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R43

September 7, 2004

Mr. Roger Briggs, Executive Officer
Regional Water Quality Control Board
Central Coast Region
895 Aerovista Place, Suite 101
San Luis Obispo, California 93401

Dear Mr. Briggs:

At the Timber Harvest Workshop held on June 28, 2004 in Santa Cruz, Mr. Chris Adair of your staff asked the participants to provide input to you regarding how your Board should proceed with monitoring related to Timber Harvesting Plans (THPs). We appreciated the opportunity to provide input to the Board at the June Timber Harvest Workshop as well as with this letter, and apologize that this follow-up information has not be sent to you in a more timely manner.

First, let me emphasize that we value Chris Adair's participation in our Memorandum Of Understanding (MOU) Monitoring Workgroup discussions. As you are no doubt aware, this group was assembled in February of 2003 in response to the MOU between the California Department of Forestry and Fire Protection, the Regional Water Quality Control Boards and the State Water Resources Control Board. The Workgroup was charged with finding ways to provide appropriate monitoring through greater interagency cooperation and consistency in the application of monitoring requirements to timber operations on non-federal lands in California. To date, the Workgroup has been able to reach general agreement on: (1) shared agency goals, (2) water quality monitoring authorities, and (3) conditions and objectives for water quality monitoring. The Workgroup has not been able to reach consensus yet on guidelines that can be applied by the agencies to determine typical monitoring needs for individual THPs, but the group is hopeful that this can be achieved in the next 1-2 months.

In general, the Workgroup members are working toward developing monitoring guidelines that provide improved mutual understanding and consistency between agencies and more certainty to landowners. Such guidelines would identify the types of monitoring activities normally expected with increasing water quality concerns, based on site factors, proposed timber operations, and water quality conditions. The THP monitoring requirements specified would be based on: (1) the type and scope of proposed operations, (2) the physical setting risk, (3) the sensitivity of the beneficial uses of water present, and (4) the current water quality conditions. The approach seems to be consistent with the direction your Board would like to take related to THP scale monitoring.

In a more general sense, we want to provide some background information regarding varying types of potential THP scale monitoring techniques. First and foremost, we believe that in-stream monitoring to determine changes in sediment loads and turbidity directly related to a THP is essentially a research level project. This has direct implication for determining Basin Plan compliance for turbidity standards (10% or 20% above background levels). With the exception of monitoring above and below discrete disturbance features, such as watercourse crossings, the use of turbidity measurements to determine compliance with Water Quality Plan standards requires pre-disturbance measurements to establish a relationship between treatment and control watershed for comparison to post-treatment measurements. Variability of sediment transport and turbidity levels in natural streams is high, and many samples must be collected over a variety of flow conditions during both pre and post-treatment study periods to determine whether there has been a significant change as a result of land management treatments. There is also a high degree of variability in suspended sediment and turbidity levels within storms, from storm to storm, and year to year, making it difficult to distinguish between background and management related sediment concentrations. Therefore, sampling must occur for a number of years to determine differences in annual sediment loads. Determining differences between individual storm loads may also take years, depending on the number of large storms that occur in a given winter.

For sediment concerns, we believe it is better to monitor the "driving" variables, not the "response" variables in watersheds. These could include: (1) on-site performance of forest practices, (2) hydrologically connected road segments or road segments near streams, (3) watercourse crossings, (4) landslide occurrence following large storms, and (5) vegetation composition along stream channels. These types of observations could be incorporated into more broadly defined categories of monitoring deemed to be appropriate for the THP scale, such as: (1) implementation monitoring (of both Forest Practice Rules, such as those requiring adequate road drainage structures, and additional mitigation measures), (2) visual or hillslope monitoring during wet weather conditions, (3) large erosion event monitoring (sediment release monitoring), (4) photo point monitoring, and (5) forensic monitoring. Depending on the risk to water quality associated with a given THP, one or more of these types of monitoring could be specified.

Implementation monitoring is generally considered to be relatively easy to accomplish and can be undertaken by either the landowner (or his representative) or by the public trust agencies. The California Department of Forestry and Fire Protection (CDF) already performs implementation monitoring as part of the normal Forest Practice Regulation Program, particularly during Work Completion Report inspections. Implementation monitoring provides accountability that practices have actually been installed on the ground as described in the plan.

