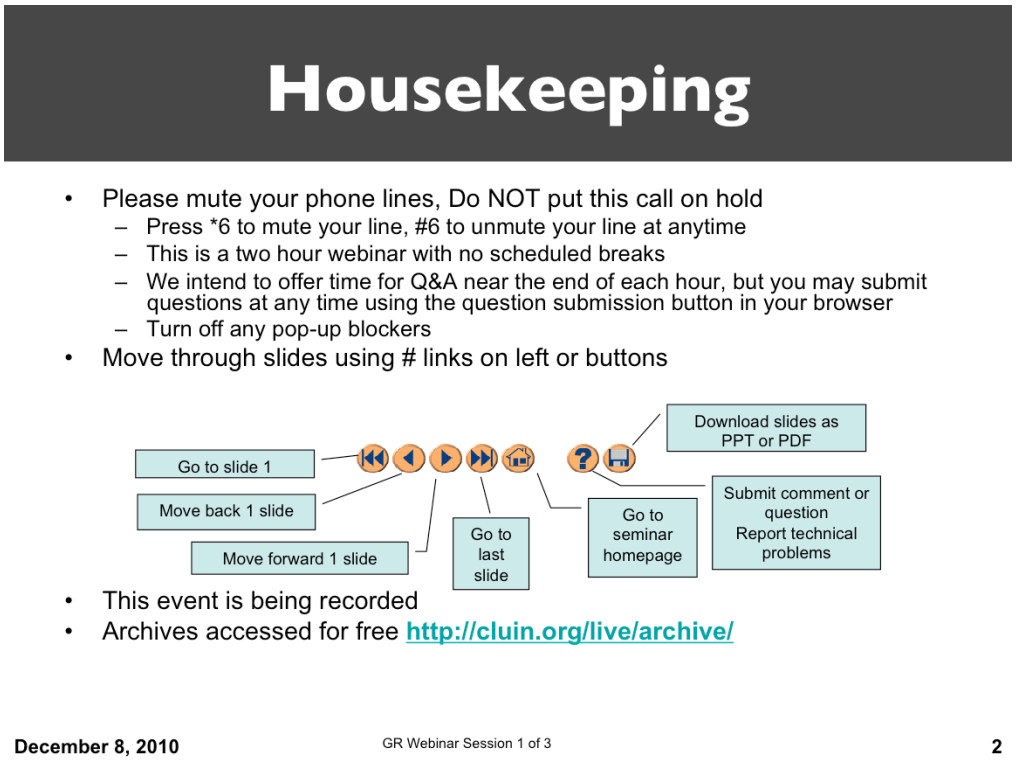
Welcome to the CLU-IN Internet Seminar

Session 1 of 3:
Your Role in Green Remediation Implementation
and
Case Studies in Green Remediation - This Year's Models and Tools
(The 2010 NARPM Green Remediation Session Follow-on Webinars)

Sponsored by: US EPA Engineering Forum
Delivered: Wednesday, Dec. 8, 2010, 11:30am-1:30pm, EST

Instructors: Suzanne Wells, Lura Matthews, Ginny Lombardo, Kristin Giacalone, Rashmi Mathur, Candice Jackson, and Karen Sheuermann
Moderator: Hilary Thornton

Visit the Clean Up Information Network online at www.cluin.org



Although I'm sure that some of you have these rules memorized from previous CLU-IN events, let's run through them quickly for our new participants.

Please mute your phone lines during the seminar to minimize disruption and background noise. If you do not have a mute button, press *6 to mute #6 to unmute your lines at anytime. Also, please do NOT put this call on hold as this may bring delightful, but unwanted background music over the lines and interupt the seminar.

You should note that throughout the seminar, we will ask for your feedback. You do not need to wait for Q&A breaks to ask questions or provide comments. To submit comments/questions and report technical problems, please use the ? Icon at the top of your screen. You can move forward/backward in the slides by using the single arrow buttons (left moves back 1 slide, right moves advances 1 slide). The double arrowed buttons will take you to 1st and last slides respectively. You may also advance to any slide using the numbered links that appear on the left side of your screen. The button with a house icon will take you back to main seminar page which displays our agenda, speaker information, links to the slides and additional resources. Lastly, the button with a computer disc can be used to download and save today's presentation materials.

With that, please move to slide 3.

Overview

- The purpose of this webinar series is to enhance the audience's understanding of the current status of Green Remediation at EPA through a mix of presentations on GR Policy and real-world case studies.
- Each of the 2-hour webinar sessions (there are a series of 3) includes approximately one hour of policy presentations, followed by one hour of case studies. Each of the 3 webinars contains different material.

Overview (cont.)

- Participants will contribute by submitting questions (either by telephone during one of the Q&A sessions near the end of each hour, or online at any time).

Agenda

- 11:30-11:35 Welcome and Housekeeping – Moderator Hilary Thornton, EPA EF
- 11:35-11:50 National Directions to Advance Superfund Green Remediation – Suzanne Wells, EPA HQ – OSRTI
- 11:50-12:05 Update on Repowering America's Land – Lura Matthews, EPA HQ
- 12:05-12:12 Update on Green Remediation efforts in EPA New England (Region 1) – Ginny Lombardo, EPA R1
- 12:13-12:20 Update on Green Remediation efforts in EPA Region 2 – Kristin Giacalone, EPA R2
- 12:20-12:30 Q &A on first half of Webinar

Agenda (Cont.)

- 12:30-12:40 Case Study: Sharon Steel Farrell Works Site – Rashmi Mathur, EPA R3
- 12:40-12:50 Case Study: Barite Hill/ NV Goldfields Site – Candice Jackson, EPA R4
- 12:50-1:20 Green Remediation – Environmental Footprint Analysis – Karen Scheuermann, EPA R9
- 1:20-1:30 Q&A on 2nd Half of Webinar

Image from: http://www.google.com/imgres?imgurl=http://www.desiwalls.com/wp-content/uploads/2009/05/jelly-buildings-what-a-concept.jpg&imgrefurl=http://www.desiwalls.com/page/126/&usg=__UMJ3szqjP4yB0wm_BV40Sq0LtOo=&h=768&w=1024&sz=59&hl=en&start=70&zoom=1&um=1&itbs=1&tbnid=QT8WFJLIARXF2M:&tbnh=113&tbnw=150&prev=/images%3Fq%3Dcartoon%2Bbuildings%26start%3D60%26um%3D1%26hl%3Den%26sa%3DN%26ndsp%3D20%26tbs%3Disch:1

Purpose of Presentation

- Update on Superfund Green Remediation Strategy
- Executive Order 13514
- Implementation of Superfund's goal to power sites using 100% renewable energy sources

Policy Drivers at Many Levels

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EPA Strategic Plan 2011-2015

Goal 3: Cleaning Up Communities and Advancing Sustainable Development

EPA's hazardous waste programs are working to reduce the energy use and environmental footprint during the investigation and remediation of sites. As part of this effort, EPA's Superfund program will implement its green remediation strategy to reduce the energy, water and materials used during site cleanups while ensuring that protective remedies are implemented.

OSWER Green Remediation Principles

- Released in August 2009, and set a goal for green remediation across the waste programs
- Consistent with existing laws and regulations, it is OSWER policy that all cleanups:
  - Protect human health and the environment
  - Comply with all applicable laws and regulations
  - Consult with communities regarding response action impacts consistent with existing requirements
  - Consider recommended five core elements
    - Total Energy Use and Renewable Energy Use
    - Air Pollutants and Greenhouse Gas Emissions
    - Water Use and Impacts to Water Resources
    - Materials Management and Waste Reduction
    - Land Management and Ecosystems Protection

Superfund Green Remediation Strategy

- Draft *Superfund Green Remediation Strategy* released for public comment in August 2009
- Final *Superfund Green Remediation Strategy* released in September 2010
- Strategy outlines nine key actions (and 40 specific actions) to promote green remediation
  - Policy and guidance development
  - Resource development and program implementation
  - Program evaluation

Regional Clean & Green Policies

- All ten regions have green remediation policies available at www.cluin.org/greenremediation

- Policies align with national policies, and include regional preferences, e.g.,

  - substituting recycled materials for virgin materials, e.g., coal ash cement in place of Portland cement

  - use of clean diesel technologies

Executive Order 13514
Federal Leadership in Environmental, Energy, and Economic Performance

- Signed October 5, 2009
- Requires agencies to “measure, report, and reduce their greenhouse gas emissions from direct and indirect activities.”
- Provides a timeline for agencies to establish GHG reduction targets and report inventories
- Scope 3: GHG emissions from sources not owned or directly controlled by a Federal agency but related to agency activities. Government remediation of private sites is considered Scope 3 (optional).

Executive Order 13514
Scope 3 (optional)

- EO 13514 guidance recognizes scope 3 emissions "can at first be difficult to calculate due to a lack of available data."
- When determining whether or not to include optional scope 3 categories, agencies should consider:

  - whether the emissions are sizeable enough to warrant inventorying;

  - feasibility and cost of collecting the data;

  - level of influence an agency may have in reducing emissions; and

  - estimated cost of measuring and making reductions.

Superfund and EO 13514

- Emissions from Superfund sites are sizeable enough to warrant inventorying.
- Superfund can have a great influence in encouraging reduction of greenhouse gas emissions by showing leadership in the green remediation field.
- Challenging to collect the data on energy usage on a site basis because the data are held by hundreds of site contractors, and there is no current requirement for reporting these data or system set up to collect the data on a national basis. Superfund proposes developing a representative empirical model with real site validation to provide energy use and GHG data.
- Beginning to learn from regional site experiences the GHG savings, and impacts on site energy costs.

Superfund Green Remediation Strategy
Maximizing Use of Renewable Energy

- Key Action #3.1, Establish a practice to maximize use of renewable energy with a goal of using 100% renewable energy to power site operations
  - on-site production
  - green power purchases from electric service providers
  - purchases of renewable energy certificates (RECs)

Maximizing Use of Renewable Energy Experiences to Date

- Numerous sites across the country use renewable energy generated on-site to power site operations (see http://www.clu-in.org/greenremediation/tab_d.cfm)
- Region 2's Clean and Green Policy established a preference for use of 100% renewable energy to power site operations

  - At approximately 20 sites, green power purchases were made through local utility providers

EPA's Experience with Renewable Energy Credit (REC) Purchases

- EPA's Green Power Partnership is a voluntary program that supports the organizational procurement of green power http://www.epa.gov/greenpower/
- EPA is the second largest purchaser of green power in the federal government
- EPA's offices and laboratories use green power for all of their electrical needs

Implementing the Goal of Using 100% Renewable Energy to Power Site Operations

- Working with EPA's Green Power Partnership and EPA's Sustainable Facilities Practices Branch to determine feasibility of making a bulk Renewable Energy Credit (REC) purchase
- Currently working to estimate/refine the Superfund program's national energy use
- Expect to make a recommendation in 2011 on way (s) to meet goal of using 100% renewable energy to power site operations


National Association of
Remedial Project Managers
Annual Training Program
N A R P M
May 24-28, 2010 • Potomac Yard • Arlington, Virginia
20th Anniversary
RE-Powering America's Land:
Renewable Energy on Potentially Contaminated Land and Mining Sites
Lura Matthews
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What Will be Covered Today

- Why Focus on Renewable Energy Generation on Contaminated Sites?
- RE-Powering Tools
- EPA RE-Powering Management Plan

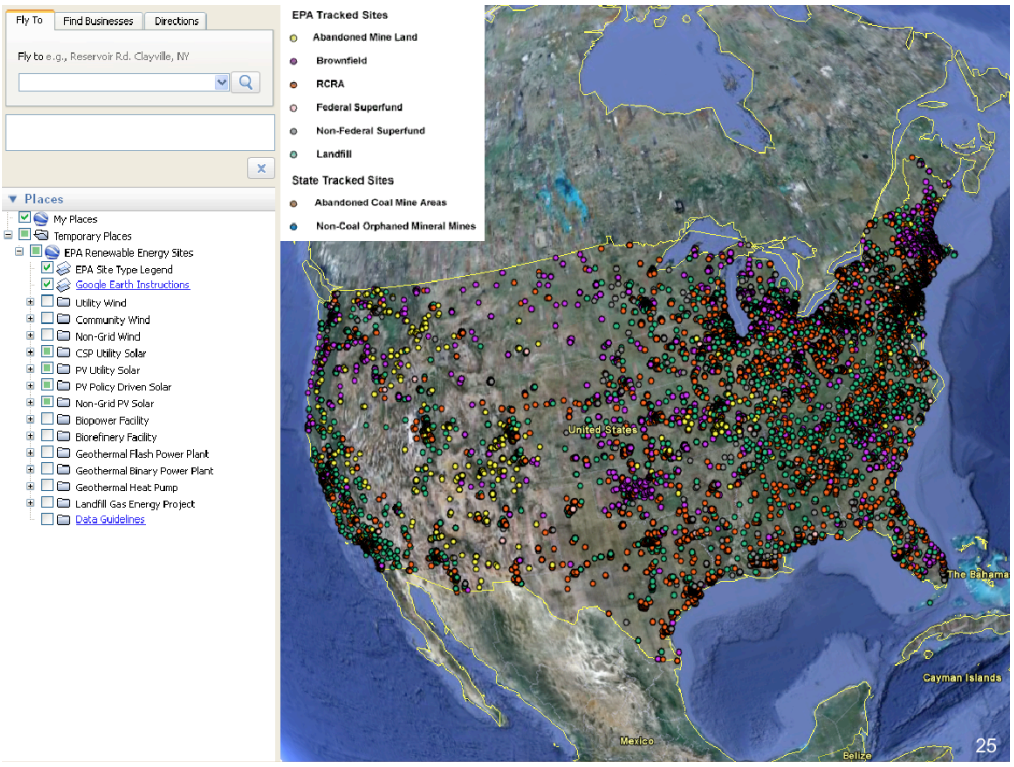
Why the Focus on Renewable Energy Development on EPA Tracked Sites?

