Comments on
US EPA Draft "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites"
Dated November 2002

Comments Submitted by
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I have reviewed the draft "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites," dated November 2002, and wish to provide the following comments.

Based on my over 40 years of work on contaminated sediment management issues, I find that this draft guidance provides a good discussion of issues that need to be considered in developing technically valid, cost-effective contaminated sediment management programs. There are, however, two areas of primary concern.

Page 2-13 indicates that the NOAA Screening Quick Reference Tables (SQuiRTs), available at http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html
"are useful as screening values at Superfund sediment sites, but are not appropriate as default, site-specific RGs or clean-up levels."

As an individual who has worked for years on the relationship between the chemical characteristics of sediments and their impacts on water quality, I fully agree that SQuiRT values are not useful as cleanup levels. However, I find that the statement about their being useful as screening values is inappropriate. They can readily lead to inadequate protection or over-regulation of contaminated sediments, and should not be used for any purpose. I have recently completed a review of the unreliability of co-ocurrence based so-called sediment quality guidelines. A copy of this discussion is appended to these comments.

Page 6-28 section 6.7.1 Sanitary/Hazardous Waste Landfills should be expanded to discuss that the current US EPA landfill regulations do not provide for landfilling of wastes that will provide for groundwater quality protection for as long as the wastes in the landfill will be threat. Recently, I presented a discussion at a US EPA national Technical Assistance Grant workshop of the potential problems of landfilling of hazardous chemical waste site wastes, "Improving the Quality of Science/Engineering in Superfund Site Investigation & Remediation II: Onsite Landfilling," that will provide for true groundwater quality protection for as long as the wastes in the landfill are a threat. This discussion also provides guidance on how landfills can be developed as part of Superfund and other hazardous waste site remediation, that will contain the contaminated sediments and other wastes within the landfill for as long as the wastes are a threat.

This issue is also discussed in a paper by Lee and Jones-Lee (2000). These issues are discussed in detail in papers and reports on our website, www.gfredlee.com.

Page 9-6 lists a personal communication to Simmons (1993). A reference of this type should be in sufficient detail so that someone else can go and talk to Simmons to discuss this issue. Additional information must be provided on how to contact Simmons. This same problem occurs on page 9-14 with the Wardlaw (1993) reference.

If there are questions on these comments, please contact me.

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Lee, G. F., "Improving the Quality of Science/Engineering in Superfund Site Investigation & Remediation II: Onsite Landfilling," Presentation at the US EPA Technical Assistance Grant Workshop, Albuquerque, NM, February (2003). http://www.gfredlee.com/Show-SuperfundAlbuquerque.pdf

Unreliability of Sediment Co-Occurrence-Based Approaches for Evaluating Aquatic Sediment Quality[1]

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Beginning in the 1980s, several individuals ignored the well-established fact that the total concentration of a constituent in sediments is an unreliable predictor of aquatic life toxicity. The most notable of the inappropriate approaches that have been advocated for evaluating sediment quality is the co-occurrence-based approach first developed by Long and Morgan. Long and Morgan (1990) proposed co-occurrence-based sediment quality "guidelines" to predict the impact of sediment-associated chemicals on aquatic life living within or upon sediments. The co-occurrence-based approach as used by Long and Morgan and others such as MacDonald (1992) involves compiling sets of sediment data that contain some information on sediment biological characteristics, such as laboratory measured toxicity, or benthic organism assemblages (numbers and types of organisms) and the **total** concentration of potential pollutants. The potential pollutants are those that are typically considered in water quality assessments that have been found in some other non-sediment-related situations to be toxic to aquatic life. The literature reported concentrations are ranked according to increasing concentration. The sediment concentration which has a so-called "effect" is used to develop a co-occurrence between a sediment chemical concentration measured as a total concentration and a water quality "effect."

