

Attachment B

Response to Public Comments on the Draft Cleanup and Abatement Order

The Draft CAO was released for public review on 23 January 2009. The public comment period closed 67 days later, at 8:00 a.m. on 1 April 2009. The adjudicatory team extended the public comment period for the US Forest Service and the California Department of Parks and Recreation, OHMVR Division to 3 April 2009. Written comments were received from 18 organizations within the comment period. Staff also received 121 separate letters from individuals and about 3,700 form letters from individuals. In addition, the Friends of the Rubicon comment package included 1,643 signed affidavits from Trail users. All comment letters have been posted on the Water Board website.

Responsible Parties (Discharger) Comments

El Dorado County has submitted three comments letters. Staff has made numerous changes to the CAO's Findings to reflect the County's comments. El Dorado County also submitted extensive legal comments that are addressed in the staff report.

The U.S. Forest Service, Eldorado National Forest, has submitted two comment letters. The Forest Service requested more clarity on the wet weather vehicle use reduction plan (now the *Saturated Soil Vehicle Restriction Plan*) and its relationship to the Operation and Maintenance (O&M) Plan, and definitions of terms used in the CAO. These issues have been addressed. Legal issues are discussed in the staff report.

General Comments

Most commenters discuss the uniqueness and importance of the Rubicon Trail, speaking either to its value as one of the most scenic and challenging off-highway vehicle (OHV) trails in the world, or to its ecological value in providing habitat for rare plants and animals. Many write about the special significance of the Rubicon Trail to them, their families and friends.

Staff is very appreciative of the many commenters expressing the desire to devise solutions that appeal to all the interests groups who value this resource.

Trail Closure / Seasonal Closure

1. Water Board staff received many comments requesting that the CAO address closing the Rubicon Trail until a full environmental review is conducted and appropriate management measures are taken to avoid, mitigate, and minimize impacts from future motorized use of the Trail. Additional commenters requested staff to require wet weather seasonal closures (such as that adopted by the Eldorado National Forest under the Eldorado National Forest Travel Management Plan) since wet season use of native surface trails is particularly damaging and contributes heavily to the sediment discharge.

Staff also received many passionate comments in support of keeping the Trail open year-round. Commenters stated that there is no evidence which suggests a reduction of OHV usage during winter months would result in a reduction of sediment discharge. Commenters also pointed out that a decline of OHV usage naturally occurs in the winter months.

Response: Staff does not propose to close the Trail on a year-round basis. However, staff agrees that additional management is needed during the wet season to protect

water quality. Therefore, the CAO requires that the Responsible Parties prepare a *Rubicon Trail Saturated Soil Water Quality Protection Plan* addressing the water quality impacts caused by vehicle use (excluding snowmobiles) during saturated soil conditions and during over-the-snow travel. Whether or not the Trail will be closed during the wet season, or how it will be closed, will be described in the Plan.

Staff included this requirement in the CAO for several reasons:

- 1) Eldorado National Forest has implemented seasonal closure of their non surfaced roads and trails to protect water quality;
 - 2) Other national forests working on their trail management plans have also included seasonal closures as options in their NEPA documents;
 - 3) Staff has observed water quality impacts from use of native surfaced roads and trails during saturated soils conditions; and
 - 4) Eldorado National Forest allows OHV users to drive over-the-snow on unplowed, paved roads during the winter. Therefore, a seasonal closure of the Rubicon Trail should not prohibit OHV activities in other areas of the Eldorado Forest during the winter.
2. Staff received comments requesting restriction of vehicle traffic during the summer.

Response: To date, there has been no accurate, accepted, survey of the number of users of the Rubicon Trail. The Responsible Parties are required to develop a *Long Term Management Plan* that includes a vehicle survey as well as an assessment of the need for a permitting system for OHV users. If the *Long Term Management Plan* shows that the Trail can not support the current number of users without adversely impacting water quality, staff would then work with the Responsible Parties to explore additional measures needed to protect the resources, including additional drainage structures and protection measures, or reduction in the number of OHV users. No revisions were made to the CAO based on this comment.

3. Staff received comments that the Rubicon Trail should not be closed until similar issues on nearby highways (i.e. 50 and 80) are addressed.

Response: The CAO requires that the Trail be closed during saturated conditions until the Responsible Parties have an approved *Saturated Soil Vehicle Restriction Plan*. Staff appreciates the concern expressed regarding potential water quality impacts from state highways. Caltrans is regulated by a Water Board Municipal Storm Water Permit and required to develop a Storm Water Management Plan. One issue addressed in the Plan is potential water quality impacts from highway discharges. Caltrans submits annual reports to Water Boards documenting compliance with the permit as well as district workplans providing advance notice on proposed work. More information on the Caltrans storm water program can be found at: www.dot.ca.gov/hq/env/stormwater/.

Trail Assessment / O&M Plan

1. Water Board staff received comments regarding the requirement to complete a Trail assessment in the O&M Plan, and stated that the Trail assessment has been conducted by the California Geologic Survey at the request of El Dorado County and

the final report is due in April 2009.

Response: The CAO has been revised to reflect this comment.

2. Staff received comments that the CAO requirement to provide operating procedures to complete construction and maintenance of new Trail segments, crossings, drainage structures, decommissioning Trail segments and training volunteer groups are moot points because existing county and state construction and maintenance standards apply.

Response: The CAO requires operating procedures for construction and maintenance work so there will be standard, effective procedures available for all parties working on the Trail to follow. Staff recognizes the thousands of hours that OHV users groups have spent on trail maintenance, and the intent of this section is to assure that the volunteer work is completed following existing standards. If the current work done on the Rubicon Trail follows existing county and state standards, the Responsible Parties would only have to document this and include those standards in the operating procedures for the Trail.

User Counts / Permits and Fees

1. Water Board staff received several comments regarding a need to determine the user count and carrying capacity (or quota system) for the Rubicon Trail and to collect user fees to cover maintenance and management of the Trail.

Response: The draft CAO included the requirement for a permitting system for OHV users to determine use patterns. The CAO has been revised to explicitly require a user count. The establishment of user fees and a carrying capacity will be issues addressed as the Responsible Parties develop their Long Term Management Plan.

2. Staff received many comments on the CAO Findings regarding El Dorado County's traffic count for the Rubicon Trail. Commenters state that the County's estimated count of 35,000 vehicles per summer is too high.

Response: Information regarding the three user counts has been included in the Findings. However, Board staff understands that no one user count has been universally accepted. Because of the uncertainty regarding user count for the Rubicon Trail, staff has included an explicit requirement in the CAO for the Responsible Parties to obtain a user count (see response above). An accurate count of Trail users is necessary for the Responsible Parties to adequately manage the Rubicon Trail.

Human Waste Issues

1. Water Board staff received comments regarding the need for a human waste assessment on the Rubicon Trail to determine if site cleanup is necessary to reduce the pathogen and nutrient loads discharging to local waterways.

Response: The CAO includes a requirement to address human waste management on the Rubicon Trail and there has been an enforcement element added to the

requirements. No revisions were made to the CAO based on this comment.

2. Water Board staff received comments regarding the need for El Dorado County to adopt a local ordinance requiring Trail users to utilize individual human waste collection systems and to address the need for sanitation and human waste control.

Response: The Order requires the Responsible Parties to enforce the use of portable human waste collection devices and WAG (Waste Alleviation and Gelling) bags, if such devices prove to be critical to the implementation of a plan to manage the water quality issues associated with the Rubicon Train, and requires an evaluation of whether installing toilets along the trail is a viable option. The Order has been revised to include an annual human waste survey to determine the effectiveness of the human waste management measures.