- **Many of these sites offer:**
  - Existing infrastructure - transmission lines, roads and railway
  - Potentially lower transaction costs
  - Improved Public Support and Faster Permitting/Zoning
- **Siting renewable energy on these sites may:**
  - Increase economic value for the property
  - Further environmental sustainability by maximizing land use
  - Reduce the stress on greenfields
  - Provide clean energy for use on-site, locally, and/or to utility grid
  - Create local jobs

RE-Powering Tools

- **Google Earth Mapping**
  - Joint EPA-NREL venture produced interactive maps
  - 11,000 sites and almost 15 million acres mapped
- **Technical Assistance**
- **Success Stories**
  - Identifying and sharing successes
- **Incentives**
  - State-specific maps and financial incentive sheets describing renewable energy and contaminated lands redevelopment incentives in each state

Website: www.epa.gov/renewableenergyland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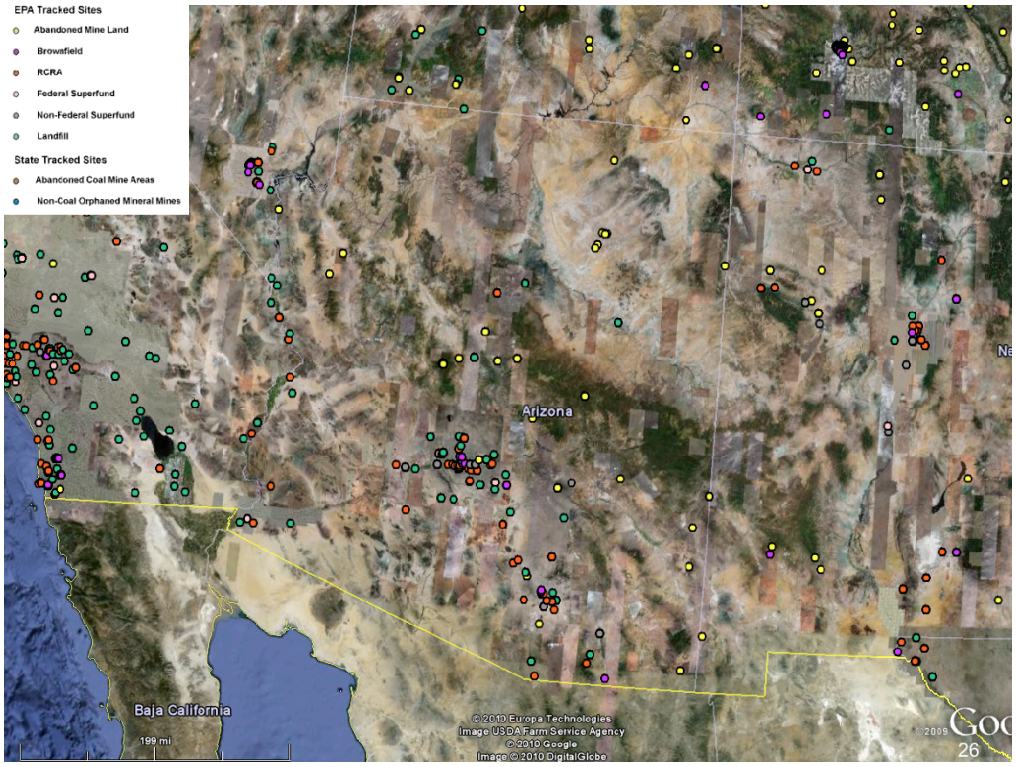
Temporary Places
EPA Renewable Energy Sites
EPA Site Type Legend
Google Earth Instructions
Utility Wind
Community Wind
Non-Grid Wind
CSP Utility Solar
PV Utility Solar
PV Policy Driven Solar
Non-Grid PV Solar
Biopower Facility
Biorefinery Facility
Geothermal Flash Power Plant
Geothermal Binary Power Plant
Geothermal Heat Pump
Landfill Gas Energy Project
Data Guidelines
EPA Tracked Sites
Abandoned Mine Land
Brownfield
RCRA
Federal Superfund
Non-Federal Superfund
Landfill
State Tracked Sites
Abandoned Coal Mine Areas
Non-Coal Orphaned Mineral Mines
United States
The Bahama
Cayman Islands
Mexico
Belize
25


EPA Tracked Sites
Abandoned Mine Land
Brownfield
RCRA
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Landfill
State Tracked Sites
Abandoned Coal Mine Areas
Non-Coal Orphaned Mineral Mines
Arizona
Baja California
199 mi
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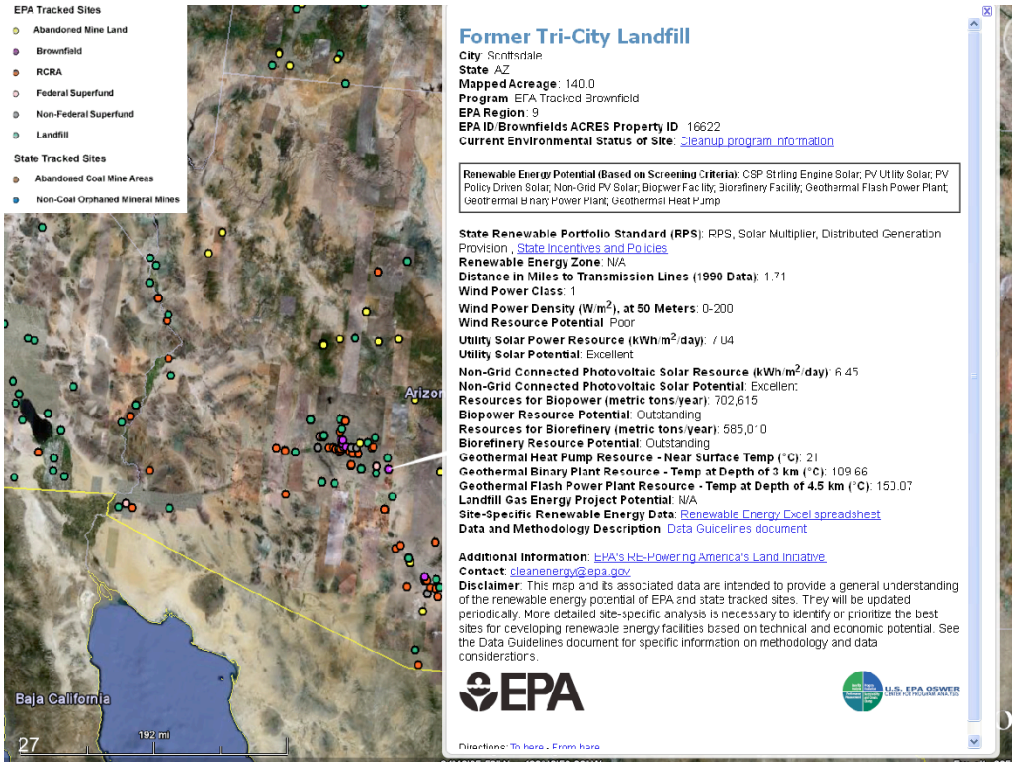
EPA Tracked Sites
Abandoned Mine Land
Brownfield
RCRA
Federal Superfund
Non-Federal Superfund
Landfill
State Tracked Sites
Abandoned Coal Mine Areas
Non-Coal Orphaned Mineral Mines
Baja California
192 mi
27
Former Tri-City Landfill
City: Scottsdale
State: AZ
Mapped Acreage: 140.0
Program: EPA Tracked Brownfield
EPA Region: 9
EPA ID/Brownfields ACRES Property ID: 16622
Current Environmental Status of Site: Cleanup program information
Renewable Energy Potential (Based on Screening Criteria): CSP Stirling Engine Solar; PV Utility Solar; PV Policy Driven Solar; Non-Grid PV Solar; Biopwer Facility; Biorafinery Facility; Geothermal Flash Power Plant; Geotrermal Binary Power Plant; Geothermal Heat Pump
State Renewable Portfolio Standard (RPS): RPS, Solar Multiplier, Distributed Generation Provision , State Incentives and Policies
Renewable Energy Zone: N/A
Distance in Miles to Transmission Lines (1990 Data): 1.71
Wind Power Class: 1
Wind Power Density (W/m2), at 50 Meters: 0-200
Wind Resource Potential: Poor
Utility Solar Power Resource (kWh/m2/day): 7.04
Utility Solar Potential: Excellent
Non-Grid Connected Photovoltaic Solar Resource (kWh/m2/day): 6.45
Non-Grid Connected Photovoltaic Solar Potential: Excellent
Resources for Biopower (metric tons/year): 702,615
Biopower Resource Potential: Outstanding
Resources for Biorefinery (metric tons/year): 585,010
Biorefinery Resource Potential: Outstanding
Geothermal Heat Pump Resource - Near Surface Temp (°C): 21
Geothermal Binary Plant Resource - Temp at Depth of 3 km (°C): 109.66
Geothermal Flash Power Plant Resource - Temp at Depth of 4.5 km (°C): 150.07
Landfill Gas Energy Project Potential: N/A
Site-Specific Renewable Energy Data: Renewable Energy Excel spreadsheet
Data and Methodology Description: Data Guidelines document
Additional Information: EPA's Re-Powering America's Land Initiative
Contact: cleanenergy@epa.gov
Disclaimer: This map and its associated data are intended to provide a general understanding of the renewable energy potential of EPA and state tracked sites. They will be updated periodically. More detailed site-specific analysis is necessary to identify or prioritize the best sites for developing renewable energy facilities based on technical and economic potential. See the Data Guidelines document for specific information on methodology and data considerations.
EPA
U.S. EPA OSWER
Directions: To here - From here

NREL Partnership: Site Specific Analysis

- EPA Partnered with NREL to evaluate the feasibility of siting renewable energy on specific sites
- In 2010, conducting 12 site-specific analyses and one alternative gas station project
- The analysis will include:
  - determining the best renewable energy technology for the site,
  - the optimal location for placement of the renewable energy technology,
  - potential energy generating capacity,
  - the return on the investment, and
  - the economic feasibility of the renewable energy projects.
- Expected Outcome: A tool for the community to use when seeking out developers for the site

Feedback from Stakeholder Meetings

- Stakeholder Meetings Held Across the U.S. in Fall and Winter
- Feedback from a wide variety of stakeholders on what barriers exist to using contaminated land and suggestions for how to overcome those barriers
- Some of the main barriers heard:
  - Misconceptions and uncertainties surrounding liability relief protections
  - Guidelines to developing on landfills or while cleanup is ongoing do not exist
  - It is not always clear who to contact at EPA
  - Communication with utilities
  - Communities often do not have expertise in developing renewable energy
  - Need to show projects are economically viable

Responding to Stakeholders: Two Year Management Plan

- Expand the toolbox of resources for use by EPA staff, states, and stakeholders
  - Developing guidances
  - Case studies tied to barriers
- Webinar Series
- Clarify Liability Protections
- Adding other sites
- Federal Partners Network
  - Partner with DOE and other Federal Agencies to promote RE-Powering in their Programs

Thank You!

» Lura Matthews
» RE-Powering Lead
» OSWER Center for Program Analysis
» Phone: (202) 566-2539
» Email: matthews.lura@epa.gov

- **www.epa.gov/renewableenergyland**

Green Remediation Webinar
December 8, 2010

Status of EPA Region 1
Efforts on Green Remediation

John Podgurski and Ginny Lombardo
Green Remediation Coordinators

EPA Region 1, New England

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Region 1 GR Approach

- Build momentum for GR support by facilitating renewable energy (RE) redevelopment on contaminated sites
- Region 1 is handicapped by relatively low solar resource and wind resource potential and smaller-sized sites, but some NE states have incentives that make projects viable
- Initial focus on Federal Facilities:
  - large parcels of land,
  - large-scale redevelopment potential,
  - existing grid access and other utility infrastructure,
  - existing property management organizations, and
  - subject to Executive Order #13423
- Objective: Achieve early and demonstrable successes at federal facilities to build expertise and momentum that can then be applied to other projects

EPA Region 1, New England

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Region 1 GR Efforts
Site Specific Technical Support

Fort Devens	Funded Remediation System Evaluation (RSE) & GR evaluation at Army landfill P&T
Naval Station Newport	Re-Power America/NREL assistance for 'Renewable Energy Master Plan' for Naval Base
MMR (Mass Military Reservation)	Wind turbine powering P&T systems; More wind turbines planned; Re-Power America/NREL assistance for Feasibility Study for solar on landfill (draft shows feasible)
Portsmouth Naval Shipyard	Funding awarded for evaluation of RE opportunities on the base, with focus on wind potential on landfill
New London Sub Base	Funding awarded for evaluation of RE opportunities on the base
Brunswick NAS	Funding awarded for evaluation of RE opportunities; Funded Feasibility Study for solar on landfill
7 MA NPL Sites	Funded Feasibility Study of rooftop solar to power P&Ts at Superfund sites (New Bedford site being further evaluated)

EPA Region 1, New England

Region 1 GR Efforts
General

- OSRR Clean and Green Policy issued February 18, 2010
- UMass Amherst Green Remediation Conference held June 15-17, 2010
- UMass Amherst Sustainable Remediation Conference planned for June 1-3, 2011
- Landfill Methane Screening Tool – working with Regions 2, 3, HQ and LMOP (Tool and report to be issued December 2010)

EPA Region 1, New England

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Region 1 GR Efforts

Facilitating RE Development Opportunities

- Participating in discussions with RE developers and consultants to facilitate RE redevelopment projects on Region 1 Superfund Sites
- Completed solar screening exercise on MA NPL sites – referred sites to solar developers/consultants
- Renewable energy development plans are underway or being considered at a number of sites:
  - Industiplex – Solar development planned
  - Rose Hill and Dover Landfills – Referred to RE consultant that is working with Municipalities
  - Elizabeth Mine – Discussions ongoing with RE developer
  - GE Pittsfield – Commercial solar development completed
  - Fort Devens – Commercial solar development planned at OU8
  - NWIRP – Solar development being considered
  - Winthrop Landfill – Solar development being considered
  - Baird&McGuire – MassDEP considering siting solar on landfill to power P&T

EPA Region 1, New England

Region 1 GR Next Steps…

- Develop a Regional GR Plan for FY11
- Add GR to Management Review of Remedies
- Consider Adding GR Language in Contracts and Enforcement Orders
- Track Region 1 GR Projects/Efforts and Highlight Successes
- Perform RSE/GR Evaluation of High Cost/Energy Sites
- Continue to Identify and Support Site Specific Projects through Technical and Funding Opportunities
- Continue to Facilitate Discussions between RPMs and Site Owners and RE Developers/Consultants
- Coordinate GR Efforts with our State Counterparts

EPA Region 1, New England

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617-918-1754

EPA Region 1, New England

Region 2 *Clean and Green* Policy

December 8, 2010

Region 2 *Clean and Green* Policy

- *Clean and Green* Policy issued on 3/17/09:
- All Superfund cleanups
  - Fund lead
  - PRP lead
  - Federal Facilities
- Brownfields
- EPA-lead RCRA Corrective Action projects

Region 2 *Clean and Green* Policy

- Touchstone Practices
  - Purchase 100% of electricity from renewable sources
  - Material Reuse, Reduction or Recycling
    - Industrial materials reuse or recycling within regulatory requirements
    - Construction and Demolition materials
    - Concrete made with Coal Combustion Products (CCP)
    - Organic materials generated on-site;
  - Clean diesel fuels, technologies, and practices
  - Methane capture at landfill sites

Green Remediation Awareness

- Green Remediation Workgroup
  - Established in October 2008
    - Members from many programs (Counsel, Enforcement, Air, Water programs, Sustainability, Caribbean)
- The policy is consistently cited in enforcement and decision documents. Measurement systems are being put in place to evaluate implementation and identify opportunities to assist project managers and expand site specific uses of GR practices.
- Although all project managers should be aware of the policy and workgroup, some are ahead of the curve, while others need direction.

