Humboldt Redwood™

January 29, 2013

Mr. Matthias St. John
California Regional Water Quality Control Board
North Coast Region
5550 Skylane Blvd, Suite A
Santa Rosa, CA 95403

Subject: Enrollment of portions of THP 1-13-005 HUM in the North Fork Elk River WWDR, "Tier II"

Dear Mr St. John:

HRC is requesting Tier II enrollment under Watershed-Wide Waste Discharge Requirement (WWDR) Order No. R1-2006-0039 for portions of THP 1-13-005 HUM. The enrollment is comprised of 175.9 acres of group selection/selection and 0.5 acres of right of way, (88.5 clear-cut equivalent acres). Total acres currently enrolled or proposed for enrollment under Order No. R1-2006-0041 Tier II is shown in the Attached Pre-Harvest Planning Report. The Erosion Control Plan (ECP), Form 200, and tier II analysis package are included. As per discussion with Water Borad Staff, submittals after 6/1 do not need a fee. No changes to the ECP have been needed since plan was reviewed during the PHI.

Landslide risks associated with this plan were evaluated in compliance with the Freshwater Creek and Elk River WWDR Permit Acreage Enrollment and Compliance Monitoring Program Quality Assurance Project Plan (Version 2.0, September 1, 2006) approved by the Executive Officer of the North Coast Regional Water Quality Control Board, as part of THP preparation. The Licensed Geologist performed this analysis in the Geology report included in the plan. This approach uses commonly accepted standards for geologic practices in forest management (Sidle et al. 1985, Soeters and Van Western 1996, and Sidle and Ochiai 2006) to assess factors known to contribute to landslides, such as steepness of slope, slope convergence, hydrology, geologic features, and visibly unstable areas. Overlapping and complementary scientific techniques combining state-of-the-art digital elevation model (DEM) slope stability models, field investigation, and terrain analysis were used in this assessment.

The plan is located in the Elk River watershed and occupies multiple aspect slopes adjacent to and above Bridge Creek, McWhinney Creek, and the North Fork Elk River. These drainages containing these waterways are characterized by incised, moderate to steep sided, v-shaped draws/valleys that contain well-developed dendritic drainage systems. A majority of the slopes within the plan area have roughly planar/ concave profiles with surface gradients of 5% to 50%. Steeper pitches (65% +) are also present, but are

generally confined to areas that flank Class I and II watercourses. In most instances, these steeper areas are encompassed by riparian management zones (RMZ) and limited harvest areas.

Regional geologic maps indicate that the plan occupies slopes underlain by bedrock associated with the Late Cretaceous age Yager terrane and the Miocene-Pliocene age undifferentiated Wildcat Group sediments. Previous regional geomorphic mapping exercises identified a large number of landslides/ landslide-related landforms on slopes currently within the operational limits of this THP. Close examination of these pre-identified features reveal a relatively limited number of of active to dormant-historic landslides.

Those failures within the operational limits of the THP and outside the RMZs that could feasibly discharge sediment into down slope watercourses were surrounded/buffered by limited harvest areas with specific retention standards. Landslides that have not directly delivered sediment to a watercourse by means of landslide processes, nor are likely to do so in the future, will undergo group selection. In essence, restricted partial cut activities have been applied to slopes within or above those areas of instability that could have an adverse impact on water quality, while areas of concern that are not actively contributing sediment to local watercourses and are not likely to do so in the near future will be subject to standard uneven aged practices.

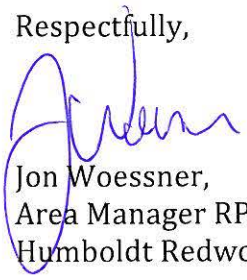
The services of a California State licensed Professional Geologist were retained during the layout of this THP. A letter report titled 'Reviewed Geologic Information and Disclosure of Known Unstable Areas' that documents the Project Geologist observations and conclusions is attached to Section 5 of the THP. The THP was also reviewed by California Geologic Survey (CGS) staff, which is documented in a Pre-Harvest Investigation (PHI) report found on the CALFIRE web site. Based on the level of review provided in the letter report, CGS PHI report, and the HRC GeoScience Departments recent evaluation, it is our opinion that the 3 Forks THP meets the requirements for Tier II enrollment.

The THP proposes an uneven-age silviculture retaining 75 sqft of basal area. Sub-merchantable trees and those with specific wildlife value characteristics (e.g., cavities, large limbs, broken tops, snags, etc.) will be retained within the harvest area to the extent feasible. Cable and ground based yarding is approved for the unit. Post-harvest no site preparation will occur.

Greater detail regarding this landslide hazard assessment is provided in the attached *THP Unit Review for Tier 2 Enrollment*. The licensed geologist involved with the Tier 2 landslide risk evaluation has concluded the proposed harvest operation, if implemented as planned and approved, will result in a negligible increase in potential for post-harvest landsliding; and thereby meets the applicable Zero Delivery of landslide related sediment performance standards of NCRWQCB Orders R1-2006-0041 and R1-2008-0071.

Please do not hesitate to contact me should you have any questions or comments regarding this application for enrollment into WWDR (Order No. R1-2006-0041).

Respectfully,



Jon Woessner,
Area Manager RPF #2571
Humboldt Redwood Company, LLC

Attachments:
Professional Certification of Design
THP Unit Review for Tier II enrollment
Pre-harvest Planning Report
Maps

Table 1. Proposed 2013 Harvest in North Fork Elk River.

THP Name	THP Number	Unit Number	Silviculture						Hazard	
			CC	ROW	CT	SHR	SEL	CC Equivalent	Low	High*
Dunlap Brown	11-054	3					31.2	15.6	20.7	135.4
Dunlap Brown	11-054	4					44.7	22.4	31.8	166.3
Dunlap Brown	11-054	5		0.3			36	18.3	29	94.1
Dunlap Brown	11-054	12		0.3			8.2	4.4	7.1	18.0
Tip Top lake	12-017	tier 1		6.4			118.6	65.7	118.3	86.4
Three Forks	13-005	1					34.8	17.4		
Three Forks	13-005	3					36.1	18.1		
Three Forks	13-005	4		0.5			23.7	12.4		
Three Forks	13-005	5					9.4	4.7		
Three Forks	13-005	8					30.3	15.2		
Three Forks	13-005	9					41.6	20.8		
								0.0		
							Total	158.6		

*The acres represented here have been converted to High Hazard Acres by multiplying by 12.807

Highlight indicates a THP and Specific Unit to be enrolled prior to establishing an enforceable Zero Discharge Monitoring Plan. Weighted Acreage Totals are listed below to demonstrate compliance with the Staff Landslide Model limit of 266 Harvest Acres in North Fork Elk River. Other THP Units will be enrolled after approval of the aforementioned Monitoring Plan

No Highlight Indicates a THP and Specific Unit to be enrolled after establishment of an enforcable Zero Discharge Monitoring Plan (Tier II).

As per 2012 enrollment, these acres are acounted for in 2012 harvest

Total Clear Cut Equivilant Acres enrolled or submitted for enrollment	158.6

Table 3. Summary of THPs by Yarding System and Site Preparation for North Fork Elk River

THP Name	THP Number	Unit Number	Yarding System			Site Preparation	
			Ground Based	Yarder	Helicopter	Mechanical	Broadcast
Dunlap Brown	11-054	3	0	31.2			
Dunlap Brown	11-054	4	0	44.7			
Dunlap Brown	11-054	5	16	20.3			
Dunlap Brown	11-054	12	3.5	5			
Tip Top lake	12-017	tier 1	19.2	78.2			
Three Forks	13-005	1		38.4			
Three Forks	13-005	3	1.7	34.6			
Three Forks	13-005	4	12.2	11.6			
Three Forks	13-005	5		9.4			
Three Forks	13-005	8	3.2	27.1			
Three Forks	13-005	9	4.9	36.7			

Three Forks

Silviculture Map

T4N R1E Sec. 21, 22, 27, 28, 33 HB&M

N

USGS Quad (s) : MCKINNEY CREEK

Map Scale: 1 inch = 1320 feet

Contour Interval: 40 feet

Property Line
Harvest Boundary
Permanent Road
Seasonal Road
Proposed Seasonal Road
Class I Watercourse
Class II Watercourse
Class III Watercourse
Class II Waters
NSO Site
500' NSO Buffer
1000' NSO Buffer
HRA

Group Selection
Selection
No Harvest

tier 2

PART OF PLAN

Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Unit 6
Unit 7
Unit 8
Unit 9

U51
U50
U46

TWO
THREE

RECEIVED
FEB 28 2013
COAST AREA OFFICE
RESOURCE MANAGEMENT

61 (2-28-13)

Produced By HRC GIS: z:/d/thp12/3forks/thpsilv.aml on Friday December 14, 2012 at 2:53 PM

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

State of California
Regional Water Quality Control Board
APPLICATION/REPORT OF WASTE DISCHARGE
GENERAL INFORMATION FORM FOR
WASTE DISCHARGE REQUIREMENTS OR NPDES PERMIT

I. FACILITY INFORMATION

A. Facility:

Name: THP 1-**13-005- HUM # forks**			
Address:			
City:	County:	State:	Zip Code:
Contact Person: Jon Woessner		Telephone Number: 707-764-4376	

B1. Facility Owner: (timber owner)

Name: Humboldt Redwood Company LLC			Owner Type (Check One): 1. ☐ Individual 2. ☒ Corporation 3. ☐ Governmental Agency 4. ☐ Partnership 5. ☐ Other
Address: P.O. Box 712			
City: Scotia	State: CA	Zip: 95565	
Contact Person: Jon Woessner		Telephone Number: 707-764-4376	Federal Tax ID:

C. Facility Operator (The agency or business, not the person): (plan submitter)

Name: Humboldt Redwood Company LLC			Owner Type (Check One): 1. ☐ Individual 2. ☒ Corporation 3. ☐ Governmental Agency 4. ☐ Partnership 5. ☐ Other
Address: P.O. Box 712			
City: Scotia	State: CA	Zip: 95565	
Contact Person: Jon Woessner		Telephone Number: 707-764-4376	Federal Tax ID:

D1. Owner of the Land:

Name: Humboldt Redwood Company LLC			Owner Type (Check One): 1. ☐ Individual 2. ☒ Corporation 3. ☐ Governmental Agency 4. ☐ Partnership
Address: P.O. Box 712			
City: Scotia	State: CA	City: Scotia	State: CA
Contact Person: Andrew Westfall		Telephone Number: 707-786-4659	Federal tax ID:

E. Address Where Legal Notice May Be Served:

Address: 125 Main Street		
City: Scotia	State: CA	Zip: 95565
Contact Person: Mike Jani		Telephone Number: 707-764-4403

F. Billing Address:

Address: P.O. Box 712		
City: Scotia	State: CA	Zip: 95565
Contact Person: Jon Woessner		Telephone Number: 707-764-4376

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

State of California
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APPLICATION/REPORT OF WASTE DISCHARGE
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WASTE DISCHARGE REQUIREMENTS OR NPDES PERMIT

II. TYPE OF DISCHARGE

Check Type of Discharge(s) Described in this Application (A or B):

☒ **A. WASTE DISCHARGE TO LAND** ☐ **B. WASTE DISCHARGE TO SURFACE WATER**

Check all that apply:

☐ Domestic/Municipal Wastewater Treatment and Disposal	☐ Animal Waste Solids	☐ Animal or Aquacultural Wastewater
☐ Cooling Water	☐ Land Treatment Unit	☐ Biosolids/Residual
☐ Mining	☐ Dredge Material Disposal	☐ Hazardous Waste (see instructions)
☐ Waste Pile	☐ Surface Impoundment	☐ Landfill (see instructions)
☐ Wastewater Reclamation	☐ Industrial Process Wastewater	☐ Storm Water

☒ Other, please describe: Timber harvest activities

III. LOCATION OF THE FACILITY

Describe the physical location of the facility.

1. Assessor's Parcel Number(s)	2. Latitude	3. Longitude
Facility:	**Facility:**	**Facility:**
Discharge Point:	**Discharge Point:**	**Discharge Point:**

IV. REASON FOR FILING

☒ New Discharge or Facility	☐ Changes in Ownership/Operator (see instructions)
☐ Change in Design or Operation	☐ Waste Discharge Requirements Update or NPDES Permit Reissuance
☐ Change in Quantity/Type of Discharge	☐ Other:

V. CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

Name of Lead Agency: California Department of Forestry and Fire Protection

Has a public agency determined that the proposed project is exempt from CEQA? ☐ **Yes** ☒ **No**

If Yes, state the basis for the exemption and the name of the agency supplying the exemption on the line below.

Basis for Exemption/Agency:

Has a "Notice of Determination" been filed under CEQA? ☐ **Yes** ☒ **No**

If Yes, enclose a copy of the CEQA document, Environmental Impact Report, or Negative Declaration. If no, identify the expected type of CEQA document and expected date of completion.

Expected CEQA Documents:

☐ **EIR** ☐ **Negative Declaration** **Expected CEQA Completion Date:**

CALIFORNIA ENVIRONMENTAL
PROTECTION AGENCY

State of California
Regional Water Quality Control Board
APPLICATION/REPORT OF WASTE DISCHARGE
GENERAL INFORMATION FORM FOR
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VI. OTHER REQUIRED INFORMATION

Please provide a COMPLETE characterization of your discharge. A complete characterization includes, but is not limited to, design and actual flows, a list of constituents and the discharge concentration of each constituent, a list of other appropriate waste discharge characteristics, a description and schematic drawing of all treatment processes, a description of any Best Management Practices (BMPs) used, and a description of disposal methods.

Also include a site map showing the location of the facility and, if you are submitting this application for an NPDES permit, identify the surface water to which you propose to discharge. Please try to limit your maps to a scale of 1:24,000 (7.5' USGS Quadrangle) or a street map, if more appropriate.

VII. OTHER

Attach additional sheets to explain any responses which need clarification. List attachments with titles and dates below:

You will be notified by a representative of the RWQCB within 30 days of receipt of your application. The notice will state if your application is complete or if there is additional information you must submit to complete your Application/Report of Waste Discharge, pursuant to Division 7, Section 13260 of the California Water Code.

VIII. CERTIFICATION

"I certify under penalty of law that this document, including all attachments and supplemental information, were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

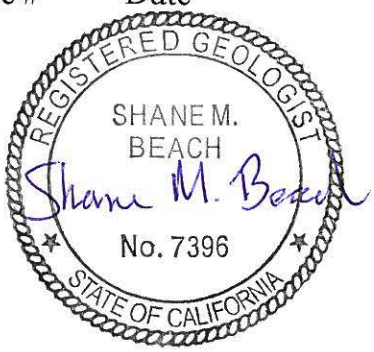
Print Name: Jon Woessner	Title: Northern Area Manager
Signature:	Date: 6/8/13

FOR OFFICE USE ONLY

Date Form 200 Received:	Letter to Discharger:	Fee Amount Received:	Check #:

Professional Certification of Design

I SHANE M. BEACH, 7396, 6/7/13
Name License # Date



Signature

hereby certify, in accordance with North Coast Regional Water Quality Control Board (NCRWQCB) Order Nos. R1-2006-0039 and R1-2006-0041, that the attached application and the description of THP modifications, and the materials submitted along with:

THP No. 1-13-005 HUM (Three Forks) Unit # 1 through 9

a. are in accordance with accepted practices, and recognized professional standards;
b. comply with the requirements of the Monitoring and Reporting Program No. R1-2008-0071, approved by the Executive Officer of the North Coast Regional Water Quality Control Board; and
c. provided that the THP is properly implemented, operated, and maintained, are adequate for the THP to meet the applicable Zero Net Delivery performance standards of NCRWQCB Orders R1-2006-0039, R1-2006-0041, and R1-2008-0100, insofar as such performance can reasonably be predicted by accepted engineering geologic practices.

The opinions presented in the subject THP have been developed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable professional geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Three Forks
THP 1-13-005 HUM
Units 1 through 9

Tools Used in This Assessment	Figure Number
Elevation Map with 10 ft Contours (Humboldt Redwood Company [HRC] LiDAR*)	1
SHALSTAB / Slope Class / Hillshade Maps (Montgomery and Dietrich, 1994; Palco, 2006)	2
California Geologic Survey (CGS) Geology and Geomorphic Features (Marshall and Mendes, 2005)	3
Mass Wasting Potential Map (HRC, 1999)	4
Aerial Photo Map (HRC, 2007)	5
HRC Elk River and Salmon Creek WA deep-seated LS inventory Map (HRC, 2004)	6
Road Condition Map	7

* Refer to back of enrollment package for referenced maps

Summary of Changes to THP Prescriptions Based on Tier II Analysis:

Geologic Review Units 1 through 8	Forestry Silviculture/Site Prep Plan Units 1 through 9	Operational Design Plan Units 1 through 3
➢ CGS (2013) ➢ HRC (2013a) ➢ HRC (2013b)	➢ Silviculture practices/ site preparation activities identified in the approved THP have been not modified. ➢ Group selection and single tree selection are the approved silviculturial practices. ➢ Site preparation is not proposed within the approved THP.	➢ Yarding methods in the approved THP have not been adjusted or modified. ➢ Ground-based and cable yarding techniques are the approved methods for timber removal.

Executive Summary

The plan is located in the Elk River watershed and occupies multiple aspect slopes adjacent to and above Bridge Creek, McWhinney Creek, and the North Fork Elk River. The upland portions of the plan overlap well-rounded ridge crests and moderate to steep (40% to 60%) midslopes. These upland slopes typically retain convex to semi-planar profiles and in some instances have developed into low gradient (10% to 40%) topographic benches. As these upland areas approach the adjoining watercourses, they develop steep orientations. These "inner valley" slopes have planar profiles and are moderately (50%) to steeply (100%+) inclined. This inner valley wall terrain extends between 20 and 100 feet upslope of the stream edge.

