Richard McHenry
Senior Engineer
Regional Water Quality Control Board, Central Valley Region
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670-6114

8 September 2004

**RE: CITY OF AUBURN WASTEWATER TREATMENT PLANT
INFORMATIONAL DRAFT ORDER, NPDES NO. CA0077712
EFFLUENT LIMITATION ASSIGNMENT/COMPLIANCE PROCEDURE**

Dear Mr. McHenry,

This letter has been prepared as a response to our review of the Informational Draft NPDES Waste Discharge Requirements for the City of Auburn Wastewater Treatment Plant (dated 19 August 2004). Although the informational draft cover letter stated that comments that are related to reasonable potential analyses are to be submitted at a later date, we believe it is warranted to provide comment now as they affect the calculations of interest. If desired, we will resubmit these comments during the public review period.

The draft order contains effluent limitations for copper, lead, nickel, silver, and zinc. Each of these limitations varies as a function of hardness. The hardness value used in the reasonable potential analysis was the lowest observed to date within the receiving stream (i.e., Auburn Ravine). The intent of this letter is to suggest that the more technically valid hardness for use in the conduct of reasonable potential analyses is that of the undiluted effluent (in general, there are few very specialized cases where this approach might not be fully protective). Typically, undiluted effluent contains sufficient hardness to mitigate metals toxicity, similar to the effects of temperature on ammonia toxicity (i.e., the toxicant is still present but is non-toxic under the actual environmental conditions present). Additionally, the elevated hardness of municipal effluent typically also mitigates, to a limited extent, natural metals toxicity. Therefore, in virtually all cases the effluent neither causes, nor contributes, to toxicity when the effluent contains sufficient hardness to mitigate its internal metals concentrations. Rationale follows.

RATIONALE DISCUSSION

Practice in the Informational Order

The practice of regulating hardness-based contaminants (e.g., copper) in the informational order is to make use of the hardness measured at monitoring station R2 (i.e., the receiving water monitoring station downstream of the discharge and presumably after the discharge has mixed with any background flow in the receiving water). The theoretical hardness observed at monitoring station R2 would therefore be calculated to be:

$$\text{R2 Hardness} = \frac{(\text{Background Flow})(\text{Background Hardness}) + (\text{Effluent Flow})(\text{Effluent Hardness})}{\text{Background Flow} + \text{Effluent Flow}}$$

For illustrative purposes, assume that the background flow is twenty times that of the discharge flow, that the discharge has a hardness of 80 mg/L, and the receiving water has a hardness of 11 mg/L. Under this set of conditions, the expected hardness at R2 would be:

$$\text{R2 Hardness} = \frac{(20)\left(11\ {}^{\text{mg}}\!/\!_{\text{L}}\right) + (1)\left(80\ {}^{\text{mg}}\!/\!_{\text{L}}\right)}{1 + 20} = 14.3\ {}^{\text{mg}}\!/\!_{\text{L}}$$

Copper is an example metallic contaminant that has associated regulatory criteria that vary with variations in hardness. For example, the chronic water quality objective for copper is:

$$\text{CCC} = e^{0.8545\ln(\text{hardness}) - 1.702}$$

The acute water quality objective for copper is:

$$\text{CMC} = e^{0.9422\ln(\text{hardness}) - 1.700}$$

Based on the practice described above, the "end of pipe" effluent limitations would be based on the R2 hardness of 14.3 mg/L. The corresponding average monthly effluent limitation (based on a hardness of 14.3 mg/L) would be:

$$\text{AMEL} = 1.55[\min(0.321\text{CMC}, 0.527\text{CCC})] = 1.1\ {}^{\mu\text{g}}\!/\!_{\text{L}}$$

and the maximum daily effluent limitation would be:

$$\text{MDEL} = 3.11[\min(0.321\text{CMC}, 0.527\text{CCC})] = 2.2\ {}^{\mu g}\!/\!_{L}$$

If the concentration of copper in the effluent were 5.0 µg/L, the effluent would be in violation of the effluent limitations. However, it will be shown that the discharge does not exceed the receiving water based limitation to preclude toxicity. Discussion follows in the following section.

