Construction Industry Coalition on Water Quality

May 14, 2012

State Water Resources Control Board
Attn: Jeanine Townsend, Clerk to the Board
1001 I Street, 24th Floor
Sacramento, CA 95814

RECEIVED
5-14-12
SWRCB Clerk

RE: Proposed Amendments to Order No. 2009-0009-DWQ as Modified by DWQ [NPDES No. CAS000002] General Permit for Discharges of Storm Water Associated with Construction and Land Disturbance Activities (Construction General Permit).

Ms. Townsend, Hon. Chair Hoppin and Members of the Board:

On behalf of the more than 3,000 member companies of the Construction Industry Coalition on Water Quality (CICWQ), we would like to thank the California State Water Resources Control Board (State Water Board) for the opportunity to offer comments on the Proposed Amendments to the Construction General Permit ("CGP") in response to the judgment and peremptory writ of mandate in *CBIA et al. v. State Water Resources Control Board* issued in December 2011 by the Superior Court for the County of Sacramento.

I. Introduction

CICWQ is an education, research, and advocacy 501(c)(6) non-profit group representing builders and trade contractors, home builders, labor unions, landowners, and project developers . Our membership is comprised of members of four major construction and building industry trade associations in southern California: The Associated General Contractors of California, Building Industry Association of Southern California, Engineering Contractors Association, and Southern California Contractors Association, as well as the Engineering and General Contractors Association in San Diego and United Contractors located in San Ramon. Collectively, members from these associations build much of the public and private infrastructure and land development projects in California. Members of all of the above-referenced organizations are affected by the CGP, as are thousands of construction employees and builders working to meet the demand for modern infrastructure and housing in California.

Our comments on the Proposed CGP Amendment (the "Amendment") reflect our commitment to protect water quality while at the same time preserve our member's business viability in this difficult economic time. CICWQ's membership has invested substantial resources developing sound approaches for construction site stormwater management based on the application of best management practices (BMPs) for erosion and sediment control, including the development of progressive training and education programs. Accordingly, our comments to

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the State Water Board reflect an industry commitment to selecting and using appropriate BMPs given construction sites' individual and watershed characteristics.

II. Comments on Proposed Amendment

CICWQ applauds the removal of Numeric Effluent Limitations (NELs) from the CGP and the decision to defer the development of NELs until sufficient information and data on the performance of BMPs at construction sites becomes available. CICWQ, however, has serious concerns regarding certain provisions in the Amendment:

1. CICWQ opposes the unjustified use of numeric triggers (also known as "Receiving Water Monitoring Triggers") for pH and turbidity for receiving water monitoring. As detailed herein, CICWQ believes that the values for the numeric triggers (i.e., pH of 6-9 and turbidity values greater than 500 NTU) are arbitrary and without scientific basis. It is neither demonstrated nor likely that the use of the numeric triggers as outlined in the current proposal would result in improvement in water quality or generate valid data and information that could lead to improvements in water quality or improvements to the CGP program. It is likely that the numeric triggers will be frequently activated by natural conditions in many watersheds.

2. CICWQ opposes the imposition of receiving water monitoring requirement for alternative treatment system ("ATS") discharges. The State Water Board eschewed including receiving water monitoring for ATS discharges after an extensive process for the adoption of the 2009 order, and has provided neither explanation nor justification for doing so now. An exceedance of NELs for ATS discharges, which will trigger receiving water monitoring, are based solely on measured technical performance of ATS and are not logically correlated to receiving water quality. In particular, the Amendment appears to be inconsistent with the Superior Court (County of Sacramento, Hon. Lloyd Connelly, Case No. 99CS01929) ruling issued on December 27, 2001, in which the superior court questioned the justification for and methodological shortcomings of receiving water monitoring (*See at page 3, lines 5-8; 18-25*).

3. Any stormwater monitoring program should be carefully designed to collect data with a specific purpose in mind. The State Water Board has not articulated how the data to be collected under the current proposal would be used in the future, or what goals those data would be intended to support. Collection of data solely for the sake of data collection and without a well-designed stormwater monitoring framework will likely fail to yield valid data that can be used to enhance water quality or to refine the State's approach to regulating stormwater discharges from construction sites.

Therefore, CICWQ recommends the removal of the numeric triggers, and the removal of the receiving water monitoring requirements for ATS dischargers. CICWQ furthermore recommends that the State Water Board design a stormwater data collection program for construction sites with appropriate reconsideration of the State's goals for the regulation of stormwater discharges generally, and stormwater discharges from construction sites in particular.

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Additional details regarding these concerns are as follows:

1. CICWQ opposes the establishment of the numeric triggers for the receiving water monitoring because the numeric triggers are without a sound scientific basis.