Visual or hillslope monitoring during wet weather conditions is a particularly valuable technique at the THP scale. A comprehensive evaluation of high risk sites during strong winter storms can indicate where water quality problems are developing and provide a

valuable feed back loop to make improvements quickly if needed. Observing a road network during storm events can indicate where road-related water quality problems are developing and is extremely cost effective since it facilitates early identification of problems without a costly monitoring scheme.

Erosion event monitoring can be a relatively easy task or exceptionally difficult task depending on the size of the event specified and where the landowners or his/her representative is to look for these features. In general, specifying small size events, such as one cubic yard, in all parts of the THP will be very difficult to accomplish, especially for large THPs. Requiring erosion features greater than 10 cubic yards to be located (with corrective action if possible) can be much more readily accomplished. Erosion events of this size have been responsible for nearly all of the sediment input into Caspar Creek (other than channel-derived sediment), the site of a detailed cooperative watershed study between CDF and the US Forest Service (USFS)-Pacific Southwest Research Station for over 40 years.

While photo point monitoring is easy to accomplish, it has several drawbacks as discussed by Dr. Robert Ziemer in a recent letter regarding THP scale monitoring for a Santa Cruz County plan (see attachment). First, most of the erosion associated with THPs is produced from a few sites and the majority of the area produces little or no erosion. Second, there is a low probability of successfully predicting the correct site to monitor that will be a significant source of erosion from the operations. This leads to the conclusion that ground photo points established in advance of anticipated erosion may not be an effective way to evaluate erosion or sediment in an area. In contrast, repeated large scale aerial photography is much more likely to provide an opportunity to identify and measure significant erosion sources because it covers the entire area, but is usually not easily available immediately before and after stressing storm events for THP projects.

Finally, forensic monitoring can be a valuable monitoring tool for high risk THPs, but it is expensive and damage noted is often after the fact, with little corrective action possible. Dr. Kate Sullivan of PALCO has developed a very detailed procedure for forensic monitoring that could be modified for more general use throughout the state when needed. Dr. Sullivan's methodology involves inspecting THP units for chronic sediment delivery from hillslopes to watercourses using in-stream turbidity levels as an indicator. Elevated levels of turbidity are followed upstream to locate sediment input sources, which are then mitigated if possible.

THP scale monitoring approaches that do not generally work well due to high cost, the time periods required for sampling, and long lag times for watershed products to reach in-stream monitoring sampling stations include: (1) channel monitoring (cross-sections, long profiles, V-star, etc., (2) coarse bedload sediment, (3) large wood loading, and (4) biological indicators (e.g., fish biomass, macroinvertebrates).

In summary, as we stated in our presentation on June 28th to the Central Coast Regional Water Quality Control Board at the Timber Harvest Workshop, much has been

learned about forestry-related impacts to water quality in California through our various monitoring efforts. In most watersheds, we have found that the majority of potential erosion sources are related to improper road design, construction, and maintenance (particularly related to drainage), and improper watercourse crossing design, construction, and maintenance. In-stream monitoring to determine changes in sediment loads and turbidity directly related to a THP and Basin Plan compliance is essentially a research level project. Currently, we are helping to fund long-term cooperative in-stream monitoring projects at four locations in California (Caspar Creek, Wages Creek, and the Garcia River Watershed in Mendocino County, and Judd Creek in Tehama County). The CalPoly long-term watershed study at Swanton Pacific Ranch in Santa Cruz will provide excellent in-stream water quality monitoring data related to timber harvesting over time. We believe that THP-scale sediment monitoring should focus on locating problem areas in a timely manner and correcting them if possible, not on collection of in-stream water samples for a very limited period of time. We are hopeful that the MOU Monitoring Workgroup will be able to produce a workable THP-scale monitoring approach in the near future that will embrace many if not all of the concepts discussed above.

We encourage you to read the letter written by Dr. Robert Ziemer, Principle Hydrologist (retired), USFS, dated March 11, 2004, regarding appropriate monitoring techniques for the Smelt-Locatelli THP (01-04-008 SCR) [attached]. We believe that Dr. Ziemer's wealth of experience in this field allows him to provide very sound guidance for THP-scale monitoring. Additionally, we concur with the comments that Dr. Richard Harris of UC Berkeley sent to Mr. Adair in an email message dated July 5, 2004 regarding the direction your Board should take on THP-scale monitoring.