Published geologic maps of the region indicate that the plan area occupies slopes underlain by sedimentary bedrock of the Late Cretaceous age Yager terrain and the Miocene-Pliocene age undifferentiated Wildcat Group sediments. The plan area overlaps the southern limb of a northwest-trending anticline that has a southwest dip of about 15°. Based on the recorded attitudes portions of Units 1, 6, and 9 include hillsides that retain slope characteristic (aspect/ gradient) potentially conducive to the exposure ("daylight") of bedding plane discontinuities. HRC staff observed no indication that hill slopes in these units are being affected by adverse bedding orientations.

No active faults are mapped passing through the project area, and no part of the plan lies within and/or adjacent to an Alquist-Priolo Earthquake Fault Zone. The harvest plan does fall in-between the Little Salmon and Fickle Hill faults, both of which are considered active, northwest-trending, high angle thrust faults (Hart and Bryant, 1997). The mapped trace of the Little Salmon fault is approximately 5.5 miles southeast of the plan area, while the Fickle Hill fault trace is about 5 miles to the northeast (McLaughlin and others, 2000).

HRC GeoScience Department staff conducted a geologic evaluation of the proposed THP area in accordance with Note 50 (CGS, 1997), Note 45 (CGS, 1999), and Tier 2 enrollment guidelines. To evaluate slope stability in the plan area the project geologist used high-resluton,10-foot LIDAR contour maps, SHALSTAB model results, historical aerial photographs, Mass Wasting Potential (MWP) maps, Geologic and Geomorphic Features Related to Landsliding, Elk River Creek Map (Marshall and Mendes, 2005), onsite investigations, and THP Operational maps with unit boundaries, creeks, and roads. A discussion of the findings, conclusions, and recommendations associated with this assessment is contained in a geologic report that is attached to Section 5 of the THP titled "Geologic Evaluation of the Three Forks Timber Harvesting Plan, Humboldt County, California". This is a public document and can be found at ftp://thp.fire.ca.gov/THPLibrary/North_Coast_Region/THPs2012/1-13-005HUM/.

A large number of unstable areas were identified within the operational portions of plan area during the investigation. A set of 1:6,000 scale maps (Figures 4 through 8) are attached to the geologic report that show the position of the unstable areas as they relate to roads, watercourses, and timber harvest boundaries. Detailed characterizations of the slide areas and justification for operations on and around them are provided in the reference geologic report.

The THP pre-harvest investigation (PHI) was attended by staff from several state agencies. PHI reports found the THP was compliant with the California Forest Practice Rules and HCP prescriptions (HRC, 2005) with respect to disclosure of all known unstable areas. These PHI reports are also available for review at the above listed website.

Units 1 through 8

General Observations (A)
The nine proposed cut blocks occupy convergent and divergent slopes with gradients that range from 5% to 90%. A majority of the steeper pitches (60% +) are concentrated along waterways. In general, slopes with gradients in excess of 50% that flank the higher order watercourses are encompassed by no-harvest and limited entry watercourse buffer zones. A majority of the streamside slopes in the project area have smooth and well-rounded profiles that are devoid of slope morphology attributable to recent and/ or historic mass movements. A significant percentage of the steeper streamside slopes within the plan area were previously classified by Marshall and Mendes (2005) as debris slide slopes (Figure 3). Intermixed with and underlying many of the debris slide slopes are large to moderate-sized, geomorphic features as being a deep-seated, landslide-related landforms. Many of these landforms are multi-acre in size and extend from ridge crest to valley floor. The landslide map attached to the Landslide module of the Elk River and Salmon Creek Watershed Analysis (Figure 6) also identifies features in the general vicinity of the queried landforms of Marshall and Mendes (2005). A relatively small percentage of the slopes within the plan area were assigned "High" (2) to "Extreme" (1) landslide potential value by the SHALSTAB model (Figure 2). Pixels with "High" and "Extreme" ratings were generally rare and scattered, with many being concentrated along waterways. "Extreme" pixels in all instances overlap/ directly abutted mapped watercourse channels. No slopes were allocated an "Extreme" potential value outside the standard RMZ no-cut band. The Mass Wasting Potential (MWP) model use to evaluate the plan area calculated a majority of the slopes to have a "Low" to "Moderate" landslide potential (Figure 2). "High" potential polygons typically overlap the sidewalls of incised waterways that were previously mapped as debris slide slopes by CGS (Marshall and Mendes, 2005).

Harvest Related Impacts and Hillslope Sensitivity (B)
The project area was initially managed in a manner similar to that of a modern clear cut using ground-based equipment. Felled timber appears to have been yarded to the ridge crest or to down slope watercourses using historic train logging methods. Stands in the immediate vicinity of the this project were re-entered in the 1990s, consequently the current plan overlaps or abuts cut blocks associated with THP 1-93-068 HUM, THP 1-95-566 HUM, THP 1-97-498 HUM, THP 1-00-030, THP 1-00-219 HUM, THP 1-02-111 HUM, and THP 1-03-159 HUM. No post-harvest open slope failures (i.e not road-related) were encountered in any portion of the plan that underwent selective harvest operation in the early 1990s. Two post-harvest, road-related slides (slide numbers 805 and 901) were observed along roadway appurtenant to the 1990 plans that now fall within the operational limits of this THP. Refer to the Landslide Inventory Tables attached to the geologic report in Section 5 for slide details. The stability of the landslide-related landforms (debris slide slopes, translational/rotational landslides, and earthflows) (Figure 3) identified by prior investigators do not appear to have been adversely impacted by past land use activities. HRC (2013) noted that there was no evidence of post-harvest adjustment associated with these features and that there was an absence of morphology relating to recent or historic movement in these areas (HRC, 2012). Those features on the surface of these larger landforms identified as having potentially negative responses to the proposed management strategies are identified as landslides on Figures 4 through 8 of the HRC geologic report. A number of regions in the plan area were identified by MWP and SHALSTAB models as having high and extreme landslide hazard potential. Those regions identified by these models that correspond to areas of recent or historic instability are mapped as unstable landforms on Figures 4 through 8. A majority of the high hazard areas overlap areas devoid of morphology indicative of recent or historic instability. As such, these areas were compared to adjacent lower hazard modeled slopes with similar slope inclination, convergence, and vegetative coverage to determine if unstable conditions existed. Where field observation suggested that the model was incorrect in assessing the potential for mass wasting, especially in response to selective silviculture, the modeled areas were not considered potentially unstable and are not identified on the landslide maps. These modeled areas underwent intensive management practices in the past (historic tractor operations, clear cut, and burning) and there is no field or aerial photographic evidence suggesting that these activities had an adverse effect on their overall stability. We anticipate that these slopes will have a similar response to the uneven age land use practice currently proposed on their surfaces; consequently we did not identify them as potential areas of concern. State agencies (CGS, 2012) also concluded subsequent to the PHI that the landslide hazards were appropriately disclosed in the HRC geologic report (2013) and the proposed mitigative treatments were suitable for site conditions.

Forestry / Silviculture Plan (C)
Silviculture prescriptions proposed in the THP have not been adjusted or modified in response to this evaluation. The approved silviculture prescriptions appear appropriate for site conditions.

Operational Design Plan (D)
Yarding methods proposed in the THP have not been adjusted or modified in response to this evaluation. The approved yarding methods, appear appropriate for site conditions.

Brief descriptions of the models used in this evaluation:

SHALSTAB was first described in Dietrich and Montgomery (1994). SHALSTAB is a simple, physically-based model based on the Mohr-Coulomb failure law that can be used to map shallow landslide potential. The model calculates the potential for failure using gridded digital elevation data. The simplicity of the model lies in the formulation of slope stability parameters that allow the model to be run parameter-free using default values suggested by the authors or determined by local measurement. Because the model uses no field measurements of critical characteristics that determine slope stability, the evaluation of potential instability is only an approximation. In applying SHALSTAB for Tier 2 enrollment, HRC has run the model on a 10-m spatial grid using LiDAR elevation data and applied the parameters as suggested by the model authors. HRC's application of the method and parameters is described in HRC (2008).

Mass Wasting Potential (MWP) modeling is a cursory regional assessment that numerically values soil, slope inclination, geology type, and geomorphology with respect to past mass wasting (HRC, 1999). The sums of the values specific to an area are measured against a set ranking system that extends from very low to extreme. The models intent is to highlight areas of high potential for instability at the planning level. The model's use at the site specific level is limited in that pedogenic soil types are used, not textures, the geologic formations utilized provide one value for all of the incorporated facies, and the model is heavily biased if past mass wasting has occurred or has been mapped as occurring in the area.

References:

Hart, E.W. and W.A. Bryant. (1997). *Fault-Rupture Zones in California, Alquist-Priolo Earthquake Fault Zoning Act* (with Index to Earthquake Fault Zone Maps, California Division of Mines and Geology Special Publication 42, with Supplements 1 and 2 added in 1999, 38). NR: DMG.

California Geologic Survey (CGS), (2005), *Geologic and Geomorphic Features Related to Landsliding, Elk River Watershed, Humboldt County, California.* Department of Conservation, now California Geological Survey Watershed Mapping Series, Map set 4, Plate 1. Available via the web at ftp://ftp.consrv.ca.gov/pub/dmg/thp/maps/elk/elk_color.pdf

---, (2012), *Engineering Geologic Review of Timber Harvesting Plan 1-13-005 HUM (Three Forks).* unpublished memorandum to William Snyder, Deputy Director, Resource Management California Department of Forestry and Fire Protection. NR:NR.

---. (1997). *Note 50: Factors Affecting Landslides In Forested Terrain.* Sacramento: CDMG.

---. (September 1999). *Note 45, Guidelines for Engineering Geologic Reports for Timber Harvesting Plans.* Sacramento: CDMG.

McLaughlin, R. J., and 6 others. (2000). Geology of the Cape Mendocino, Eureka, Garberville, and Southwestern Part of the Hayfork 30 x 60 Minute Quadrangles and Adjacent Offshore Area, Northern California," U.S. Geological Survey Miscellaneous Field Studies. 27 p., 6 plates. NR: USGS.

Montgomery, D.R. and W.E. Dietrich, (1994). *A physically based model for the topographic control on shallow landsliding.* Wat. Resour. Res. 30: 1153-1171. For specific details regarding the model used in this evaluation, please see Palco, 2006. Additional information from the model authors is available at the following website: http://socrates.berkeley.edu/~geomorph/shalstab

Humboldt Redwood Company (HRC), (1999). The Pacific Lumber Company's Habitat Conservation Plan, Vol. 2 Part D, Landscape Assessment of Geomorphic Sensitivity, Public Review Draft.

---, (2004). Elk River / Salmon Creek Watershed Analysis, Scotia, California, prepared for Pacific Lumber Company (PALCO), and acquired by Humboldt Redwood Company, LLC in 2008.

---, (2005). (Policy Acquired from The Pacific Lumber Company (PALCO)) Prescriptions Based on Watershed Analysis for Freshwater Creek, California, August 15, 2002.

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---, (2008). Freshwater Creek and Elk River WDR Permit Acreage Enrollment and Compliant Monitoring Program, NCRWQCB R1-2006—0039 and R1-2006-0041, Quality Assurance Project Plan, Version 3.0. Policy document submitted to NCRWQCB dated June 7, 2006.

---, (2013a). *Geologic Evaluation of the Three Forks THP, Humboldt Co., California.* Unpublished Report Prepared for HRC. 33 pgs.

---, (2013b). *Response to Review Team Questions for THP 1-13-005 HUM (Three Forks), Humboldt Co., California.* Unpublished Technical Memorandum Prepared for HRC. 1 pgs.

Humboldt Redwood Company LLC

Erosion Control Plan (ECP) for the "Three Forks" THP

This plan is being included in the THP to partially meet the requirements of the North Coast Regional Water Quality Control Board Watershed-wide Discharge Requirements. (**WWDRs**)

All operational portions of this ECP that are to be enforced through the Forest Practice Rules have been included in Section II of the THP.

Version **20080819**

Humboldt Redwood Company LLC Erosion Control Plan (ECP)

This document addresses the requirements of the California Regional Water Quality Control Board, North Coast Region Order No. R1-2006-0039 (Elk River) for an Erosion Control Plan (ECP) related to timber harvest activities on Non-Federal lands in the North Coast Region (Sec. III D2 and D3). The responsible party for this ECP is Humboldt Redwood Company LLC, P.O. Box 712 Scotia, CA 95565 (707) 764-2330.

This ECP is submitted for: THP Name: **Three Forks**

Contact Person: **Jon Woessner** Phone: **(707) 764-4376**

The landowner is committed to a wide variety of measures to prevent and minimize the discharge or threatened discharge of sediment from controllable sediment discharge sources as part of this project into the waters of the state in violation of applicable water quality requirements. Prevention and Minimization of Controllable Sediment Discharge Sources associated with this project are identified in the *Controllable Sediment Sources* table. The specific conditions of sediment discharge sources and a summary of prevention and minimization measures (Section I) are identified in the table. General prevention and minimization measures for the project (Section II) are incorporated in the ECP by reference.

The RPF and/or the RPF Designee have conducted an inventory of potential "controllable sediment discharge sources" within the project area. As defined in California Regional Water Quality Control Board Order No. R1-2006-0039 (Elk River).

> "Controllable sediment discharge source" means sites or locations, both existing and those created by proposed timber harvest activities, within the Project area that meet all the following conditions:
>
> 1. is discharging or has the potential to discharge sediment to waters of the state in violation of applicable water quality requirements or other provisions of these WWDRs,
> 2. was caused or affected by human activity, and
> 3. may feasibly and reasonably respond to prevention."

Upon guidance of the North Coast Regional Water Quality Control Board (NCRWQCB) staff, discharge from the source must be likely to occur during the life of the Timber Harvesting Plan (THP) and WWDR. (Holly Lundborg, personal communication)

The inventory method consisted of an appurtenant road survey, aerial photos and ground assessments of the harvest units, and a complete ground assessment of all watercourses and associated stream protection zones.

The schedule for implementing the prevention and minimization management measures for the controllable sediment sources will be consistent with the duration of the THP. These measures will be implemented in accordance with the priority level assigned to each site. High priority sites will be addressed first with low priority sites to follow. Work at all sites will be accomplished prior to THP expiration. The general prevention and minimization measures will be implemented concurrent with operations.

I. Inventory and Treatment of Controllable Sediment Sources

All controllable sediment sources are listed in the attached "Erosion Control Plan" table. These sources have been assigned a treatment priority of low, medium or high based on: 1) potential for significant sediment delivery to a Class I, II or III channel; 2) treatment immediacy (a subjective combination of event probability and sediment delivery); and 3) treatment cost-effectiveness.

The Prioritization for implementing prevention and minimization measures for road-related and non road-related controllable sediment sources is based upon guidance provided in Order No. R1-2006-0039 (Elk River). Highest priority is assigned to the largest sediment discharge sources that discharge to waters that support domestic water supplies or fish. The landowner's prioritization method considers this guidance, and combines it with consideration for accessibility and level of imminent risk of significant sediment discharge. Sources that receive a high priority rating will be treated by a date certain as noted in the Controllable Sediment Sources table. Sources that receive a low or medium rating are determined to have a low to moderate risk of imminent discharge and will be treated prior to completion of the THP, or as otherwise indicated.

Non-road related controllable sediment sources can include skid road crossings, yarding furrow, skid road in watercourse, perched skid road fill, skid road rutting, landslide, layouts, railroad grade, incline, etc.

Information specific to Controllable Sediment Discharge Sources is listed in the Controllable Sediment Sources Table, below. An explanation of information provided in that table is provided below.

