

Integrating Green Technologies and Strategies into Site Remediation

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California Department of
Toxic Substances Control

DTSC's Green Remediation Team

- **Initiated in February 2007**
- **Eight staff participate**
- **Meet routinely, work on deliverables in between meetings**

DTSC's Green Remediation Team

- **Initiative to promote the use of green technologies and strategies in site remediation work**
- **Green remedies and technologies are least disruptive to the environment, recyclable, and emit fewer pollutants and greenhouse gases to the atmosphere**

Green Remediation Team Goals

- **Define Green Remediation**
- **Develop Evaluation Tool(s)**
- **Develop Training for Staff**
- **Invite Technology Presentations**
- **Identify Incentives to use Green Technologies**
- **Publicize Efforts**
- **Legislative proposals**

Conventional Remediation

- **Focuses on Endpoints**
 - **Protect or restore water resources**
 - **Reduce or eliminate hazardous substance risk**
 - **Restore property to developable condition**
- **Remedies Not Always Sustainable**
 - **Natural resources extracted, used in project**
 - **Recycling, reuse of materials rarely considered**

Conventional Remediation (cont.)

- **Energy Use Not Considered**
 - **Transportation to and from site**
 - **On and off-site operations**
- **Greenhouse Gas, Other Substances Emitted**
 - **Heavy vehicle traffic**
 - **On-site construction**
 - **Long term remedy operations**

Green Remediation

- **Remains Endpoint Focused**
- **Examine Impacts Beyond Site Boundaries**
- **Considers Impacts Not Always Addressed Under RCRA, CERCLA**
 - **Consumption of energy, raw materials**
 - **Greenhouse gas and other emissions**
 - **Impacts over life of remedy**

DTSC's Green Remediation Team

- **Initially focused on alternative energy sources such as bio-diesel and solar**
- **Recognized the difficulty of separating the technology from the remedy**
- **Expanded our interests to include broader range of considerations in remediation and remedy evaluation**

DTSC's Green Remediation Team

- **Not facilitating the 'no action' alternative**
- **Not focusing on monitored natural attenuation**
- **Not facilitating capping and containment**

Early Efforts

- **Literature review produced limited results**
- **Needed to define 'Green'**
- **First cut at a basic rating matrix**

Early Matrix Factors

- **Energy Consumption**
- **Liquid and Solid Waste Production**
- **Air Quality**
 - **Regulated pollutants**
 - **Non-regulated pollutants, greenhouse gases**
- **Product Utilization, Including Recycling**

Early Matrix Factors (cont.)

- **Community Benefits**
- **Duration Required**
- **Treatment Effectiveness**
- **Life-Cycle Cost**
- **Worker Safety**

Lessons Learned from First Attempt

- **Too detailed, no system boundaries**
- **Discussions bogged down in the details**
- **Went back to the drawing board to find a 'better' approach**

