EPA-SAB-EPEC-COM-94-001

November 19, 1993

Honorable Carol M. Browner
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460

Subject: Commentary on the Ecological Risk Assessment for the Proposed RIA for the RCRA Corrective Action Rule

Dear Ms. Browner:

In response to a request from the Office of Solid Waste and Emergency Response (OSWER), the Science Advisory Board (SAB) has reviewed several aspects of the draft Regulatory Impact Analysis (RIA) prepared in support of the RCRA Corrective Action Rule. At the October 1992 meeting of the SAB Executive Committee, the Board was asked to review several components of the draft RIA. The Executive Committee, recognizing the importance, complexity and creativity of OSWER's work and its multi-disciplinary nature, established an ad hoc Steering Committee to assure that certain significant aspects of the RIA--both methodology and application--received appropriate attention from the relevant SAB Committees.

At a public meeting on January 29, 1993, the Steering Committee concluded, based on presentations by and discussions with OSWER personnel, that four SAB committees, with appropriate inter-committee liaison participation, should review major segments of the RCRA Corrective Action RIA as follows: the Environmental Economics Advisory Committee (EEAC) would review the contingent valuation methodology and its application in the RIA; the Environmental Engineering Committee (EEC) would review the MMSOILS fate and transport model; the Ecological Processes and Effects Committee (EPEC) would review the ecological risk analysis; and the Environmental Health Committee (EHC) would review the human health risk

assessment. In addition, the Steering Committee agreed to prepare an overview report, if one is deemed necessary, to accompany the individual committee reports.

This report is the result of EPEC's review of the ecological risk analysis in the draft RIA. We hope our comments on the draft RIA will assist the Agency in further developing and integrating contemporary concepts of ecological risk assessment into the proposed rule on corrective action for releases of hazardous substances from solid waste management units.

1. Statement of Charge and Review Process

In the charge to the SAB, dated March 26, 1993, OSWER requested that the Board assess "the implications of the fate and transport modelling assumptions on the ecological and human health risk assessment." To accomplish this, EPEC designated two consultants to participate in the EEC's review of the MMSOILS model, and comments on this topic are largely included in the report of that committee. However, we felt that it was important to evaluate the adequacy of the ecological risk chapter itself with the hope of improving this and future Agency risk assessments and cost/benefit analyses. In consultation with OSWER, we developed the following additional questions:

a) Given the constraints on available data and modeling assumptions, is the ecological risk assessment contained in the RCRA RIA consistent with the Ecorisk Framework developed by the EPA Risk Assessment Forum?

b) Are the ecorisk methodologies used in the RIA appropriate for assessment of risk at this broad scale (i.e., national vs. site-specific assessment)? What additional analyses could be added to strengthen the assessment?

Our comments on the draft RIA are the result of a conference call on June 7, 1993, by the Ecorisk Subcommittee of EPEC, and subsequent discussion of the document at a public meeting of EPEC on June 21, 1993.

2. Summary of Findings

We are pleased that the Agency is beginning to incorporate ecological risk assessment into the day-to-day policy and regulatory decision making process. We fully recognize the immensity of the task faced by the Agency in developing an evaluation program sufficiently general to have application to the estimated 5,800 facilities and 100,000 solid waste management units (SWMUs) across the country which will be subject to the RCRA Corrective Action Rule. Any such exercise necessarily involves numerous trade-offs of site-specificity and accuracy vs. general applicability to many diverse facilities and locations. Nevertheless, we feel that the present document is

incomplete in its consideration of ecological risks and benefits of site remediation, and is not fully consistent with the Agency's Ecorisk Framework document. Substantial additional effort will be required to complete a defensible ecological risk analysis on a national scale, even one which covers only baseline conditions.

There are at least three approaches open to the Agency: a) the final RIA could present the full range of environmental endpoints that should be considered, then state clearly that only a subset have been evaluated in the document; b) the current ecological risk analysis could be refined and used to answer a less sweeping set of questions (e.g., how widespread is the risk of exceeding water quality standards and other ecological benchmarks in nearby surface waters); or, c) the Agency could choose to allocate additional resources to complete the full ecological risk assessment on a national scale. If resources are not available for a full risk assessment, the Agency should, at a minimum, adopt the first alternative.