What are We Trying to Achieve?

- GHG reductions
  - As of June 2010 - **4,585,568 pounds of carbon,** the equivalent of GHG emissions from 398 vehicles.
- Reduction of air toxics (NOx, SOx, etc.)
  - Retrofitted 3 EPA-owned excavators
  - Switched 83 non-road vehicles from Low Sulfur Diesel to Ultra Low Sulfur Diesel before the June 2010 regulatory required date
- Development of more sustainable practices
- Awareness of GR Policy, Practices, Ideas
- Education to provide project managers with the tools needed to implement GR practices

Challenges

- Myths about GR implementation
  - taking too long
  - negatively affecting project budget (too expensive)
- Identification of sites where GR workgroup can assist RPMs with implementation
- Centralized data warehouse
- Engaging RPMs who do not attend the trainings


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20th Anniversary
Sharon Steel Farrell Works Site
OSRTI Pilot Study Update
Farrell, PA
NARPM, MAY 2010
by Rashmi Mathur- EPA Region 3
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Sharon Steel Farrell Works Site


Northern Part
of the Site
Southern Part of
the Site


Floodplains on Site along side the Shenango River


BOF Sludge Area on Site

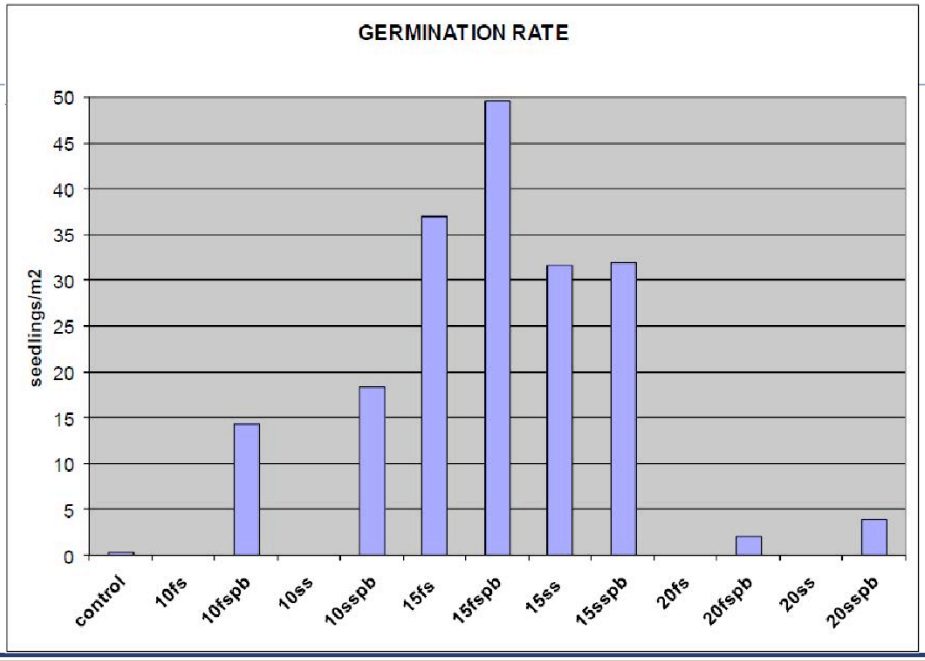
Dunbar Asphalt Plant on Site

RI Recommendations

- Minimize dust exposure
- Minimize contaminated slag/sludge exposure

- Eliminate runoff into Shenango River & wetlands
- Reduce contamination into shallow groundwater

- Use of groundwater onsite for non-drinking
- Restore habitat value of barren areas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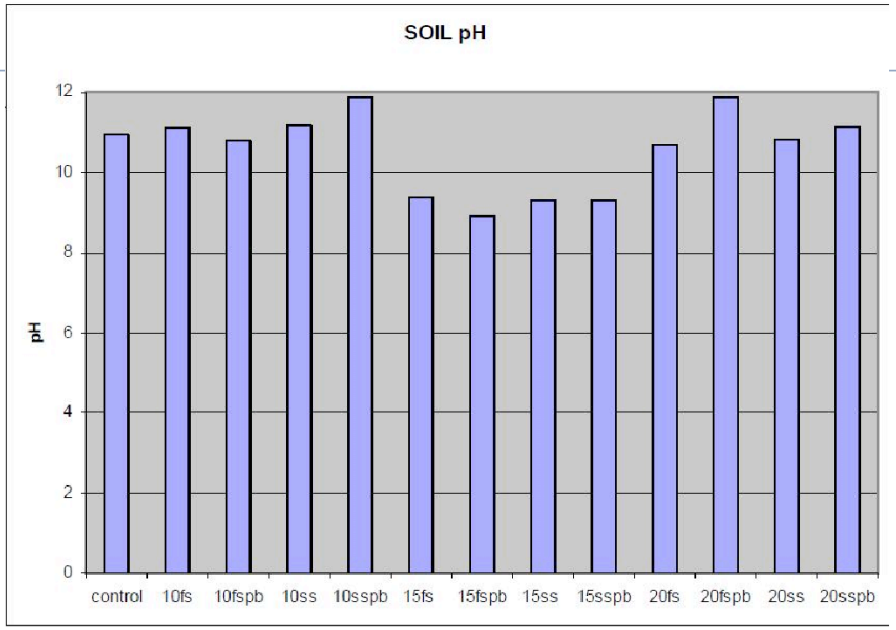
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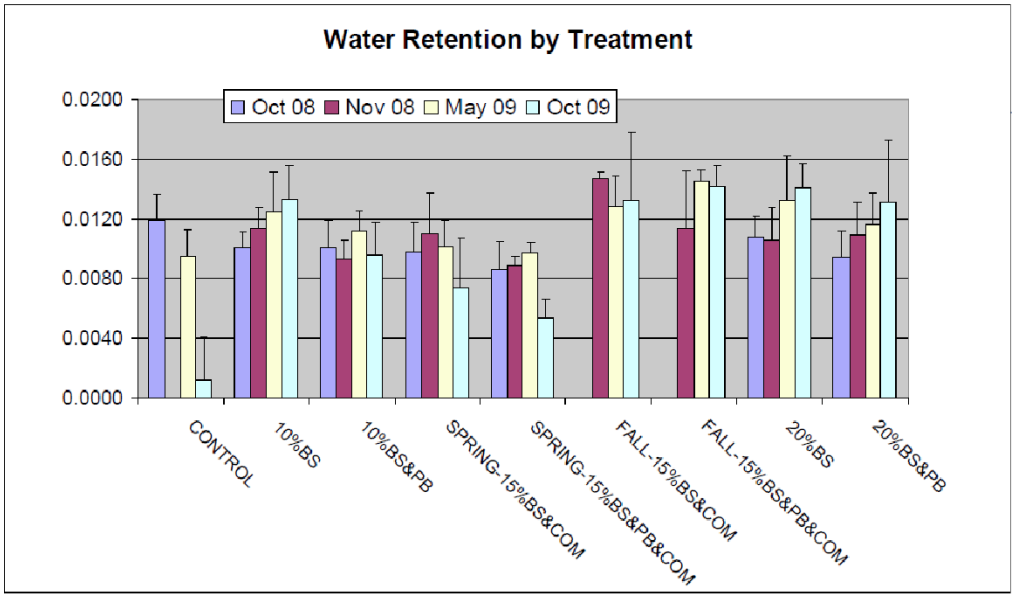

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BS= BIOSOLIDS

PB= PINE BARK CHIPS
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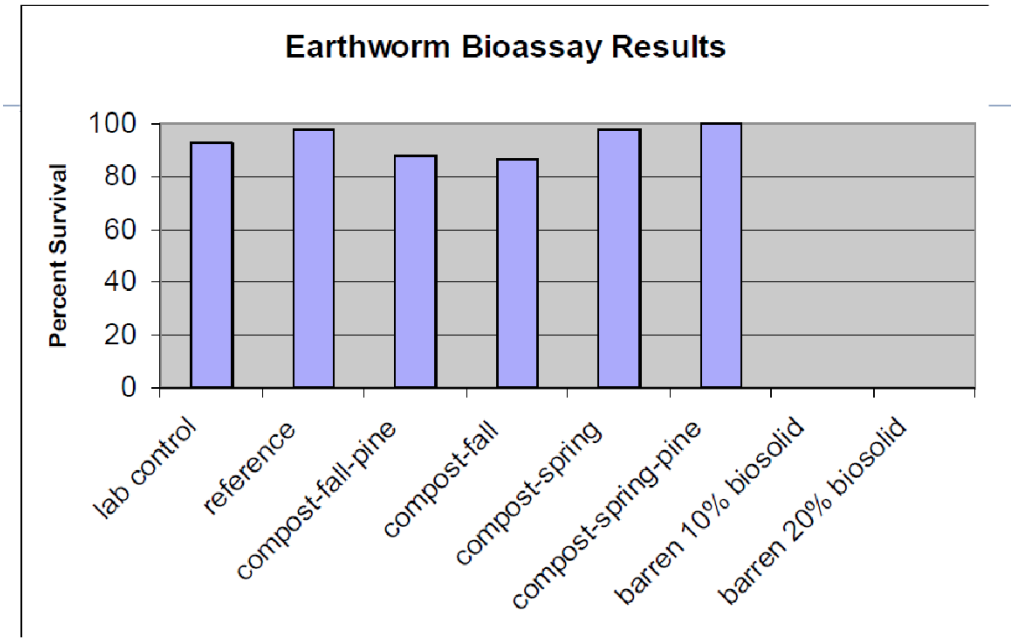
Earthworm Bioassay Results
Percent Survival
100
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40
20
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lab control
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compost-fall-pine
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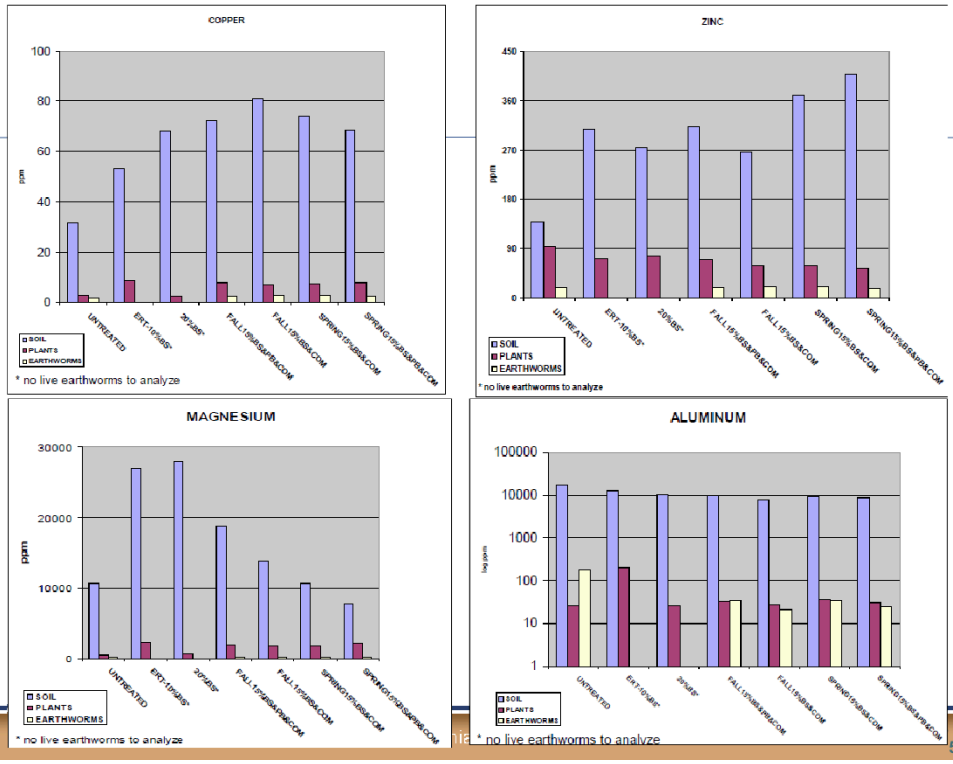
barren 10% biosolid
barren 20% biosolid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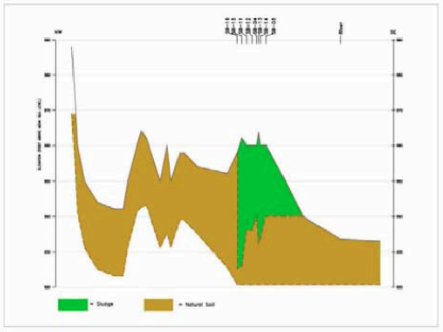
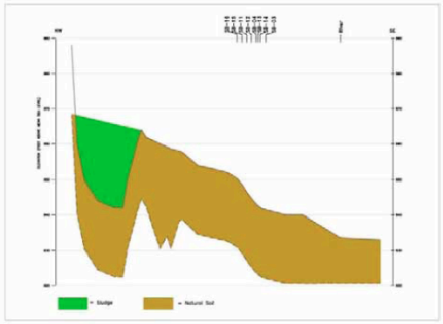
* no live earthworms to analyze

Current Cross Section Site Versus Conceptual Cross Section of Cap after Cleanup

Current Cross Section of Site



Cross Section after Cleanup



Carbon Sequestration Study

- EPA Headquarters Office of Solid Waste and Emergency Response and Ohio State
- Developing a protocol for carbon accounting after application of carbon-rich soil amendments for remediation
- Using Sharon Steel Site as test site

Future Site Milestones

- EPA currently reviewing 30% design
- EPA will receive 90% design in September 2010

Questions?