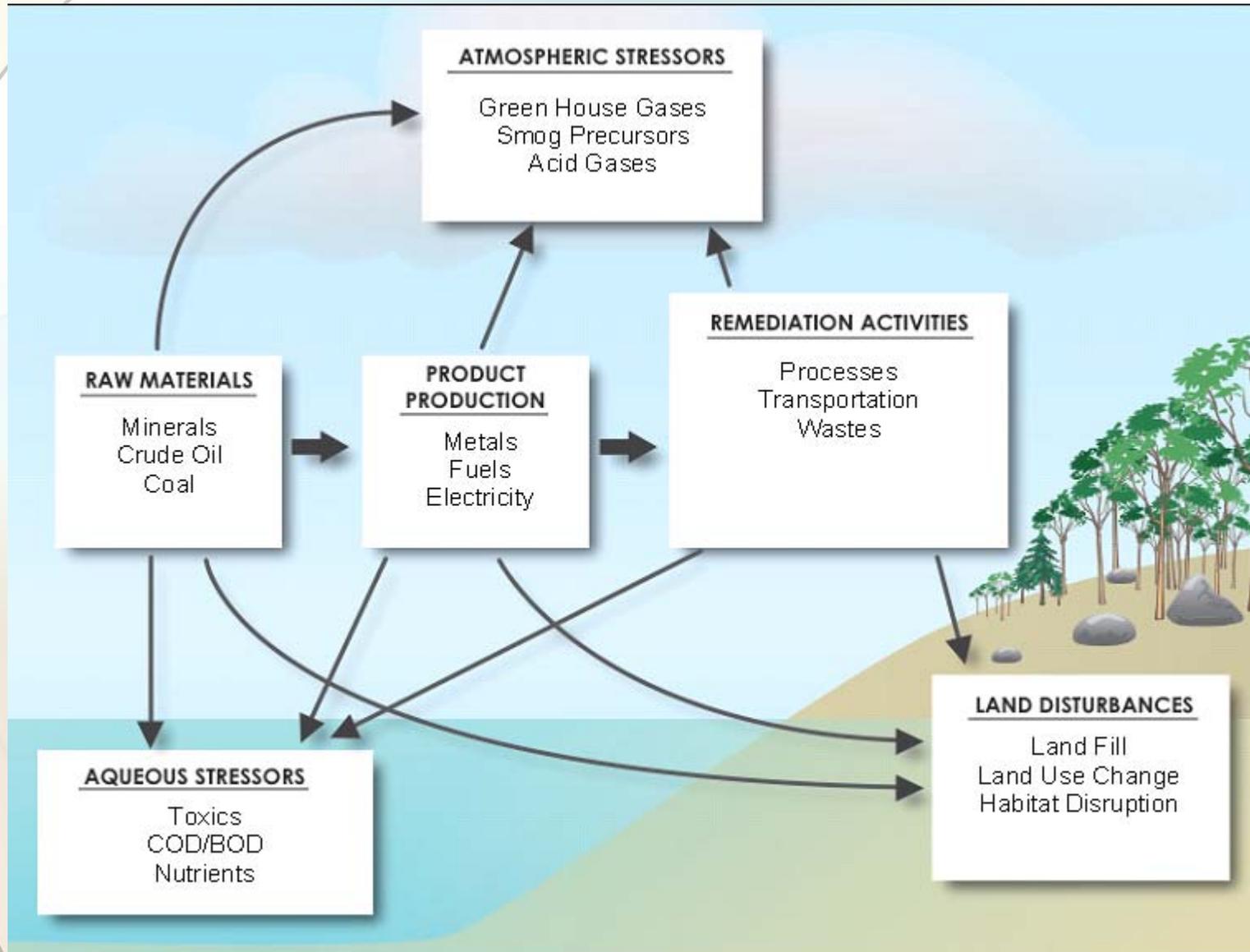
Life-Cycle Framework

- **Life Cycle Assessment – detailed, quantitative**
- **Life Cycle Management – not so detailed, qualitative**
- **Major Reference – Diamond and Page, Environmental Toxicology and Chemistry, 1999**

Life Cycle Assessment

- **Offers a methodology for 'cradle-to cradle' evaluation**
- **Considers on-site and off-site impacts**
- **Could become more cumbersome than other aspects of remedy process combined**

Life-Cycle Framework



Green Remediation Evaluation Matrix (GREM)

Stressors	Affected Media	Mechanism/ Effect	Y/N	Score
Substance release/production				
Airborne NO _x & SO _x	Air	Acid rain & Photochemical smog		
Chloro-fluorocarbon vapors	Air	Ozone Depletion		
Greenhouse gas emissions	Air	Atmospheric warming		
Airborne particulates/Toxic vapors/gases/Water vapor	Air	Gen Air Pollution/Toxic air/Humidity increase		
Liquid waste production	Water	water toxicity/sediment toxicity/sediment		
Solid waste production	Land	Land use/toxicity		
Thermal releases				
Warm water	Water	Habitat warming		
Warm vapor	Air	Atmospheric humidity		
Physical disturbances/disruptions				
Soil structure disruption	Land	Habitat destruction/ Soil Infertility		
Noise/Odor/Vibration	Gen Env	Nuisance & Safety		
Traffic	Land; Gen Env	Nuisance & Safety		
Land Stagnation	Land; Gen Env	Remediation time; Cleanup efficiency;re- development		
Resource Depletion/Gain (Recycling)				
Petroleum (energy)	Subsurface	Consumption		
Mineral	Subsurface	Consumption		
Construction material	Land	Consumption/reuse		
Land & space	Land	Impoundment/reuse		
Surface water & groundwater	Water, Land (subsidence)	Impoundment/ Sequester/reuse		
Biology Resources (Plants/trees/animals/microorganisms)	Air, Water, Land, Subsurface	Species Disappearance/ Diversity Reduction Regenerative Ability Reduction		

