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Memorandum

To: Craig E. Anthony  
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P.O. Box 670  
Santa Rosa, California 95402

Date: July 28, 1997

From: Department of Conservation  
Division of Mines and Geology  
P.O. Box 670  
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Subject: Review of ~~Consultant's~~ Engineering Geologic Report for Timber Harvesting  
Plan 1-97-232 HUM

County: Humboldt

Location:

Sections 34, 35; T1N/R1E, HBM  
Sections 2, 3; T1S/R1E, HBM

Quadrangle: Scotia 7.5 min. Quadrangle

Watershed: Ann Fork of Jordan Creek, Tributary to the Eel River

Silviculture: clear cutting, shelterwood removal step, right-of-way, alternative

Loading Methods: tractor (including end/long lining), rubber tired skidder/forwarder, high lead cable, skyline cable, helicopter

Area: 92 acres

Slopes: Moderate to steep

EHR: Low to Moderate

Geologic Concerns: Concentrated drainage from "stacked" switchbacks on proposed road, clear cutting steep slopes, mapped landslides in Plan, excessive sedimentation of Ann Fork of Jordan Creek and the Eel River and its tributaries causing adverse impacts to stream habitat.

Introduction:

On July 18, 1997, CDF requested DMG to evaluate a consulting Engineering Geologist's report for THP 1-97-232 HUM. No focused field work was conducted for this review. This report is limited to the evaluation of consultant's report based upon interpretations of aerial photographs taken over a span of 50 years, an aerial overview flown in February 1997, and experience in this and adjacent watersheds. Comments regarding the concerns listed above are included, as are recommendations for further work.

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References:

- California Department of Natural Resources, Division of Forestry, 1942, black and white photographs, frames CVL-9B-167 and 168, nominal scale 1:24,000, dated February 16, 1942.
- California Department of Natural Resources, Division of Forestry, 1954, black and white photographs, frames CVL-9N-119 and 120, nominal scale 1:12,000, dated August 3, 1954 .
- Falls, J.N., 1997, Preliminary Engineering Geologic Review of Debris Flow at Stafford, Humboldt County, California, Memorandum to Craig E. Anthony, Deputy Director, Resource Management, CDF & FP, dated March 12, 1997, 14 pp., 5 figs.
- Gray, D.H., 1977, Final Report; Creep Movement and Soil Moisture Stress in Forested vs. Cutover Slopes: Results of Field Studies, University of Michigan College of Engineering, Dept. of Civil Engineering, Division of Research and Development Administration, Ann Arbor, Michigan, Project 012577.
- Gray, D.H., 1973, Effects of Forest Clear Cutting on the Stability of Natural Slopes: Results of Field Studies; University of Michigan College of Engineering, Dept. of Civil Engineering, Division of Research and Development Administration, Ann Arbor, Michigan, Project 002790.
- Gray, D.H. & Sotir, R. 1996, Biotechnical and Soil Bioengineering Slope Stabilization, John Wiley & Sons, New York
- Huang, J., Lacey, S.T., and Ryan, P.J., 1996, Impact of Forest Harvesting on the Hydraulic Properties of Surface Soil, Soil Science, v. 161, no. 2, pp. 79-86.
- Huber, O.L., 1997, Slope Stability in Ann Fork THP, unpublished report for Jim Adams, Scotia Pacific Holding Company, dated July 17, 1997, 5 pp., 2 figs.
- Humboldt County Assessor, 1963, black and white photographs, frames HC-S-2-3 20-45 through 20-47, nominal scale 1:12,000, dated August 15, 1963.
- Mount, J.F., 1995, California Rivers and Streams: The Conflict Between Fluvial Process and Land Use, University of California Press, 359 pp.
- Spittler, T.E., 1982, Geology and Geomorphic Features Related to Landsliding, Scotia 7.5' Quadrangle: California Division of Mines and Geology Open File Report OFR-82-20 S.F., scale 1:24,000.

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Spittler, T.E., and McKittrick, M.A., 1995, Geologic and Geomorphic Features Related to Landsliding, North and South Forks of Caspar Creek, Mendocino County, California: California Division of Mines and Geology Open-File Report 95-08, scale 1:12,000.

U.S. Forest Service, 1947, black and white photographs, frames CDF2-10-150 through 155; CDF2-11-25 and 26, nominal scale 1:26,400, dated, October 13, 1947.