Please contact

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mathur.rashmi@epa.gov


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20th Anniversary
Barite Hill / Nevada Goldfields
McCormick, SC
Candice Jackson, RPM
EPA R4
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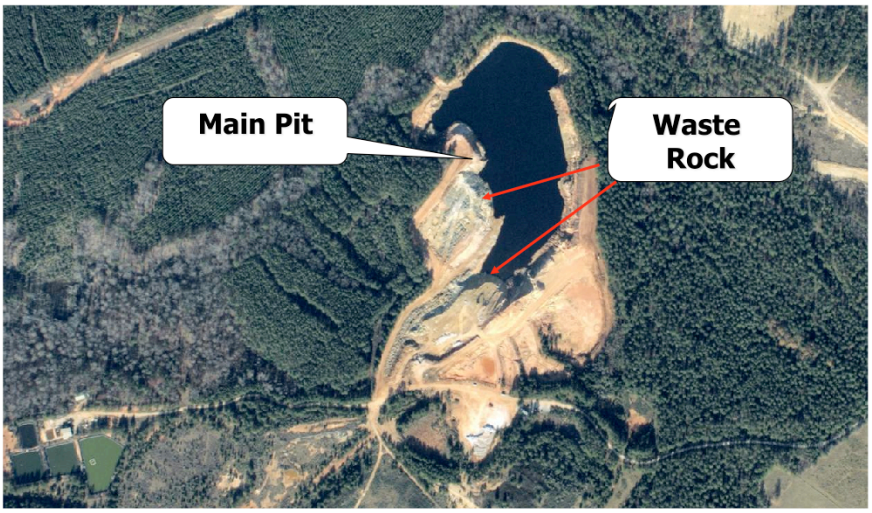
Site Overview

- McCormick, South Carolina
- Mined from 1991 to 1995
- PRP Reclamation until 1999
- Abandoned in 1999
- Removal Action 2007-2008
- NPL Listed in 2009

Site



http://www.epaosc.org/sites/2768/files/osc%20readiness%202009%20pp%20jan%2026%202009.ppt

Defining the Problem

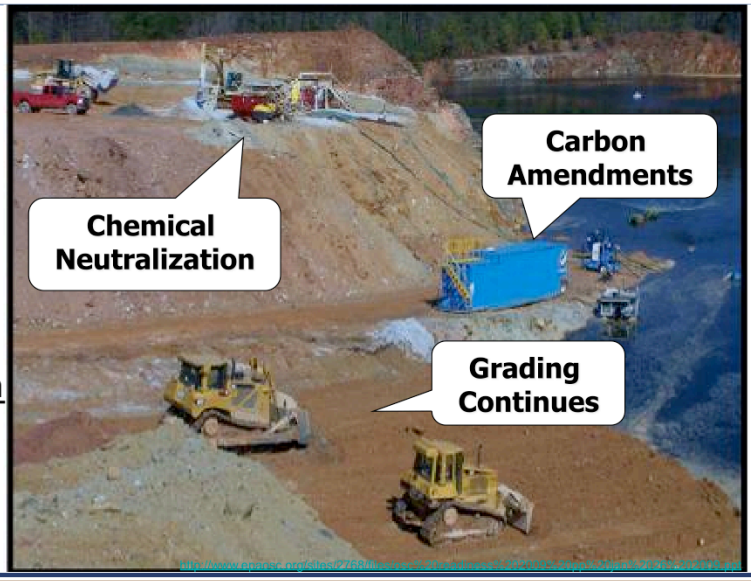
http://www.epaosc.org/sites/2768/files/osc%20readiness%202009%20pp%20jan%2026%202009.ppt

Innovative Treatment

- Leo Francendese
U.S. EPA OSC

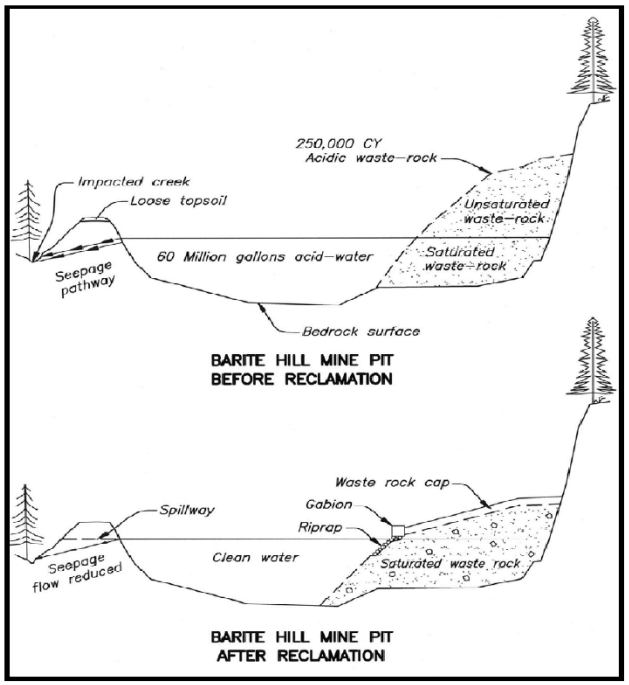
- Mike Gobla
U.S. Bureau of Reclamation

- Joe Harrington
Alexco

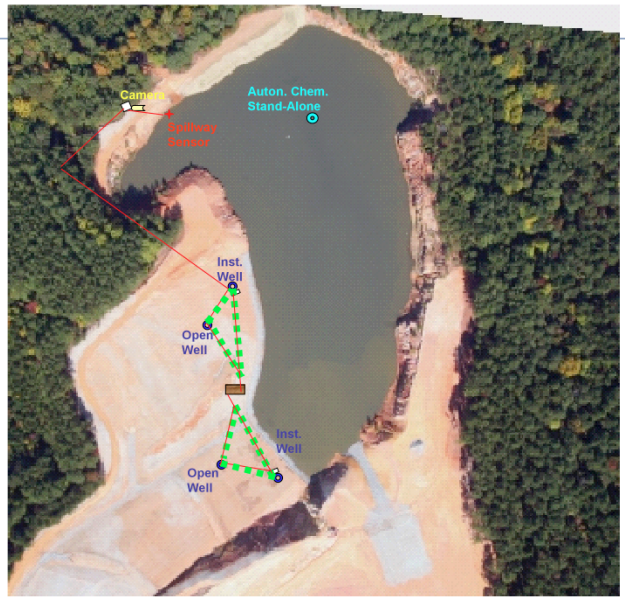


Innovative Treatment

http://www.epaosc.org/sites/2768/files/osc%20readiness%202009%20pp%20jan


250,000 CY
Acidic waste-rock
Impacted creek
Loose topsoil
Unsaturated waste-rock
60 Million gallons acid-water
Saturated waste-rock
Seepage pathway
Bedrock surface
BARITE HILL MINE PIT
BEFORE RECLAMATION
Waste rock cap
Gabion
Riprap
Spillway
Clean water
Saturated waste rock
Seepage flow reduced
BARITE HILL MINE PIT
AFTER RECLAMATION

Monitoring System



Monitoring System Objectives

- Near real-time site performance information
- Multi-sensor design
- Automated data collection, storage, and reporting
- Self-calibrating
- Remotely controlled
- Accessible through a secure webpage

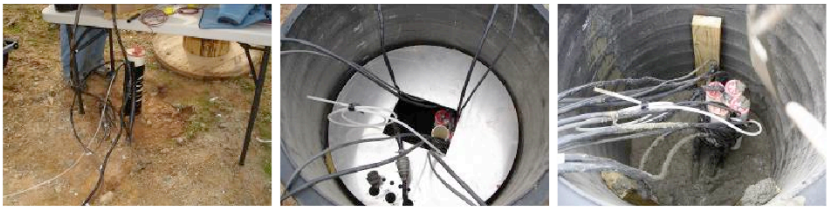
Monitoring Parameters

- Pit lake & Ground Water Monitoring Analytes
  - pH
  - ORP
  - Dissolved Oxygen
  - Conductivity
  - Temperature
- Lake level sensor
- Weather Station

- Subsurface Monitoring
  - Resistivity
  - Temperature
  - Water levels

Monitoring Wells

temperature, water level, automated water pumping and calibrated water chemistry from every well

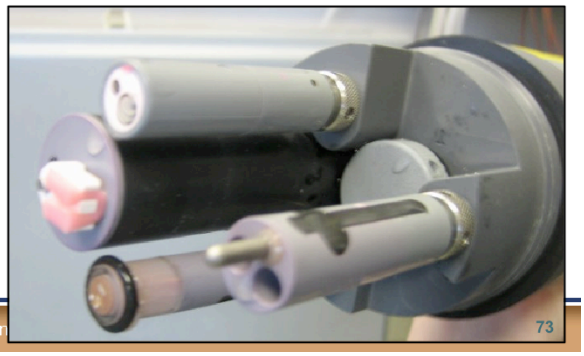


Photos courtesy of Idaho National Laboratory

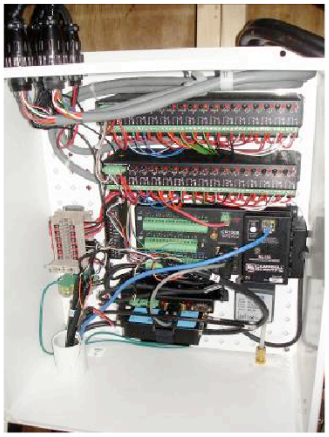
YSI 6600EDS Chemistry Sensor

- Dissolved Oxygen
- pH
- ORP
- Conductivity
- Temperature

Photos courtesy of Idaho National Laboratory



Pinch Valves, Pumps, Controllers, Flow Through Cell, Sensors, and Calibration fluids

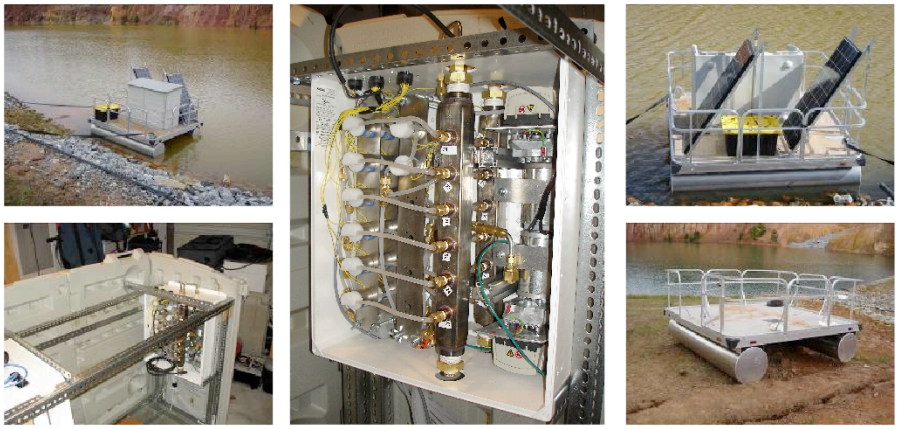

Photos courtesy of Idaho National Laboratory

Camera and Lake level sensor

Photos courtesy of Idaho National Laboratory

Lake Sampling

Samples automatically taken at 5 foot intervals from the surface to 55 foot bls and then a calibrated chemical analysis is completed



Photos courtesy of Idaho National Laboratory

Benefits and Results

- Helps us to understand the system dynamics and monitor the effectiveness of the remedy
- Provides near real-time information and early warning system in case of treatment failure
- Monitors multiple parameters
- Reduces travel to the site
- Capable of running on power generated by wind or solar

Questions?

Same presentation that Steve Armann gave at NARPM in May 2010, with a few updates.

Will describe the Green Remediation Pilot Study that Region 9 is conducting, in which we are exploring how to estimate the environmental footprints of our clean-up remedies.

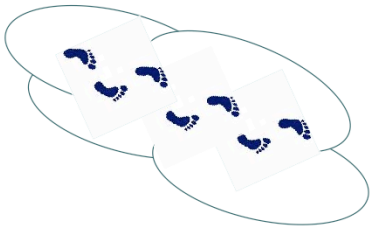
Overview

- → Description of footprint analysis
- → Methods used in Pilot Study to conduct footprint analyses
- → Results of footprint analyses and how they may be used at clean-up sites
- → Observations
- → Wrap-up

What is an "Environmental Footprint Analysis"?

Estimate of the resources used and emissions created during site remediation

1. Develop an inventory of materials, activities, and services
2. Apply some of the principles of a Life Cycle Assessment
3. Compile "footprints" for key environmental parameters
4. ***Use the results to reduce the environmental footprint of the clean-up remedy***



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Our footprint analysis is not the same as a Life-Cycle Assessment.

Life Cycle Assessment includes an impact analysis, which we are not doing in our footprint analysis.

Purpose of the Pilot Study

- ✓ Acquire experience in estimating the environmental footprints of clean-up remedies
- ✓ Develop a "library" of resources for site remediation activities
- ✓ Construct an analytic framework for use at other sites
  - in "modular" format in excel spreadsheets
  - separate tabs for each site remediation activity

designed for ease of application to each new site

site investigation | well construction | capping | tree planting

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Three main purposes.

Acquire experience:

explore how to get as complete an estimate of the environmental footprint as possible

find out what activities may contribute the greatest to the footprint

Library of resources now contains:

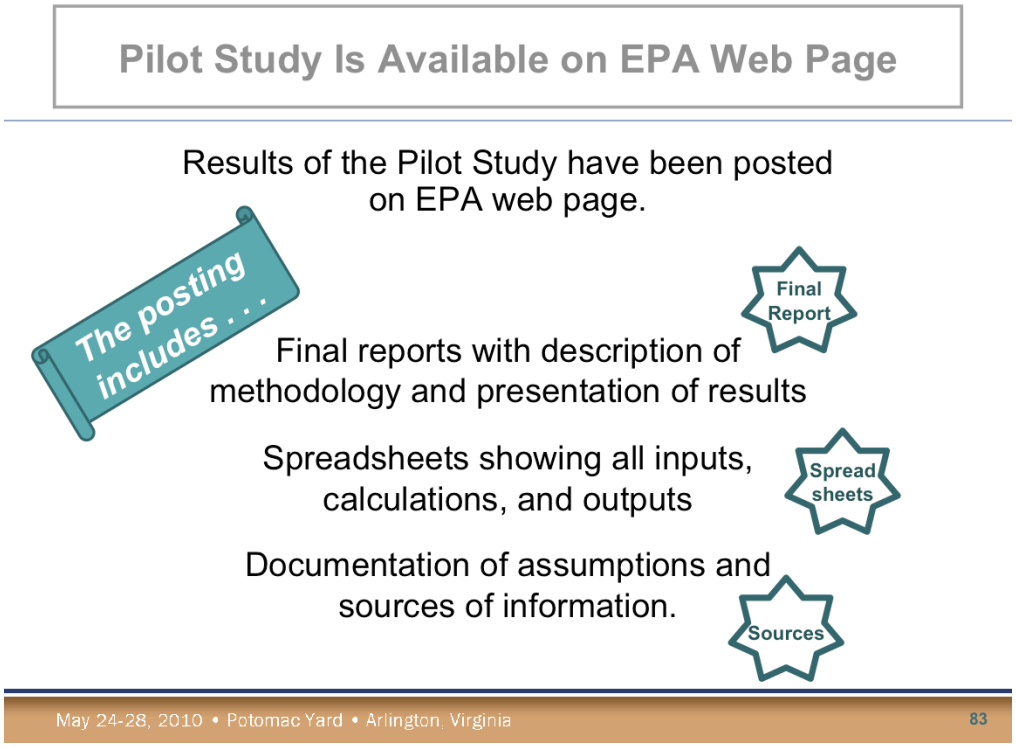
a variety of remediation technologies

information on common remediation materials

conversion factors for important environmental parameters

… and this "library" will grow as we continue with the Pilot Study.