3. Staff received comments stating that it is a moot point to request a human waste management strategy on the Trail because volunteers have been working for more than five years to communicate to users the importance of using portable human waste collection devices and WAG bags.

Response: Trail volunteers and County staff have provided human waste WAG bags free of charge to Trail users since 2003; however, the Responsible Parties have not initiated a program to enforce the use of WAG bags or to track their use to determine if voluntary individual human waste disposal methods are working. During our Trail evaluation in July and August 2008, Board staff observed multiple areas along the Trail with visible human excrement and toilet paper. The CAO was revised to require an annual survey to record the prevalence of human waste along the trail.

Monitoring

1. Water Board staff received several comments requesting that a Monitoring and Reporting Plan (MRP) be adopted within the CAO. The commenters requested a MRP which enables the Water Board to determine compliance with water quality objectives, the condition of receiving water beneficial uses, and the effectiveness of measures implemented to correct documented problems.

Response: The CAO requires the Responsible Parties to report on Trail use and maintenance activities annually following adoption of the CAO. Given the remoteness of the Rubicon Trail, the number of water bodies which cross the Trail, and the difficulties associated with timing runoff events, a monitoring program requiring in-stream sampling to determine compliance with water quality objectives would be very expensive. Staff believes that the resources would be better spent on drainage improvements and management of human waste and petroleum spills on the Trail.

However, staff supports the evaluation of site conditions through implementation and effectiveness monitoring of management practices similar to what has been used for management of native-surfaced rural roads and other non-point sources of pollution. In addition, the Water Board Executive Officer has the independent authority to issue MRPs. Therefore, a MRP does not need to be incorporated into the CAO at this time.

The Water Board Executive Officer can issue a MRP at a later date if there are indications that the Responsible Parties' *Long Term Management Plan* is not protective of water quality. No revisions were made to the CAO based on this comment.

2. Water Board staff received requests for the Responsible Parties to complete a sediment load assessment of Ellis Creek below the Rubicon Trail crossing to determine if sediment cleanup is necessary and to include a time schedule for the assessment.

Response: Staff believes that implementation of management measures and construction of the proposed bridge at this crossing would be the best use of available resources. No revisions were made to the CAO based on this comment.

3. Staff received comments on the need for testing transparency. Commenters requested that future water quality testing for sediment discharge, human sanitation, and petroleum-based fluids are completely transparent to the public. There are requests that an oversight committee, which includes all concerned user groups, should be established to ensure testing transparency.

Response: Staff supports working with a group such as the Rubicon Oversight Committee to involve the public in future water quality testing regarding the Rubicon Trail. The Responsible Parties may elect to develop a monitoring program as part of the *Long Term Management Plan*. No revisions were made to the CAO based on this comment.

4. Staff received comments that data from SMUD and PCWA indicate that the Trail is not adversely impacting water quality. The data was collected to relicense SMUD and PCWA's hydroelectric facilities with the Federal Energy Regulatory Commission.

Response: The intent of the SMUD and the PCWA monitoring is to evaluate whether their hydroelectric facilities are causing impacts to local water bodies. The monitoring locations are mostly within the reservoirs at the inflows and outflow from the reservoirs. The monitoring locations and timing of sample collection were not adequate for determining whether or not activities on the Rubicon Trail are impacting water quality.

5. Staff received comments that water samples taken from Spider Lake in July 2004 did not show impacts from human waste, and that human waste management does not need to be addressed in the CAO.

Response: Although the data was obtained during immediately before and immediately after a high-use period at Spider Lake, staff questions the timing of the monitoring and whether it adequately captures the impacts of the human waste in the watershed. For example, staff would have designed a monitoring program that would take samples of water bodies immediately after the first rains that caused runoff. There are also questions about the non-specific nature of the analyses in that they do not distinguish between human and animal waste.

Water quality monitoring to evaluate compliance with water quality objectives is

challenging for the Rubicon Trail because of its remoteness, the number of potentially-affected water bodies, and difficulties associated with timing runoff events. A human waste management program dependent on in-stream water quality monitoring data would be very expensive. No revisions were made to the CAO based on this comment.

Petroleum Spills

1. Water Board staff received comments regarding the need for the Responsible Parties to cleanup the petroleum product residues that pervade much of the area and are hazards to water quality. The comments include a request to complete monitoring for compliance and effectiveness.

Response: The Order includes a requirement to develop a process for cleaning up petroleum contaminated soils, and a requirement to conduct annual monitoring and reporting to assess the implementation and effectiveness of management measures. No revisions were made to the CAO based on this comment.

2. Water Board staff received comments regarding the Finding that low levels of oil and grease were identified in water samples collected on the Rubicon Trail. The commenters state that staff inappropriately relied on data from the Center for Regional Environmental Science and Technology (CREST) to make that finding. In 2005, CREST obtained water and soil samples on or near the Rubicon Trail and analyzed them for oil and grease as well as other constituents of concern. Commenters noted that the method of analysis employed by CREST for oil and grease would also measure decomposing plant matter, so the results do not specifically indicate the oil and grease levels in the water sample are due to OHV use on the Rubicon Trail.

Response: This sampling data is part of the draft EIR, which was extensively reviewed by El Dorado County staff (as documented by the ROC meeting minutes) before being released to the public. Regardless of the validity of this particular sampling program, based on staff's professional opinion, the numerous spills of petroleum products on the trail noted during our 2008 inspections have the potential to affect water quality. The Water Board is charged with protecting both surface and ground water quality, and therefore must protect against the potential discharge of oil and grease to the waters of the state. The CAO requires that oil and grease on the Trail be addressed.

Law Enforcement

1. Water Board staff received many comments regarding the need for the Responsible Parties to provide law enforcement on the Rubicon Trail to ensure the Responsible Parties' abatement efforts are not damaged by illegal use. Greater law enforcement presence was requested for areas used by both motorized and non-motorized users. Commenters also suggest that there need to be significant fines for illegal use and illegal dumping.

Response: Water Board staff added a requirement in the CAO for the Responsible Parties to determine how many law enforcement officers are needed along the trail and to provide adequate funding to support these officers.

Staff recognizes that there might be opportunities for the Responsible Parties to partner with the OHMVR Division through an interagency agreement or another formal designation to obtain additional law enforcement presence on the Rubicon Trail.

CEQA

1. Water Board staff received comments that the Water Board's adoption CAO would not comply with CEQA. One issue brought up is the potential to shift the environmental impact from the Rubicon Trail to other locations. The Rubicon Trail Foundation submitted 1,643 affidavits from Trail users that state they would move to another location to recreate if the Rubicon Trail was closed at any time of the year.

Response: The seasonal closures are consistent with nearby Eldorado National Forest closures of native surface trails. The extent of the closures that would be imposed by the Central Valley Water Board, should the Board choose to adopt the Order as proposed, would fall within the scope of several CEQA categorical exemptions.

Timelines

1. Water Board staff received comments stating that El Dorado County has used the Trail Management Plan and the Rubicon Oversight Committee as stalling mechanisms. The comments include a request that the CAO include firm timeframes for compliance with the requirements of the Order.

Staff has also received many requests to extend the deadline for the O&M Plan. Commenters state that the time frame proposed in the CAO does not allow adequate time to identify all sediment discharge issues or to implement solutions.

Response: Staff has revised the CAO to extend the deadlines for development of a *Long Term Management Plan* and includes interim deadlines for specific elements.

2. Staff received comments that the Central Valley Water Board should delay adoption of the CAO until the California Geological Survey's study is finalized.

