS	1	D	100	65	4	963	P	NW	40	385	520		N	P	S	S		CL-ML	12								
320	CA	16	1978	2-5	DS	1	D	65	65	4	626	P	NW	40	250	338		N	P	S	S		CL-ML	12								
321	CA	9	1978	2-5	DF	1	D	130	100	4	1926	P	SW	40	770	1040		N	P	N	R		CL-ML	12								800' runout
322	CA	16	1978	2-5	DS	4	D	100	130	4	1926	P	SW	40	770	1040		N	P	N	R		CL-ML	10								
323	CA	16	1978	3-4	DS	2	D	65	65	4	626	I	NE	40	250	338		N	P	N	S		CL-ML	10								
324	CA	16	1978	3-4	DS	3	D	100	65	4	963	I	SW	40	385	520		N	P	N	S		CL-ML	10								
325	CA	9	1978	3-5	DS	1	D	100	65	4	963	P	NW	40	385	520		N	C	S	R		CL-ML	24								
326	CA	9	1978	3-5	DS	3	D	65	65	4	626	I	SE	40	250	338		N	C	N	R		CL-ML	22								
327	CA	9	1978	3-5	DS	3	D	65	65	4	626	I	SW	40	250	338		N	P	N	R		CL-ML	10								
328	CA	9	1978	3-5	DS	3	D	65	65	4	626	I	SW	40	250	338		N	P	N	R		CL-ML	10								
329	CA	9	1978	3-5	DS	2	D	65	65	4	626	I	SW	40	250	338		N	P	S	S		CL-ML	12								
330	CA	9	1978	3-5	DS	1	D	65	100	4	963	P	NW	40	385	520		N	C	S	R		CL-ML	10								
331	CA	9	1978	3-5	DS	1	D	100	100	4	1481	P	NE	40	593	800		N	P	S	R		CL-ML	10								
332	CA	9	1978	3-5	DS	2	D	100	65	4	963	P	NE	40	385	520		N	P	H	R		CL-ML	10								
333	CA	9	1978	3-5	DS	4	D	65	65	4	626	N	NE	0	0	0		N	C	N	S		CL-ML	10								
334	CA	10	1978	3-5	DS	4	D	65	65	4	626	P	NE	40	250	338		N	C	S	S		CL-ML	10								
335	CM	32	1978	2-8	DS	1	D	100	65	3	722	P	SW	50	361	488	80	N	P	S	R		CL-ML	13							Y	
336	CM	29	1978	2-8	DS	2	D	100	130	2	963	P	SE	25	241	325	70	N	P	S	R		CL-ML	13							Y	
337	CM	29	1978	2-8	DS	3	D	195	65	4	1878	I	SE	40	751	1014		N	C	H	S		CL-ML	17								
338	CM	29	1978	2-8	DS	2	D	65	65	4	626	P	SW	40	250	338		N	P	N	S		CL-ML	17								
339	CM	32	1978	2-8	DS	4	D	65	100	4	963	P	SE	40	385	520		N	P	N	S		CL-ML	17								
340	CM	32	1978	2-8	DF	1	D	100	65	4	963	P	NW	40	385	520		N	C	N	S		CL-ML	21								500' runout
341	CM	32	1978	2-8	DS	2	D	65	65	4	626	P	NE	40	250	338		N	C	N	S		CL-ML	10								
342	CM	32	1978	2-8	DS	3	D	100	100	4	1481	I	SW	40	593	800		N	P	S	S		CL-ML	10								
343	CM	33	1978	2-8	DS	1	P	100	65	3	722	P	NE	100	722	975	90	N	C	S	S		CL-ML	17							Y	
344	CM	33	1978	2-8	DS	1	D	65	65	2	313	P	SW	100	313	423	100	N	P	S	R		CL-ML	10							Y	recent reactivation
345	CM	33	1978	2-8	DS	1	P	65	65	3	469	P	SW	50	235	317	80	N	P	S	R		CL-ML	10							Y	
346	CM	33	1978	2-8	DS	3	D	100	65	4	963	N	NE	0	0	0	75	N	C	N	S		CL-ML	17							Y	
347	CM	33	1978	2-8	DS	4	P	65	65	4	626	I	SE	40	250	338		N	P	S	S		CL-ML	17								
348	CM	29	1978	2-8	DF	3	D	195	100	4	2889	P	SW	40	1156	1560		N	C	H	S		CL-ML	13								700' runout
349	CM	33	1978	2-8	DS	1	D	65	65	3	469	P	NE	75	352	475	95	N	P	S	S		CL-ML	17							Y	
350	CM	33	1978	2-8	DS	1	Q	65	65	3	469	N	SE	0	0	0	85	N	C	S	N	L	CL-ML	17							Y	
351	CM	33	1978	2-8	DS	3	D	100	65	4	963	P	SW	40	385	520		N	C	S	S		CL-ML	10								
352	CM	33	1978	2-8	DS	3	D	130	100	4	1926	P	NW	40	770	1040		N	C	H	S		CL-ML	10								
353	CM	33	1978	2-8	DS	2	D	100	130	4	1926	I	SW	40	770	1040		N	C	H	S		CL-ML	10								
354	CM	28	1978	2-8	DS	3	D	130	100	4	1926	I	SW	40	770	1040		N	C	H	S		GC-GM	17								
355	CM	28	1978	2-8	DS	4	D	65	65	4	626	P	SW	40	250	338		N	P	S	S		CL-ML	22								
356	CM	28	1978	2-8	DS	3	D	100	100	4	1481	N	SW	0	0	0		N	P	H	S		GC-GM	21								
357	CM	3	1978	3-7	DS	1	D	100	65	4	963	I	NW	40	385	520		N	P	S	R		GC-GM	17								
358	CM	3	1978	3-7	DS	3	D	65	100	4	963	I	SE	40	385	520		N	C	S	R		GC-GM	15								
359	CM	3	1978	3-7	DS	4	D	100	100	4	1481	I	NW	40	593	800		N	C	S	R		GC-GM	10								
360	CM	3	1978	3-7	DS	2	D	65	65	4	626	I	NE	40	250	338		N	C	S	S		GC-GM	21								
361	CM	3	1978	3-7	DS	1	P	65	130	4	1252	P	NE	40	501	676		N	P	S	S		CL-ML	10								
362	CM	4	1978	3-7	DT	3	D	100	65	4	963	I	NE	40	385	520		N	C	N	S		GC-GM	13								400' torrent track
363	CM	4	1978	3-7	DS	4	D	100	65	4	963	P	NE	40	385	520		N	C	S	S		CL-ML	22								
364	CM	4	1978	3-7	DS	1	D	65	65	4	626	P	NW	40	250	338		N	C	S	S		CL-ML	22								
365	CM	33	1978	3-7	DS	1	D	65	100	4	963	P	NW	40	385	520		N	C	S	S		CL-ML	10								
366	CM	33	1978	3-7	DS	1	D	65	65	4	626	P	NW	40	250	338		N	C	S	S		CL-ML	10								
367	CM	33	1978	3-7	DS	4	D	100	65	4	963	P	SE	40	385	520		N	P	S	S		CL-ML	10								
368	CM	33	1978	3-7	DS	2	Q	65	100	4	963	N	SE	0	0	0		N	C	N	S		GC-GM	13								
369	CM	34	1978	3-7	DS	2	D	100	100	4	1481	P	SE	40	593	800		N	P	S	S		GC-GM	22								
370	CM	34	1978	3-7	DS	4	D	65	100	4	963	P	SE	40	385	520		N	P	S	S		GC-GM	21								
371	CM	34	1978	3-7	DS	2	D	100	65	4	963	P	SE	40	385	520		N	C	S	S		GC-GM	17								
372	CM	34	1978	3-7	DF	4	D	100	100	4	1481	I	SW	40	593	800		N	C	H	S		GC-GM	10								500' runout
373	CM	33	1978	3-7	DS	1	D	65	100	4	963	I	NW	40	385	520		N	C	S	S		GC-GM	10								
374	CA	14	1978	4-3	DS	3	D	100	65	4	963	N	NW	0	0	0		N	C	N	S		CL-ML	22								on DSL crown
375	CA	14	1978	4-3	DS	2	D	65	100	4	963	P	SW	40	385	520		N	P	S	S		GC-GM	10								
376	CA	11	1978	4-3	DS	3	D	195	100	4	2889	N	SW	0	0	0		N	P	N	S		GM	13								
377	CA	11	1978	4-3	DS	2	D	65	65	4	626	P	SE	40	250	338		N	C	S	S		CL-ML	22								
378	CA	11	1978	4-3	DF	3	D	100	65	4	963	P	NE	40	385	520		N	C	N	R		GC-GM	7								400' runout
379	CA	12	1978	4-3	DS	2	D	100	65	4	963	P	NE	40	385	520		N	P	N	S		GC-GM	22								