Construct analytic framework …



The Pilot Study is complex.

This presentation will touch on only some of the highlights of the methodology and results.

We're posting full details as they become available on EPA's web page.

The web address will be provided at the end of the presentation.

Scope of the Pilot Study

Romic East Palo Alto (California)

In-situ bioremediation of VOCs in groundwater

BP Wood River (Illinois)

Phytoremediation to control landfill leachate

Travis Air Force Base (California)

In-situ bioreactor for VOCs in groundwater

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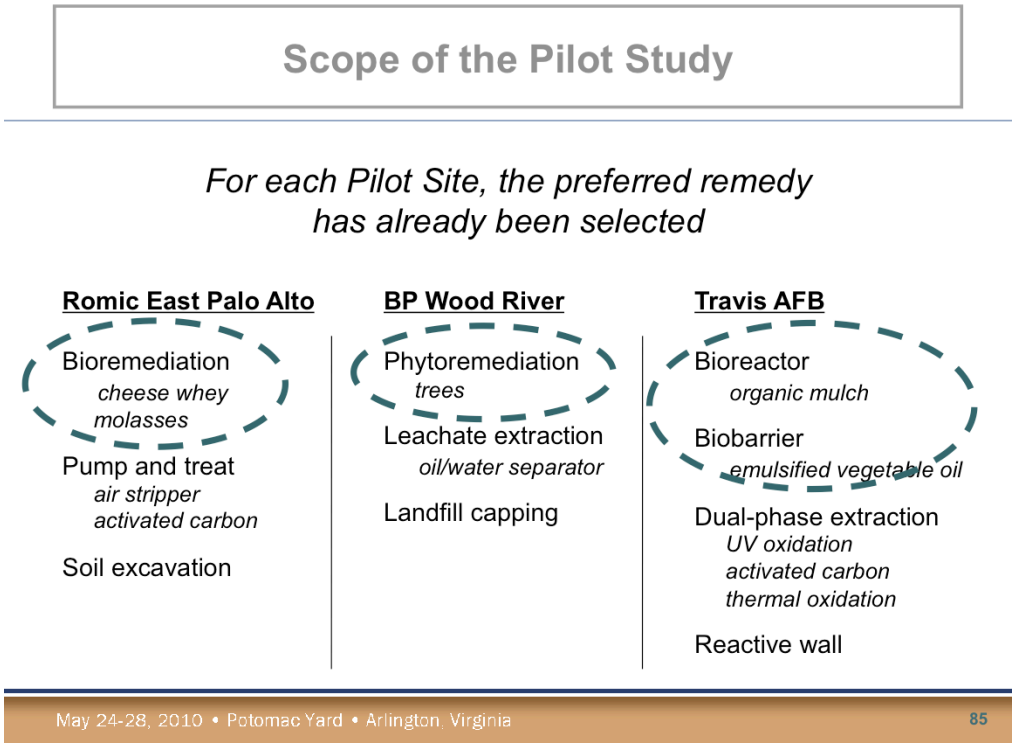
Outline of the on the Scope and Methodology of the Pilot Study …

Three clean-up sites:

Romic and	In-situ bioremediation of VOCs in groundwater using cheese whey molasses
BP	Phytoremediation using trees to control landfill leachate
Travis	In-situ bioreactor containing mulch for remediation of VOCs in groundwater

The footprint analyses for Romic and BP are completed and up on the web page.

We expect to complete the Travis footprint by January 2011.

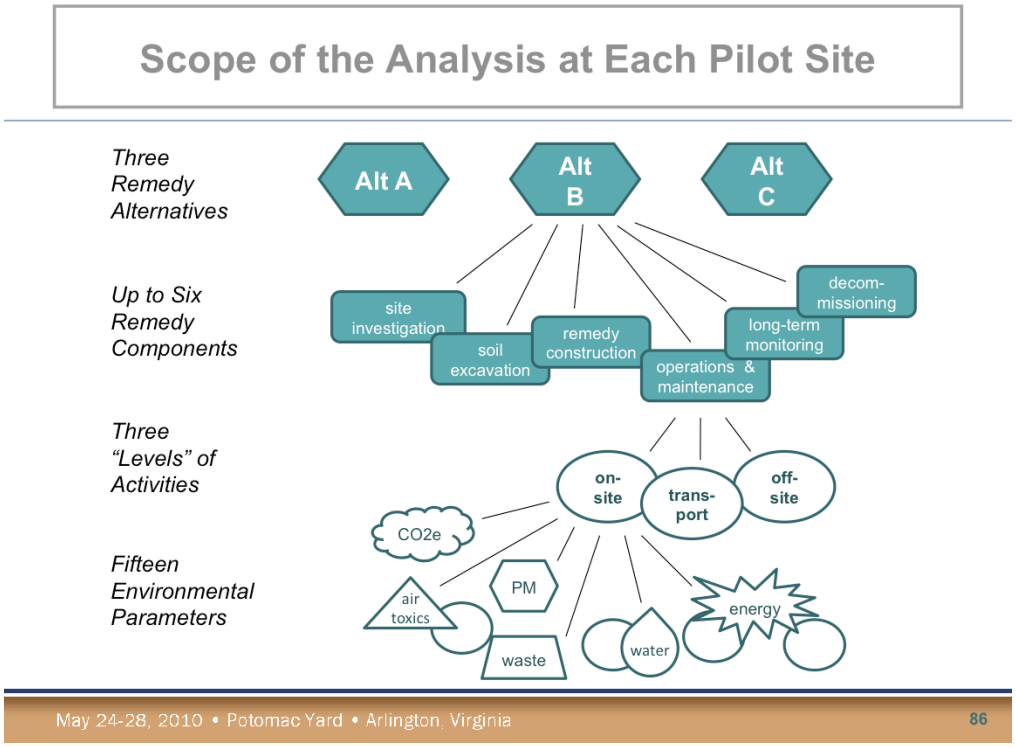


The remedy selection had already been made at these 3 sites before we began the Pilot Study, so the results will not be used in remedy decision-making.

The results may, however, be used to improve the selected remedies.

In the Pilot Study, we compared the selected remedies with alternative remedies.

We have included an assortment of remedy technologies including: bioremedation, phytoremediation, pump and treat, landfill capping, and permeable reactive wall.



This diagram shows how we organized the footprint analysis.

For each Pilot Site we looked at:

→ Three remedy alternatives …

→ For each alternative, up to six remedy components...

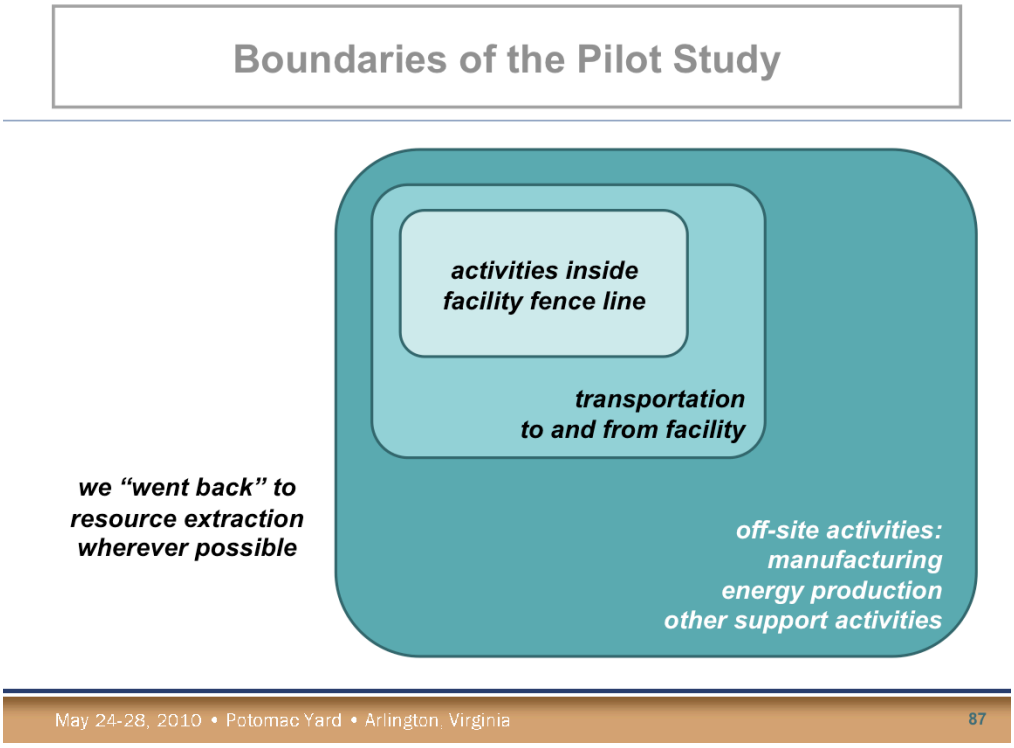
→ For each remedy component, three "levels" of activities…

On-site activities – activities within the fence line of the facility.

Transport activities – transportation of materials, equipment, and personnel to and from the site.

Off-site activities – manufacturing and support services.

→ For each level of activity, fifteen environmental parameters.

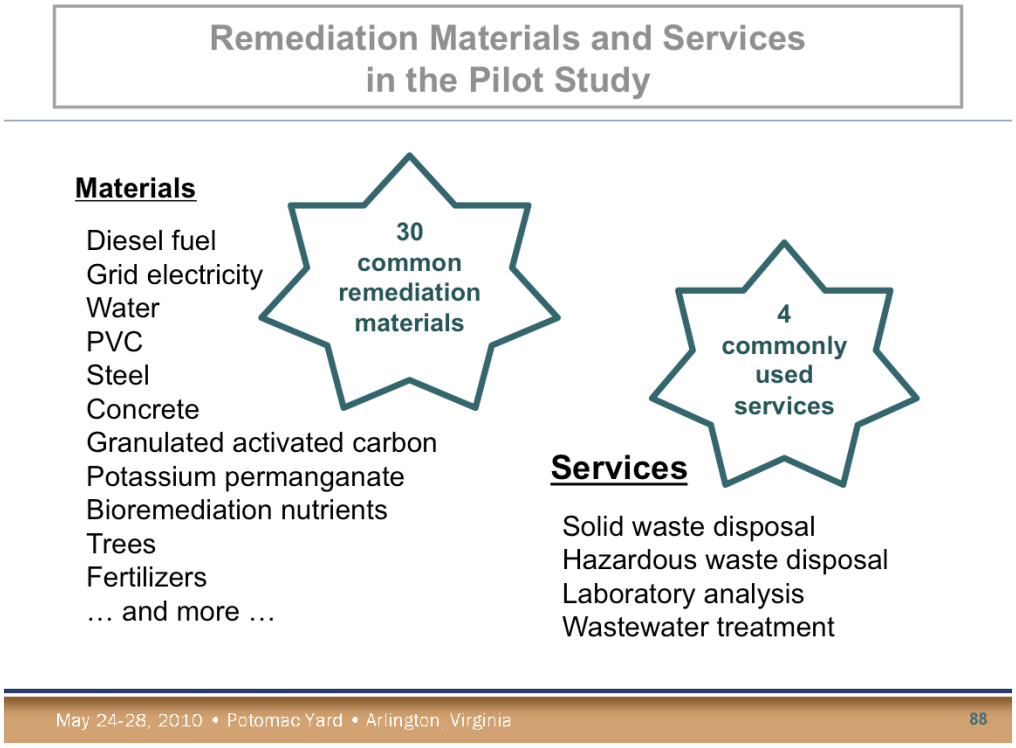


This is to illustrate that we included three "levels" in the footprint analysis:

activities inside the facility fence line

transportation to and from the facility

off-site activities



• This shows some of the remediation materials and services that we included in the Pilot Study.

• "Materials" refers to energy, water, mined or manufactured materials, and biological materials such as trees.

• "Services" refers to off-site support services such as waste management at a landfill, laboratory analyses, and wastewater treatment at a POTW.

• We obtained life-cycle inventory data for all these materials and services, to the extent possible, from resource extraction through manufacturing.

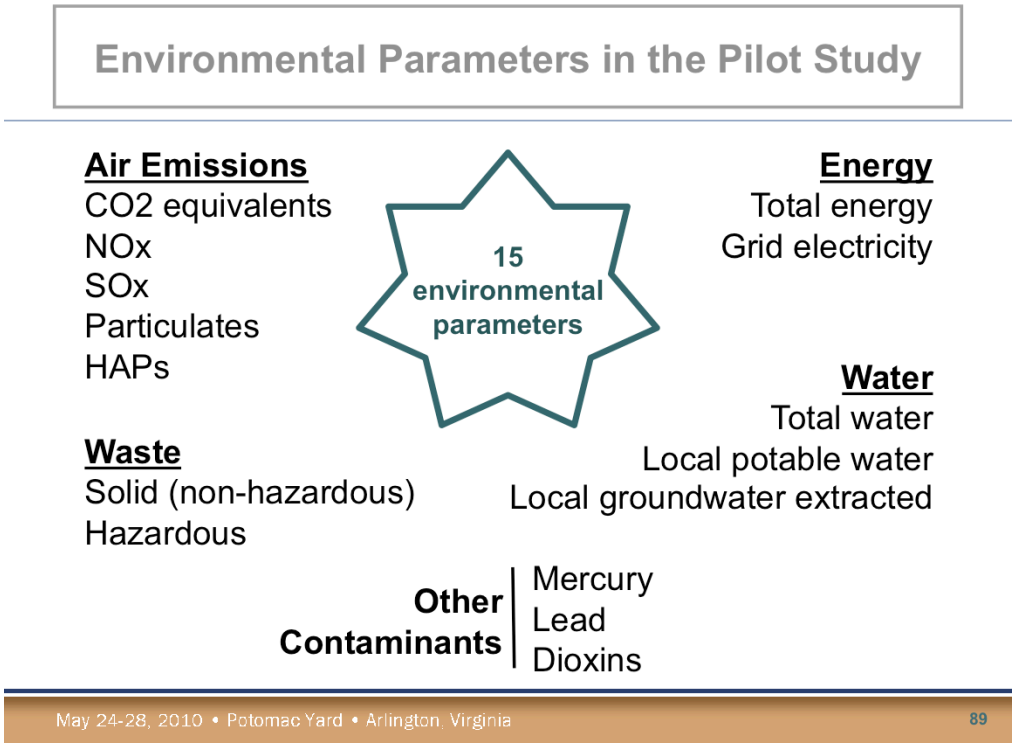
********** *Background Notes* **********

*Full list of remediation materials for which we currently have LCI data (or are researching *):*

Gasoline
Diesel fuel
Biodiesel mix
Ethanol mix
Natural gas
Grid electricity
Water
**Solar panels*
**UV lamps*

PVC
HDPE
Steel
Stainless steel
Sand and gravel
Cement grout
Concrete
Bentonite
Clay
Potassium permanganate
Sodium hydroxide
**Hydrogen peroxide*

Regenerated GAC
Virgin GAC
Molasses
Cheese whey
Vegetable oil
Trees
Nitrogen fertilizer
Phosphorus fertilizer
**Mulch*
**Iron pyrite*



• This shows all the environmental parameters we included in the Pilot Study.

