# Development of TMDL for the Control of Aquatic Life Toxicity in Ambient Waters

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April 24, 2000

Total Maximum Daily Loads (TMDLs) for constituents that exist in ambient waters that have been found to be toxic to certain forms of aquatic life in standard aquatic life toxicity tests such as the organophosphate pesticides, diazinon and chlorpyrifos must be developed within two years in several areas of California. Also TMDLs have to be developed for constituents that are potentially toxic to aquatic life such as the heavy metals (Cu, Pb, Zn and Cd) that are present in ambient waters above US EPA national water quality criteria because of the potential for these constituents to cause aquatic life toxicity in ambient waters. Presented herein is an environmentally protective approach for the protection of aquatic life related beneficial uses of aquatic systems from aquatic life toxicity.

This recommended approach is based on worst case assumptions with allowance for comprehensive site specific evaluations that reliably demonstrate that worst case assumptions are likely to be significantly over protective and cause unnecessary expenditures for chemical constituent control. This recommended approach is based on assuming that in those situations where there is a lack of knowledge on the impact of a chemical that the regulatory approach adopted shall err on the side of protection of aquatic life related beneficial uses of waterbodies.

**Issues**

The basic premise of developing an environmentally protective TMDL for potentially toxic substances such as an pesticide and or a heavy metal is that ambient waters shall be free of aquatic life toxicity using a suite of appropriately sensitive test organisms with appropriate reference site/conditions and standardized test procedures. Both water column and sediments shall be evaluated for aquatic life toxicity.

If is recognized that laboratory based toxicity tests can yield a toxic response that is not manifested under ambient water conditions. The protective approach assumes that unless demonstrated otherwise by site specific toxicity evaluations, that the standard laboratory tests yield results that are representative of ambient water toxicity. The burden of showing that the standard laboratory tests do not reliably demonstrate ambient water toxicity that is adverse to the beneficial uses of a waterbody is on those who want to sell/use the constituents that are toxic under laboratory conditions or are potentially toxic based on exceedance of a water quality criterion that is based on aquatic life toxicity.

For those waterbodies that are listed on a 303(d) list as impaired because of existing or potential aquatic life toxicity, TMDL control programs shall be developed to control the aquatic life toxicity that exits or could exist in ambient water water column and or sediments. The discharger/source of the constituent responsible for the toxicity

shall fund the necessary studies to demonstrate to a high degree of certainty that toxicity do to the constituents of potential concern is not impairing the aquatic life related and other beneficial uses of a waterbody.

The demonstration shall include reliably evaluating the following issues.

The exceedance of US EPA national and site specific water quality criteria/standards can underestimate aquatic life toxicity due to unknown/unidentified toxic constituents as well as additive/synergistic impacts with other chemicals or conditions. Also exceedance of the US EPA national and site specific criteria/standards can over estimate the toxicity of a constituent (s) that exist in ambient waters in a variety of chemical forms only some of which are toxic. It is for this reason that the ultimate assessment of toxicity in ambient waters is appropriately conducted toxicity tests. These test should properly reflect the conditions of exposure that can occur in ambient water relative to the duration/conditions of exposure that exits in the toxicity tests.

- The aquatic organism tissue residues should be evaluated relative to SETAC (2000) and COE (1999) critical concentration data for excessive bioaccumulation that is a threat to the host organisms health.

- The presents of toxicity based on appropriately conducted toxicity tests is assumed to be adverse to aquatic life related beneficial uses unless it is convincingly demonstrated that laboratory based toxicity to a test organism does not represent an impairment of the a waterbodies beneficial uses. If the organism assemblages are the same in the "toxic" area as nearby non-toxic areas with the same habitat characteristics it maybe concluded that the laboratory based toxicity test is not a significant cause water quality impairment.

- The users of a chemical (s) such as a pesticide shall have the responsibility of reliably demonstrating that substituting one chemical for another can be done without significant risk to public health and the environment. This evaluation will likely require pre and post monitoring to insure that no new environmental problems are caused by the use of the replacement chemical – pesticide.

- For those potentially toxic constituents that are present at concentrations above the existing water quality standard, an adjustment of the standard in accord with US EPA guidance is recommended. If this adjustment is not adequate then changes in the site specific standard development approach should be used.

**Evaluation of Impacts**

The evaluation of significant adverse impacts or lack thereof shall be based a best professional judgment (BPJ) weight of evidence (WOE) water quality evaluation. Tables 1 through 3 present a summary of the components of the BPJ WOE evaluation. As indicated, technical disputes in this evaluation shall be resolved by use of a fully public interactive peer review of the issues in disputes.

In making the evaluation it is understood that toxicity tests results can override chemical concentration data relative to worst case potential for toxicity of a constituent i.e. exceedance of US EPA water quality criteria/standards. Aquatic organism assemblage information overrides toxicity test information in a BPJ WOE water quality evaluation.