Response: The CGS study will be an important tool for El Dorado County to prioritize projects for the Rubicon Trail and to document work completed. However, this study is not needed to demonstrate that there are ongoing impacts associated with OHV use on the Rubicon Trail; therefore, the study does not need to be completed prior to consideration of the Order. Staff understands that the study will be completed by late April. CGS has provided briefings of the study results to El Dorado County staff, and other interested parties including Water Board staff.

Public Meetings

1. Central Valley Water Board staff received numerous comments requesting a public meeting that is made available to all Rubicon Trail users and user groups. Specifically, commenters asked for staff's reasons for recommending issuance of the CAO.

Response: Cleanup and Abatement Orders are generally issued by the Executive Officer, without a public hearing. However, in response to the many requests for a

public hearing, staff has scheduled the CAO for consideration of adoption by the Central Valley Water Board at its April public meeting. The staff report was written to provide more clarification on our reasons for drafting the CAO. Staff will also present this information during the Board meeting.

Future Usage / Next Steps

1. Staff received comments asking what the CAO means for future usage of the Rubicon Trail.

Response: As part of the public hearing, the Regional Water Board has several options. The Board could adopt the CAO as proposed by staff, it could adopt the Order with changes based on public input, or it could not adopt the Order. Future usage on the Trail will depend on what the Central Valley Water Board does at its April meeting. If the CAO is adopted, future usage will also depend on the outcome of the *Long Term Management Plan*.

2. Staff received comments asking what the next steps are for the CAO.

Response: The next step is to bring the CAO to the Central Valley Board meeting. In addition, staff has committed to continue to work with all the stakeholders on resolving water quality issues on the Rubicon Trail.

3. Staff received many comments that any ongoing use should be limited to street legal vehicles in order to minimize erosion and subsequent waterway sedimentation. The commenters stated that non-street-legal vehicles tend to cause greater damage than street legal vehicles. Other commenters stated that the Trail should be restored to its original condition where street legal 4X4 vehicles are capable of traversing the Trail.

Response: The CAO does not address the use of non-street legal vehicles on the Trail. While staff agrees that non-street legal vehicles do have the potential to cause more environmental damage, they can also be driven in such a way to have less impact than street legal vehicles. Staff's understanding is that the main issue with the non-street legal vehicles that they are easily driven off the Trail and also can be used to widen the Trail by driving on the banks of incised areas. This is an issue that can be addressed with legal recording of the Trail and adequate enforcement, items that are required by the *Long Term Management Plan*.

4. Staff received comments that permanent, heavy duty, destruction resistant signs need to be erected at all Trail heads and many Trail junctions stipulating what recreational travel uses are permitted and which are prohibited. Also, substantial gates or barriers need to be erected to dissuade OHV users from utilizing areas that are off limits to their use.

Response: Staff will pass along this comment to the Responsible Parties for their consideration while developing their *Long Term Management Plan*.

5. Staff received comments stating that it would be most productive for the Water Board to

appoint a staff member to actively participate in the Rubicon Oversight Committee (ROC) meetings and observe the progress being made.

Response: Staff attended the ROC meeting in March 2009 and plans to continue attendance in the future.

User Participation

1. Staff received comments on how individual users and user groups can assist the Water Board in finding solutions to the challenges outlined in the CAO.

Response: Staff welcomes the participation and assistance of all interested parties in the public process for addressing the water quality issues on the Trail. Interested parties may work with organizations responsible for the Rubicon Trail by attending the Rubicon Oversight Committee (ROC) meetings.

2. Staff received many comments on the good work done by the users, with regard to human sanitation, sediment, and petroleum spill kits. These comments are often followed by a request to allow the Responsible Parties to work with the users and resolve the issues without a CAO, and without any closures of the trail.

Response: Staff appreciates the willingness and enthusiasm of users when it comes to tackling issues on the Rubicon Trail. There has been steadfast participation on the Rubicon Oversight Committee and many projects done by users on the Trail. While the users have worked successfully to secure grants and to leverage their own resources to do work on the Trail, staff is convinced that a CAO with firm deadlines is needed to ensure appropriate management of the Rubicon Trail. We appreciate the work that the ROC has conducted to date, but it appears that many of the toughest water quality issues still need to be resolved, and issuance of a CAO is a method to accomplish the resolution of these issues.

Economic Impact

1. Staff received comments on potential significant economic impact from even short closures of the Rubicon Trail.

Response: Staff appreciates that neighboring communities benefit economically from business associated with the Rubicon Trail users. The one "closure" option referred to in the CAO is for vehicle restrictions or reductions during periods of saturated soils. Staff has heard from users that the majority of users do not use the Rubicon Trail during these conditions. If the Responsible Parties were to restrict access during these times, it should only affect a very small number of users; therefore, it would have minimal economic impact on the nearby communities.

2. Staff received comments that an economic analysis is needed on the economic impacts of the CAO.

Response: The Water Board is not required to conduct an economic analysis for the issuance of a CAO.

Responsible Parties Oversight

1. Staff received many comments on the good work done by El Dorado County Department of Transportation (DOT) and its Deputy Director, Tom Celio. Specifically, commenters refer to the new restroom at Loon Lake, the County grant effort to purchase and hand out WAG bags, working through the Rubicon Oversight Committee, and the proposed bridges at Ellis and Gerle Creeks.

Response: Staff looks forward to working with Mr. Celio and the El Dorado County DOT on the water quality issues on the Rubicon Trail. Staff recognizes that the County has been working on environmental issues by initiating the Rubicon Oversight Committee, obtaining grants from the Department of Parks and Recreation, OHMRV Division and others. Staff also believes that timelines and an enforcement order are necessary to ensure that the County, as well as the Forest Service, continues working on the Rubicon Trail.

2. Staff received a number of comments pointing out that most if not all of the requirements in the CAO either have been addressed or are already earmarked with funding to be completed by late summer of 2010. The commenters state that this clearly shows that the County and USFS are effectively managing the Rubicon Trail and that a CAO is not needed.

Response: In developing the CAO, staff reviewed the Draft EIR and Rubicon Trail Management Plan. Staff is pleased that there is much agreement concerning the importance of the requirements in the CAO, and that the parties involved have started work on many of the items, but the Board must have enforceable deadlines in order to gain assurance that these measures will be completed as proposed. In addition, it is clear from discussions with the Responsible Parties that they need to develop a Long Term Management Plan which defines their responsibilities relative to each other.

3. El Dorado County commented that the Draft EIR and Rubicon Trail Master Plan were developed by the County's consultant and had not been vetted for legality. Staff received other comments that that El Dorado County's draft EIR and Rubicon Trail Management Plan are draft documents that were never adopted; therefore, staff should not refer to them in the CAO.

Response: Staff acknowledged that work on the draft EIR and RTMP had been stopped because of budget constraints. Although these documents were not formally adopted by the El Dorado County Board of Supervisors, they are products of a multiple-year planning process that, according to the Rubicon Oversight Committee (ROC) minutes, included review and comment by El Dorado County departments, including a review by County Counsel.

El Dorado County's comments are not consistent with information contained in the ROC meeting minutes. The minutes from each ROC meeting are written by County staff and approved by the ROC prior to being published on the web.

The July 2006 ROC minutes include the following statement, "...the Administrative Draft EIA (Admin DEIR) had been circulated to various County departments, including County Counsel, DOT and General Services." All the ROC minutes thereafter in 2006 contains a discussion regarding County review of the CEQA documents. The February 2007 ROC minutes contain the following, "...the unified set of County comments was being prepared and would be submitted to ESP in the next week. ESP would then provide the County with a revised Administrative Draft EIR which would be reviewed by the County. Following County review and approval of the revised Admin DEIR the Draft EIR would be released for the 45-day public comment period." The DEIR was released for public review in October 2007.

