ROBERTSON - BRYAN, INC.
Specializing in Water and Power Resources

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April 20, 2007

DELIVERED BY ELECTRONIC MAIL

Mr. Jim Marshall
Regional Water Quality Control Board
Central Valley Region
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670

SUBJECT: COMMENTS ON THE MARCH 21, 2007 TENTATIVE WASTE DISCHARGE REQUIREMENTS AND TIME SCHEDULE ORDER FOR THE MOUNTAIN HOUSE COMMUNITY SERVICES DISTRICT

Dear Mr. Marshall:

On behalf of the Mountain House Community Services District (MHCSD), Robertson-Bryan, Inc. (RBI) is submitting final comments on the March 21, 2007 Tentative Waste Discharge Requirements (WDRs) and Time Schedule Order (TSO) issued for MHCSD's Wastewater Treatment Plant (WWTP). We appreciate the opportunity to provide comments (Attachment 1) on these Tentative Orders, and look forward to discussing our comments with you, Dr. Carlson, and Mr. Landau prior to the Board hearing at which these Tentative Orders would be adopted as final Orders. We believe that meeting with Board staff to discuss our final comments is an important part of the public process associated with issuing these Orders.

As you are aware, we submitted a draft of these comments, per your request, on Friday, April 13, 2007, to assist you in making appropriate changes to the Tentative Order prior to issuing it to your Board in the Board package. However, we understand that you had insufficient time to fully process and discuss with us our comments of April 13, 2007. We also understand that the late release of this Tentative Order has placed time constraints on you such that the Board package for the May hearing needed to go out on April 13th, which was prior to the close of the public comment period for the Order, which is April 20th. Thus, to best facilitate addressing our comments prior to the Orders being brought before your Board for adoption as currently planned (at the May 3-4, 2007 hearing), we wish to meet with you, Dr. Carlson, and Mr. Landau next week (week of April 23-27) to discuss the attached comments.

Please email me, at your earliest possible convenience, with dates and times to meet that would work for the three of you. We will work to accommodate your busy schedules. If your schedules are unable to accommodate this meeting in a timely manner to discuss the possibility of late revisions to address at least some of our concerns, then we must respectfully request that this item be removed from the May 3-4, 2007 Board agenda and be re-scheduled for hearing at the June 21-22, 2007 Board meeting.

ROBERTSON - BRYAN, INC.
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We look forward to working through the remaining issues and to assisting you in the development of a Tentative Order that both the Regional Board and MHCSD staff can support, and that we can jointly present, uncontested, to your Board.

Please contact me at (916) 714-1802 if you have any questions.

Sincerely,

ROBERTSON-BRYAN, INC.

Michael D. Bryan, Ph.D.
Partner and Principal Scientist

cc: via electronic copy only

Ken Landau, RWQCB
David Carlson, Ph.D., RWQCB
Paul Sensibaugh, General Manager, MHCSD
Duane Grimsman, Sterling Pacific Assets
Kevin Peters, Shea Homes
Roberta Larson, Somach, Simmons, & Dunn
Paul Rydzynski, PACE

Attachments: Comments on the March 21, 2007 Tentative Orders

COMMENTS
FROM
MOUNTAIN HOUSE COMMUNITY SERVICES DISTRICT
ON
TENTATIVE WASTE DISCHARGE REQUIREMENTS
FOR
NPDES NO. CA0084271
Issued March 21, 2007

MOUNTAIN HOUSE COMMUNITY SERVICES DISTRICT
WASTEWATER TREATMENT FACILITY
SAN JOAQUIN COUNTY

Submitted April 20, 2007

I. COMMENTS ON THE TENTATIVE NPDES PERMIT

A. Specific Comments

(1) p. 3, Facility Design Flow. The tentative order states that the facility design flow is 3.0/5.4 million gallons per day (mgd). The facility design flow description needs to be further clarified by adding in that the design flow is based on average dry weather flow ("ADWF"). Without the clarification and addition of ADWF, the permit implies that the design flow is limited to 3.0/5.4 mgd as a static limit under all circumstances. In addition to making the correction on page 3, the correction must also be made throughout the permit wherever the facility design flow is discussed or identified.

(2) p. 10, Final Effluent Limitations – Iron. The tentative order proposes a final effluent limitation for iron that is 300 ug/L as a maximum daily limit. The application of the iron effluent limitation as a daily maximum is not appropriate. The numeric objective for iron, as contained in the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, is 300 ug/L (dissolved). (Basin Plan at p. III-4.00.) The numeric objective for iron was derived from the *Tentative Guidelines for Evaluating the Quality of Raw Water Used as a Source of Municipal Supplies (MUN)* (issued to the Regional Board by the State Water Resources Control Board in the development of the 1975 Basin Plans). A review of the administrative record for the Basin Plan indicates that these objectives were adopted in the original 1975 Basin Plan to be protective of drinking water uses and were consistent with drinking water standards contained in the Administrative Code at that time.[1] In particular, the drinking water standard for iron is a taste and odor standard that does not pose an acute threat to aquatic life or public health. As such, the

[1] The Administrative Record for the adoption of the 1975 Basin Plan includes a *Staff Report on Major Issues of Public Testimony* that contains a staff response supporting the contention that the iron numbers were adopted for drinking water supplies and that filtration removes the oxidized form of iron found in surface waters. "The iron and fluoride standards, unlike copper, were set for drinking water supplies. At concentrations greater than the 0.3 mg/L limit, iron imparts objectionable taste and stains laundry. Domestic water treatment can remove the oxidized form of iron normally found in surface waters, however."

final effluent limitation for iron should be applied based on a long-term average and not as a daily maximum.

