

4886 East Jensen Avenue  
Fresno, California 93725

Tel: 559-237-5567  
Fax: 559-237-5560

[www.krcd.org](http://www.krcd.org)

March 10, 2009

Mr. Danny McClure  
Regional Water Quality Control Board  
Central Valley Region  
11020 Sun Center Drive, Suite 200  
Rancho Cordova, CA 95670

Re: Proposed Revisions to the 303(d) List of Impaired Water Bodies  
Proposed Listing - Kings River, Lower (Pine Flat Reservoir to Island Weir)

Dear Mr. McClure:

We have reviewed the proposed revisions to the 303(d) List of Impaired Water Bodies and must object to the listing of a portion of the Kings River as impaired due to some "unknown toxicity". We believe that this proposed listing is inappropriate and not supported by existing data.

Page 19 of Appendix A: Proposed Changes to the 303(d) List identifies the Kings River, Lower (Pine Flat Reservoir to Island Weir) as a waterbody segment to be listed as impaired for the pollutant "unknown toxicity". Since we monitor the water quality in the Kings River on a regular basis, the only possible reason for the listing would be for "toxicity" of algae. Under our monitoring program, we have sampled the water for toxicity. One of the toxicity tests involves algae (*Selenastrum capricornutum*) growth.

During the period July 6, 2004 through April 11, 2007, we tested Kings River water at 4 monitoring sites for water quality. Of the 86 samples tested for toxicity, 43 (50%) demonstrated significantly reduced algae growth. Under water quality criteria, "significantly reduced algae growth" is considered as "toxicity". Under the Irrigated Lands Regulatory Program, there was concern that the "toxicity" was the result of discharges from irrigated agriculture into the Kings River. We did not believe that this was the "cause" so we began sampling the river immediately below Pine Flat Reservoir at the Army Corp of Engineers (ACOE) Bridge. There is no irrigated land above the Reservoir. Other than the recreational use of the Reservoir, there are no other significant sources of possible impacts to water quality in the watershed; therefore, the water released from the Reservoir is considered Kings River source water.

**BOARD OF DIRECTORS**

**Division I**, NORMAN B. WALDNER, Dinuba • **Division II**, MASARU YOSHIMOTO, Fowler • **Division III**, GILDO NONINI, Fresno • **Division IV**, MARK McKEAN, Riverdale • **Division V**, BRENT GRAHAM, Hanford  
**Division VI**, CEIL W. HOWE, JR., Stratford • **At Large**, DR. DAVID CEHRS, Sanger

**OFFICERS**

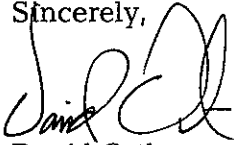
MARK McKEAN, President • BRENT GRAHAM, Vice President • DAVID ORTH, General Manager-Secretary • RANDY SHILLING, Auditor

The water samples taken at the ACOE Bridge also demonstrated "significantly reduced algae growth" or "toxicity". As a result, we worked with the local office of the Regional Board to determine if the laboratory results were correctly identifying "toxicity". From our joint analysis, it was determined that the "toxicity" results were not reflective of water quality but are related to laboratory methods. Enclosed is a copy of a letter written to the Regional Board on August 10, 2007, which summarizes this issue.

In closing, the listing of the Kings River, Lower (Pine Flat Reservoir to Island Weir) as impaired for an "unknown toxicity" is neither appropriate nor justified. It should be removed from the Proposed List.

If you have any questions, please do not hesitate to contact David Cone of my staff at (559) 237-5567, extension 126.

Sincerely,



David Orth  
General Manager

DO/DC/sjs

Enclosure: As stated

Cc: Regional Board, Fresno office (with enclosure)  
William Thomas (with enclosure)

**Kings River Sub-Watershed**  
**a member of the**  
**Southern San Joaquin Valley Water Quality Coalition**  
**4886 East Jensen Avenue**  
**Fresno, CA 93725**  
**(559) 237-5567**

August 10, 2007

Central Valley Regional Water Quality Control Board  
Attention: Irrigated Lands Program  
1685 "E" Street  
Fresno, CA 93706

Re: Amendment to Kings River Sub-Watershed MRP for Water Column  
Toxicity Testing

Ladies and Gentlemen:

Since the beginning of the Ag Waiver Program, the Kings River Sub-Watershed (through its managing agency, the Kings River Conservation District (KRCD)) has conducted sampling as prescribed by the Ag Waiver at Regional Board approved MRP sites along the Kings River. Beginning in December 2005, at KRCD's own initiative and expense, additional sampling has been conducted at 2 additional sites (U. S. Army Corps of Engineers Bridge (ACOE Bridge) ½-mile below Pine Flat Dam and Mill Creek a downstream tributary) in order to characterize Kings River source water. This was to establish a baseline for water quality on the Kings River before it enters the area where it can be impacted by irrigation agriculture.