It would appear that the County reviewed the CEQA documents for more than a year and had extensive input to their development. It is appropriate to refer to these documents to supply the background information for the development of the CAO.

Sediment Study

1. General Comments. Water Board staff received extensive comments and criticisms on the Staff Report "Assessment of Sediment Delivery from the Rubicon Jeep Trail, Summer 2008" (Sediment Study or Assessment Study). This study was completed as a short-term, rapid assessment to determine the relative magnitude of water quality impacts from OHVs on the Rubicon Trail. Based on peer review from professionals in the field of hydrology and through review of comments provided, the Sediment Study was revised to provide a more comprehensive document.

There have been inquires regarding the impairment of fish habitat in the South Fork American River from activities on the Rubicon Trail. The Sacramento Bee article dated 28 January 2009 incorrectly stated, "Water Quality Control Board finds that erosion caused by vehicle traffic on the trail threatens fish habitat in the South Fork of the American River and its tributaries." In the CAO, we state that "This Trail intersects the head waters of Gerle Creek, Ellis Creek, and parts of the Rubicon River. Surface drainage is toward the south and west and is within the Middle Fork American River watershed, and via the Loon Lake diversions, also within the South Fork American River watershed."

The Central Valley Water Board protects the quality of all waters within the Region for all beneficial uses. The water bodies most impacted by the Rubicon Trail are Gerle Creek, Ellis Creek, Loon Lake, and the Rubicon River, and they are all as tributaries to the Middle Fork American River. The designated beneficial uses of the Middle Fork American River, as specified in the Basin Plan, are municipal and domestic supply, irrigation, stock watering, power, contact and non-contact water recreation, cold freshwater habitat, and wildlife habitat.

2. Staff received many comments regarding whether staff conducted water quality monitoring and how our rapid soil assessment can be linked to potential water quality impacts.

Response: Staff did not obtain water samples for our assessment. Our rapid soil assessment is a relative determination of sediment discharging from the Rubicon Trail into ephemeral and higher order streams. It is based on the thickness of the dust layer on the Trail and connectivity to streams. The results of the assessment indicate that there are likely dump-truck loads of sediment being delivered to surface waters from the Trail.

3. Staff received comments regarding the references to the Ziegler study done in Thailand in the rapid soil assessment. The commenter stated that the potential sedimentation values stated in the order are based on false assumptions. Actual sedimentation readings were not taken. Instead, the only real data taken was the surface area of the trail and depth of loose material. Rainfall rates were not taken into account or the fact that snow covers the Rubicon Trail during much of the wet weather season. The methodology of the Ziegler study does not conform to the realities of the rainfall and snowfall that takes place on the Rubicon Trail. In the Ziegler study, a rainfall at the rate of 90-120 mm per hour was used, which is 3.5 to 4.7 inches per hour. Rainfall at this elevated rate does not take place on the Rubicon Trail. Snow covered land will not have the same water sheeting as the non-snow covered area in Thailand.

Therefore, please do not use that study as a means of determining the amount of siltation created by rainfall. Documentation of the Ziegler study can be found at: [\[webdata.soc.hawaii.edu/hydrology/vita/papers/se21c.pdf\]](http://webdata.soc.hawaii.edu/hydrology/vita/papers/se21c.pdf).

Response: Depth duration frequency data from Loon Lake (i.e., 6,650 feet above mean sea level) show that the 1-year recurrence interval for a 1-hour duration rainfall is 0.37 inches per hour, or an order of magnitude less than the simulated rainfall rate used in the Ziegler study (Ziegler, et al., 2002). Kattelmann (1990) also states the following:

“Rainfall has occurred up to the highest elevations of the Sierra Nevada during winter, but the freezing level of winter storms generally fluctuates between about 1000 m and 2500 m. Even during the warmest storms, snowpacks above 2500 m rarely melt much because temperatures are close to freezing. Snow in the forest zone, particularly at elevations between 1500 m and 2000 m, can dramatically add to floods with melt from convection and condensation processes at temperatures of up to 15°C.”

The elevation of the Rubicon Trail ranges from 5400-7000 feet (<http://www.co.el-dorado.ca.us/rubicon/About.htm>). The freezing level of winter storms in the Sierra Nevada usually fluctuates between 3300-8200 ft (Kattelmann, 1990), and this causes a corresponding fluctuation in the depth and extent of snow cover over time. While we agree that seasonal snow cover can potentially influence the erosive force applied to the trail surface by rainfall impact and runoff, the Rubicon Trail is not strictly subjected to snowfall during the wet season. Given the fine-grained and uncohesive nature of the loose surface layer, snowmelt runoff would provide sufficient transport capacity to transport sediment on the Trail surface.

This suggests that the RJT is not solely within the snow zone. While we acknowledge

the differences in rainfall intensity between Thailand and the Sierra Nevada, we believe there is ample sediment transport capacity on the Rubicon Trail segments to mobilize the loose surface sediments.

Sediment transport capacity is not only a function of precipitation, but also of the characteristics of the trail. Surface erosion on a trail surface depends on the ability of road runoff to transport sediment (i.e., sediment transport capacity) and the availability of moveable sediment on the trail surface (i.e., sediment supply) (Luce and Black, 1999). Sediment transport capacity on a road or trail surface can be expressed by:

$$Q_s \propto k(\tau - \tau_c)^n \quad (1)$$

where Q_s is the sediment transport capacity of trail runoff, τ is shear stress, τ_c is the critical shear stress for incipient motion, and n is an exponent between 1 and 2 (Luce and Black, 1999). In turn, the shear stress of trail runoff is proportional to the length (L) and slope (S) of the trail so that:

$$\tau \propto LS^n \quad (2)$$

where n is an exponent between 1 and 2 (MacDonald et al., 1997; Luce and Black, 1999; Ramos-Scharron and MacDonald, 2005). Welsh found that the exponent for slope on OHV trails was approximately 1.8. Equations 1 and 2 indicate that longer and steeper trail segments have a greater capacity to transport sediment than shorter trail segments. While plots in Ziegler et al.'s study were subjected to much higher rainfall intensities, sediment transport capacity of road runoff was limited by the short length of the runoff plots (i.e., 12 feet long). The length of the Rubicon Trail segments are 24-125 times longer than the plots used in the Ziegler study.

In addition, the published literature indicate that road surfaces typically have saturated hydraulic conductivities under 0.12 inches per hour (Reid and Dunne, 1984; Luce and Cundy, 1994; Loague and Kyriakidis, 1997; Luce, 1997; Ziegler and Giambelluca, 1997). Given the amount of rainfall necessary to initiate trail runoff is the upper range of reported values for road surfaces (i.e., approximately 0.12 in hr^{-1}), the fact that this amount is exceeded on a yearly basis (0.37 in hr^{-1}), and the fact that the Rubicon Trail segments are relatively long, we posit that there is ample transport capacity to move the sands and silts comprising the loose surface sediments.

- Staff received comments regarding the following statement in Section 3.1 of the Sediment Study, "However, these trail segments are not the only segments delivering to waters of the state." The commenter states that other factors contributed to the observed sedimentation, and only the Rubicon Jeep Trail (and the Dischargers) is being noticed to provide abatement actions.

Response: The statement in Sediment Study reflects the fact that our rapid assessment survey was completed on approximately one mile of Trail. The Trail through El Dorado County from the Wentworth Springs Campground to the Placer County line is approximately eight miles long. Staff believes that there may be

additional Trail segments that deliver to waters of the state within the seven miles of Trail that was not surveyed; however, due to our rapid assessment timeframes, we only looked at one mile of the Trail and identified that seven segments of the Trail were determined to have hydrologic connectivity to the channel network.

