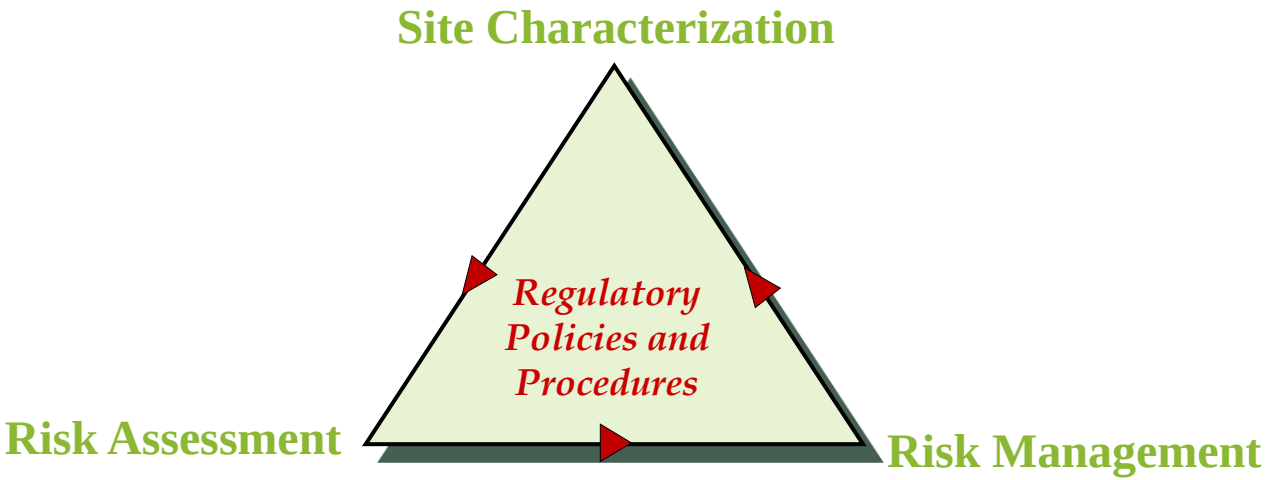
Sustainable Remediation: Why has the Idea Not Taken Off?



Atul Salhotra, Ph.D.
RAM Group, Inc.
5201 Evergreen St, Bellaire, TX
Tel: 713-784-5151
E-mail: asalhotra@ramgp.com

Land, Water, Air ….Our Earth

Treat the earth well
It was not given to you by your parents,
it has been loaned to you by your children.

We do not inherit the earth from our ancestors, we borrow it from our children.

~ *Ancient Proverb* ~

Hypothesis/thesis is…..

1. We are spending too much on remediation but not enough on the environment.

   Spending: Time, energy, water, ultimately translated into dollars!

2. Perhaps if we include the concept of "sustainability" in the management of contaminated sites, benefits to society will increase, without an increase in the spend.

Working hard vs. working smart

How can we do it?
Who will take the lead?

Our Cleanup Program

Early days

- Valley of drums
- Love Canal
- Leaking municipal landfills
- Acid mine drainage
- Rivers (unfishable and unswimmable)
- Deadly air pollution

Remediation Industry was born out of an atmosphere of crisis/public outrage/anger.
Focus became to prevent such occurrences and "clean"sites

How to clean & how much to clean?

