

Green Remediation Best Management Practices: An Overview

A fact sheet about the concepts and tools for using best management practices to reduce the environmental footprint of activities associated with assessing and remediating contaminated sites

www.clu-in.org/greenremediation

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The Principles and Core Elements

As part of its mission to protect human health and the environment, the U.S. Environmental Protection Agency (EPA) develops and promotes innovative strategies that restore contaminated sites to productive use, reduce associated costs, and promote environmental stewardship and sustainability. The Agency recognizes that the process of cleaning up a hazardous waste site uses energy, water and other natural or processed material resources and consequently creates an environmental footprint of its own. EPA's *Principles for Greener Cleanups* (the Principles) outline the Agency's policy for considering the footprint.¹

Green remediation is the process of examining the environmental footprint of site cleanup activities and taking steps to minimize the footprint. Green remediation best management practices (BMPs) can help project managers and other stakeholders apply the Principles while maintaining the cleanup objectives and ensuring protectiveness of a site-specific remedy. The ASTM Standard *Guide for Greener Cleanups* (E2893-16) offers a collection of greener cleanup BMPs and a process for screening, prioritizing, selecting and implementing BMPs in a verifiable manner.²

Green remediation BMPs focus on the core elements of greener cleanups:

- ▶ Reduce total energy use and increase the percentage of energy from renewable resources.
- ▶ Reduce air pollutants and greenhouse gas emissions.
- ▶ Reduce water use and preserve water quality.
- ▶ Conserve material resources and reduce waste.
- ▶ Protect land and ecosystem services.



BMPs involving use of renewable energy, green infrastructure or carbon sequestering vegetation during site cleanup and restoration also may help mitigate and adapt to ongoing climate change.

Where and When to Use the BMPs

Green remediation BMPs may be applied to cleanup actions taken at almost any hazardous waste site, whether conducted under federal, state or local cleanup programs. Success in reducing the environmental footprint of cleanup activities has been demonstrated at sites involving:

- Superfund remedial or removal actions.
- Corrective actions under the Resource Conservation and Recovery Act.
- Federally owned or operated facilities.
- Cleanup of leaking underground storage tanks.
- Brownfield cleanups.
- Voluntary or mandatory actions under state programs.

Consideration of the socioeconomic aspects of sustainability is built into the statutory, regulatory, or administrative frameworks for performing site assessment and remediation activities under these programs. The sustainability of activities at restored sites may be enhanced by meeting site reuse or redevelopment goals set through other federal, tribal, state, local and community initiatives or requirements.

Green remediation strategies emphasize a whole-site approach to be used throughout the life of a cleanup project, including:

- Site investigation.
- Remedy design.
- Remedy construction.

BMP Examples



◆ Install an onsite renewable energy system that offsets usage of grid power to operate remediation equipment such as groundwater extraction pumps.

Continental Steel Corp., Indiana

- Remedy operation and maintenance.
- Long-term monitoring.

A green remediation strategy and associated BMPs for a given site may be documented in project materials such as a feasibility study and subsequent cleanup service contracts.

Tools for BMP Implementation

BMPs presented in this fact sheet series address common remediation technologies, frequently encountered cleanup scenarios, or activities performed in most cleanup projects. Specific topics include:

- Site investigation and environmental monitoring.
- Excavation and surface restoration.
- Soil vapor extraction and other air-driven systems.
- Pump and treat systems.
- Bioremediation.
- Implementing in situ thermal technologies.
- Landfill cover systems and energy production.
- Sites with leaking underground storage tanks.
- Mining sites.
- Integrating renewable energy.
- Clean fuel and emission technologies for site cleanup.
- Materials and waste management.

For large, complex or long-duration cleanup projects, stakeholders may wish to quantify the existing or potential environmental footprint of cleanup activities. EPA's *Spreadsheets for Environmental Footprint Analysis* (SEFA) are available to help interested parties compile the data needed for evaluating the footprint and identifying the largest contributions.³ Findings can then be used to target BMPs with the greatest potential to reduce the footprint.

Sample Metrics and Units

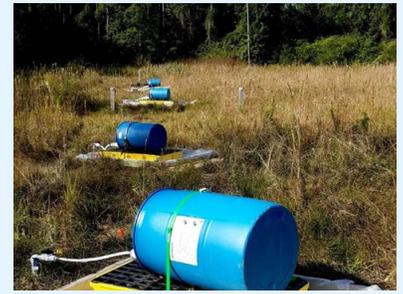
- Renewable energy generated onsite (kilowatts)
- Greenhouse gas emitted onsite (tons)
- Refined materials used onsite (tons)
- Unrefined materials from recycled or waste matter (percent)
- Onsite hazardous waste generated (tons)
- Onsite waste recycled or reused (percent)
- Treated water used onsite (gallons)

EPA continues to identify additional BMPs for greener cleanups and to periodically update the "BMP fact sheets" as a means to foster BMP use in normal business operations in the site cleanup sector. This fact sheet series is part of a compendium of tools available on the CLU-IN *Green Remediation Focus* website maintained by EPA.⁴ The website also contains:

- Monthly announcements about new tools or reports and upcoming training events.
- Profiles of projects employing green remediation BMPs and descriptions of associated qualitative or quantitative improvements to environmental outcomes.
- Links to related technical reports and no/low-cost software or calculators.
- Information about related state initiatives and policies.

References

- 1 U.S. EPA. *Principles for Greener Cleanups*. August 2009. www.epa.gov/greenercleanups/epa-principles-greener-cleanups
- 2 ASTM International. *Standard Guide for Greener Cleanups*. ASTM E2893-16. May 2016 update. <https://www.astm.org/e2893-16e01.html>
- 3 U.S. EPA. *Spreadsheets for Environmental Footprint Analysis* (SEFA). <https://clu-in.org/greenremediation/SEFA/>
- 4 U.S. EPA. CLU-IN Green Remediation Focus. www.clu-in.org/greenremediation



- ◆ Use gravity flow rather than pumps wherever feasible, to avoid onsite air emissions associated with using petroleum-based fuel.
Camp Lejeune Military Reservation, North Carolina



- ◆ Integrate green infrastructure such as a constructed wetland to manage onsite stormwater while providing wildlife habitat.
Pharmacia & Upjohn Company LLC Site, Connecticut



- ◆ Use industrial or commercial waste to treat contaminants, such as waste cooking oil supplying carbon for a biogeochemical reactor.
Travis Air Force Base, California



- ◆ Deploy direct-push equipment rather than hollow-stem auger drill rigs for sampling, to minimize land and ecosystem disturbance.
Kerr-McGee Navassa Superfund Site, North Carolina