WAC Inc., 1984, black and white photographs, frames WAC-84C, 24-83 and 24-84; 24-177 through 180, nominal scale 1:31,680, dated May 6, 1984.

WAC Inc., 1988, black and white photographs, frames WAC-88CA, 18-43 and 18-44, nominal scale 1:31,680, dated June 18, 1988.

Ziemer, R.R., 1981, The Role of Vegetation in the Stability of Forested Slopes, International Union of Forestry Research Organizations, XVII World Conference, Kyoto, Japan, dated September, 1981, 12 pp.

#### Geologic Conditions:

Please refer to Huber (1997) for a general discussion of the local geology. A possible ancient landslide may underlie the western part of Unit 2 (see Figure 1, Regional Geologic Map). Figure 1 in this report is based upon Spittler (1982) and has been augmented based upon the interpretation of numerous sets of aerial photographs (listed above) and field mapping performed during other preharvest inspections in the area.

#### General Observations:

1. The consultant's report is not in the recommended format as presented in DMG Note 45, Guidelines for Geologic Reports for Timber Harvesting Plans.
2. Based upon conditions observed during prior PHI's, fly-overs, and aerial photograph interpretation, the Jordan Creek system has been heavily impacted by numerous landslides.
3. Slope Runoff: The alignment of the proposed roadway snakes back and forth down the crest of the ridge, avoiding the steepest slopes and staying out of debris slide amphitheatres mapped by Spittler (1982). However, the cumulative effects of roadway runoff has not been adequately addressed in the THP nor the Consultant's report.

Although not discussed in the THP, the RPF proposes to outslope the road (Bruce Chapman, 1997, personal communication). Runoff at the switchbacks is planned to be drained off using short sections of inside ditch and energy dissipators. This would be appropriate if no concentration of runoff would occur, particularly along sections of

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sidehill road with few switchbacks. However, even if drained adequately per the Forest Practice Rules, any runoff concentrated from a section of road could potentially be transferred to the next section downhill. With the 15 stacked switchback sections that are proposed in this THP, concentrations of runoff will probably occur. Observations of existing roads in the ownership in nearby areas reveal a significant level of perched fill, concentrated road and skid trail drainage, and failing cut slopes. There are no reasonable assurances that the proposed road will be built differently. The net effect will be to have more water than normal concentrated along a vertical band on the slope (see Figure 2, Road Drainage Overlap).

Roads generate much more runoff than equivalent areas of relatively undisturbed slopes because of their hard, compacted surfaces (Mount, 1995). Also, the permeability of the soil between the roads may be reduced depending upon the level of ground disturbance, in turn reducing the amount of water that will be absorbed (Huang, et al., 1996). This will help to deliver more water than usual to the next section of roadway.

Landslides and other instabilities could occur as a result of the higher than normal amount of water that would be encountered on portions of the slope where concentrations and/or diversions occur. Based upon the behavior of prior landslides in the immediate vicinity of this THP, many of these landslides would be in the position to enter the watercourses directly.

4. Clear Cutting: Incidence of shallow landslides has been shown to be higher in clear cuts in the Pacific Northwest (Gray and Sotir, 1996). However, these studies occurred in areas dominated by fir and pine, whose root masses die after the trees are cut down. The implication is that the internal strength of the soil mantle decreases over time as the roots decay (Ziemer, 1981; Gray, 1973, 1977; Gray and Sotir, 1996). New roots are also being developed by new vegetation after the harvest, and these begin to add strength to the soil. There appears to be a "window of opportunity", typically 3 to 8 years after harvest, where the soil strength is at its lowest. Storms during this time are more likely to trigger landslides.

However, the forests in this part of Humboldt County are dominated by redwoods and hardwoods (aggressive competitors); all of which are active "stump sprouters". There is probably a certain amount of die-off until the new sprouts are large enough to support the large root mass. The degree to which this adversely affects soil strength is unknown at this time, and is probably very site-specific (Bigg, 1997, personal communication).

Trees also reduce the ground water levels in a slope during the active (warmer, sunnier) portion of the year through evapotranspiration. Slopes with lower ground water levels will take longer to "fill up" in the winter, thereby remaining more stable further into the winter. However, after long, soaking periods of rain, ground water levels in cut and non-cut slopes become indistinguishable (Gray, 1997, personal communication).