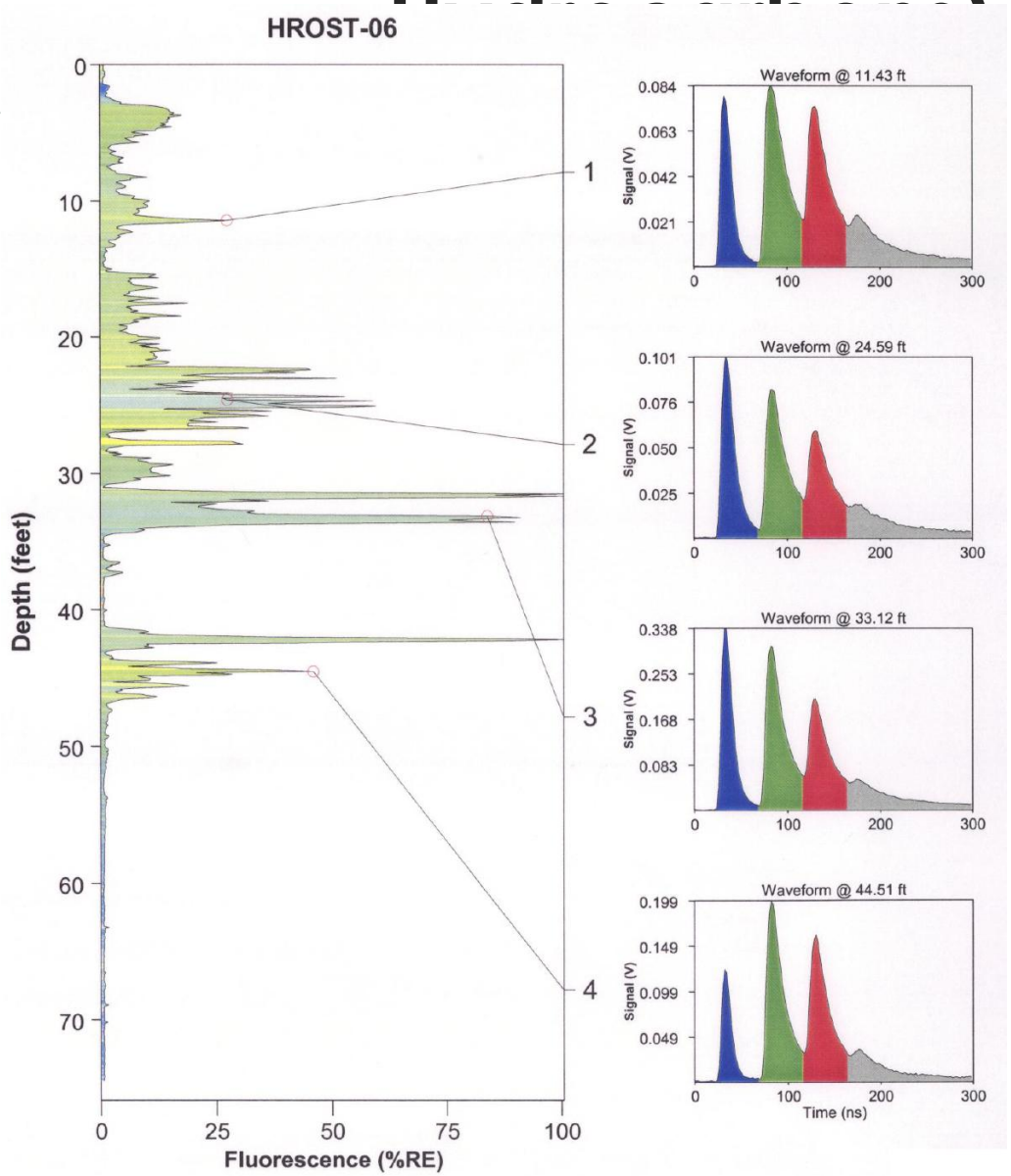
- Lack of technical knowledge
  - *Toxicity of chemicals*
  - *Behavior of chemicals in the multi-media environment*
  - *Measurement of concentrations*
  - *Data collection and analysis protocols*

- Lack of public awareness
  - *Rights of citizens*
  - *Corporate responsibility*

- Lack of regulations

US truly pioneered the management of contaminated sites

Example ROST Log (For Petroleum Hydrocarbons)



ROST: Rapid Optical Screening Tool

Consequences- Regulatory

- Several pollution control laws, policies, regulations, voluminous guidance documents developed by government, industry and trade organizations

- Environmental regulations have become increasingly complex, cumbersome and often conflicting
  (RCRA benzene vs. UST benzene has different standard!)

Living in 2019 with 1970's rules!

