Monitoring Study Group Meeting Minutes

March 20, 2014
Bureau of Land Management Ukiah Field Office
Ukiah, California

The following people attended the MSG meeting: George Gentry (BOF—MSG Chair), Julie Bawcom, (CGS [retired]), Fred Blatt (NCRWQCB), Jim Burke (NCRWQCB), Bill Condon (DFW), Kevin Faucher (Campbell Global), David Fowler (NCRWQCB), Richard Gienger (Forests Forever+), Dennis Hall (CAL FIRE), Jon Hendrix (DFW), Dr. Russ Henly (CNRA), Matthew House (GDRCo), Jonathan Hvozda (Campbell Global), Mike Jani (MRC/HRC), Randy Klein (RNSP [retired]), Nick Kunz (SWRCB), Jack Lewis (USFS PSW [retired]), Dave Longstreth (CGS), Holly Lundborg (NCRWQCB), Gerald Marshall (CGS), Mike Miles (HRC), Jesse Noell (Salmon Forever), Andrew Pellkofer (HRC), Nick Simpson (DFW), Dennis Slota (MCWA), Kirk Vodopals (MRC), Adona White (NCRWQCB), Marily Woodhouse (Battle Creek Alliance), Kristi Wrigley (Elk River Residents), and Pete Cafferata (CAL FIRE).

Participants on the GoToMeeting webinar/conference call included: Caroline Petersen (DFW), Wesley Smith (NMFS), Stu Farber (WM Beaty and Associates), Simona Altman (DFW), Bill Short (CGS), Jacqueline Matthews (CVRWQCB), Mary Olswang (DFW), Daniel Whitley (CVRWQCB), Lorna Dobrovolny (DFW), Matt Dias (BOF), Anthony Toto (CVRWQCB), Drew Coe (CAL FIRE), David Haynes (DFW), Jim Robbins (CAL FIRE), David Lamphear (GDRCo), Susan Sniado (DFW), Randi Adair (DFW), and Stacy Stanish (DFW).

[Action items are shown in bold print].

The meeting began with general monitoring-related announcements:

- Dr. Richard Harris, UCCE (retired) and consulting ecologist and education specialist, is working with Susie Kocher and Mike De Lasaux to plan their next series of webinars and/or workshops. They are looking for topics and potential presenters. Anyone with ideas about this should contact Richard at: rrharris2464@sbcglobal.net. One possible topic being considered is the use of PTEIRs as a tool to promote forest sustainability and rural community well-being. Past webinar topics have included roads, riparian function and management, and reforestation practices for California (see: http://ucanr.edu/sites/forestry/Webinars/).

- A Fire Ecosystem Forest Management and Water Yield Symposium will be held on May 2, 2014 at the USFS Wildland Fire Training Center, McClellan, CA. Presenters include Drs. Roger Bales, Martha Conklin, Carolyn Hunsaker, Terri Hogue, and Bill Stewart. Additional information and registration for the symposium is available at: http://www.firesymposium.arwi.us/

- The California Forest Soils Council Summer Utramafics Field Tour will be held on June 20st-22nd in Plumas County. For additional information, see: http://www.caforestsoils.org/

- The Northern California and Southern California Society of American Foresters 2014 Summer Meeting will be held on August 22-23, 2014 at the Black Oak Casino Resort, Tuolumne. The meeting will feature a tour of the 2013 Rim Fire, including discussion of fire science issues, water quality and quantity, and salvage logging. Additional information and registration for the meeting will be available at: http://norcalsaf.org/

- The California Licensed Foresters Association (CLFA) Fall Workshop on the new road rules, "The Road Network Through Our Forests," will be held in Chester on September 25, 2014, with a field day on September 26, 2014. More information will be posted at: http://www.clfa.org/

- State Board of Forestry and Fire Protection Meetings: April 8-9, Sacramento; May 13-14, Riverside; June 17-18, Sacramento (6 weeks between meetings in 2014). A complete list of meeting dates in 2014 is available at: http://bofdata.fire.ca.gov/board_business/2014_board_meeting_dates/2014_schedule.pdf

- Richard Gienger announced that there will be a Klamath Fire Ecology Symposium on April 15-17 in Orleans, CA. For more information, see: http://www.mkwc.org/programs/fire-fuels/klamath-fire-ecology-symposium/

- Richard Gienger announced that the Redwood Forest Foundation, Inc. (RFFI) will have a workshop on April 23rd (location TBD) addressing fish survey results and the Baker Creek off-channel habitat improvement project in the Mattole River watershed. For more information, see the RFFI website at: http://www.rffi.org/index.html.