3. Prioritization of Ecological Risks

The assessment of benefits in the document is incomplete in that no attempt is made to assess the ecological benefits (or risks) which would result from site remediation. Although the table of contents describes Chapter 8 of the draft RIA as addressing "ecological benefits," the chapter itself is titled "ecological threats." The overall impression left by the document, and exemplified by Exhibit 13-2, is that ecological considerations, even the extent of ecological risk from the "no action" scenario, are not being factored into the proposed cost/benefit analysis. The authors appear to have relegated both human and ecological risks to secondary issues in deference to non-use benefits calculated from the developing contingent valuation method.

As noted previously, the Environmental Economics Advisory Committee of the SAB is conducting a detailed assessment of the contingent valuation (CV) methodology. However, we feel strongly that the CV approach cannot yield a realistic valuation of a resource unless the respondents have a firm knowledge of and appreciation for the human health and ecological risks involved.

A much better definition of the problem is needed at the very outset of the document in order to avoid misleading or false expectations as to what can really be done to quantify ecological risks in the absence of corrective action, as well as benefits (or risks) of site remediation. A clear discussion of the realistic state-of-the-science limitations, broad-based assumptions and generalized nature of results is needed to properly qualify and caveat any conclusions.

4. Risk Assessment Framework

The Framework for Ecological Risk Assessment (Ecorisk Framework, EPA/630/R-92/001) developed by the Agency's Risk Assessment Forum provides a conceptual outline for the conduct of ecological risk assessments. The authors of the draft RIA do refer to the framework in the case study discussion; however, Chapter 8 of the draft RIA could be substantially improved by reorganizing it to more closely follow the ecological risk paradigm. For example, the proximity analysis is essentially equivalent to the conceptual step referred to in the Ecorisk Framework as problem formulation. Discussing the elements of the proximity analysis in terms of the problem formulation phase will ensure that the first step of the ecorisk assessment is properly structured, that key questions will be addressed and that meaningful results will be produced. Similarly restructuring the concentration-based screening analysis and case studies to follow the framework document steps of stressor-response assessment and risk characterization phases will help identify weaknesses in the current document and provide guidance to ensure that ecologically sound results are provided.

The problem formulation step appeared to be driven more by conveniently accessible data than by development of a conceptual model, probably due to time and resource constraints. As a result, the major exposure pathway which was considered (chronically contaminated surface water) is not necessarily the most likely to cause adverse effects from RCRA sites, as was shown in the case studies in Appendix F of the RIA. The results of the case studies should now be used to reformulate the conceptual model. The proximity analysis should also include a component which identifies particularly valuable habitats, such as those containing rare and endangered species. One source of information on the location of rare and endangered species is The Nature Conservancy's Heritage System database.

Clearly, the Ecorisk Framework approach has not been used to its full benefit. It is the process of this approach that is useful. By taking a systems perspective on risks, the choice of endpoints, models, and stressors all make sense (e.g., see pp. 13-14 of the Ecorisk Framework document). This approach is missing in the draft RIA. Rigorous application of the risk assessment approach would have clarified numerous questions left unresolved in the current draft, including:

a) Why was 1 mile selected as the distance to be used in the proximity analysis? The distance should be selected based on ecological or physical considerations. Also, relative rather than absolute distances should be considered. For example, sites down-slope or along steeper topographic gradients may be more susceptible than sites up-slope or on less steep areas. The choice of area should also depend on the stress being considered (e.g., some chemicals are more mobile than others).

b) What was the ecological basis for the choice of the time scales (e.g., why were exposures evaluated over a 128-year period)?

c) Why were particular receptors selected (e.g., shrew, hawk, owl)? An ecosystem endpoint (e.g., increasing biodiversity, improving habitat quality in terms of food availability and cover) would have been useful. We recommend that the authors of the RIA consult with the Agency's Risk Assessment Forum for assistance in identifying appropriate ecological endpoints.

