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Comparison of Environmental Evaluation Tools and Incorporation of Monetized Socioeconomic Damages for Sediment Remediation Projects

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Background/Objectives. Sediment remediation projects can be greatly improved by life cycle assessment (LCA) evaluation to identify and optimize the most sustainable practices. As a less time-consuming alternative to LCA, the environmental footprint tool SiteWise™ was upgraded in 2015 to include sediment remediation components. Here we used data from a contaminated sediment site to compare remedial alternative analyses between SiteWise™ and LCA. The environmental results were then quantified and normalized through the monetization of global impacts by extrapolated socio-economic costs, thereby making comparison of dissimilar environmental impacts possible. Monetization also contributed social and economic aspects to round out the sustainability evaluation. The goal was to make a direct comparison of the results between the two analytical tools addressing sediments for the first time, and provide guidance for future streamlined but well-considered sustainability evaluations of such sediment projects.

Approach/Activities. The case study site (US) included two adjacent coastal inlets connected to the Atlantic Ocean. Sediment concentrations of polychlorinated biphenyls (PCBs) were as high as 4,000 mg/kg, with co-contaminants polycyclic aromatic hydrocarbons (PAHs) and heavy metals. Remedial action included excavation, dredging, and in situ treatment with activated carbon. Supporting activities included dewatering, waste transport/disposal, engineering controls (e.g., silt curtains), and bank stabilization. The sustainability assessment began with environmental impact evaluation by both SiteWise™ version 3.1, and LCA with SimaPro© software. The results from both calculations were then normalized through conversion to long-term social costs by the methodology developed by M. Harclerode at Montclair State University (2013-2016). These social costs were derived from estimated damages caused by incremental increases in CO_2 and hazardous air pollutant emissions, and resource consumption.

Results/Lessons Learned. SiteWise™ and LCA both identified the same remedial activities as the major contributors to environmental impacts: dewatering and engineering controls. Identification of less dramatic but still significant secondary impacts was different, but with some overlap, between the two tools. One surprising conclusion was that engineering controls provided a major negative impact, but dredging (only on-site activities) did not. This was explained by migration control's heavy resource use, including PVC booms, geotextile, and galvanized steel fittings, compared to the less significant amount of fuel consumption in dredging. SiteWise™ identified bank stabilization as a large contributor to NO_x emissions, but monetization showed this to be an insignificant overall impact compared to the other types of emissions caused by the project. Altogether the results demonstrated similar outcomes from the two environmental analysis tools. Monetization of the SiteWise™ and LCA results allowed direct comparisons between disparate environmental impacts. Furthermore, incorporation of the costs of extrapolated long-term socio-economic damages both helps practitioners focus on alleviating the heaviest impacts from remedial activities, and provides a way to include social and economic concerns in the decision making process, thereby integrating all three elements of the triple bottom line.