United States Environmental Protection Agency

Office of Solid Waste and Emergency Response (5102G)

EPA 542-F-12-023
March 2012

Green Remediation Best Management Practices:
Overview of EPA's Methodology to Address the Environmental Footprint of Site Cleanup

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

The U.S. Environmental Protection Agency (EPA) *Principles for Greener Cleanups* outline the Agency's policy for evaluating and minimizing the environmental "footprint" of activities undertaken when cleaning up a contaminated site.[1] Use of the best management practices (BMPs) recommended in EPA's series of green remediation fact sheets can help project managers and other stakeholders apply the principles on a routine basis while maintaining the cleanup objectives, ensuring protectiveness of a remedy, and improving its environmental outcome.

Remediation is underway or planned at thousands of sites across the United States under cleanup programs administered by government agencies and through voluntary efforts of site owners or operators. The activities needed to treat, contain, or otherwise address contaminated soil, water, and other environmental media and restore a site to productive use can collectively leave an environmental footprint. Cleanups involving complex activities may benefit from a detailed footprint analysis to inform decision-making about application of suitable BMPs for greener cleanups. EPA's **Methodology for Understanding and Reducing a Project's Environmental Footprint** identifies metrics associated with this footprint and a specific process to quantify or qualify those metrics.

The methodology adheres to EPA's *Principles for Greener Cleanups*, which involve five core elements:

- Reducing total energy use and increasing the percentage of renewable energy
- Reducing air pollutants and greenhouse gas (GHG) emissions
- Reducing water use and negative impacts on water resources
- Improving materials management and waste reduction efforts, and
- Protecting ecosystem services.

EPA developed the methodology (as documented in EPA report 542-R-12-002) as a means to encourage environmentally friendly behaviors on the part of decision-makers and day-to-day staff involved with site cleanup. It is designed to identify the most significant contributors to a project's environmental footprint and help integrate associated reduction parameters into conceptual design, construction, and operation of the project. EPA does not require environmental footprint analysis of cleanup activities but prefers use of the methodology when an analysis is conducted. Voluntary use of the methodology to varying degrees during any stage of cleanup may improve the project's environmental outcome.

EPA began developing the methodology in 2009 in order to identify a single, comprehensive set of metrics that could apply to most sites. Establishment of the methodology was also a strategic action outlined in the Agency's 2010 *Superfund Green Remediation Strategy*.[2] To test and refine proposed metrics and processes, the Agency conducted multiple pilot studies for RCRA corrective actions and Superfund remedial actions. Detailed information on three studies overseen by EPA Region 9 is available online.[3] In September 2011, the draft methodology also was made available to the public for review and feedback.

The methodology provides a **roadmap** to quantify the project's environmental footprint. The quantified information can then be used to identify opportunities for adjusting the project's operating parameters and applying BMPs in ways that reduce the footprint.

The process for conducting a footprint analysis following the methodology involves seven general steps:

1) Determining the goals and scope of the analysis, which vary with the remedial stage and site-specific factors
2) Gathering information about design, construction, and operation of the site's existing or anticipated remedy
3) Quantifying the onsite materials and waste metrics, which account for the materials used, the recycled content of those materials, various wastes generated, and portions of the waste that are recycled or reused
4) Quantifying the onsite water metrics, which consider the source and amount of water used on site as well as the fate of water after use
5) Using the combined information to quantify energy metrics and air metrics, which jointly consider the total amount of energy used (including the portion from renewable resources) and the air emissions associated with energy usage, onsite activities, and offsite support
6) Qualitatively describing ecosystem services that are affected during remedy implementation, and
7) Presenting results of each previous step and the overall results of analysis.

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Access EPA's in-depth methodology report online at:
http://www.clu-in.org/greenremediation/methodology

EPA's methodology report includes sample approaches to reducing environmental footprints of projects involving pump-and-treat, in situ chemical oxidation, and bioremediation technologies or excavation. In addition, its appendices provide:

- Seventeen exhibits containing planning checklists along with user-friendly reference tables on aspects such as common conversion factors, contents of materials frequently used for cleanup, and typical energy demands of equipment deployed in the field
- A series of detailed tables illustrating potential formats for organizing raw data and quantified estimates and for presenting overall results of footprint analysis, and
- Several scenarios illustrating use of the methodology to quantify the environmental footprint of a cleanup.

Based on the results of the pilot projects and input from cleanup project managers, EPA selected a set of **15 primary metrics** and **7 secondary metrics** for estimating the project footprint (as summarized below). Users may wish to supplement this set with additional metrics meeting project or organizational needs and to tailor the presentation of footprint analysis results accordingly. The Agency's rationale for selecting each of these metrics is provided in the methodology report.

Summary of Primary and Secondary Metrics

Core Element	Metric	Unit of Measure
Materials & Waste (M&W)	M&W-1. Refined materials used on site	Tons
	M&W-2. % of refined materials from recycled or waste material	%
	M&W-3. Unrefined materials used on site	Tons
	M&W-4. % of unrefined materials from recycled or waste material	%
	M&W-5. Onsite hazardous waste disposed of off site	Tons
	M&W-6. Onsite non-hazardous waste disposed of off site	Tons
	M&W-7. % of total potential waste recycled or reused	%
Water (W)	Onsite water used (by source)	
	▪ W-1. Source, use, fate combination #1	Millions of gallons
	▪ W-2. Source, use, fate combination #2	Millions of gallons
	▪ W-3. Source, use, fate combination #3	Millions of gallons
	▪ W-4. Source, use, fate combination #4	Millions of gallons
Energy (E)	E-1. Total energy used	MMBtu
	E-2. Total energy voluntarily derived from renewable resources	
	▪ E-2A. Onsite generation or use and biodiesel use	MMBtu
	▪ E-2B. Renewable electricity purchase	MWh
	▪ E-2C. Purchase of renewable energy certificates (RECs)	MWh
Air (A)	A-1. Onsite NOx, SOx, and PM emissions	Pounds
	A-2. Onsite HAP emissions	Pounds
	A-3. Total NOx, SOx, and PM emissions	Pounds
	A-4. Total HAP emissions	Pounds
	A-5. Total GHG emissions	Tons CO_2e
Land & Ecosystems	Qualitative description	

The series of technical tables appending the methodology report provides potential formats for data management. Use of these formats can help decision-makers understand the relationships among activity-specific data, identify activities with the largest footprints, and **map various opportunities** to reduce the overall project footprint.

Considerations when interpreting final results of footprint analysis include:

- Goals of the analysis
- Data quality
- Tradeoffs between metrics, and
- Magnitude of the footprint.

[1] U.S. EPA; *Principles for Greener Cleanups;* August 27, 2009; http://www.epa.gov/oswer/greenercleanups
[2] U.S. EPA; Superfund & Green Remediation; http://www.epa.gov/superfund/greenremediation/
[3] U.S. EPA; CLU-IN Green Remediation Focus; Footprint Assessment; http://www.cluin.org/greenremediation/subtab_b3.cfm

Visit **Green Remediation Focus** online to learn more about the BMPs:
http://www.cluin.org/greenremediation

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