

Advances in Adaptive Management for Cleanup of Complex Sites

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Background/Objectives. As cleanup programs for complex contaminated sites mature, those remaining often have significant underlying technical challenges and financial constraints. Often remediation efforts at these "complex" sites must implement one or more interim actions and prioritize these actions to protect receptors, reduce the source strength and/or stabilize/contain the plume rather than uniformly achieve stringent, promulgated cleanup goals. Within remedial programs, such as EPA Superfund, decisions then have to be made about whether and how to commit resources towards achieving meaningful remedial progress, protecting receptors in the interim, and ultimately, the path for developing a final remedy. Often, there is significant uncertainty in the site conceptual model as programmatic decisions are made for implementing remedial actions, which can create barriers to efficient cleanup when conditions are different. Often, adaptive management approaches are better suited to facilitate meaningful cleanup by using an adaptive framework to reduce risk to human health and the environment as progress is made and more is learned about the site during implementation. Adaptive management strategies for complex contaminated sites includes strategic management of uncertainty and risks using tools like risk registers and multi-criteria decision analysis (MCDA) to make strategic decisions and drive successful cleanup. Advances in adaptive and risk management tools and technologies can be used to quantitatively and qualitatively evaluate risk and develop flexible remedies that can adjust to changing conditions over the course of remedy life-cycle implementation.

Approach/Activities. Managing project risk can include developing performance metrics, and using innovative tools, to evaluate progress towards remedial objectives and implementing successful risk-based cleanup approaches in step-wise fashion. This presentation will overview a risk-management framework and provide lessons learned from implementing remediation at complex sites. As will be presented in the framework discussion, risk management objectives often overlap, share drivers and barriers to implementation, and have the common goal of efficiently utilizing resources to protect human health and the environment.

Results/Lessons Learned. Two case studies will be presented that illustrate use of risk registers to manage schedule, cost and technical risks during each phase of the CERCLA remedy process (i.e., Remedial Investigation, Feasibility Study, Remedial Design, Remedial Action). In addition, MCDA will be reviewed (e.g., multi-objective decision algorithm and analytical hierarchy process) with the case studies used to highlight how these decision tools were used to modify (i.e., course-correct) remedial technology selection and design and technology implementation, ultimately saving millions of dollars in reduced costs due to realized efficiencies. A discussion of how these adaptive management approaches were implemented within the CERCLA framework will also be discussed.