Furthermore, a determination of assimilative capacity for iron must be based on an evaluation of dissolved data and not total iron data as the adopted objective is specifically expressed as dissolved in the Basin Plan. (Basin Plan, Table III-1 at p. III-4.) The fact sheet should be revised to reflect that assimilative capacity must be determined by reviewing dissolved data. Finally, the time schedule order should be revised to reflect the potential development of a translator for iron as the Regional Board staff has currently applied a default translator of 1 to translate the dissolved iron objective into a total effluent limitation.

(3) p. 11, Final Effluent Limitations – EC. The MHCSD does not support the final effluent limit for electrical conductivity as contained in the tentative order. As proposed, the MHCSD would be subject to final limits of 700 umhos/cm (April 1 to August 31) and 1000 umhos/cm (September 1 to March 31) unless the District implements measures to meet an interim goal of 500 umhos/cm over source water; and, the District participates financially in the development of the Central Valley Salinity Management Plan. In both instances, the District's compliance with the effluent limitation provisions is a subjective interpretation by the Executive Officer. Furthermore, the amount of financial participation that would be required is open-ended and undisclosed. Due to uncertainties associated with complying with these provisions in order to avoid the application of the final effluent limits, MHCSD cannot support the inclusion of these effluent limitations.

However, MHCSD is generally supportive of the Regional Board's efforts to develop a Central Valley Salinity Management Plan. To assist the Regional Board in this endeavor, MHCSD may be willing to support such efforts financially at a reasonable level, to the extent that their share be proportionate to other dischargers in the region. However, the MHCSD Board of Directors must ultimately approve any such participation. It is not appropriate for such a financial contribution to be included as a NPDES permit provision.

For the permit itself, MHCSD has reviewed the salinity control options provided by the Regional Water Board staff on *Enclosure 1 – Salinity Control Options*. The most appropriate option, as presented by the Regional Water Board staff, is the application of Option 1. Option 1 would include effluent limitations for electrical conductivity in a finding but not as an enforceable limit. MHCSD supports this option as the most appropriate method to address salinity in the District's permit, as compliance with the final effluent limitations of 700 umhos/cm and 1000 umhos/cm is uncertain and costly. However, MHCSD is concerned with some of the language contained within the proposed finding as it implies that the effluent limitations may be viable at a future time. We recommend the following revisions to the Regional Board staff's proposed findings language for Option 1:

> The discharge has the reasonable potential to cause or contribute to an exceedance of the State Water Board's Salinity Compliance Points in the vicinity of the discharge. There is little or no assimilative capacity for electrical conductivity in Old River at times. The ~~appropriate~~ anticipated effluent limitations for the discharge, based on the adopted numeric water quality objectives, are a monthly

average of 700 umhos/cm (April 1 to August 31) and a monthly average of 1000 umhos/cm (September 1 to March 31). The Regional Board finds that ~~C~~ compliance with these effluent limitations will take many years, if at all feasible. Actions that may lower salinity in the effluent may include ~~probably~~ requiring identification and elimination of saline discharges to the collection system, acquisition of lower salinity community water supplies, and possibly providing treatment of at least a portion of the wastewater flow to remove salt constituents. These limitations would be new requirements that become applicable to the Order after the effective date of adoption of the waste discharge requirements, and after 1 July 2000, for which new or modified control measures are necessary in order to comply with the limitation, and the new or modified control measures cannot be designed, installed, and put into operation within 30 calendar days.

CWC sections 13385(h) and (i) require the imposition of mandatory minimum penalties upon discharges that violate certain effluent limitations. CWC section 13385(j)(3) exempts the discharge from mandatory minimum penalties "where the waste discharge is in compliance with either a cease and desist order issued pursuant to Section 13301 or a time schedule order issued pursuant to Section 13300, if all the [specified] requirements are met." One of the specified requirements is that the time schedule may not exceed five years in length. Compliance with the effluent limitations for electrical conductivity will require more than five years to accomplish, if at all feasible, making the Discharger subject to potential mandatory minimum penalties even if it is working with due diligence to ~~achieve compliance~~ lower salinity in the effluent. Therefore, the final effluent limitations are only referenced in this Finding, and not adopted as an enforceable final effluent limitation. If the Discharger fails to make reasonable progress towards ~~achieving compliance with~~ reducing the electrical conductivity of the discharge, the Regional Water Board will reconsider the need to adopt final effluent limitations for electrical conductivity.

See also Fact Sheet p. F-11-12, and F-55, where text pertaining to the 700 umhos/cm and 1000 umhos/cm EC effluent limitations also exists.

(4) p. 14, Interim Effluent Limits. As stated in the TSO (p. 1, section 3), effluent limitations specified for iron and Group A pesticides are based on Basin Plan water quality objectives, and are new limitations for this discharger. The Group A pesticides also is a new objective, because it is a "ND" objective and analytical methods have improved since the objectives were adopted, and since September 25, 1995. Consequently, their compliance schedules should be in the permit (along with aluminum), not in the TSO.

Edit also needed in Fact Sheet, p. 43 for iron and p. 46-47 for organochlorine pesticides.

(5) p. 23, iii Numeric Monitoring Trigger. MHCSD requests that the parenthetical "*(where TUc = 100/NOEC)*" be edited to read: (where TUc = 100/NOEC or 100/IC25), consistent with how this section reads for the Town of Windsor's (Region 1) NPDES permit (see email sent to J.