Watershed:		Southcoast Streams						Shallow-seated landslides																		Deep-seated landslides							Mass Wasting Inventory Sheet Mendocino Redwood Company, LLC
Unique ID#	PWS	T & R Sec. #	Air Photo year	Air Photo frame	Landslide Type	TSU	Certainty	Length	Size Width	Depth	Slide Vol.	Sed. Routing	Dom. Aspect	Sed. Del. Ratio	Sed. Delivery	Sed. Delivery	Slope (field)	Age	Slope Form	Slide Loc.	Road Assoc.	Contrib. Area	Soil Type	Struc. Class	Toe Activity	Body Morph.	Lat. Scarps	Main Scarps	DS Veg.	Complex	Field Obs.	Comments
					DS DF DT EF RS	1 2 3 4 5 6	D P Q	feet	feet	feet	yd^3	P I N	NE SE NW SW	25 50 75 100 (%)	yd^3	tons	(%)	N R O	C D P	H S I N	R S L N I	S M L	USCS	1 to 24	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
380	CA	11	1978	4-3	DS	4	D	65	100	4	963	P	SW	40	385	520		R	C	N	S		GC-GM	22								
381	CA	2	1978	4-3	DS	3	D	100	65	4	963	P	SW	40	385	520		R	C	H	S		GC-GM	10								
382	CA	11	1978	4-3	DS	1	D	65	65	4	626	P	SE	40	250	338		N	C	S	S		CL-ML	22								on DSL toe
383	CA	11	1978	4-3	DS	1	D	65	65	4	626	P	SE	40	250	338		N	C	S	S		CL-ML	22								on DSL toe
384	CA	3	1978	4-5	DS	2	D	100	65	4	963	I	SW	40	385	520		N	C	H	S		CL-ML	7								
385	CA	2	1978	4-5	DS	2	D	65	65	4	626	N	SE	0	0	0		N	C	N	S		GC-GM	8								
386	CA	1	1978	4-5	DS	2	D	65	65	4	626	I	NW	40	250	338		N	C	N	S		GC-GM	12								
387	CA	1	1978	4-5	DS	3	D	65	65	5	782	I	SW	40	313	423		N	C	H	N	S	GC-GM	22								
388	CA	6	1978	5-3	DS	2	D	65	65	4	626	I	SW	40	250	338		N	C	N	S		GC-GM	10								
389	CA	6	1978	5-3	DS	2	Q	100	65	5	1204	I	SW	40	481	650		N	C	S	N	M	GC-GM	7								
390	CA	1	1978	5-3	DS	3	D	130	100	4	1926	I	SE	40	770	1040		N	C	N	S		GC-GM	10								
391	CN	6	1978	5-3	DS	3	D	100	100	4	1481	I	SW	40	593	800		N	C	H	S		GC-GM	5								
392	CN	9	1978	6-2	DS	2	D	100	65	4	963	P	SE	40	385	520		N	C	S	S		GM	5								
393	CN	9	1978	6-2	DS	2	D	65	65	4	626	P	SW	40	250	338		N	P	S	S		GM	10								
394	CN	9	1978	6-2	DS	1	D	65	100	4	963	P	SW	40	385	520		N	C	S	S		GM	12								
395	CN	9	1978	6-2	DS	3	D	65	65	4	626	P	NE	40	250	338		N	C	S	S		GM	12								
396	CN	9	1978	6-2	DS	1	D	65	65	4	626	P	NE	40	250	338		N	C	S	S		GM	12								
397	CN	9	1978	6-2	DS	1	D	65	100	4	963	P	SW	40	385	520		N	C	S	S		GM	12								
398	CN	9	1978	6-2	DS	1	D	65	195	4	1878	P	SW	40	751	1014		N	C	S	S		CL-ML	12								
399	CN	9	1978	6-2	DS	1	D	65	65	4	626	P	NW	40	250	338		N	C	S	S		GM	10								
400	CN	9	1978	6-2	DS	1	D	65	65	4	626	P	NW	40	250	338		N	C	S	S		GM	22								
401	CN	9	1978	6-2	DS	3	D	100	100	4	1481	I	SW	40	593	800		N	C	H	S		GM	10								
402	CN	22	1978	7-2	DS	3	P	100	65	4	963	I	SW	40	385	520		N	C	N	R		CL-ML	10								
403	CN	27	1978	7-2	DS	2	D	65	65	4	626	I	SW	40	250	338		N	C	N	S		CL-ML	10								
404	CN	27	1978	7-2	DS	3	D	100	100	4	1481	I	NE	40	593	800		N	C	N	S		GC-GM	13								
405	CN	26	1978	7-2	DS	4	D	130	100	4	1926	P	NW	40	770	1040		N	C	N	S		GC-GM	7								
406	CN	25	1978	8-2	DS	4	P	65	100	4	963	I	SW	40	385	520		N	P	N	S		GC-GM	21								on DSL toe
407	CN	25	1978	8-2	DS	4	P	65	100	4	963	I	SW	40	385	520		N	P	N	S		GC-GM	12								on DSL toe
408	CN	25	1978	8-2	DS	4	P	65	65	4	626	I	SW	40	250	338		N	P	N	S		CL-ML	12								on DSL toe
409	CM	32	1978	field obs.	DS	1	D	40	150	2	444	P	SW	100	444	600	80	O	P	S	R		CL-ML	10							Y	
500	GP	27	1987	M18-6	DS	2	P	100	50	4	741	P	SW	40	296	400		R	P	S	S		CL-ML	22								
501	GP	27	1987	M18-6	DS	2	P	100	50	4	741	P	SW	40	296	400		R	P	S	S		CL-ML	22								
502	GP	27	1987	M18-6	DS	2	Q	50	50	4	370	P	SE	40	148	200		R	P	S	S		CL-ML	22								
503	GP	27	1987	M18-6	DS	2	Q	50	50	4	370	P	SE	40	148	200		R	C	S	S		CL-ML	22								
504	GP	35	1987	M19-4	DF	3	D	100	50	4	741	I	SW	40	296	400		N	C	H	S		CL-ML	10								
505	GP	35	1987	M19-4	DS	2	D	100	150	4	2222	P	SW	40	889	1200		N	P	S	S		CL-ML	21								
506	GP	35	1987	M19-4	DS	2	P	50	50	4	370	P	SW	40	148	200		N	C	S	S		CL-ML	22								
507	GP	26	1987	M19-5	DS	2	D	100	50	4	741	I	SW	75	556	750	70	N	C	H	R		CL-ML	22							Y	
508	GP	26	1987	M19-5	DS	4	Q	75	50	4	556	P	SW	40	222	300		N	P	N	R		CL-ML	21								
509	GP	36	1987	M20-5	DS	2	P	50	75	4	556	I	SW	40	222	300		N	C	S	S		CL-ML	22								
510	CM	4	1987	M17-19	DS	2	D	75	50	4	556	I	NW	40	222	300		N	C	N	S		GC-GM	10								
511	CM	4	1987	M17-19	DS	2	P	50	50	4	370	I	NE	40	148	200		N	C	N	S		CL-ML	22								
512	CM	29	1987	M17-20	DS	3	D	50	50	4	370	I	SW	40	148	200		N	C	H	S		CL-ML	17								
513	CM	29	1987	M17-20	DT	3	D	100	100	4	1481	P	SE	40	593	800		N	C	H	S		CL-ML	13								
514	CM	32	1987	M17-20	DS	2	D	75	50	4	556	P	SW	25	139	188	85	N	P	S	R		CL-ML	10							Y	
515	CM	32	1987	M17-20	DS	4	D	100	75	4	1111	P	SW	25	278	375	90	N	C	S	R		CL-ML	13							Y	
516	CM	33	1987	M17-20	DS	4	D	75	50	3	417	I	SE	50	208	281	75	N	P	S	S		CL-ML	17							Y	
517	CM	33	1987	M17-20	DS	4	D	75	75	3	625	I	NW	25	156	211	85	N	C	S	S		CL-ML	17							Y	
518	CM	33	1987	M17-20	DS	3	D	50	50	3	278	I	NW	50	139	188	85	N	C	S	S		CL-ML	17							Y	
519	CM	28	1987	M17-20	DS	3	D	50	50	4	370	I	NW	40	148	200		N	C	H	R		GC-GM	22								
520	CM	28	1987	M17-20	DS	4	D	50	50	4	370	I	SW	40	148	200		N	C	N	R		GC-GM	21								
521	CM	28	1987	M17-20	DS	3	P	100	100	4	1481	N	SW	0	0	0		N	C	H	S		GC-GM	21								
522	CM	33	1987	M17-20	DS	1	D	50	100	4	741	P	SW	50	370	500	80	N	P	S	R		CL-ML	10							Y	
523	CM	33	1987	M18-21	DS	1	D	50	50	4	370	P	SW	40	148	200		N	C	S	R		CL-ML	22								
524	CM	34	1987	M18-21	DS	1	D	75	50	4	556	P	SW	40	222	300		N	C	S	S		CL-ML	13								
525	CM	34	1987	M18-21	DS	4	D	50	50	4	370	I	SE	40	148	200		N	P	N	S		GC-GM	21								
526	CM	3	1987	M18-21	DS	2	D	75	50	4	556	I	SW	40	222	300		N	C	S	S		GC-GM	10								
527	CM	3	1987	M18-21	DS	2	D	50	50	4	370	I	NW	40	148	200		N	C	H	S		GC-GM	10								
528	CM	3	1987	M18-21	DS	1	D	75	75	4	833	N	NW	0	0	0		N	C	S	R		GC-GM	22								
529	CM	3	1987	M18-21	DS	2	D	75	75	4	833	I	SE	40	333	450		N	C	N	S		GC-GM	17								
530	CM	34	1987	M18-21	DS	2	D	50	100	4	741	P	NW	40	296	400		N	P	S	S		GC-GM	10								
531	CM	34	1987	M18-21	DS	4	D	50	50	4	370	N	SW	0	0	0		N	C	H	S		GC-GM	10								
532	CM	34	1987	M18-21	DS	4	D	75	100	4	1111	I	SW	40	444	600		N	C	S	S		GC-GM	10								
533	CM	34	1987	M18-21	DS	2	D	50	75	4	556	I	SE	40	222	300		N	P	S	S		GC-GM	17								
534	CM	28	1987	M18-23	DS	4	D	75	50	4	556	I	SW	40	222	300		N	C	H	R		GC-GM	10								