If you would like to discuss any of these points in greater detail, please do not hesitate to contact us.

Sincerely

Dennis O. Hall
Staff Chief, Forest Practice
RPF 2597

By
Peter H. Cafferata
Forest Hydrologist
RPF 2184
CPESC No. 417

Attachments

Report of Field Trip Related to
Smelt-Locatelli THP (1-04-008 SCR) – Proposed Waiver of Waste Discharge Requirements. Order # R3-2004-0011

On February 18, 2004, I accompanied Steve Auten and Bob Reynolds to observe field conditions relative to the Smelt-Locatelli THP (1-04-008 SCR) and the Proposed Waiver of Waste Discharge Requirements. Order # R3-2004-0011.

During the night, 2.52 inches of rain fell between 18:57 on February 17 and 05:48 on February 18, based on the record at Eureka Canyon (Corralitos 6NW) EKN. Monitoring Program R3-2004-0011 states: *Samples shall be collected within 24 hours of the end of all storm events of two inches of rain or greater within a 24-hour period.* This storm substantially exceeded this threshold in that 2.52 inches of rain fell within about an 11-hour period. Further, we were in the field observing conditions within about 4 hours after the conclusion of the storm, which is a much more rapid response than might be normally anticipated. Consequently, our observations are fully relevant to the requirements of the monitoring program.

Enroute to the proposed THP site, we observed that Corralitos Creek at Bridge 36-01 (Holohan College Rd. and Hwy 152) and at Green Valley Road and Thicket Street (USGS 11159200) was extremely turbid, having the color of dark chocolate. The USGS stream gage 11159200 reported a peak discharge of about 600 cfs on February 18. The discharge at this location had receded to about 400 cfs when we visited that station. Median daily flow at that location for this date is about 20 cfs and the flow on February 15, 3 days prior to the storm, was 3 cfs. Again, this suggests that the conditions during our observations were relevant to those conditions anticipated during proposed monitoring requirement.

As we drove up Corralitos Creek, the turbidity dropped rapidly. At the 6-foot Redwood Canyon culvert, the water was just a murky light gray, suggesting the important sediment pollution sources are from the lands downstream. At the Ramsey – Browns Creek confluence, each stream appeared to have about equal turbidity. At the Gamecock – Browns Creek confluence, Gamecock Creek appeared somewhat more turbid than Browns Creek, suggesting, perhaps, that the sediment regime or sources differed between these two watersheds.

Next, we visited a recent timber sale on Big Creek property (Biggars THP, # 1-99-392 SCR). Although the harvest area is recorded in the THP as 53 acres, the area where timber was removed is approximately 40 acres. About 800,000 BF or approximately 20,000 BF per acre was selectively harvested. The THP was closed out in the summer of 2000. This area is physically close to the Smelt-Locatelli THP and represents similar topography, geology, and type of treatment. After the previous night's storm, there were a few cut-bank failures of a cubic yard or so that slumped onto the roadway, but did not become further mobilized. Many of the intermittent streams were flowing water, but all appeared non-turbid and flowed through a substantial length of forest before entering

Browns Creek. I saw no evidence of erosion problems that would produce turbidity or suspended sediment in a Class I or II stream from this completed THP.

We next visited the Smelt-Locatelli THP (1-04-008 SCR) and inspected the proposed water quality monitoring sites. The total proposed new harvest area is 41 acres, of which 31.3 acres is on land that drains to Gamecock Creek. All proposed water quality monitoring sites are in Gamecock Creek, so 31.3 acres is the relevant harvest area of concern. The Gamecock Creek drainage area above the upper property line (Monitoring Point A) is 252 acres, and the drainage area above the lower property line (Monitoring Point B) is 962 acres. Thus, 711 acres lie between Monitoring Points A and B. The distance between Monitoring Points A and B is about 3,600 feet. The proposed harvest area between Monitoring Points A and B is 31.3 acres, representing 4.4% of the 711 acres between the Monitoring Points, and 3.3% of the area (962 acres) above Monitoring Point B. It would require an extraordinary amount of erosion and sediment to be introduced into the stream from the 31.3 acres of proposed harvest area to be able to detect in increase in sediment between Points A and B. Sources of sediment that large would easily be observed on the ground as large gullies or landslides.