Staff has also heard that there are other sources of sediment in the vicinity of the Rubicon Trail (i.e. forest service roads and landings) and is committed to working with interested parties to address those other sediment issues where appropriate.

5. Staff received multiple comments on the Sediment Study from Steve Kooyman, P.E., representing the El Dorado County DOT.
 - A) Mr. Kooyman commented on equation 1 stating that the authors elect to ignore the E_b component of the equation which can be a substantial sediment production from surrounding watersheds. **Response:** E_b is the baseline erosion rate of the trail surface in the absence of OHV traffic, and is related to the erodibility of the trail surface, trail gradient, and the force applied to the trail surface by rainfall, overland flow, etc. E_b can be relatively small when the trail surface is consolidated and/or armored because the trail surface can be resistant to the erosive forces of rainsplash, sheetwash, or rill erosion, or can be a substantial portion of total erosion when gullying, rutting, or extreme precipitation events occur. For the purposes of this short-term, rapid assessment, relative magnitude sediment production study, Water Board staff assumed the baseline erosion rate is equal to zero and the total erosion would be equal to the accelerated erosion due to motorized use of the Trail.

Using this assumption, the calculated erosion rate underestimates the total erosion rate.

- B) Mr. Kooyman states that the authors assume that 100% of the sediment production from the Trail calculated within this estimated formula is delivered to the waters of the state on an annual basis. This assumption is not based on hydrologic connectivity, in that, the sediment delivered to waters of the state are only connected during certain precipitation events. Therefore, a more thorough hydrologic analysis should be used to define the actual sediment delivery from the Trail versus the basic formula used within Attachment A [Sediment Study]. **Response:** Staff agrees that the sediment delivered to waters of the state are only connected during runoff events (including certain precipitation and during snow melt events), and the revised Sediment Study provides a new relationship to estimate the accelerated erosion (E_s) due to motorized Trail use. This new relationship includes variables that relate to characteristics of the disturbed soil body and the transport capacity of runoff on the trail surface. Sediment delivery was estimated for each hydrologically connected trail segment and annual sediment delivery was assumed to be 100% when the trail drained directly into the stream channel. For segments that did not directly drain into a stream channel (i.e., trail segments connected to the channel network via sediment plumes), sediment delivery was assessed using two scenarios: 1) no sediment delivery; and 2) 100% sediment delivery. These scenarios allow us to calculate a range of sediment delivery rates based on a best

case scenario (i.e., 0% sediment delivery) and a worst case scenario (i.e., 100% sediment delivery).

- C) Mr. Kooyman states that without rainfall there would be no hydrologic connectivity of sediment to surface waters, and an assessment of sediment load to surface water must be conducted during wet-weather conditions, not dry weather conditions as were present in August [when the Sediment Study field work was completed].

Response: The main premise of the Sediment Study is that following a study by Ziegler in northern Thailand (Ziegler et al., 2001; 2002), observed sediment delivery can be predicted using dust layer measurements. Figure 2 in the Sediment Study shows a one-to-one relationship between predicted and observed sediment outputs for six road plots subjected to simulated rainfall in northern Thailand.

- D) Mr. Kooyman states that the authors assumed the presence of overland flow from the Trail to surface waters of the state in estimating the annual sediment load. This assumption does not consider initial abstraction of the soils, the infiltration of precipitation, or the transmission losses from the runoff from the Trail prior to reaching the waters of the state. Therefore, it is the Departments contention that the infrequent low intensity rainfall conditions which are present along the Trail during the summer months produce sediment mobilization and overland flow transport conditions which result in sediment reaching the water of the state at fractions significantly less than 100% as assumed by the authors. More accurate sediment loading estimates must be calculated using rainfall and transmission loss variables and validated with measured or simulated sediment loads from the Trail to water of the state. **Response:** Staff stated in the Sediment Study that sediment delivery from OHV trails is inextricably tied to trail related runoff generation and redistribution processes. Like unpaved roads, we assume the hydrological impacts of OHV trails include: 1) a highly compacted trail surface, which results in a preponderance of Horton overland flow; 2) the interception of subsurface runoff by trail cutbanks; 3) the interception of surface flow at unimproved stream crossings; and 4) the lateral redistribution and concentration of this runoff by trail surfaces. We are not suggesting that sediment transport and deposition occurs entirely during the summer months, but throughout the year especially during snowmelt and extreme rainfall events.

- E) Mr. Kooyman states that the authors assume that the dust depth is directly related to the trail use, or 100% OHV, and that within this sediment supply volume the natural occurring dust layer volume is 0%. This assumption is extremely misleading and overestimates the amount of dust sediment volume generated by the OHV mechanical erosion and underestimates the amount of dust sediment created by natural erosive processes. **Response:** Staff agrees that the thickness of dust measured on the Trail surface was assumed to be 100% derived from OHV activity. Dust measurements ranged from 0 (rock, boulder, or bedrock) to 0.28 feet, with a median of 0.03 feet, and a mean of 0.04 feet. Overall, the distribution of dust depths was right skewed, indicating that the median dust depth was a better indicator of

central tendency than the mean. As a result, sediment production and delivery estimated were calculated using the median dust depth for the each trail segment.

F) Mr. Kooyman states that the author's assumption that the correlation between predictions and observed sediment yield for this study in the Sierras will have the same relationship as Ziegler's study using simulated rainfall in northern Thailand is a poor assumption since the authors did not make observations during rainfall events. The authors did not complete the same level of observation within the scientific standards of Ziegler's work hence, this assumption is not directly proportional, therefore false. Furthermore, the primary means of sediment transport is rainfall, the Sierras are a snowmelt driven watershed and northern Thailand is not. **Response:** Same response as 5C above.

G) Mr. Kooyman states that the methods used in the pebble count survey are not well documented. Could it be that the larger grain sizes upstream are due to different slopes of the channel where the samples were collected? Were samples collected using the same techniques and what about replications? Also, is this reach of Ellis Creek crossing a fish passage site for upstream spawning? The Department would recommend a more comprehensive fish passage/stream crossing analysis in regards to the impaired use issue. **Response:** Comments noted. The Sediment Study has been revised to include a better description of the pebble count survey completed at the Ellis Creek / Rubicon Trail wet crossing.

H) Mr. Kooyman states that Figure 5 in the Sediment Study presents the sediment production from staff's calculations relative to measured logging road sediment production. The authors concluded that this comparison validates the absence of drainage structures in the Trail. The conclusion has not been validated by similar studies, is inaccurate and is not representative of how sediment transport conditions happen in nature, and therefore are a poor means of evaluating the water quality impact of the Trail. The comparison of the Rubicon highly granitic erosive trail system to that of forested logging roads is a very poor comparison and is misleading, hence, the exaggerated 50-fold difference. The department would recommend using other OHV trail systems within California or Nevada which have similar watershed and user characteristics as the Rubicon Trail to complete a comprehensive comparison analysis. **Response:** Comments addressed in the revised Sediment Study.

6. Staff received multiple comments on the Sediment Study from Lance Clifford.

A) Mr. Clifford states that climate, particularly precipitation from rainfall, was not considered and that climate is a vital element of any predictive model for sediment production. **Response:** The revised Sediment Study provides clarification on the theoretical basis of the assessment methodology (see section 1.1). The assessment relies on a modification of Megahan's time dependent negative exponential model for surface erosion following disturbance (Megahan, 1974). The general form of Megahan's model has been validated in the western United States (ID and OR), the U.S. Virgin Islands, and Thailand. The model has also applied across a range of

lithologies, climates, and road types. The model is modified by staff to predict first year sediment production. The volume of loose sediment is used to represent the S_o variable as per the concepts proposed by Ziegler et al. (2002). The Megahan model does not consider climate, and only considers erosion as a function of time and sediment supply (S_o). Megahan (1974) and Luce and Black (2001) suggest that sediment production on a road surface is more sensitive to sediment supply than to rainfall erosivity. Climatic considerations and how they affect the relative accuracy of the estimate provided by the modified Megahan model are discussed in Section 4.2. Several experts in the field of road erosion are reviewing the theoretical basis of the assessment.