In the Amendment, dischargers at Risk Level 3/LUP Type 3 sites will be required to conduct receiving water monitoring if an effluent discharge exceeds numeric triggers for pH and turbidity. The numeric triggers are set as the range of 6 to 9 for pH and 500 NTU for turbidity. These values for the numeric triggers were carried forward from the original 2009 adopted CGP, where they were used as NELs. It appears that no additional analysis was conducted to establish the numeric triggers independently from the NELs, and that no effort has been made to address issues raised previously by CICWQ and other stakeholders regarding the derivation of these values. As detailed below, CICWQ believes these values were developed using incorrect assumptions and calculations, and using limited and non-representative data.

A. NUMERIC TRIGGER FOR pH

The numeric trigger at plus or minus three standard deviations from the mean is not an appropriate metric

The numeric trigger values for pH were established by "*calculating three standard deviations above and below the mean pH of runoff from highway construction sites in California*" (p. 15 of the 2009 CGP Fact Sheet). The State Water Board staff appear to have assumed that the Caltrans data in the dataset used to derive the numeric trigger for pH are normally distributed; however, the data are neither normally nor log-normally distributed according to the normality test (i.e., Kolmogorov-Smirnov test) conducted by Flow Science at the request of CICWQ. When data are not normally distributed, the use of a mean and a standard deviation based on the normal distribution would over- or under-estimate pH values that could occur within the normal variation of data. In addition, even if the data were normally distributed, the calculated values cannot be reproduced—our calculation yields a range corresponding to the mean ± 3 standard deviations of 5.4 – 9.4 (not 6.0 - 9.0).

The numeric trigger was developed without consideration of receiving water quality

pH values outside the range of the numeric trigger occur naturally in some streams (see Section 4 of Flow Science (2008)). For example, some areas of California include alkaline soils, and pH in runoff from these soil types may be higher than average values. Background receiving water pH ranges as high as 8.9 in the Trinity River near Weitchpec (see Figure 1 and Section 4 and Table 18 at p. A-20 of Flow Science (2008)) and as high as 9.5 in San Diego Creek [see p. A-23, Flow Science (2008)]. Because of regional variations in natural or background pH levels, it is inappropriate to apply a uniform numeric trigger statewide. Where natural or background pH levels fall outside or at the margins of the numeric trigger range, the numeric trigger should not apply.

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The pH of rainfall falls outside the numeric trigger range

Data collected by the U.S. Geological Survey (USGS) indicate that rain in California has a long-term average pH that varies between 5.3 and 6.0, depending upon location (Figure 2). For individual storms, pH values as low as 4.5 have been observed (see, e.g., http://nadp.sws.uiuc.edu/ads/2003/CA45.pdf). If storm water runoff includes water that has not had significant contact time with soil or earth, it is possible for runoff pH values to be low and outside the range of the numeric trigger. Samples with a pH value below 6.0 (i.e., below the numeric trigger) should not be considered to trigger the receiving water monitoring if insufficient contact time with the ground surface is the cause of the exceedance.

Regional variability in pH should be considered in establishing the pH numeric trigger

The Blue Ribbon Report recommended that in establishing NELs for discharges from construction sites, the SWRCB should consider "the site's climate region, soil condition, and slopes, and natural background conditions (e.g., vegetative cover) as appropriate and as data are available" (p. 17 of Blue Ribbon Report). Although the numeric trigger is not a NEL, the same logic should be applied to establish a scientifically defensible numeric trigger and to obtain information which will lead to enhanced water quality in California. The Caltrans data used to establish the numeric trigger for pH were taken from six of the eleven Caltrans Districts (Caltrans 2002) and may not be fully representative of conditions throughout the state. Because soil alkalinity varies regionally, local conditions may be an important influence on pH levels of stormwater runoff. The State Water Board should evaluate regional and local variations in soil chemistry and receiving water pH. The numeric trigger should not apply in any region or local area where natural conditions would cause or contribute to exceedances of the numeric trigger.

B. NUMERIC TRIGGER FOR TURBIDITY

The turbidity numeric trigger of 500 NTU was developed originally for the turbidity NEL and then carried forward for use as the numeric trigger for the receiving water monitoring in the Proposed Amendment. This trigger value was established using two data sets, studies of in-situ best management practices (BMPs), and State Water Board staff's best professional judgment (BPJ).

> "*The analyses fell into three, main types: (1) an ecoregion-specific dataset developed by Simon et. al. (2004) 8; (2) Statewide Regional Water Quality Control Board enforcement data; and (3) published, peer-reviewed studies and reports on in-situ performance of best management practices in terms of erosion and sediment control on active construction sites.*" (p. 15 in the 2009 Fact Sheet)

> *"(1) results of the Simon et. al dataset reveals turbidity values in background receiving water in California's ecoregions range from 16 NTU to 1716 NTU (with a mean of 544 NTU); (2) based on a constructed 95% confidence interval, construction sites will be subject to administrative civil liability (ACL) when their turbidity measurement falls*