There are two locations of Up and Down Stream of Class I and II Crossings by Roads, designated in MRP R3-2004-0011 as R1 and R2.

- R1 is a wooden bridge with stable banks and channel bottom where, because of drainage condition, there is absolutely no possibility of sediment being introduced between the designated monitoring points. To require such monitoring has no justification whatsoever and consumes resources that could be devoted to more useful observations.
- R2 is a concrete bridge where there is a short steep pitch of road on the north side that drains to Gamecock Creek between the designated monitoring points. There is perhaps more than 800 acres of the Gamecock watershed that drains to both of these points and perhaps 0.1 acre between the monitoring points. This represents an increase in area between the monitoring points of 0.01%. Unless there was an extraordinary amount of sediment introduced, stream turbidity measurements would never show a difference. Such a large input of sediment would be obvious to an on-site observer and the volume of erosion could be measured easily. There was, in fact, evidence that water ran down the road during the previous night's storm, resulting in a small rill (about 1" x 6"/2 x 50') that could potentially have delivered a maximum of 1 ft^3 of sediment to Gamecock Creek. The point of this observation was not to document the possible delivery of a small quantity of sediment, but more importantly, at the time we were at this site about 5 hours after the storm, water was no longer flowing down the road. Hence, it would be impossible for any instream measurement of turbidity obtained during our visit to show a difference since no sediment was being introduced at that time.

It is well documented that sediment transport and turbidity in small steepland streams tracks the storm hydrograph and that sediment transport after the peak rapidly returns to pre-storm conditions. If one is concerned about sediment coming from land management activities, the design must either require: (1) collecting sediment samples or turbidity

during those times when sediment moves (e.g. during storms and particularly near the hydrograph peak); or (2) measuring the erosion volume and consequences after the storm. The ability to place field crews in appropriate locations to collect data during large hydrologically significant storms has been demonstrated repeatedly to be both impractical and unsafe. Measuring stream turbidity in small steepland streams 24 hours, or even 4 hours, after the storm ends will generally provide no information relevant to sediment production and transport from those watersheds. There are local data from CalPoly's Little Creek Experimental Watersheds that clearly demonstrates this point.

Monitoring turbidity above and below suspected locations of sediment introduction is a well-accepted methodology. However, unless the sampling locations meet specific criteria, the method is guaranteed to provide misleading information.

- The method is appropriate if **all** of the following criteria are met: (1) there is a discrete location of sediment introduction; (2) the volume of introduced sediment is large relative to that being carried by the stream at the above the sampling point; (3) the distance between the above and below sampling points is small; and (4) the measurements are made during the time that the introduced sediment is being transported.
- If the distance between the above and below sampling points is large and/or the difference in watershed area is large (as is the case between Monitoring Points A and B), then there are likely differences between the sediment being transported past these two locations that are unrelated to the present land management practice. In such case, it is necessary to make sufficient measurements before the treatment to establish the pre-treatment relationship. An example from Caspar Creek illustrates this serious flaw in the design of above and below monitoring at this scale without measurements to characterize the sediment relationship before treatment. The watershed size at Caspar Creek gauging station HEN is 96 acres and lies upstream of gauging station ARF which is 948 acres. Thus, 852 acres lie between HEN and ARF. This is about the same scale differences as in the Gamecock Creek case. The sediment yield for 7 storms from HEN was 248 kg/ha and for the same 7 storms from ARF was 865 kg/ha. This translates to 3.5 times more sediment per unit area at the downstream ARF gage than from the upstream HEN gage. That is, the land between the two gages yielded 617 kg/ha more sediment. These measurements were made before any treatment was applied to the land. However, if this had represented monitoring after logging, one might have **erroneously** concluded that the logging increased sediment yield by 3.5 times. Using different gages at Caspar Creek to make such above and below comparisons produce similar results.

I believe the requirement to conduct visual monitoring of all roads, watercourse crossings, landings, skid trails, water diversions, watercourse confluences, and known landslides on the timber harvest plan is defensible and is the best way to determine whether problems exist that might degrade water quality. In this way, existing and emerging problems can be corrected on the site before they enlarge to become a more serious issue.