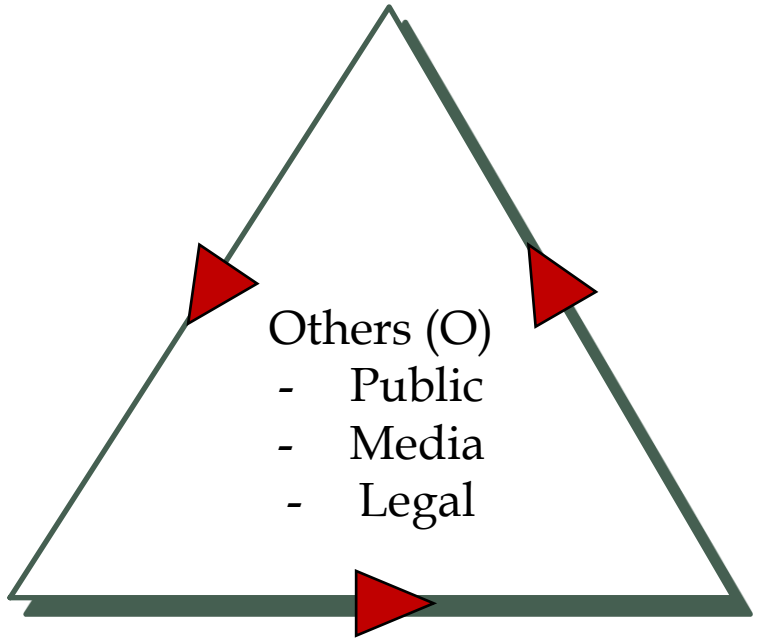
Variety Of Cleanup Programs

- CERCLA process
- RCRA process
- Voluntary cleanup process
- Brownfields process
- Underground Storage Tanks (UST)
- Dry clean sites program
- Department of Defense (DOD)
- Department of Energy (DOE)
- Other Federal Agencies

Urgent need for one cleanup process!

Remediation Industry
Managing Competing Interests

Regulator and regulations (R&R)



Responsible Party(PR)
- **Government**
- **Large corporations**
- **Individuals**

Service Providers (SPs)
- **Consultants**
- **Contractors**
- **Laboratories**

National Burden of Legacy Sites

- Thousands of sites
- Annual expense: 10 billion dollars per year
- 20-35 years to manage the legacy sites

Countries outside US are just beginning the process!

In the US the indiscriminate discharge of chemicals in the multi-media environment has been successfully curtailed

RBCA (1992): Fundamental Paradigm Shift

Conventional Approach:

- How much chemical mass can we remove?

RBCA Approach:

- How much chemical mass can we safely leave behind?
- How do we ensure that future generations are aware of the chemical left behind?

Tiered Analysis: Total Project Cost

Tier	Data Collection	RA	Monitoring	Remediation	Opportunity Loss
Tier 1 1 mg/kg	Low	Low	High	High	Low
Tier 2 5 mg/kg	Medium	Medium	Medium	Medium	Low
Tier 3 25 mg/kg	High	High	Low	Low	High

Total project cost must decrease as the project moves to higher tiers
All tiers meet target risk levels and other requirements

Tiered Approach: Unintended Consequence

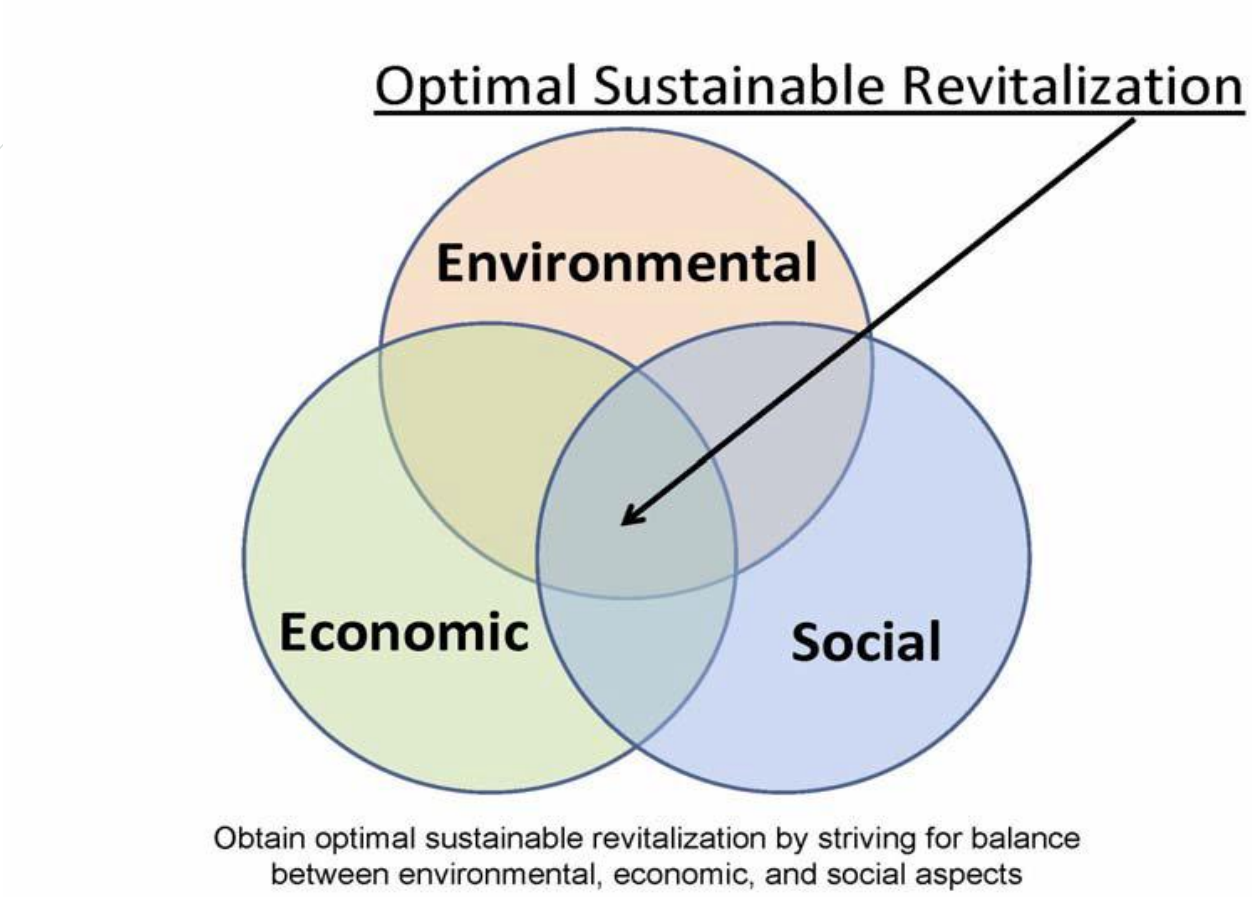
The SLs presented in the Generic Tables are chemical-specific concentrations for individual contaminants in air, drinking water and soil that may warrant further investigation or site cleanup……. **It should be emphasized that SLs are not cleanup standards**.

