



Green Remediation: Maximizing the Benefit of Site Cleanups

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Green Approaches in Cleanup & Redevelopment



**Deconstruction,
Demolition, and
Removal**

**Cleanup,
Remediation, and
Waste Management**

**Design and
Construction for
Reuse**

**Sustainable Use
and Long Term
Stewardship**

- Reuse/recycle deconstruction and demolition materials
- Reuse materials on site whenever possible
- Consider future site use and reuse existing infrastructure
- Preserve/Reuse Historic Buildings
- Use clean diesel and low sulfur fuels in equipment and noise controls for power generation
- Retain native vegetation and soils, wherever possible
- Protect water resources from runoff and contamination

- Power machinery and equipment using clean fuels
- Use renewable energy sources, such as solar, wind, and methane to power remediation activities
- Improve energy efficiency of chosen remediation strategies
- Select remediation approaches, such as phytoremediation, that reduce resource use and impact on air, water, adjacent lands, and public health
- Employ remediation practices that can restore soil health and ecosystems and, in some cases, sequester carbon through soil amendments and vegetation

- Use Energy Star, LEED, and GreenScapes principles in both new and existing buildings
- Reduce environmental impact by reusing existing structures and recycling industrial materials
- Incorporate natural systems to manage stormwater, like green roofs, landscaped swales, and wetlands
- Incorporate Smart Growth principles that promote more balanced land uses, walkable neighborhoods, and open space
- Create ecological enhancements to promote biodiversity and provide wildlife habitat and recreation

- Reduce use of toxic materials in manufacturing, maintenance, and use of buildings and land
- Minimize waste generation, manage waste properly, and recycle materials used/generated
- Maintain engineering and institutional controls on site where waste is left in place
- Reduce water use by incorporating water efficient systems and use native vegetation to limit irrigation
- Maximize energy efficiency and increase use of renewable energy
- Take appropriate steps to prevent (re)contamination

What is Green Remediation?

The practice of considering all environmental effects of a cleanup during each phase of the process, and incorporating strategies to maximize net environmental benefit of the cleanup.

Focus is on remedy implementation vs. remedy selection



Is it Our Job?

- ◆ **Executive Order 13423, January 26, 2007-Strengthening Federal Environmental, Energy, and Transportation Management**
 - » Section 1. Policy. It is the policy of the United States that Federal agencies conduct their environmental, transportation, and energy-related activities under the law in support of their respective missions in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner.
- ◆ **EPA Strategic Plan Goal 1: Clean Air and Global Climate Change**
 - » Protect and improve the air so it is healthy to breathe and risks to human health and the environment are reduced. Reduce greenhouse gas intensity by enhancing partnerships with businesses and other sectors.
- ◆ **EPA Strategic Plan Goal 5: Compliance and Environmental Stewardship**
 - » Stewards of the environment recycle wastes to the greatest extent possible, minimize or eliminate pollution at its source, conserve natural resources, and use energy efficiently to prevent harm to the environment or human health.



Opportunities to Increase Sustainability in Site Cleanups

- Apply to all cleanup programs
- Exist throughout site investigation, design, construction, operation, and monitoring
- Are aligned with our mandates (EPA Strategy, EO13423, etc).



Core Elements: Air Emissions

- ◆ Optimal use and proper maintenance of heavy equipment
- ◆ Use of cleaner fuel and retrofit diesel engines for heavy equipment
- ◆ Modified operations to reduce operating and idle time
- ◆ Minimized dust export of contaminants



Core Elements: Water Requirements and Resources

- ◆ Minimum fresh water use and maximum reuse during treatment and site operations
- ◆ Reclaimed treated water for beneficial use or aquifer storage
- ◆ Native vegetation requiring little or no irrigation (regrading, vegetative caps, etc)
- ◆ Prevention of water quality impacts such as nutrient-loading