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between 190.78 – 833.68 NTU; and (3) sites with highly controlled discharges employing and maintaining good erosion control practices can discharge effluent from the BMP with turbidity values less than 100 NTU. Therefore, the appropriate threshold to set the technology-based limit to ensure environmental protection, effluent quality, and cost-effectiveness ranges from 100 NTU to over 1700 NTU. To keep this parameter and the costs of compliance as low as possible, State Water Board staff has determined, using its BPJ, that it is most cost effective to set the numeric effluent limitation for turbidity at 500 NTU." (p. 18 in the 2009 Fact Sheet)

<u>The eco-region data used to develop the numeric trigger for turbidity are limited and not suitable to describe stormwater quality from a construction site</u>

Simon et al. (2004) estimated suspended sediment concentrations (SSC) that were median values for 1.5-year flow events; these data were provided "*for the purpose of defining long-term transport conditions*" of sediment. The Simon et al. (2004) dataset did not characterize event-scale variability, even though data for individual storms would be used to assess exceedances of the proposed numeric trigger. Even using staff's estimate of 1:3 ratio for turbidity:SSC (which is faulty, as described below), more than 50% of the data in more than 40% of the State would greatly exceed the numeric trigger of 500 NTU. For example, *median* values of SSC in ecoregions 6 and 14 for a 1.5-year flow event are 1530 and 5150 mg/l, respectively **(**Figure 3). The state-wide "area-weighted average" median SSC concentration provided in the Fact Sheet (p. 16) is 1633 mg/l, far higher than the proposed numeric trigger of 500 NTU, and appears to indicate that at least 50% of samples from across the state would exceed the numeric trigger. In addition, the ecoregion data clearly indicate that some regions of the state experience greater erosion than others. For example, the median SSC concentration from ecoregion 5 (8.8% of California's land area) is 35.6 mg/l, while the median SSC concentration from ecoregion 14 (21.7% of the state's land area) is 5150 mg/l. These data indicate that a blanket, "one-size-fits-all" numeric trigger is inappropriate for the state.

<u>The SWCRCB enforcement data used to develop the turbidity numeric trigger are not representative, and it appears that the calculation has significant errors</u>

The enforcement data cited in the Fact Sheet (Table 3 at p. 17; reproduced as Table 1 in this letter) include 19 data points from seven construction projects located within two regions of California [Central Valley (Region 5) and Lahontan (Region 6)]. In fact, 13 of the 19 data points are from a single construction project (i.e., Northstar Village). All of these projects are located in the northern part of the state, where conditions are significantly different than in the more arid environments of southern California. These data also are not representative of the broad range of soil types that occurs throughout the state. The hydrologic conditions under which the data were collected (e.g., rainfall amount, storm intensity) are unknown, and the conditions that led to Regional Water Board enforcement at these locations are not specified by State Water Board staff in the Fact Sheet.

Further, the calculation for the 95% confidence interval for the mean turbidity of the enforcement data appears to contain significant errors, as follows:

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- It appears that the State Water Board staff conducted the calculation with 20 data points. However, 19 data points are available (not 20; see Table 3 at p. 17 of the Fact Sheet), and we calculate a mean of 537.4 NTU (not 512.23 NTU) from the data in the Fact Sheet.
- As noted above, 13 of the 19 data points are from a single construction project. Turbidity values for these 13 data points are much lower (ranging from 12 to 900 NTU) than the turbidity values of the remaining six data points (which range from 97.4 to 1800 NTU). It appears that the mean value of 512.23 NTU and 95% confidence interval of 190.78 to 833.68 NTU were calculated by treating all 19 data equally. To avoid this bias, a single representative value for each construction project should have been calculated first. The corrected calculation yields a mean of 1,193 NTU and a 95% confidence interval of 510 to 1,876 NTU. Thus, the 500 NTU value of the numeric trigger is outside the 95% confidence interval of the enforcement data; further, the enforcement data, when treated in this manner, indicate that turbidity as low as 500 NTU would occur only 2.5% of the time.

<u>The proposed NEL does not consider background conditions in receiving water</u>

Background turbidity and/or suspended sediment levels in stormwater runoff vary considerably both within different areas of the state and in response to different storm conditions (e.g., rainfall intensity, rainfall amount, and antecedent conditions). Thus, it makes little sense to adopt a single numeric trigger for turbidity that is applied uniformly throughout the state. Numeric triggers established for sediment must be site- or watershed-specific, and must consider natural conditions.

