Integrated Strategy to stimulate application of *in-situ* remediation approaches

Hans van Duijne

*Geological Survey of The Netherlands*

TNO Built Environment and Geosciences
Subsurface and Groundwater
The Netherlands

RemTech 2007, Banff, Canada
October 24-26, 2007
Contaminated sites in The Netherlands per municipality - 2005

Area: 42,000 km²
Population density: 481 persons/km²
Gas Works Facility (1962)
Number of Potentially Contaminated Sites per Municipality 2005

- Total Surface: 41,526 km²
- 600,000 sites are suspected of soil pollution
- 58,000 need remediation
- 12,000 urgent remediation (< 2015)

Soil and Groundwater Remediation: More than just technologies

Budget NL 0,5 B€/yr

Non-sustainable Innovation Sustainable

Crisis ’70 – ‘80

Conventional clean up Technology Sustainable Management

+ in-situ + MNA +

Policy Single sites Mega sites

Costs B€

Time Required to implement

1995 1997 1999 2001 2003


2015

WFD National

RemTech 2007, Canada; hans.vanduijne@tno.nl
Brief History

Lekkerkerk 1980

<1980

• No soil policy
• No funding
• No awareness

>1980

• Legislation
• Inventarisation of the problem
• Remediation
• Soil Contamination perceived as risk

• 1983 Soil Remediation Law
• 1995 Soil Remediation in Soil Protection Law
• 2005 New Policy in Soil Protection Law
• 2007 New Policy in Soil Protection Law

RemTech 2007, Canada; hans.vanduijne@tno.nl
Lack of confidence in-situ remediation technologies

- In-situ techniques not fully matured
- In-situ techniques insufficiently demonstrated in back yard
- No standardized approach to remediate common situations

- Mind set of competent authority/regulators lacks confidence in in-situ techniques:
  - “Outcome uncertain and risks difficult to manage”
  - Insufficient flexibility to deal with risks and uncertainties
  - Processes (authorisations etc.) with soil remediation too complex (many stakeholders, red tape)
  - Lack of knowledge and experience at daily practice level
Why Holland In-situ Program (HIP)?

Growing attention in (sub-)urban brownfields to:
- Provide building space in a densely populated area
- 600,000 contaminated sites, 90% in urban environment

- Ministry of Environment adjusted its policy for the soil remediation plan until 2030
  - Adopting risk based approach: only the “immediate risk” sites to be remediated
  - Risk driven clean-up plan:
    - 15,000 high priority risk sites, in 10 years
    - 60,000 risk carrying sites, in 30 years
- Shallow contamination needs to be remediated;
  - Targets made flexible (land use, costs and risks)
  - Industrial sector oriented programs
  - From 900 to 2000 sites/yr remediated
Innovation added to full scale projects

- Duration 3 years (2007-2010), 24 in-situ projects,
- 10 contracting firms with financial contribution
- Biological-, physical-, and chemical technologies and combinations
- Development of standardized in-situ technologies for situations with a high occurrence (a high repetition factor, low costs, good market position)
- Process pilots
- Decision support tool - Soilection
Towards standardized reliable and accepted in-situ technologies: the “Holland In Situ Demo” project (HIP).

<table>
<thead>
<tr>
<th>Site Characteristics</th>
<th>Occurrence (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contaminant type (C)</strong></td>
<td></td>
</tr>
<tr>
<td>C.1 Chlorinated Hydrocarbons</td>
<td>45</td>
</tr>
<tr>
<td>C.2 Aromatics/Oil/MTBE/Cyanide</td>
<td>45</td>
</tr>
<tr>
<td>C.3 Other</td>
<td>10</td>
</tr>
<tr>
<td><strong>Geo-hydrology (G)</strong></td>
<td></td>
</tr>
<tr>
<td>G.1 Permeable (sandy)</td>
<td>45</td>
</tr>
<tr>
<td>G.2 Layered, permeable and impermeable layers</td>
<td>45</td>
</tr>
<tr>
<td>G.3 Other</td>
<td>10</td>
</tr>
<tr>
<td><strong>Built Environment (B)</strong></td>
<td></td>
</tr>
<tr>
<td>B.1 Urban</td>
<td>70</td>
</tr>
<tr>
<td>B.2 Industrial</td>
<td>25</td>
</tr>
<tr>
<td>B.3 Other</td>
<td>5</td>
</tr>
</tbody>
</table>
HIP technical pilots

• In situ bioremediation of a creasote contaminated site by DNAPL extraction and stimulated biodegradation

• Example of a suite of in situ technologies at a dry-cleaning contaminated site in the Netherlands

• Monitoring enhanced anaerobic bioremediation at contaminated sites in the Netherlands; The use of specific monitoring tools
Mega Site Approach – Rotterdam project

In-Situ Remediation Approach

Contaminant Source → Plume → Receptor

Remediation Approach
- Cost-effective technologies
- Split source and plume remediation

Figure 4.2. Classical contaminant conceptual model.

Chapter 4 – p. 5

RemTech 2007, Canada; hans.vanduijne@tno.nl
Integrated Management Strategy

1. Identifying Risks (Site Characterization + Risk Assessment)
2. Determining the degree of contamination removal required
3. Calculation of necessary investments
4. Selection of most cost effective scenario

Possible Significant Effects on GWQ; time frame, 2020-2060. Contribution NA??

Significant Effects on GWQ; time frame, 2005-2040

No significant Effects on SWQ
3rd plane of compliance
Regional Groundwater flow
2030: Chance of exceeding intervention value at 3rd Plane of Compliance
Autonomous scenario (impact on POC 3)
Scenarios for effect of risk management measures (e.g. source removal, NA, Isolation)

**Effect of scenario A**
(impact on 3rd plane of compliance)

- **Scenarios**
  - **Autonomous**
  - **Scenario A**

Active measures start in 2005

17.5 M€/y

% of length impacted above I-value

RemTech 2007, Canada; hans.vanduijne@tno.nl
Soil and Groundwater Remediation: More than just technologies

Budget NL 0,5 B€/yr

Time Required to implement

1995 1997 1999 2001 2003

Non-sustainable

Innovation

Sustainable

Conventional clean up

Technology

Sustainable Management

Policy Single sites Mega sites

 costs B€

Crisis ’70 – ‘80

WFD National

RemTech 2007, Canada; hans.vanduijne@tno.nl