Core Elements: Land and Ecosystems

- ◆ Minimal soil disturbance and compaction
- ◆ Adoption of eco restoration and reuse practices
- ◆ Reduced noise and lighting disturbance
- ◆ Adoption of ecosystem and reuse practices
- ◆ Factor sensitive species and habitat considerations in site operations



Core Elements: Material Consumption and Waste Generation

- ◆ Technologies designed to minimize waste generation
- ◆ Reuse and recycling of materials, including C&D debris
- ◆ Minimized extraction and disposal of natural resources
- ◆ Passive sampling devices producing minimal waste



Core Elements: Long-Term Stewardship

- ◆ Reduced emission of CO₂, methane, and other greenhouse gases
- ◆ Adaptive management approach integrated into long-term actions and redevelopment
- ◆ Renewable energy systems for long-term cleanup and future economic benefit
- ◆ Leverage of remedy infrastructure for reuse



Core Elements: Energy Requirements

- ◆ Energy efficient equipment operating at peak performance
- ◆ Periodic evaluation and optimization of equipment with high energy demand
- ◆ Renewable energy systems to replace or offset grid electricity
- ◆ Managed demand to leverage low peak capacity and rates



Carbon & Energy Footprints of Superfund Cleanup Technologies

Technology	Estimated Energy Annual Average (kWh*10³)	Total Estimated Energy Use in 2008-2030 (kWh*10³)
Pump & Treat	489,607	11,260,969
Thermal Desorption	92,919	2,137,126
Multi-Phase Extraction	18,679	429,625
Air Sparging	10,156	233,599
Soil Vapor Extraction	6,734	154,890
Technology Total	618,095	14,216,209
	Annual Carbon Footprint (MT CO₂)	
Sum of 5 Technologies	404,411	



Recap on Energy & Carbon Footprint Strategies

- ◆ Optimize systems to maximize efficiency and return per unit energy invested
- ◆ Build renewable energy capacity at contaminated sites to power remedies
- ◆ Tap into grid renewable energy portfolios
- ◆ Leverage carbon sequestration from soil amendment treatment (policy vacuum)



Green Remediation Profile: Ferdula Landfill, Frankfort NY

- ◆ Soil vapor extraction relying on wind power to draw vacuum from landfill vents
- ◆ Exclusively off-grid operations providing a pulsed effect for carbon removal of VOCs
- ◆ VOC concentrations in soil gas reduced over 90% in five years of operation



Green Remediation Profile: Operating Industries Landfill, Monterey Park CA

- ◆ Meets about 70% of plant needs (thermal oxidizer, refrigeration, and air blower)
- ◆ Six 70-kW microturbines for landfill gas collection (5,500 scfm) at Superfund site
- ◆ Savings reaching up to \$400,000 each year through avoided grid electricity



Green Remediation Profile: St. Croix Alumina, St. Croix VI

- ◆ PV panels generating electricity for fluid-gathering system during oil recovery
- ◆ Wind-driven turbine compressors and electric generators powering pumps to recover free-product oil
- ◆ Reclaimed oil from RCRA site used for refinery feedstock



“OSWER” Green Remediation Strategy

For the purpose of advancing green remediation best practices across cleanup programs OSWER seeks to:

- » Benchmark and document GR best management practices
- » Assemble a toolkit of enablers
- » Build networks of practitioners
- » Develop performance metrics and tracking mechanisms