II. General Prevention and Minimization Measures for Controllable Sediment Discharge

In addition to the site specific measures detailed above, the general measures proposed in this project, either as required by another State or Federal regulating agency, or as a matter of Humboldt Redwood Company policy, will prevent or minimize future sediment delivery. These measures include, but are not limited to measures incorporated in the THP Section Items as follows:

THP Section II:

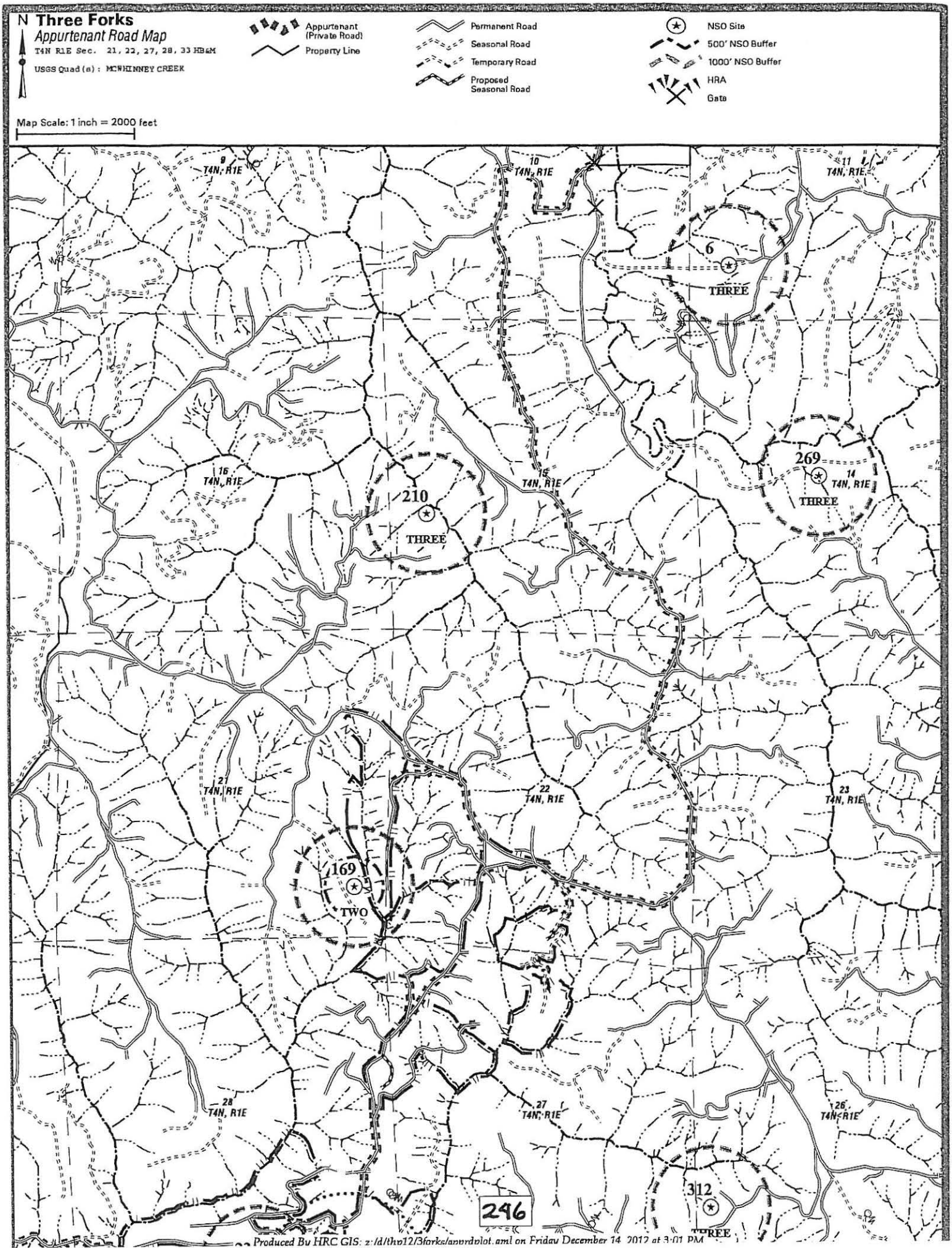
- Item 14 – Describes silvicultural prescriptions
  - (i) Site Preparation – Disclosure of selected site preparation treatments and mitigation measures
- Item 16 – Harvesting Practices – Describes yarding systems, equipment utilized, equipment limitations, and drainage facility installation timing
  - Inclusive through (m) – equipment use limitations and mitigation
- Item 18 – Soil Stabilization – waterbreak requirements, mitigation to minimize soil disturbance and sediment transport
- Item 20 – Ground Based Equipment Use Location
- Item 21 – Ground Based Equipment Use in Sensitive Areas – locations, descriptions of operations, limitations and mitigation measures
- Item 22 – Alternative Practices to Harvesting and Erosion Control
- Item 23 – Winter Operations – Provides descriptions of limitations and mitigation measures required during winter period operations and Winter Operating Plan
- Item 24 – Roads and Landings – Describes road and landing construction and re-construction operations, limitations, drainage relief structure installation, mitigation measures, road maintenance, inspections and wet weather road use restrictions
- Item 25 – Site Specific Measures to Reduce Adverse Impacts and Special Instructions to the LTO
- Item 26 – Watercourse and Lake Protection (WLPZ)
- Item 27 – "In Lieu" WLPZ Practice(s)
- Item 28 – Downstream Water Users Notification and Domestic Water Supply Protection Description of protection measures
- Item 29 – Sensitive Watershed – Identifies whether the plan is located in a designated sensitive watershed and mitigation measures
- Item 29 – 1 Hillslope Management (HCP 6.3.3.7) – Describes HCP hillslope management measures required as per watershed analysis

THP Section V:

- Sediment Reduction from Roads and THP Sediment Production--Including Table 1 – "Sediment Delivery for Units and Roads for this THP," references, letter regarding Road related sediment assessment for this THP with the calculations of deliverable net cubic yards of sediment, calculations and PWA information related to the THP project area when available

Maps attached:

- **Appurtenant Road**
- **Road Construction Locations/ECP Site Locator Map**


N
Three Forks
Appurtenant Road Map
T4N R1E Sec. 21, 22, 27, 28, 33 HB&M
USGS Quad (s) : MCWHINNEY CREEK
Appurtenant (Private Road)
Property Line
Permanent Road
Seasonal Road
Temporary Road
Proposed Seasonal Road
NSO Site
500' NSO Buffer
1000' NSO Buffer
HRA
Gate
Map Scale: 1 inch = 2000 feet
9 T4N, R1E
10 T4N, R1E
11 T4N, R1E
6
THREE
16 T4N, R1E
15 T4N, R1E
14 T4N, R1E
269
THREE
210
THREE
21 T4N, R1E
22 T4N, R1E
23 T4N, R1E
169
TWO
28 T4N, R1E
27 T4N, R1E
26 T4N, R1E
312
THREE
246
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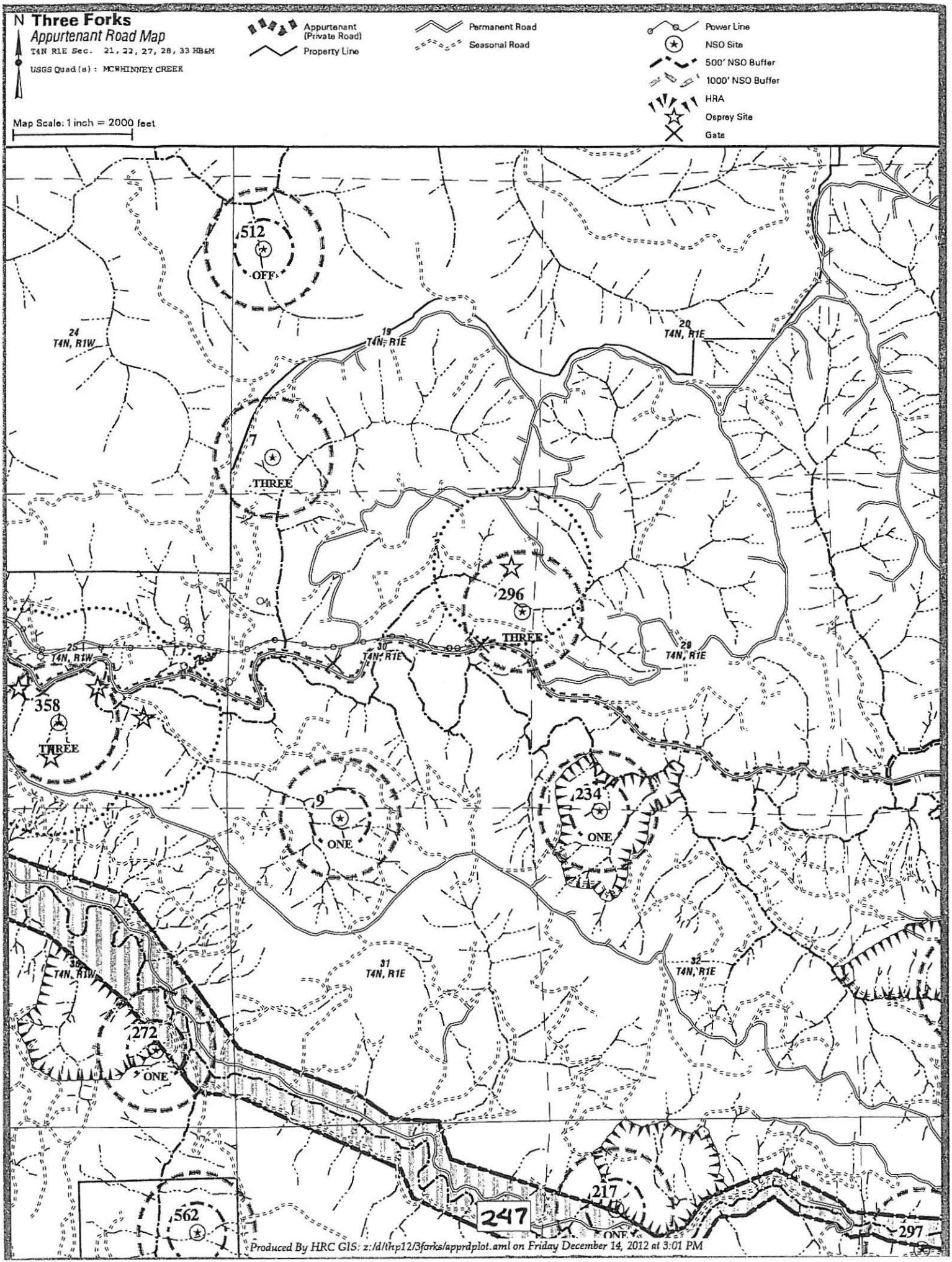
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Three Forks
Appurtenant Road Map
T4N R1E Sec. 21, 22, 27, 28, 33 HB&M
USGS Quad(s): MCWHINNEY CREEK
Map Scale: 1 inch = 2000 feet
Appurtenant (Private Road)
Property Line
Permanent Road
Seasonal Road
Power Line
NSO Site
500' NSO Buffer
1000' NSO Buffer
HRA
Osprey Site
Gate
512
OFF
24 T4N, R1W
19 T4N, R1E
20 T4N, R1E
7
THREE
296
THREE
25 T4N, R1W
30 T4N, R1E
29 T4N, R1E
358
THREE
9
ONE
234
ONE
31 T4N, R1E
32 T4N, R1E
272
ONE
562
247
217
ONE
297
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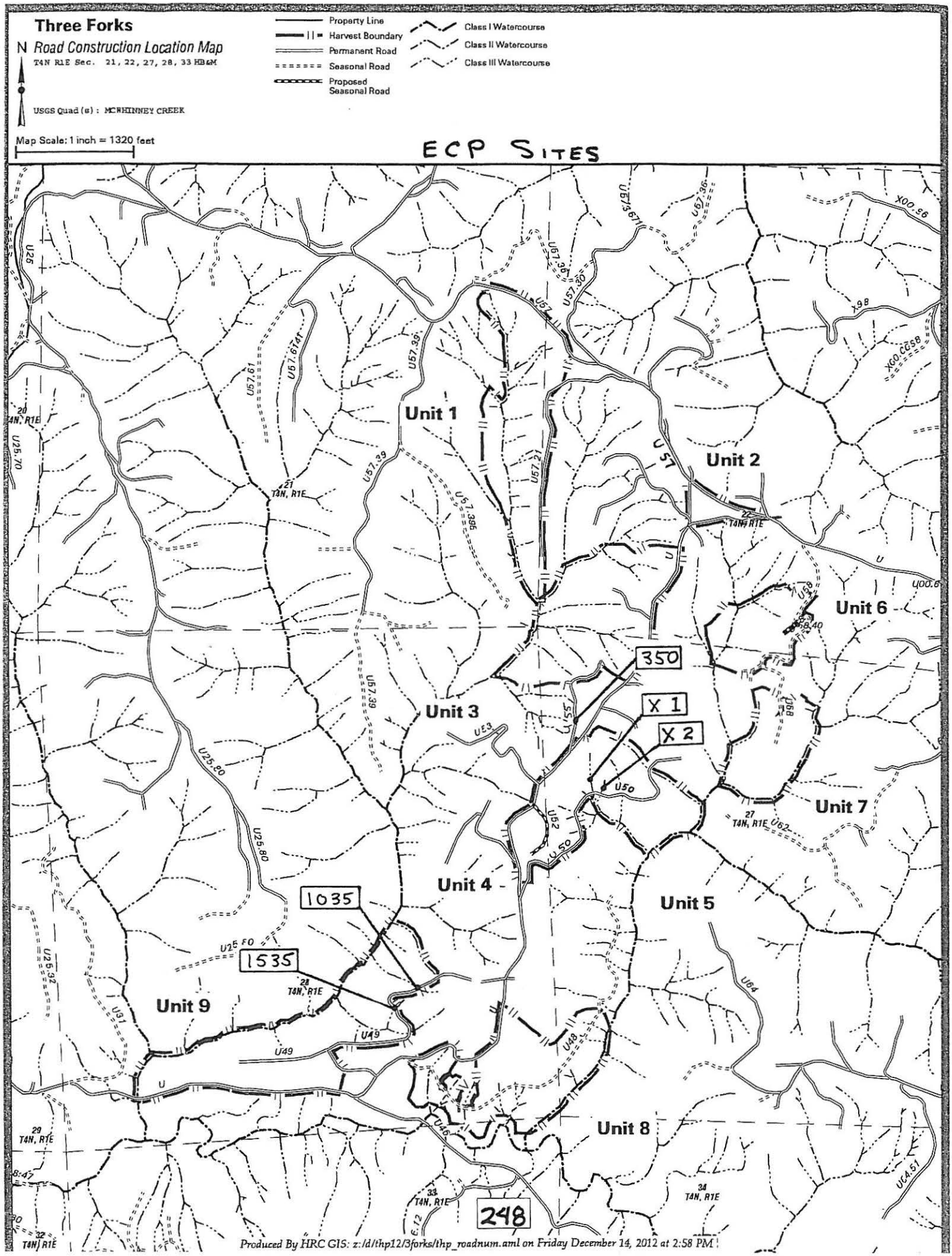
Three Forks
Road Construction Location Map
T4N R1E Sec. 21, 22, 27, 28, 33 HB&M
N
USGS Quad (s) : MCWHINNEY CREEK
Map Scale: 1 inch = 1320 feet
Property Line
Harvest Boundary
Permanent Road
Seasonal Road
Proposed Seasonal Road
Class I Watercourse
Class II Watercourse
Class III Watercourse
ECP SITES
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Unit 6
Unit 7
Unit 8
Unit 9
350
X 1
X 2
1035
1535
248
20 T4N, R1E
21 T4N, R1E
27 T4N, R1E
28 T4N, R1E
29 T4N, R1E
32 T4N, R1E
33 T4N, R1E
34 T4N, R1E
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III Inspection Plan and Reporting Requirements

A. Inspection Plan
The Inspection Plan is designed to ensure that all required management measures are installed and functioning prior to rainfall events; that the management measures are effective in controlling sediment discharge sources throughout the winter period; and that no new controllable sediment discharge sources developed.

B. Qualified and trained professionals will conduct all specified inspections of the project site to identify areas causing or contributing to a violation of the applicable water quality requirements or other provisions of these WWDRs. The responsible party for inspection and reporting is **Jon Woessner (707) 764-4376**.

C. No inspections are required in Project Areas where Timber Harvest Activities have not yet commenced.

D. Project Areas where Timber Harvest Activities have commenced and no winter period Timber Harvest Activities have occurred inspections will be conducted each year and throughout the duration of the Project while Timber Harvest Activities occur.

a. The Project is covered under WWDRs and the following inspection requirements will begin at the startup of timber harvest activities within the Project area:
   i. By November 15 to assure Project Areas are secure for the winter period;
   ii. Once following ten (10) inches of cumulative rainfall commencing on November 15 and prior to March 1, as worker safety and access allows; and
   iii. After April 1 and before June 15 to assess the effectiveness of management measures designed to address controllable sediment discharges and to determine if any new controllable sediment discharges sources have developed.

b. Project Areas with Winter Period Timber Harvest Activities will conduct inspections of such Project Areas while Timber Harvesting Activities occur and the Project is covered under the WWDRs as follows:
   i. Immediately following cessation of winter period Timber Harvest Activities to assure areas with winter Timber Harvest Activities are secure for the winter;
   ii. Once following ten (10) inches of cumulative rainfall commencing on November 15 and prior to March 1, as worker safety and access allows; and
   iii. After April 1 and before June 15 to assess the effectiveness of management measures designed to address controllable sediment discharges and to determine if any new controllable sediment discharges sources have developed.

c. Inspection reports will identify where management measures have been ineffective and when repairs and design changes will be implemented to correct management measure failures.

d. After completing the required inspections, and when it has been determined new controllable sediment discharges sources have developed, the ECP, implementation schedule, and inspection plan will be updated, if required, consistent with the WWDRs and submit the updated documents to the Regional Water Board to maintain coverage under the WWDRs. If the approved amendment is found to be out of compliance with the WWDRs, the Project will be amended to be consistent with the provisions of the WWDR within 30 days, or coverage under the WWDRs will be terminated. The Project will then be required to seek Project coverage under an individual WDR.

e. Equipment, materials, and workers will be available for rapid response to failures and emergencies, implement, as feasible, emergency management measures depending upon field conditions and worker safety for access.

D. If during the inspection or during the course of conducting timber harvest activities, a violation of an applicable water quality requirement or conditions of WWDRs is discovered, the following procedures will be followed:

a. When it has been determined that discharges are causing or contributing to a violation or an exceedence of an applicable water quality requirement or a violation of a WWDR prohibition:
   i. Corrective measures will be implemented immediately following the discovery that applicable water quality requirements were exceeded or a prohibition violated, followed by notification to the Regional Board by telephone as soon as possible but no later than 48 hours after the discharge has been discovered. The notification will be followed by a report within 14 days to the Regional Board, unless otherwise directed by the Executive Officer, that includes:
      1. the date the violation was discovered;
      2. the name and title of the person(s) discovering the violation;

3. a map showing the location of the violation site;
4. a description of recent weather conditions prior to discovering the violation;
5. the nature and cause of the water quality requirement violation or exceedence or WWDR prohibition violation;
6. photos of the site characterizing the violation;
7. the management measure(s) currently being implemented;
8. any maintenance or repair of management measures;
9. any additional management measures which will be implemented to prevent or reduce discharges that are causing or contributing to the violation or exceedence of applicable water quality requirements or WWDR prohibition violation; and,
10. the signature and title of the person preparing the report.
11. the report will include an implementation schedule for corrective actions and describe the actions taken to reduce the discharges causing or contributing to violation or exceedence of applicable water quality requirements or WWDR prohibition violation.

E. For other inspections conducted where violations are not discovered, a summary report will be submitted to Executive Officer by June 30th for each year of coverage under the WWDRs or upon termination of coverage. The summary report, at a minimum will include the date of inspections, the inspector's name, the location of each inspection, and the title and name of the person submitting the summary report.

If helicopter operations are proposed for this project, please find attached a Columbia Helicopters, Inc. (CHI) Fuel Spill Prevention and Cleanup Plan For Columbia Helicopters Field Operations.