I have not seen "Standard Operation Procedure 5.2.3 – Photo Documentation Procedure" and there is insufficient discussion about photo point monitoring in MRP R3-2004-0011 for me to understand exactly how this information might be designed, stored, retrieved, or used to evaluate sediment input to streams. It has been clearly documented in the scientific literature that most of the erosion is produced from a few sites and also that most of the area produces little or no erosion. This means that there is a low probability of successfully selecting, in advance, a site to monitor that will in the future be a significant source erosion from the area. For example, one or several discrete landslides, road fill failures, or streambank failures will likely be the principal erosion and sediment story for an area. Predicting where these might occur and establishing photo points at the appropriate locations before the event is extremely difficult. Even if the photo point is established in the approximate area and the actual failure is say 10 feet to the right or left, the feature will probably not be seen in the photo coverage. Even if a photo point happens to cover an erosion feature, there remains the problem of interpreting the respective photos to determine the volume and the disposition of erosion shown. My personal experience is that I have not found ground photo points established in advance of anticipated erosion to be an effective way to evaluate erosion or sediment in an area. Repeated large scale aerial photography is much more likely to provide an opportunity to identify and measure significant erosion sources, because it covers the entire area and allows one to focus on the area of subsequent erosion. Further, calculating the volume of erosion is improved using stereographic coverage.

The triggering storm in MRP R3-2004-0011 that requires monitoring is "two inches of rain or greater within a 24-hour period". Whether this is a reasonable value depends on how many such events are anticipated in any given year and what type of erosion activity might result from such an event. It is probably reasonable to expect the prudent manager to visit the site 2 to 3 times a winter following events that have the potential to produce an erosion problem. Requiring repeated visits when no erosion is expected tends to reduce the credibility of the inspection program. All erosion processes do not respond equally to the same rainfall. Each process responds to a different function of both rainfall intensity and duration. Surface erosion and gullying is responsive to high intensity rainfall that exceeds the infiltration rate of the soil surface resulting in overland and concentrated flow. Shallow-seated landslides require saturation and increased pore pressure within the potentially unstable soil mass. Deep-seated landslides require prolonged rainfall to saturate a large mass of hillslope. It has clearly been documented that a 2-inch storm on a dry watershed will result in far less erosion and streamflow than the same storm on a saturated watershed. CalPoly has estimated that an accumulation of at least 6 inches of rain is required in the fall before there is a significant streamflow response at Little Creek. At Caspar Creek, the rule-of-thumb is an accumulation of 10 inches of rain. The longer the time between rainfall events, the greater the size of the storm needed to produce a similar runoff event. In western Washington, I determined that several landslides were initiated only after 14 inches of rain were received over a 15-day period. In Redwood Creek, I determined a direct relationship between the amount of seasonal precipitation and the corresponding amount of block-glide slope deformation of the graywacke sandstone and mudstone units.

RECOMMENDATIONS

As discussed above, it is important to refine the definition of a significant storm having the potential to cause erosion. This is not a single value, but is a relationship between rainfall intensity and duration that is dependent on a number of factors, including antecedent conditions, geology, and the type(s) of erosion that results in sediment transport to and by the stream. As first approximation, one could use the relationships reported in the scientific literature. With some effort, these relationships could be developed for the Santa Cruz region.

After each large storm, conduct visual monitoring of all roads, watercourse crossings, landings, skid trails, water diversions, watercourse confluences, and known landslides in the harvest units. This should include walking the main channel from the lower property boundary and each tributary, looking for unusual sources of turbidity. If such sources are found, locate and document the source, such as small bank failure, woody debris jam, landslide, etc. Similarly, walk the roads and skid trails looking for evidence of erosion and follow its path to the stream or deposition on forest floor. Immediately correct the erosion source, if possible, or schedule correction at an appropriate time given the site conditions.