Lee and Jones-Lee (1996a,b, 2002a) have provided a detailed discussion of the lack of technical validity of the co-occurrence-based approach for evaluating sediment quality. As they point out, this approach has a number of inherent, invalid assumptions. First, the approach presumes that there is a causal relationship between the concentration of each contaminant considered in sediment and the water quality impact of that sediment. Second, it presumes that the "effect" reported for each sediment was caused independently by each of the measured chemical contaminants in that sediment. Third, it presumes that no other chemical or condition not included in the database has any influence on the manifestation of the "effect" that co-occurs with the particular chemical of focus; ignored are several sediment-associated contaminants and conditions that are well-recognized to cause aquatic life toxicity, including ammonia, hydrogen sulfide, and low dissolved oxygen. Fourth, it presumes that the assessments made of "effects" of the sediments relate in some meaningful way to adverse impacts on beneficial uses of the waterbody in which the sediments are located.

In regulatory applications, co-occurrence information has been used or proposed for use, albeit incorrectly, to establish various "effects threshold" values. That is, applying statistics to

[1] Excerpts from Lee and Jones-Lee (2002b)

the ranked listing of co-occurrence information of a given chemical, it was determined for that data set the concentration of the chemical that has a given probability of co-occurring with an impact, or the lowest concentration with which "no effect" co-occurred for that set of sediments. Examples of these approaches are the "Apparent Effects Threshold" (AET), and numeric values developed from Long and Morgan's (1990) data presentation in the form of ER-L and ER-M values, and "Probable Effects Levels" (PEL) values derived from MacDonald's (1992) co-occurrence compilations. If a sediment contains a chemical in concentrations above the AET, PEL, or similar value, the sediment is considered by some regulators or proposed regulations to be "polluted," and to require special consideration such as "remediation," alternate methods of dredged sediment disposal, or control of permitted discharges to the waterbody of a chemical that accumulates in the sediments.

As discussed by O'Connor (1999a,b, 2002), O'Connor and Paul (2000), O'Connor, *et al*. (1998), Engler (pers. comm.), Ditoro (2002), Chapman (2002), Burton (2002), Lee and Jones (1992), and Lee and Jones-Lee (1993; 1996a,b; 2000, 2002), the co-occurrence approach is not a technically valid approach for assessing the potential impacts of chemical constituents in sediments. It has been well-known for over 30 years that the total concentration of a chemical constituent in sediments is not a valid measure of the toxic/available forms of constituents that can impact aquatic life through toxicity or cause other impacts. Further, and most important, co-occurrence is not a valid basis for simple systems with a limited number of constituents for evaluating the cause of a measured impact. Co-occurrence is obviously not valid for relating the concentrations of sediment-associated potential pollutants to observed laboratory-measured toxicity or altered organism assemblages in which the chemical constituent of concern is measured. In normal situations, there is no valid cause-and-effect relationship between the total concentration of a chemical constituent in a sediment and its responsibility for some measured "impact."

As more and more data were accumulated that showed that the Long and Morgan and MacDonald guideline values were not reliable predictors of sediment toxicity and other impacts, Long and his associates tried to improve the reliability of the co-occurrence-based approach by using the normalized summed quotients for several chemical constituents to establish the value for comparison with the biological characteristic of the sediments determined by their co-occurrence evaluation. While not discussed by Long and Morgan and others who advocate this approach, the magnitude of the normalized summed value depends on the constituents included in the data review. While for highly degraded areas there is some claimed success for the expanded approach, the expanded co-occurrence approach is also not valid to relate the concentration of a single chemical constituent or a group of constituents' impacts on sediment and overlying water quality/beneficial uses.

Even though it is well-recognized that the Long and Morgan (and, subsequently, MacDonald) co-occurrence approaches are not valid tools to evaluate the potential significance of a chemical constituent in a sediment, there is continuing use of the co-occurrence-based guideline values as regulatory goals upon which control programs, such as TMDLs, are based. This arises from a lack of knowledge and understanding of sediment chemistry and toxicology/biology by those who are responsible and/or interested in sediment quality management.