• We chose these 15 parameters because we found them useful in addressing questions of local, regional, or global interest.

• There is overlap in some of these parameters. For example: energy and electricity ; and mercury and HAPs .

• We just have to be sure to keep the overlaps in mind as we interpret the results of the analysis.

********** *Background Notes* **********

Total energy: sum of the Btu values of all energy sources: gasoline, diesel fuel, natural gas, electricity as a measure of the overall energy intensity of each remedy

Grid electricity: we separated out because of the potential for excess burden on existing infrastructure

Total water: includes on-site water, and water required for off-site manufacturing and services, because water is an important global resource

Local potable water: we separated out local potable water (i.e., potable water used on-site) because it may have special interest for local stakeholders

Local groundwater extracted: we separated out groundwater extracted on-site, because it may have special interest for local stakeholders

Carbon dioxide equivalents (CO2e): includes carbon dioxide, nitrous oxide, methane, CFCs (on-site)

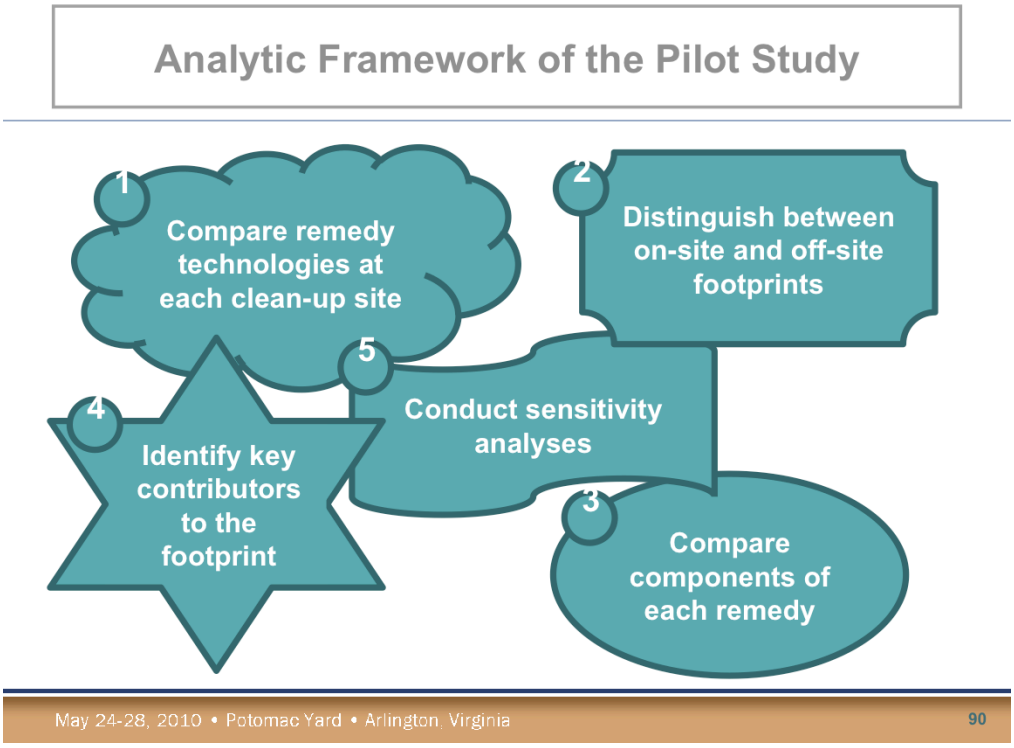
NOx, SOx, PM, and HAPs: emissions to the air, because these emissions can have local and regional effects

NOx = nitrogen oxides (NO and NO2) SOx = sulfur dioxide (SO2) PM = particulates 10 microns and less in diameter

HAPs = hazardous air pollutants, about 200 contaminants as defined by the Clean Air Act (including Pb and Hg below, but not including dioxins)

Solid and hazardous waste: waste sent off-site for disposal, because generation of solid and hazardous waste can be of local and regional interest

Mercury, lead, and dioxins: released to air, water, and soils, because we wanted to test whether it was feasible to quantify specific contaminants in a footprint analysis -- we selected these three contaminants for their toxicity and persistence in the environment



We wanted the analytic framework to be versatile, and so we developed it to accommodate 5 analytic techniques.

1 – Compare remedy technologies at each clean-up site

2 – Distinguish between on-site and off-site footprints

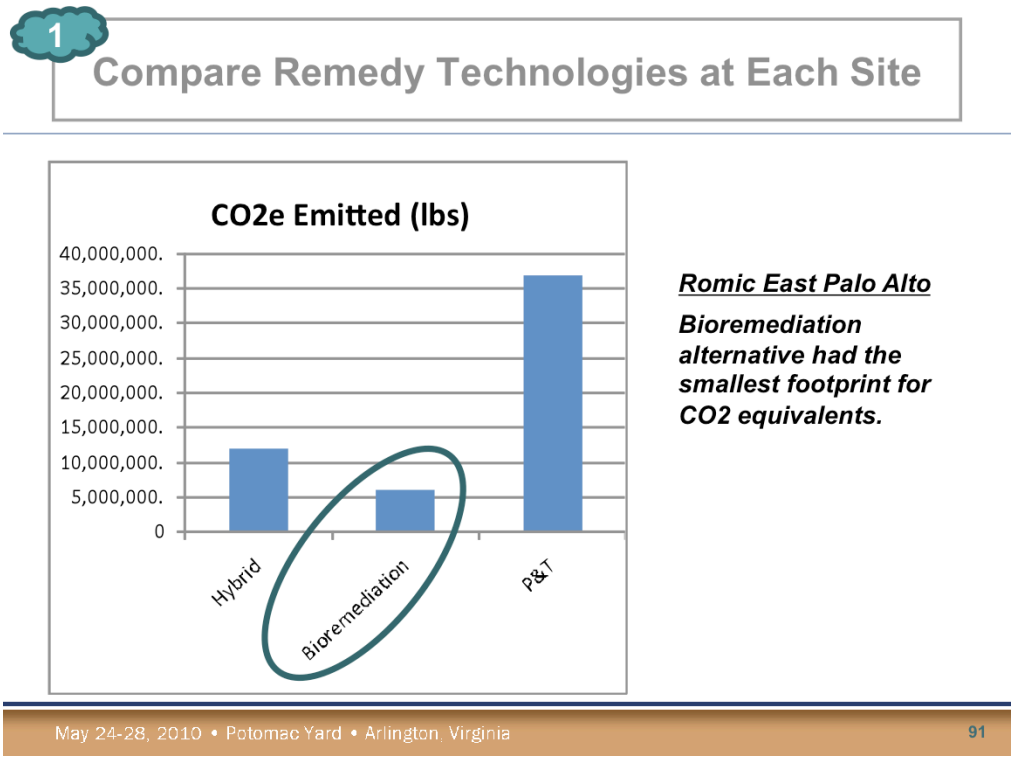
3 – Compare components of each remedy

4 – Identify key contributors to the footprints

5 – Conduct sensitivity analyses

Each of these analytic techniques can help us focus on ways to reduce the environmental footprint of our clean-ups.

We will show some of the results of applying each of these techniques, drawing from the analyses at two of the Pilot Sites: Romic East Palo Alto and BP Wood River.



• The simplest and most straightforward analytic technique in the Pilot Study is to compare remedy technologies at a single clean-up site.

• This chart shows the three remedy alternatives at Romic, comparing their footprints for CO2 equivalents.

• Bioremediation, circled, had the smallest footprint, as compared with Pump & Treat and a Hybrid alternative.

• Remember that CO2 equivalents is one of 15 environmental parameters we included in the Study.

• For Romic, Bioremediation had the smallest footprint for 11 of the 15 parameters.

********** *Background Notes* **********

The parameters for which Bioremediation was the highest are: potable water and dioxins.

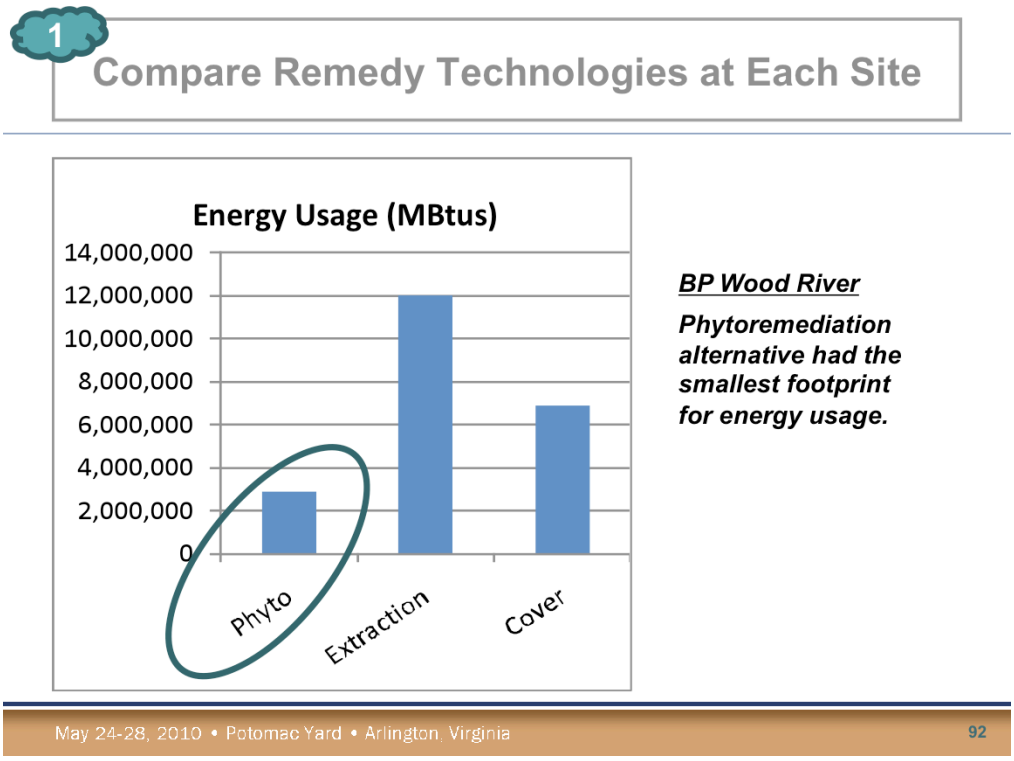
Bioremediation was equal to the other two alternatives for particulates and hazardous waste generated.

Major contributors for CO2e:

Pump & Treat – electricity production, GAC regeneration, wastewater treatment

Bioremediation – diesel combustion, production of cheese whey & molasses, off-site laboratory analysis

Hybrid – mix of the two above contributors



This chart shows the three remedy alternatives at BP Wood River, comparing their footprints for energy usage.

Phytoremediation, circled, had the smallest footprint, as compared with Leachate Extraction and Landfill Cover.

At BP, Phytoremediation had the smallest footprint for 14 of the 15 environmental parameters.

Comparing various remedy technologies at a single clean-up site can provide useful information during remedy selection.

********** *Background Notes* **********

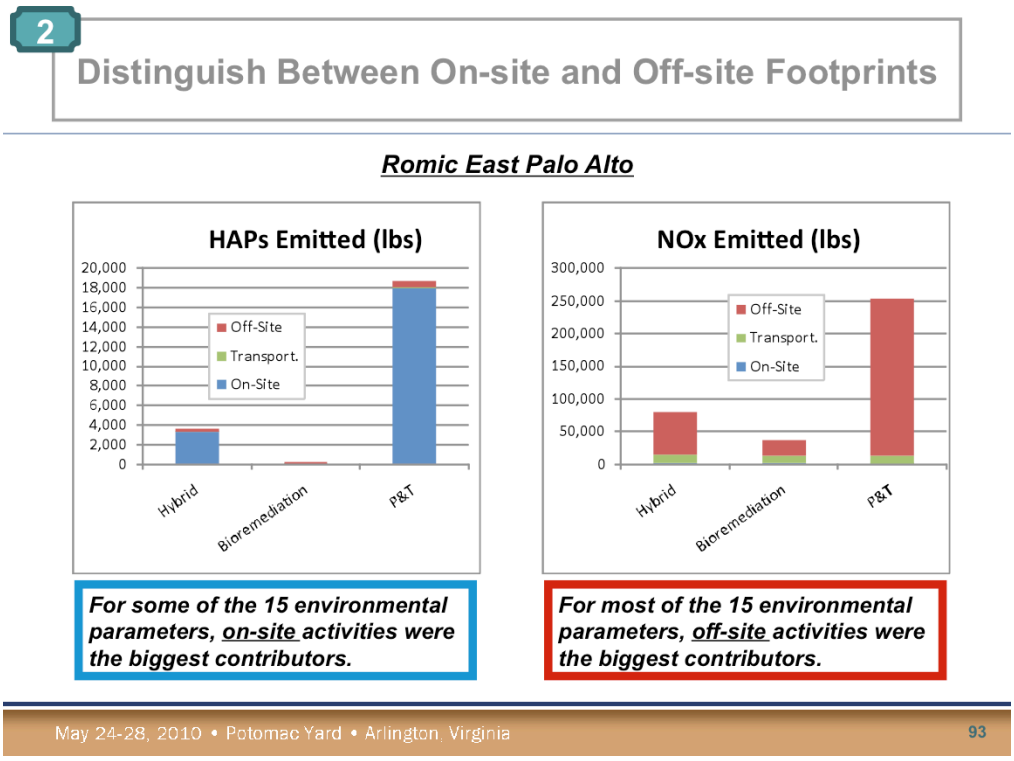
On-site potable water was the only parameter for which phytoremediation was the highest.

Major contributors for energy used:

Phytoremediation – off-site laboratory analysis, steel production, gasoline combustion

Leachate extraction – electricity production, off-site laboratory analysis, wastewater treatment

Landfill cover – diesel combustion, off-site laboratory analysis



• In some situations it may be useful to distinguish between on-site and off-site contributors to the footprint.