- B) Mr. Clifford states that the Agency has failed to substantiate overland flow.
Response: Overland flow was not witnessed in August. However, the presence of sediment plumes below the trail discharge points and deposited sediment in the channel network confirm that overland flow is generated on the trail surface, and that overland flow has sufficient capacity to transport sediment to the channel network. Like roads, OHV trails are capable of generating overland flow and erosion during relatively low intensity storms (i.e., $I_{30} = 10 \text{ mm hr}^{-1}$) (Welsh, 2008). Historical depth duration frequency data from Loon Lake suggest that this intensity is exceeded on an annual basis (Goodridge, 2000) (see revised Sediment Study section 4.2). Overland flow generation is also strongly controlled by trail length (Welsh, 2008). See comment 3.
- C) Mr. Clifford states that an R factor for the study area is not stated. **Response:** The R factor for the study area is approximately 10 (Renard et al., 1997), which is the same R factor for the study area where the Megahan model originates (Megahan, 1974; Renard et al., 1997). This is discussed in the revised assessment 4.1 and 4.2.
- D) Mr. Clifford considers the use of road erosion and hydrology literature as an inaccurate representation of OHV trail erosion processes. **Response:** Welsh (2008) suggests that many of the concepts from the road surface erosion literature are applicable to OHV trails.
- E) Mr. Clifford states that Kondolf and Wolman (1993) have nothing to do with determining “suitable” sediment size for spawning gravel. Mr. Clifford states that Yount and Niemi (1990) are used out of context. **Response:** Regarding Kondolf and Wolman (1993), please refer to Buffington et al. (2003) which states that:

“A general range of suitable spawning substrate is defined by Kondolf and Wolman’s (1993) data ...”

Regarding use of Yount and Niemi (1990), please refer to Frissell and Bayles (1996) which states:

“Repeated, chronic, persistent, or anomalously extensive but sometimes subtle alteration of the pattern of lower-magnitude processes, such as seasonal and diurnal patterns of river discharge, temperature, and sediment mobility, can have

more severe effects on the integrity and resilience of aquatic ecosystems and biota than large floods and other single-pulse, catastrophic events of much higher magnitude (Yount and Niemi, 1990).”

- F) Mr. Clifford does not find the use of “personal communication” as an appropriate reference. **Response:** “Personal communication” removed. However, Dr. Elliot’s comments are embodied in the WEPP: Road model, which predicts relatively high sediment transport through filter strips over decadal time scales.
- G) Mr. Clifford states that OHV trails have no cutbanks and do not intercept subsurface flow. **Response:** Staff acknowledges that OHV trails have no excavated cutslopes. However, incision of the trail over time can potentially expose restrictive layers in the soil profile (e.g. soil-regolith/bedrock interface), especially for hillslopes with shallow soils. In these cases, OHV trails are capable are intercepting subsurface water or preferential flowpaths. While the vertical faces of the trail footprint are not excavated cutslopes, they function hydrologically like a road cutslope.
- H) Mr. Clifford states that the Sediment Study misrepresents Megahan’s (1974) equation 2 (i.e., $E_t = E_b + E_s$). **Response:** Megahan (1974) states that equation 2 applies to a “severely disturbed site”. Megahan (1974) defines severe soil disturbance as a site with increased erosion hazard (h) and decreased surface cover (p). The Rubicon Jeep Trail fits Megahan’s description of “severely disturbed site” as it has an abundance of loose sediment on the trail surface (i.e., increased erosion hazard) and has little or no cover on the trail surface (i.e., decreased p).
- I) Mr. Clifford states that the Sediment Assessment does not acknowledge limitation of erosion models. **Response:** While staff tried to frame estimated delivery rates as relative estimates (i.e., see original Sediment Study objectives), we acknowledge that too much emphasis has been placed on the absolute values of the estimated sediment delivery rates. Estimates are best viewed as being “small”, “moderate”, or “large”. The revised Sediment Assessment places additional emphasis on the estimate being a first order approximation of sediment delivery, and estimates are given one significant figure as opposed to two. The relative accuracy of the estimates are discussed in Section 4.2.
- J) Mr. Clifford disagrees with staff’s criteria for determining hydrologic connectivity, and states that “utilizing these criteria, the Agency has listed nearly every natural feature surrounding the RJT as hydrologically connected. Mr. Clifford disputes that sediment can diffusely travel across hillslopes and deliver to the stream channel, or can deliver via unchanneled swales. **Response:** Staff disagrees with this assertion. The RJT was assessed from Loon Lake to Buck Island Reservoir. Hydrologically connected segments were generally confined to the stretch of trail between Ellis Creek and the FOTR stringer bridge (see revised Sediment Assessment Table 1). There are large portions of the RJT that are not hydrologically connected to waters of the state. Staff observed a diffuse sediment plume below segment 2 that traveled approximately 140 feet before reaching Ellis Creek. Coe (2006) documented sediment delivery via diffuse sediment plumes. La Marche and Lettenmaier (2001)

discuss the role of swales in connectivity. However, no connectivity was witnessed via unchanneled swales.

- 7) Jesse W. Barton, representing the Rubicon Trail Foundation, had several comments on the Sediment Assessment.
- A) Mr. Barton doesn't agree with the sediment delivery estimates from the Sediment Assessment. Mr. Barton states that the Sediment Assessment misused equation 2 (i.e., $E_t = E_b + E_s$) of Megahan's (1974) paper and that the study should have used an approach based on the equation 1:

$$E = f(h, p, f)$$

where E is the surface erosion rate, h is the soil erosion hazard, p is the protection afforded by cover, and f is the force applied by raindrops, overland flow, etc.

Response: Please refer to Megahan's (1974) discussion of erosion time trends at his study sites (pg 13).

"The foregoing suggest that's that variations in erosive forces (f) and protection (p) as defined in equation 1 did not cause the time trend."

The revised Sediment Study provides clarification on the theoretical basis of the assessment methodology (see section 1.1). The assessment relies on a modification of Megahan's time dependent negative exponential model for surface erosion following disturbance (Megahan, 1974). The general form of Megahan's model has been validated in the western United States (OR and ID), the U.S. Virgin Islands, and Thailand. The model has also applied across a range of lithologies, climates, and road types. The model is modified by staff to predict first year sediment production. The volume of loose sediment is used to represent the S_0 variable as per concepts proposed by Ziegler et al. (2002). The Megahan model does not consider climate, and only considers erosion as a function of time and sediment supply (S_0). Megahan (1974) and Luce and Black (2001) suggest that initial sediment production rate following disturbance is more sensitive to initial sediment supply than to variation in erosive forces. Climatic considerations and how they affect the relative accuracy of the estimate provided by the modified Megahan model are discussed in Section 4.2. Several experts in the field of road erosion are reviewing the theoretical basis of the assessment.

- B) Mr. Barton states that the Sediment Assessment fails to account for force exerted by precipitation and quotes the following from Megahan (1974):

"the erodibility index, defined as the kinetic energy of rainfall (foot-tons per acre-inch of rainfall) times the maximum 30-minute rainfall intensity (inches per hour) was a reliable index of the forces available for surface erosion."