Logging and Turbidity in the Coastal Watersheds of Northern California—Updated Information

Mr. Randy Klein, RNSP (retired), provided a PowerPoint presentation titled "Logging and Turbidity in the Coastal Watersheds of Northern California: A Regional Analysis of Watershed Disturbance and Water Quality." The PowerPoint is posted on the Monitoring Study Group Archives website at: http://www.bof.fire.ca.gov/board_committees/monitoring_study_group/msg_archived_documents/. Mr. Klein began by providing a brief history of the research that led to publishing the paper by this title, along with coauthors Jack Lewis and Dr. Matthew Buffleben, in Geomorphology (the paper is posted at: http://www.stopclearcuttingcalifornia.org/bca/research/Logging%20and%20Turbidity%20Klein%202011.pdf). The initial research was submitted as a report for the USEPA in 2003.

The primary question investigated was why many North Coast streams exhibit chronic turbidity. Mr. Klein and his co-authors undertook the study to identify the most important causal factors affecting stream turbidity in this region. Similar to the process used to develop flow duration curves, they used the turbidity level that was exceeded 10% of the time over the winter months (i.e., 10%TU) to index chronic turbidity. They regressed 10%TU on a set of natural and human-driven factors to attempt to answer this question. Mr. Klein summarized the reasons why chronic turbidity can have serious impacts on anadromous salmonids (site feeders, reduced food intake, smaller fish, reduced ocean survivability). Examples of different turbidity levels were shown for Prairie and Jacoby Creeks in Humboldt County and the turbidity threshold sampling (TTS) procedure was briefly summarized (for more information on TTS, see: http://www.fs.fed.us/psw/topics/water/tts/). This methodology was stated as producing very accurate storm suspended sediment load estimates. Plots of turbidity and discharge were displayed for Jacoby Creek, as well as turbidity for Prairie Creek and Elk River stations with differing levels of harvesting intensity. Upper Prairie Creek and Little South Fork Elk River, reference watersheds, were shown to have much lower turbidity levels than basins with more harvesting (see Peter Manka's 2005 MS thesis for Elk River data; http://www.krisweb.com/biblio/hum_hsu_manka_2005_elksediment.pdf).

Mr. Klein stated that the regional turbidity study published in Geomorphology included data from 28 North Coast watersheds. They were placed into harvest rate categories, including pristine (never harvested), legacy (no harvest since 1990), low harvest (<1.4% clearcut equivalent area (CCE) 10–15 yrs earlier), and high harvest (≥1.5% CCE 10–15 yrs earlier). Five of the watersheds were in the pristine grouping, 8 in legacy, 7 low, and 8 high. Geographically, the watersheds ranged from Little Jones Creek (granitic) in Del Norte County south to four Garcia River tributaries in southern Mendocino County. Drainage areas ranged from 28.1 mi^2 for Freshwater Creek at Howard Heights Bridge to 1.1 mi^2 at South Fork Wages Creek above Center Gulch. Turbidity data were available for one or more years from 2003-2005, and in all cases for 2005. Data were collected for 30 variables to regress against turbidity values, including natural watershed variables (e.g., drainage area, slope, stream density), basin-wide road characteristics (e.g., road density), and data from THPs (e.g., CCE, 1990-2004; CCE, 1995-2004; seasonal roads constructed 1990-2004). Silvicultural prescription weighting factors for determining CCE were obtained from the North Coast Regional Water Quality Control Board (e.g., clearcut =1.0, selection = 0.50). Mr. Klein stated that these factors are generally reasonable, but that they could be improved with satellite data. He stated that they were surrogates for the canopy cover remaining following timber harvesting.

