SURF: Advances in the Incorporation of Sustainability Into Remedial Approaches – 16451

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ABSTRACT

The inclusion of sustainability considerations in remediation cleanup process (investigation through site closure) benefits site owners, including Federal agencies such as the Department of Defense (DOD) and Department of Energy (DOE), through development of more efficient and cost-effective remedies as well as communities by considering socio-economic impacts and redevelopment into remedial decisions. The incorporation of social, environmental, and economic considerations early in the remedial process often enables achievement of regulatory site closure sooner and with broader community acceptance. In order to achieve these objectives, stakeholders, including federal facilities, regulators, contractors, and consultants, have expressed the need for case studies demonstrating successful implementation of sustainable practices.

The Sustainable Remediation Forum emerged in 2006 and was established as a non-profit organization in 2010. Through exploration of technical issues such as groundwater conservation and reuse at remediation sites to life cycle assessment approaches, subject matter experts have led discussions across the industry of how the incorporation of sustainability into the remediation process can provide benefits through:

- Consideration of socioeconomic impacts and drivers for remediation and redevelopment;
- Reduced environmental impacts of remedial actions; and
- Enhanced economic value through partnerships and informed decision making.

Incorporation of sustainable remediation concepts provides distinct and recognizable value, as demonstrated through the technical initiatives of the Sustainable Remediation Forum, remediation industry conferences and events, and the prevalence of government agency and corporate sustainable remediation programs, such as the DOE's Cross-Programmatic Work Group.

Sustainable remediation has evolved from discussions of environmental impacts of cleanups (with considerable greenwashing), to quantifying and minimizing the environmental footprint and subsequent long term global impacts of a remedy, and currently, incorporating strategies to address all three components of sustainability – environmental, social, and economic. However, the practice of sustainability must continue to advance and new approaches should be adopted to holistically evaluate beneficial and detrimental impacts from the remedial process and incorporate sustainability concepts throughout the project life cycle. A more holistic and comprehensive approach, beyond the traditional paradigm of sustainable remediation, will lead a project team to achieve social and economic sustainability objectives of the community while protecting human health and the environment. This “advanced” approach is where the most significant benefits will be achieved.

Practitioners need documented, peer-reviewed, technically sound concepts and examples of sustainable remediation as supporting material to gain acceptance and approval of incorporation of best management practices and evaluation techniques. Reviewing the advancements of sustainable remediation over the last 5-10 years and the identification of lessons learned has great merit. This discussion of case studies will highlight successful incorporation of social impacts, economic analysis, and site redevelopment into the remedial process to provide a roadmap for site owners in developing sustainable approaches for their sites. Specifically, benefits were achieved in these case studies through promotion of economic development, innovative financing, incorporation of risk-based approaches, and consideration of social value of a site.

INTRODUCTION

Sustainable remediation is defined as the use of sustainable practices during the investigation, construction, redevelopment, and monitoring of remediation sites, with the objective of balancing economic viability, conservation of natural resources and biodiversity, and the enhancement of the quality of life in surrounding communities [1]. Benefits of considering and implementing measures to balance the three pillars of sustainability (i.e., society, economics, and environment) may include lower project implementation costs, reduced cleanup timeframes, and maximizing beneficial while alleviating detrimental impacts to surrounding communities. However, the value of sustainable remediation is often most recognized when a project team is able to identify and incorporate stakeholder sustainability objectives into the remedial decision making process through thoughtful stakeholder engagement that may not have been considered previously. As a result of considering stakeholders’ values and how those values correlate to outcomes of the remediation or redevelopment process, a more efficient, sustainable, and widely accepted approach can be selected that also achieves regulatory objectives.

The remediation industry has reported numerous examples of conservation (e.g., of natural resources), optimization (e.g., of existing remedial technologies), and minimization (e.g., of waste generation) during the remediation life cycle. While these approaches are favorable and beneficial to the site owner and other stakeholders, there still exists an opportunity to expand the role of the remediation team in providing environmental, social, and economic benefits through implementation of sustainable remediation and redevelopment activities and discovering new and improved remediation solution space (Figure 1).