# Table 1
# Best Professional Judgment Weight of Evidence for Water Quality and Sediment Quality Evaluation

**Issue:**

Regulatory Agencies/Boards/Courts Are Not Necessarily Using Adequate or Reliable Technical Information in Developing Public Policy for Water Pollution Prevention and Control

How to Reliably Evaluate Whether Elevated Concentrations of a Constituent in a Waterbody's Water Column and/or Aquatic Sediments Is Responsible for an Adverse Impact to the Beneficial Uses of a Waterbody

Determine Whether Pollution (Impairment of Water Quality Beneficial Use (s)) Exists or Could Exist Because of the Presence of Elevated Concentrations of a Chemical Constituent(s) in the Water Column or Sediments

**Evaluation:**

Blueprint for More Technically Valid Water Quality Management

Requires Appropriate Use of:

- **Aquatic Toxicity/Bioaccumulation Testing/Evaluation**

  Toxicity Evaluation with Suite of Appropriate Sensitive Test Organisms with Several Appropriate Reference Sites

  Do Not Assume Sediment or Water Column Toxicity Represents Significant Impact on Beneficial Uses – Conduct Evaluation

Tissue Concentrations Relative to Residues in Critical Host Organism Residues and Higher Trophic Level Food-Web Organisms

- **Aquatic Organism Assemblage Information Relative to Habitat Characteristics**

  Use Gradient Analysis for the Same Habitat Characteristics to Discern Impact on Populations

- **Chemical Information**

  Elevated Concentrations Relative to Natural Background

  Do Not Use Co-Occurrence Based Guidelines"

If Toxicity Exists, Use Toxicity Identification Evaluation (TIEs) to Determine Cause of Toxicity

Use Forensic TIEs to Identify Source of Constituents Responsible for Toxicity

Use Equilibrium Partitioning as Part of TIE to Rule Out Groups of Chemicals Not Responsible for Toxicity, e.g., Acid Volatile Sulfides to Screen for Potential Heavy Metal Toxicity

## Table 2
# Best Professional Judgment (BPJ) Weight of Evidence (WOE) Information Evaluation

- Use Panel of Experts Current Real World Aquatic Toxicology, Biology and Chemistry to Conduct BPJ WOE Evaluation

- Conduct BPJ Review in Full Public Interactive Peer Review

  Non-Adversarial Review with Full Disclosure

  Provide Reviewers with Complete Background Information on Issue

**Provide Funding** to Environmental and Other Stakeholders to Actively Participate in BPJ WOE Peer Review Process

## Purpose of BPJ WOE Information Evaluation

Determine with a Reasonable Degree of Certainty Whether the Chemical Constituents in a Water Column or Sediment Are Causing Sufficient Adverse Impacts on the Beneficial Uses of the Waterbody to Cause the Sediment to Need Remediation and/or Potential Pollutant Source Control

Are the Numbers, Types and Characteristics of Aquatic Organisms Present in the Area of Concern Appropriate for Habitat Characteristics?

## Funding of BPJ WOE Water Quality Evaluation

Should Be Paid for by Dischargers, i.e., Those Who Benefit by Less Stringent Control of Potential Pollutant at the Source

If Discharger Will Not Adequately Fund BPJ WOE Evaluation, Apply Plausible Worst Case

# Criteria/Standards in Water Quality Evaluation to Establish Necessary Control Program

## Table 3
# Additional Studies/Follow-Up Monitoring

If BPJ WOE Evaluation Provides Insufficient Information to Make Reliable BPJ Evaluation of Water Quality, Define the Additional Studies Needed to Provide the Required Information

Conduct Follow-Up Monitoring to:

- Evaluate Reliability of BPJ WOE Evaluation
- Evaluate Effectiveness of Remedial Action/Source Control
  - Use Information to Guide Future BPJ WOE Water Quality Evaluations
- Evaluate Subtle Un-Detected/Defined, and New, Water Quality Problems

Screen New and Expanded Use Chemicals for Potential Pollutants.

- Avoid MTBE, Perchlorate, PCB, DDT Etc Problems

# References

G. Fred Lee, and Anne Jones-Lee, "Appropriate Use of Chemical Information in a Best Professional Judgment Water Quality Weight of Evidence Evaluation," Report of G. Fred Lee & Associates, El Macero, CA, October (1999).

G. Fred Lee, and Anne Jones-Lee, "Public Interactive Peer Review Process for Water Quality Technical Dispute Resolution: A Guide For Implementation of CA Health &Safety Code Section 57004 for Conducting Peer Review of Proposed Policy," Report of G. Fred Lee & Associates, El Macero, CA, October (1999).

Further Information: www.gfredlee.com

**Surface and Groundwater Quality Evaluation and Management**
**and**
**Municipal Solid & Industrial Hazardous Waste Landfills**

**http://www.gfredlee.com**

Dr. G. Fred Lee and Dr. Anne Jones-Lee have prepared professional papers and reports on the various areas in which they are active in research and consulting

including domestic water supply water quality, water and wastewater treatment, water pollution control, and the evaluation and management of the impacts of solid and hazardous wastes. Publications are available in the following areas:

- Landfills and Groundwater Quality Protection
- Water Quality Evaluation and Management for Wastewater Discharges, Stormwater Runoff, Ambient Waters and Pesticide Water Quality Management Issues, TMDL Development
- State Stormwater Quality Task Force – Task Force Activities
- Impact of Hazardous Chemicals -- Superfund, LEHR Superfund Site Reports
- Contaminated Sediment -- Aquafund, BPTCP
- Domestic Water Supply Water Quality
- Excessive Fertilization/Eutrophication
- Reuse of Reclaimed Wastewaters
- Watershed Based Water Quality Management Programs:
  Sacramento River Watershed Program,
  Delta -- CALFED Program,
  Upper Newport Bay Watershed Program,
  San Joaquin River Watershed DO and OP Pesticide TMDL Programs

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