Marshall from M. Bryan on 4-13-07, 2:25 pm). The justification is provided below and in the above-cited email.

A chronic toxic unit (TUc) is defined by EPA as the reciprocal of the effluent concentration in a bioassay that causes no observable effect (NOEC) on the test organisms (i.e., TUc = 100/NOEC) (USEPA 1991). In calculating the TUc, the NOEC is determined through statistical hypothesis testing, the result of which can be significantly limited by the choice of dilution series. EPA review of toxicity testing data suggests that the 25 percent inhibition concentration (IC25) can serve as a reliable analogue to the NOEC, and states in fact that the IC25 point estimate is the preferred statistical method for determining the NOEC (USEPA 1991). For this reason, TUc can equal the reciprocal of the IC25 (i.e., 100/IC25)

See also Attachment A – Definitions, p. 1 and Fact Sheet for additional places to make this change.

United States Environmental Protection Agency. 1991. Technical support document for water quality-based toxics control. EPA 505-2-90-001. Office of Water. Washington D.C. March 1991.

(6) p. 20, Reopener Provisions, C.1.f Dilution Credits. The following language modifications are requested:

"……Section IV.c.2.b., the Discharger has not provided adequate information for the allowance of dilution credits.~~, most importantly, real-time flow monitoring data in the vicinity of the discharge~~. Should adequate data be developed and provided to RWQCB staff, ~~a real-time flow monitoring station be installed in the vicinity of the discharge,~~ and if this information ~~real-time flow monitoring data from the station~~ demonstrates that sufficient dilution flows are available in Old River, this Order may be reopened to allow dilution credits based on the ~~real-time flow monitoring~~ data."

Request that the same edits be made to the Fact Sheet, page 26, xii Dilution Credits for Future Permits, and Fact Sheet Page 68, h Dilution Credits.

(7) p. 26 Salinity reduction goal. 1000 EC is not consistent with final limit approach of background + 500.

(8) p. 27, a, ii – Discharge Flow Expansion (Phase III) and III – Request for Increase. As currently drafted, the discharge flow can not be increased from 3.0 to 5.4 mgd unless the District is compliant with the final effluent limitations IV.A. and VI.C.4.b for aluminum, regardless of the compliance schedule for aluminum and other constituents that are contained in the tentative order and the TSO. MHCSD does not support the tentative order's provision requiring compliance with the final effluent limitations, including the aluminum final effluent limit which is specifically "called-out" under VI.C.4.b, for an increase in permitted discharge flow. Compliance with the aluminum final effluent should be tied directly to the compliance schedule as contained in the tentative order. A decision to allow the increase in discharge is unrelated to

compliance with the final effluent limits, which is controlled by the compliance schedule provisions contained in the tentative order and the TSO.

(9) p. 34, D Average Dry Weather Flow. The tentative orders should be revised to reflect that average dry weather flow should be determined over three consecutive dry weather months each year. Thus, we recommend that the following sentence be added to the final effluent limitation for average dry weather flow. "The average dry weather flow shall be determined over three consecutive dry weather flow months each year."

(10) p. 35, Group A Pesticides Effluent Limitation. The MHCSD requests the following text edit.
"The non-detectable (ND) limitation applies to each individual pesticide. No individual pesticide may be present in the discharge at detectable concentrations. The Discharger shall use USEPA standard analytical techniques with ~~the lowest possible detectable level for Group A pesticides with~~ a minimum acceptable reporting level as indicated in appendix 4 of the SIP."
Because the objective is "ND," the current language effectively results in the Discharger changing the applicable criteria to which they must comply based on the lab they select. The edit locks the "ND" objective to a level of quantification that the State has defined in SIP App. 4.

1. ATTACHMENT A - Definitions

(11) p. 1, Best Practicable Treatment or Control (BPTC). The tentative order includes a definition for best practicable treatment or control (BPTC), which basically recites that BPTC is part of Resolution 68-16 and includes a sentence from Resolution 68-16. In addition, the tentative order includes a citation to the definition of pollution from the California Water Code. Overall, MHCSD does not object to the tentative order's references to resolution 68-16. However, resolution 68-16 and State Policies currently do not define BPTC.

Furthermore, MHCSD does not support the last sentence of this definition, which claims that "[i]n general, an exceedance of a water quality objective in the Basin Plan constitutes 'pollution'." This statement is not consistent with the definition of pollution in the California Water Code and must therefore be removed from the tentative order. In order for there to be "pollution," there must first be "an alteration of the quality of the waters of the state by **waste.**" (Water Code section 13050(l), *emphasis added*.) Second, there must be alteration to a degree that unreasonably affects the beneficial uses. The mere presence of an exceedance of a water quality objective does not necessary involve waste and does not necessarily affect beneficial uses. Thus, this sentence must be removed from the definition of BPTC.

(12) p. 1, Chronic Toxicity Unit. See comment No. 4 (above).

2. Monitoring and Reporting Program

(13) p. E-8, VIII. Receiving Water Monitoring Requirements, A. Surface Water Monitoring.

It is unnecessary to conduct receiving water monitoring for constituents that are effectively regulated via end-of-pipe effluent limitations, and this has not been required of other dischargers in the region. Consequently, we request that the following be removed from the receiving water monitoring requirements. If any of the constituents listed below are retained in the MRP for sites R-001, R-002, R-003, and R-004, we request their frequency be reduced from monthly to quarterly or annually.