Watershed: Southcoast Streams								Shallow-seated landslides																	Deep-seated landslides							Mass Wasting Inventory Sheet Mendocino Redwood Company, LLC
Unique ID#	PWS	T & R Sec. #	Air Photo year	Air Photo frame	Landslide Type	TSU	Certainty	Size Length	Size Width	Size Depth	Slide Vol.	Sed. Routing	Dom. Aspect	Sed. Del. Ratio	Sed. Delivery	Sed. Delivery	Slope (field)	Age	Slope Form	Slide Loc.	Road Assoc.	Contrib. Area	Soil Type	Struc. Class	Toe Activity	Body Morph.	Lat. Scarps	Main Scarps	DS Veg.	Complex	Field Obs.	Comments
					DS DF DT EF RS	1 2 3 4 5 6	D P Q	feet	feet	feet	yd^3	P I N	NE SE NW SW	25 50 75 100 (%)	yd^3	tons	(%)	N R O	C D P	H S I N	R S L N I	S M L	USCS	1 to 24	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
535	CA	17	1987	M16-13	DS	1	D	50	100	4	741	P	NE	40	296	400		N	C	S	S		CL-ML	12								
536	CA	17	1987	M16-13	DS	3	D	50	75	4	556	P	SE	50	278	375	80	N	C	S	R		CL-ML	10							Y	
537	CA	17	1987	M17-16	DS	4	D	50	75	4	556	P	NW	40	222	300		R	C	S	S		CL-ML	10								
538	CA	16	1987	M17-16	DS	2	D	50	50	4	370	P	SW	40	148	200		N	P	S	S		CL-ML	22								
539	CA	16	1987	M17-16	DT	2	D	75	50	4	556	I	SW	40	222	300		N	C	S	S		CL-ML	10								400' torrent track
540	CA	16	1987	M17-16	DS	4	D	50	50	5	463	P	NE	40	185	250		N	C	S	N	M	CL-ML	5								
541	CA	16	1987	M17-16	DS	4	D	100	75	4	1111	P	SW	40	444	600		N	C	S	S		CL-ML	10								
542	CA	16	1987	M17-16	DS	4	D	100	50	4	741	P	SW	40	296	400		N	C	S	S		CL-ML	10								
543	CA	16	1987	M17-16	DS	2	D	75	50	4	556	P	NW	40	222	300		N	C	S	S		CL-ML	22								
544	CA	17	1987	M17-16	DS	3	D	75	50	3	417	N	SW	0	0	0	75	N	C	N	R		CL-ML	10							Y	
545	CA	9	1987	M17-16	DS	1	P	75	50	4	556	P	SE	100	556	750	75	N	C	S	N	L	CL-ML	22							Y	
546	CA	9	1987	M17-16	DS	1	D	50	50	5	463	P	SE	100	463	625	75	N	C	S	S		CL-ML	22							Y	on DSL body
547	CA	9	1987	M17-16	DS	1	D	75	50	4	556	P	SE	50	278	375	85	N	P	S	S		CL-ML	21							Y	
548	CA	9	1987	M17-16	DS	1	D	50	50	3	278	P	NW	75	208	281	90	N	C	S	S		CL-ML	12							Y	
549	CA	9	1987	M17-16	DS	3	D	75	75	4	833	I	SE	40	333	450		N	C	H	S		CL-ML	22								
550	CA	16	1987	M18-18	DS	2	D	50	50	4	370	I	SW	40	148	200		N	C	N	S		CL-ML	10								
551	CA	16	1987	M18-18	DS	3	D	50	50	4	370	N	NW	0	0	0		N	C	N	S		CL-ML	22								
552	CA	4	1987	M18-18	DS	3	D	75	50	4	556	N	SE	0	0	0		N	C	N	R		SM	12								
553	CA	9	1987	M18-18	DS	1	D	50	50	4	370	P	SE	40	148	200		N	P	S	S		CL-ML	10								
554	CA	9	1987	M18-18	DS	2	D	75	75	4	833	P	SE	40	333	450		N	C	S	S		CL-ML	10								
555	CA	10	1987	M18-18	DS	1	D	50	75	4	556	P	SW	40	222	300		N	P	S	S		CL-ML	10								
556	CA	10	1987	M18-18	DS	1	D	75	75	4	833	P	SW	40	333	450		N	P	S	S		CL-ML	10								
557	CA	10	1987	M18-18	DS	1	D	50	50	4	370	P	SW	40	148	200		N	P	S	S		CL-ML	22								
558	CA	3	1987	M18-18	DS	4	D	50	50	4	370	I	SE	40	148	200		N	C	H	S		CL-ML	21								
559	CA	10	1987	M18-18	DS	2	D	100	100	4	1481	I	SE	40	593	800		N	C	N	S		CL-ML	10								
560	CA	10	1987	M18-18	DS	2	D	75	100	4	1111	I	SW	40	444	600		N	C	N	S		CL-ML	22								on DSL toe
561	CA	2	1987	M19-20	DS	2	D	75	50	4	556	I	SW	40	222	300		N	C	N	S		CL-ML	21								
562	CA	2	1987	M19-20	DS	2	D	50	50	4	370	I	SW	40	148	200		N	C	N	S		GC-GM	21								
563	CA	2	1987	M19-20	DS	3	D	50	50	4	370	I	NW	40	148	200		N	C	N	S		GC-GM	22								
564	CA	2	1987	M19-20	DS	2	D	75	50	4	556	I	SW	40	222	300		N	C	N	S		GC-GM	13								
565	CA	1	1987	M20-21	DS	2	D	50	50	4	370	I	SE	40	148	200		N	C	N	S		GC-GM	22								
566	CA	11	1987	M19-19	DS	3	P	50	100	4	741	I	NW	40	296	400		N	C	N	S		CL-ML	22								
567	CA	11	1987	M19-19	DS	2	D	50	50	4	370	I	SW	40	148	200		N	C	N	S		GC-GM	21								
568	CA	14	1987	M19-19	DS	4	D	50	50	5	463	N	SW	0	0	0		N	C	N	N	S	GM	15								
569	CA	14	1987	M20-20	DS	2	D	75	75	4	833	P	SW	40	333	450		N	C	S	S		CL-ML	21								
570	CA	11	1987	M20-20	DS	4	D	100	75	4	1111	I	NE	40	444	600		N	C	N	S		GC-GM	18								on DSL
571	CA	12	1987	M20-20	DS	2	D	50	50	4	370	P	SW	40	148	200		N	C	S	S		GC-GM	21								
572	CA	11	1987	M20-20	DS	2	D	50	50	4	370	I	NW	40	148	200		N	P	N	S		GC-GM	22								
573	GU	30	1987	M21-11	DS	2	D	50	75	4	556	I	NE	40	222	300		R	C	N	S		GC-GM	10								
574	GU	31	1987	M21-11	DS	2	D	50	50	4	370	I	NE	40	148	200		N	C	N	R		GC-GM	7								
575	CN	25	1987	15-188	DS	4	D	100	75	5	1389	N	SW	0	0	0		N	C	H	N	S	CL-ML	10								on DSL crown
576	CA	9	1987	field obs.	DS	1	D	60	50	6	667	I	SE	100	667	900	120	O	P	S	N	M	CL-ML	10							Y	
577	CA	9	1987	field obs.	DS	1	D	80	120	3	1067	P	SE	50	533	720	90	O	P	S	S		CL-ML	10							Y	
578	CM	32	1987	field obs.	DS	4	D	70	45	4	467	P	SW	75	350	473	70	O	P	S	R		CL-ML	17							Y	
579	CM	33	1987	field obs.	DS	1	D	75	45	2	250	P	NE	75	188	253	100	O	P	S	S		CL-ML	17							Y	
580	CM	33	1987	field obs.	DS	1	D	60	45	4	400	P	SE	25	100	135	75	O	C	S	R		CL-ML	17							Y	
581	CM	33	1987	field obs.	DS	1	D	45	25	3	125	P	NW	75	94	127	85	O	C	S	S		CL-ML	10							Y	
582	CM	33	1987	field obs.	DF	3	D	75	50	4	556	P	NW	25	139	188	75	O	C	S	S		CL-ML	10							Y	
583	CM	33	1987	field obs.	DS	2	D	60	35	5	389	I	NW	75	292	394	65	O	P	N	S		CL-ML	10							Y	
600	GP	17	2000	7A-2	DS	4	P	50	50	4	370	P	NW	40	148	200		N	P	N	S		CL-ML	22								
601	GP	28	2000	8A-1	DS	4	D	75	50	4	556	I	NW	40	222	300		N	P	N	S		CL-ML	21								
602	GP	34	2000	9A-3	DF	3	D	100	65	8	1926	P	SW	100	1926	2600	65	N	C	S	R		CL-ML	22							Y	300' runout
603	GP	34	2000	9A-3	DS	4	D	50	50	4	370	P	NE	40	148	200		N	C	S	S		CL-ML	21								
604	GP	26	2000	10A-3	DS	4	D	75	50	4	556	N	SW	0	0	0	65	N	C	N	R		CL-ML	13							Y	
605	GP	36	2000	11A-3	DS	2	D	75	75	4	833	I	NE	40	333	450		N	P	N	S		CL-ML	22								
606	GW	28	2000	9B-2	DS	4	D	75	50	4	556	I	NE	40	222	300		N	C	N	R		CL-ML	7								
607	CM	32	2000	7B-7	DS	2	D	50	100	4	741	P	NW	40	296	400		N	P	S	S		CL-ML	10								
608	CM	33	2000	8B-10	DS	1	D	75	50	1	139	P	SE	25	35	47	80	N	C	S	S		CL-ML	10							Y	
609	CM	33	2000	8B-10	DS	1	D	100	100	3	1111	P	SW	50	556	750	70	N	P	S	S		CL-ML	10							Y	
610	CM	32	2000	8B-10	DS	1	D	100	75	4	1111	P	SW	50	556	750	65	N	P	S	R		CL-ML	10							Y	
611	CM	33	2000	8B-10	DS	4	D	75	50	4	556	I	SW	40	222	300		N	P	N	R		CL-ML	22								
612	CM	34	2000	9B-10	DS	2	D	50	50	5	463	I	NW	40	185	250		N	P	S	N	S	GC-GM	17								
613	CA	8	2000	7B-2	DS	4	D	250	150	6	8333	P	SW	25	2083	2813	75	N	C	N	R		CL-ML	21							Y	
614	CA	17	2000	7B-2	DS	4	D	75	50	4	556	P	SW	25	139	188	85	N	C	S	S		CL-ML	10							Y	
615	CA	17	2000	7B-2	DS	1	D	50	50	4	370	P	SE	100	370	500	95	N	P	S	S		CL-ML	12							Y	