The results for water year 2005 were displayed in a table that showed turbidity values (in FNU or formazin nephelometric units) at specified exceedence levels, as well as cumulative hours above specified turbidity levels for the 28 watersheds. Two analyses were conducted; one for the complete data set and one for just Humboldt County streams. The cumulative hours above 25 FNU was very high for many watersheds in the high harvest category, as were the 10%TU values. More naturally erodible watersheds were located in

Humboldt County and considerably more sensitive to logging disturbance, but Mr. Klein stated that it was difficult to quantify this factor. Geologic variables for rock strength were considered (e.g., distance from the Mendocino Triple Junction, reflecting uplift rates) but they were ultimately not used in the analyses run. SINMAP (Stability Index Mapping, modeling used to evaluate landslide risk at a basin scale) was included but not found to be a significant variable. Assistance from the California Geological Survey to improve this aspect of the study for future analyses was suggested.

A bar chart was used to display turbidity durations for WY 2005 at different turbidity values (e.g., 25, 50, 1000 FNU). The watersheds with the highest turbidity duration values were shown on the left, and those with the lowest values on the right. The pristine basins were displayed at the far right end of the chart, followed by legacy, then low harvest rate, and high harvest rate, moving from right to left. Drainage area was found to be a significant variable in one the analyses run on the dataset. Plots of predicted 10%TU for all streams vs. observed 10%TU for all streams and just Humboldt County streams were also displayed based on the multiple regression results. For all the streams (except Canoe Creek which had extensive wildfire impacts in 2003, n=27), the adjusted multiple regression equation explained 63% of the variability ($r^2 = 0.63$) using the CCE 10-15 and drainage area variables. For just the Humboldt County streams (n=19), the regression equation explained 82% of the variability using the same two predictors. The North Fork Elk River station data points were very close to the predicted values for both plots. A photo of the Bridge Creek watershed located in Redwood National Park was shown from 1977 (before Park expansion), illustrating poor legacy logging practices at that time. Substantial recovery since that time has occurred at Bridge Creek, greatly reducing the threat to water quality. “Legacy” watersheds in this study (i.e., no harvest since 1990), similar to Bridge Creek had low 10%TU values.

A jitter plot was used to display 10%TU values for the pristine, legacy, low, and high disturbance categories; data from both 2004 and 2005 were plotted. Some overlap between categories was present. Nonparametric permutation tests showed that the low category was significantly different from the legacy category, but only by a small amount; the other categories were highly significantly different from one another. Grouping the sites by timber harvest history showed that the pristine group mean was 8 FNU at the 10% turbidity exceedence level in WY 2005, while the legacy harvest, low, and high harvest rate group means were 16, 32, and 61 FNU, respectively. Mr. Klein discussed possible reasons why road variables were not significant in the regression equations generated for this study. These included the considerable road improvement work conducted in the past 20 years and the incomplete road data derived from THPs and USGS maps. The relative predictive strength of different variables was displayed in several bar charts. Simple correlation between individual variables and 10%TU showed that canopy variables out performed road variables (i.e., road variables had poorer predictive capability). The CCE 10-15 variable was only slightly better than the CCE 0-15 variable. Once the drainage area (DA) and CCE 10-15 factors were utilized in the predictive models, the road variables were shown to add very little to the predictive capability of the regression equations.

Possible mechanisms for the importance of harvest rates over road variables were discussed next. Root decay rates and changes in hillslope hydrology were listed as possible reasons why changes in canopy levels can influence chronic turbidity values. Mr. Klein stated that while this study has been criticized for not taking a mechanistic approach, it was not possible to use this method for 28 watersheds. Results from experimental watersheds such as Caspar Creek were relied upon (e.g., root strength/landsliding, changes in peak flows/gullying) and applied elsewhere (not at the same magnitude, but similar mechanisms were used to explain the results observed). Mr. Klein stated that his recent field visit to the Elk River watershed coordinated by Humboldt Redwood Company’s Mike Miles revealed far more benign practices currently in use by HRC. Numerous photos were shown illustrating these practices (e.g., group selection, road decommissioning work). Newer BMPs appear to be reducing water quality impacts in this basin, but Mr. Klein stated that effectiveness monitoring should rely on turbidity measurement over hillslope observations, since hillslope erosion features such as rills do not last long and are hard to quantify.
Current high rates of timber harvesting were then displayed for the Maple Creek watershed in Humboldt County; Maple Creek flows into Big Lagoon north of Trinidad and has a watershed area of approximately 47 mi^2. Data from a recent Green Diamond Resource Company report (House et al. 2012; see: http://www.greendiamond.com/responsible-