Ammonia (as N)
Mercury, total)
Mercury, methyl
Nitrate (as N)
Nitrite (as N)
Total Kjeldahl Nitrogen (as N)
Total Organic Carbon
Total phosphorus
Trihalomethanes (change to chloroform).

(14) p. 5, V.A.1 – Monitoring Frequency. Request the following edit.

"the Discharger shall, for the first year following adoption of this Order, perform ~~weekly~~ monthly acute toxicity testing, concurrent with effluent ammonia sampling. This frequency may then be changed to the normal quarterly frequency, upon approval by the Executive Officer."

(15) p. 12, 3.b. – Detected but not Quantified. The MHCSD requests the following edits.

"With the exception of Group A Pesticides, s~~S~~ample results less than the RL, but greater than or equal to the laboratory's MDL, shall be reported as "Detected, but Not Quantified," or DNQ. The estimated chemical concentration of the sample shall also be reported."

The reason being is that any detect, quantified or not, would be an exceedance of the Group A pesticide limitation of "ND."

3. *Fact Sheet*

(16) p. F-31/32, and F-54, Effluent Limitations, Aluminum. The following is stated in the permit on p. F-27 of the Fact Sheet: *"Based on 15 samples collected in 2004-2005, the lowest receiving water hardness was measured as 100 mg/L as* $CaCO_3$*."* In addition, the lowest effluent hardness on record is 91 mg/L as $CaCO_3$. Because the receiving water hardness is expected to always be above 91 mg/L as $CaCO_3$, the U.S. EPA's recommended 87 µg/L chronic aquatic life criteria used as the basis for this effluent limitation is not appropriate (see Attachment 1). U.S. EPA's recommended aluminum criterion for chronic protection of aquatic life for waters having pH at or above 6.5 and hardness above 91 mg/L as $CaCO_3$ is 750 µg/L. Because the maximum effluent concentration of aluminum is 540 µg/L, there is no reasonable potential to exceed the applicable aquatic life criterion for aluminum.

See also p. 6 of the 1988 Aluminum criteria document, last sentence of first paragraph (Attachment 2).

Based on this factual information, the 200 ug/l MCL should drive the Al effluent limit, not the appropriate chronic aquatic life criterion of 750 ug/l.

(17) p. 56-57 – Total THMs. Page 57 states: "*Therefore, to protect the MUN use of the receiving waters, the Regional Water Board finds that, in this specific circumstance, application of the USEPA MCL for total THMs for the effluent is appropriate, as long as the receiving water does not exceed the OEHHA cancer potency factor's equivalent receiving water concentration at a reasonable distance from the outfall.*" The permit provided individual effluent limitations for DBCM and DCBM, which is inconsistent with the above cited statement in the Fact sheet.

B. FACTUAL AND TECHNICAL CORRECTIONS

1. Limitations and Discharge Requirements

(18) p. 10, f. Average Dry Weather Flow. This effluent limitation is duplicative of Effluent Limitation IV.2.b on p. 12 and is inconsistent with Effluent Limitation IV.3.b on p. 13 and should be deleted.

(19) p. 11, Provision IV.A.1.k, Electrical Conductivity. This section identifies a new "*interim salinity goal of a maximum 500 umhos/cm electrical conductivity increase over the weighted average electrical conductivity of the MHCSD's water supply.*" This discharge specification (and similar language in the Fact Sheet (p. F-50), IV.C.3.z.vi, Item 1) is inconsistent with Provision VI.C.3.c (p. 25) and in the, Rationale for Effluent Limitations and Discharge Specifications.

2. Monitoring and Reporting Program

(20) p. E-14, X.D.1, Progress Reports Matrix. The reference to the Special Provision for aluminum should be VI.C.4.b, not VI.C.4.c.

3. Fact Sheet

(21) Fact Sheet – Table 1 – The footnote to table 1 is inconsistent with the permit terms and would require compliance with the final effluent limitation for aluminum before the District could discharge up to 3.0 mgd. [See comment #6 (above). Request appropriate edit here as well.]

(22) Fact Sheet – Facility Description 3 – The tentative order is being revised to reflect that the District has begun discharging on March 13, 2007. The tentative order should be further revised to reflect that the discharge that begun on March 13, 2007 is a legally permitted discharge pursuant to NPDES Permit No. 0084271, Order No. 98-192.

(23) p. F-9/10, Antidegradation Policy, and p. F-50, Effluent Salinity Controls. The last sentence of the following paragraph should be modified as follows: "*The Discharger develops and implements a salinity source control program as approved by the Executive Officer that will*

identify and implement measures to reduce salinity in discharges from residential, commercial, industrial and infiltration sources in an effort to meet an interim salinity goal of a maximum 500 umhos/cm electrical conductivity increase over the weighted average conductivity of the ~~City of Tracy's~~ <u>MHCSD's</u> water supply; and"

<u>(24) p. F-12, Antidegradation Policy</u>. The following sentence should be modified as follows: *"Furthermore, this Order establishes an interim effluent limitation of ~~1400~~ <u>1406</u> umhos/cm as electrical conductivity…"*

<u>(25) p. F-41, Organo-Chlorine Pesticides</u>. The following sentence should be modified as follows: *"Aldrin and heptachlor were detected in the effluent in concentrations as high as ~~0.002~~ <u>0.005</u> µg/L, and ~~0.01~~ <u>0.023</u> µg/L, respectively."*