<u>Numerous studies demonstrate that turbidity in receiving water often exceeds the numeric trigger of 500 NTU</u>

- The median suspended sediment concentrations (SSC) for 1.5-year recurrence interval flows for each ecoregion in California range from 35 to 5150 mg/l (p. 16 of the Fact Sheet), roughly equivalent to turbidity values in excess of the numeric trigger of 500 NTU.
- Caltrans monitoring data for turbidity show that "typical construction site runoff" in California ranges from 15 NTU to 16,000 NTU (Caltrans 2002). Available Caltrans data from 1999-2002 show that 60% of Caltrans data exceeded the numeric trigger of 500 NTU (Figure 4). These data indicate that the numeric trigger of 500 NTU does not represent an "*upset value, which is <u>clearly above the normal observed variability</u>*," as recommended by the Blue Ribbon Panel (p. 17 of Blue Ribbon Report, emphasis added).
- The data from the Natural Loadings study (Yoon and Stein 2008) show that natural background sediment concentrations in undeveloped areas often exceed 500 NTU. Table 2 shows summary statistics derived from data collected from multiple sampling stations located in watersheds with more than 95% undeveloped area. Table 3 shows the statistics by watershed, and indicates that the variability in TSS concentrations in

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stormwater runoff from natural areas is quite large and would certainly exceed the proposed turbidity trigger.

These data support the premise that a numeric trigger for turbidity should be site-specific and established after consideration of receiving water conditions.

No scientific basis exists for the 1:3 relationship between turbidity (NTU) and suspended sediment concentrations.

In our June 24 2009 comment letter, we also noted concerns with the conversion between TSS/SSC and turbidity. These concerns have not been addressed. In summary, it appears that many general and erroneous assumptions were made in the calculation of the turbidity trigger. Because conditions vary significantly within a region, from region to region, and from one individual storm event to another, we believe that it is indefensible to establish any single statewide numeric trigger for sediment.

If and when it is developed, a significantly larger dataset will be required to properly establish a numeric trigger, and it may be necessary to calculate a numeric trigger for areas smaller than an ecoregion and in consideration of various environmental characteristics found throughout California and at individual construction sites.

2. CICWQ objects to the addition of a receiving water monitoring requirement for ATS discharges

The Amendment contains a new requirement which is clearly not within the scope of the limited reopener of the Notice of Availability of Draft Documents. The new monitoring requirement for ATS discharges is not required to respond to the court order. The State Water Board chose not to include receiving water monitoring for ATS discharges in the adopted 2009 order, and has provided no justification for doing so in connection with the Amendment. NELs for ATS discharges (i.e., 10 NTU for daily weighted average and 20 NTU for any single sample) are based solely on measured technical performance of ATS and were not associated with receiving water quality. Both the Amendment and the Fact Sheet completely lack any explanation for how the ATS NELs are associated with a threat to water quality in the receiving water. CICWQ recommends removal of the receiving water monitoring requirement for ATS discharges.

Moreover, the Amendment appears to suffer from many of the same shortcomings that were criticized by the Superior Court (Hon. Lloyd Connelly, County of Sacramento, Case No. 99CS1929) in its December 27, 2001 Order Enforcing Writ of Mandate concerning receiving water monitoring, at page 3 thereof. There, the superior court criticized the State Water Board for uncritically requiring receiving water monitoring and cited the State Water Board's failure to conform to the analytical prescripts of the Code of Federal Regulations, Title 40, Part 136. These federal regulations are intended to assure that receiving monitoring requirements are rational, understandable, beneficial, and logically related to consideration of anthropogenic pollution in naturally variable contexts.

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Therefore, CICWQ urges the State Water Board to consider and take into account the federal requirements for analytical monitoring, or to otherwise provide a logical rationale for the requirements imposed.

3. CICWQ believes that stormwater monitoring program should be carefully designed to collect data with a specific purpose in mind.

Stormwater discharges are intermittent and highly variable, both in terms of flow rates/volumes and constituent concentrations. Storm flow characteristics and constituent concentrations can vary from facility to facility, from storm to storm, and from sample to sample. As detailed in Flow Science (2008), available data are insufficient to support development of scientifically valid numeric limits such as numeric triggers and NELs. Collection of a dataset to support numeric limit development will require a well-designed, carefully-planned program of data collection over a period of years. Data should be collected to characterize variability in flow and concentration within a storm and from storm-to-storm; variability by region and soil type; relationship to rainfall amount and storm intensity; and BMP effectiveness.

Inherent variability in storm flows and pollutant concentrations makes steady-state approaches inappropriate for calculating numeric limits for storm flows. Because of this variability, dynamic modeling approaches may be required to calculate appropriate numeric limits. However, dynamic modeling approaches require detailed data sets; it is not clear that the current receiving water monitoring proposal would provide data or information useful for the future calculation of numeric limits, for a variety of reasons. First, it does not appear that the resulting dataset would be representative of conditions throughout the state, or of the range of conditions that the permit must regulate. Second, the data collection program would not characterize BMP performance, or effluent variability from storm-to-storm or over a range of sites.

For these reasons, CICWQ believes that the appropriate course of action would be for the SWRCB to initiate a comprehensive data collection program and to use these data to test various approaches for determining reasonable potential and developing appropriate numeric limits.