forestry/california/reports/Review%20of%20GDRCo%20Timber%20Harvest%20June%202012.pdf) were displayed, illustrating a 3% annual harvest rate, placing Maple Creek in the high harvest category used for the Klein et al. (2012) chronic turbidity study. Data from two turbidity monitoring stations in the Maple Creek watershed are presented in the House et al. 2012 report, but were not available to Mr. Klein for his study. Mr. Klein stated that he expects fairly serious water quality impacts to occur in this watershed in the future. Mr. House, in attendance, however stated that the 10%TU values for the main stem Maple Creek and North Fork Maple Creek for WY 2005 were only 18 and 25 NTU, respectively, and that these values are comparable to those in the legacy-low categories in the Klein et al. 2012 study.

Mr. Klein finished his presentation by displaying a figure with 10%TU data for all the stations in his study with data available (n=13) for water years past 2005 (water years 2000 to 2013 are shown, but data were not available for many of the stations for several of these years). This new data shows that high 10%TU values for watersheds with high harvest rates for WY 2005 remained high for the other water years, and that similarly, low 10%TU values for low harvest rate streams remained low for other water years (i.e., there was high persistence in the data through time). South Fork Elk River had the highest 10%TU value recorded, 333 FNU for WY 2006 (NF Elk was ~150 FNU). Since 2007, South Fork Elk River and North Fork Elk River turbidity values have been much more similar. Mr. Klein's overall conclusion remains that despite much improved best management practices, contemporary timber harvest can trigger serious water quality impacts when too much of a watershed is harvested over too short a time period.

Results from a Decade of Monitoring in the Elk River and Freshwater Creek Watersheds

Mr. Jack Lewis, USFS PSW (retired), provided a PowerPoint presentation titled "Results from a Decade of Watershed Monitoring in Elk River and Freshwater Creek, Humboldt County, California." The PowerPoint is posted on the Monitoring Study Group Archives website at: http://www.bof.fire.ca.gov/board_committees/monitoring_study_group/msg_archived_documents/. Mr. Lewis's report titled "Salmon Forever's 2013 Annual Report on Suspended Sediment, Peak Flows, and Trends in Elk River and Freshwater Creek, Humboldt County, California" is posted at: http://www.naturalresourcesservices.org/projects/elk-river-and-freshwater-creek-sediment-monitoring-project. He began by saying that the reasons for presenting this information at the MSG meeting were (1) involvement in Salmon Forever monitoring and data analysis for four stations in these two watersheds, (2) co-author of the Klein et al. (2012) report, and (3) apparent contradictions that were raised in the Sullivan et al. 2012 report, posted at: http://www.mrc.com/wp-content/uploads/2012/01/HCP_Turbidity-Trends-Report_SFS1.pdf).

Mr. Lewis stated that he computed the regressions in Table 16 of the HRC report from the data in Appendix B of the Sullivan et al. (2012) report, plotting harvest rate and 10%TU values (log transformed). He found that the statistics matched closely. The effect of 10-15 year harvest rate on 10% turbidity was plotted and shown to be positive for the individual years from 2003-2011. The coefficients were not significant in most cases but it was noted that the sample sizes for individual years were smaller than that in the regional data set analyzed by Klein et al (2012). Sullivan et al. (2012) reported a negative overall relationship between CCE10-15 and 10% turbidity exceedence with the full dataset (2003-2011, although when just water year 2005 was analyzed, they did find a positive relationship). Mr. Lewis explained that HRC staff used a mixed effect model for 10% exceedence turbidity with two fixed variables and two random variables (site and year). He was able to reproduce their model's results closely. He then developed an alternative model omitting the "site" random effect, but retaining "year" and found that the CCE 10-15 coefficient went from -3.270 to +7.039. In other words, without the site random effect, CCE10-15 has a positive coefficient that is highly significant. Mr. Lewis added that if removing an effect flips the coefficient of another, it means that the two variables are correlated and confounded. In this case, the effect of location (site) is highly correlated to CCE10-15. He explained that the sign of the coefficient is dependent on the inclusion of the site random effect because some of the watersheds experienced a narrow range of harvest rates during the study period. He informed the group that if the fixed effects being investigated are correlated with a random effect, the random effect should be left out of the model for correct interpretation of the coefficients.