<u>(26) p. F-53, Table F-4</u>. The following corrections to this table are required:

- Bentazon – MEC is 0.49 ug/L
- Dalapon – MEC is 0.55 ug/L
- Heptachlor – MEC is 0.023 ug/L
- Pentchlorophenol – MEC is 0.065 ug/L
- Phosphorus – MEC is 1000 ug/L
- Thallium – MEC is 0.005 ug/L

<u>(27) p. F-54, Table F-5, Summary of Reasonable Potential Analysis</u>. The following corrections to this table are required:

- Aluminum – MEC is 540 ug/L
- Barium – MEC is 37 ug/L
- Bentazon – MEC is 0.49 ug/L
- Chloride – MEC is 310 ug/L
- Fluoride – MEC is 560 ug/L
- Foaming agents (MBAS) – MEC is 74 ug/L
- Heptachlor – The table currently cites Endrin criteria for heptachlor. These criteria should be replaced with the CTR criteria for heptachlor.
- Iron – MEC is 800 ug/L
- Manganese – MEC is 20 ug/L
- Phosphorus – MEC is 1000 ug/L
- Specific conductance – MEC is 1242 umhos/cm
- Sulfate – MEC is 160 mg/L
- Thallium – MEC is 0.005 ug/L
- TDS – MEC is 840 mg/L

<u>(28) p. F-66, VII.B.1, Special Provisions, Reopener Provisions</u>. This section of the Fact Sheet contains errors in the cross-references to the Special Provisions section of the Limitations and Discharge Requirements. Specifically, the following corrections are warranted on pages 75:

  - d. Temperature – cross reference should be to Special Provision VI.C.2.b.

- e. Pollution Prevention Plan – aluminum should be included in the list of constituents, consistent with Special Provision VI.C.1.d (p. 21)

(29) p. F-72, VII.B.3.d, Pollution Prevention Plans. In the first sentence of this section, the reference to copper should be deleted and a reference to aluminum added.

(30) p. F-73, VII.B.4.b, Compliance Schedule for Aluminum. This item should reference Special Provision VI.C.4.b

(31) p. F-81, d. CWC Section 13263.3(d)(3) Pollution Prevention plans. The first sentence needs to be edited as follows: "*The pollution prevention plans required for ~~copper,~~ salinity~~,~~ and mercury shall, at minimum, meet the requirements outlined in CWC section 13263.3(d)(3).*"

The reason for this is that copper did not show RP, and the permit does not require a PPP for copper, but does for mercury and salinity.

II. TIME SCHEDULE ORDER

(32) p. 4 (table), Interim effluent limitations for cyanide. The table does not identify the interim effluent limitation for cyanide.

ATTACHMENT 1

LETTER FROM U.S. EPA HEADQUARTERS REGARDING THE PROPER PERMITTING OF ALUMINUM

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER

December 19, 2003

Richard McHenry
Central Valley Regional Water Quality Control Board
McHenrR@rb5s.swrcb.ca.gov

Michael Bryan
Robertson-Bryan, Inc.
bryan@robertson-bryan.com

Dear Mr. McHenry and Mr. Bryan:

This is in follow-up to my letter of November 1, 2002. Both of you have requested clarification of the issues discussed therein.

As has been previously pointed out, EPA's 1988 chronic aluminum criterion, 87 µg/L, is based on two tests, one with brook trout and one with striped bass, at low hardness (10 - 12 mg/L) and low pH (6.5 - 6.6 SU). This value is considered to be necessary for protecting waters having such low hardness and pH. However, this value is expected to be overly protective when applied to waters of moderate hardness and pH. Many such waters are known to exceed this value while fully attaining the goals of the Clean Water Act.

Based on data for a diversity of species tested at hardness in the range of 45 - 220 mg/L and pH in the range of 6.5 - 8.3, the 1988 document notes that the chronic criterion would be determined to be 750 µg/L. Consequently, with EPA approval, some states apply this 750 µg/L value to waters of moderate (or higher) hardness and pH.

EPA has recently worked with the State of Utah to develop the following provision in their standards:

> The aluminum criteria are expressed as total recoverable metal in the water column. The 87 µg/L chronic criterion for aluminum is based on information showing chronic effects on brook trout and striped bass. The studies underlying the 87 µg/L chronic value, however, were conducted at low pH (6.5 - 6.6) and low hardness (< 10 ppm CaCO3), conditions uncommon in Utah's surface waters. A water effect ratio toxicity study in West Virginia indicated that aluminum is substantially less toxic at higher pH and hardness (although the relationship is not well quantified at this time). Further, EPA is aware of field data indicating that many high quality waters in the U.S. contain more than 87 µg/L aluminum when either the total recoverable or dissolved aluminum is measured. Based on this

> information and considering the available toxicological information in Tables 1 and 2 of EPA's Aluminum Criteria Document (EPA 440/5-86-008), the Department of Environmental Quality will implement the 87 µg/L chronic criterion for aluminum as follows: where the pH is equal to or greater than 7.0 and the hardness is equal to or greater than 50 ppm as $CaCO_3$ in the receiving water after mixing, the 87 µg/L chronic criterion will not apply, and aluminum will be regulated based on compliance with the 750 µg/L acute aluminum criterion. In situations where the 87 µg/L chronic criterion applies, a discharger may request development of a site-specific chronic criterion based on a water effect ratio. Or, a discharger may request development of a permitting procedure (a translator) that would take into account less toxic forms of particulate aluminum. In either case, the Department may require that the discharger requesting the change provide the technical information and data needed to support such a change.