Mr. Barton continues to state that without the index of erosive force the Regional Board study is incomplete and inaccurate. **Response:** Staff believes this quote is

taken out of context. The quote actually refers to findings of Wischmeier and Smith (1958), not those of Megahan (1974). Regarding inaccuracy and incompleteness please refer to Megahan's (1974) findings regarding the use of the erodibility index variable at the Deep Creek study area (pg 11):

"Notice that there is no time trend in the erodibility index similar to that shown for erosion in figure 5. These data suggest that variation in erosive forces did not have a primary influence on the time trend in erosion found on deep creek."

Please also refer to Megahan's (1974) findings regarding the use of the erodibility index variable at the Bogus Basin study area (see pg 11, Figure 6 in Meghan's paper):

"Note there is no time trend in either the average or the peak erodibility index that corresponds to the time trend found for erosion."

Please also note discussion from Megahan (1974) on page 13:

"Obviously, variations in erosive forces will tend to modify erosion rates over time. However, these studies suggest that a widely used index of erosive forces (the erodibility index) was not well related to the time trends in erosion, at least during the initial period of rapid recession."

Megahan then proceeds to discuss the relative importance of (f) and (p), along with a hypothesis about the observed time trends in erosion (pg 13):

"The foregoing suggests that variations in erosive forces (f) and protection (p) as defined by equation 1 did not cause the time trend. Therefore, it is postulated that the dominant causal factor was "armoring" of the erosion surface."

From Megahan's (1974) and Luce and Black's (2001) work we clearly see that erosion rates immediately following disturbance are most sensitive to the supply of easily erodible sediment (S_0). This is the variable we quantify by measuring the volume of the loose sediment layer.

- C) Mr. Barton also states that snow does not have significant force for erosion, and that Megahan (1974) did not calculate the erosivity index for his sites when a snowpack existed. Mr. Barton uses Mr. Drew Coe's email dated August 1, 2008 stating that the assumption of 100% annual transport of the loose sediment layer "may only be valid if the first storm event(s) are rain rather than snow, as very light rain or early snow can provide cohesion to the dust layer (Coe, 2006)." **Response:** See comment 3. Megahan's study provides several insights regarding the role of erosivity in a snow dominated climate. Megahan's study sites were in the Idaho Batholith, an area with a climate characterized by high-intensity rainstorms during the summer, and snowfall and snowmelt during the winter and spring (1974). If one looks at maps of annual rainfall erosivity (R factor maps) provided by Renard et al., 1997, we see that the R factor is identical to that of the area surrounding the RJT. Despite the

apparent lack of annual erosivity and the predominance of snowfall during the winter, Megahan still found that 80% of the total erosion from his Deep Creek site occurred during the time period from November 1961 to June 1, 1962 – a period characterized by low rainfall erosivity and the predominance of snowfall. A similar story exists for his Bogus Basin study area, where approximately 80% of the total erosion came during the period between the Fall of 1962 and June 1, 1962. Again, this suggests that initial erosion rates are most sensitive to the initial supply of erodible sediment, and not necessarily to the magnitude of rainfall erosivity or to the type of precipitation (i.e., snow vs. rain.). Given the relative similarities in climate (i.e., snow and snowmelt dominated during the winter and spring) and annual rainfall erosivity, we presume that rainfall and/or snowmelt would be sufficient to transport the loose sediment layer along the RJT. In regards to the comments offered by Mr. Coe, we have adjusted our rate constant (k) downwards from 1.0 to 0.8 yr⁻¹ as per values from the literature (Megahan, 1974; Luce and Black, 2001). In the revised Sediment Assessment, this is reflected in the new estimate of sediment delivery as being 60 to 80 yd³ yr⁻¹.

- D) Mr. Barton states that the sediment assessment does not account for the baseline erosion rate, and that the study incorrectly assumes that total erosion is equal to the amount attributed to OHV traffic. Mr. Barton states that the study proves nothing about the erosive impact of OHV travel. **Response:** The revised Sediment Assessment reframes the estimate as a quantification of E_s rather than E_t . Consideration of a baseline erosion rate is in the revised Sediment Assessment, Section 4.2.
- E) Mr. Barton states that equation 3 and the sediment delivery assumptions are flawed. Mr. Barton states that,

“Sediment delivery into hydrological systems is affected by a number of factors including sediment source, texture, size, nearness to the main stream, channel density, basin area, slope, length, land use/land cover, and rainfall intensity and runoff factors. Additionally, the impact of vehicle detachment of sediment is a function of numerous variables related to the variables related to the vehicle, the road surface, the rain event and topography.”

Mr. Barton states that these factors are not considered in Equation 3. **Response:** Equation 3 has been revised to reflect a rate constant (k) based on the published literature (i.e., 0.8 yr⁻¹) (Megahan, 1974; Luce and Black, 2001). This revised rate constant suggests the 80% of the loose surface sediment will be transported off the trail segment, and that 20% will deposit along the road segments. Sediment delivery is only considered to be 100% when there is a direct linkage to the channel network via 1) stream crossing approaches; 2) connected gullies; and/or 3) the interception of low order stream channels by the trail and subsequently rerouting of the intercepted stream channel to the main channel network. This assumption is consistent with the literature (Croke and Hairsine, 2006). It was not Staff’s job to document all of the independent variables controlling sediment delivery from the RJT to the channel network. However, studies indicate that longer road segments

(i.e., approximately > 330 ft in length) are most capable of delivering sediment to the channel network (Croke and Mockler, 2001; Coe, 2006), and that a lack of drainage structure is a controlling factor for road connectivity (MacDonald and Coe, 2007). The surveyed trail segments often exceed this length threshold, and much of the trail lacks drainage structures.

- F) Mr. Barton states that the methodology for calculating the median surface grain size (D50) is not disclosed, and that sample size, sampling methods, and channel features of Ellis Creek need to be disclosed. **Response:** Staff utilized the zig-zag pebble count method proposed by Bevinger and King (1995). Since method appears to be valid for smaller channels with poorly organized habitat units (Schnackenberg and MacDonald, 1998). Particles were randomly selected by the observer looking away and placing the tip of a mechanical pencil on the substrate in front of their wader boots. The reach length was 10x the bankfull channel width above-and-below the crossing. Staff sampled 108 particles above the Ellis Creek crossing and 129 particles below the crossing. Above-and-below reaches had similar gradient and valley confinement. The below reach had more pool habitat than the above reach.
- G) Mr. Barton states “the finding that the purported sediment load into Ellis Creek is filling spawning gravels and reduces aquatic habitat” is not supported by the evidence. **Response:** Reference to spawning gravels has been removed from the revised Sediment Assessment. The revised Sediment Assessment only compares the grain size distribution above-and-below the crossing.
- 8) Will Harris (C.E.G.) of the California Geological Survey provided a number of comments on the Sediment Study on behalf of the Department of Parks and Recreation, Off-Highway Motor Vehicle Recreation Division.
- A) Mr. Harris states that no map is included. **Response:** A map is included in the revised Sediment Assessment.
- B) Mr. Harris states that the report does not discuss the hydrologic effects from existing and previous land practices on areas adjacent to the Rubicon Trail, on how this might affect sediment delivery in the Assessment area. **Response:** Comment noted. Staff acknowledges the mixed land use within the Assessment Study area. However, it was beyond the scope of the Assessment Study to perform a comprehensive assessment of the hydrogeomorphic effects of other land uses. While upstream activity can clearly affect sediment inputs to Ellis Creek, we only assessed impacts within the footprint of the trail.
- C) Mr. Harris questions the central assumption of the Assessment methodology: that “dust layer measurements” is nearly equal to sediment delivery. **Response:** Equation 3 of the Sediment Study states that sediment production, not delivery, is a function of the depth of the loose surface sediment. Matthew Welsh’s sediment production data from OHV trail segments in the Colorado Front Range suggest that the measurements of the loose surface sediments underpredict total erosion by a factor of more than 3 (Welsh, 2008). As a result of this empirical evidence, we can

posit that a one-to-one relationship is conservative. However, in response to peer review and published literature (Meghan, 1974; Luce and Black, 2001), the rate constant (k) of 1.0 yr^{-1} implied in Equation 3 has been changed to 0.8 yr^{-1} (see revised Sediment Study; section 1.1). The revised rate constant reflects that 80% of the loose surface material will be transported off a trail segment on an annual basis.

