World’s Largest ISTD Project

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Why Listen?

- Scale challenges – how big can we go?
- $ saved – alternatives cost a lot more
- How to account for project uncertainties
- Why this is the most scalable thermal technology
3.2 Acre Treatment Area

PCE
TCE
DCE
CFC-113

10-10,000 mg/kg

30-50,000 lbs

Goal: 1 mg/kg
In Situ Thermal Desorption

$\theta$C

$t_1, t_2, t_3 = \text{temperature progression}$

$t_{1,2,3} = \text{temperature progression}$
907 heaters
35 MPE wells
116 horizontal SVE wells
80 TMP strings
Direct Push

$500,000 cheaper than drilling
Issues

[Images of a person handling a pipe, a close-up of a rusted pipe, and a close-up of ground with rocks and debris]
Shallow Water Table

Contingency: 35 MPE wells
Water removal from horizontal wells
Groundwater Influx
Impact of water flowing in

![Graph showing the relationship between groundwater inflow (m³/hr) and duration (days) on the x-axis, and energy usage (million kWh) on the y-axis. The graph includes two lines: one for duration (days) and another for energy (million kWh).]
Hydraulic barrier
11 MW power supply
Vapor flow 3,000 scfm (4900 m³/hr)

Water treatment 50 gpm (11 m³/hr)

30,000 lbs COCs
CFC-113
NJ DEP regulations
Neighbors
When are we done?

1. Temperatures
2. Mass removal
3. Soil concentrations
80 vertical temperature profiles
Extracted vapor temperatures
Cool zone in road and across T-7 area (wet)
30,000 lbs (13.5 tons)
Soil Sampling

Total number of borings:
- 58 per plan, 5 ft sampling intervals
- 65 (including repeat borings)
Final soil concentrations

<table>
<thead>
<tr>
<th>Compound</th>
<th>Soil concentration (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroethane</td>
<td>0.01</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>0.01</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td>10</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>100</td>
</tr>
<tr>
<td>1,1-Dichloroethylene</td>
<td>1000</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>10000</td>
</tr>
<tr>
<td>cis-1,2-Dichloroethylene</td>
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<tr>
<td>trans-1,2-Dichloroethylene</td>
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</tr>
<tr>
<td>Freon-113</td>
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<tr>
<td>1,1,1-Trichloroethane</td>
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<tr>
<td>Vinyl Chloride</td>
<td>1000000000</td>
</tr>
<tr>
<td>Benzene</td>
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</tr>
</tbody>
</table>

Sitewide Max. Initial

Sitewide Max. Final

Remediation Goal
Energy balance

- Actual ISTD energy input
- Modeled ISTD energy input
- Modeled energy net in
- Modeled energy as steam out
- Modeled energy as heat loss
- Modeled energy as water out

Cumulative energy (kWh) vs. Duration (days)

Took longer
Used less energy than modeled
You always ask…

Cost per cubic yard - $15 million / 122,300 cy = $120 per cubic yard

How much energy – 249 kwh/m³ = 174 kWh per cubic yard

29,800 lbs of COCs removed - $503 per pound

BUT:

Excavation was the only other alternative

Excessive cost

Shallow water