Watershed:		Southcoast Streams						Shallow-seated landslides																	Deep-seated landslides							Mass Wasting Inventory Sheet Mendocino Redwood Company, LLC
Unique	PWS	T & R	Air Photo	Air Photo	Landslide	TSU	Certainty		Size		Slide	Sed.	Dom.	Sed. Del.	Sed.	Sed.	Slope	Age	Slope	Slide	Road	Contrib.	Soil	Struc.	Toe	Body	Lat.	Main	DS	Complex	Field	
ID#		Sec. #	year	frame	Type			Length	Width	Depth	Vol.	Routing	Aspect	Ratio	Delivery	Delivery	(field)		Form	Loc.	Assoc.	Area	Type	Class	Activity	Morph.	Scarps	Scarps	Veg.		Obs.	Comments
					DS DF DT	1 2 3	D P Q	feet	feet	feet	yd^3	P I N	NE SE	25 50 75	yd^3	tons	(%)	N R O	C D P	H S I N	R S L	S M L	USCS	1 to	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3 4	Y N	Y N	
					EF RS	4 5 6							NW SW	100 (%)							N I			24	4 5	4 5	4 5	4 5				
616	CA	8	2000	7B-2	DS	4	D	50	50	4	370	P	NW	40	148	200		N	C	S	S		CL-ML	21								
617	CA	9	2000	8B-6	DF	4	D	75	75	3	625	P	SE	25	156	211	75	N	C	H	R		CL-ML	10							Y	600' runout
618	CA	9	2000	8B-6	DS	3	D	50	50	2	185	I	SE	75	139	188	80	N	C	N	R		CL-ML	22							Y	
619	CA	9	2000	8B-6	DS	1	D	50	50	4	370	P	SW	50	185	250	100	N	C	S	N	S	CL-ML	13							Y	
620	CA	9	2000	8B-6	DS	1	D	50	75	6	833	P	SW	25	208	281	100	N	C	S	N	S	CL-ML	13							Y	
621	CA	9	2000	8B-6	DS	1	D	50	50	5	463	P	SE	75	347	469	90	N	P	S	N	S	CL-ML	10							Y	
622	CA	9	2000	8B-6	DS	1	D	75	150	4	1667	P	SE	100	1667	2250	95	N	P	S	N	S	CL-ML	10							Y	
623	CA	9	2000	8B-6	DS	2	D	100	50	4	741	I	NW	40	296	400		N	C	N	S		CL-ML	21								
624	CA	16	2000	8B-6	DS	2	D	75	50	4	556	I	NW	40	222	300		N	C	N	S		CL-ML	21								
625	CA	4	2000	8B-8	DS	4	D	200	100	4	2963	I	SW	40	1185	1600		N	P	N	S		CL-ML	12								
626	CA	10	2000	9B-6	DF	2	D	150	150	5	4167	I	SW	40	1667	2250		N	C	N	N	L	CL-ML	22								on DSL toe
627	CA	14	2000	10B-3	DS	2	P	50	50	5	463	N	NE	0	0	0		N	C	N	N	S	CL-ML	13								on DSL toe
628	CA	2	2000	10B-6	DS	4	Q	75	100	5	1389	I	SW	40	556	750		N	P	S	N	M	GC-GM	21								
629	CA	2	2000	10B-6	DS	2	D	75	100	5	1389	P	NW	40	556	750		N	P	S	N	L	GC-GM	12								
630	CA	6	2000	11B-7	DS	2	P	50	50	4	370	P	NW	40	148	200		N	P	S	S		GC-GM	12								
631	CA	6	2000	11B-7	DS	2	P	50	50	4	370	P	NW	40	148	200		N	P	S	S		GC-GM	12								
632	CA	6	2000	11B-8	DS	3	Q	150	100	4	2222	I	NW	40	889	1200		N	C	N	R		GC-GM	7								
633	CN	22	2000	15C-3	DS	4	D	50	50	5	463	I	NE	40	185	250		N	C	S	N	M	CL-ML	5								
634	CN	22	2000	15C-3	DS	2	P	50	75	4	556	I	SW	40	222	300		N	C	N	S		GC-GM	10								
635	CM	33	2000	field obs.	DS	1	D	75	50	2	278	P	SE	75	208	281	80	R	P	S	N	M	CL-ML	17							Y	
700	GP	26	2004	19-19	DS	2	D	100	50	5	926	N	SW	0	0	0	60	N	C	N	R		CL-ML	13							Y	on DSL
701	CM	33	2004	17-128	DS	3	D	150	75	5	2083	I	SE	40	833	1125		N	C	N	N	M	CL-ML	17								
702	CA	17	2004	16-15	DS	4	P	100	75	4	1111	N	SW	0	0	0	65	N	P	S	R		CL-ML	10							Y	
703	CA	8	2004	16-15	DS	4	D	75	75	5	1042	P	NW	40	417	563		N	C	S	N	M	CL-ML	12								
704	CA	16	2004	17-125	DS	1	D	75	150	5	2083	P	SE	40	833	1125		N	C	S	N	L	CL-ML	22								
705	CA	9	2004	17-126	DS	1	D	75	100	4	1111	P	SE	75	833	1125	70	N	C	S	S		CL-ML	10							Y	
706	CA	15	2004	18-80	DT	2	D	75	75	5	1042	I	NE	40	417	563		N	C	H	N	M	CL-ML	18								2000' torrent track
707	CA	15	2004	18-81	DS	3	D	100	100	5	1852	I	NE	40	741	1000		N	C	N	N	L	CL-ML	22								
708	GP	27	2004	19-18	DS	4	D	100	100	7	2593	I	SW	25	648	875	50	N	C	N	R		SM	13							Y	on DSL
709	GP	34	2004	19-18	DS	4	D	75	75	4	833	P	NE	40	333	450		N	C	N	S	M	CL-ML	21								
710	GP	35	2004	19-18	DS	4	D	50	50	4	370	I	SW	40	148	200		N	C	N	S		CL-ML	10								
711	CA	17	2004	field obs.	DS	1	D	40	40	3	178	P	SW	100	178	240	120	R	C	S	N	S	CL-ML	12							Y	
712	CA	17	2004	field obs.	DS	1	D	30	30	4	133	P	SE	100	133	180	80	N	C	S	N	S	CL-ML	1							Y	
800	GP		1987	M19-5	EF		D	700	350																3	2	3	2	2	N		
801	GP		1987	M19-5	RS		Q	1600	600																4	3	4	4	4	N		
802	GP		1987	M19-5	RS		P	1400	700																4	4	4	4	4	N		
803	GP		1987	M19-4	RS		Q	1300	600																3	3	4	3	4	N		
804	CM		1987	M17-19	RS		P	1000	500																4	4	3	4	4	N		
805	CM		1987	M17-19	RS		P	1200	800																4	3	3	4	3	N		
806	CM		1987	M17-19	RS		Q	900	500																3	3	4	4	3	N		
807	CM		2004	16-19	RS		Q	1600	700																3	4	4	4	4	N		
808	CM		2004	16-19	RS		P	1300	500																4	4	4	4	4	N		
809	CM		1987	M18-20	RS		P	1100	500																3	3	4	3	4	N		
810	CM		1987	M18-20	RS		P	700	300																3	3	4	3	4	N		
811	CA		1987	M16-12	RS		P	800	600																3	3	4	3	4	N		
812	CA		1987	M17-16	RS		P	1600	1500																3	3	3	3	4	N		
813	CA		1987	M17-16	RS		P	1200	1200																2	3	3	3	4	N		
814	CA		1987	M17-17	RS		P	1300	500																3	3	4	4	4	N		
815	CA		1987	M18-18	RS		Q	1200	500																3	3	4	4	4	N		
816	CA		1987	M18-18	RS		D	1800	1400																2	3	3	4	4	N		
817	CA		1987	M19-19	RS		D	2800	1500																1	1	1	1	1	N		
818	CA		1987	M19-19	RS		D	1600	2200																4	3	3	3	3	Y		
819	CA		1987	M19-19	RS		P	1500	600																3	3	4	3	4	N		
820	CA		1987	M19-18	RS		D	700	400																3	2	4	3	4	N		
821	CA		1987	M19-18	RS		P	800	1000																4	3	4	4	4	N		
822	CA		1987	M20-19	RS		P	1600	2000																3	3	3	3	4	Y		
823	CA		1987	M20-19	RS		P	1300	1300																4	3	4	3	4	N		
824	CA		1987	M20-19	RS		D	1500	500																3	3	3	2	3	N		
825	CA		1987	M20-20	RS		D	1100	1000																3	3	4	3	4	N		
826	CA		1987	M20-20	RS		P	1200	400																3	4	4	3	4	N		
827	CA		1987	M20-20	RS		Q	1200	500																4	4	4	4	4	N		
828	CA		1987	M20-21	RS		Q	900	600																4	3	4	4	4	N		
829	CA		1987	M20-21	RS		Q	800	600																3	3	4	3	4	N		
830	CA		2004	20-225	RS		P	1300	900																4	3	3	4	4	N		
831	CA		2004	20-225	RS		Q	1100	300																4	4	4	4	4	N		