Green Cleanups Information & Feedback Channels

Technology Innovation Program Green Remediation (GR) Effort
Superfund GR Workgroup
Technical Support Project (TSP) Green Committee
Green Remediation, Revitalization, and Reuse (GRRR) Team
Climate Change and Contaminated Lands (CCCL) Workgroup
Climate Change Coordinating Committee (C4)
ASTSWMO Greener Cleanups Task Force
ITRC Green and Sustainable Remediation (GSR) Project
Federal Remediation Technologies Roundtable (FRTR) GR Focus
EPA Partnerships with Other Federal Agencies Department of Defense (USACE IAG & MOU) Department of Energy (NREL IAG & MOU)
State Initiatives (Cal/EPA GR Team, Illinois Greener Cleanups, Wisconsin Initiative on Sustainable Cleanups (WISC)
Brownfields Sustainability Pilots: Green Redevelopment
Tribal Initiatives
EPA Regional Initiatives: Region 3 Pilot Project on Green Cleanup Standards Region 9 Cleanup-Clean Air Initiative
Sustainable Remediation Forum (SuRF)



Green Remediation Activities

Existing

- ◆ Green remediation primer, website, and profiles of projects
- ◆ Internet seminars, and archived discussions (clu-in.org)
- ◆ Tech support for Federal and State project managers
- ◆ Contracts toolkit for RACs
- ◆ Renewable energy fact sheets and website
- ◆ NARPM 8-hour training

In the Pipeline

- ◆ MOU with NREL
- ◆ MOU with the USACE recognizing and fostering GR BMPs at Superfund cleanups
- ◆ Green Remediation Analyses and Development of Methodology (Region 9)
- ◆ Contracts toolkit for ERRS
- ◆ Remedy specific green remediation “cheat sheets”
- ◆ Site cleanup energy audit tool
- ◆ Who’s who in green remediation (EPA Intranet)
- ◆ ER3 for green remediation
- ◆ OSC 4-hour training
- ◆ Engineering forum “GR review and technical support” capability
- ◆ **Green cleanup voluntary standards project**



Opportunities for a Standard

- ◆ Growing interest in social responsibility
- ◆ Companies have internal goals to become greener
- ◆ New tools are being developed to evaluate impacts from cleanups
- ◆ Builds upon state and local government incentives currently being developed
- ◆ US Green Building Council has indicated interest in EPA developing green cleanup standard
- ◆ Initiates a constructive dialogue



Environmental Outcomes

- ◆ Minimize air emissions (e.g. CO2 emissions, particulates)
- ◆ Minimize total energy use and promote use of renewable energy
- ◆ Preserve and restore natural resources (e.g. water, ecosystems)
- ◆ Minimize raw material use & waste generation and maximize material recycling
- ◆ Maximize reuse options for land
- ◆ Minimize long-term stewardship obligations



Conceptual Development for Green Cleanups Standard

Standards Development

EPA initiates workgroup to develop Concept Paper for EPA management

EPA Workgroup partners with ASTSWMO to develop straw metrics and incentives

EPA collaborates with Standard Developing Organization

SDO Develops Green Cleanup Standard through Consensus Process

Green Standard

Conformity Assessment

EPA/States Evaluate Standard and Develop Recognition Program(s)

Self Declaration

Submit documentation to cleanup program

EPA/States Partners with Accrediting Organization(s)

Certifying Organization(s)

Recognized Compliance with Green Cleanup Standard

Key Attributes

- ◆ **Voluntary** - Not mandating new cleanup evaluation
- ◆ **Transparent** - Consensus based standards development
- ◆ **Universal** - Easier for stakeholders to implement
- ◆ **Flexible** - Program or State-specific recognition options
- ◆ **Minimal Resources** - Independent 3rd party or self-certification (audits)
- ◆ **Market Driven** - Certifying Projects or Persons (promote technology innovation)



Balancing Energy Use vs. Active Cleanup Options for Considerations

Cleanup agency approval of selected remedy is a prerequisite

- ◆ Promote contaminant destruction
- ◆ Minimize need for long-term use restrictions
- ◆ Promote use of renewable energy for cleanup and beyond
- ◆ Maximize energy efficiency for cleanups