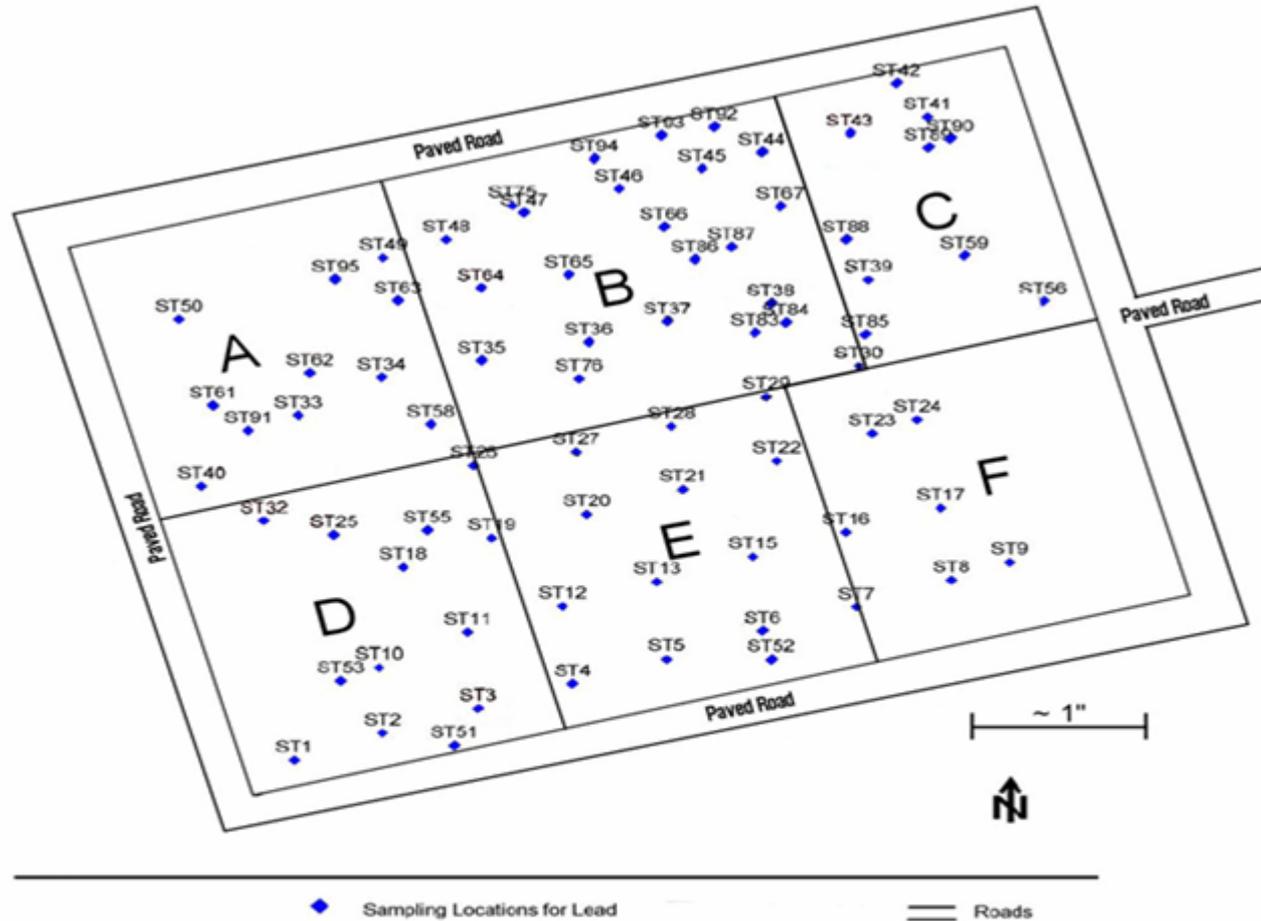
Next Steps

- **Finalize matrix, prepare guidance document**
- **Pilot Projects**
- **DTSC Symposium Planned February 2009**
- **Continue working with Sustainable Remediation Forum (SURF)**
- **Staff Training**
- **Potential changes – regulation, incentives?**

Pilot Project

- **Currently participating in a pilot project for a PCE site**
- **Considering energy and environmental parameters for site characterization**
- **So far, this appears to be the first look at sustainability in site sampling and characterization**