The effect of 10-15 year harvest rate was also analyzed four years at a time. The CCE 10-15 coefficient was positive and significant for each four-year period. A decreasing trend in the coefficient was not tested for significance, but suggests that more recent harvesting methods (e.g., group selection) are having a lower impact on turbidity levels. Reasons why harvest rates 10 to 15 years earlier are a key variable for explaining turbidity were listed as: (1) additional water available (up to 50% due to reduced interception loss and evapotranspiration—see Reid and Lewis 2007, Dhakal and Sullivan 2014), reducing pore water pressures and increasing the potential for landsliding, and (2) coast redwood root biomass dieback (live root biomass [<25 mm size] is lowest 10-15 years after harvest [Ziemer and Lewis 1984—unpublished report, also Appendix A in Lewis and Klein 2014—Comments on the Draft Elk River TMDL].

The four Salmon-Forever gaging stations monitored in the Elk River and Freshwater Creek watersheds were then described. In the Elk River watershed, the South Fork (SFM) station has a drainage area of 19 mi^2 and the North Fork (KRW, Ms. Kristi Wrigley's parcel) station has a drainage area of 22 mi^2. In the Freshwater Creek basin, the Upper Mainstem (FTR, Dr. Terry Roelofs parcel) and Lower Mainstem at Howard Heights Bridge (HHB) stations have drainage areas of 13 and 28 mi^2, respectively. Mr. Lewis showed a map displaying the location of the Elk River stations in the watershed, as well as maps displaying landuse types and geologic terrains in the basin. Much of the upper basin is underlain by the erodible Wildcat Formation. Similarly for the Freshwater Creek watershed, a map with the locations of the two monitoring stations was shown, as were maps displaying landuses and bedrock geology (dominated by the Hookton, Wildcat, and Franciscan Formations). Continuous recording turbidimeters are installed at all the stations and turbidity threshold sampling (TTS) is utilized. A typical stage and turbidity record for two storm events was shown for station SFM in water year 2008. Mr. Lewis provided figures illustrating how it is possible to convert turbidity to suspended sediment concentration (SSC in mg/l). The sediment load is the sum of the products of discharge and SSC for each 10 minute period. The annual sediment load is estimated by adding the storm loads and the inter-storm loads (inter-storm loads are estimated using an annual regression of SSC on turbidity, or when necessary, a standard sediment rating curve). This process was illustrated for the SFM station. Annual suspended sediment loads were displayed for the SFM, KRW, FTR, and HHB stations, as well as for the Jacoby Creek and Little South Fork Elk River stations, for water years 2003 to 2013. The South Fork Elk River station (SFM) consistently had the highest annual sediment loads.

Multiple regression and scatterplots were used to explain as much variation as possible for the data collected at the four stations in the Elk River and Freshwater Creek watersheds, and then to evaluate trends in the datasets. Dependent variables included storm event peaks, storm event sediment loads, storm event mean SSC, and instantaneous SSC. Predictors used included rainfall totals and an antecedent precipitation index (API), time, responses at other watersheds, and related responses from the same watershed. For storm peak flow, the log of 6-hr maximum flow was used instead of instantaneous peak flow. Multiple regression equations for storm peak flow explained 51% and 49% of the variability for the SFM and KRW stations, respectively. Plots of KRW, SFM, and FTR peak model residuals from 2003 to 2013 show no statistically significant trends for these stations. Mr. Lewis's conclusion was that current management is neither reducing peak flows nor increasing them. For the HHB Freshwater Creek station, there is a significant upward trend in peak flows (~25% higher for the 6-hr peak flow), but Mr. Lewis stated that he is skeptical that this actually occurred; it could be due to channel aggradation at this station. He added that this does not mean that there are not increased peak flows associated with timber operations in small headwater basins.

The response variable for the storm event sediment load regression models was the log of storm event load; the predictors were storm event flow volume (log or square root [sqrt]) and storm event peak flow (log or sqrt). Square root transformations were found to be slightly better than log transformations. A plot of predicted sediment load vs. observed load for the KRW station was displayed based on the multiple regression results. The equation explained 88% of the variability (r^2=0.88). A plot of predicted sediment load residuals and percent deviation from the mean revealed that there was a significant downward trend from 2006 to 2008. Similar plots for SFM were shown. In this case, the equation explained 87% of the variability and there was a significant upward trend from 2008 to 2013. In the Freshwater Creek watershed, the multiple regression equation explained 92% of the variability for both the FTR and HHB stations. There was suggestion of a downward trend in storm event sediment loads for station HHB from 2008 to 2013.