Another important component of the Ecorisk Framework approach is the analysis of uncertainty in the overall risk assessment. The draft RIA lacks adequate treatment of uncertainties in the risk estimates. For example, it would be useful to know the variability/uncertainty surrounding outputs from the MMSOILS model, expected uncertainties of risk, and how valuation methods deal with uncertainties.

5. Stratification of the Sample Frame

Appendix A to the draft RIA provides details of how the universe of sites was stratified and how the subsample of facility sites was selected. Facilities potentially subject to the Corrective Action Rule were stratified according to the magnitude of potential costs of corrective action (i.e., very large, large, and other) and the availability of data for an assessment. This stratification does not consider the distribution of ecologically-relevant site characteristics, and there are no data to indicate that the subsample selected is indeed representative of the range of ecological risks at all sites. We were unable to assess what other extremes may be represented by those sites excluded. For example, does the subsample accurately represent the myriad of soil types, groundwater and surface water flow regimes that could be encountered? Thus, it is unclear how the Agency can relate results obtained using the subsample of sites to the entire population of sites.

6. Emphasis on Modeling - MMSOILS

The results of the ecological risk assessment are highly dependent on the results of the MMSOILS model. Since MMSOILS has been the subject of a separate review by the Environmental Engineering Committee of the SAB, we include only overview comments here.

We question the use of this simplistic model for the RCRA evaluation. The model should be subject to formal, comprehensive sensitivity and uncertainty analyses. Results of these analyses can be used to: a) determine the range of model outputs in relation to uncertainty on input data; b) determine what the critical data are for improving model predictions; and c) simplify the model structure without sacrificing accuracy or precision of model results. At the very least, sensitivity analysis should be done to compare outputs from MMSOILS with other chemical fate models such as EXAMS. It may be that using a variety of different existing fate and transport models, rather than any single model, is the most appropriate way to evaluate risks.

The MMSOILS model is emphasized as a screening tool. However, it is clear that the model is used beyond screening in estimating quantitatively the fate and transport of contaminants. Care must be taken in implementing and evaluating the model for these two different purposes.

One major problem that must be confronted in the development of multimedia models, such as MMSOILS, is the forcing of differently scaled environmental transport processes into a single model construct. Forcing disparate temporal and spatial scales into a single model can produce inaccuracies in model results. These scale considerations should be used to examine the basic model constructs of MMSOILS.

7. Adverse Impacts of Site Remediation

As mentioned earlier, the draft RIA does not address the potentially adverse ecological impacts of corrective actions. These actions could include mobilization and release of large quantities of contaminants (e.g., during dredging of contaminated sediment or due to accidental ruptures of tanks, dams, etc.); destruction of terrestrial habitat due to road-building, soil removal, etc.; and greatly increased loadings of silt in streams due to erosion of exposed soil. Methodologies for addressing these effects should be developed and the impacts should be considered in the overall analysis.

8. Use of Case Studies

In the draft RIA, the three ecorisk case studies are used simply to document the fact that ecologically significant contamination can be observed at some sites, and that pathways for potential exposure do exist. A much more valuable use of the case studies would be to evaluate the conceptual model used for the ecological risk assessment and the fate and transport predictions of the MMSOILS model. Actual contaminant concentrations and hazard indices could be compared to predicted values; land-use designations obtained from on-site surveys could be used to verify land use designations obtained from maps, etc.

9. Assumptions and Incomplete Information

The information provided in Appendix F of the RIA on the concentration-based screening methodology is quite sketchy, and lacks sufficient discussion of data sources and assumptions. However, from the information given, it seems possible that some inappropriate assumptions have been made. Areas of incomplete information include:

a) The time frame used in the model for predicted concentrations of contaminants in surface waters was an annual time step, while the time frame used for deriving chronic ambient water quality criteria is 4 days. Mixing these different time scales is likely a problem since the annual average value could mask short-term extreme events. The document should clearly state that this is a problem.

b) Many of the extrapolation factors described in Exhibit F-1 are consistent with general usage by regulatory agencies, although better methods are now available in the scientific literature. They are, however, derived principally from studies involving fish. It appears from the documentation that data from invertebrate toxicity tests may also have been used in the assessment. The values in Exhibit F-1 should not be applied to toxicity test data for organisms other than fish.

