CVEN 4474/5474 Haz Waste Outline

- How clean is clean?
- Risk based corrective action (RBCA)

Three Common Approaches to Clean

- Return to background levels
  - Metals, inorganics -- vary with location!
  - Anthropogenic cmpds = 0 (can’t measure)
- Comply with ARARs
  - SDWA (MCLs or MCLGs), CWA, CAA,...
- Risk-Based criteria
  - Site average conc for “acceptable” chronic effects (1x10^-6, 1x10^-4,...)
  - Site max conc for safety from acute effects (<MRL)

Compliance at or Near Measurable Levels

- EPA certified lab analyses
  - Many detection limits of µg/L are near MCL values (the desired clean-up goal)
  - Lab certification if matche known concs of 6 of 7 VOC stds at >10 µg/L at ±20%
  - OR ±40% if <10 µg/L (or ±40% for any vinyl chloride conc)
  - Example: 2 µg/L MCL for VC; lab reports 2.5 µg/L -- violate! But may really have been 1.8

Compliance with Standards at or near measurable levels....

- How to include values below quantification in computing average concentrations at a site? (example)
  - Detection limit for VC 0.4 µg/L
  - Quantification limit 1.3-2.4 µg/L (* = BQL)
  - What is the average conc?
    - 2.1, 2.7, 1.5*, BDL, BDL
    - Eliminate samples < det limit = 2.1 µg/L
    - Below DL set at DL = 1.4 µg/L
    - Below DL set a 0 = 1.3 µg/L

How Clean is Clean at Rocky Flats?

- 1995 Future Site Use working group:
  - Soil to average bkg radiation level
  - (public) 0.04 pCu/g plutonium
- 1996 EPA, DOE, CDPHE interim stds
  - “radionuclide soil action level” (RSAL) 651 pCu/g soil plutonium
- 1999 “Risk Assessment Corporation” hired
  - Scenario: family living & ranching on site (future) RSAL 10 pCu/g plutonium
  - If open space or light industrial use 650 pCu/g ok
- RSAL at other sites, pCu Pu/g
  - HF 34, Johnston Atoll 15, Nevada Test site 200

BEST GOAL = ??

RBCA = Risk-Based Corrective Action

- Used at state and local sites inc. Brownfields and voluntary clean-up
- Possible for use at Superfund & RCRA corrective action sites
- Common for petroleum contaminated sites (LUST cleanup)
Example: BaP RSCL
- Risk-based soil clean-up level (RSCL)
- Assume: living on site, 100 mg/d ingested, and dermal contact
- Acceptable risk level $1 \times 10^{-5}$ for cancer
- $1 \times 10^{-5} = \text{Intake} \times \text{oral slope factor}$
- $1 \times 10^{-5} / 7.3 = [(\text{Cs} \times 100 \text{ mg/d} \times 1^1) / (\text{Cs} \times 3160 \text{ cm}^2/\text{d} \times 0.5 \text{ mg/cm}^2 \times 0.5 \text{ abs})] / 70 \text{ kg}$
- RSCL = $1.12E-7 \text{ mg/mg} = 0.11 \text{ mg/kg}$

Different states select different ARLs, etc.

Tier 1 Evaluation
- Look-up tables
- Exposure pathways
  - Air, top soil, soil leach to GW, GW
  - Residential vs commercial
  - "Target Levels" of specific compounds or cumulative

Tier 2 Evaluation
- More specific to site conditions, inc.
  - Distance from source to receptors
  - Soil type on site

Tier 3 Evaluation
- Contaminant fate modeling
- Need LOTS more data

Example of Tier 1 table

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Alaska</th>
<th>Arizona</th>
<th>Delaware</th>
<th>Kansas</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPH, mg/kg</td>
<td>150-3000</td>
<td>7000 R</td>
<td>24.5K NR</td>
<td>&lt;1000</td>
</tr>
<tr>
<td>BTEX, mg/kg</td>
<td>10-100</td>
<td>&lt;10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benz, mg/kg</td>
<td>0.1-0.5</td>
<td>47 R</td>
<td>197 NR</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Example Tier 1 Fla - more detail

<table>
<thead>
<tr>
<th>Comp</th>
<th>Resid Direct Contact</th>
<th>Work</th>
<th>Leach a</th>
<th>Leach b</th>
<th>Leach c</th>
<th>Leach d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benz</td>
<td>1.1</td>
<td>1.5</td>
<td>0.007</td>
<td>0.007</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>BaP</td>
<td>0.1</td>
<td>0.5</td>
<td>7.8</td>
<td>1.2</td>
<td>1.2</td>
<td>78</td>
</tr>
<tr>
<td>MTBE</td>
<td>350</td>
<td>6100</td>
<td>0.2</td>
<td>0.2</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Tol</td>
<td>300</td>
<td>2000</td>
<td>0.4</td>
<td>0.4</td>
<td>0.48</td>
<td>4</td>
</tr>
</tbody>
</table>
Brownfields - A Rational Approach to Clean-Up of Industrial Sites

- **Brownfield** = abandoned, idled or underused industrial or commercial facility where expansion or redevelopment is complicated by real or perceived environmental contamination
- **EPA “Brownfields Economic Redevelopment Initiative”**
  - empowers States, localities, etc. to work together to prevent, assess, safely clean up, and sustainably reuse brownfields
  - benefits are a cleaner environment, new jobs, and an enhanced tax base

**REMEDIATION METHODS**

- Generally need more than one method per site depending on “media” of interest
  - Soil
  - Groundwater
- “Treatment train” approaches may be used even for the same media
  - Multiple processes in series to target different contaminants (such as ion exchange then biodeg)
- 26% of Superfund sites have had a remedy change from initial ROD to implemented remedial action (RA)

**Groundwater Contamination at SF sites**

- 588 sites with pump & treat only (89%)
  - Poor for remediation but good for containment
- 39 sites with pump&treat and in situ treatment (6%)
- 26 sites with in situ treatment only (5%)
- In situ treatments: air sparging, natural attenuation, bioremediation

**Soil Contamination at SF sites**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>M cubic yds of soil</th>
<th>Ave cubic yds per site</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVE</td>
<td>29.11</td>
<td>237,000</td>
</tr>
<tr>
<td>Ex situ S/S</td>
<td>3.66</td>
<td>48,000</td>
</tr>
<tr>
<td>Ex situ biorem</td>
<td>2.97</td>
<td>80,000</td>
</tr>
<tr>
<td>On site incin</td>
<td>1.74</td>
<td>48,000</td>
</tr>
<tr>
<td>In situ biorem</td>
<td>1.35</td>
<td>79,000</td>
</tr>
<tr>
<td>In situ S/S</td>
<td>1.29</td>
<td>43,000</td>
</tr>
</tbody>
</table>

**More SF site data**

- 34 sites with population relocated (14,341)
- 121 alternate water supply (339,000)
- 330 site security
- 727 institutional controls
- 595 emergency removal actions
- Longterm: 1371 containment technology (more than 1 per site with operable units, etc.)