In our view, detailed data sets would be required to establish numeric limits for storm flows. At a minimum, these data sets would include:

- Effluent concentration data collected more frequently than once per hour during storm events
- Effluent flow data, preferably as a continuous record, but at a minimum more frequently than once per hour during storm events
- Receiving water concentration data, collected more frequently than once per hour during the intended discharge time period
- Receiving water flow data, preferably as a continuous measurement, but at a minimum more frequently than once per hour
- Information on the storm event during which data collection occurs – e.g., rainfall amount, antecedent dry period, and generation of a storm hydrograph

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- Information on BMPs and storm water management practices at construction sites

Preferably, data collection requirements will be specified by the State Water Board, so that data would be collected in a uniform manner throughout the state. These data could be used to establish a methodology for calculating appropriate permit limits and for subsequent data collection. The methodology would specify acceptable approaches to calculating permit limits, data collection requirements to be used in the permit, and procedures for determining compliance with those limits.

III. Concluding Remarks

CICWQ membership and its coalition partners are in the forefront of water quality regulation, providing to water quality regulators practical ideas that are implementable at construction job sites and that have as their goal clean water outcomes. If you have any questions or want to discuss the content of our comment letter, please feel free to contact me at (951) 781-7310, ext. 213, (909) 525-0623, cell phone, or mgrey@biasc.org.

Respectfully,

Mark Grey, Ph.D.
Technical Director
Construction Industry Coalition on Water Quality

Attachments

Tables 1-3
Figures 1-4
References Cited

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Table 1. Regional Water Boards' enforcement data; Reproduction of Table 3 at p. 15 of the Fact Sheet.

Table 3 – ACL Sampling Data taken by Regional Water Board Staff

WDID#	Region	Discharger	Turbidity (NTU)
5S34C331884	5S	Bradshaw Interceptor Section 6B	1800
5S05C325110	5S	Bridalwood Subdivision	1670
5S48C336297	5S	Cheyenne at Browns Valley	1629
5R32C314271	5R	Grizzly Ranch Construction	1400
6A090406008	6T	El Dorado County Department of Transportation, Angora Creek	97.4
5S03C346861	5S	TML Development, LLC	1600
6A31C325917	6T	Northstar Village	See Subdata Set

Subdata Set - Turbidity for point of storm water runoff discharge at Northstar Village

Date	Turbidity (NTU)	Location
10/5/2006	900	Middle Martis Creek
11/2/2006	190	Middle Martis Creek
01/04/2007	36	West Fork, West Martis Creek
02/08/2007	180	Middle Martis Creek
02/09/2007	130	Middle Martis Creek
02/09/2007	290	Middle Martis Creek
02/09/2007	100	West Fork, West Martis Creek
02/10/2007	28	Middle Martis Creek
02/10/2007	23	Middle Martis Creek
02/10/2007	32	Middle Martis Creek
02/10/2007	12	Middle Martis Creek
02/10/2007	60	West Fork, West Martis Creek
02/10/2007	34	West Fork, West Martis Creek

Table 2. Statistical summary of pH and TSS (mg/l) levels in receiving water in undeveloped areas of southern California by watershed during storm events; source (Yoon and Stein 2008).

	Size	Min	25%	Median	75%	Max
pH	41	6.9	7.1	7.8	8.1	8.5
TSS (mg/l)	212	0	4	22	170	103,000

Size= number of data points; Min = minimum; Max = maximum; 25%=25th percentile; 75%=75th percentile

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Table 3. Statistical summary of pH and TSS (mg/l) levels in receiving water in undeveloped areas of southern California by watershed during storm events; source (Yoon and Stein 2008).

Parameter	Watershed	Size	Min	25%	Median	75%	Max
pH	Calleguas	2	7.8	7.8	7.8	7.8	7.8
	LA River	4	7.5	7.6	7.8	7.9	8.0
	San Gabriel	8	7.7	7.9	8.0	8.1	8.2
	San Luis Rey	11	6.9	7.0	7.0	7.1	7.3
	San Mateo	4	7.0	7.1	7.4	7.7	7.7
	Santa Ana	9	8.3	8.3	8.4	8.5	8.5
	Santa Clara River	2	7.9	7.9	7.9	7.9	7.9
TSS	Arroyo Sequit	26	1	10	49	153	2220
	Calleguas	6	201	1820	2975	3190	3350
	LA River	13	4	8	23	115	260
	Malibu Creek	10	10	32	177	205	342
	San Gabriel	32	2	2	8	56	1100
	San Juan	21	2	2	51	95	932
	San Luis Rey	20	0	1	4	9	104
	San Mateo	17	2	10	158	990	5100
	Santa Ana	29	0	0	2	5	161
	Santa Clara River	17	2	133	269	4122	103000
	Ventura River	18	1	10	63	208	724

Size= number of data points; Min = minimum; Max = maximum; 25%=25th percentile; 75%=75th percentile