Proposed Practice

It is proposed that the more appropriate hardness for use in setting the regulatory criteria is that of the effluent because it is the responsibility of the discharger not to "cause or contribute to a condition of aquatic toxicity," including causing a condition of toxicity once non-point sources of pollution are abated. It is not the responsibility of the discharger to clean up a condition of pollution caused by other factors (e.g., non-point source discharges, naturally occurring quality, etc).

Returning to the example conditions outlined in the previous section, prior to the mixing of the discharge with the receiving water, the appropriate regulatory criterion applicable to copper in the discharge would be based on a hardness of 80 mg/L. The corresponding AMEL and MDEL precluding toxicity of the effluent would be 5.6 µg/L and 11 µg/L, respectively, calculated as follows:

$$\text{AMEL} = 1.55[\min(0.321\text{CMC}, 0.527\text{CCC})] = 5.6\, {}^{\mu g}\!/_{L}$$

$$\text{MDEL} = 3.11[\min(0.321\text{CMC}, 0.527\text{CCC})] = 11\, {}^{\mu g}\!/_{L}$$

Thus, if copper were present in the discharge at a concentration of 5.0 µg/L, the effluent should not cause toxicity in its undiluted state. Stated in a different manner, prior to dilution the effluent neither causes or contributes to toxicity. The concern, therefore, appears to occur once dilution occurs in the receiving water.

Toxicity Impacts Post Mixing

For the receiving water, at a hardness of 11mg/L (calculated and reported above) the corresponding AMEL and MDEL are 0.87 µg/L and 1.7 µg/L, respectively. Thus, if copper were naturally present in the receiving water at a concentration of 0.87 µg/L, the receiving water would not be considered toxic (it lacks assimilative capacity, but is not toxic). This condition represents the critical case where non-point source pollution has been controlled by source control (possibly via a TMDL) to where the receiving water just meets a water quality limitation that should preclude statistically unacceptable exceedances of water quality objectives.

For the effluent, at a hardness of 80 mg/L (calculated and reported above) the corresponding AMEL and MDEL are 5.6 µg/L and 11 µg/L, respectively. Thus, if copper were present in the effluent at a concentration of 5.6 µg/L, the effluent would not be considered toxic (it, too, lacks assimilative capacity but is not toxic).

Thus, prior to the discharge, both waste streams would not be considered toxic.

The theoretical copper concentration at monitoring station R2 can be calculated making use of the following equation:

$$\begin{matrix}\text{R2}\\\text{Copper}\\\text{Concentration}\end{matrix} = \frac{\begin{pmatrix}\text{Background}\\\text{Flow}\end{pmatrix}\begin{pmatrix}\text{Background}\\\text{Copper}\\\text{Concentration}\end{pmatrix} + \begin{pmatrix}\text{Effluent}\\\text{Flow}\end{pmatrix}\begin{pmatrix}\text{Effluent}\\\text{Copper}\\\text{Concentration}\end{pmatrix}}{\text{Background Flow} + \text{Effluent Flow}}$$

If after discharge there were 20:1 dilution of receiving water to effluent, the copper concentration at monitoring location R2 based on the conditions outlined above would be:

$$\begin{matrix}\text{R2}\\ \text{Copper}\\ \text{Concentration}\end{matrix} = \frac{(20)\left(0.87\,{}^{\mu g}\!/\!_{L}\right) + (1)\left(5.6\,{}^{\mu g}\!/\!_{L}\right)}{20+1} = 1.1\,{}^{\mu g}\!/\!_{L}$$

As calculated and reported above, the corresponding hardness would be 14.3 mg/L. The corresponding AMEL and MDEL would be:

$$\text{AMEL} = 1.55[\min(0.321\text{CMC}, 0.527\text{CCC})] = 1.1\,{}^{\mu g}\!/\!_{L}$$

$$\text{MDEL} = 3.11[\min(0.321\text{CMC}, 0.527\text{CCC})] = 2.2\,{}^{\mu g}\!/\!_{L}$$

Thus, after the discharge, the receiving stream did not exceed water quality criteria. In some instances (not depicted herein), a gain in a small amount of assimilative capacity is possible.