Site-Specific Cleanup levels

Who is motivated/responsible to develop and enforce site-specific levels?

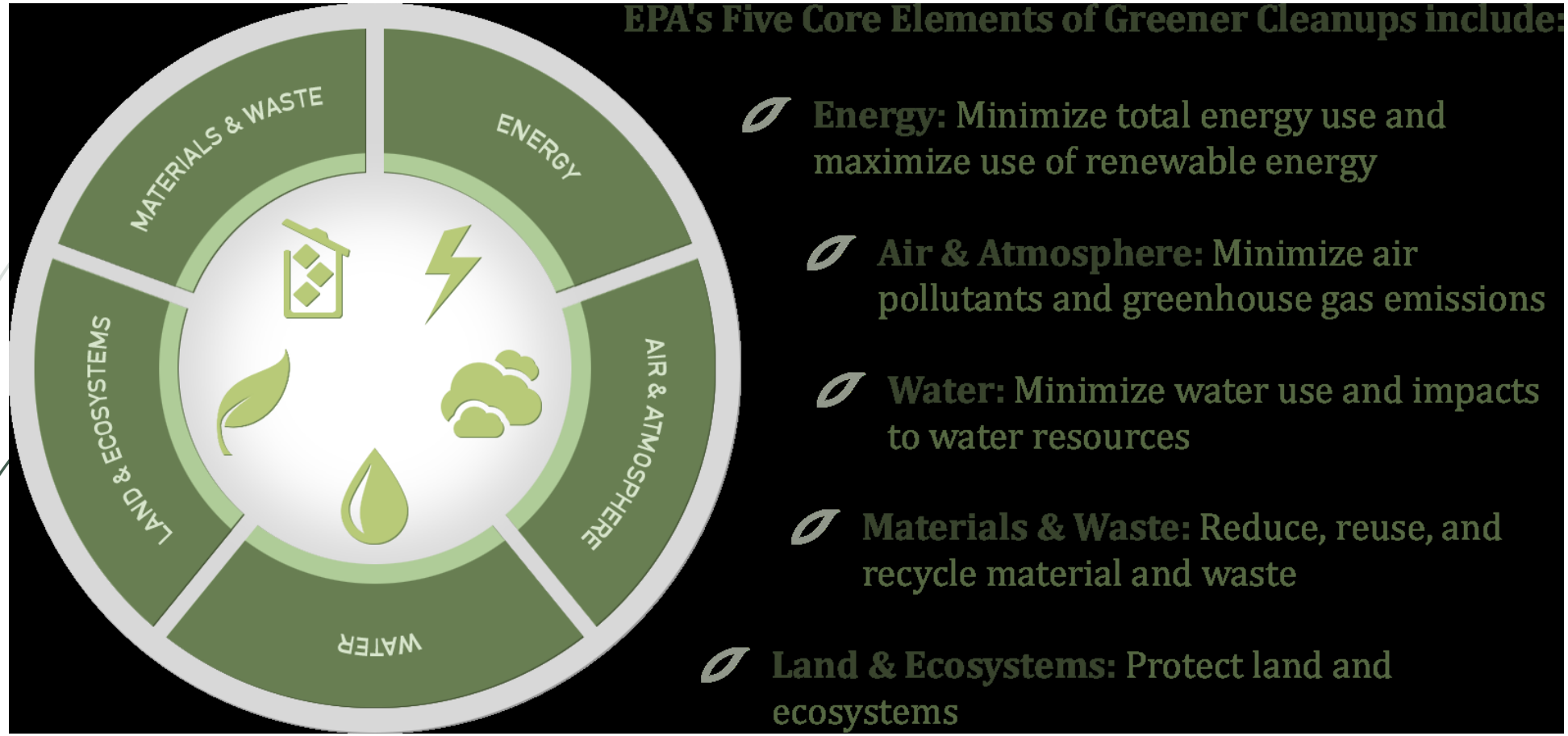
- Regulator?
- Responsible Party?
- Service Provider?
- Public?