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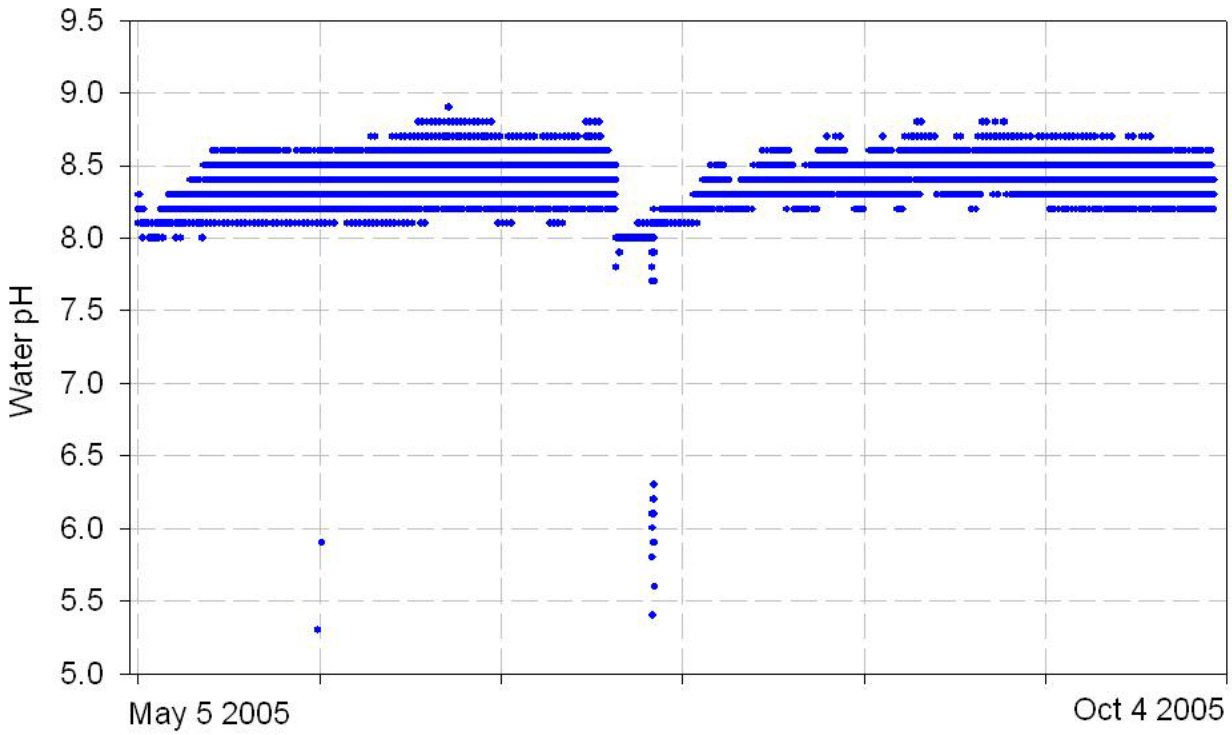

Figure 1. Hourly pH in the Trinity River near Weitchpec. The station (WPC) is located at latitude 41.179 and longitude -123.706. pH data (N=11,864) are available only from 05/05/2005 to 10/04/2005. Source: http://cdec.water.ca.gov.