I believe that such an approach may be helpful in resolving the water quality issues you are dealing with. Depending on hardness and pH, either the criterion 750 µg/L is applied, or a criterion of 87 µg/L with or without a Water-Effect Ratio (WER) modification is applied.

Experience indicates that WER studies are appropriate for aluminum, using *Ceriodaphnia* as the test species. Under conditions of low pH and temperature, *Ceriodaphnia* is as sensitive as brook trout or striped bass.

Although EPA endorses the Utah approach, we recognize that such an approach does not resolve all aluminum issues. In particular, in some streams, nontoxic clay particles (aluminum silicate), measured by the total recoverable procedure, are high enough to exceed the 750 µg/L criterion. Although measured by the total recoverable procedure, the criterion is not intended to apply to aluminum silicate particles, as noted in the 1988 document.

The EPA criteria program recognizes that a more thoroughgoing solution is needed for resolving the problems with the 1988 criterion. Nevertheless, resources have not been allocated to such an undertaking. There are two reasons for this. First, aluminum is not a priority pollutant. Most states do not have an aluminum criterion. Nor has EPA ever promulgated a criterion for aluminum in any rule. Second, aluminum chemistry is extremely complex. Attempting development of a biotic ligand model for aluminum would require more resources than for copper or silver, already daunting jobs in themselves.

From phone conversations with both of you it is apparent that there is question about the actual hardness and pH of the river to which the criterion is being applied. I cannot become further involved with such data for the site. But I will set forth the appropriate procedure for setting the hardness and pH applicable to the criterion.

The key point is that the applicable hardness and pH are those that occur in the waters downstream of the effluent. The protectiveness and appropriateness of the criterion cannot be guaranteed unless the downstream water quality parameters are used.

If using data on upstream and effluent hardness, then use the dilution formula to determine the downstream hardness concentration C_D:

$$C_D = \frac{C_E Q_E + C_U Q_U}{Q_E + Q_U}$$

where C_E and C_U are the effluent and upstream concentrations, and Q_E and Q_U the effluent and upstream flows.

Determination of downstream pH from upstream and effluent pH is more convoluted and requires data on alkalinity. EPA's 1988 document Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling sets forth the procedure, which is based on carbonate equilibrium. The subscripts U and E refer to the upstream and effluent:

1. Calculate the carbonate equilibrium constants, pK:

$$pK_U = 6.57 - 0.018\,T_U + 0.00012\,T_U^2$$
$$pK_E = 6.57 - 0.018\,T_E + 0.00012\,T_E^2$$

where T is temperature.

2. Calculate the corresponding ionization fractions, F:

$$F_U = \frac{1}{1 + 10^{pK_U - pH_U}} \qquad F_E = \frac{1}{1 + 10^{pK_E - pH_E}}$$

3. Calculate the total inorganic carbon concentrations, TIC:

$$TIC_U = \frac{Alk_U}{F_U} \qquad TIC_E = \frac{Alk_E}{F_E}$$

where Alk is alkalinity.

4. Calculate the downstream T_D, Alk_D, and TIC_D, using the standard dilution formula shown for hardness at the top of the page.

5. Calculate the downstream ionization constant.

$$pK_D = 6.57 - 0.018\,T_D + 0.00012\,T_D^2$$

6. Finally, calculate the downstream pH:

$$pH_D = pK_D - \log_{10}\left(\frac{TIC_D}{Alk_D} - 1\right)$$

State implementation procedures vary considerably with respect to the frequency corresponding to a design parameter such as hardness or pH. For the National Toxics Rule, EPA only indicated that the design hardness selected by the state should be consistent with what occurs during the low flow design event.

I hope this is helpful for resolving your issues.

Sincerely,

Charles Delos
Environmental Scientist

ATTACHMENT 2

U.S. EPA'S RECOMMENDED AMBIENT WATER QUALITY CRITERIA FOR ALUMINUM – 1988

United States
Environmental Protection
Agency

Office of Water
Regulations and Standards
Criteria and Standards Division
Washington, DC 20460

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Water

EPA

Ambient Water Quality Criteria for

Aluminum - 1988

AMBIENT AQUATIC LIFE WATER QUALITY CRITERIA FOR

ALUMINUM

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL RESEARCH LABORATORY
DULUTH, MINNESOTA

NOTICES

This document has been reviewed by the Criteria and Standards Division, Office of Water Regulations and Standards, U.S. Environmental Protection Agency, and approved for publication.

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FOREWORD

Section 304(a)(1) of the Clean Water Act of 1977 (P.L. 95-217) requires the Administrator of the Environmental Protection Agency to publish water quality criteria that accurately reflect the latest scientific knowledge on the kind and extent of all identifiable effects on health and welfare that might be expected from the presence of pollutants in any body of water, including ground water. This document is a revision of proposed criteria based upon consideration of comments received from other Federal agencies, State agencies, special interest groups, and individual scientists. Criteria contained in this document replace any previously published EPA aquatic life criteria for the same pollutant(s).

The term "water quality criteria" is used in two sections of the Clean Water Act, section 304(a)(1) and section 303(c)(2). The term has a different program impact in each section. In section 304, the term represents a non-regulatory, scientific assessment of ecological effects. Criteria presented in this document are such scientific assessments. If water quality criteria associated with specific stream uses are adopted by a State as water quality standards under section 303, they become enforceable maximum acceptable pollutant concentrations in ambient waters within that State. Water quality criteria adopted in State water quality standards could have the same numerical values as criteria developed under section 304. However, in many situations States might want to adjust water quality criteria developed under section 304 to reflect local environmental conditions and human exposure patterns before incorporation into water quality standards. It is not until their adoption as part of State water quality standards that criteria become regulatory.