Watershed: Southcoast Streams

Shallow-seated landslides | *Deep-seated landslides*

Mass Wasting Inventory Sheet
Mendocino Redwood Company, LLC

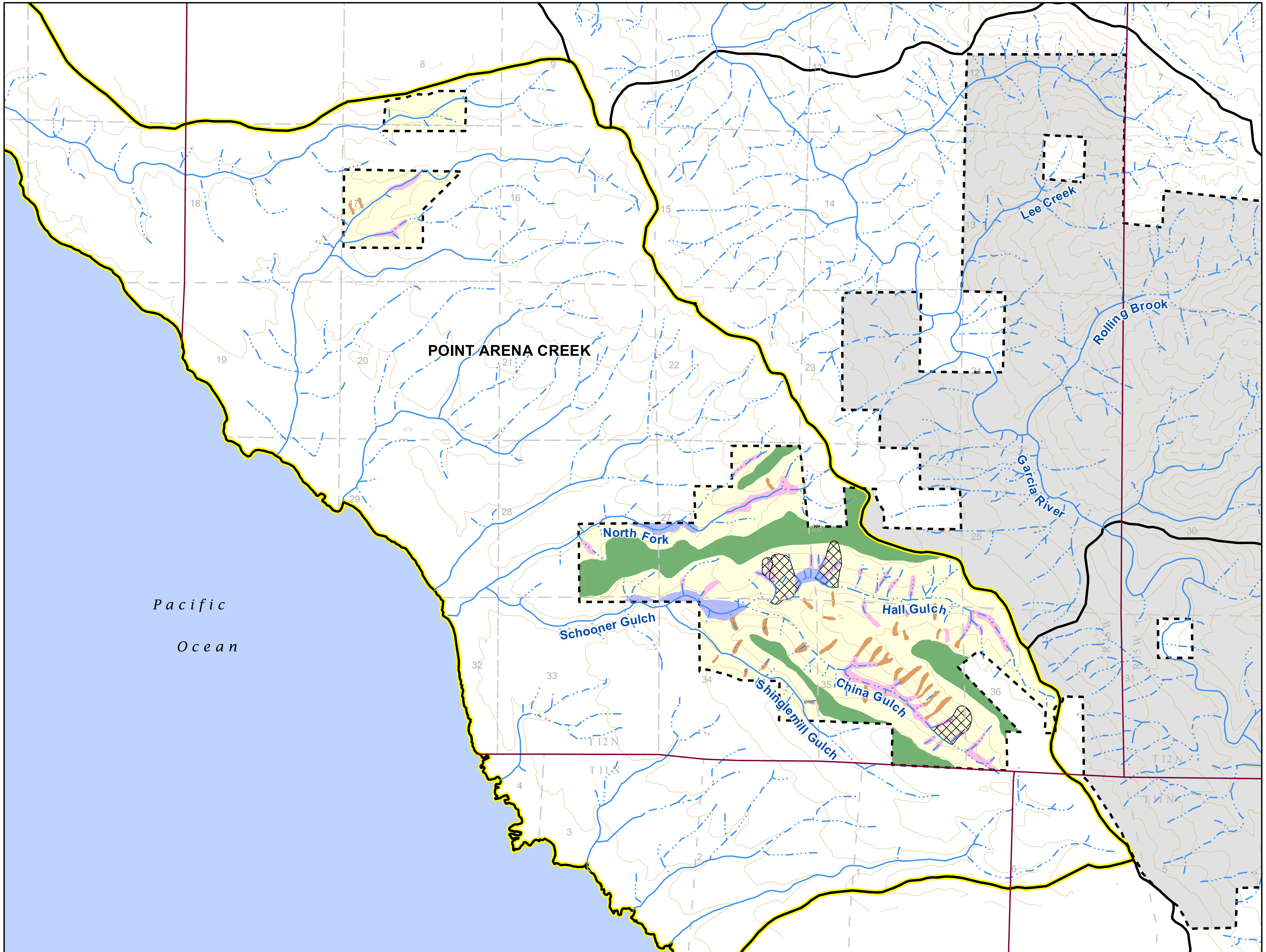
Unique ID#	PWS	T & R Sec. #	Air Photo year	Air Photo frame	Landslide Type	TSU	Certainty	Size Length	Size Width	Size Depth	Slide Vol.	Sed. Routing	Dom. Aspect	Sed. Del. Ratio	Sed. Delivery	Sed. Delivery	Slope (field)	Age	Slope Form	Slide Loc.	Road Assoc.	Contrib. Area	Soil Type	Struc. Class	Toe Activity	Body Morph.	Lat. Scarps	Main Scarps	DS Veg.	Complex	Field Obs.	Comments
					DS DF DT EF RS	1 2 3 4 5 6	D P Q	feet	feet	feet	yd^3	P I N	NE SE NW SW	25 50 75 100 (%)	yd^3	tons	(%)	N R O	C D P	H S I N	R S L N I	S M L	USCS	1 to 24	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
832	CN		2004	23-27	RS		P	700	600																3	3	4	3	3	N		
833	CN		2004	23-28	RS		Q	1300	1200																3	3	4	3	4	Y		
834	CN		2004	23-29	RS		D	2000	1100																3	3	4	3	4	N		
835	CN		2004	23-29	RS		Q	800	500																3	3	4	4	4	N		
836	CN		2004	25-119	RS		P	1200	900																3	3	4	3	4	N		
837	CN		2004	25-119	RS		Q	1500	800																3	3	4	3	4	Y		
838	CA		1987	M17-16	RS		P	1000	800																4	4	4	4	4	Y		
839	CM		2004	16-19	RS		D	700	600																4	4	4	4	4	Y		

Southcoast Streams Watershed Analysis Unit

Point Arena Creek Planning Watershed

Map A-2 (b)
Terrain Stability Units