Significance tests for trends in storm event loads showed, however, that the only two statistically significant trends were for SFM (2008-2013, increase), and KRW (2006-2008, downward).

The response variable for models used for instantaneous SSC prediction was the log of SSC, with the predictors being the log of simultaneous discharge and hourly API. A plot of SSC vs. discharge for a storm event at station SFM showed hysteresis caused by depletion of transportable sediment during a storm event, as well as higher rainfall intensity during the rising limb of the hydrograph and reduced intensity during the falling limb. Use of an API in the model addressed this issue. The regression equations used to predict SSC for SFM explained 62% of the variability with log(Q), and increased to 70% after adding the API variable, while those for the KRW station explained 73% of the variability with log(Q) and 82% after adding API. Plots of predicted SSC residuals and percent deviation from the mean for the two Elk River stations from 2003 to 2013 (missing years 2009, 2010, 2011) showed that SFM had a statistically significant downward trend from 2006-2008 and a significant upward trend from 2008-2013, while the KRW station had a significant downward trend from 2006-2008. There were no statistically significant trends for the Freshwater Creek stations for water years 2003-2011 (missing years 2009 and 2010). Overall, Mr. Lewis stated that there was very little change in overall SSC trends for these two watersheds from 2003-2013 (i.e., not much evidence of declining or increasing SSC values).

Mr. Lewis next presented his analyses for Elk River and Freshwater Creek cross-sections. Aerial photographs of the cross-section station locations in both watersheds were shown. In Freshwater Creek, 12 cross-sections have been surveyed at least twice since 1999. In the lower Elk River, 10 cross-sections on the main-stem, 14 on the North Fork, and 10 on the South Fork have been measured at least twice since 2001. In the NF Elk River basin, there have been five surveys from 2001-2011. Two examples were displayed in which cross-sections were measured five times in the NF Elk River from 2001-2011. In the first example, approximately one foot of aggradation occurred, mostly on the side bank of the channel. In the second example, there has been approximately two feet of aggradation on the channel bed. Cumulative infill over a decade for the Elk River mainstem cross-sections has ranged from 0 to ~100 ft^2, for the North Fork above the confluence 0 to ~130 ft^2, and for the South Fork 0 to ~120 ft^2. In the Freshwater Creek basin, some of the cross-sections have scoured, while the Howard Heights Bridge cross-section has aggraded ~80 ft^2. The average infill for all the Freshwater Creek cross-sections is considerably less than in the Elk River watershed. Mean aggradation for all Elk River cross-sections has been 0.76 foot in a decade.

<u>Overall Elk River findings were listed as</u>: (1) SFM has consistently had the highest sediment loads of streams monitored in the Humboldt Bay region; in most years, KRW is a distant second; (2) aggradation continues at most cross-sections in lower Elk River, often exceeding 1 ft or 100 ft^2 for the decade: SF > NF > main; (3) no trends in peak flows were detected at either gaging station (Class III watercourses are likely different, but no data were available for analysis); and (4) both Elk River stations saw a decline in storm event loads and SSC prior to 2008, followed by an increase in 2011 (in 2013, SFM increased to 35-37% above the mean). <u>Overall Freshwater Creek findings were listed as</u>: (1) Freshwater Creek loads are less than those in Elk River; at FTR the unit area loads are 30-60% higher than downstream at HHB; (2) while there is less information, there is apparently less aggradation than in Elk River (we know decadal change only at Howard Heights Bridge, where infill has been 80 ft^2 or 9 inches in 11 years); (3) no trends in peak flows were detected at the FTR gaging station while the change observed at HHB was likely due to infill and undocumented shifts in the discharge rating curve; and (4) no significant trends in SSC or loads were observed for the whole period, but HHB loads may have declined after 2005.