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Another factor with clear cuts may be the reduction of rainfall interception by the tree canopy. Thomas E. Spittler (1997, DMG personal communications) and Robert R. Ziemer (1997, personal communications) theorize that tree canopy decreases the rainfall delivery rate to the soil mantle, thereby "buffering" the input of a localized, intense storm. Without an adequate amount of canopy, the rain water is probably introduced into the soil mantle much more quickly, causing rapid saturation and pore pressure rise leading to failure.

Bruce Chapman (personal communication), the RPF that prepared this THP, stated that the proposed clearcuts would have a large volume of residual trees in the 24 inch (dbh) and smaller range, and would meet stocking upon completion of harvest. However, the potential reduction in transpiration potential from the proposed harvest is unknown.

5. Aerial Photographs: Interpretation of historical aerial photographs for the Plan vicinity show that the area has been heavily impacted by past land-use activities. Dozens of debris slides are now present along the inner portions of the Jordan Creek drainage and its forks. Logging haul roads were located in the channels in many instances. The area appeared to have been intensively entered in the 1950's and 60's.

Nearly all of the mapped debris slides, debris flows, and inner gorge failures appear to have occurred in the time between the early 1963 and 1984 photos in areas that had been heavily cut and roaded.

The slopes in the Plan should be expected to behave in a similar manner unless the planned operations are carefully mitigated taking the past performance of slopes in the drainage into account.

6. Proposed Culvert Crossing: The proposed 24 inch diameter culvert is indicated as a temporary pipe to be removed "unless the road is surfaced and drainage is established to permanent standards." As proposed, if the permanent upgrade were to occur, the pipe would be upgraded to a minimum 36 inches in diameter.

Because this crossing is remote, it is unlikely to receive maintenance during storm periods. The site condition suggest that the pipe and crossing should be expected to fail based upon the water introduced into this portion of the slope by the roadway drainage, and the proposed silviculture. The better alternative would be to keep the crossing temporary as proposed, regardless of road upgrading.

Comments on Items Discussed in Consultant's Report:

1. Paragraph 2, page 2: Cracks observed along outer edge of existing road. The cracks appeared to be relatively recent (several years old) per Huber (Huber, 1997, personal communication) and the slope immediately down hill of this area was densely vegetated with understory conifers up to 10 inches in diameter.

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Although the cracks may be related to fill settlement and/or decay of buried organic debris as stated in the report, they may be related to the unstable area mapped immediately downhill (compare Huber Figures 1 and 2). This landslide was not evaluated.

If these features are related, the presence of fill on the slope above the mapped slide, particularly where the fill was not engineered, could increase the driving force for slope failures in this area, possibly triggering larger movement.

2. Paragraph 3, page 2: Wet Areas. The RPF's recommendation for "fabric burritos" to be used in these locations (Per the RPF, this refers to horizontal gravel drains encased in filter fabric) is appropriate. However, the installation may be confusing without a clear diagram for the LTO to refer to during construction.

3. Paragraph 4, page 2: Bowl-shaped Depression. The Consultant's description and interpretation of this feature as an ancient debris flow scar is reasonable, as is the RPF's plan to have an EEZ around the feature.

Cumulative Impacts: (related to landsliding, soil erosion, and sedimentation)

The Cumulative Effects addendum in the proposed THP is designed to identify past, current, and future activities in the THP area that have contributed or that may contribute to adverse cumulative effects. The addendum also includes a discussion of present watershed conditions and probable future activity. The statements in the addendum generally conform with conditions observed during this inspection with the following exceptions.

1. The RPF states that "large and small earth movement incidences occurred across the landscape where land use activities occur, and where activities have not." This is generally correct. However, comparison of Figures 3 and 4 (1947 and 1984 Aerial Photographs of Plan Area) demonstrates that a tremendous increase in slope stability problems has occurred since road building and timber harvesting activities began in the 40's. Comparison of aerial photographs of Humboldt Redwoods State Park with those for the Plan vicinity shows that although landslides did fail in the Park, far fewer occurred than in adjacent managed lands during the same time period. Much, if not most, of the increased landsliding is associated with timber harvesting practices that occurred prior to the implementation of the Forest Practice Rules. However, experience in nearby watersheds suggests that slope stability problems are occurring at a higher rate in recently harvested areas compared with those that have not been entered in the past decade.