Sensitivity Analysis

In this situation, the background contaminant concentration exceeds water quality objectives. Making reference to the example presented above, this condition would be present if the ambient background concentration of copper were 2 µg/L (recall that the ambient hardness is 11 µg/L with a corresponding AMEL of 0.87 µg/L). By inspection, a discharge containing 5.0 µg/L of copper would further increase the concentration of copper in the receiving water:

$$\begin{matrix}\text{R2}\\ \text{Copper}\\ \text{Concentration}\end{matrix} = \frac{(20)\left(2.0\,{}^{\mu g}\!/\!_{L}\right) + (1)\left(5.0\,{}^{\mu g}\!/\!_{L}\right)}{20+1} = 2.1\,{}^{\mu g}\!/\!_{L}$$

Although the background concentration of copper was increased by 0.1 µg/L, it can be shown that the effluent in fact did not worsen the state of toxicity in the receiving steam. Prior to the discharge, the concentration of copper in the receiving stream exceeded the water quality objective by 1.1 µg/L (e.g., 2.0 µg/L – 0.87 µg/L = 1.1 µg/L). The regulatory criterion was, thus, exceeded by 230 percent:

$$\begin{matrix}\text{Percent Exceedance}\\ \text{Prior to Discharge}\end{matrix} = 100\%\ \text{x}\left(\frac{\text{In Stream Concentration}}{\text{Regulatory Objective}}\right) = 100\%\ \text{x}\left(\frac{2.0\,{}^{\mu g}\!/\!_{L}}{0.87\,{}^{\mu g}\!/\!_{L}}\right) = 230\%$$

After the discharge, the increase in hardness (from 11 mg/L to 14.3 mg/L) results in an AMEL increase from 0.87 µg/L to 1.1 µg/L. The concentration of copper at monitoring station R2 thus exceeds the water quality objective by 1.0 µg/L (e.g., 2.1 µg/L – 1.1 µg/L = 1.0 µg/L). The regulatory criterion was, thus, exceeded by 191 percent:

$$\begin{matrix}\text{Percent Exceedance}\\ \text{After Discharge}\end{matrix} = 100\% \text{ x} \left(\frac{\text{In Stream Concentration}}{\text{Regulatory Objective}}\right) = 100\% \text{ x} \left(\frac{2.1 \,{}^{\mu g}\!/_{L}}{1.1 \,{}^{\mu g}\!/_{L}}\right) = 191\%$$

Thus, although the concentration of copper increased after the discharge, the actual toxicity was reduced.

REVISED ANALYSIS

The minimum observed effluent hardness to date was 50 mg/L (Fact Sheet, Table 1, 30 October 2002).

Per Attachment E of the Information Order, the associated AMEL and MDEL associated with copper at a hardness of 50 mg/L are 3.6 µg/L and 7.3 µg/L, respectively. The maximum observed effluent copper concentration was 8.4 µg/L. Effluent limitations for copper, based on the effluent hardness, are warranted.

Per Attachment F of the Information Order, the associated AMEL and MDEL associated with lead at a hardness of 50 mg/L are 1.1 µg/L and 2.2 µg/L, respectively. The maximum observed effluent lead concentration was 7.1 µg/L. Effluent limitations for lead, based on the effluent hardness, are warranted.

Per Attachment G of the Information Order, the associated AMEL and MDEL associated with nickel at a hardness of 50 mg/L are 24 µg/L and 48 µg/L, respectively. The maximum observed effluent nickel concentration was 11.4 µg/L. Effluent limitations for nickel, based on the effluent hardness, do not appear to be warranted.

Per Attachment H of the Information Order, the associated MDEL associated with silver at a hardness of 50 mg/L is 1.2 µg/L. The maximum observed effluent silver concentration was 1.0 µg/L. Effluent limitations for silver, based on the effluent hardness, do not appear to be warranted.

Per Attachment I of the Information Order, the associated AMEL and MDEL associated with zinc at a hardness of 50 mg/L are 33 µg/L and 67 µg/L, respectively. The maximum observed effluent zinc concentration was 170 µg/L. Effluent limitations for zinc, based on the effluent hardness, are warranted.

SUMMARY

The City requests that compliance with metallic, hardness-based effluent limitations be based on the hardness of the effluent rather than the hardness of the receiving water after the discharge. Making use of this methodology, effluent limitations for nickel and silver do not appear to be warranted.

Please do not hesitate to call me or Robert Emerick (ECO:LOGIC Engineering; 916-773-8100) should you have further questions, require additional clarification, or if additional analysis would aid in your revising the analysis approach to allow use of effluent hardness in gauging compliance.

Sincerely,

CITY OF AUBURN