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Introduction to Green Remediation:

Incorporating Sustainable Practices into Site Remediation

Office of Superfund Remediation and Technology Innovation | Quick Reference Fact Sheet

***Green Remediation**: the practice of considering all environmental effects of remedy selection and implementation, and incorporating options to maximize net environmental benefit of cleanup actions.*

This introduction is the first of a series of fact sheets on the opportunities for implementing best practices of *Green Remediation*. Upcoming topics include use of renewable-energy sources, daily operations, and enabling mechanisms.

Overview of Green Remediation

As part of its mission to protect human health and the environment, EPA is committed to developing and promoting innovative cleanup strategies that restore contaminated sites to productive use, reduce associated costs, and promote environmental stewardship. The Agency strives for cleanup programs that use natural resources and energy efficiently, reduce negative impacts on the environment, minimize pollution at its source, and reduce waste to the greatest extent possible. To this end, EPA supports the adoption of green remediation as the practice of considering all environmental effects of cleanup actions and incorporating strategies to maximize the net environmental benefit.

Sustainable practices result in cleanups minimizing the environmental and energy "footprints" of all actions taken during a project lifecycle. Best operating practices emphasize the need to more closely evaluate core elements of a cleanup project:

- Energy requirements,
- Air emissions,
- Water requirements and associated impacts on water resources,
- Impacts on land and ecosystems,
- Material consumption and waste generation, and
- Impacts on long-term stewardship of a site.

Evolving Practices

Increasing concerns regarding the impacts of climate change have prompted major efforts across the globe to reduce greenhouse gas (GHG) emissions with the aim of becoming "carbon neutral." To become carbon neutral, an activity must add no more carbon dioxide to the atmosphere than it effectively removes or prevents. Emissions of GHG by processes such as fossil fuel consumption significantly contributes to climate change. Recognizing these concerns, EPA is placing greater emphasis on remediation approaches that reduce energy consumption and GHG emissions, including:

- *Designing treatment systems with optimum efficiency and modifying existing systems as needed*,
- *Using renewable sources such as wind and solar energy* to meet power demands of energy-intensive treatment systems or auxiliary equipment,
- *Using alternative fuels* such as biodiesel to operate machinery and vehicles,
- *Generating electricity* from byproducts such as methane gas or waste, and
- *Participating in power generation or purchasing partnerships* offering electricity from large-scale renewable resources.

Profile: Umatilla Army Depot, Hermiston, OR

- *Treated 15,000 tons of explosives-contaminated soil by mixing with livestock manure, sawdust, alfalfa, and potato waste,*
- *Destroyed or permanently bound byproducts to soil or humus, resulting in non-detectable concentrations of explosives,*
- *Provided $150,000 potential end-revenue from sale of humus-rich soil,*
- *Saved an estimated $2.6 million compared to alternative of incineration, and*
- *Avoided significant fossil fuel consumption by an incinerator and for offsite transportation.*

Building on Current Practices

Sustainable revitalization of a site considers a range of environmental factors and community impacts aimed to maximize the environmental, social, and economic benefits of a cleanup. Green remediation builds on environmentally conscious practices already used across business and public sectors, and promotes incorporation of state-of-the art methods for:

- Pollution prevention,
- Solid and hazardous waste management,
- Waste minimization,
- Reuse and recycling,
- Use of environmentally preferable products,
- Water conservation and reuse,
- Storm water and waste water management,
- Soil erosion and sedimentation control,
- Value engineering and life-cycle analysis, and
- Greenspace allocation.

Where and When to Apply Green Practices

Best practices of green remediation may be applied to cleanup actions taken at almost any hazardous waste site, whether conducted under federal, state, or local cleanup programs or by private parties. The practices apply to all phases of site assessment, remediation, and redevelopment, including removal actions, site investigations, remedy construction, operation of treatment systems, monitoring of treatment processes and progress, and site close-out.

To maximize sustainability, cleanup and reuse options are considered early during the planning process, enabling best practices used during remediation to carry forward to redevelopment activities and ultimate land reuse. Incorporation of green remediation strategies into cleanup procurement documents is one way to open the door for best practices in the field.

In accordance with federal procurement policy, selection of cleanup equipment and services meets a project's performance and cost requirements, ***while giving preference to green products and providers****.*

Green remediation strategies apply to all types of activities undertaken during all stages of a site cleanup and land revitalization project, such as:

- Deconstruction, demolition, and removal,
- Cleanup, remediation, and waste management,
- Design and construction for reuse, and
- Reuse and environmental stewardship.

Benefits of Green Remediation

Implementation of the best practices of green remediation results in a range of benefits, including:

- Reduction in GHG and associated climate change,
- Better conservation of natural resources,
- Cost savings derived from improved efficiencies of energy-intensive treatment systems and from increased use of passive-energy treatment systems,
- Educational opportunities regarding environmental stewardship and sustainable activities, and
- Regional employment opportunities for renewable-energy business at revitalized sites.

Profile: Pemaco, Maywood, CA

- *Uses high-vacuum dual-phase extraction, thermal oxidation, ultraviolet/oxidation treatment, electrical resistance heating, biostimulation, and monitored natural attenuation,*
- *Coordinated remedy construction with the city's development of infrastructure for riverfront park,*
- *Added a 3-kW photovoltaic system to treatment building roof, providing 375 kWh of electricity for the treatment system each month, and*
- *Avoids annual emission of 4,311 pounds of carbon dioxide through use of solar energy.*

Advancing the Use of Green Remediation

To achieve green remediation goals, EPA's Office of Solid Waste and Emergency Response (OSWER) is:

- Documenting the state of best management practices,
- Identifying opportunities for improvement,
- Establishing a community of practitioners, and
- Developing mechanisms and tools for best practices.

Partners include other agencies such as the U.S. Department of Energy and the Army Corps of Engineers, state environmental agencies, and local development organizations. To help stakeholders make informed decisions, OSWER is developing illustrations of green remediation in action throughout the cleanup lifecycle. Key opportunities lay in integrated cleanup and reuse planning, daily operations, system optimization, and expanded use of renewable energy.

Visit ***Green Remediation*** *online to learn or contribute more about best practices and other resources. Products include an introductory primer, expanded case studies, technical reports, and decision-making tools:* [*http://cluin.org/greenremediation*](http://cluin.org/greenremediation)

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