Guidance to assist States in the modification of criteria presented in this document, in the development of water quality standards, and in other water-related programs of this Agency has been developed by EPA.

Martha G. Prothro
Director
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Introduction

The chemistry of aluminum in surface water is complex because of five properties (Campbell et al. 1983; Hem 1968a,b; Hem and Roberson 1967; Hsu 1968; Roberson and Hem 1969; Smith and Hem 1972). First, it is amphoteric: it is more soluble in acidic solutions and in basic solutions than in circumneutral solutions. Second, such ions as chloride, fluoride, nitrate, phosphate, and sulfate form soluble complexes with aluminum. Third, it can form strong complexes with fulvic and humic acids. Fourth, hydroxide ions can connect aluminum ions to form soluble and insoluble polymers. Fifth, under at least some conditions, solutions of aluminum in water approach chemical equilibrium rather slowly. This document addresses the toxicity of aluminum to freshwater organisms in waters in which the pH is between 6.5 and 9.0, because the water quality criterion for pH (U.S. EPA 1976) states that a pH range of 6.5 to 9.0 appears to adequately protect freshwater fishes and bottom-dwelling invertebrate fish food organisms from effects of the hydrogen ion. At a pH between 6.5 and 9.0 in fresh water, aluminum occurs predominantly as monomeric, dimeric, and polymeric hydroxides and as complexes with humic acids, phosphate, sulfate, and less common anions. This document does not contain information concerning the effect of aluminum on saltwater species because adequate data and resources were not available.

Several investigators have speculated about the toxic form of aluminum. Freeman and Everhart (1971) found that the toxicity of aluminum increased as pH increased from 6.8 to 8.99. They concluded that soluble aluminum was the toxic form. Hunter et al. (1980) observed the same relationship with rainbow trout over a pH range of 7.0 to 9.0. However, the opposite relationship resulted in a study with rainbow trout by Call (1984) and in studies with the fathead minnow by Boyd (1979), Call (1984), and Kimball (Manuscript). The tests conducted by Freeman and Everhart (1971), Hunter et al. (1980), and Kimball (Manuscript) were all renewal or flow-through and showed the lowest acute values, whereas the other tests were static. In addition, because the polymerization of aluminum hydroxide is a relatively slow process, the chemical form of aluminum might have differed from test to test due to the amount of time the aluminum was in stock and test solutions.

Driscoll et al. (1980) worked with postlarvae of brook trout and white suckers under slightly acidic conditions and concluded that only inorganic forms of aluminum were toxic to fish. Hunter et al. (1980) reported that the toxicity of test solutions was directly related to the concentration of aluminum that passed through a 0.45 µm membrane filter. In a study of the toxicity of "labile" aluminum to a green alga, Chlorella pyrenoidosa, Helliwell et al. (1983) found that maximum toxicity occurred in the pH range of 5.8 to 6.2. This is near the pH of minimum solubility of aluminum and maximum concentration of $Al(OH)_2^+$. They found that the toxicity of aluminum decreased as pH increased or decreased from about 6.0, and they speculated that the monovalent hydroxide is the most toxic form. Seip et al. (1984) stated that "the simple hydroxides ($Al(OH)^{+2}$ and $Al(OH)_2^+$) are regarded as the most dangerous forms while organically bound Al and polymeric forms are less toxic or essentially harmless."

In dilute aluminum solutions, formation of particles and the large insoluble polynuclear complexes known as floc is primarily a function of the concentrations of organic acids and the hydroxide ion (Snodgrass et al. 1984). Time for particle formation varies from < 1 min. to several days (Snodgrass et al. 1984) depending upon the source of aluminum, the pH, and the presence of electrolytes and organic acids. When particles form aggregates large enough to become visible, the floc is whitish and tends to settle. Mats have been reported blanketing a stream bed (Hunter et al. 1980). Laboratory studies conducted at alkaline pHs have reported floc in the exposure chambers (Brooke 1985; Call 1984; Lamb and Bailey 1981; Zarini et al. 1983). The floc did not appear to affect most aquatic species. However, the swimming ability of Daphnia magna was impeded by "fibers" of flocculated aluminum trailing from the carapaces, and the movements and perhaps feeding of midges was affected, ultimately resulting in death (Lamb and Bailey 1981). Bottom-dwelling organisms might be impacted more by aluminum floc in the field than in the laboratory.

Aluminum floc might coprecipitate nutrients, suspended material, and microorganisms. Removal of phosphorus from water has been observed in laboratory studies (Matheson 1975; Minzoni 1984; Peterson et al. 1974) and in a lake (Knapp and Soltero 1983). Turbidity due to clay has been removed from pond waters using aluminum sulfate (Boyd 1979). Unz and Davis (1975) speculated that aluminum floc might coalesce bacteria and concentrate organic matter in effluents, thus assisting the biological sorption of nutrients. Aluminum sulfate has been used to flocculate algae from water (McGarry 1970; Minzoni 1984; Zarini et al. 1983).