• Here, the blue indicates contributions from on-site activities and the red indicates contributions from off-site activities.

• The chart on the left shows mostly blue, indicating that HAPs emissions from the three remedy alternatives at Romic are due mainly to on-site activities.

• The chart on the right shows mostly red, indicating that NOx emissions from the same three remedy alternatives at the same site are due mainly to off-site activities.

• Identifying parameters with high on-site footprints will be important for the local community.

• Identifying parameters with high off-site footprints will be important for the regional or global environment.

• This is a useful analytic technique for distinguishing between the on-site and off-site footprints.

********** *Background Notes* **********

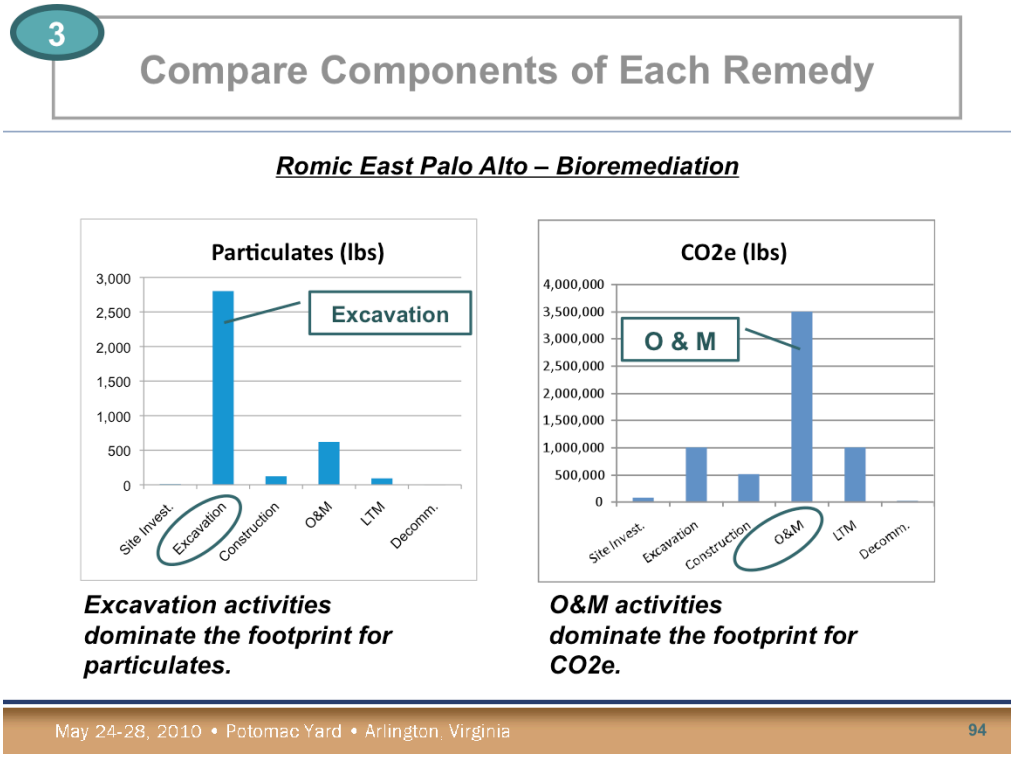
For Pump & Treat, on-site HAPS are due mostly to on-site emissions of vinyl chloride from contamination in the groundwater that is not captured in the activated carbon.

Major contributors for off-site NOx:

Pump & Treat – regeneration of the GAC

Bioremediation – production of cheese whey and molasses

Hybrid – mix of the two above contributors



For the Bioremediation alternative at Romic, excavation activities dominate the footprint for particulate emissions.

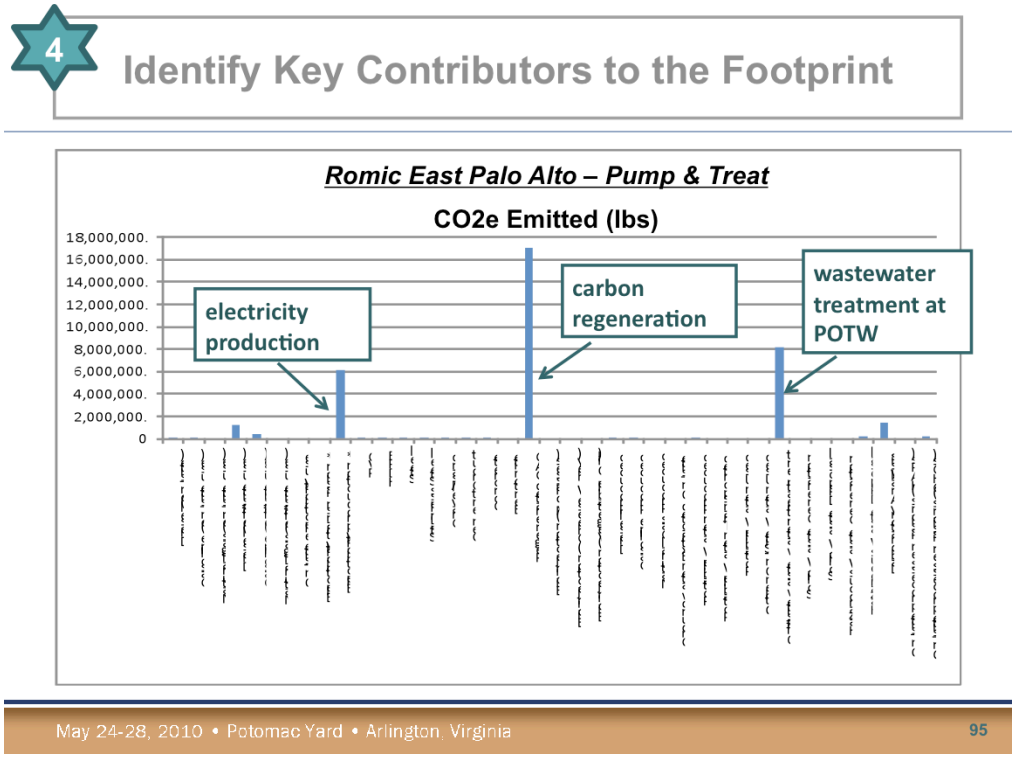
However, O&M dominated the footprint for CO2e emissions.

This sort of analysis can help the site manager focus on certain components of the remedy when seeking to reduce the footprint of any of the 15 environmental parameters.

********** *Background Notes* **********

For total particulates, the major contributor to the excavation component is off-site waste management (at the landfill where the excavated soils are disposed).

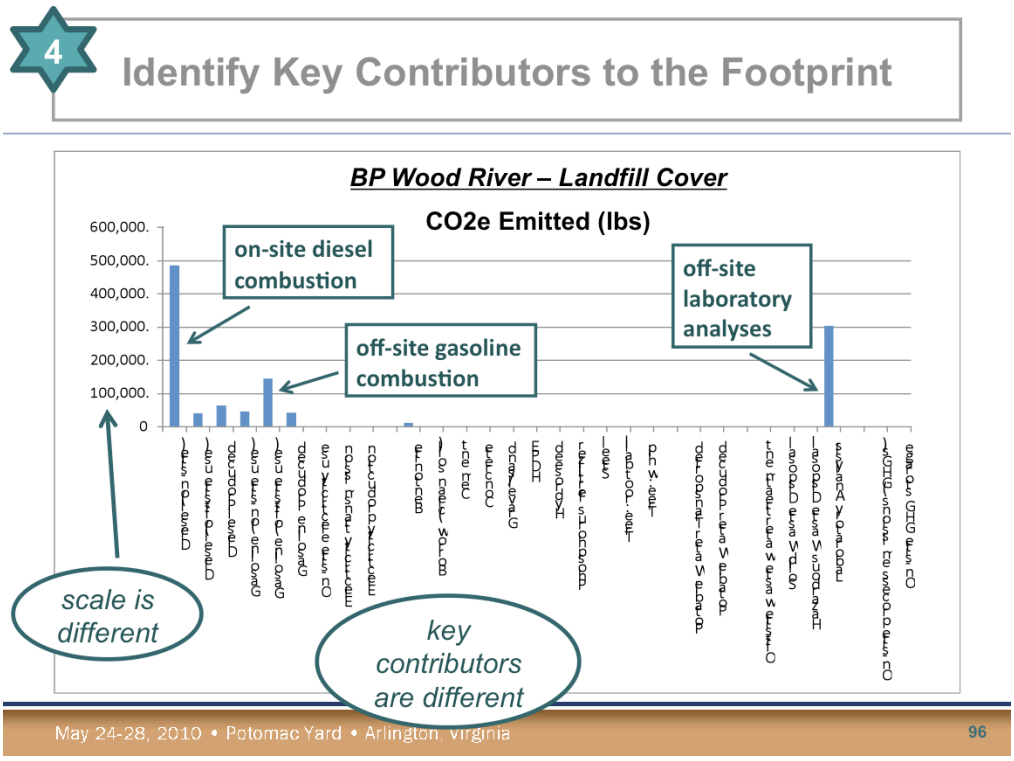
For total CO2e, the major contributor to the O&M component is production and transport of cheese whey and molasses.



The analytic framework also allows the site manager to focus more closely onto the individual contributors to the footprint.

This chart shows contributions to the CO2e footprint from all the activities and materials used in the Pump & Treat alternative at Romic.

Electricity production, carbon regeneration, and wastewater treatment are the key contributors to the footprint.



Key contributors will depend on the clean-up site and the remedy technology.

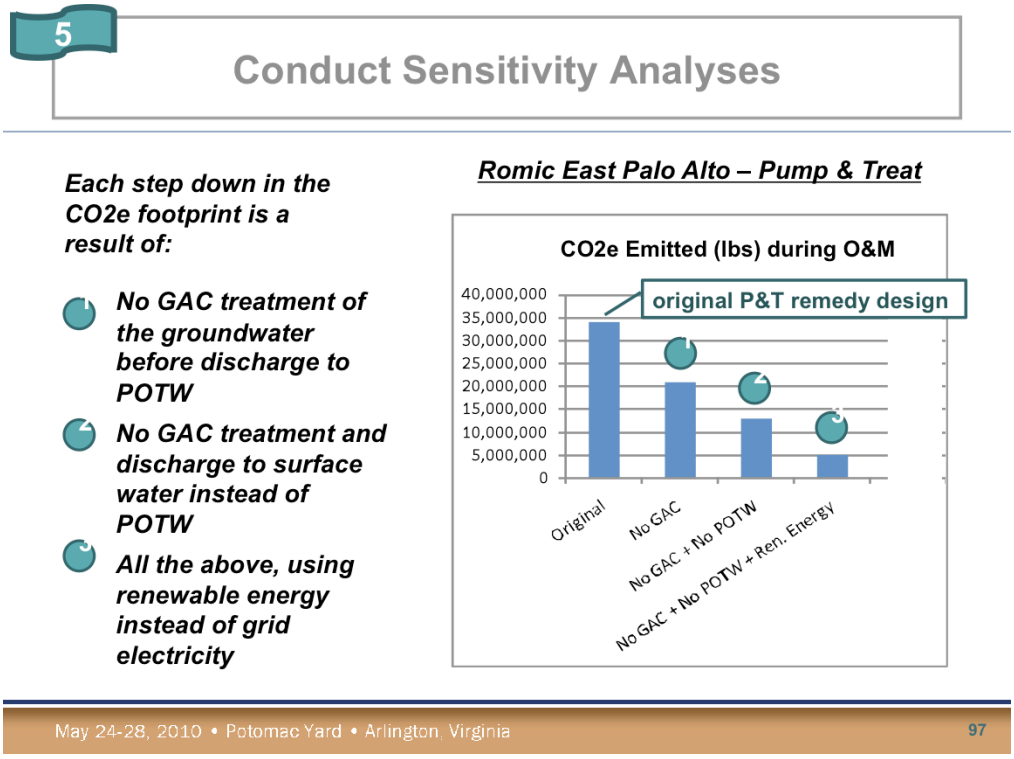
This chart shows contributions to the CO2e footprint from all the activities and materials used in the Landfill Cover alternative at BP Wood River.

In this case, on-site diesel combustion, off-site gasoline combustion, and laboratory analyses are the key contributors to the footprint.

Using this type of analysis, the site manager can make better decisions for designing a remedy to minimize the footprint, or can reduce the footprint of a remedy that is already operating.

********** *Background Notes* **********

Key contributors may also be different at the same site, depending on the environmental parameter. For example, the distribution for air toxics looks different for BP Wood River (Landfill Cover) than the distribution shown here for CO2e.



The sensitivity analysis is an important part of the analytic framework, and this chart shows one of many analyses that we conducted.

We modeled hypothetical improvements to the Pump & Treat alternative at Romic, in which we estimated reductions to the CO2 equivalents footprint that would result if we were able to:

1 – remove the need for activated carbon treatment of the groundwater (using only an air stripper)

2 – discharge treated groundwater to surface waters rather than to the POTW

3 – take advantage of sources of renewable energy rather than grid electricity.

Each improvement resulted in significant reductions in the footprint.