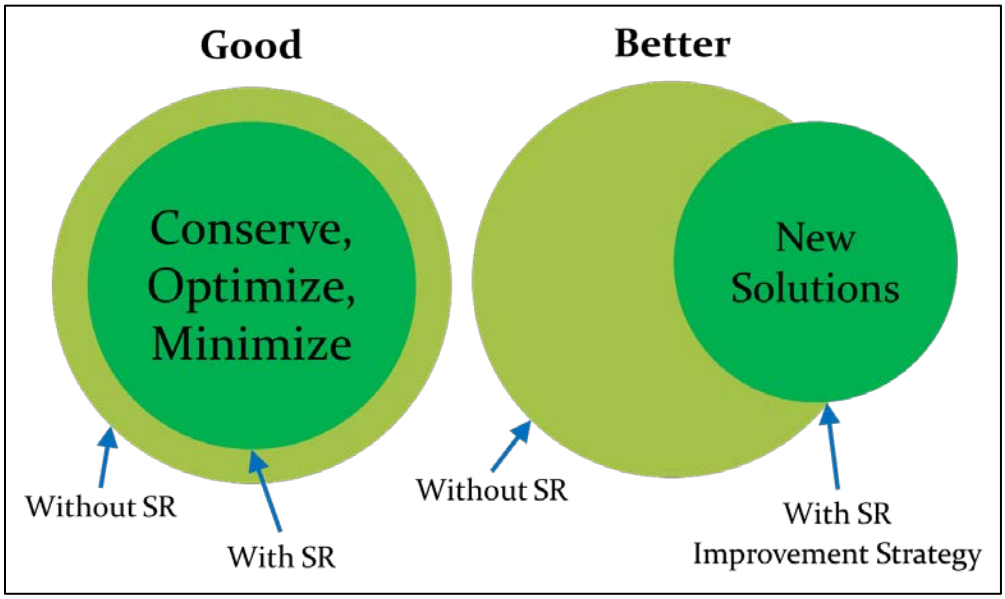

Figure 1: Sustainable Remediation Solutions

The mission of the Sustainable Remediation Forum (SURF), founded in 2006 and established as a non-profit organization in 2010, is to maximize the overall environmental, societal, and economic benefits from the site cleanup process by:

- Advancing the science and application of sustainable remediation;
- Developing best practices;
- Exchanging professional knowledge; and
- Providing education and outreach. [1]

SURF, through execution of its mission, has endeavored to create opportunities for remediation practitioners to implement innovative, sustainable solutions that achieve greater benefits than solutions developed via the existing remediation paradigm. In 2014, SURF introduced the Case Study Initiative [2] in order to provide practitioners with documented, peer-reviewed, technically sound concepts and examples of sustainable remediation, contributed and reviewed by its members and participants. The case studies published to date [1] highlight successful incorporation of social impacts, economic analysis, and site redevelopment into the

remedial process. When viewed holistically, these case studies can provide a roadmap for site owners in developing sustainable approaches for their sites. The following is a discussion of three case studies that highlight specific strategies and benefits of sustainable approaches, including thorough stakeholder engagement, promotion of economic development, innovative financing, and incorporation of risk-based approaches.

CASE STUDIES

Pharmacia and Upjohn Company, LLC, North Haven, Connecticut [3]

This Pharmacia and Upjohn Company LLC site is located in North Haven, Connecticut in a mixed commercial and industrial area along the Quinnipiac River. The site has historically been used as a clay mine and brickyard and for chemical and electric component manufacturing. The investigation and cleanup of the site is managed by Pfizer (who assumed responsibility for the site in 2003 as a result of its acquisition of the Pharmacia Corporation) and is performed under RCRA Corrective Action, administered by EPA Region 1 in coordination with the Connecticut Department of Energy and Environmental Protection (CTDEEP). The project was evaluated using the ASTM Standard Guide for Greener Cleanups (E2893-13) [4]. Notably, extensive community outreach was conducted to engage local stakeholders in the selection of the remedy and future use of the site. A number of organizations were included in the remediation process, including: North Haven Citizens' Advisory Panel, Quinnipiac River Watershed Association, North Haven Land Trust, Regional Growth Partnership, North Haven Trail Association, and North Haven Board of Selectmen.

A multi-faceted remediation strategy was developed to address contaminants of concern in soil, groundwater, and sediment that incorporated environmental, economic, and social best management practices (BMPs) identified through the ASTM process. Specific elements of the remediation strategy included:

- *In-situ* thermal remediation to treat area impacted with dense non-aqueous phase liquid. Hydraulic control system for shallow groundwater consisting of a perimeter sub-grade, low-permeability vertical barrier along three sides of the site that intercept contaminated groundwater, thereby preventing impacts to the Quinnipiac River and abutting properties.
- Groundwater treatment consisting of biological treatment, chemical coagulation, suspended solids removal, and ultraviolet light oxidation with hydrogen peroxide.
- Low permeability cover systems in former soil pile and lagoon areas; remedy includes consolidating contaminated soils from other areas of the site under these covers.

- Enhancement of ecological habitat, including creation of higher value uplands and wetlands habitat. The wetlands also offer storm water management and treatment.
- Long-term maintenance of the ecological restoration area, potential future commercial/industrial use of a specified area of the site, and the operation, monitoring, and maintenance (OM&M) of remediation components and systems to verify continued protection of human health and the environment.

Examples of sustainable remediation BMPs implemented throughout the course of the project include:

- Reuse assessment to evaluate future land uses with periodic updates.
- Local buying commitment, including a web-based form enabling local businesses to provide information on prospective services and products.
- Community workshops and interviews to solicit and incorporate input to the remediation process.
- Involvement of town Selectmen in remedial decision making to ensure local government support for the proposed remedy.
- Ecological restoration.

As part of the ASTM process, Pfizer documented the complete list of BMPs implemented on the project on the ASTM Technical Summary Form, accessible via the ASTM E50 Committee website. By developing a robust community outreach program to solicit input, and then working with the community on the remedy selection and site redevelopment plans, Pfizer fostered an environment where the community is integrated into the remediation process.

