South River Remedial Options Program (ROPs) – Results of Remedy Screening

Between 2009 and 2012, the ROPs Work Group performed detailed reviews of a range of remediation technologies and associated implementation approaches that might be applicable to the South River aquatic system. The objectives of the remedy screening process were to identify potentially implementable technologies and strategies, provide focus for ongoing science and engineering activities on the river, and develop a remedies matrix for the remediation proposal. The South River Conceptual Site Model (CSM), including abiotic and biotic pathway diagrams, guided the ROPs Work Group in assessing the applicability of potential remedial technologies. Remedial technologies were sorted and rated as high, medium, or low according to their potential to address internal and external mercury loading to the South River aquatic system.

Criteria considered in this initial sorting of potential remedies built upon current Superfund NCP evaluation criteria, and included the following:

- Effectiveness
  - Overall protection of human health and environment
  - Compliance with specific regulatory requirements
  - Long-term effectiveness and permanence
  - Short-term effectiveness
  - Reduction of toxicity, mobility, or volume
- Implementability
  - Technical feasibility
  - Constructability
  - Safety
  - Community acceptance
  - Regulatory acceptance
- Cost effectiveness
- Sustainability

The product of this effort was a preliminary remedial technology matrix specific to different mercury loading sources to the aquatic system. Table 1 summarizes the results of the technology screening evaluation.

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Table 1 - Preliminary Remedial Technology Screening Matrix

Potential Sources		Remediation Target	Remediation Priority[1]	Remedial Alternatives or Approach	Notes
External Sources of Mercury Loading	Site Outfalls	Reduce mercury loading to compartments in the aquatic system	High: – Most upstream source – Relatively large IHg load – IHg from outfalls may be more available for methylation than other sources of IHg – May confound potential downstream remedies	On-site source remediation (sewers, sumps, soil, SWMUs)	– Mass load and variation are quantified – Relative bioavailability of source is assumed to be high – Time required for interim remedial measure success is not known – Very high cost/benefit ratio for end-of-pipe treatment of large, dilute stream
				Filtration (membrane, sand, etc.)	
				Filtration plus pre- and post-treatment: – Thiol-based polymer – Activated carbon – Polymeric adsorption resin	
				$SnCl_2$ reduction and air stripping plus capture	
	River Banks	Reduce mercury loading to compartments in the aquatic system	High: – Potentially most significant source of mercury to the river system – Soil-derived IHg may be more available for methylation than sediment-derived IHg	Physical stabilization or isolation	– Length of time to achieve desired objective is uncertain – Longevity of stabilization
				Chemical stabilization: – Carbon amendment and coagulants	– Length of time to achieve desired objective uncertain – Behavior/efficacy of amendments if eroded or inundated not known – Potential for deleterious ecological effects unknown
				Best management practices to reduce soil erosion: livestock management	
				Targeted removal plus stabilization or disposal	Soil may be removed as part of physical stabilization
	Floodplain Runoff	Reduce mercury loading to compartments in the aquatic system	Low: – Floodplain (adjacent to eroding banks) contributes less than 10% of total load between RRMs 0 and 10	Sediment traps	The importance of floodplain runoff is not known, but considered low based on the conceptual site model
				Rerouting river/runs	
				Flood control measures (e.g., increase storage capacity)	
Internal Sources of Mercury Loading	Fine-Grained Sediment Deposits	Reduce importance of deposits as a source of MeHg to the aquatic environment	High: – Areas potentially support high rates of mercury methylation	Monitored natural recovery[2]	Importance of MeHg produced in bulk sediment vs. other habitats to overall food web burden not known
				(Im)permeable and/or reactive cap: – AquaBlok®, AquaGate®, Reactive Core Mat™, etc.	Changes in hydraulic sheer stress over time could destabilize cover
				Targeted removal plus stabilization/disposal	Removal may expose higher mercury concentrations at depth
				Large woody debris management	
				Maintenance/filling ditches/millraces	Account for very small proportion of MeHg to system
				Aeration/oxidation	– Effectiveness questionable – Bioavailability of IHg in sediment over time uncertain
	Interstitial Sediment	Reduce importance of sediment as a source of MeHg to the aquatic environment	Moderate: – Areas potentially support high rates of mercury methylation	Monitored natural recovery[2]	Reduced bioavailability of IHg over time unknown
				(Im)permeable and/or reactive cap: – AquaBlok®, AquaGate®, Reactive Core Mat™, etc.	Change in hydraulic sheer stress may occur over time
				Aeration/oxidation	
	Water Column	Reduce mercury concentrations	Moderate: – Important exposure medium at base of food web – Water column is an important transport pathway	Monitored natural recovery[2]	Length of time to achieve desired objective unknown
				Chemical treatment: – Removable carbon sorbent – Pump and treat	– Proportion of volume that must be treated unknown – Treatment longevity unknown
				Phytoremediation	
				Sediment traps	
				Aeration/oxidation	Likely that methylation areas will not respond to treatment

Notes:
1 Remediation priority from Reed Harris (2012)
2 Includes institutional controls on fish consumption by humans
Green shading denotes a technology with a high potential to control mercury loading
Yellow shading denotes a technology with a medium potential to control mercury loading
Orange shading denotes a technology with a low potential to control mercury loading