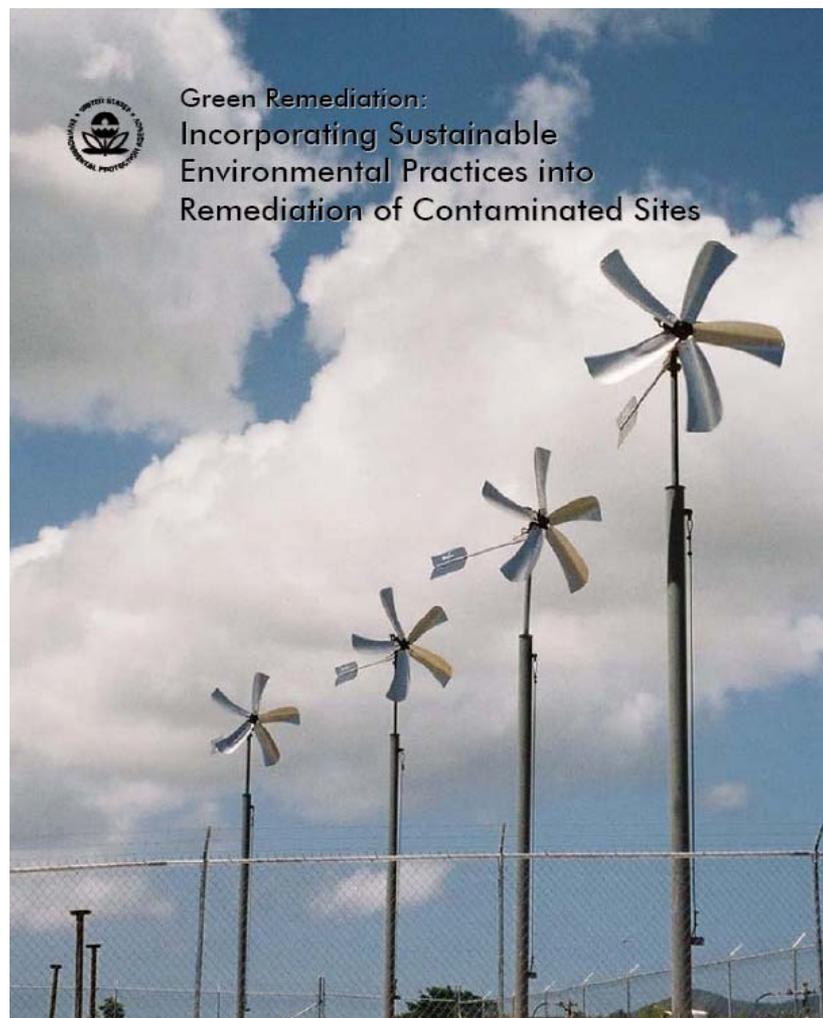
Opportunities for FRTR Collaboration

- ◆ Green remediation technology and best practice cost and performance case studies
- ◆ Sustainability evaluation tools
- ◆ Establishment of green cleanups subgroup
 - » Developing products
 - » Communication among FRTR members
- ◆ Agenda for follow up green remediation meeting
 - » Focus on case studies?
 - » Focus on renewable energy?



EPA Green Remediation Primer

- ◆ Provides introduction to best practices with examples of how and where they are used
- ◆ Focuses on remedy implementation across regulatory frameworks
- ◆ Released April 2008, available at: <http://clu-in.org/greenremediation>



Green Remediation on the Web

www.clu-in.org/greenremediation



Site Name	State	Core Elements						
		Energy Efficiency	Renewable Energy	Air Emission	Water	Land & Ecosystem	Materials & Waste	Stewardship
Altus Air Force Base	OK							
Apache Powder	AZ							
Barksdale AF Base	LA							
BP Casper	WY							
BP Paulsboro	NJ							
California Gulch	CO							
Crozet Orchard	VA							
De Sale Restoration Area	PA							
Former Carswell Air Force Base	TX							
Former Ferdula Landfill	NY							
Former Nebraska Ordnance Plant	NE							
Former St. Croix Alumina Plant	VI							
Fort Carson	CO							