The Sullivan et al. (2012) report findings were stated as being contradictory to Mr. Lewis's Salmon Forever findings, particularly in regard to the point that there have been statistically significant decreases in sediment parameters from 2003 to 2011. Mr. Lewis informed the group that it is not correct to state that there has been no deposition within the lower reach of the SF Elk River since 2000. In the Sullivan et al. report, there are two analyses of trends, divided into "event" years and "non-event" years, and an erosivity index is calculated and plotted over time. Mr. Lewis described how using multiple regression is a better approach. He said that a significant interaction between site or watershed and time would mean the trends vary by location. That none was detected by Sullivan et al. may be related to a sample size that was reduced by splitting the data set, or a rejection level that was lowered to p=0.0125. He cautioned that failure to detect an effect does not imply no effect. Sullivan et al.'s (2012) conclusions from the HRC trend analysis include: (1) regression analysis with all sites combined showed significant negative trends for both sediment yield and 10% turbidity, (2) the interaction of time and location was not statistically significant, and (3) no further regressions were done, but partial correlation analysis detected no significant time relationships for Elk or Freshwater as a whole or any individual sites except 528 (Little FW).

Mr. Lewis's new analysis of this dataset did not divide the data between "event" and "non-event" years, and the Erosivity Index was used as a covariate when it explained more variability than annual flow peak. The data were plotted to reveal trends, and Freshwater Creek and Elk River were analyzed first together and then separately, rather than relying on a borderline significant interaction to decide whether they are the same. The new mixed effects model was found to explain a considerable amount of the variability. Analyzed in this manner, Mr. Lewis stated that Elk River alone does not show a decreasing trend in sediment yield, while Freshwater Creek does show a considerable decline.

Mr. Lewis stated that while we have a long enough record to begin to identify trends in watershed responses, it will take longer before trends may be attributed to recent management changes. Regarding monitoring, he recommended: (1) funding Salmon-Forever to bring their analyses up-to-date; continuing cross-section measurements and stream gaging; (2) sharing and pooling data with HRC and GDRC; (3) improving access and continuing monitoring of Little South Fork Elk River (Headwaters), or (4) establishment of a more accessible control watershed where logging will not occur (it need not be pristine or large, as long as its responses are well-correlated with other watersheds in the basin).

Three management-related hypotheses were presented: (1) management is now benign and the monitoring reflects it (Lewis: maybe in Freshwater, not in Elk River); (2) management is now benign but it will take more time for the monitoring to reflect it (Lewis: plausible); and (3) management has not improved enough or is still being applied over too much area (Lewis: may depend on how harvest rates are calculated and reported). For example, harvest history data from 2005 through 2011 from the HRC report shows that harvest rates in the Elk River watershed are below 1.5% clearcut equivalent area (CCE), and approximately 2% for the Freshwater Creek basin. In contrast, CCE data compiled by Randy Klein and Adona White, NCRWQCB, are higher for these watersheds over this time period.

Mr. Lewis concluded by stating that forest managers in these watersheds should be cautious until improvements are measurable in the Elk River watershed. Management recommendations to lower watershed impacts from timber operations included: keep out when roads and soils are wet; limit canopy removal and keep openings small; avoid the most unstable areas; minimize ground disturbance, especially near stream channels and maintain soil cover; reduce the frequency of reentry; and be selective/smart when fixing legacy issues.

Points brought up during the discussion period included: (1) the need for more data on landslide rates and linkages to management practices; (2) reasons for high anadromous salmonid fish numbers in Elk River and Freshwater Creeks (including the advantages of Humboldt Bay Estuary for rearing), and the need for a life cycle monitoring station on Elk River; and (3) problems with aquatic habitat due to low dissolved oxygen (DO) levels, duckweed propagation, and excessive vegetation in the channel.

Other MSG Agenda Items (FORPRIEM, AB 1492 Report, VTAC Pilot Projects/Public Comment)

Due to the length of the two presentations for this MSG meeting, updates on CAL FIRE's FORPRIEM monitoring, the AB 1492 Report/Effectiveness Monitoring Committee, and the VTAC pilot projects were not provided. **These topics will be covered at the next MSG meeting.** There was no public comment.

Next Monitoring Study Group Meeting Date

The next MSG meeting date is tentatively planned for June or July 2014, with the location to be determined. When a definite date, venue, and agenda are available, this information will be emailed to the MSG contact list.