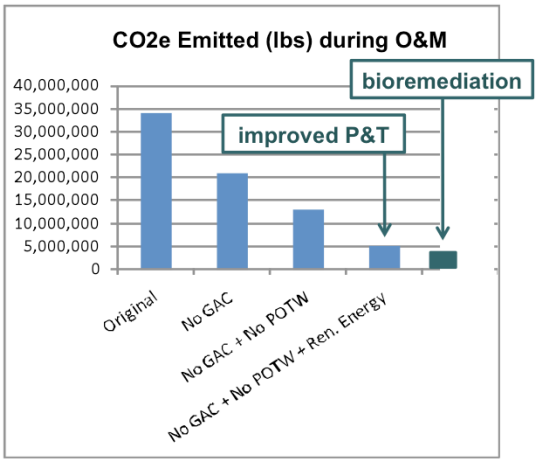
5

Conduct Sensitivity Analyses

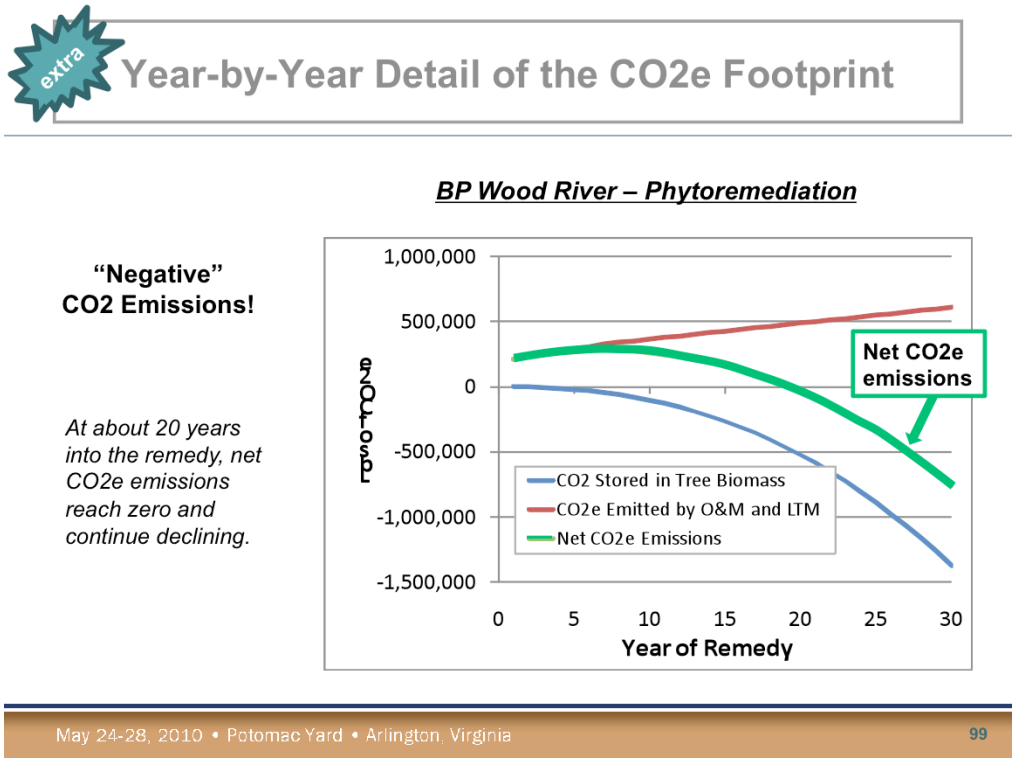
Each step down in the CO2e footprint is a result of:

- ***No GAC treatment of the groundwater before discharge to POTW***
- ***No GAC treatment and discharge to surface water instead of POTW***
- ***All the above, using renewable energy instead of grid electricity***

Romic East Palo Alto – Pump & Treat



In fact, the improved P&T remedy is estimated to have nearly the same CO2e footprint as the bioremediation remedy.



The green curve shows the net CO2e emissions for the phytoremediation remedy at BP Wood River.

Although the trees will be left in place indefinitely, we did not model the net CO2e emissions beyond 30 years, as the trees die off and carbon is returned to the atmosphere.

Observations

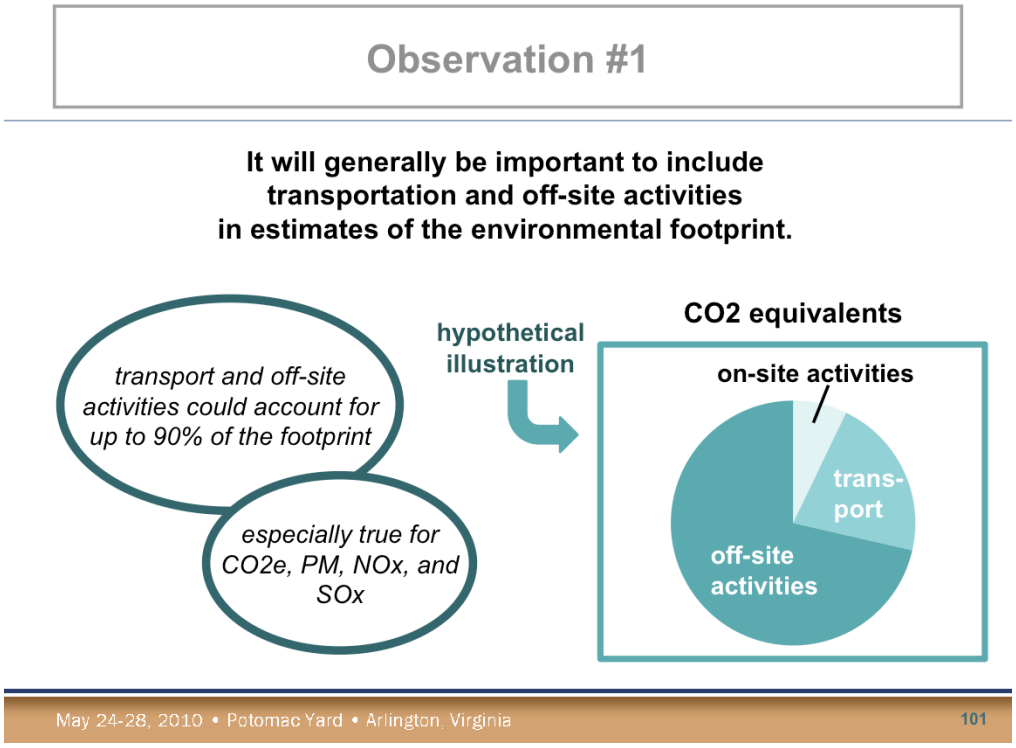
The following observations are based on the footprint analyses performed at the sites in this Pilot Study.

Different observations may result from conducting footprint analyses at other sites or for other remediation technologies.

We are beginning to draw many observations from the Pilot Study, all of which will be in the final reports on EPA's web page.

Following are 6 of the observations.

Keep in mind that different observations may result from conducting footprint analyses at other sites or for other remediation technologies.

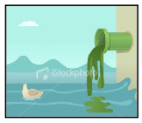


Of course, there will be exceptions to this “rule”.

For example, off-site contributions to the CO2e footprint may be very small for a phytoremediation remedy, or for a dig and haul where the hauling distance is short.

Observation #2

There may be "hidden" off-site contributors to the environmental footprints.



Wastewater treatment at a POTW

Reactivation of GAC

Laboratory analyses

These off-site activities may account for a significant portion of the footprints from site remediation.

********** *Background Notes* **********

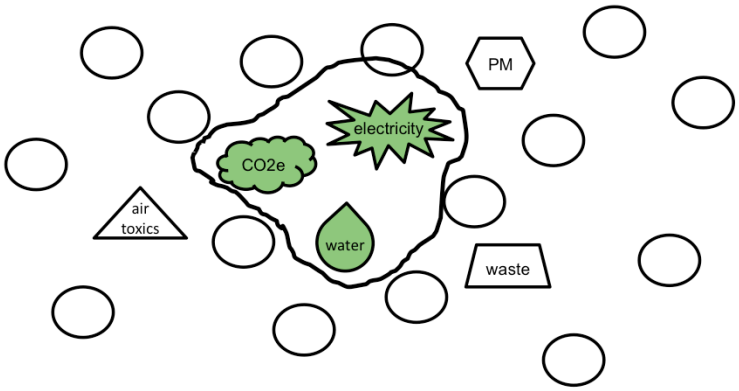
For Bioremediation at Romic, laboratory analyses accounted for about 20% of the CO2e footprint.

For Pump & Treat at Romic, wastewater treatment and reactivation of GAC accounted for about 50% of the CO2e footprint.

For Leachate Extraction at BP, wastewater treatment accounted for about 50% of the CO2e footprint.

Observation #3

Choice of environmental parameters for a footprint analysis can influence the apparent outcome.

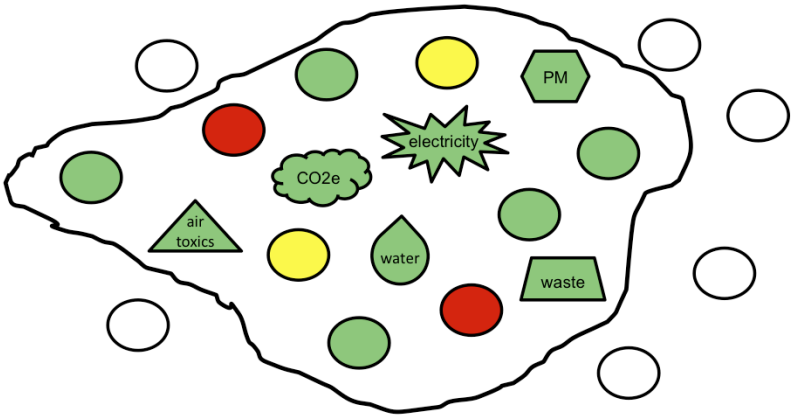


In our early footprint analysis at Romic, we included only 3 environmental parameters.

The bioremediation alternative had the smallest footprint for all three parameters.

Observation #3

Choice of environmental parameters for a footprint analysis can influence the apparent outcome.

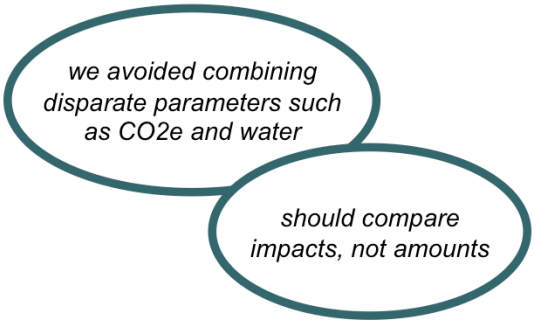


However, when we expanded the analysis from 3 to 15 parameters, we found the Bioremediation alternative had the smallest footprint for 11 of the 15, making the judgment of which alternative was “greener” a little more difficult.

The judgment depended on how the observer valued the various environmental parameters.

Observation #4

We did not combine environmental parameters into a single score for determining the "best" remedy.



Do not "combine" environmental parameters. This is because …

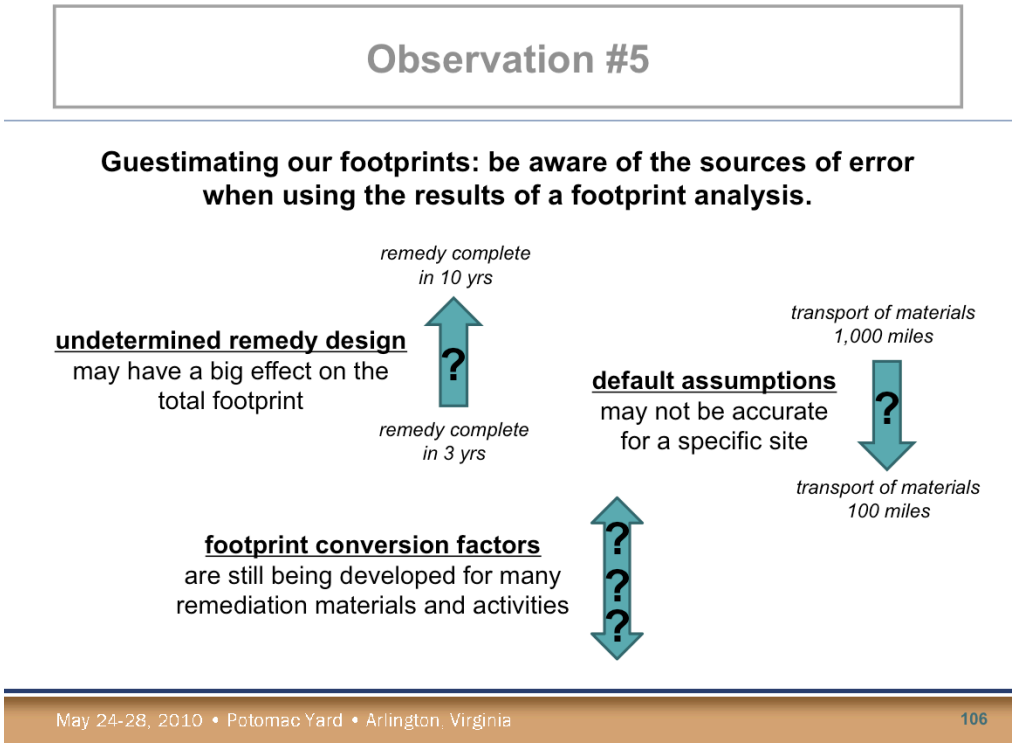
→ There is overlap in some of our 15 environmental parameters.

→ The parameters represent disparate items which do not have common denominators and so there is no clear basis for combining them.

If we wanted to combine the environmental parameters, we might first want to determine human health or environmental impacts resulting from these parameters. This would be the next step in a Life-Cycle Assessment.

We still think it's valuable to quantify the 15 environmental parameters for their importance to local communities and agency goals.

We would then consider each parameter in light of site-specific conditions, community interests, and global effects.



Keep in mind that results from the a footprint analysis are estimates.

Observation #6

Footprint analyses can provide useful information for reducing the environmental footprint of a clean-up during remedy optimization, and for improving remedy selection.

remedies must first be protective of human health and the environment

footprint analysis can then be used as a "balancing factor", not as a deciding factor

footprint analysis as a "balancing factor"

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Remedies must first be protective of human health and the environment.

Footprint analysis can then be used as a "balancing factor", not as a deciding factor.

Wrap-up

→ know your site

accurate inventory depends on a good understanding of the site and the activities involved in the remedy

→ know the questions you want to answer

streamline the footprint analysis by identifying the questions of most importance to the site and nearby community

→ one size does not fit all

be alert for “out of the ordinary” materials, activities, or emissions that may be part of the remedy at your site

→ consistent methodology is important

especially when comparing different remedies at one site, or compiling results of footprint analyses at different sites

Using Experience from the Pilot Study …

- ✓ **Conduct streamlined footprint analyses at selected clean-up sites**
  - reduce the environmental footprint for remedies already in place
  - provide information during remedy evaluation
- ✓ **Apply principles of the footprint analysis to our clean-up programs**
  - develop methodology for estimating environmental footprints

Reducing the environmental footprints of our clean-ups

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BP Wood River (Illinois)
Travis Air Force Base (California)

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EPA's Office of Resource Conservation and Recovery (ORCR)

Resources

Results of Pilot Study are posted at:

Romic East Palo Alto
http://www.clu-in.org/greenremediation/romic/

BP Wood River
http://www.clu-in.org/greenremediation/bpwoodriver/

Travis Air Force Base
to be posted January 2011

Questions and Comments to:
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Promoting Green Remediation

Reducing the Environmental Footprints of Our Site Clean-ups

Thank you for your time!

If you have additional questions or comments, please contact

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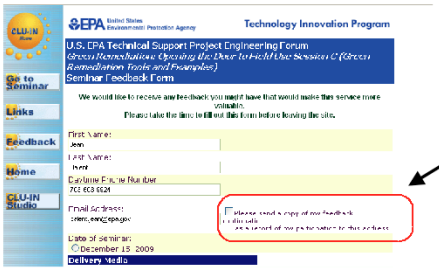
Resources & Feedback

- To view a complete list of resources for this seminar, please visit the **Additional Resources**
- Please complete the **Feedback Form** to help ensure events like this are offered in the future



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