MRP R3-2004-0011 requires reporting all natural or anthropogenic releases of soil to a waterway of at least one cubic yard. This seems to me to be an exceedingly small feature. At Caspar Creek, we walk the streams and maintained a log of observations of new erosion features having a volume of 10 cubic yards or greater. Our experience with field crews is that there is no consistency in the ability to find and report features having smaller volumes. In addition, features larger than 10 cubic yards are responsible for nearly all of the sediment transported in Caspar Creek, other than channel-derived sediment. Similarly, Pacific Watershed Associates excluded erosion volumes less than 10 cubic yards in their 1999 analysis of Jordan Creek and stated "*... while nearly 40% of all features were less than 10 yds^3 in volume, they accounted for less than 2% of the total erosion, and the cost of measuring them were beyond what Tetra Tech, Inc. and the U.S. EPA were able to fund*".

The location of greatest concern to me in the entire project area is the man-made watercourse (gully) located between Point C and the water tank (near the southwest corner of property). This gully appears to be capable of actively eroding. Further, the lower banks from the proposed crossing to Gamecock Creek appear to be composed of relatively recent fill and appear particularly vulnerable. I believe the proposed temporary crossing and the skidtrails and logging northwest of this gully have the potential of producing nearly all of the sediment likely from this THP. As such, I suggest extreme care. In addition, I suggest not attempting to "rehabilitate" this man-made channel unless the design is certified by an engineer, approved by the regulatory agencies, and the operation supervised closely.

I suggest developing a context for sediment in Gamecock Creek relative to that in Corralitos Creek. To do this, collect some grab turbidity samples at a number of

locations immediately following large storms, starting from perhaps Bridge 36-01 (Holohan College Rd. and Hwy 152) and progressively upstream at road crossings, trying to get samples in each main tributary. Looking at an old road map, there appears to be at least 6 major road crossings between Bridge 36-01 and the Corralitos Creek and Browns Creek junction. Include in this information, the rainfall data from, for example, Eureka Canyon (Corralitos 6NW) EKN, and the streamflow data from USGS gauge 11159200. This information, requiring only a small effort to collect, should demonstrate to any reasonable observer the relative magnitude of the sediment issue in various portions of the Corralitos watershed.

Along this line, some possible additional information might prove to be useful in the future. A number of fish biologists believe that the health or condition of fish is related to the length of time that turbidity remains high. Some fish biologists believe that fish have difficulty feeding at turbidity greater than 25 NTU. Other fish biologists believe the important variable is not a threshold of turbidity, but a shift in the turbidity magnitude/duration relationship. Small streams tend to clear much more rapidly than large streams. I expect that this is the case as one travels downstream from Browns/Gamecock to lower Corralitos Creeks. To be proactive, following a storm that results in Corralitos Creek becoming very turbid, you might consider collecting some turbidity samples at the locations discussed above at varying times after the storm, say every 4 hours. Then plot turbidity vs. time for each location. This should demonstrate that the turbidity is initially lower and then drops more rapidly with time in the headwater streams than for those locations progressively downstream. Again, only a small effort would be required to develop a reasonable approximation for this relationship.

Robert R. Ziemer, PhD

July 5, 2004

2) LETTER FROM RICHARD HARRIS

Hi Chris, I am sending this to you so that you may forward it on as appropriate. First of all, thanks so much for inviting me to come to the workshop. It was quite an event. I felt that my presentation was a little bit late in the game because by the time I was up, most of what I had to say had already been said. I hope it contributed at least a bit to the program.

Regarding thoughts on how your board should proceed.

I think that the Regional Board staff efforts in the Central Valley, especially their work in developing a "Risk Matrix", can inform your process. I further think that the MOU monitoring group meeting in Sacramento and chaired by John Munn should be encouraged to address your issues directly through your active participation. Clearly, there is a big difference between what might be used for THP monitoring in the southern sub-district where there are so few plans and where the rules are so strict and what may be used on the coast or in the Sierra.

THP monitoring requirements should be based on: 1) risk to the resource e.g., the intensity of the operation, 2) inherent risk in the watershed or on the THP site e.g., erosion hazard rating, proximity to fish-bearing streams, degree of existing impairment, 3) practical considerations e.g., costs, utility of data collected. I understand that your Board's mandate for protecting beneficial uses is different than the CEQA standard of "no significant impact" in that in an impaired watershed especially, a higher standard is required. As you know, this has been a big topic of discussion at the cumulative impacts MOU meetings. So, for example, a ground-based harvest in unstable terrain in a sediment-impaired watershed should have more stringent implementation monitoring requirements than a cable operation in relatively benign geology where existing sediment loads are less. That being said, the rules and mitigation requirements set by the THP review team will be directly keyed to the risks. So, implementation or compliance monitoring should be your first concern. This monitoring may have to go beyond compliance with the standard Forest Practice Rules and include compliance with additional mitigation measures included at the request of your Board or DFG.