- D) Mr. Harris states that road erosion/hydrology literature is broadly applied to the issues of OHV erosion. Mr. Harris states that Equation 1 is not necessary if the Sediment Assessment does not consider the baseline erosion rate. **Response:** Welsh (2008) suggest that concepts from the road erosion/hydrology literature are applicable to OHV trails. This allows for the transfer of road-derived process understanding to the issue of sediment production on OHV trails. Staff expands on road erosion theory and how it applies to erosion on an OHV trail in the revised Sediment Study. Consideration of the baseline erosion rate is addressed in the revised Sediment Study.
- E) Mr. Harris states that it is unclear whether the five “hydrologic connectivity” criteria were observed along the trail. **Response:** Staff generally observed connectivity at trail-stream crossings, via diffuse sediment plumes, and via a combination of stream interception. See revised Sediment Study table 1 for additional clarification.
- F) Mr. Harris states the following in regards to the dust depth measurements:

“The authors measured the width of a trail segment, on average, every 10 feet. For every trail width measurement, only one measurement of “dust depth” was taken. The widths were averaged and the dust depths were averaged, and those two averaged number were multiplied by the trail segment length to determine what the authors considered to the available volume of loose sediment that is delivered to a water body.

The trail tread profile of any segment of the Rubicon Trail is variable, both along its length and along any point where the trail width is measured. Many tread section contain outcrops of granite adjacent to loose material. Given the topographic and compositional variability of the trail tread, the authors’ practice of taking one “dust depth” measurement for every ten linear feet of trail segment is not representative of the amount of loose material available at any one cross-section of a trail segment, and the calculated volumes based on the average dust depth measurements are not representative of actual volumes along trail segments.”

Response: Staff used a segment averaged width multiplied by segment length to obtain trail area. However, Staff utilized the median dust depth for the final calculation of estimated sediment production as the distribution of loose sediment was log-normally distributed (see Table 1; note the difference in the sediment production estimate between the median and mean). It is beyond the scope of this document to assess the statistical rigor of the sample design used to characterize the loose sediment layer. However, Ziegler et al. (2001b) validated his concept of dynamic erodibility using 32 samples of loose sediment samples spaced over a

mile worth of road – an average sample every approximately 160 feet. Welsh (2008) characterized the mass of loose sediment every 30 feet (i.e., 5 samples per segment), and was able to provide a significant predictive relationship between the mass of loose material and sediment production. Staff used a method that was random along the length and width of the trail, and did not focus on portions of the trail with the most accumulation of loose sediment. Additionally, our sample per unit distance of trail was higher than the previous studies (i.e., one random sample every 12 feet). As a result, staff believes that this method will be adequate to provide an order of magnitude prediction of sediment production from the trail.

G) Mr. Harris states the following in regards to sediment delivery:

“The last sentence in the second paragraph on page 4 states that “annual sediment delivery is assumed to be less than 100% for trail segments connected to the channel network via sediment plumes.” This assumption is later contradicted in Section 3.3. Here the authors identify two segments that are indeed “connected to the channel network via sediment plumes,” but then assume that annual sediment delivery for those two segments is 100% of the calculated available sediment. This overestimates the calculated amount of sediment delivery based on the author’s own assumptions. This overestimated quantity is 25 cubic yards per year, which is 25% of the total estimated annual delivery of sediment from the measured trail segments. **Response:** Comments noted. The revised Sediment Study now considers two delivery scenarios for segments connected via sediment plume: 1) zero delivery; and 2) 100 percent delivery. The final estimate of sediment delivery is as expressed as a range using these two scenarios. As such, it allows one to evaluate the sensitivity of the sediment delivery estimate to sediment delivery assumptions.

H) Mr. Harris states that the mean depth of loose sediment was used instead of the median depth when comparing estimated erosion rates from the trails to forest roads. Mr. Harris states that rates from the trail are inappropriately compared to measured erosion rates from logging roads. **Response:** Staff calculated a sediment production rate based on the median depth of the loose sediment layer. The segment scale sediment production rates were then averaged to provide a mean unit area sediment production rate based on the median depth. Comments regarding comparison with forest road erosion rates are noted. Staff feels that data from Coe (2006) reflect an order of magnitude estimate of baseline erosion rate for roads in the general area. In the revised Sediment Study, the comparison is framed in terms of an order of magnitude rather than absolute differences.

I) Mr. Harris states that there are many local controls (e.g., gradient; bedform) that influence velocity and surface grain size distribution. He also states that two samples are statistically insufficient to justify the conclusions regarding substrate fining and impacts to trout species. **Response:** We agree that local controls can influence grain size distribution, and that surface grain size distribution is a function of driving forces within the channel (shear stress), resisting forces within the channel (roughness), and sediment supply. The rapid nature of the assessment did not allow

us to collect information to adjust grain size data in response to all those variables. However, our revised Sediment Study indicates that on the order of 4 yd³ (i.e., an order of magnitude prediction ranging from 1-10 yd³) of loose sediment is being delivered from the Ellis Creek crossing. Observations of Ellis Creek below the trail crossing indicate a mantle of fine sediment that resembles the size distribution of sediment (i.e., <2.0 mm) from the trail surface. The revised Sediment Study removes the reference of impact to trout species.

- 9 John Arenz, Director of the Rubicon Trail Foundation, provided comments on the Sediment Study.

Mr. Arenz believes the application of science from Thailand is inappropriate because of the obvious difference in climate, soils, and land use between Thailand and the Sierra Nevada. **Response:** Staff uses a model based on Megahan (1974), and validated across a range of climate, soils, and land use. Staff modified Megahan's equation to explicitly consider the presence of a loose sediment layer using concepts discussed by Ziegler et al., 2002. Please see comments 6A and 7A.

- 10 Jacquelyne Thiesen, a member of Friends of the Rubicon, provided several comments on the Sediment Study.

A) Ms. Thiesen states that MacDonald et al. (2004) show very low sediment production rates for ungraded and rocked roads, and that the Rubicon Jeep Trail is both ungraded and rocked, thus Ms. Thiesen disputes the estimates of sediment production from the Sediment Study. **Response:** Staff agrees that the RJT is not graded. However, we disagree that the RJT is rocked. While bedrock is common within the footprint of the RJT, it does not have a rock aggregate surface. Much of the RJT has a layer of loose sediment, and the role of a loose sediment layer in sediment production is well documented in the road erosion literature (Luce and Black, 2001; Ziegler et al., 2001a, b; 2002; Ramos-Scharrón and MacDonald, 2005);

B) Ms. Thiesen states that consideration needs to be given to the fact that snowfall is the dominant form of precipitation along the RJT, and this would affect sediment production rates. Total suspended sediment samples from Loon Lake do not exceed 1 mg/L. **Response:** See Comment 7C. Without knowing when, where, and how the sediment samples were taken, it is difficult to place these data points into their proper context.

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