Former Chemical Recycling Facility, Olathe, Kansas [5]

The former chemical recycling facility (details are confidential) is located in a mixed commercial and residential area, bordering a railroad right-of-way and single family residences. The site was formerly operated as a chemical brokerage recycling facility between 1951 and 1989. Over time, chemicals shipped to the site for recycling were spilled or leaked into soil and groundwater due to improper on-site housekeeping practices. Some of these substances migrated off-site via air, surface water runoff, and groundwater migration. Groundwater is not used as a source of municipal drinking water, but private wells are present within three miles of the site.

The site was remediated as part of an EPA CERCLA Order with the goals of eliminating exposure to contaminants of concern in soil, groundwater, and soil vapor; maintaining positive community relations; and restoring the site to open greenspace and a pollinator habitat. The strategy included:

- Targeted hotspot soil excavated with off-site disposal;
- *In situ* chemical oxidation of groundwater via a perimeter trench; and
- On-site water treatment.

The remediated site has been converted to an ecological habitat consisting of mostly native plants that provide sources of food, shelter and safe breeding areas for various pollinators like bees, birds, and butterflies, especially monarch butterflies. Before remediation, the site was secured to limit public access. Now the site has four gardens, each with a unique interpretive sign to educate users about the plants growing there. In November 2013, the Wildlife Habitat Council certified the site in its Corporate Lands for Learning Program, which links corporate habitats with students to aid in science education. This aspect of the site reuse not only created an ecological resource, but made the site a source of pride for the community.

Through this project, it was found that public- and private-sector collaboration is critical to identifying and implementing appropriate and sustainable site reuse options. Additionally, by defining the end use of the property with community input, the project team was able to negotiate an environmentally protective remedy that also reduced traffic and noise impacts to the neighboring community. The project team estimated an overall cost savings (over the originally proposed approach) of $43 million.

Gilbert and Mosley, Wichita, Kansas [6]

The Gilbert and Mosley site in Wichita, Kansas, is a former industrial facility located in a mixed commercial/industrial/residential/recreational area. Investigation and Remediation activities have been conducted to address contamination in groundwater that resulted from historical industrial activities at the site. Work at the site was conducted by the Kansas Department of Health and the Environment (KDHE) under the State Cooperative Program and a Settlement Agreement with the City of Wichita. Sustainability was considered for this site before the commencement of the Remedial Investigation and Feasibility Study, allowing opportunities for early stakeholder engagement and incorporation of sustainability considerations during the remedial decision making process.

The project team collaborated with KDHE to devise a preemptive voluntary cleanup approach for the 4 mile long groundwater plume at the site. The team also worked with the City of Wichita to pursue tax increment financing of the remediation, liability waivers for property owners, property loans, and cost sharing formula with a major potentially responsible party.

The selected remedial approach included design and construction of a groundwater pump and treat system, with a designated reuse for the treated groundwater. A

risk-based approach was employed that allowed alternate cleanup levels for groundwater that considered the end user of the treated effluent. This approach reduced the volume of groundwater requiring treatment by 40 percent and saved approximately $8 million in total remediation costs.

Most significantly, however, the project helped promote more than $300 million in economic development in Wichita through fast, aggressive cleanup. The site includes an environmental education center that uses treated groundwater for on-site water features. The innovative financing approach used at this site is an example of how public-private partnerships can be leveraged to deliver increased benefit for a project and the surrounding community.

CONCLUSIONS

The projects highlighted herein represent examples of sustainable remediation, featuring key strategies that minimize negative environmental impacts of remediation activities, improve the community engagement and acceptance with a project, and/or provide economic benefit beyond reductions in project costs. In many cases, multiple benefits are achieved when a project team incorporates sustainability into the decision making framework. SURF, along with several other organizations, such as ASTM and the Interstate Technology Regulatory Council (ITRC) and numerous international entities, have developed guidance related to the incorporation of sustainability into remediation. Significant opportunities exist to advance our remediation practices to include consideration of environmental, social, and economic impacts.

As noted by the World Bank, and echoed by Dr. Robert Montgomery at a recent SURF meeting in Washington, D.C., contaminated sites can be seen as “engines for economic development, including sources of sustainable energy and food security and resource efficient – all while assuring public health and environmental protection.” [7] Resources for remediation practitioners are available to assist in developing sustainable approaches, including SURF’s 2009 White Paper and subsequent issue papers [8-88], ITRC’s Green and Sustainable Remediation: State of the Science and Practice (GSR-1) [12] and A Practical Framework (GSR-2) [13], and ASTM’s Standard Guide for Greener Cleanups (E2893-13) [4] and Standard Guide for Integrating Sustainable Objectives into Cleanup (E2876-13) [14]. These documents discuss frameworks that may be applied to projects of any size and during any phase of the remediation life cycle, and many provide BMPs that may be implemented to improve the environmental, social, or economic aspects of a project. The frameworks, and the specific tools they reference, are a valuable asset to the remediation industry as the drivers for sustainability – resource scarcity, climate change, executive mandates, DOD and DOE policies, and environmental

justice, to name a few – become more prevalent in engineering, design and development.

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