Concept of Sustainability



Source:
CalEPA, 2009. Interim Advisory for Green Remediation. Department of Toxic Substances Control, California Environmental Protection Agency, December 2009.

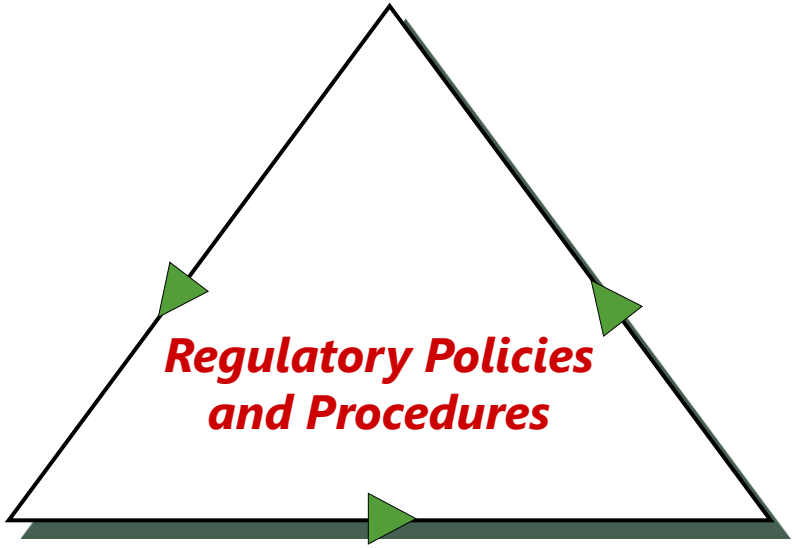
EPA's Five Core Elements of Greener Cleanups



Source:
USEPA, 2012. Green Remediation Best Management Practices: Overview of EPA's Methodology to Address the Environmental Footprint of Site Cleanup. EPA 542-F-12-023, March 2012.

Site Activities Required at Contaminated Sites

Site Characterization



Risk Assessment
- Explosive Conditions
- Human Health
- Environment
- Nuisance conditions

Risk Management
- Cleanup
- Institutional controls

Sustainable Remediation

- Understand the environmental footprint of each activity
- Mitigate the environmental footprint
- Factor in lifecycle “environmental costs”

At many sites we pollute more than we clean!

At many sites, the activities/costs are a huge burden to society and not-beneficial.

Sustainable Remediation: Many tools

- USEPA
- ITRC
- SURF
- Various state agencies
- International agencies

Many tools and frameworks available

Example Sustainable Activities

- Reduce the number of mobilizations
- Delineation is not absolutely necessary
- Reduce the excavations and off-site transport of soil
- Close sites with LNAPL if risk is acceptable
- Reduce monitoring number and frequency
- Use institutional controls
- Periodically evaluate effectiveness of remediation systems
- Educate the public to reduce/manage the outrage

Start with realistic end points!

Summary

- One cleanup program
- Do not accept DTLs or RSLs as the cleanup standards
- For hydrocarbons, use biodegradation as the default as opposed to no biodegradation.
- Include “sustainability” as a remedy selection criteria
- A day long seminar on the use of available tools

Land, Water, Air ….Our Earth

Treat the earth well
It was not given to you by your parents,
it has been loaned to you by your children.

We do not inherit the earth from our ancestors, we borrow it from our children.

~ *Ancient Proverb* ~