

The Need for Comparative Net Risk Evaluation (CNRE) – Steps Toward Resolution

Presented by the SMWG at:
**ADDRESSING UNCERTAINTY AND
MANAGING RISK AT
CONTAMINATED SEDIMENT SITES**
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Comparative Net Risk Defined

- ✓ **Comprehensively Considers Risks Due to**
 - **Direct Impacts/Target Risks**
 - Those associated with the presence of contamination in sediments
 - **Indirect Impacts/Competing Risks**
 - Those associated with remedy implementation
- ✓ **“Each intervention to protect against a target risk can simultaneously generate countervailing (i.e., competing) risk” (Wiener & Graham 1995)**
- ✓ **CNRE Seeks to Measure the Net Effect of Intervention, Offset by the Degree of Competing Risk Created**

Basis & Need for Comparative Net Risk

- ✓ 'Traditional' Risk Assessment Approach Does Not Fully Satisfy Needs, as Articulated in NRC Recommendations and EPA Sediment Management Principles

- NRC Recommended broadening the evaluation of remedy effectiveness to include the consequences of remedy implementation, including indirect risk*

"All remediation technologies have advantages and disadvantages when applied at a particular site and it is critical to the risk management that these be identified individually and as completely as possible for each site"

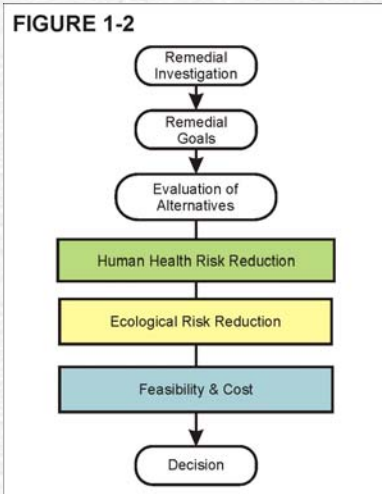
"For a site, it is important to consider "overall" or "net" risk in addition to specific risks."

¹ A Risk Management Strategy for PCB Contaminated Sediments – National Research Council – 2001

U.S. EPA Contaminated Management Principles

- EPA Management Principle Nos. 8 and 10 emphasize risk management and risk reduction:
 - No. 8 – Ensure that Sediment Cleanup Levels are Clearly Tied to Risk Management Goals
 - No. 10 – Design Remedies to Minimize Short-Term Risk While Achieving Long-Term Protection

'Traditional' Approach



Shortcomings of Traditional Approach

- ✓ Emphasizes Quantitative Goals
 - The Degree of Human Health or Ecological Risk Reduced
 - Compliance with Promulgated ARARs
 - Mass of Contamination Removed
 - Extremely Low and Sometimes Unachievable Cleanup Action Levels are Established
- ✓ The Net Effectiveness of the Remedial Alternative is not Considered, for example:
 - If Post-Dredging Residuals Remain, What Would the Long Term Effectiveness of the Remedy be, Such as the Length of the Time to Remove Fish Consumption Advisories?
 - If MNR is Selected, What Would the Impact on its Long Term Effectiveness Be if There is a Flood Event?

Shortcomings of Traditional Approach

- ✓ Consideration of Implementation Risk is Either Not Considered or is Deferred to a "Design Consideration"
- ✓ Often Does Not Consider Real-World Barriers Which Impede or Diminish the Anticipated Effectiveness of One or More of the Sediment Management Alternatives
- ✓ Pre-empts Consideration of Other Factors that Could Create a More Balanced Comparative Analysis if the True Net Effectiveness of the Alternatives Was Considered

Shortcomings of Traditional Approach

- ✓ Lack of Incorporation of These Factors May Drive Remedy Decisions that are
 - Less Protective than Anticipated
 - More Injurious to the Environment
 - More Costly than Necessary
- ✓ Traditional Approach Originally Developed to Address Land-Based Contamination – May not be Sensitive to the Unique Problems Posed by Sediments

The Challenge

- ✓ Raise the Awareness of Decision-Makers Regarding Incorporation of a Broad Array of Potential Risks in Evaluating Potential Remedial Alternatives
- ✓ Begin the Process of Institutionalizing Comparative Net Risk Assessment into a Workable Protocol that can be Generally Accepted and Used at Contaminated Sediment Sites

Possible Benefits of CNRE Approach

- ✓ By Incorporating Consideration of Broader Range of Impacts, Helps to Ensure that both Traditional Risks (Human Health/Environment) and Risks of Remedy Implementation are Considered
 - Direct Impacts
 - Indirect Impacts
- ✓ Comparative Format Allows Each Remedial Alternative to be Evaluated on its Merits Against its Potential Impacts
- ✓ Helps to Ensure that All Relevant Criteria are Evaluated Throughout the Process

Possible Benefits of CNRE Approach

- ✓ Enables Uncertainty to be Portrayed in Comparing Alternatives
 - Current Alternatives Analysis Tends to View Outcomes as More Well-Defined than they Really Are
 - Some Outcomes Where Sensitivity Analysis May Make Sense
 - Relative Time Frames to Achieve Risk Reduction
 - Degree of Risk Reduction Achievable
 - Relative Costs
 - Relative Effectiveness –
 - e.g., Resuspension Losses in Dredging
 - Post-Dredging Residuals
 - Sediment Stability - MNR
 - Relative Occupational Exposure Risk/Public Safety Issues
 - Transferred Risk to Other Locations