Those who advocate use of co-occurrence-based sediment guidelines frequently claim that there are insufficient funds available to conduct the needed biological-effects-based evaluation of sediment chemistry and toxicology/biology to properly evaluate the water quality significance of a constituent in sediments. Since total chemical concentration data are frequently available for sediments, and since co-occurrence approaches superficially seem to provide a way to use these data in sediment quality evaluation, the co-occurrence-based approach receives use by regulatory agencies in order to provide some "information" on sediment quality without having to spend any significant amount of additional funds in sediment quality evaluation. There is also a strong desire by some to do something in addressing sediment quality even if there is an inadequate technical information base to enable a reliable sediment quality evaluation to be made. Such an evaluation would require detailed study of the sediments' aquatic chemistry/toxicology/biology.

One of the most significant recent inappropriate uses of co-occurrence-based approaches for regulating sediment quality has been proposed by the US EPA (2002c) Region 9. The Agency used the Buchman (1999) "NOAA Screening Quick Reference Tables (SQuiRTs)" to obtain TMDL targets for managing excessive bioaccumulation of organochlorine pesticides and PCBs in Upper Newport Bay, Orange County, CA, and its tributary San Diego Creek. The organochlorine chemicals of concern (for which there is excessive bioaccumulation in the Upper Newport Bay and its tributaries) are chlordane, dieldrin, DDT, PCBs and toxaphene. In discussing numeric targets for organochlorine TMDLs, the US EPA (2002c) states,

> *"As discussed in Section II, EPA evaluated the applicable water quality criteria and sediment and tissue screening levels to determine the appropriate numeric targets for these organochlorine TMDLs. We have prioritized sediment quality guidelines over tissue screening values and water column criteria. This decision is based on the following factors:*
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> *1) these pollutants are directly associated with sediments (i.e., fine particulate matter);*
> *2) sediments are the transport mechanism for these organochlorine compounds from freshwaters to salt waters;*
> *3) limited water column data are available to adequately describe the past or current conditions; and*
> *4) attainment of the sediment targets will be protective of the water column criteria and tissue screening values."*

This approach and the reasoning in support of it are fundamentally flawed from several perspectives. First, the so-called "NOAA SQUIRT values" are co-occurrence-based values that evolved out of the Long and Morgan and MacDonald work. The biological effect used to establish these values did not consider bioaccumulation. Further, critical human health bioaccumulation concentrations in edible fish are frequently far below any concentration that is adverse to the host organism (fish). There is no relationship between the co-occurrence values of Long and Morgan and MacDonald and the potential for a chemical constituent in sediments to bioaccumulate to excessive levels in edible fish tissue.

With respect to the first and second justification listed above in support of this approach, the fact that a chemical tends to become associated with sediments is not justification for using co-occurrence to predict excessive bioaccumulation. As far as the validity of the third justification, those familiar with bioaccumulation situations know that measurement of constituents of concern in the water column is not a reliable approach for predicting the bioaccumulation of organochlorine pesticides, PCBs, dioxins, etc. With respect to the fourth justification in support of this technically invalid approach, because of its fundamental unreliability, it is inappropriate to say that it is either under- or over-protective.

There is no reliable way to relate sediment concentrations of organochlorine pesticides and PCBs to excessive bioaccumulation of these chemicals in edible fish tissue except through site-specific studies. This issue is discussed in a subsequent section. The US EPA Region 9 has made a serious error in using the Buchman SQUIRT co-occurrence-based values. This approach should be immediately abandoned in favor of fish tissue target values developed by the CA Office of Environmental Health Hazard Assessment. These values are appropriate TMDL goals for managing the excessive bioaccumulation of organochlorine pesticides and PCBs.

The approach that should be followed in evaluating the water quality/sediment quality significance of a chemical constituent in sediments was defined by the US EPA and the Corps of Engineers in the 1970s for regulating contaminated dredged sediments. As discussed above, the US EPA/US ACOE (1991, 1998) developed dredged sediment quality evaluation manuals which provide detailed guidance on determining whether the management of a contaminated dredged sediment in a particular manner will impact water quality of the receiving waters where the management/disposal of the dredged sediment takes place. These agencies used a biological-effects-based approach rather than a chemical-concentration-based approach – e.g., rather than measure copper in the sediments and then speculate about the copper toxicity and its sediment/water quality impacts, the US EPA/US ACOE approach measures toxicity and then uses Toxicity Investigation Evaluations (TIEs) to determine its cause.

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