United States Environmental Protection Agency

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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

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. 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* (E2893-13)[2] offers a collection of greener cleanup BMPs.

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

- Minimize total energy use and increase the percentage from renewable energy.
- Minimize emission of air pollutants and greenhouse.
- Minimize water use and preserve water quality.
- Conserve material resources and minimize waste.
- Protect land and ecosystem services.

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 site cleanups.
- Voluntary or mandatory actions under state programs.

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

Early incorporation of a green remediation strategy into project documents such as a feasibility study and cleanup service contract can help attain cost efficiencies throughout the project life and integrate site reuse plans into the cleanup infrastructure.

BMPs in the Field

♦ Reduce **energy** loads of motorized equipment such as pumps by using variable rather than single-speed frequency drives.

Massachusetts Military Reservation

♦ Power cleanup equipment with onsite sources of clean, renewable energy to minimize **air** emissions.

Pennsylvania Mine

A process for screening, prioritizing, selecting and implementing BMPs in a verifiable manner is provided in the *ASTM Standard Guide for Greener Cleanups* (E2893-13).[2]

Tools for BMP Implementation

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

- Site investigation.
- Excavation and surface restoration.
- Soil vapor extraction and air sparging technologies.
- Pump and treat technologies.
- Bioremediation.
- In situ thermal technologies.
- Landfill cover systems and associated energy production.
- Leaking underground storage tank systems.
- Mining sites.
- Renewable energy applications.
- Clean fuel and emission technologies.
- Materials and waste management.
- EPA's methodology for environmental footprint assessment.

For large or complex cleanups, stakeholders may wish to quantify an existing or potential environmental footprint of the cleanup activities. Use of EPA's *Methodology for Evaluating and Reducing a Project's Environmental Footprint* can aid this process by identifying the largest footprint contributions.[3] Findings can then be used to target BMPs with the greatest potential to reduce the footprint. The methodology involves 21 metrics and a seven-step quantification process supported by planning checklists and references such as common conversion factors and typical energy demands of field equipment. EPA's supporting set of *Spreadsheets for Environmental Footprint Analysis* (SEFA) is available to help interested parties compile the data needed for this methodology.[4]

Sample Metrics & Units

- Renewable energy generated onsite (kilowatts)
- Greenhouse gas emitted onsite (tons)
- Waste recycled (tons)
- Treated water used onsite (pounds)
- Barren ground surface (acres)

EPA continues to identify additional BMPs for greener cleanups and to periodically update these "BMP fact sheets" as a means to foster BMP use in normal business operations for site cleanup. This series is part of a compendium of tools available on the CLU-IN *Green Remediation Focus* website maintained by EPA's Office of Superfund Remediation and Technology Innovation.[5] The website also contains:

- Monthly announcements about new tools and upcoming events.
- Profiles of projects employing green remediation BMPs.
- In-depth reports on using EPA's methodology for footprint assessment.
- Links to related technical reports and online software or calculators.
- Information about greener cleanup initiatives and policies undertaken by state agencies.

♦ Avoid stormwater runoff and resulting soil erosion near treated **water** drainage outlets by installing deep-rooted plants, emplacing pervious mats for anchorage, and stabilizing rocks along banks.

Lawrence Aviation Industries Superfund Site

♦ Segregate clean excavated soil from **material** requiring treatment or offsite disposal as **waste** and stockpile it as a source of borrow material for remedy construction and future site needs.

Elizabeth Mine Superfund Site

♦ Surgically remove rather than clear-cut trees or small plants obstructing remedy construction or maintenance, to protect **land** and **ecosystems**.

Barksdale Air Force Base

CLU-IN Green Remediation Focus: www.clu-in.org/greenremediation

References

1 U.S. EPA. *Principles for Greener Cleanups*. August 2009. www.epa.gov/greenercleanups/epa-principles-greener-cleanups
2 ASTM International. ASTM E2893-13, *Standard Guide for Greener Cleanups*. November 2013. www.astm.org/Standards/E2893.htm
3 U.S. EPA. *Methodology for Evaluating and Reducing a Project's Environmental Footprint*. EPA 542-R-12-002. February 2012. www.clu-in.org/greenremediation/methodology/docs/GC_Footprint_Methodology_Feb2012.pdf
4 U.S. EPA. *Spreadsheets for Environmental Footprint Analysis* (SEFA). www.clu-in.org/greenremediation/methodology/#SEFA
5 U.S. EPA. CLU-IN Green Remediation Focus. www.clu-in.org/greenremediation

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