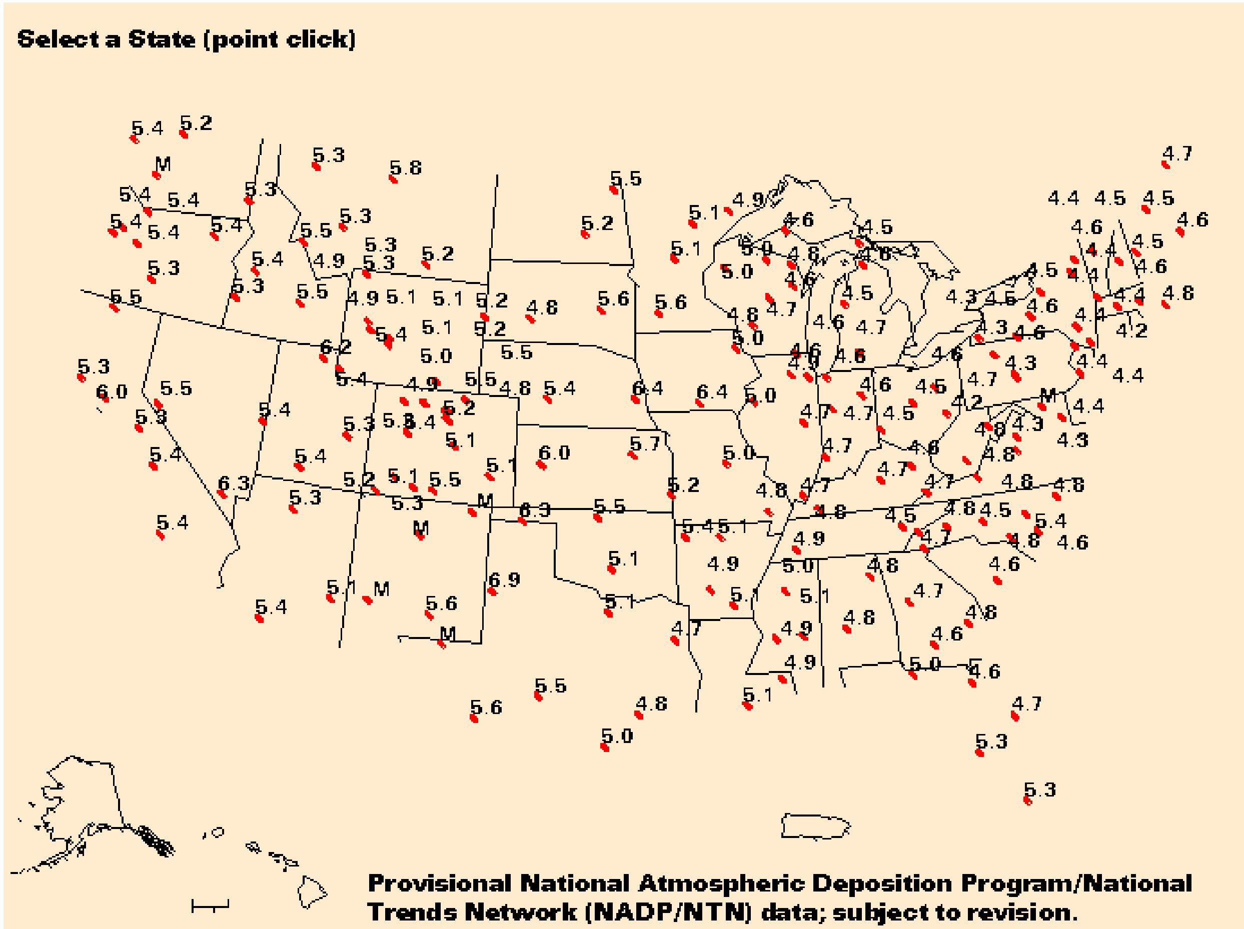

Figure 2. pH of precipitation for November 26 - December 23, 2001. Obtained from http://water.usgs.gov/nwc/NWC/pH/html/ph.html.

