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Integrating Sustainable Principles, Metrics and Practices into Remediation Projects

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Abstract

There are many benefits to expediting cleanup of contaminated sites; however, these efforts can be energy and resource intensive and result in a number of unintended impacts. Growing awareness of the need to use resources wisely and reduce our overall energy and carbon footprint, has led to a wide spread call for factoring sustainability into site remediation and thinking outside the boundaries of the contaminated site when selecting and implementing a remedy.

Quantitative analysis provides a strong basis for comparing alternatives as well as identifying how remedies in the design, construction and operating phases of the project life cycle might be improved. These quantitative measures include carbon emissions, energy and resource consumption, habitat loss, as well as worker and community risks and air impacts posed by remedy implementation.

Key words

Sustainable remediation, environmental footprint

Overview of Green and Sustainable Remediation

Green and Sustainable Remediation (GSR) has emerged as a leading edge approach to optimize the remediation of contaminated sites. With sustainability increasingly becoming a priority for corporations, governments, and society-at-large, remediation site solutions that include GSR offer many environmental, economic and social advantages.

While environmental remediation may inherently seem green and sustainable, site remediation activities often have significant impacts including air emissions, water consumption, energy utilization, landfilling, and resource usage. Beyond these physical impacts, businesses and organizations tasked with environmental site cleanups are often subject to additional and equally significant project dimensions—requiring that community concerns and broader economic issues be addressed in the site remediation plan.

What are key GSR considerations?

Table 1 presents AECOM's approach for considering sustainability at different stages of the remediation life cycle. The approach integrates environmental, social and economic factors to ensure that the remedial approach minimizes the environmental footprint of the cleanup while maximizing the societal and economic benefits. The examples of sustainable approaches are illustrative and should be modified on a site specific basis considering regulatory requirements and other physical or practical limitations.

Table 1. AECOM's GSR Integration Framework for Site Investigtaion and Remediation Projects

	Environmental	Social	Economic
Site Investigation	• Collect data to understand risks of on-site treatment and containment of contaminated media • Use direct push tools to reduce Investigation Derived Waste (IDW) and energy consumption • Use passive diffusion or grab type samplers for groundwater samples to reduce IDW and energy consumption	• Conduct community outreach to communicate site conditions and risks and engage in planning of site cleanup and reuse options • Create key contacts list of stakeholders to facilitate communications	• Use field screening technologies to reduce IDW and off-site sample shipping
Feasibility Study/Response Action Plan	• Evaluate on site and *in situ* treatment and containment technologies • Conduct energy use and emissions calculations to compare alternatives • Identify opportunities to create habitat as part of site remediation • Consider green technologies and green products	• Communicate site remediation options and risk reduction achieved • Obtain input on site cleanup alternatives and community concerns/needs	• Determine short-term and long-term cost of site remediation alternatives contrasting with environmental and social costs/benefits
Remedial Design	• Identify low-energy, low-emission and low water intensive equipment • Minimize water consumption and maximize water reuse • Minimize impacts to local natural resources and habitats • Maximize use of renewable energy and fuels • Minimize off-site transport of contaminated materials • Identify recycling options or use of green materials • Utilize on-site treatment and containment approaches • Integrate remote monitoring features into design	• Engage community leaders in design meetings to obtain input on configurations and timing of site work • Communicate site remediation plan including short-term community impacts and long-term risk reduction • Consider use of local materials and labor • Evaluate community impacts and safety issues from site remediation actions	• Use on-site approaches to management of contamination to reduce site cleanup costs and potential long-term liabilities of off-site disposal • Use adaptive site-reuse approach incorporating existing structures into site reuse options • Evaluate opportunities for capturing value of eco-assets such as wetlands credits or carbon sequestration
Remedial Action Implementation/ Construction Management	• Minimize equipment engine idling • Control and mitigate dust, odors, noise and light impacts • Conduct monitoring of air, odors, noise and light • Set-up comprehensive on-site recycling program for all wastes and residuals	• Conduct community meetings to inform of project progress • Post information on monitoring programs and project progress/plans	• Determine cost impact to project from use of GSR approaches
Operations, Monitoring and Maintenance (OM&M)	• Utilize remote monitoring system to monitor effectiveness of treatment systems and reduce field travel • Recycle sampling residuals • Use recycled materials for sampling and monitoring to reduce IDW and fabrication of new material • Design adaptive monitoring programs to reduce sampling frequency over time	• Communicate site remediation status using website and other public communication approaches	• Utilize low energy intensive approaches to reduce energy costs • Use on-site sample testing / screening approaches to reduce transportation File electronic reports to reduce paper consumption

Several factors make GSR an attractive option for a remediation program:

1. Growing awareness and acceptance of GSR concepts within federal and state governmental agencies may help other public agencies and corporations develop better and more cost-effective remedies.
2. GSR is consistent with and supports an organization's overarching sustainability program and policy.
3. Organizations that have already developed sustainable remediation policies or programs or use GSR regularly have realized significant benefits.
4. In the social impact component of GSR, stakeholder engagement should result in the identification of remedial actions that satisfy community and economic goals.
5. Implementing GSR often results in less resource-intensive remedies, which generally cost less.
6. GSR solutions enhance community relations and good will.

Passive and Low-Energy Remedial Approaches Reduce Impacts

Passive, lower energy and *in situ* technologies generally provide better results in a GSR evaluation when compared to pump-and-treat and large, energy-intensive remedial construction projects, which yield larger environmental footprints and greater GHG emissions.

How can organizations explore GSR at the enterprise or project level?

First and foremost, it is important to identify the business case specific to your organization. It could be that you want to align your site remediation program with your sustainability program, or it could be that you want to understand and mitigate the unintended consequences of site cleanup projects. Whatever the basis, your business case will drive the organizational framework for your GSR program. Following this, there are a variety of actions you can undertake to get started, including the following "first steps":

- Identify the overall objectives of your program and the metrics you want to evaluate for each project and track and report.
- Establish a baseline for existing remedial projects to measure applicable metrics such as energy consumption, water use, GHG emissions, etc.
- Develop a checklist to evaluate projects throughout the remedial investigation/feasibility study/remedial design/remedial assessment life cycle to

identify opportunities. This could be similar to the Illinois "Greener Cleanup" matrix listed in Key References.

- Identify projects for pilot implementation of Green Remedial Process Optimization, such as alternative energy applications, e.g., pump, treat and heat, renewable energy or waste reduction.
- Identify projects where adaptive reuse of contaminated sites fits with expansion or retrofit of base facility development, e.g., a new campus for training.
- Develop "green investigation" protocols, using less invasive technologies for site characterization.
- Identify a project in the feasibility study stage and complete an evaluation of sustainable metrics for the alternatives. The first phase would be to develop a metrics proposal for engagement with agencies.

Key References

There are multiple sources of information on GSR that can help project teams evaluate how these considerations can be factored into remedy selection.

- EPA's publications, Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites. http://cluin.org/greenremediation.
- Comprehensive, peer reviewed paper by the Sustainable Remediation Forum, "Integrating sustainable principles, practices, and metrics into remediation projects". Remediation Journal, 19(3), pp. 5 – 114, editors P. Hadley and D. Ellis: http://www.sustainableremediation.org.

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