This map presents an interpretation of the terrain stability units (TSUs) delineated for the Southcoast Streams WAU. The TSUs characterize the landscape by similar geomorphic attributes, shallow-seated landslide potential, and sediment delivery potential. The TSU designations for the Southcoast Streams WAU are only meant to be general characterizations of similar geomorphic and terrain characteristics related to shallow-seated landslides. Deep-seated landslides are also shown on this map. The deep-seated landslides have been included to provide land managers with supplemental information to guide evaluation of harvest planning and subsequent needs for geologic review. The landscape and geomorphic setting in the Southcoast Streams WAU is certainly more complex than generalized TSUs delineated for this evaluation. The TSUs are only meant to be a starting point for gauging the need for site-specific field assessments. Field observations will override unit boundaries of this map.



Terrain Stability Units

Unit	Description
1	Steep slopes along low gradient watercourses
2	Steep slopes adjacent to select intermittent or ephemeral streams
3	Steep dissected or convergent topography
4	Non-dissected topography
5	Low relief topography
6	Identified earthflow complexes
8	Ohlson Ranch Formation

- Deep-Seated Slide
- MRC Ownership
- Planning Watershed Boundary
- Watershed Analysis Unit Boundary
- 200' Contour Interval

Flow Class

- Class I
- Class II
- Class III

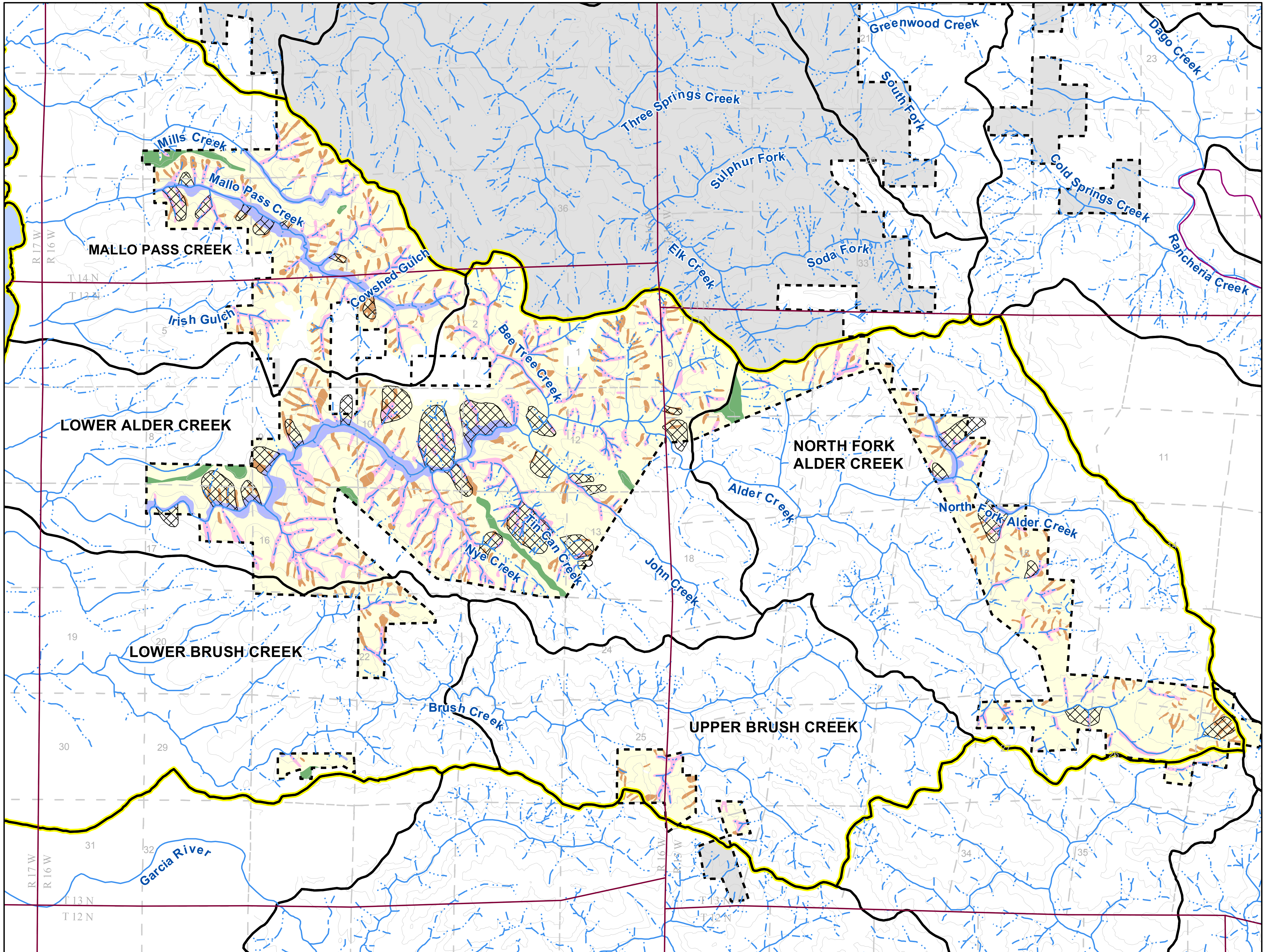
0 0.5 1 Miles

April 2014

Southcoast Streams Watershed Analysis Unit

Mallo Pass, Lower Alder, N.F. Alder, Lower and Upper Brush Creeks Planning Watersheds