An understanding of the "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" (Stephan et al. 1985), hereafter referred to as the Guidelines, and the response to public comment (U.S. EPA 1985a) is necessary in order to understand the following text, tables, and calculations. Results of such intermediate calculations as Species Mean Acute Values are given to four significant figures to prevent roundoff error in subsequent calculations, not to reflect the precision of the value. Unless otherwise noted, all concentrations of aluminum in water reported herein from toxicity and bioconcentration tests are expected to be essentially equivalent to acid-soluble aluminum concentrations. All concentrations are expressed as aluminum, not as the chemical tested. The latest comprehensive literature search for information for this document was conducted in July, 1986; some more recent information was included.

Acute Toxicity to Aquatic Animals

The earliest study of the toxicity of aluminum to aquatic life was performed by Thomas (1915) using mummichogs acclimated to fresh water. His report lacks detail and it is unclear whether the aluminum sulfate was anhydrous or hydrated. Assuming that the anhydrous form was used, the calculated concentrations of aluminum where all of the fish died in 1.5 and 5 days were 2,200 and 1,100 μg/l, respectively. More recent tests with fish showing similar sensitivities to aluminum (Tables 1 and 6) were conducted with brook trout with a 96-hr LC50 of 3,600 μg/L (Decker and Menendez 1974), rainbow trout with a 72-hr LC50 of 5,200 μg/L (Freeman and Everhart 1971), and common carp with a 48-hr LC50 of 4,000 μg/L (Muramoto 1981). Other fish species tested were more resistant to aluminum.

The range of concentrations of aluminum that was acutely toxic to freshwater invertebrate species was about the same as the range of concentrations that was toxic to fish. The lowest acute values for invertebrates are 1,900 μg/L (McCauley et al. 1986) and 3,690 μg/L (Call 1984) for ceriodaphnids, whereas the highest acute value is 55,500 μg/L in a test with a snail (Call 1984). No data are available concerning the effect of pH on toxicity of aluminum to invertebrates.

Species Mean Acute Values (Table 1) were calculated as geometric means of the available acute values, and then Genus Mean Acute Values (Table 3) were calculated as geometric means of the available Species Mean Acute Values. Several species tested were not exposed to aluminum concentrations high enough to allow calculation of an LC50. Although these were ranked in Table 3 according to the highest concentration used in the test, this does not imply a true ranking of sensitivities. The freshwater Final Acute Value for aluminum at a pH between 6.5 and 9.0 was calculated to be 1,496 μg/L using the procedure described in the Guidelines and the Genus Mean Acute Values in Table 3. Because acute values are available for only fourteen genera, the FAV is about one-half the acute value for the most sensitive genus

Chronic Toxicity to Aquatic Animals

Chronic toxicity values for aluminum have been determined with three freshwater species (Table 2). McCauley et al. (1986) found that 2,600 μg/L reduced survival and reproduction of *Ceriodaphnia dubia* by 23% and 92%, respectively. An aluminum concentration of 1,400 μg/L reduced survival by 11%, but increased reproduction. Although survival increased at concentrations above 2,600 μg/L, no reproduction occurred. In a life-cycle test with *Daphnia magna*, survival was the same at 540 μg/L as in the control treatment, but was reduced about 29% at 1,020 μg/L (Kimball, Manuscript). Reproduction was about the same at 1,020 μg/L as in the control treatment. Biesinger and Christensen (1972) obtained a 21-day LC50 of 1,400 μg/L with *D. magna* (Table 6). They estimated that 320 μg/L would reduce reproduction by 16%, but the concentrations of aluminum were not measured in the test solutions.

Kimball (Manuscript) reported the results of an early life-stage test with fathead minnows. An aluminum concentration of 4,700 μg/L reduced weight by 11.4%, whereas 2,300 μg/L reduced weight by 7.1%. Survival at both concentrations was as good or better than in the control treatment. These chronic tests indicate that, of the three species tested, the invertebrates are more sensitive to aluminum than the vertebrate.

The three available acute-chronic ratios for aluminum are 0.9958 with *Ceriodaphnia dubia*, 51.27 with *Daphnia magna*, and 10.64 with the fathead minnow (Table 2). These values follow the common pattern that acutely sensitive species have lower acute-chronic ratios (Table 3). The Final Acute-Chronic Ratio is meant to apply to acutely sensitive species, and, therefore, should be close to 0.9958. However, according to the Guidelines, the Final Acute-Chronic Ratio cannot be less than 2, because a ratio lower than 2 would result in the Final Chronic Value exceeding the Criterion Maximum Concentration. Thus the Final Chronic Value for aluminum is equal to the Criterion Maximum Concentration of 748.0 µg/L for fresh water at a pH between 6.5 and 9.0 (Table 3).

Data in Table 6 concerning the toxicity of aluminum to brook trout and striped bass show that the Final Chronic Value should be lowered to 87 µg/L to protect these two important species. Cleveland et al. (Manuscript) found that 169 µg/L caused a 24% reduction in the weight of young brook trout in a 60-day test, whereas 88 µg/L caused a 4% reduction in weight. In a 7-day test, 174.4 µg/L killed 58% of the exposed striped bass, whereas 87.2 µg/L did not kill any of the exposed organisms (Buckler et al., Manuscript). Both of these tests were conducted at a pH of 6.5 to 6.6.

Toxicity to Aquatic Plants

Single-celled plants were more sensitive to aluminum than the other plants tested (Table 4). Growth of the diatom, *Cyclotella meneghiniana*, was inhibited at 810 µg/L, and the species died at 6,480 µg/L (Rao and Subramanian 1982). The green alga, *Selenastrum capricornutum*, was about as sensitive to aluminum as the diatom. Effects were found at concentrations