Given that, I think you would also want to have "forensic monitoring" in the sense that if something goofs, you want to know it and correct it if possible. Most goofs occur under stressing event conditions, so those should be the trigger for forensic monitoring.

The choice of monitoring tools should be appropriate to the situation. Photo-monitoring, visual surveys, grab sampling, may all be needed to document both correct and incorrect implementation compliance and problems that may arise. I would not recommend continuous monitoring of any kind unless you are looking at the cumulative effects of several operations at the watershed scale. Pulsed monitoring before and after implementation would be more reasonable. I include before implementation because without knowing pre-treatment conditions, it is difficult to interpret what has occurred. That could, or probably should be part of the pre-harvest inspection or may be included in the plan by the project proponent as part of the plan preparation process if the information is already available. If you haven't already, you may want to take a look at some of the pre-harvest assessment work that Pete Cafferata has done. It is often keyed directly to evaluating potential effects on stream temperature. Timing for monitoring after that should be during operations, after completion and when stressing events occur during the mandatory 3-year maintenance period.

For implementation monitoring, I think that your staff and board would benefit from knowing more about the modified completion report that CDF is using. Although it was developed as a

statewide monitoring tool, and only samples some THPs, perhaps in your case, it could be used on every plan. It would also have to be modified to evaluate the entire THP. Now, it samples some road sections, parts of SPZ's and other aspects from THPs. It would also have to be modified to accommodate evaluation of mitigation measures that are not associated with the rules. With modification, the process developed for this program could be a pretty good tool for standardizing compliance monitoring. Maybe your staff could be trained in its current use for auditing random THPs. We have developed similar tools for implementation monitoring by DFG on stream restoration projects. I would be happy to share those with you. They include checklists, photo-monitoring and feature location protocols.

I guess I am arguing for setting up a standardized, consistent process for documenting compliance. That would be the first element. The second element is forensic monitoring. Both should rely on landowner implementation and reporting, with quality control auditing by agencies.

I think that systematic forensic monitoring may be required in some high-risk cases. Gaylon Lee and others working with the CWE MOU group have been considering different ways for assessing risk and should probably be consulted. For high-risk cases, you may want to consider the approach used by Kate Sullivan on PALCO lands. I have asked Kate to forward you more information on her approach. You may want to follow up with her at ksullivan@scopac.com. In the case of forensic monitoring, there needs to be a linkage to management response. That is, in your waiver conditions, you need to stipulate what must be done when a problem is identified.

Dennis Hall and Pete Cafferata have informed me that Big Creek Lumber Company has adopted a forensic monitoring approach for its road systems that you might also want to look into. Since everyone at the workshop seemed to agree that the main problem in Santa Cruz County is roads (roads, roads, roads) having a defined process for monitoring road performance during the winter is of definite merit.

There are several issues that were raised at the workshop that indicate your staff and board would also benefit from learning more about the FPA rules in the southern sub-district. Maybe you could take Dennis up on his suggestion for a presentation in the future. Soquel Demonstration State Forest may provide the perfect testing grounds to verify the merit of any approaches developed and their appropriateness within the context of your region (e.g. geology, regulations, weather patterns, etc.).

Those are my comments for now. Please contact me if I can help in any way. I was very impressed with the intellectual quality and integrity of your board members and board staff.

Best regards and thanks again,

Richard

Richard R. Harris, Ph.D.
Extension Forestry Specialist
Environmental Science, Policy, and Management
University of California

July 7, 2004

1) LETTER FROM BETSY HERBERT

Dear Roger Briggs and Board Members:

Thank you for inviting me to present information to your board last Monday in Santa Cruz, regarding local stressors to ranking water as a beneficial use. After listening to the many excellent presenters on the panel, am writing to express my thoughts, as you requested, about the board's current task of deciding how to ass impacts from timber harvests on beneficial uses of water.