Map A-2 (a) Terrain Stability Units



This map presents an interpretation of the terrain stability units (TSUs) delineated for the Southcoast Streams WAU. The TSUs characterize the landscape by similar geomorphic attributes, shallow-seated landslide potential, and sediment delivery potential. The TSU designations for the Southcoast Streams WAU are only meant to be general characterizations of similar geomorphic and terrain characteristics related to shallow-seated landslides. Deep-seated landslides are also shown on this map. The deep-seated landslides have been included to provide land managers with supplemental information to guide evaluation of harvest planning and subsequent needs for geologic review. The landscape and geomorphic setting in the Southcoast Streams WAU is certainly more complex than generalized TSUs delineated for this evaluation. The TSUs are only meant to be a starting point for gauging the need for site-specific field assessments. Field observations will override unit boundaries of this map.

Terrain Stability Units

Unit	Description
1	Steep slopes along low gradient watercourses
2	Steep slopes adjacent to select intermittent or ephemeral streams
3	Steep dissected or convergent topography
4	Non-dissected topography
5	Low relief topography
6	Identified earthflow complexes
8	Ohlson Ranch Formation

Deep-Seated Slide

MRC Ownership

Planning Watershed Boundary

Watershed Analysis Unit Boundary

400' Contour Interval

Flow Class

Class I

Class II

Class III

0 0.75 1.5 Miles

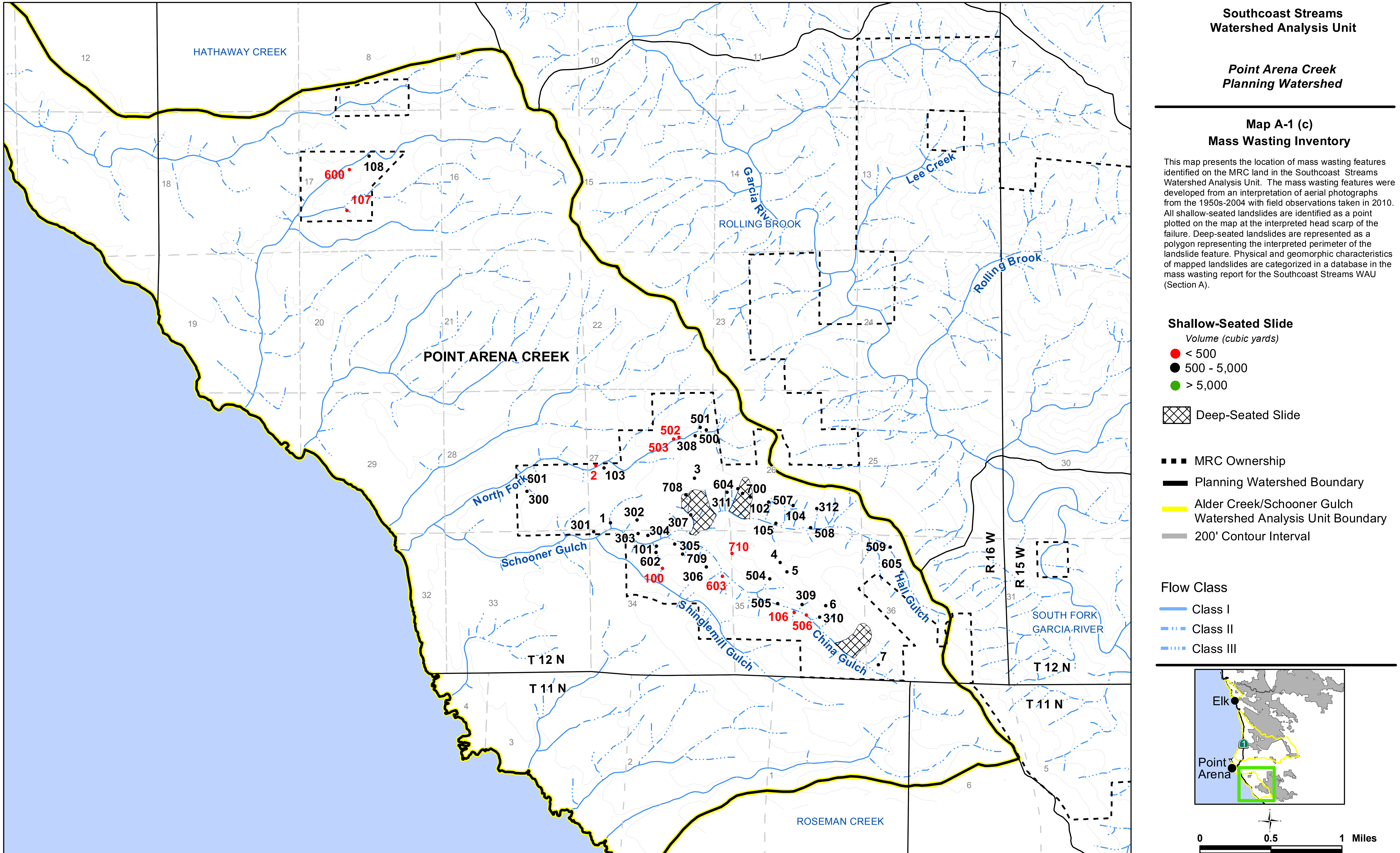
April 2014

Southcoast Streams
Watershed Analysis Unit

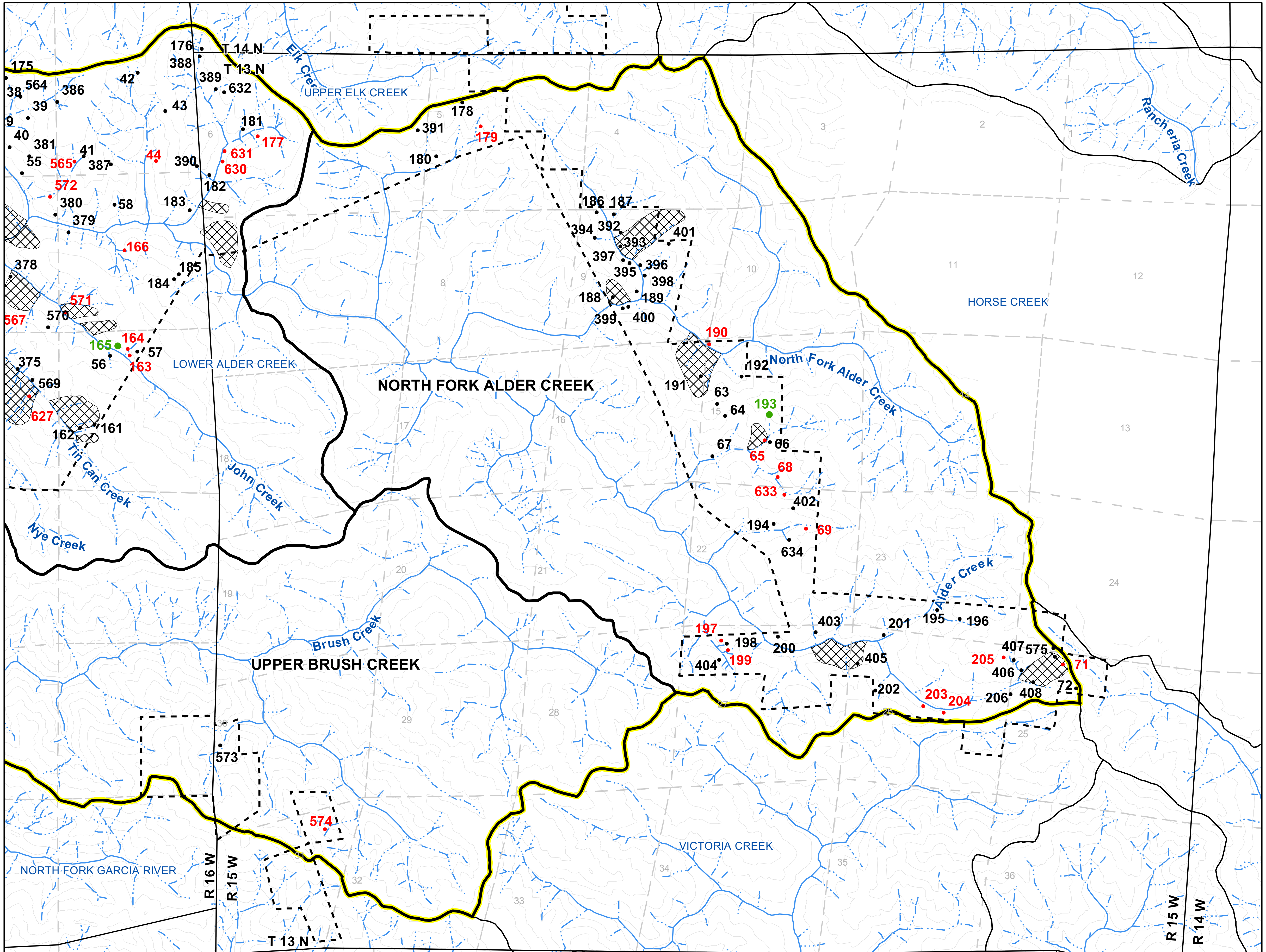
Point Arena Creek
Planning Watershed

Map A-1 (c)
Mass Wasting Inventory

This map presents the location of mass wasting features identified on the MRC land in the Southcoast Streams Watershed Analysis Unit. The mass wasting features were developed from an interpretation of aerial photographs from the 1950s-2004 with field observations taken in 2010. All shallow-seated landslides are identified as a point plotted on the map at the interpreted head scarp of the failure. Deep-seated landslides are represented as a polygon representing the interpreted perimeter of the landslide feature. Physical and geomorphic characteristics of mapped landslides are categorized in a database in the mass wasting report for the Southcoast Streams WAU (Section A).