A Site Remediation Example – One Outcome



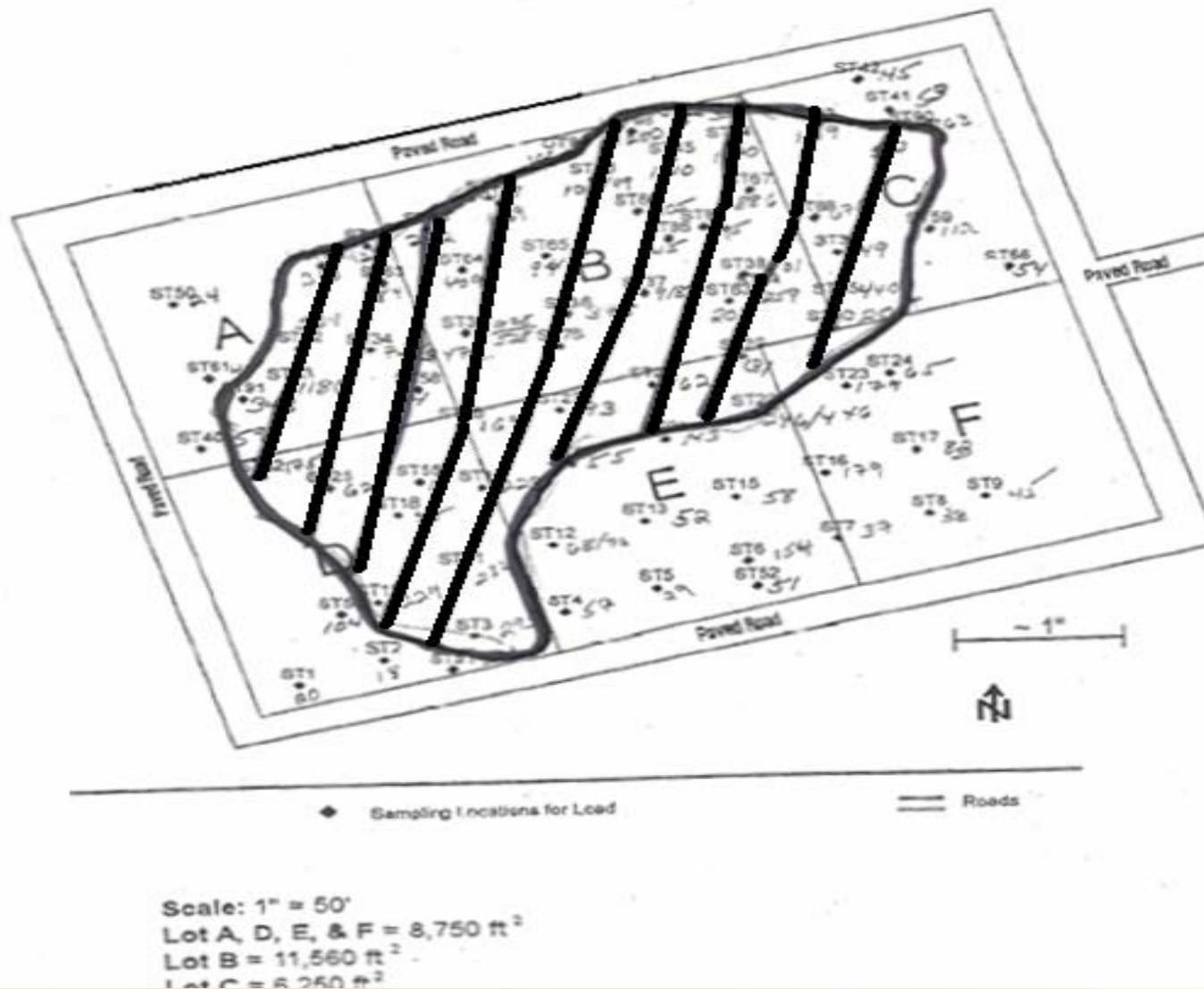
Scale: 1" = 50'

Lot A, D, E, & F = 8,750 ft²

Lot B = 11,560 ft²

Lot C = 6,250 ft²

Same Site – Another Outcome



References and Contact Info

- **Use of Risk Assessment in Management of Contaminated Sites; ITRC, Aug. 2008**
- **http://www.itrcweb.org/Documents/Risk_Docs/RISK2.pdf**
- **Paul Hadley**
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Where Do We Go From Here?



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