Explanation of Information Included in the Controllable Sediment Sources Table	
Column Heading	Explanation
Site No.	Site identification unique to project area
Site Type	A description of the existing site. Example: Humboldt Crossing; Culvert Crossing; Unstable Fill; Unstable Cut Slope; Diversion Potential.
Estimate of Potential Erosion	A quantitative estimate of the volume, in cubic yards, of the total amount of potential erosion/displacement of soil that will occur should the site entirely fail. The landowner often uses a methodology developed by Pacific Watershed Associates to estimate erosion, which assumes 100% delivery of calculated volume—use of this method for individual sites is noted in Site Description.
Potential Sediment Delivery Percent	An estimate of the relative potential for sediment delivery expressed as a percent of the total amount of Potential Erosion that will be discharged to waters of the State should the site fail.
Sediment Prevention Volume	The volume, in cubic yards, of sediment discharge estimated to be prevented by implementation of the prescribed treatment. Volume represents the Estimate of Potential Erosion multiplied by the Potential Sediment Delivery Percent.
Priority for Treatment	Treatment priority reflects the immediacy of sediment discharge and the relative risk to the receptor, should the site fail. Low priority sites are ones that will not likely deliver significant amounts of sediment during the life of the WWDR permit, and will be treated prior to filing of THP work completion report, which does not exceed 5-years following THP approval date. Medium or high priority sites indicate potentially imminent discharge, and the timing of treatment is indicted in Implementation Schedule column.
Implementation Schedule	Indicates the timing of implementing the prevention and minimization measures listed in the Treatment column.
Site Description	Provides sufficient information that describes the existing condition of the site and factors that inform the chosen treatment methods and implementation schedule. This information will include a description of how the existing condition of the site (ie. stable or unstable) will be affected by different storm events, and whether sediment discharge is imminent. For example, an unstable site could easily discharge significant amounts of sediment in a small storm, thus the treatment priority should be higher. Conversely, a stable site that may take one or more very large storms to trigger discharge could be lower treatment priority. If PWA method is used to calculate erosion/delivery volumes, it will noted here.
Treatment	Sediment discharge prevention and minimization measures that will be implemented at the site, including treatment specifications if necessary.

Attachments:

- **ECP Table**

Erosion Control Plan

Site	Site Type	Est. Potential Erosion (Cu.Yards)	Est. Potential Delivery (Cu.Yards & %)	Priority for Treatment	Implementation Schedule	Site Description	Treatment
Project three forks							
RD: 1600 Cat-Xing STATION: 0 SITE: X 1 WOID: 1355786061 SEDID: 11874 REPAIRED: NO	Tractor Crossing	10	10 100%	Low	Prior to THP Final Completion.	Tractor road crosses a Class III watercourse at a downhill angle, creating a potential for diversion.	Tractor skid road within cable yarding area crosses Class III at a downhill angle that will promote channel diversion. Excavate the channel, placing spoils on the downhill side where possible. Use on-site debris to pack into exposed channel bed.
RD: 1600 Cat-Xing STATION: 0 SITE: X2 WOID: 1355788543 SEDID: 11875 REPAIRED: NO	Tractor Crossing	20	20 100%	Low	Prior to THP Final Completion.	Tractor road crosses a Class III watercourse at a downhill angle, creating a potential for diversion.	Tractor skid road within cable yarding area crosses Class III at a downhill angle that will promote channel diversion. Excavate the channel, placing spoils on the downhill side where possible. Use on-site debris to pack into exposed channel bed.
RD: U48 STATION: 2545 SITE: C4 WOID: 1003087793 SEDID: 30789 REPAIRED: NO	Pulled Crossing	2	2 100%	Low	Prior to THP Final Completion.	A pulled (2007) Class III crossing with minor erosion on the upper right bank.	Pulled Class III crossing, previously labeled 2545 from THP 05-131, Magnum Opus. Some minor eroding is occurring on the right side channel bank. Use available woody debris to pack onto the area. The site will not be reconstructed for operations, as equipment access will not be necessary beyond this site.
RD: U49 STATION: 1035 SITE: NFE850 WOID: 5921 SEDID: 30795 REPAIRED: NO	Pulled Crossing	50	50 100%	Low	Prior to THP Final Completion.	A shallow, upper end Class III crosssing, formerly inventoried by PWA as not fully excavated.	A shallow, upper end Class III crosssing, formerly inventoried by PWA as not fully excavated. Refill the dipped out crossing and install a rocked ford.
RD: U49 STATION: 1535 SITE: NFE851 WOID: 5922 SEDID: 30796 REPAIRED: NO	Pulled Crossing	61	61 100%	Low	Prior to THP Final Completion.	A shallow, upper end Class III crosssing, formerly inventoried by PWA as not fully excavated.	A shallow, upper end Class III crosssing, formerly inventoried by PWA as not fully excavated. A sinkhole at the lower end indicates subsurface flow. Excavate the crossing to eliminate subsurface flow. Refill the dipped out crossing and install a rocked ford.
RD: U55 STATION: 350 SITE: NFE98 WOID: 5836 SEDID: 30803 REPAIRED: NO	Culvert Maintenance	55	55 100%	Low	Prior to THP Final Completion.	DRC is rusted out at the inlet. Gullying below the outlet (PWA 1998) is no longer visible.	DRC is rusted out at the inlet. Gullying below the outlet (PWA 1998) is no longer visible. Remove the existing pipe and install a rolling dip. Install another dip up the road about 100 feet where there is no inside ditch.
Total Estimated Yards		198	198				

252

Note: During THP field layout no new legacy tractor skid road crossings were located other than Sites X1 and X2 in Unit 4.

Humboldt Redwood
COMPANY, LLC

FOREST
OPERATIONS
P.O. Box 712
125 Main Street
Scotia, CA 95565
(707) 764-4472
www.hrcllc.com

January 11, 2013

Mr. Jon Woessner R.P.F.
Northern Area Manager Forester
Humboldt Redwood Company LLC
125 Main St.
Scotia, Ca. 95541

SUBJECT: Geologic Evaluation of the Three Forks Timber Harvesting Plan, Humboldt County, California

INTRODUCTION

This report presents the results of a geologic evaluation of slopes within the proposed Three Forks Timber Harvesting Plan (THP) conducted by Humboldt Redwood Company (HRC) LLC GeoScience Department. Our investigation was initiated in response to a request from the HRC Project Forester to asses slope stability with the proposed plan area. The plan is located in the North Fork Elk River Watershed on HRC property. This report documents our geologic consultation on this project. Ultimately, our investigation and proposed mitigations are meant to minimize the potential impacts to local watercourses with regard to landslide-derived sediment.

The scope of our investigation included a review of pertinent and available regional geologic maps and literature, geologic reports and letters attached to adjacent harvest plans, the Mass Wasting Module of the Elk River/ Salmon Creek watershed analysis, a series of site visits, and the preparation of this report and attached figures. In our report, we use the landslide terminology presented in California Geological Survey (CGS) Note 50 (1997) and in Cruden and Varnes (1996). Landslide age classes used herein are based on the scheme presented in Keaton and DeGraff (1996).

This investigation was conducted in general conformance with the work scope outlined in CGS *Note 45: Guidelines for Engineering Geologic Reports for Timber Harvesting Plans* (1999). As such, our study is inherently focused on documenting existing slope failures within and adjacent to the proposed timber harvesting areas, qualitatively evaluating slope stability conditions (to locate potentially unstable sites), and assessing the potential for sediment delivery to watercourses as a result of mass wasting processes. This report discusses geomorphic processes as they relate to landslide activity and that we believe are pertinent to delivery of sediment to watercourses.

Recommendations will be formulated with the assistance of the project forester and are intended to minimize the impact that the proposed management activities could have on the delivery rate of landslide-derived sediment to local watercourses.

Our initial reconnaissance of the plan area occurred on November 15, 2012. We revisited the subject area on numerous additional occasions to complete our site assessment. Our evaluation consisted of a review unstable areas as defined in HRC Habitat Conservation Plan (HCP) prescriptions for the Elk River/ Salmon Creek Watershed (HartCrowser, 2000), areas of concern identified by the project forester using the "Hillslope Management Check List", and unstable areas identified by previous investigations (Kilbounre, 1985; Best, 1998; Geo Engineers, 2000; Busch, 2002; Scopac, 2003; 2005; HartCrowser, 2000; Marshall and Mendes, 2005a; Oswald Geologic, 2012). During our evaluation we worked closely with the project forester to ascertain suitable harvest levels. In general, the proposed siliviculture prescriptions have been laid out based on the distribution of stable and unstable geologic areas. The silvicultural practices were modified over the course of our multiple site visits in order to mitigate areas of concern. Where necessary, when there is potential hazard to down slope resources, the project geologist proposed less aggressive silivicultural practices or yarding methods.

To the best of our knowledge, this THP conforms to the Forest Practice Rules and the hill slope management mass-wasting strategy that applies to HRC's ownership under the prescriptions developed based on the Elk River/ Salmon Creek watershed analysis.

GENERAL SETTING

The Three Forks THP consists of nine harvest blocks that cover approximately 238 acres in the North Fork Elk River watershed. Units 1, 3, and 9 occupy slopes within the Bridge Creek, a generally southward-flowing Class I tributary to the North Fork Elk River. The remaining cut blocks are located in the McWhinney Creek basin, just east of Bridge Creek (Figure 1). McWhinney Creek flows in a northwest to southwest direction and is also a Class I tributary to the North Fork Elk River. The North Fork Elk River which is a generally westward-flowing, fish-bearing watercourse feeds into Elk River, which ultimately drains into Humboldt Bay. Elk River is listed as sediment and temperature impaired watercourse under Section 303(d) of the Federal Clean Water Act

Elevations within the proposed plan area range from a minimum of approximately 200 feet above Mean Sea Level (MSL) at the western tip of Unit 9, to a maximum of 800 feet MSL along the northern boundary of Unit 1. Refer to Figure 1 for unit boundary locations as currently proposed and their relationship to mapped watercourses and roadways. Pertinent regional location information is presented below in Table 1.

TABLE 1

Table 1: Pertinent Location Information	
Legal Description	Township 4 North, Range 1 East, Sections 21, 22, 27, 28, 33
USGS Quadrangle	McWhinney 7.5-minute quadrangles.
Cal Watershed	Lower North Fork Elk River

The silvicultural practices and yarding methods proposed consists primarily of group selection and cable yarding. Single tree selection is proposed within the Riparian Mitigation Zones (RMZ). Limited areas of ground based yarding are proposed on slopes less than 30% within Units 2, 4, 8 and 9. Please see Section II of the THP for the corresponding acreages of the proposed silviculture and yarding methods.

There are no reported domestic water supplies within 1,000 feet of the THP area. No public resources or infrastructure facilities are located within 1,000 feet of the plan area, consequently operations as proposed do not pose a significant hazard to public safety.

A brief discussion of harvest level associated with specific silivicultural prescription follows.

Group selection is an uneven-age type management that involves both group openings and partial-cut activities (single-tree selection). Under the California Forest Practice Rules (CFPR), group openings proposed under a group selection cannot exceed 2.5 acres in size and must incorporate less than 20% of the harvestable area. Stands outside the open areas will be managed in accordance with prescriptions for single-tree selection.

Single-tree selection requires that a minimum of 75 square feet (sq. ft.) of conifer basal area per acre be retained post harvest. This stocking standard must be met immediately upon the completion of operations. Pre-harvest conifer stocking in the single-tree selection areas ranges from 120 sq. ft. to 260 sq. ft. per acre (see "Vegetation and Stand Description" in Section III of the harvest plan).

Riparian management zones comprise approximately 31% of the stands of timber enveloped by this THP. These stands fall inside Class I, II, and III Riparian Management Zones (RMZs) and riparian buffers for Class I and Class II watercourses are composed of an inner and outer band. The inner band is a 30-foot (Class II watercourse) or 50-foot (Class I watercourse) wide no-cut zone that extends from either the watercourse transition line or the back edge of the channel-migration zone. Above the inner band is a variable width (between 45 and 70 feet wide Class II and 100 feet for Class I) limited-entry zone (outer band). A minimum of 50% of the existing canopy (overstory and understory) must be retained in the outer band of a Class I RMZ. A minimum of 60% of the existing canopy within a Class II RMZ must be retained.

Special Treatment Zones incorporate timber stands that will undergo reduced levels of harvest or are excluded from group selection operations.

GENERAL SITE CONDITIONS AND HISTORY

The dispersed nature of this plan has resulted in the occupation of a broad range of slope aspects and hillside gradients. The upland portions of the THP occupy broad, well-rounded ridges, and moderate to steep (40% to 60%) midslopes. Typically, the upland slopes retain convex to semi-planar profiles and in some instances have developed into low gradient (10% to 40%) topographic benches. As upland areas approach the valley floors, they often develop steep orientations. These "inner valley" slopes often retain a planar profile and are inclined at moderate to precipitously steep gradients (near vertical along the North Fork Elk River). This inner valley wall terrain extends between 20 and 100 feet upslope of the stream edge.

Timber stands encompassed by this THP are not homogeneous and are comprised of various assortments of conifer and hardwood. Slopes support open to dense, single to multi-tiered stands of second and third growth trees. The conifer component is dominated by second growth redwood, Douglas fir, and Grand fir. Intermixed with these conifers are groups of indigenous hardwoods, principally red alder. Hardwoods are typically confined to slopes along watercourse channels, old road alignments, and the surface of draws. Scattered residuals are also present, although in very low numbers.

Douglas-fir and alder saplings dominate the understory component. These regeneration stands are often densely stocked and concentrated along old roadways, skid trails, and railroad grades. Underlying the overstory and sub-canopy is a variably thick shrub layer composed of huckleberry, salal, poison oak, and other common groundcover species. These groundcover species can occur in very dense patches. There is also an abundant down woody debris and slash mantling/obscuring the ground surface in portions of the plan area. In addition most of the lower order watercourses and streamside slopes are choked with large pieces of woody debris.

Due to the abundance of groundcover and down wood in selected portions of the THP area, our ability to conduct a thorough geomorphic reconnaissance was limited. Prior to the commencement of our site reconnaissance, we acquired information from existing topographic maps, LIDAR maps, geologic maps, SHALSTAB modeling, and aerial photographs to help direct and assist our field effort in these particular areas. It is unlikely that we overlooked large failures that could have a significantly adverse impact on water quality, but we acknowledge that additional small-scale failures (such as, cut slope and fill slope failures) that are not identified or discussed in this report may be present.

As presently laid out, this THP overlaps or abuts cut blocks associated with THP 1-93-068 HUM, THP 1-95-566 HUM, THP 1-97-498 HUM, THP 1-00-030, THP 1-00-219 HUM, THP 1-02-111 HUM, and THP 1-03-159 HUM. Harvest plans associated with THP 1-00-003, THP 1-00-219 HUM, THP 1-02-111 HUM, and THP 1-03-159 HUM were developed in accordance with interim prescriptions presented in PALCO's Habitat Conservation Plan (HCP) (PALCO, 1999) and therefore have geologic reports. These geologic reports provide a detailed discussion regarding slope stability within the THPs, as well as supply site-specific geologic recommendations meant to minimize the impact of proposed timber operations on the identified unstable areas.

Under the interim rules outlined in Section 6.3.3.7 (Hillslope Management) of PALCO's HCP, no-cut areas were required around all those slopes identified as being unstable or that attained a Factor Total value in excess of 15 points. Factor Totals is a quantitative ranking system (Watershed Sensitivity Factor Total System) that is based on four parameters: slope gradient, bedrock, soil type, and mass wasting landforms. Each parameter has a predetermined range of values, which are then mathematically combined to provide a preliminary estimate of the geomorphic sensitivity of an area. If the summation of these values for a certain slope exceeds 15 points, then the hillside is considered a Mass Wasting Area of Concern (MWAC) and was excluded from timber operations (regardless of stability level). Several landslides identified in these prior investigations now fall within or abut the operational limits of this THP.

This harvest plan is being submitted under the Prescriptions Based on watershed analysis for Elk River and Salmon Creek (PALCO, 2005). Under the current rules package, trees can be removed from unstable and potentially unstable slopes provided that a California-licensed geologist reviews the areas proposed for management. Consequently, a number of the areas of instability previously identified and omitted from the operational limits of earlier plans may be subject to various levels of harvest.

GEOLOGIC SETTING

Bedrock

Published geologic maps of the region indicate that the plan area occupies slopes underlain by sedimentary bedrock of the Late Cretaceous age Yager terrane of the Franciscan Complex Coastal Belt and the Miocene-Pliocene age undifferentiated Wildcat Group (Figure 2a). The Yager terrain is the younger and less deformed of the tectonostratigraphic terranes that make up the Coastal belt. Ogle (1953) and subsequent investigators mapped Wildcat sediments northeast of the Little Salmon fault as undifferentiated due to the poor exposures and general lack of distinctive lithologies and indicator fossils or volcanic ashes in this area. A detail discussion pertaining to these formations can be found in the Cumulative Watershed Effects Assessment (CWEA) module of the Elk River/ Salmon Creek watershed analysis (HartCrowser, 2000). Refer to the GEOLOGY section on pages 3 and 4 of the CWEA module for discussions relating to the origin and composition of the sediments underlying the plan area (www.mendocinoredwoodcompany.com/pdf/WatershedAnalysis/HRC/Elk%20River Salmon%20Creek%20-%20Cummulative%20Effects.pdf)

Bedrock exposures are present throughout the plan, both as natural outcroppings and in road cuts. Our review of these exposures confirmed that the plan area is underlain by Coastal Belt Yager terrane and Undifferentiated Wildcat sediments.