April 2014



Southcoast Streams Watershed Analysis Unit

North Fork Alder Creek & Upper Brush Creek Planning Watersheds

Map A-1 (b)
Mass Wasting Inventory

This map presents the location of mass wasting features identified on the MRC land in the Southcoast Streams Watershed Analysis Unit. The mass wasting features were developed from an interpretation of aerial photographs from the 1950s-2004 with field observations taken in 2010. All shallow-seated landslides are identified as a point plotted on the map at the interpreted head scarp of the failure. Deep-seated landslides are represented as a polygon representing the interpreted perimeter of the landslide feature. Physical and geomorphic characteristics of mapped landslides are categorized in a database in the mass wasting report for the Southcoast Streams WAU (Section A).

Shallow-Seated Slide

Volume (cubic yards)

- < 500
- 500 - 5,000
- > 5,000

Deep-Seated Slide

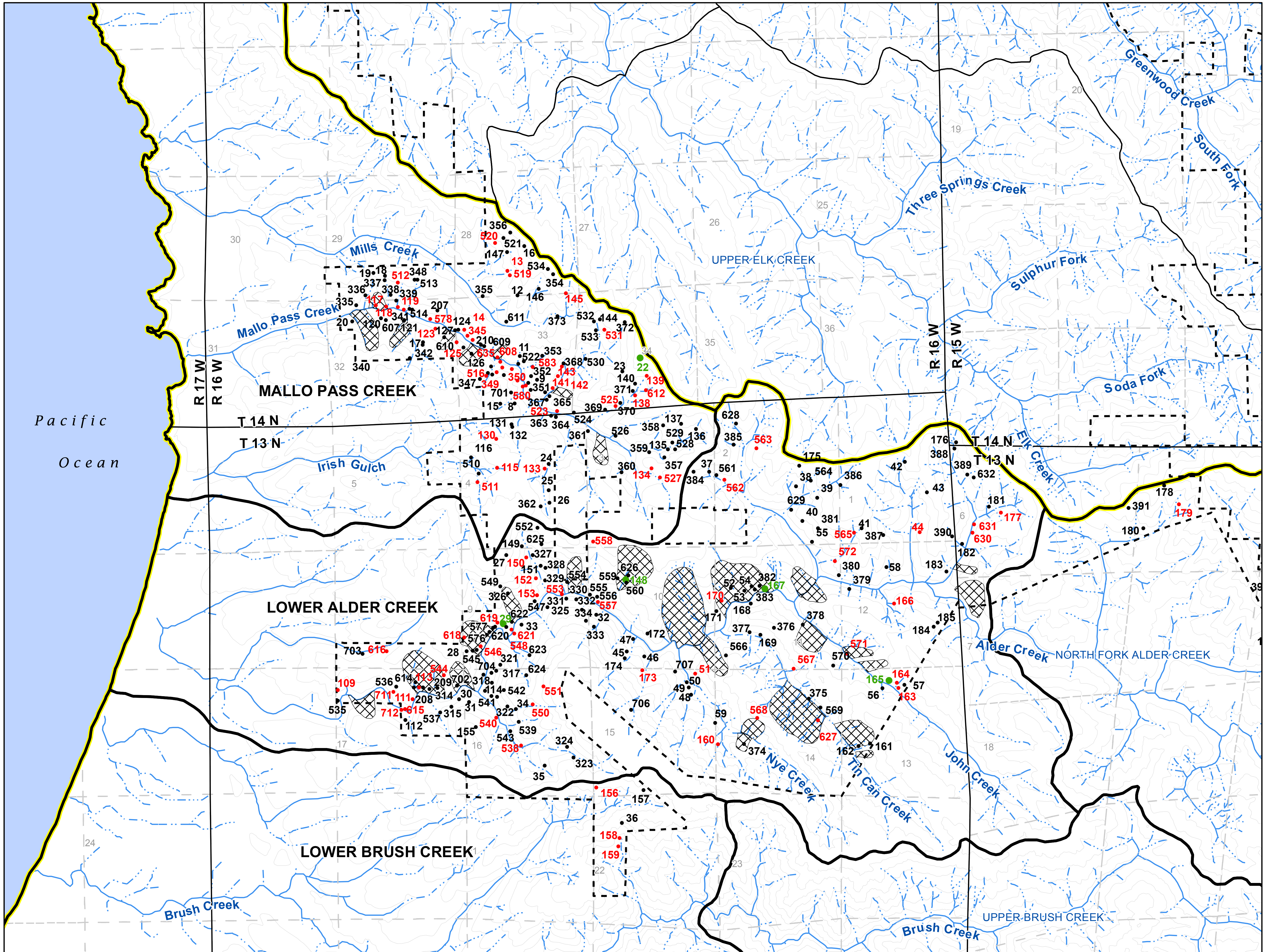
MRC Ownership
Planning Watershed Boundary
Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
200' Contour Interval

Flow Class
Class I
Class II
Class III

Elk
Point Arena

0 0.5 1 Miles

April 2014



Southcoast Streams Watershed Analysis Unit

Mallo Pass, Lower Alder & Lower Brush Creeks Planning Watersheds

Map A-1 (a)
Mass Wasting Inventory

This map presents the location of mass wasting features identified on the MRC land in the Southcoast Streams Watershed Analysis Unit. The mass wasting features were developed from an interpretation of aerial photographs from the 1950s-2004 with field observations taken in 2010. All shallow-seated landslides are identified as a point plotted on the map at the interpreted head scarp of the failure. Deep-seated landslides are represented as a polygon representing the interpreted perimeter of the landslide feature. Physical and geomorphic characteristics of mapped landslides are categorized in a database in the mass wasting report for the Southcoast Streams WAU (Section A).

Shallow-Seated Slide

Volume (cubic yards)

- < 500
- 500 - 5,000
- > 5,000

Deep-Seated Slide

MRC Ownership

Planning Watershed Boundary

Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary

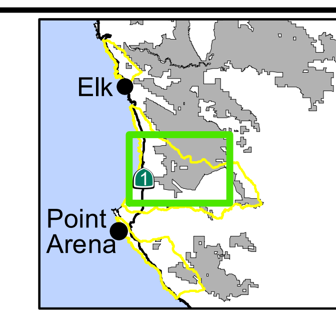
200' Contour Interval

Flow Class

Class I

Class II

Class III



0 0.5 1 Miles

April 2014