c) The Hazard Index results (Exhibit F-3) are poorly documented. Contaminants responsible for the values are identified, but the pathways and receptors are not. In addition, some of the index values are extremely high (10^2 or more). If environmental contaminants were really present at the levels indicated and the exposed species were as sensitive as assumed in the analysis, overt ecological effects should already have occurred and should be easily detectable. The concern here is that most regulatory applications of the hazard index approach are deliberately conservative and designed to overstate the magnitudes of ecological risks. In this case, conservatism can result in poor decision making because

contaminant-related risks may be overstated relative to corrective action-related risks, which are not even being considered.

d) The document describes methods for estimating exposures and effects on benthic invertebrates and terrestrial wildlife, but is vague about data sources and assumptions.

e) In the equation used to calculate aqueous benchmarks for piscivorous wildlife (p. F-7), what is the source of the values for "species sensitivity factor " (SSF)? This may be the most important value in the equation.

In addition to the many limitations of the methodology acknowledged in the draft RIA, there are a number of specific application and interpretive errors in Appendix F, including:

a) Proximity Analysis

(1) p. F-1, paragraph 2: Land use categories were ranked in terms of habitat value (i.e., surface water and terrestrial ranked higher than residential, agricultural and industrial land uses). However, assessing land uses in terms of vulnerability ("ecosystems at risk") would result in the opposite ranking.

(2) p. F-1, paragraph 3: "Smaller areas" of surface water are not necessarily at lower risk than "larger areas": for example, greater volume and surface area tend to reduce risk in larger bodies of water due to dilution and air stripping.

b) Ecological Benchmark Levels

(1) p. F-2, paragraph 4: There is no scientific rationale provided for the extrapolation factors used to account for variation in species sensitivity, extrapolation from acute to chronic value, and high bioaccumulation potential.

(2) p. F-4, paragraph 2: One cannot estimate BCF values when log K_{ow} is greater than 4 or 5, since the correlation is not linear in that range: many of the chemicals of concern have log K_{ow} values greater than 4.

(3) p. F-5, paragraph 2: "No observed effect levels" (NOELs), which are protective of individual organisms, are not the appropriate population threshold for wildlife.

(4) p. F-8, paragraph 1: The document states that, "BCF values in the Superfund Chemical Data Matrix are the highest measured for any aquatic species." What is the impact of all these worst-case estimates on the final values for the screening-level surface water criteria?

c) Case Studies

(1) p. F-19, paragraph 2: If, as stated, "the data do not allow for separation of the effects of SWMU releases from permitted releases under the facility's NPDES outfalls," the methodology will not be useful for diagnostic purposes. Is this a generic situation?

(2) p. F-21, paragraph 2: The finding that parasites and fin rot were most prevalent among fish collected closest to the facility may not be significant, since most fish are not territorial in lakes and move around a lot.

10. Conclusion

In conclusion, we support the inclusion of an ecological risk assessment in the RCRA Corrective Action RIA. However, we are concerned that the current draft does not incorporate the approach contained in the Ecorisk Framework, and the assessment of ecological risks is incomplete. We recognize that resource limitations may preclude a complete ecological risk assessment in this document, yet the approach taken may serve as a model for other risk assessments and RIAs. Consequently, we recommend that the RIA be modified to: a) more explicitly follow the Ecorisk Framework; b) discuss which ecorisk factors were considered in the RIA and why; c) discuss which ecorisk factors were not considered and why; and, d) discuss uncertainties associated with insufficient knowledge, inadequate data, natural variability, etc.

We sincerely appreciate the opportunity to review the progress of this important activity. We hope these comments will be helpful to the Agency in revising the RIA, and we look forward to your response on the issues we have raised.

Sincerely,

/signed/
Dr. Raymond C. Loehr, Chair
Science Advisory Board

/signed/
Dr. Kenneth L. Dickson, Chair
Ecological Processes and
Effects Committee

/signed/
Dr. Alan W. Maki, Chair
Ecorisk Subcommittee

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