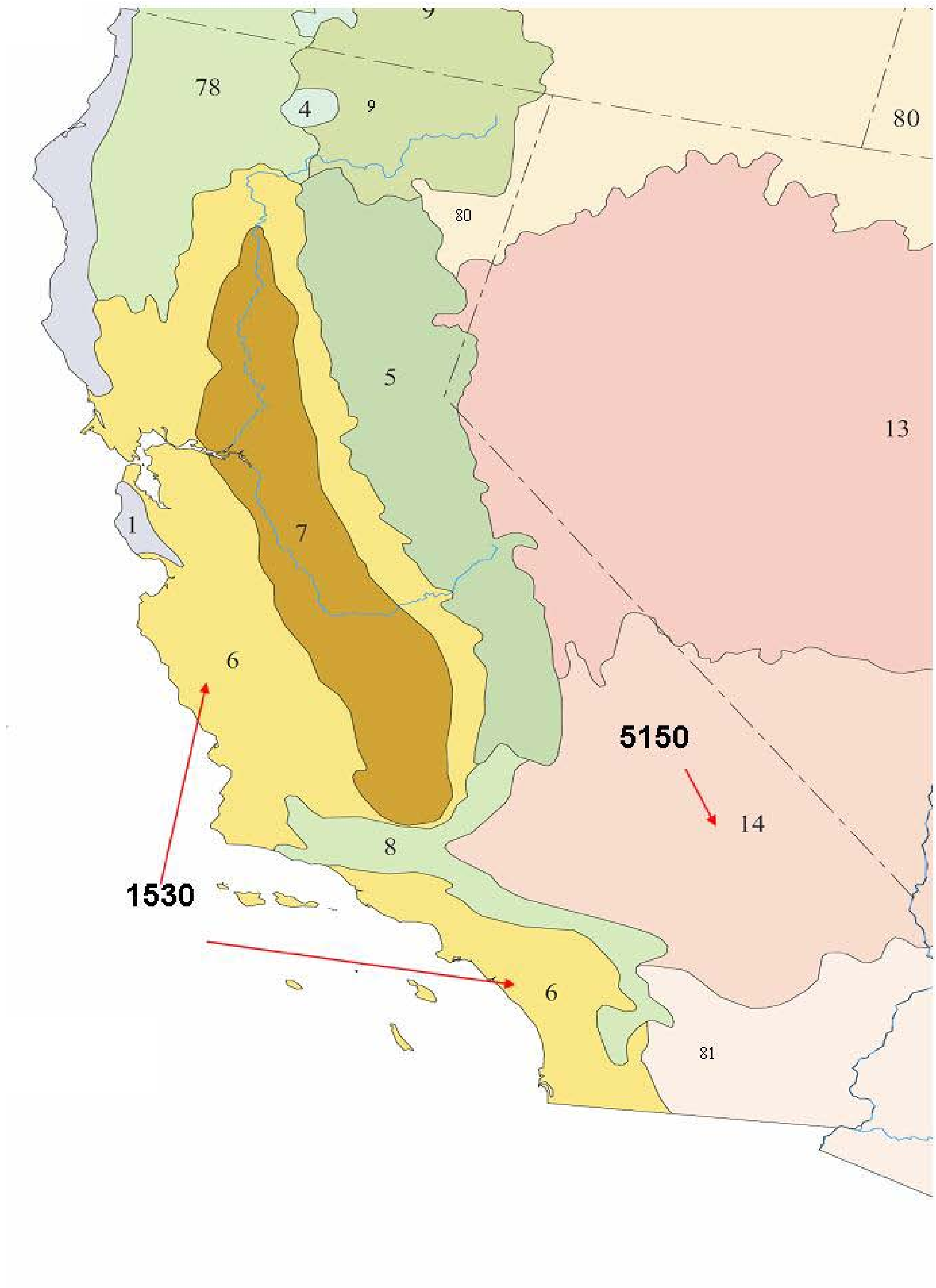

Figure 3. EPA level III ecoregion map with median suspended sediment concentrations (mg/l) for ecoregions 6 and 14 from Simon et al. (2004).

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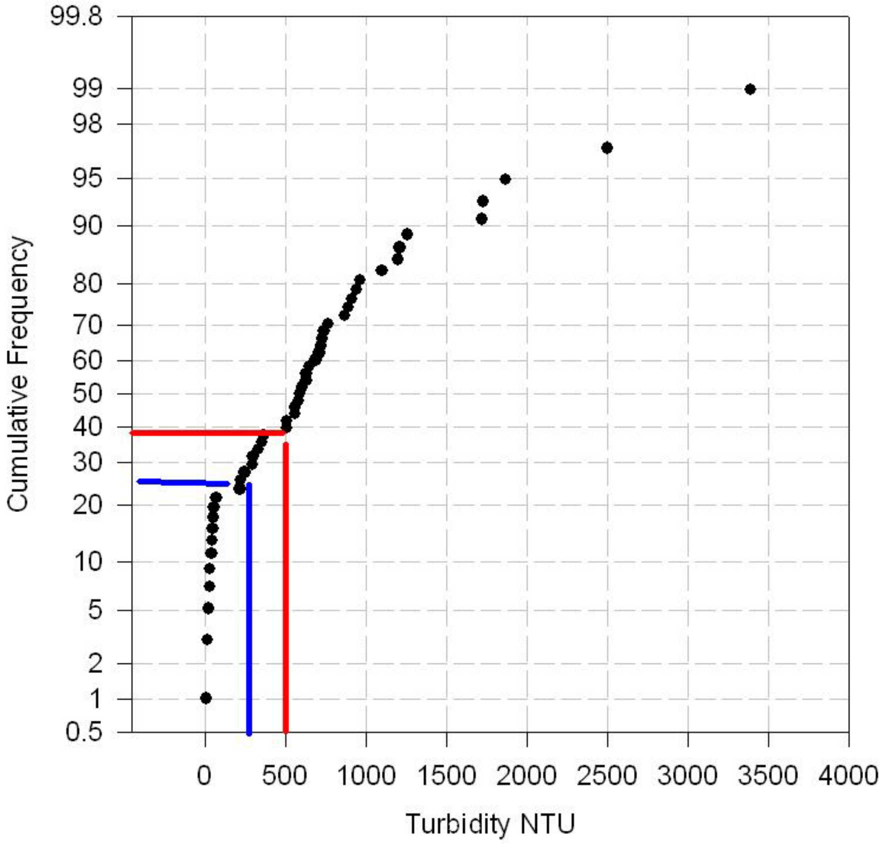

Figure 4. Cumulative percentile plot of Caltrans turbidity data, based on 49 data points collected during water year 1999/2000 and 2001/2002 (no data were collected during water year 2000/2001; Caltrans 2002). The data in the Caltrans (2002) dataset would exceed the proposed NEL of 500 NTU 60% of the time and would exceed the proposed NAL of 250 NTU 75% of the time.

REFERENCES CITED

Caltrans (2002). Caltrans construction sites runoff characterization study. Sacramento, CA, California Department of Transportation.

Flow Science (2008). General Construction Permit: Action Levels and Numeric Effluent Limits Analysis and Recommendation of Alternatives - Prepared for California Building Industry Association (CBIA) Pasadena, CA: 131.

Yoon, V. K. and Stein, E. D. (2008). "Natural catchments as sources of background levels of storm-water metals, nutrients, and solids." Journal of Environmental Engineering 134(12): 961-973.