KRCD expanded its testing of the waters at ACOE Bridge to include Phase II monitoring for pesticides, metals, and nutrients when we began Phase II sampling in July 2006. This further characterized the mineral content of the water so that ambient conditions could be better understood. Since we had acquired sufficient data to characterize the source water of the Kings River, we terminated our sampling at the ACOE Bridge as well as at Mill Creek in May 2007.

As a result of the significantly reduced algae (*Selenastrum capricornutum*) growth problems identified in Phase I, we continued to sample for Water Column Toxicity beyond the required under Phase I. This was identified in our MRP.

The purpose of this communication is to outline the reasons why the Kings River Sub-Watershed is amending its MRP to discontinue Water Column Toxicity testing at our 4 MRP monitoring sites with our last samples in August 2007. We will have conducted Water Column Toxicity from July 2004 through August 2007 (3 years).

### **The Problem**

As I explained to the Regional Board on August 2, 2007, and as your staff is well aware, significantly reduced algae growth in the Kings River has been a continuing issue since the inception of our monitoring program (July 2004). It is not uncommon for samples to be returned from the laboratory (Sierra Foothill Laboratory, SFL, Jackson, CA) showing statistically significant differences in growth between the lab control and the samples submitted. Currently 43 (50%) of our 86 samples from our 4 MRP monitoring sites have demonstrated significantly reduced algae growth.

The purpose of doing the algae testing is to determine the effects of any potential contamination on the bottom rung of the food chain, knowing that impacts here may eventually occur further up. *Selenastrum capricornutum* is a standard test organism for many types of aquatic contamination studies, because of its relative ease of culture and reliability in detecting problems. The other two toxicity tests look at the potential impacts on higher organisms for the same reasons. With very few exceptions, the Kings River has not had any significant mortality to the higher organisms tested, and when those exceptions occurred, no specific cause or causes could be identified from the chemical analyses performed. KRCD considers these events the result of random statistical chance, not the result of any contamination within the watershed.

There is no pattern as to when or where the reduced algae growth takes place. It occurs year round, during both irrigation and storm events. Very few samples actually showed increases in growth over the control.

In order to determine the cause for this pattern, it is necessary to eliminate certain factors from consideration. These include:

1. **Temperature.** It cannot be temperature dependent, because the shipping procedures for the sample require that they be transported at or below 4°C. Samples at ACOE Bridge typically run 8-9°C when collected, so chilling to below 4°C is not a great shock to the sample. Field samples are collected, packed in a cooler with "blue-ice" to maintain temperatures close to or lower than sampling temperature for transport, and packed/repacked with cubed ice prior to transport the

next morning. Samples arrive at the lab approximately 30 to 36 hours after sampling, giving the lab a minimum twelve hour window to begin testing. All hold times have been observed, so it not a problem with the lab not getting to the samples quickly enough.

2. **Dissolved Oxygen.** Dissolved oxygen (DO) is not an issue, as the field measurements of DO are all above the Basin Plan Objectives (BPO) for the Tulare Basin. Samples are also collected and subjected to a Winkler titration, which confirms the results from the field instrumentation. In addition, releases are made through the Pine Flat Power Plant Bypass as required to maintain the DO for the Fisheries Management Program and maintain compliance with the plant's FERC license.

### The Physical Characteristics

This leaves the physical characteristics of the water itself. A chemical analysis of the water used for the control sample and the submitted river sample show practically no difference in chemical content *except* in a few parameters. These are electrical conductivity (EC), pH, and hardness.

Table One shows the comparison between the elements/compounds tested for by the laboratory when it conducts its annual audit of its control water and the list of constituents tested for in the Phase II tests by the Kings Sub-Watershed, (APPL Inc., Fresno, CA). Those tests in common are in **bold**.