Structure

The plan area overlaps the southern limb of a northwest-trending anticline, as initially mapped by Ogle (1953) (Figure 2). Sediments on the southern limb are shown as having a southwest dip of about 15°. Based on the recorded attitudes portions of Units 1, 6, and 9 include hillsides that retain slope characteristic (aspect/ gradient) potentially conducive to the exposure ("daylight") of bedding plane discontinuities. This relationship could result in dip slope failures; although the low angle of the bedding planes in this area reduces the potential that day lighting of bedding contacts could contribute to the activation of landslides.

We observed no indication that hill slopes in these units are being affected by adverse bedding orientations. There was no evidence of bedding plane / discontinuities failures in any of these units.

SIESMIC CONDITIONS

No active faults are mapped passing through the project area, and no part of the plan lies within and/or adjacent to an Alquist-Priolo Earthquake Fault Zone. The harvest plan does fall in-between the Little Salmon and Fickle Hill faults, both of which are considered active, northwest-trending, high angle thrust faults (Hart and Bryant, 1997). The mapped trace of the Little Salmon fault is approximately 5.5 miles southeast of the plan area, while the Fickle Hill fault trace is about 5 miles to the northeast (McLaughlin and others, 2000). The Little Salmon fault poses the greatest seismic hazard to the project based on regional studies.

Nearly 2.5 miles west of the plan area are a series of mapped fault traces that are affiliated with the Freshwater fault zone. The Freshwater fault zone is composed of the Freshwater and Greenwood Heights faults (Knudsen, 1993), which are inferred to be parallel northwest-trending, northeast-dipping, high angle thrust faults. In the Freshwater and Elk River watersheds these faults place undifferentiated Wildcat and Yager terrane sediments into contact with Central Belt bedrock. This fault is not considered active by the State of California under the provisions of the Alquist-Priolo

Earthquake Fault Zone Act. Refer to the Seismic Regime section on pages 4 and 5 of the CWEA module for a more detail discussion of regional tectonics and faulting.

Considering the location of the project, it is possible that slopes proposed for timber operations will be subject to ground shaking. Ground motion affiliated with a large seismic event in this semi-mountainous/steep terrain would likely trigger or reactivate landslides within and adjacent to the plan area. It is well documented that earthquake-induced landslides often occur at localities where slopes are naturally unstable under nonseismic conditions (Keefer, 1984; McPherson and Dengler, 1992; Dunklin, 1992). Consequently, there is the potential that some landslides could be triggered on slopes within and/or immediately adjacent to the plan area following a significant seismic event, regardless of whether management activities occur.

NORTH COAST REGIONAL WATER QUALITY CONTROL BOARD TIER 2

As part of our assessment, we evaluated a series of maps that represent the minimum data review required to harvest in the Elk River watershed under the California Regional Water Quality Control Board, North Coast Region (RWQCB) permits. The RWQCB uses a model to estimate the effect of timber harvesting on peak flows in the Elk River Watershed. This model is based on the instigation of clear cut silvicultural practices and is used to determine allowable harvest limits in the watershed. Because the current landowner is only implementing selective silvicultural practices in the watershed, the previously determined harvest limits are considered conservative.

The following items were reviewed to evaluate slope stability in the plan area.

- 10-foot LIDAR contour map
- SHALSTAB model results
- Mass Wasting Potential (MWP) model results
- Geologic and Geomorphic Features Related to Landsliding, Elk River Watershed (Marshall and Mendes, 2005a; HartCrowser, 2000)
- Relative Landslide Potential Map, Elk River Watershed (Marshall and Mendes, 2005b)
- Orthophotoquad imagery
- Watershed Analysis Deep-Seated Landslide Inventory (HartCrowser, 2000)
- THP Operational maps with unit boundaries, creeks, and roads

Our review of CGS maps (Marshall and Mendes, 2000a and 2000b) and the Deep-Seated Landslide Inventory Map (HartCrowser, 2000) reveal that a majority of the mass wasting features portrayed on these maps were not present or of such age as to not be impacted by current land use activities. Those features identified as having potentially negative responses to aggressive (clear-cut) management strategies are illustrated on the landslide maps attached to this report. Refer to Figure 2 for location of dormant-young or older landslide-related features.

A number of regions in the plan area were identified by MWP and SHALSTAB models as having high and extreme landslide hazard potential. The MWP model assesses streamside slopes and is designed around slope gradients, while the SHALSTAB model accounts for gradient and slope convergence. The results of these models are portrayed on Figure 4.

Those regions identified by these models that correspond to areas of recent or historic instability are mapped as unstable landforms on Figures 5 through 9. A majority of the high hazard areas occur in the plan where we did not find existing instabilities. As such, these areas were compared to adjacent lower hazard modeled slopes with similar slope inclination, convergence, and vegetative coverage to determine if unstable conditions existed. Where field observation suggested that the model was incorrect in assessing the potential for mass wasting, especially in response to selective silviculture, the modeled areas were not considered potentially unstable and are not identified on the landslide maps contained in this report.

SLOPE STABILITY

Overview

In general, the stability of slopes currently proposed for timber operations under this THP was not negatively impacted by past land use activities (that is tractor and rail road logging, clear cut, partial cut, and site preparation. We identified 39 areas of recent/historic instability within this 238-acre plan. There is no indication that past land use operations significantly altered the mass balance of the managed slopes such that it resulted in the renewal or activation of a large number of mass wasting events. The project area, overall, is characterized by very low levels of mass wasting activity.

Our investigation revealed that ground movement is generally confined to streamside slopes associated with Class I and II watercourses. Slope gradients in these areas typically range from 60% to 120%. In this steeper terrain we mapped independent, as well as nested groups of landslides that were usually greater than 30 years in age (dormant-historic). The highest concentration of streamside mass movement in the plan area is associated the inner gorge slope situated below the southern boundary of Unit 8.

Ground movement outside the watercourse zones in the upland areas of this THP is much less frequent and commonly associated with road/skid trail building activities. Earthwork affiliated with the construction and/or expansion of a haul road/skid trail systems can decrease the overall stability of a slope by interrupting and diverting overland flow, altering subsurface water movement, and modifying the distribution of earth materials (excavation and sidecasting) on the surface of a slope. These activities--either independently or in combination—can reduce a hill slope's resistance to mass wasting processes and to large landslide triggering events (winter storms and earthquakes).

This distribution of landslides is in conformance with the findings of the watershed analysis (HartCrowser, 2000), in that the study noted similar landslide distributions and failure mechanism.

No post-harvest open slope failures (that is not road-related) were encounter in any portion of the plan that underwent selective harvest operations in the early 1990s. Two post-harvest, road-related slides (embankment failures) (805 and 901) were observed along roadways appurtenant to plans (1990s) that now fall within the operational limits of this THP.

Recent and Historic Landslide Characteristics

Ground movement in the plan area is dominated by hill slope processes affiliated with translational and block slide failures. We classified a majority of the mass movements in the plan area as dormant-historic debris slides. Translational/rotational failures comprise a relatively minor percentage of the landslides identified on Figures 5 through 9.

We have not included site-specific descriptions of individual landslide in the text of this report; rather, we provide a brief summary of slide characteristics of each failure in tabular form in Attachment 1. Our report does, however, include a generalized description of the landslide types identified within the plan area. A brief description of the landslide types observed in this THP follows.

Debris slide/flow

Debris slides in the plan area are usually defined by linear, well-defined debris chutes. Scarps at the heads and along the lateral margins of these older slide paths range from 2 to 6 feet in height and are often steeply inclined. The bodies of these slides, in many instances, have become revegetated with groundcover species, young second growth conifers (10 to 35 years in age), and/or alder. Downed woody debris, buried logs, tilted stumps, and leaning residual trees are common at the toes of these shallow (2- to 8-foot deep) to moderately-deep (up to 15-foot deep) failures. At several locations, we noted where slide debris had encircled and buried the bases of old growth stumps and second growth trees and had overrun legacy skid trails and roads.

These slides range from 10 to 60 feet in width and typically are less than 100 feet long; however, two failures (805 and 901) greater than 300 feet in length have been mapped within the plan area.

Slopes that supported coalescing groups of debris slides and debris flows are classified on our mass wasting maps as debris slide slopes. Debris slide slopes include those aggregates of shallow landslides that were triggered by mechanisms unrelated to fluvial processes. Slope destabilized by fluvial process were mapped as inner gorges.

Translational/Rotational Landslides

These commonly deep-seated failures retain a blocky, stepped surface expression but support undeformed stands of mature (more than 50-year-old) second growth conifers. Only a few pistol-butted trees were observed on the surfaces of these historically active slides. Scarps along their crowns are still steeply inclined, but have more rounded expressions. Most of these secondary scarps retain a subdued and weathered profile but are still readily identifiable as being related to mass-wasting processes.

Typically, the arcuate-shaped scarps observed at the heads of these slides encompass and grade into low (less than 20%) to moderate (55%) gradient slopes that have irregular and uneven surface expressions. We estimate that these slides range from 50 to 100 feet in width and are up to 100 feet in length.

Uncategorized Slopes

Those areas previously mapped as being potentially unstable (models) or as landslide-related landforms (deep-seat, multi acre landforms) not shown on Figures 4 through 8 lacked evidence of having been altered by mass wasting processes either historically or in the recent past. These pre-identified features underwent intensive management practices in the past (historic tractor operations, clear cut, and burning) and there is no field or aerial photographic evidence suggesting that these activities had an adverse effect on their overall stability. We anticipate that these features will have a similar response to the uneven age land use practice currently proposed on their surfaces; consequently we did not identify them as potential areas of concern.

PREVIOUSLY MAPPED LANDSLIDE-RELATED LANDFORMS

General

Intermixed with and underlying many of the slides identified on Figures 4 through 8 are large to moderate-sized, geomorphic features identified during previous investigations as being a potential by-product of landslide activity. These geomorphic features are intermittently dispersed across the slopes occupied by this THP. Many of these landforms are multi-acre in size and extend from the ridge crest to valley floor.

These landforms were mapped during previous watershed-wide landslide-inventory studies (Kilbourne, 1985: HartCrowser, 2000; Marshall and Mendes, 2005b) and were typically classified as either dormant earthflows or translational/rotational failures (Figure 2). The California Geologic Survey (CGS, 1997; Note 50) considers these landforms to be the byproduct of compound-type failures, which involve a combination of roughly circular and linear failure planes. These failures are characterized by either cohesive or disrupted slide masses with relatively deep slide planes.

A significant percentage of the slopes within and adjacent to these large scale landforms were classified as debris slide slopes or large individual debris slides (Figure 2). CGS Note 50 (1997) defines a debris slide slope as a geomorphic landform with a surface that has been sculpted over time by numerous debris slide events. Hillsides mapped as debris slide slopes typically have slope gradients greater than 65% and support an aggregate of variously-aged slide paths and debris masses. Mass movement on these slopes typically is translational in origin and occurs in unconsolidated colluvium and highly weathered bedrock.

It is our understanding that the landslide and landslide-related landforms mapped on the geomorphic and geologic maps of the McWhinney Creek 7.5 minute quadrangles and the Elk River Watershed were differentiated from adjacent slopes using standard aerial photographic interpretation techniques. The amount of field review conducted for the verification of these features is uncertain. Consequently, the classification of a hillside as an unstable landform during these previous investigations does not necessarily indicate that it has experienced recent or historic ground movement or is inherently unstable.

Deep-Seat Landslide Characteristics

Most of the landforms identified by Kilbourne (1985), HartCrowser (2000), and Marshall and Mendes (2005a) extend from the ridgeline down to the valley floor and overlap prominent, v-shaped tributary valleys that contain watercourses (Figure 2a). In plan view, these features have an irregular, lobate-

shape with nebulous source areas that transition into broad, fan-shaped accumulation zones with diffuse toe margins.

Our assessment of slopes encompassed by the landforms revealed a general absence of slope morphology directly attributable to historic landslide processes. In some places, the upper reaches of these features correspond to broad, poorly defined, breaks in topography with no distinguishing landslide characteristics. Generally the upland margins of these landforms are vague and virtually undistinguishable from adjacent slopes both in the field and on regional aerial photographs.

Well-defined stream valleys have migrated into and down-cut through the toes of these landforms. These roughly sinuous, deeply incised valleys drain well-established dendritic systems of Class II and III watercourses, both within and above the mapped extent of the inferred landforms. Streams associated with the lower reaches of these systems have encroached into the bodies of each landform resulting in the development of steep inner valley slopes.

Slopes within the bodies of these landforms, regardless of their topographic profiles (stepped, concave, convex, or planar), have undergone significant modification by erosional processes, and consequently, now retain a smooth and well-rounded surface expression. In most instances, the surface expressions of these landforms are only remotely recognizable as being related to landslide processes.

Not only is there an absence of youthful appearing slide morphology affiliated with these landforms, but the watercourses that flow down their surfaces appear to have returned to a pre-slide configuration. That is, they have re-established their channels and are no longer being influenced by ground movement associated the hill slope processes that produced these landforms. Based on the significantly degraded appearance of the features both in the field and on aerial photographs, the mature nature of the drainage pattern of their surfaces, stand conditions, and their overall geomorphic expressions, we concluded that these previously mapped large-scale features are dormant-mature or older in age, if present at all.

Shallow Landslides Characteristics

During our assessment of the previously identified debris-slide slopes and larger scale debris slides, we observed only limited amounts of geomorphic and/or vegetative irregularities indicative of landslide activity (Figure 2a). Although steep, most of the slopes in these areas were devoid of landslide characteristics that would imply that they have been subject to widespread or localized landslideing, either recently or in the distant past. We did not encounter any scarps (fresh or weathered), slide scars, disturbed soils, deformed trees, or patches of irregular ground in these areas. In the field, there was no distinguishable break in timber type, age, or density between the pre-identified debris-slide slopes and adjacent hillsides. Based on our site evaluation, we concluded that most of the debris-slide slopes mapped by others are dormant-mature in age, if present at all. Those areas that exhibit evidence of having a negative response to past management activities or could be prone to landslide processes are mapped as unstable areas on Figures 4 through 8 of this report.

DISCUSSION

Overview

Land-use activities proposed under this THP include the removal of timber from slopes near and within a number of the areas of instability mapped on Figures 4 through 8. Prior to our site visit, the project forester had placed a majority of the larger slide areas outside operational limits of plan. Those failures that remain within the operational limits of the THP, that could feasibly discharge sediment into down slope watercourses, were encompassed / buffered by special treatment zones. The areas-of-concern that have not directly delivered sediment to a down slope water body by means of landslide processes will undergo uneven-age management in accordance with group selection silviculture.

Recent and Historic Landslides

The removal of timber as currently proposed in the THP from in and around the areas of instability mapped on Figures 4 through 8 should not have a detrimental impact on slope stability or adversely impact water quality (as it relates to landslide-derived sediment) of North Fork Elk River.

Approximately 70% of the landslides identified during this assessment fall within Class I and Class II RMZs or are located outside the operational limits of the THP. RMZs in the plan area included a wide range of timber types, including brush patches, open hardwood stands, and moderately to densely stocked stands of conifer. The project forester estimates that approximately 20% of the merchantable timber in areas that support ample amounts of canopy will be removed. There is a low probability that reducing the conifer component by this amount will adversely affect the hydrologic regime of the slopes in the RMZs or significantly reduce the resisting (cohesive) forces afforded by roots. Unharvested conifers (approximately 80% retained) and hardwoods (all) within these watercourse-protection zones will continue to provide substantial amounts of canopy, root strength properties, and evaporation and transpiration mechanisms to the managed and adjoining slopes.

Our survey of the slopes within the RMZs also revealed that a significant number of the trees marked for harvest are situated along the upper margins of the watercourse buffers and are frequently associated with stump sprouts. Harvesting timber from the upper edge of the RMZ will minimize the amount of ground disturbance within the buffer as well as reduce the amount of collateral damage to unharvested timber. In addition, because many of the trees proposed for harvest in these zones are affiliated with dense pockets of timber and brush, we expect that there will be only a minimal impact on canopy coverage and root strength properties.

Timber stands on slides positioned outside the watercourse buffers will be managed in accordance with a group selection siliviculture. No group openings will be placed on or directly adjacent to slides identified as being potential sources of sediment to down slope watercourses. Operations on these particular slides will be conducted in accordance with single-tree selection. Vegetation retention areas (such as the ones proposed in this THP) have been found to be an effective management strategy for minimizing the impact of harvesting operations on and around unstable slopes (Sidle, 1992; Sidle and Wu, 2001). Where applicable, the boundaries of limited harvest areas were positioned in a manner that would, in our professional opinion, mitigate and buffer against the anticipated changes in slope hydrology due to upslope land-use activities.

Because the slopes in the single-tree selection portions of the plan area support fairly irregular stands of timber, harvesting levels on the slides in these areas will vary. In the areas where conifers are in

concluded that past clear cutting and road building activities did not significantly impact the stability of these large landforms.

RECOMMENDATIONS

- No group openings are allowed in STZ-1 or STZ-2. After discussion with the project forester, it was determined it would be appropriate to retain a minimum of 75 sq. ft. of conifer basal area per acre. Refer to Figure 7 for general location of STZ.
- An intermediate/partial-cut harvest method should be applied to slopes encompassed by special treatment zone STZ-3 and STZ-4. After discussion with the project forester, it was determined it would be appropriate to retain a minimum of 100 sq. ft. of conifer basal area per acre. No group openings are allowed in these areas. Refer to Figure 4 for general location of STZ.
- Expand the Class II RMZs to encompass the crown margin of the slides at 805 and 901.
- No group openings should be established within 50 feet of the crowns or lateral margins of the landslide at 101, 103, 301, 306, 307, 308, 309, 501, or 502.

CONCLUSION

Logging operations, as presently proposed under the Three Forks THP, have a low probability of accelerating mass wasting activity within or adjacent to the plan area such that it will increase the delivery rate of landslide-derived sediment to local watercourses.