2. The RPF also states that "the difference between where land use activities on these landscapes occur in comparison to where no activities occur, that land usage creates a minor amount of additional disturbance in relation to what will occur naturally." The

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aerial photographs and field reviews of other THPs in this area suggest that this may not be the case.

Jordan Creek, Bear Creek, and other watersheds in the vicinity of this THP, including the one above the town of Stafford, all experienced significant debris torrent activity, significantly damaging stream channels. Aerial over-flights and site investigations demonstrate that most of the larger failures are in areas that were recently harvested or are associated with roads. Quantitative studies have demonstrated a correlation between many of the activities associated with timber harvesting, particularly road and skid trail construction, and landslides (Spittler and McKittrick, 1995). In watersheds that have been significantly impacted by slope failures, such as Jordan Creek, the proposal to build new roads across steep slopes should be anticipated to trigger additional adverse impacts unless significant mitigations are proposed and properly executed.

General Recommendations:

1. A planning watershed-level assessment of the road network should be developed to identify which roads will be needed for long-term management, and which ones may be abandoned.
2. The proposed road should not be built without documenting its purpose in the long-term management of the area. Because of the hazards that would develop if the road alters the surface and subsurface drainage on the slope, it should not be built in its entirety during one entry without a great deal of specific design, review, and supervision. This will minimize the amount of freshly disturbed ground that could be affected by a major storm. Otherwise, slope instabilities could occur that would further damage the Jordan Creek drainage.
3. The Consultant should demonstrate that any proposed road construction will not create slope stability or soil erosion problems. The report should also document areas where mitigations could substantially reduce the management-induced high rate of sediment yield from the slopes within this watershed. This information should be submitted to CDF for review and approval prior to any construction activities.
4. It may be necessary to use helicopters to yard logs from much of this area, has been proposed as an option for parts of the THP. Easily accessible landing sites are located nearby downstream, per the RPF.

If the proposed yarding systems (tractor and cable) are still planned for use, the RPF and the Consultant should demonstrate that these methods will not result in more damage to the watershed than full helicopter operations.

3. No more than 50% of the canopy leaf surface area from both conifers and hardwoods should be removed between the top of the Plan Units and the bottoms of

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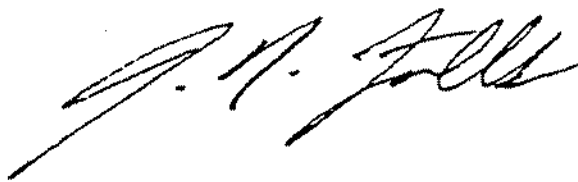
the adjacent drainages during this rotation because of numerous landslides that impacted watercourses in the Plan area after wide-spread clear cutting in the drainage. This could be achieved by reducing the size of harvest blocks.

In order to provide additional slope stability, the harvesting of trees within any inner gorge in this area should be evaluated and described in detail. The inner gorge trees will be needed for both the stability they provide to the slopes, and for the large woody debris that will enter the channels once failures do ultimately occur. Leave trees within inner gorges should be of the largest size class of those that will enter watercourses, including Class IIs and larger Class IIIs. The percentage of trees harvested should also be low adjacent to the break in slope at the top of the inner gorge. Information on the silvicultural design to minimize inner gorge debris slide failure should be included as part of this and any THP within the watersheds that were significantly impacted by recent storm events.

If a higher level of harvest is desired, the Consultant should demonstrate that this will not have an adverse impact on the slope stability.

Site Specific Recommendations:

1. The landslide on the slope below the indicated cracks on the road should be evaluated by the Consultant. The Consultant should provide additional mitigation recommendations as needed to maintain the current slope stability.
2. The RPF should provide an installation diagram for the proposed "fabric burrito" for use by the LTO during construction.
3. None.



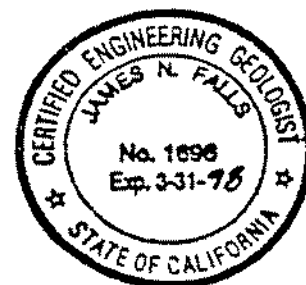
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Concur:

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Attachments



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