**Table One:** Comparison of SFL Tests to APPL Tests for Kings River Sub-Watershed Samples.

<b>EC</b>	<b>Color</b>	<b>Cadmium</b>
<b>pH</b>	Bicarbonate	<b>Copper</b>
<b>TDS</b>	Carbonate	<b>Lead</b>
<b>Turbidity</b>	Phosphorus	<b>Nickel</b>
<b>Nitrate-N</b>	Sulfate	<b>Selenium</b>
<b>Nitrite-N</b>	Chloride	<b>Zinc</b>
Orthophosphate-P	<b>Arsenic</b>	<b>Hardness</b>
Ammonia-N	Barium	TKN
Boron		

SFL also tests for a number of other materials that the Kings River Sub-Watershed does not contract APPL to test for, and these material are listed in Table Two.

**Table Two:** SFL Tests for Elements/Compounds not Contracted for with APPL by Kings River Sub-Watershed

Aluminum                      Sodium                      Magnesium, Calculated

Beryllium	Thallium	Chromium
Fluoride	Antimony	Alkalinity, Hydroxide
Calcium	Alkalinity, as CaCO <sub>3</sub>	Iron
Foaming Agents	Manganese	VOC's
Mercury	Odor	Silver
Corrosivity		

**Discussion**

Table Three shows a comparison between the SFL tests and the APPL tests for those items in common. As can be seen, for a majority of the items tested, very little difference in chemical makeup is seen.

**Table Three: Comparison of SFL and APPL Results for Tests in Common**

Constituent	Units	SFL	APPL by Test Date			
			2-21-07	3-1-07	3-13-07	4-11-07
<b>EC</b>	umhos/cm	184	31.2	31.5	33.3	35
<b>pH</b>		7.7	6.93	6.94	6.88	6.86
<b>TDS</b>	mg/l	110	22	26	24	26
<b>Turbidity</b>	NTU	<0.1	0.3	0.35	0.43	0.025
<b>Nitrate-N</b>	mg/l	0.25	0.74	0.85	0.88	0.98
<b>Nitrite-N</b>	mg/l	<0.05	ND	ND	ND	ND
<b>Color</b>		<3	1	5	5	8
<b>Arsenic</b>	ug/l	<2	0.64	0.46	0.68	0.65
<b>Cadmium</b>	ug/l	<1	0.058 J	0.16 J	0.047 J	0.049 J
<b>Copper</b>	ug/l	<50	0.59	ND	ND	0.55
<b>Lead</b>	ug/l	<3	ND	0.16 J	ND	0.13 J
<b>Nickel</b>	ug/l	<5	0.75	0.35 J	0.65 B	0.42 J
<b>Selenium</b>	ug/l	<2	0.39 J	ND	ND	0.34 J
<b>Zinc</b>	ug/l	<5	13.3 J	14.4 J	2.4 J	3.3 J
<b>Hardness</b>	mg/l	88	10.1	10	12.1	13

"J" indicates reading below PQL limit at lab. "B" indicates that tested material was found in blank.

While only the 2007 tests are shown here, the results are typical of what has been found in the Kings River samples dating back to July 2006.

Several characteristics of the Kings River samples are at variance with the SFL control water. These include EC, pH, TDS, Nitrate-N, and Hardness. Of these characteristics, only Nitrate-N is reported higher in the Kings River samples, but only marginally so.

The magnitude of the differences between the control and the samples for each of the above characteristics is considerable. The most prominent

difference is the EC level. The control solution is nearly 6 times higher than that of the sample, yet the concentration of the materials within the solution are nearly the same as the sample. The TDS measurement is also about 6 times higher in the control solution, and the pH has shifted from slightly acidic (sample) to a stronger alkaline condition for the control. Finally, Hardness is running about 7 times higher in the control than the sample. It is the purity of the Kings River samples that could be an underlying cause of the significantly reduced algae growth.

Electrical Conductivity has been consistently low for the Kings River, regardless of the sampling point. With the exception of storm water runoff from the Mill Creek watershed (an ephemeral creek that empties into the Kings below Pine Flat), the EC values of the Kings rarely exceeds 60 umhos/cm. Even during the flood event of 2006 when samples were available at James Weir (the last diversion point on the north fork of the Kings River), the EC values of the water were only in the 40-50 umhos/cm range. This is after the river had run its complete course through the agricultural lands covered by the Kings River Sub-watershed, a distance of some 79 miles.

#### **Other Sampling and Laboratory Results**

Over the course of the last year (May 2006 through April 2007, 10 events), samples at ACOE Bridge demonstrated significantly reduced growth for algae at all events, regardless of flow levels (345 cfs, April 2007 to 12,878 cfs, May 2006). Since no irrigated agriculture occurs upstream of the sampling site (approximately ½ mile downstream of Pine Flat Dam) or in the upper Kings watershed, the water is considered source water for the system and is not impacted by irrigated agricultural activities.