As hydrologist Dennis Jackson stated in his letter to your board (March 15, 2004), the Basin Plan describes water quality in terms of turbidity, and has defined turbidity thresholds to protect beneficial uses. These thresholds are around 25 NTU for protecting native fish, and my research shows limits of 10-25 NTUs for protecting drinking water sources,
Depending on the capability of each water treatment facility.

In order to determine whether increases in turbidity are impacting beneficial uses, in my view, water quality monitoring is a necessary part of timber harvest plan assessment. The timber harvest review process under the categorical waiver has been enmeshed in a conundrum for many years. CDF has relied solely on BMPs mitigate the impacts of Timber harvest on water quality, but they have never required water quality monitorir to show whether these BMPs are actually working. Compounding this problem, CDF routinely allows in-lieu practices and alternatives to existing rules to be incorporated into THPs, as long as the forester justifies the practices in writing. Again, no empirical testing is required to show that these in-lieu practices protect water quality.

Scientists, including Randy Klein and Leslie Reid, both who made presentations to your board last Monday, have shown that water quality monitoring can be done successfully, if the right questions are asked to addre the problems at hand, and if monitoring methods are designed to answer these questions. I support a multi-tiered monitoring approach to answer the different kinds of questions that must be asked to address the complexity of watershed functioning. I would start by asking the question, "What are the existing conditions the watershed?"

Each watershed is a unique combination of geological, hydrological, biological and cultural aspects. To ass existing conditions, one could begin by assembling available information from various sources, including watershed sanitary surveys, the Coast Dairies Management Plan, the City of Santa Cruz Watershed Management Plan, and numerous planning documents and maps available at the Santa Cruz County Plann Department. Some of this descriptive information could also be gleaned from existing timber harvest plans. addition, I would calculate critical information, including road density and percent logged per year, from exis documentation. I recently did this type of analysis as part of my PhD dissertation. For two case study watersheds, I used CDF timber harvest plan data to calculate the number of acres logged per year, and the average percent logged per year. I also used THPs, along with aerial photographs available from state agencies, and readily available GIS tools to estimate road density in watersheds.

Once existing conditions data are compiled, one might assess and compare the cumulative impacts from timber harvests and roads in the manner in which Randy Klein explained in his presentation to your board. I work identified two key factors in North Coast forested watersheds that serve as good indicators of high imp from human land use. These factors are road density and the percent of the watershed logged annually. His study showed that in high impact watersheds, turbidity reached levels of 25 NTUs more often and stayed hi longer than in low-impact watersheds.

Klein's turbidity and peak flow data also showed that turbidity and suspended sediment concentrations (SS can be correlated, and that turbidity measurements can be used as a surrogate for SSC measurements.

In Santa Cruz County, an overall existing condition assessment would allow watersheds to be ranked in terr of existing impacts, such as road density and average annual percent logged. Watershed scale turbidity monitoring could be done in paired watersheds. Watersheds at the low end of the scale of impairment could serve as control watersheds in the paired studies.

Another type of question that needs to be asked is, "Are BMPs actually working?"

Effectiveness monitoring could be aimed at assessing policies and practices that are most suspect in terms protecting beneficial uses. Likely candidates might be practices that address stream-crossings. Instead of putting the burden the Water Quality Board to design monitoring programs for every situation, I believe the p submitter should design their stream-crossings so that they can be monitored for their effectiveness. If the practice cannot be effectively monitored, then it should not be allowed. Additionally, I believe that any THP t proposes in-lieu practices requiring road building or other disturbance within the WLPZ should also require effectiveness monitoring. Again, each in-lieu practice proposed should be designed so that it can be adequately monitored. If it is not possible to monitor the practice adequately, then the in-lieu practice should not be allowed. Every THP, no matter how large or small, that proposed these practices would require that practice to be monitored, and then over time, the effectiveness of the practice could be assessed.

Finally, certain THPs would require asking the question, "How much cumulative impact will this individual pl have?"

In my view, certain thresholds should trigger forensic monitoring for individual THPs. Thresholds would be established for cumulative stream lengths within the THP boundary, acres of steep slopes and existing slide For example, the prime candidate might be a THP of over 200 acres in areas of high stream densities, steep slopes, and existing slides. Such a plan would be require a water quality monitoring plan that measured turbidity upstream and downstream of the plan.

Thank you for your consideration.

Yours truly,
Betsy Herbert, Ph.D.