Partial-cut silviculture methods will be implemented on those slopes identified as being unstable and potential sources of sediment to downstream watercourses. The restrictive practices proposed on these slopes will result in the retention of a variably thick assemblage of conifers, hardwoods, and shrubs following the completion of operations. Timber remaining in the no-cut and partial-cut areas will continue to provide canopy coverage, root strength, and transpiration and interception mechanisms. Even though the stabilizing effects provided by canopy coverage and root strength will decrease as a result of harvest operations, the overall reduction should be minor and, in our professional opinion, have a low probability of increasing the rate of landslide-derived sediment to down slope watercourses. This plan appears to conform to the hill slope-management strategy that applies to HRC ownership under the prescription of the HCP. Impacts to sediment delivery are not anticipated to exceed offsetting sediment mitigation required under the terms of HRC's HCP.

Although intermediate harvest methods are proposed for all those unstable areas that could produce sediment delivering events, future failures cannot be prevented from occurring on these slopes. For example, debris-slide slopes and inner-gorge slopes are inherently prone to mass-wasting events; therefore, it is reasonable to assume that the dynamic hill slope process affiliated with these geomorphic features will continue regardless of whether management activities occur or not. It has been demonstrated that unseasonably high intensity/long-duration rainfall events or large magnitude earthquakes can trigger landslides in these types of geologic environments, whether the ground is forested or not. Consequently, restricting logging operations on these slopes does not preclude ground movement from occurring.

LIMITATIONS

The analyses, conclusions, and recommendations contained in this report are based on site conditions that we observed at the time of our investigation, our current understanding of proposed project, and our experience with similar projects in similar geologic environments. We have assumed that the information obtained from our limited observation is representative of conditions throughout each of the repair sites. If differing conditions are encountered during operations, our department should be notified immediately so that we can reevaluate the applicability of our conclusions and recommendations. Such an evaluation may result in reconsidered and/or amended recommendations. If proposed harvest unit locations and intended uses change from those described in this report, our recommendations should also be reviewed.

In addition, because the project area is located in a dynamic environment that is subject to large scale, catastrophic events (great earthquakes, large storms, etc.), we cannot preclude changes that may occur in the future that could alter site conditions. Consequently, we reserve the right to make such adjustments to our report that may be required by passage of time, change in condition, or in the consideration of additional or more pertinent data that may become available in the future.

Figures contained within this report are for illustrative proposes only and the location of the landslides and their dimensions are approximate. Any differences that may be noted in dimensions, locations, etc., are not likely to affect the conclusions contained within this report significantly.

The GeoScience Department has prepared this report for your exclusive use on this project in substantial accordance with the generally accepted practice as it exists in the site area at the time of our study, including time and budget constraints. No warranty is expressed or implied.

Lastly, this report applies only to the sites described above. Because of the high degree of variability in geology in this region, it is not possible to extrapolate the results described herein to any other site. This report is to be considered in its entirety. No part, section, paragraph, sentence, or phrase is to be quoted, evaluated, or otherwise used without considering its context and relationship to the entire report.

Respectfully,

HRC GeoScience Department

Shane M. Beach, P G #7396
HRC Senior Geologist

Spencer Watkins, GIT 177(Summer)
HRC Geology Technician

ATTACHED FIGURES

Figure 1: Location Map
Figure 2: CGS Geology and Geomorphic Features Related to Landsliding
Figure 2b: Key to CGS Geology and Geomorphic Features Related to Landsliding
Figure 3: SHALSTAB Map
Figure 4: Unit 1 Mass Wasting Site Map
Figure 5: Units 2, 3, and 6 Mass Wasting Site Map
Figure 6: Units 4, 5, and 7 Mass Wasting Site Map
Figure 7: Unit 8 Mass Wasting Site Map
Figure 8: Unit 9 Mass Wasting Site Map

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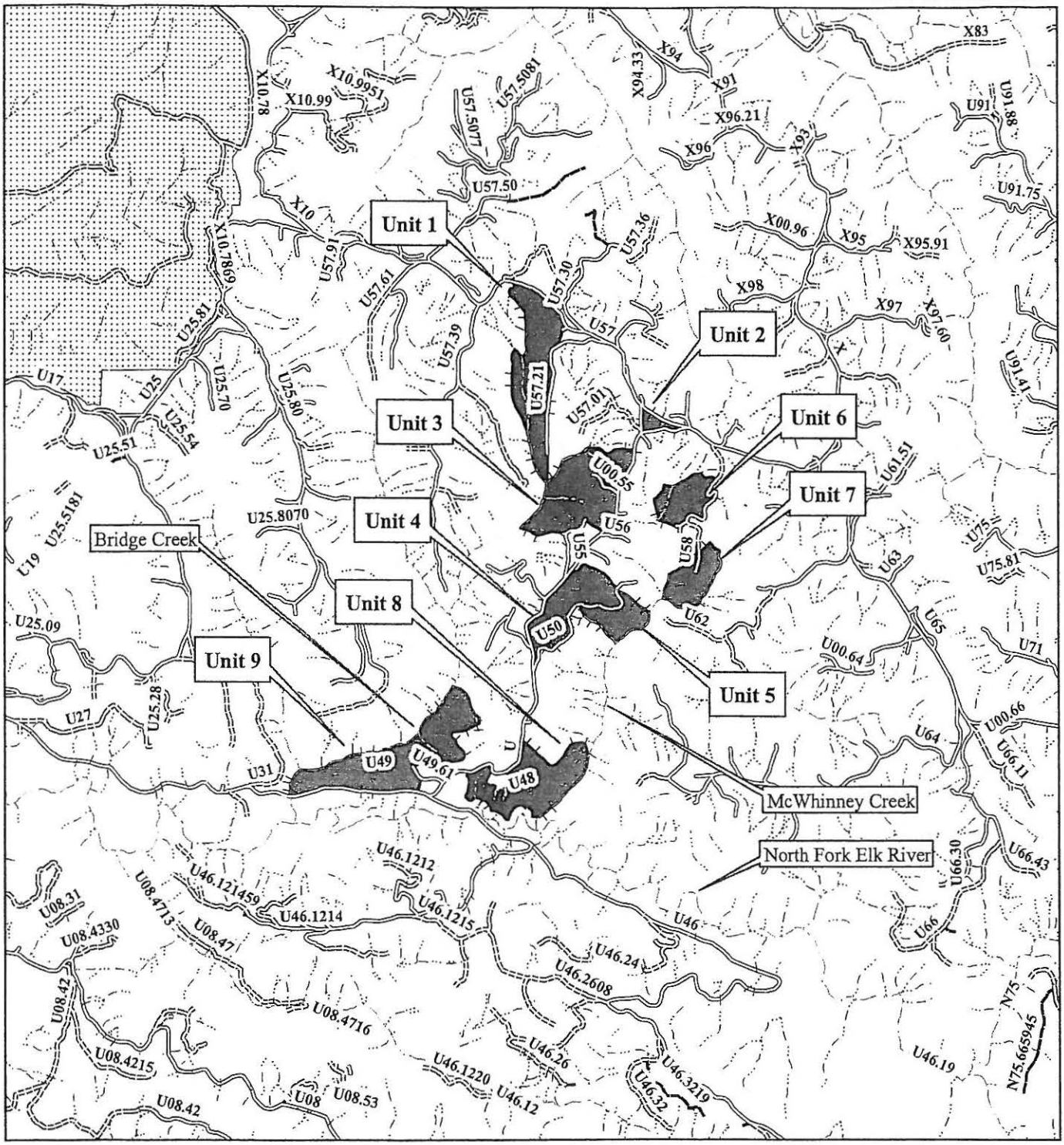
Three Forks THP



Watercourses	Roads	THP Boundary	Ownership
Class 1	Paved Roads	Three Forks	Other
Class 2	Rocked Roads		HRC
Class 3	Dirt Roads		
	Proposed Roads		

Humboldt Redwood Company	N	Feet: 2,500 1,250 0 2,500	Figure 1: Location Map
Drawn by: swatkins			
Date: 1/8/2013			

Geologic Symbols

active

dormant

CGS Geologic Contacts

approximately located

certain

known

queried

Dipbed

Dipbed-approx

Dipfault

Dipfrac

Dipover

Dipvert

Dipvrtfrac

Horiz-bed

Gorges/Torrents

Gorge

Torrent-track

inner gorge

Slide

debris slide, active

debris slide, dormant

earthflow, active

earthflow, dormant

translational/rotational, active

translational/rotational, dormant

disturbed ground

debris slide ampitheater

CGS structural mapping

Anticlinal-axis, a

Anticlinal-axis, k

Fault, a

Fault, k

Lineament,

Scarp, s

Slip-fault, a

Slip-fault, k

Synclinal-axis, a

Synclinal-axis, k

Thrust-fault, a

Thrust-fault, k

Qrt RIVER TERRACE DEPOSITS (Holocene-Pleistocene): sand and gravel deposited during higher stands of major streams and rivers.

QTwu UNDIFFERENTIATED WILDCAT GROUP (Pleistocene-Miocene): mudstone, shale, sandstone, siltstone, and minor amounts of conflomerate.

TKy YAGER FORMATION (Tertiary-Cretaceous): indurated silt-shale, siltstone, sandstone, mudstone, and conglomerate; highly sheared in places; the silt-shale and mudstone often disaggregate by slaking when wetted.

HRC Geology Department	**Figure 2b: Key to Geologic and Geomorphic Features Related to Landsliding** modified from Marshall & Mendes, 2005
Drawn By: smw	
Date: 1/9/2013	

Three Forks THP

Watercourses
- Class 1
- Class 2
- Class 3

Roads
- Paved Roads
- Rocked Roads
- Dirt Roads
- Proposed Roads

Ownership
- Other
- HRC

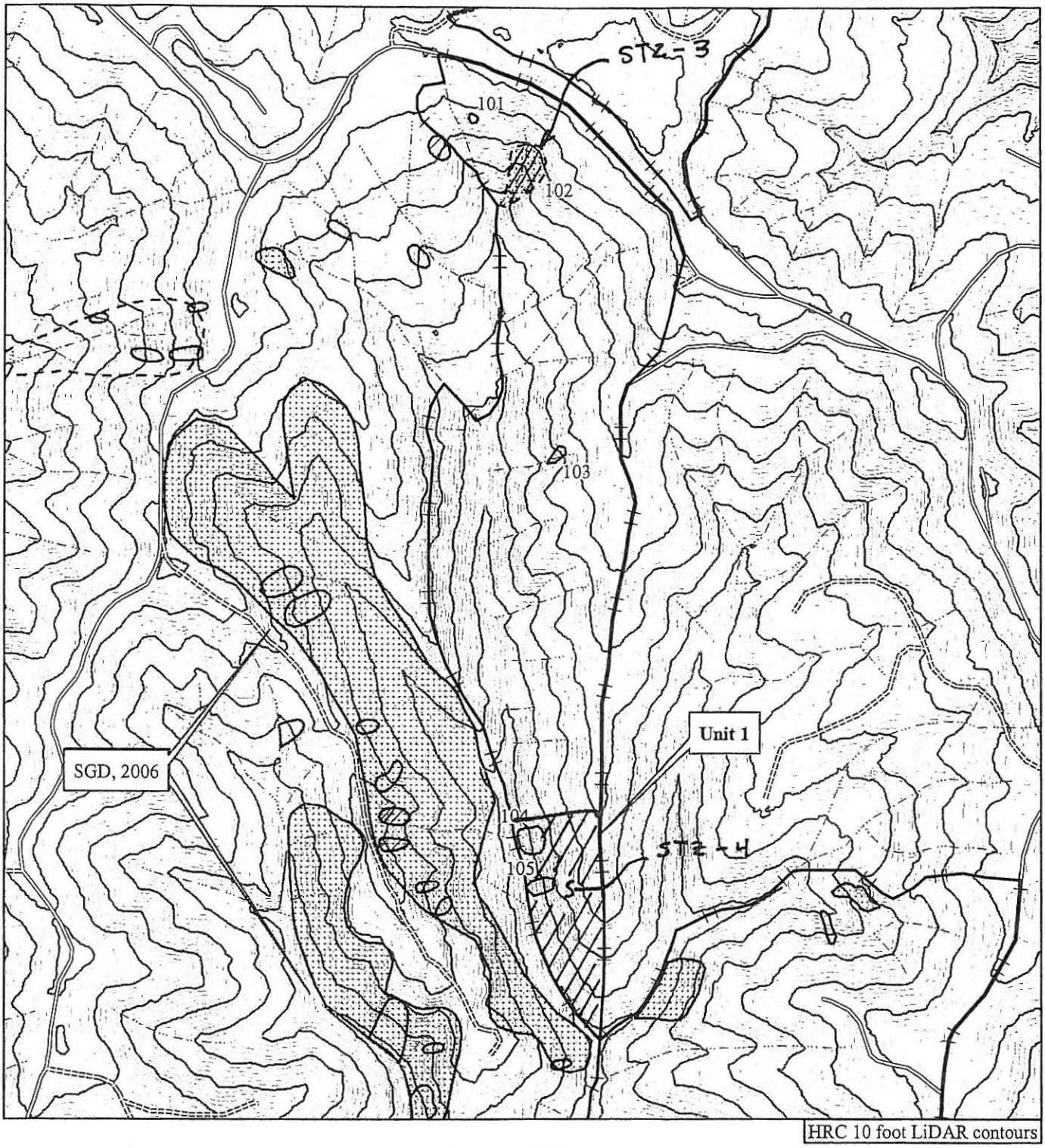
THP Boundary
- Three Forks

modified from Marshall & Mendes, 2005

Humboldt Redwood Company	N	Feet: 2,000 1,000 0 2,000	**Figure 2a: Geologic and Geomorphic Features Related to Landsliding**
Drawn by: swatkins			
Date: 1/9/2013			

Figure 3: Shalstab Map

Three Forks THP



Watercourses
- Class 1
- Class 2
- Class 3

Roads
- Paved Roads
- Rocked Roads
- Dirt Roads
- Proposed Roads

Mass Wasting
- EF, DYDM
- EF, ASDH
- DFTT, DH or younger
- DSS, DHDY
- DS, DH or younger
- DS, DY or older
- DSS, DH or younger
- IG, DH or younger
- TR, DH or younger

THP Boundary
- Three Forks

Humboldt Redwood Company	N	Feet: 500 250 0 500
Drawn by: swatkins		**Figure 4: Unit 1 Mass Wasting Site Map**
Date: 1/8/2013		