Samples of the source water (Kings River at the ACOE Bridge and Mill Creek) have demonstrated significantly reduced algae growth in 20 of the 27 samples. The Kings River at ACOE Bridge had 15 out of 17 and Mill Creek had 5 out of 10 demonstrate algae growth problems.

The results of the algae testing were so unusual (no clear cut reason for the problem had been detected) that the Regional Board staff of the Fresno office accompanied KRCD staff members to collect independent samples during an irrigation event in 2006. The Regional Board's samples were sent to the California Fish and Game lab for analysis, with no significant reduction in algae growth reported (Lab # P-2442, September 25, 2006) for either of the two sample sites. Yet the samples sent to the lab contracted by KRCD reported that both samples from the same sites demonstrated significant reductions in growth.

With this inconsistency in mind, KRCD submitted two additional samples (collected in February 2007: one irrigation event sample and one storm event sample) to another lab (one used by other Sub-Watersheds of the Southern San Joaquin Valley Water Quality Coalition) for evaluation. The results from the tests conducted by the other lab did not show algae growth problems for the 2 samples. Our lab reported growth problems for both of our samples.

In July 2006, we began Phase II of the monitoring program. To our knowledge, we have not had an exceedance for pesticides, metals, and/or nutrients at any of our monitoring sites. Therefore, since the Kings River source water is not impacted by irrigated agriculture and demonstrates algae growth problems, it is unlikely that these other constituents would be causing the problem.

### **Further Investigation**

In attempting to determine the cause of this paradox, we contacted a scientist with extensive experience in using algae as an indicator for herbicide toxicity within water samples. His opinion is that a time lag exists between the growth rate curves for the control sample and the river sample, and that at the end of the prescribed 96-hour run of the test, the river sample, while showing positive growth that parallels the control growth curve, has not had enough time to match the total cell population of the control group. His opinion, based on the literature he provided and sample data we submitted, is that if the tests were carried out to an end-point of approximately 10 days, the two samples would have similar cell concentrations, or even the sample might exceed the control. The charts in the literature he submitted suggests that if the test were run for another 48 hours, the control growth would have leveled out and the sample growth would then match up at that point. The reference is as follows:

Hughes, Jane S., Alexander, Meryl M., and Balu, K. **An Evaluation of Appropriate Expressions of Toxicity in Aquatic Plant Bioassays as Demonstrated by the Effects of Atrazine on Algae and Duckweed.** *Aquatic Toxicology and Hazard Assessment: 10<sup>th</sup> Volume, ASTM STP 971*, W.J. Adams, G. A. Chapman, and W. G. Landis, Eds., American Society for Testing and Materials, Philadelphia, PA 1988, pp. 531-547.

His opinion is that the cause of the time lag is due to acclimatization of the sample culture to the river samples. Some of this can be due to the changes in water characteristics between the control sample (which is the medium the algae cells are used to) and the river sample, with its much lower values of EC, pH, TDS, and Hardness, as well as the changes in the specific ion concentrations within the control and river samples. This creates a "shock" effect that delays the onset of cell reproduction once the test is initiated.



The sudden change in EC and other values may also be causing an osmotic effect on the algae cells. The low EC water, with its very high osmotic potential, migrates into the cells where the osmotic potential is lower, potentially causing some cellular lysis to occur. This in effect reduces the available cellular population available to reproduce, thus also negatively impacting the observed growth rates.

Since the Coalition is not in the laboratory business nor does it conduct actual research, this is only included as one of the explanations for the reduced algae growth.

### Conclusion

Since the quality of the source water is beyond the control of the Kings River Sub-Watershed, beyond the scope of the Irrigated Lands Program, there is very little variation from the previous sampling, and we have been unable to identify a potential source of the problem from irrigated agriculture, it is our intention to discontinue Water Column Toxicity testing at our 4 MRP monitoring sites after our last irrigation event sampling this year (August 2007). Phase II testing will continue as listed in Table 1 under Regional Board Order No. R5-2005-0833 at all 4 MRP sites for irrigation and storm events.

Please contact me if your have any questions or wish to discuss this further.

Sincerely,



David Cone  
Coordinator  
Kings River Sub-Watershed  
(A Member of the SSJWQC)

DC/dr

Cc: William Croyle, RWQCB, Rancho Cordova, CA  
William Thomas, Esq.  
Alan Cregan, RWQCB, Fresno