Examples of Indirect Human Health/Ecological Impacts - Dredging

- ✓ Contaminant Resuspension at Dredge-head
- ✓ Increased Water Column Concentrations at Material Dewatering Outfalls or in the Vicinity of Confined Disposal Sites
- ✓ Post-Dredging Residuals May Not Result in Acceptable Risk Reduction
- ✓ Airborne Exposures via Volatilization/Fugitive Dusts
- ✓ Accidental Transportation Spills
- ✓ Releases During Storage, Pre-Treatment and Final Treatment and Transportation
- ✓ Impact to Benthic Organisms and Aquatic Vegetation

Examples of Indirect Human Health/Ecological Impacts - Dredging

- ✓ Releases to Ground Water/Surface Water during Off-Site Treatment or from Upland Disposal Sites
- ✓ Mobilization of Co-Contaminants
- ✓ Worker Injury During Dredging Activities
- ✓ Traffic Accidents During Material Shipment
 - Injury to the General Public
 - Risk of Spillage of Contaminated Media
 - Injury to Drivers
- ✓ CDF or Landfill Failure in the Future

Examples of Indirect Human Health or Ecological Impacts - Capping

- ✓ Mobilization of Contaminants During Cap Placement
- ✓ Impacts to Benthic Organisms and Aquatic Vegetation
- ✓ Worker Injury During Capping Activities
- ✓ Traffic Accidents During Material Shipment
 - Injury to the General Public
 - Occupational Exposures and Injuries

Examples of Indirect Impacts – Monitored Natural Recovery

- ✓ Prolonged Impacts Due to Extended Time to Reach Remediation Goals
- ✓ Worker Injury During Monitoring

Components of a Comparative Net Risk Protocol

- ✓ Basic Components
 - Baseline Exposure Forecast
 - Acceptable Risk Target
 - Time to Reach Targets
 - Cumulative Exposure & Risk
 - Net Effectiveness Evaluation of Each Alternative
- ✓ Uncertainty is Associated with Each Component and Must be Satisfactorily Bounded
 - Risk Protocol Can be Used to “Inform” Data Gathering
 - Sensitivity Analyses Can Highlight Key Data Gaps

Consistency with CERCLA 9 Criteria

- ✓ Threshold Factors:
 - Overall Protection of Human Health & the Environment
 - Compliance with ARARs
- ✓ By Definition, These Factors Must be Achieved by All Remedial Alternatives for Direct Risks
- ✓ Additional Consideration Should be Given to Indirect Risks
 - Impacts to Biota Resulting from Remedial Actions
 - Worker Injuries
 - Traffic Accidents
 - Material Spills during Transport

Consistency with CERCLA 9 Criteria

- ✓ Balancing Factors:
 - Long-Term Effectiveness & Permanence
 - Time to Target
 - Post-Dredging Residuals Impact on Risk Reduction
 - Impact of Remediation on Channel Hydrodynamics
 - Releases from Disposal Sites
 - Migration of Contaminants through Caps
 - Cap Longevity
 - MNR - Sediment Stability
 - Reduction of Toxicity, Mobility, or Volume Through Treatment
 - Impacts Attributed to Treatment Facilities

Consistency with CERCLA 9 Criteria

✓ Balancing Factors:

- Short-Term Effectiveness
 - Water Column Releases During Remediation & Dredge Material Dewatering/Treatment
 - Mobilization of Co-Contaminants at Depth
 - Volatilization of Contaminants During Remediation and Post-Removal Handling/Transport
- Implementability
 - Availability of Materials
 - Relative Difficulty of Construction Techniques
 - Time Required for Design & Implementation
- Cost

Consistency with CERCLA 9 Criteria

✓ Modifying Factors

- State & Tribal Acceptance
 - Public Acceptance
- ✓ Many of the Indirect Risks Previously Discussed Relate Directly to Modifying Factors

Comparative Measures of Direct Impacts

- ✓ Potential Alternative Measures of Direct Impacts
 - Cumulative Exposure Reduction
 - Relative Residual Exposure Levels
 - Percent Reduction in Present-Day Exposure
 - Time-to-Target
 - Reduction in Downstream Transport

Comparing Safety Indirect Risks

- ✓ Potential Categories of Risk
 - Worker Fatalities
 - Worker Disabling Injuries
 - Vehicle Accidents
 - Vehicle Accident Fatalities
 - Accidental Spills
 - During Active Remediation
 - During Transport

Comparing Environmental Indirect Risks

- ✓ EPA Guidance: "A Guidebook to Comparing Risks and Setting Environmental Priorities" (USEPA, 1993)
 - Relative Vulnerability
 - Relative Receptor Response to Stressors
 - Area of Impact by Trophic Level
 - Probability of Occurrence of Stressors to Specific Receptors

Closing Thoughts

- ✓ Current Risk Assessment/Decision Paradigms do not Address a Sufficiently Broad Array of Risk
- ✓ Current Remedy Evaluation Does Not Evaluate the Net Risk Reduction of the Remedial Alternatives
- ✓ Comparative Net Risk is Essential to Development and Selection of Robust and Effective Sediment Remediation Alternatives

Closing Thoughts

- ✓ While Tools Exist to Support Comparative Net Risk Assessment, a Comprehensive Approach is Lacking
- ✓ A Useable Protocol Should be Developed and Incorporated Into the Remedy Selection Process to Ensure that the Net Effectiveness of Remedial Alternatives Is Compared As Part of the Remedy Selection

For Further Info ...

- ✓ Contact the SMWG:

*Steven C. Nadeau, Esq., Coordinating Director,
SMWG*

Honigman Miller Schwartz and Cohn LLP

Phone: (313) 465-7492

Fax: (313) 465-7493

email: snadeau@honigman.com

- Visit the SMWG website: www.smwg.org