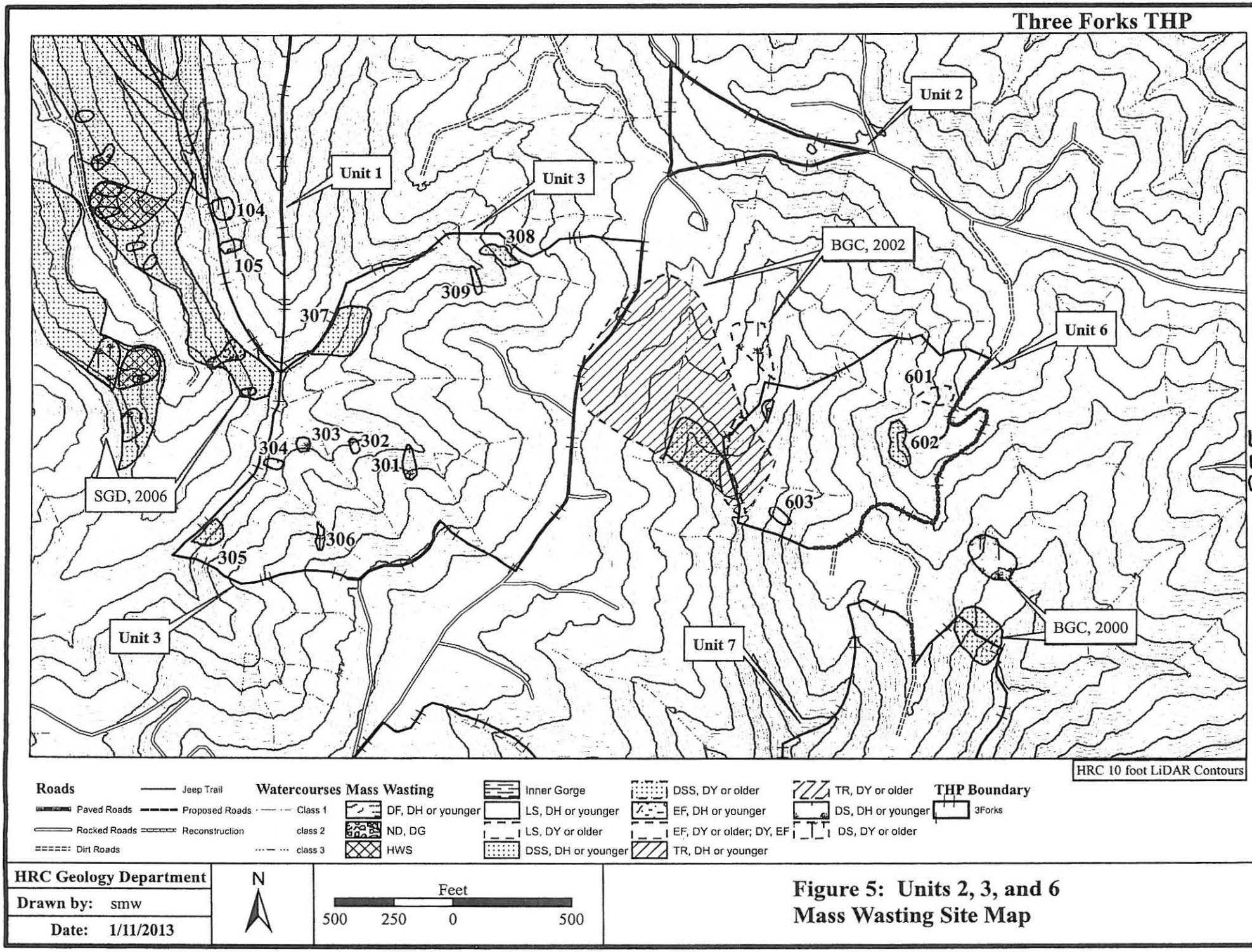


Figure 5: Units 2, 3, and 6
Mass Wasting Site Map

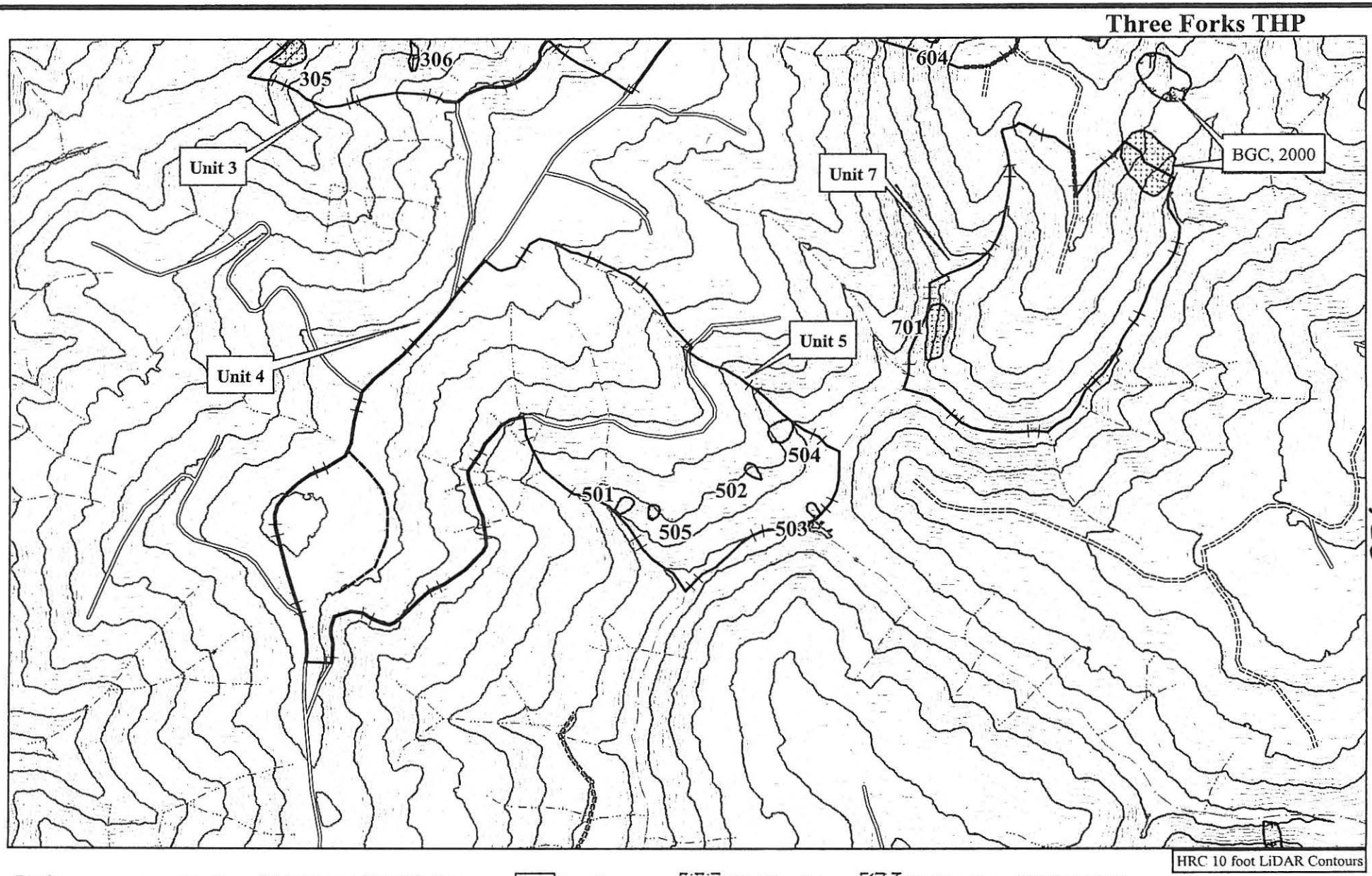


Figure 6: Units 4, 5, and 7
Mass Wasting Site Map

276

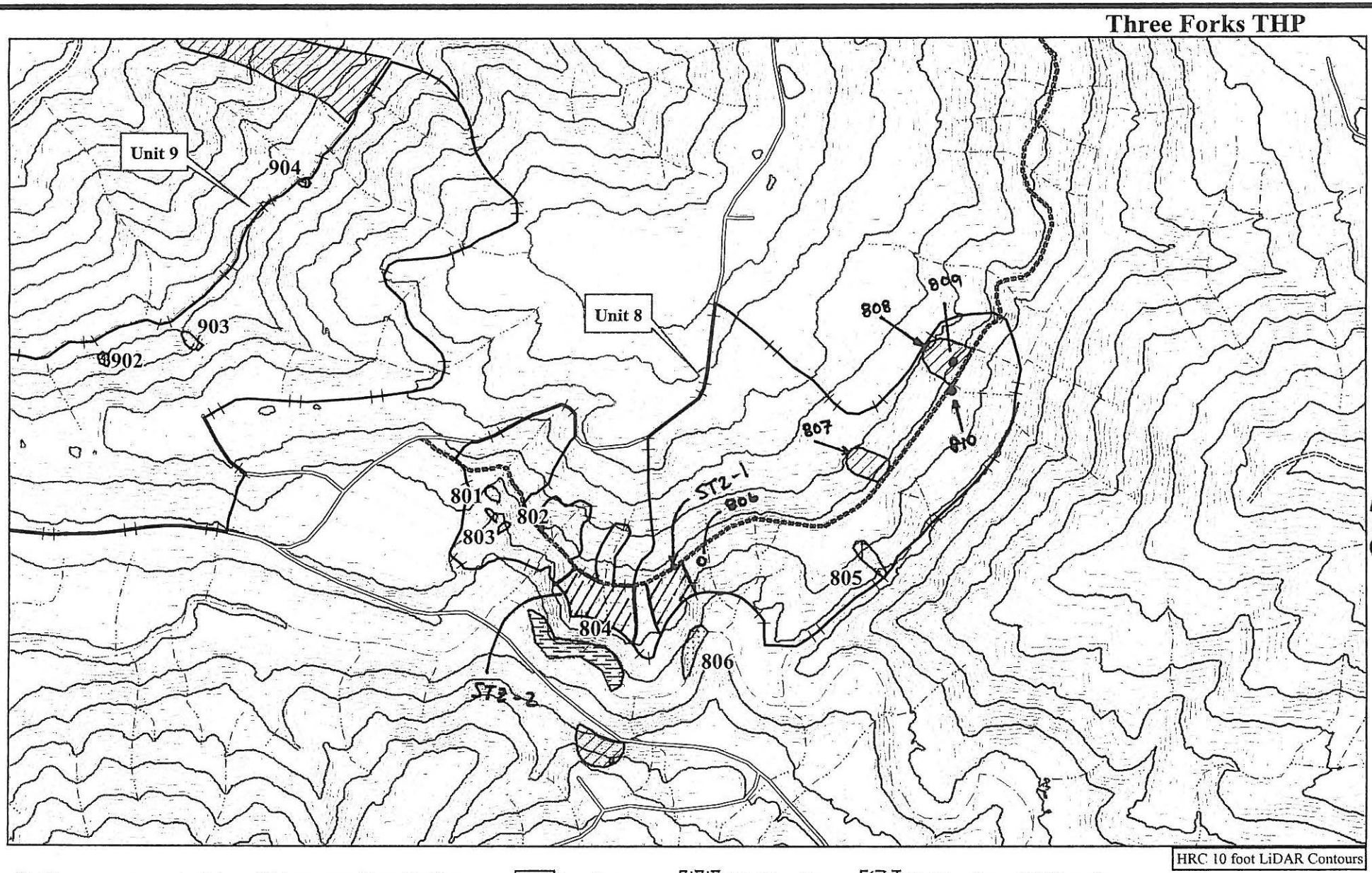


Figure 7: Unit 8
Mass Wasting Site Map

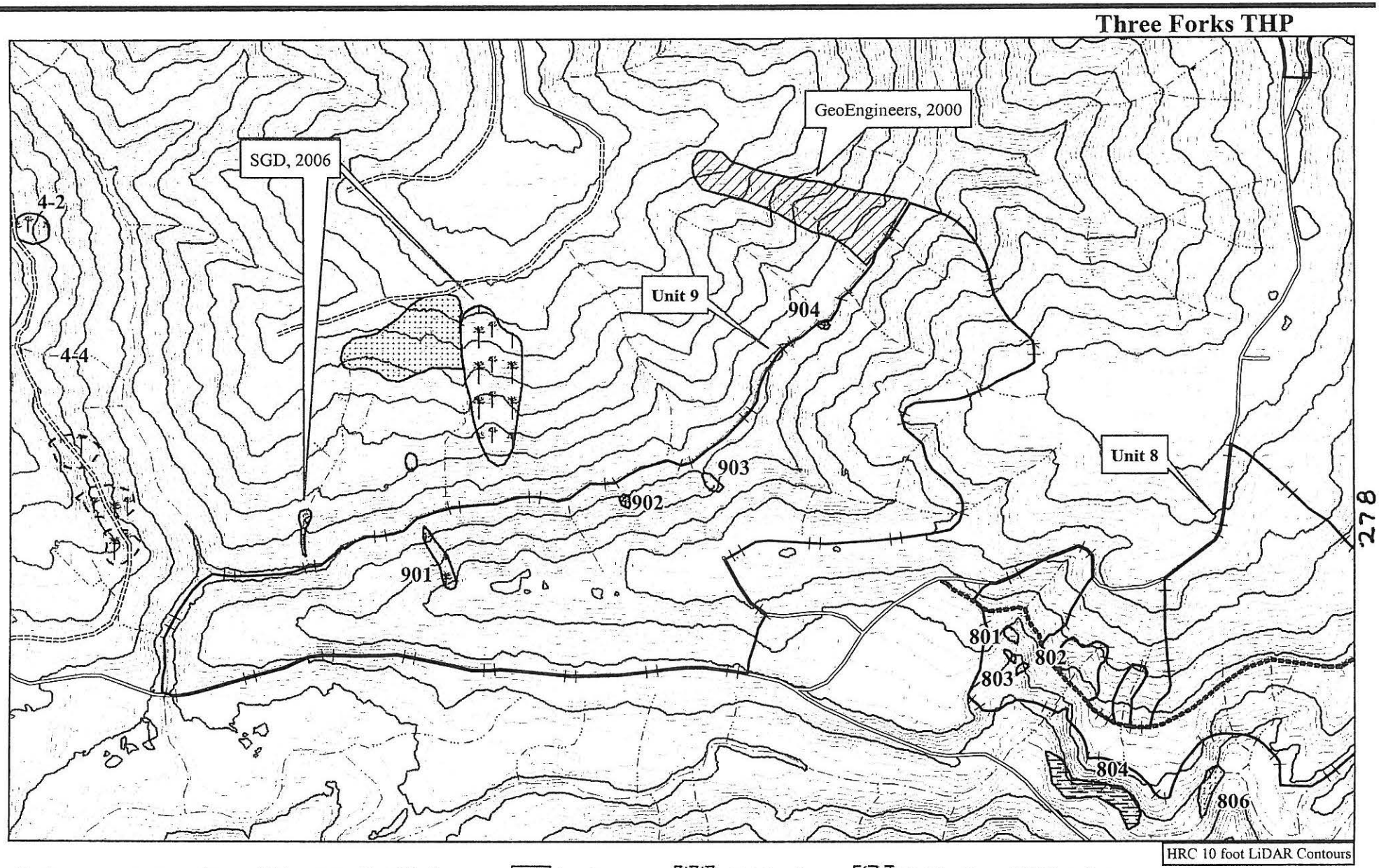


Figure 8: Unit 9
Mass Wasting Site Map

Appendix 1
Areas of Concern Characteristics
Three Forks THP

ID #	Landslide type	Age	Dimensions (W x L x D) (ft.)	Depletion/ Accumulation Zone Characteristics	Del.	Proposed Silviculture	Comments	Rec.
101	debris slide (?)	dormant-historic	30 x 30 x 3	down wood, brush and in place old growth stump at toe	no	single tree selection	could be an old ground lead yarning furrow	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
102	debris slide slope amphitheater	dormant-historic to dormant-young	200 x 800	bedrock, old growth stumps, standing second growth conifers	yes (?)	single tree selection	steep sided draw with unstable side slopes	no group openings and retain 100 sq. ft. of conifer; refer to Rec. Sec. for details
103	block slide	dormant-historic	30 - 40 x 100 x 2	bedrock, deformed conifers, hardwoods, and brush	yes (?)	Class III RMZ and single tree selection	streamside slope failure	no group openings and retain 100 sq. ft. of conifer; refer to Rec. Sec. for details
104	micro debris slide slope	dormant-historic	95 x 100 x 3	mature second growth fir and displaced old growth stump	yes (?)	Class II RMZ and single tree selection	steep hillside with abrupt slope break at crown	no upslope group openings; refer to Rec. Sec. for details
105	debris slide	dormant-historic	50 x 100 x 4	mature second growth fir	yes (?)	Class II RMZ and single tree selection	headwall like failure	no upslope group openings; refer to Rec. Sec. for details
301	debris slide	active suspended to dormant-historic	50 x 150 x 4	bedrock, grasses and saplings, no merchantable trees on slide	yes (?)	Class II RMZ and single tree selection	steep streamside slope	no upslope group openings; refer to Rec. Sec. for details
302	debris slide	dormant-historic	40 x 70 x 4	brushy, 3 merchantable fir trees on body, existing canopy < 60%	yes	Class II RMZ and single tree selection	dense brush cover	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
303	debris slide	dormant-historic	50 x 60 x 6	brush and saplings, no merchantable trees on body	yes	Class II RMZ and single tree selection	steep streamside slope	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
304	debris slide	dormant-historic	40 x 80 x 4	bedrock, swept conifers at toe, hardwoods, and brush	yes (?)	Class II RMZ and single tree selection	few merchantable trees on slide	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
305	debris slide slope	active suspended to dormant-historic	115 x 90 x 3	down wood, brush and in place old growth stump throughout, few merchantable trees	yes	Class II RMZ	steep streamside slopes, hummocky ground, diffuse margins	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses

Appendix 1
Areas of Concern Characteristics
Three Forks THP

ID #	Landslide type	Age	Dimensions (W x L x D) (ft.)	Depletion/ Accumulation Zone Characteristics	Del.	Proposed Silviculture	Comments	Rec.
306	debris slide	dormant-historic	30 x 100 x 5	steep streamside slope, no stumps on slide, no merchantable timber on slide, brushy	yes	no trees available for harvest on slide	steep hillside with abrupt slope break at crown	no upslope group openings; refer to Rec. Sec. for details
307	debris slide slope	dormant-historic	230 x 140 x 4	individual slides typically <50'W x 50'L, slides pre-date selection harvest that occurred in 1993	yes	Class II RMZ and single tree selection	multiple small slides on steep streamside slope	no upslope group openings; refer to Rec. Sec. for details
308	debris slide slope	dormant-historic	120 x x80 x 3	steep raveling slope, shallow bedrock observed beneath dense brush cover	no	single tree selection	one merchantable fir on body, stump clump of redwoods upslope of source are	no upslope group openings; refer to Rec. Sec. for details
309	debris slide	dormant-historic	30 x 120 x 3	bedrock, grasses and saplings, few merchantable trees on slide	yes	Class II RMZ	narrow debris chute with weathered morphology	no upslope group openings; refer to Rec. Sec. for details

Appendix 1
Areas of Concern Characteristics
Three Forks THP

ID #	Landslide type	Age	Dimensions (W x L x D) (ft.)	Depletion/ Accumulation Zone Characteristics	Del.	Proposed Silviculture	Comments	Rec.
501	debris slide	active suspended to dormant-historic	40 x 50-65 x 1 -3	chain fern, down trees, bare mineral soil, and bedrock	yes	inner and outer band of Class II RMZ	recent sliding noted along over steepen head scarp	no upslope group openings; refer to Rec. Sec. for details
502	debris slide (?) surface erosion (fill)	dormant-historic	20 - 40 x 65 x 3 - 5	ferns, huckleberry, and blocks of wood debris	no	outer band of Class II RMA and single tree selection	back filled draw that has been subject to erosion and landslide processes	no group opens on or within 50 feet of lateral limits
503	debris slide (fill embankment failure)	dormant-historic	40 x 60 x 5-8	solitary redwoods	yes	inner band of Class II RMZ	pair of failure along outboard edge of old railroad grade	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
504	debris slide (cut bank)	dormant-historic	20 x 30 x 5	chain fern	no	inner band of Class II RMZ	skid trail	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
505	debris slide	dormant-historic	30 x 30 x 3	dense ground cover	no	single tree selection	very difficult to locate do to vegetation and past ground disturbance	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
601	debris slide	dormant-historic	75 x 150 x 6	in place stumps and straight mature 2nd growth	no	single tree selection	muted landslide morphology, subtle hummocks and weathered scarp and margins	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
602	debris slide	dormant-historic	75 x 200 x 5	backfilled stumps and trees at toe	no	single tree selection	possible ground disturbance during initial entry, old yarning furrow leads to site	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
603	debris slide	dormant-historic	40 x 110 x 4	brushy, few merchantable trees on slide	no	single tree selection	straight trees on slide approximately 60 yrs old. No mass wasting response to 1995 selection	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
701	debris slide slope	dormant-historic	215 x 80 x 5	down wood, brush, mature second growth conifer	yes	Class II RMZ	multiple discontinuous scarps, ranging 2-5 feet tall, extending less than 20 feet laterally	none; RMZ provides adequate protection for resources present

Appendix 1
Areas of Concern Characteristics
Three Forks THP

ID #	Landslide type	Age	Dimensions (W x L x D) (ft.)	Depletion/ Accumulation Zone Characteristics	Del.	Proposed Silviculture	Comments	Rec.
801	debris slide (trestle approach)	dormant-historic	30 x 60 x 2 - 4	ferns and scattered suppressed redwood	yes	inner and outer band of Class II RMZ	initiated in fill embankment associated with right bank approach to trestle	none; proposed land use activities appear appropriate for site conditions
802	block slide	dormant-historic	50 x 70 x 4	mature second growth redwoods	yes	inner band of Class II RMZ	older slide	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
803	debris slide (fill embankment)	dormant-historic	40 - 60 x 100 x 2-4	ferns and scattered suppressed redwood	yes	inner and outer band of Class II RMZ	embankment along an old incline traveyway; large volume of woody at toe	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
804	debris flow	dormant-historic	40 x 55 x 5	dense brush and scattered hardwoods	yes	outside southern limits of Unit 8	swale concentrates surface water onto inner valley wall of the Elk River, triggering landslide processes,	no upslope group openings; refer to Rec. Sec. for details
805	debris slide	dormant-historic	30 - 75 x 500	reforested with hardwood and conifer	yes	inner and outer band of an enhanced Class II RMZ	large debris flow just below the U48 road. Dammed McWhinney Creek	extend Class II RMZ to outboard edge of the U48 Road
806	surface erosion (rills)	dormant-historic	30 x 100 x NA	dense patched of second growth conifers	yes?	outer band of RMZ and Single tree selection	groups of rills; poor road drainage; no longer appears to conduct surface water	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
807	translational / rotational (?)	dormant-historic	100 x 100 x 10	reforested with mature second growth conifers; two tilted old growth snags	no	single tree selection	steep head scarp with very muted lateral margins; rolling topography below scarp; railroad grade is in good condition	none: no delivery potential (no risk to aquatic resources) therefore land use activities appear appropriate for site conditions
808	translational / rotational (?)	dormant-historic to dormant-young	100 (?) x 100 (?) x 10 (?)	reforested with mature second growth conifers	no	single tree selection	very diffuse and difficult to delineate in the field; head scarp is highly weathered but recognizable	none: no delivery potential (no risk to aquatic resources) therefore land use activities appear appropriate for site conditions
809	translational/ rotational (?) (possible associated with 808)	dormant-historic	75 x 50 x 3	reforested with mature second growth conifers; two tilted old growth stumps	no	single tree selection	weathered linear scarp defines upper margin of instability: does not appear to extend to railroad grade	none: no delivery potential (no risk to aquatic resources) therefore land use activities appear appropriate for site conditions
810	cut bank failure	recently active	20 x 30 x 3	bare mineral soil, bedrock, grass	yes	none; road prism	right bank slump in excavated area	none
811	debris slide slope/ inner gorge	dormant-historic to dormant-young	110 x 800 x 2 -5	supports number age groups and timber types	yes	outside southern limits of Unit 8	inner valley slope	none; unit boundary locations appears to be appropriate set back for site conditions; no group openings upslope: refer to Rec. Sec. for details

Appendix 1
Areas of Concern Characteristics
Three Forks THP

ID #	Landslide type	Age	Dimensions (W x L x D) (ft.)	Depletion/ Accumulation Zone Characteristics	Del.	Proposed Silviculture	Comments	Rec.
812	debris slide slope/ inner gorge	dormant-historic to dormant-young	110 x 800 x 2 -5	supports number age groups and timber types	yes	outside southern limits of Unit 8	inner valley slope	none; unit boundary locations appears to be appropriate set back for site conditions; no group openings upslope: refer to Rec. Sec. for details
901	debris flow (embankment failure)	dormant-historic	60 - 75 x 400 x 4 -8	reforested with brush and young regeneration hardwoods and conifers	yes	inner and outer band of an enhanced Class I RMZ	fill embankment failure; corresponds to CGS debris slide (Marshall and Mendes, 20##) (CGS-1)	extend Class II RMZ to outboard edge of road U49; refer to Rec. Sec. for details
902	block slide	dormant-historic to dormant-young	45 x 60 x 4 -8	chain fern with in situ second growth group on toe	no	outer band of Class II RMZ	associated with bluff development	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses
903	debris flow	dormant-historic	30 x 45 x 2-5	ferns, brush and some bare mineral soil along head scarp	no	outer band of Class II RMZ	spoon-shape appearance; site appears to have been backfilled with logging debris; recent activity across face of head scarp;	no upslope group openings; refer to Rec. Sec. for details
904	debris slide	dormant-historic	not observed by project geologist	brush	yes	inner band of Class II RMZ	identified by forester and placed within no-cut band	none; proposed land use activities appear appropriate for site conditions and will not pose a risk to aquatic recourses

Figure 1

Three Forks

THP #

Elevation Map with 10ft Contours

1 inch = 850 feet

0 165 330 660 990 1,320 1,650 Feet

ROW
Partial Cut
No Cut
Unit

Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned, or Abandoned Roads

Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership

Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
Unit #9

4N,1E 16
4N,1E 21
4N,1E 22
4N,1E 28
4N,1E 27
4N,1E 33
4N,1E 34

Produced by HRC-GIS \\redwood\dora\GIS_sisters\Larry_In_House\Mike Miles\Tier1Tier2_BaseMaps\Mapbooks\map1\ElevationMap_small.mxd 9/9/2008 10:52:22 AM

Figure 3

Three Forks

THP #

Landslide Inventory and Geology Map

Geology Modified from California Geologic Survey

1 inch = 1,200 feet

0 370 740 1,480 2,220 2,960 Feet

HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership
ROW
Partial Cut
No Cut

Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned, or Abandoned Roads

Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
USGS 40-foot Contours
Unit

Geologic Symbols

- Strike and Dip of Bedding
- Quarry
- contact, approx. located, concealed
- contact, approx. located
- anticline, certain
- anticline, approx. located
- anticline, approx. located, concealed
- fault, certain
- fault, approx. located
- thrust fault, approx. located
- thrust fault, concealed
- thrust fault, concealed, queried
- thrust fault, inferred

Official Landslide Database

- Landlside Initiation Points

Twu
Qtwu
Qrt
Ty
Unit #1
Unit #2
Unit #3
Unit #4
Unit #5
Unit #6
Unit #7
Unit #8
Unit #9
WF Bridge Creek
Bridge Creek
McWhinney Creek
600
800
400
200
15
26

Geologic Units (Marshall & Mendes, 2005)

Q Q (Qal of McLaughlin and others, 2000) Alluvium consisting of sand, silt, clay and gravel along major stream channels. Because of the location of this material, mass wasting is typically not an issue, but in certain locations, in-stream alluvium can be incorporated into debris torrents traversing the channel.

Qrt Qrt (Included in Qt of McLaughlin and others, 2000) Quaternary river terrace deposits. Unconsolidated generally poorly sorted pebbly sands and sandy pebble- to boulder-conglomerates with silt interbeds. Generally flat -lying but can be susceptible to debris sliding on steep slopes and small -scale rotational landsliding where adjacent to streams.

Qh Qh (Included in Qt of McLaughlin and others, 2000) Hookton Formation. Warped and folded unconsolidated marine and nonmarine sand, gravel and silt. Fossiliferous. Contains rare thin beds of volcanic ash. This formation is prone to erosion and debris sliding. Can be subject to shallow and deep-seated bedding plane failures resulting in translational and earthflow landslides where out of slope bedding occurs.

Qtwu Qtwu (Included in Qtw of McLaughlin and others, 2000) Marine and non-marine sedimentary rocks of the Wildcat Group . Typically consists of poorly to moderately consolidated siltstone and fine-grained silty sandstone with some lenses of pebble conglomerate. These deposits are moderately susceptible to deep-seated landsliding, with rotational displacements in massive units and translation along planar weaknesses such as bedding planes , joints and fractures . However, where more strongly indurated they can sometimes stand in relatively steep sustained slopes . Wildcat Group deposits readily weather into non-plastic clayey silts and clayey sands (MLs and SCs as per the Unified Soil Classification System) that are susceptible to colluvial processes and are often relatively permeable. Significant thicknesses of residual and colluvial soils derived from Wildcat Group materials can be especially prone to shallow soil slips and debris slides if present on relatively steep slopes.

Ty Ty (y1 of McLaughlin and others, 2000) Yager terrane of the Franciscan Complex Costal Belt. In the Elk River Watershed it typically consists of well-indurated and highly folded arkosic sandstone and argillite. The sandstone is typically very strong and often forms cliffs. The argillite is prone to slaking , and deep weathering and is often very sheared. Slopes underlain by this material are often irregular and lack well developed sidehill drainages. The slaking, shearing and deep weathering results in deep-seated flow type failures on moderate slopes. On steep convergent slopes with watercourses , an initial deep-seated rotational or translational failure of this material can sometimes develop into a far traveling debris torrent due to the low internal cohesion of the sliding mass.

Kjfs Kjfs (cm2 of McLaughlin and others, 2000) Melange of the Franciscan Complex Central Belt. Deeply sheared meta-sandstone and meta-argillite with chert and carbonates. Includes large rock blocks with diverse lithologies. Where the unit is deeply sheared, particularly within the argillite, the rock and regolith may fail as earthflows. Because this unit may contain large deep-seated earthflow failures with large inclusions of well indurated sandstone, areas underlain by this unit may appear hummocky and may lack well-defined drainages. Because of the pervasive shearing that limits internal cohesion of the sliding mass, relatively deep-seated translational sliding occurring on steeper slopes underlain by this material can develop into debris flows and occasionally torrents. Soils developed from this sheared rock are typically plastic sandy clays and clayey sands. Large blocks of massive sandstone present in the Central Belt are typically well indurated and support steep slopes. The soils and colluvium developed from the sandstone are sandy silts to silty sands that have relatively low cohesion and are susceptible to debris flows.

Mass-Wasting Features (Marshall & Mendes, 2005)

Rock slide: Slope movement with bedrock as its primary source material. This class of failure includes rotational and translational landslides; relatively cohesive slide masses with failure planes that are deep-seated in comparison to those debris slides of similar areal extent. The slide plane is curved in a rotational slide. Movement along a planar joint or bedding surface may be referred to as translational. Complex versions with combinations of rotational heads and translational movement or earthflows downslope are common. Y Indicates a scarp; arrows show direction of movement; queried where the presence of the slide is uncertain; boundary is solid where active, dashed where dormant.

Earthflow: Slow to rapid movement of mostly fine-grained soil with some rocky debris in a semi-viscous, highly plastic state. After initial failure, the mass may flow or creep seasonally in response to changes in groundwater level. These types of slope failures often include complexes of nested rotational slides and deeply incised gullies; boundaries are usually indistinct. Hatch marks at head indicates a scarp; arrow indicates direction of movement; queried where the presence of the slide is uncertain.

Debris slide: Mass of unconsolidated rock, colluvium, and coarse-grained soil that has moved slowly to rapidly downslope along a relatively steep, shallow, translational failure plane. Debris slides form steep, unvegetated scars in the head region and possibly irregular, hummocky deposits in the toe region. Scars commonly ravel and remain unvegetated for several seasons depending on slope aspect.

Debris slide slope/source area: A geomorphic feature characterized by steep, usually well vegetated slopes that appear to have been sculpted by numerous debris slides and debris flows. Upper reaches (source areas) of these slopes are often tightly concave and very steep. Soil and colluvium atop bedrock may be disrupted by active debris slides and debris flows. Slopes near the angle of repose may be relatively stable except where weak bedding planes, bedrock joints and fractures parallel the slope.

Debris flow/torrent track: Long stretches of bare ground that have been scoured and eroded to bedrock by extremely rapid movement of water-laden debris. Debris flows are commonly triggered by debris sliding in the source area during high intensity rains. Debris is often deposited downslope as a tangled mass of organic material in a matrix of rock and soil; debris may be reworked and incorporated into subsequent events; lack of vegetation indicates recent activity.

Inner Gorge: A geomorphic feature consisting of steep slopes adjacent to channels. The gorge typically is created by accelerated downcutting in response to regional uplift. It is defined as an area of stream bank between the channel and the first break in slope.

Disrupted Ground: Irregular ground surface that may be caused by complex landsliding processes resulting in features that are indistinguishable or that may be too small to delineate individually at 1:24,000; also may include areas affected by downslope creep, expansive soils, and/or gully erosion; boundaries are usually indistinct.

Figure 4

Three Forks

THP #

Mass Wasting Potential

1 inch = 1,000 feet

1,500 750 0 1,500 Feet

- HRC HCP/SYP Timberlands
- Other HRC Timberlands
- Other Private Ownership
- ROW
- Partial Cut
- No Cut
- Paved Road
- Rocked Road
- Dirt Road
- Dirt Jeep Trails
- Proposed Roads
- Closed, Decommissioned, or Abandoned Roads
- Class 1 Watercourse
- Class 2 Watercourse
- Class 3 Watercourse
- Unit

Mass-Wasting Potential

- Very Low
- Low
- Moderate
- High
- Very High
- Extreme

Ryan Creek

4N,1E 17

4N,1E 16

4N,1E 20

4N,1E 21

4N,1E 22

Unit #1

Unit #2

Unit #3

Unit #6

Unit #7

Unit #4

Unit #5

Low

Moderate

WF Bridge Creek

4N,1E 28

4N,1E 27

4N,1E 29

Bridge Creek

Unit #9

Unit #8

McWhinney Creek

Very Low

Very High

4N,1E 32

4N,1E 33

4N,1E 34

NF Elk River

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Figure 2

Three Forks

THP #

Hillshade / Shalstab 10 meter grid / Slope Class Map

1 inch = 2,000 feet

0 500 1,000 2,000 3,000 4,000 Feet

Paved Road
Rocked Road
Dirt Road
Dirt Jeep Trails
Proposed Roads
Closed, Decommissioned or Abandoned Roads
Class 1 Watercourse
Class 2 Watercourse
Class 3 Watercourse
ROW
Partial Cut
No Cut
HRC HCP/SYP Timberlands
Other HRC Timberlands
Other Private Ownership
THP Boundary
THP Boundary

Unit #1
Unit #2
Unit #3
Unit #6
Unit #7
Unit #4
Unit #5
Unit #9
Unit #8

SHALSTAB Hazard Map

1
2
3
4
5

4N 1E 20
4N 1E 21
4N 1E 22
4N 1E 23
4N 1E 25
4N 1E 26
4N 1E 27
4N 1E 28
4N 1E 29
4N 1E 32
4N 1E 33
4N 1E 34
4N 1E 35
4N 1E 36

Slope Class Map
Slope %

0 - 10%
10 - 20%
20 - 30%
30 - 40 %
40 - 50%
50 - 60%
> 60%

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Figure 5

Three Forks

THP #

Aerial Photo Map

1 inch = 850 feet

0 285 570 1,140 1,710 2,280 Feet

N S

- HRC HCP/SYP Timberlands
- Other HRC Timberlands
- Other Private Ownership
- ROW
- Partial Cut
- No Cut
- Paved Road
- Rocked Road
- Dirt Road
- Dirt Jeep Trails
- Proposed Roads
- Closed, Decommissioned, or Abandoned Roads
- Class 1 Watercourse
- Class 2 Watercourse
- Class 3 Watercourse
- Unit

Unit #1

Unit #2

Unit #3

Unit #4

Unit #5

Unit #6

Unit #7

Unit #8

Unit #9

4N,1E 16

4N,1E 21

4N,1E 22

4N,1E 28

4N,1E 27

4N,1E 33

4N,1E 34

4N,1E 32

Creek

WF Bridge Creek

Bridge Creek

NF Elk River

McWhinney Creek

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Figure 6

Three Forks

THP #

Watershed Analysis Deep-Seated Landslide

1 inch = 1,000 feet

0 500 1,000 2,000 Feet

N

S

- HRC HCP/SYP Timberlands
- Other HRC Timberlands
- Other Private Ownership
- ROW
- Partial Cut
- No Cut
- Paved Road
- Rocked Road
- Dirt Road
- Dirt Jeep Trails
- Proposed Roads
- Closed, Decommissioned, or Abandoned Roads
- Class 1 Watercourse
- Class 2 Watercourse
- Class 3 Watercourse

Landslide Symbols (HartCrowser, 2000)

- Scarp
- Earthflow
- Rotational / Translational /Earthflow
- Rotational/ Translational

Unit #1

Unit #2

Unit #3

Unit #4

Unit #5

Unit #6

Unit #7

Unit #8

Unit #9

West Fork Bridge Creek

McWhinney Creek

North Fork Lake

4N.1E 17

4N.1E 16

4N.1E 20

4N.1E 21

4N.1E 22

4N.1E 28

4N.1E 27

4N.1E 29

4N.1E 33

4N.1E 32

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Figure 7

Three Forks

THP #

Road Map

1 in = 1,000 ft

0 395 790 1,580 2,370 3,160 Feet

N

S

- HRC HCP/SYP Timberlands
- Other HRC Timberlands
- Other Private Ownership
- ROW
- Partial Cut
- No Cut
- Paved Road
- Rocked Road
- Dirt Road
- Dirt Jeep Trails
- Proposed Roads
- Closed, Decommissioned, or Abandoned Roads
- Stormproofed Road
- Updgraded Road
- Decommissioned
- Class 1 Watercourse
- Class 2 Watercourse
- Class 3 Watercourse
- Unit

Ryan Creek

4N,1E 17

4N,1E 16

4N,1E 20

4N,1E 21

4N,1E 22

Unit #1

Unit #2

Unit #3

Unit #6

Unit #7

Unit #4

Unit #5

WF Bridge Creek

4N,1E 28

4N,1E 27

Unit #9

Bridge Creek

Unit #8

McWhinney Creek

NF Elk River

4N,1E 32

4N,1E 33

4N,1E 34

Lake Creek

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