



Remediation project 'Dellen Wuyts'

Field experiences & results

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Turn key, Design & Construct project



Remediation project 'Dellen Wuyts'

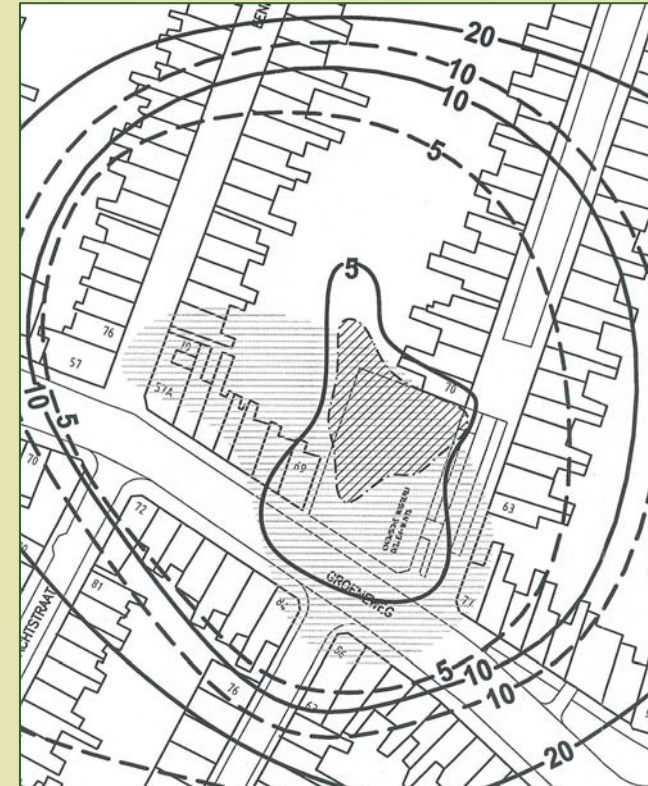
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Remediation project 'Dellen Wuyts'

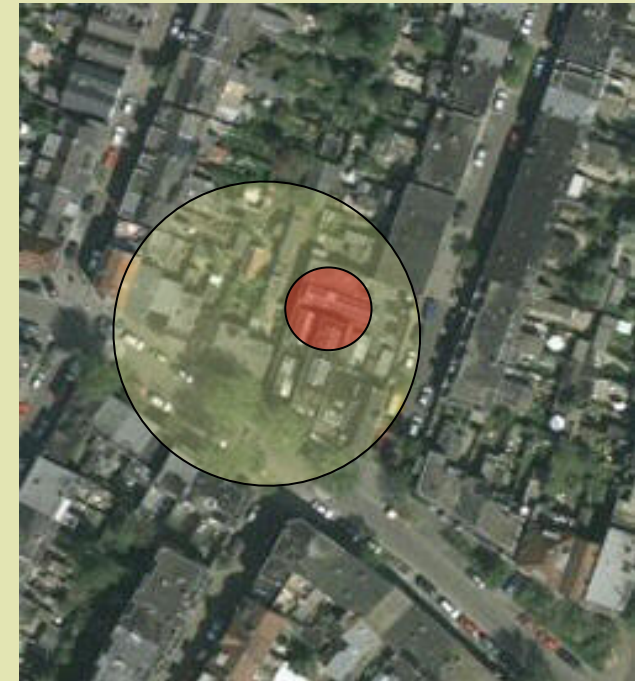
Site Characteristics

- Former dry cleaner
- Urban environment
- Soil type: sand, silty. Water table at ca. 2,5 m-bs
- Estimation: >5.000 kg product
- Max. 20-30.000 µg/l
- Horizontal distribution: ca. 10.000 m²
- Vertical distribution: ca. 70 m
- Sanitation goals:
 - PCE 20 µg/ltr
 - TCE 250 µg/ltr
 - DCE 10 µg/ltr
 - VC 2,5 µg/ltr
- Sanitation depth until 10 m-bs



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Side Characteristics - photo impression



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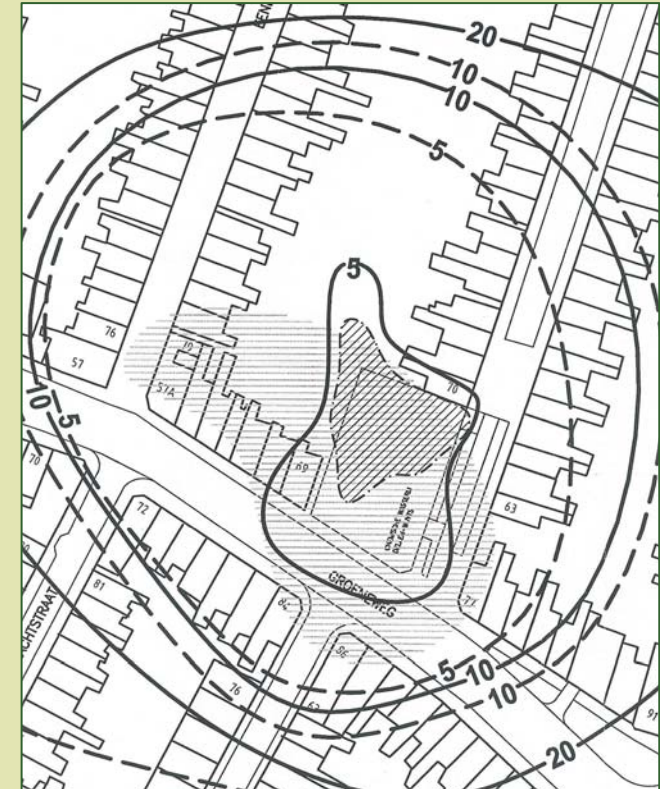
Combination of remediation techniques

Source area:

- Excavation unsaturated zone - source area
- Soil vapour extraction
- Chemical oxidation - Fenton's reagents

Plume & remaining source area

- Stimulation of natural degradation





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Filter plan chemical oxidation & soil vapour extraction





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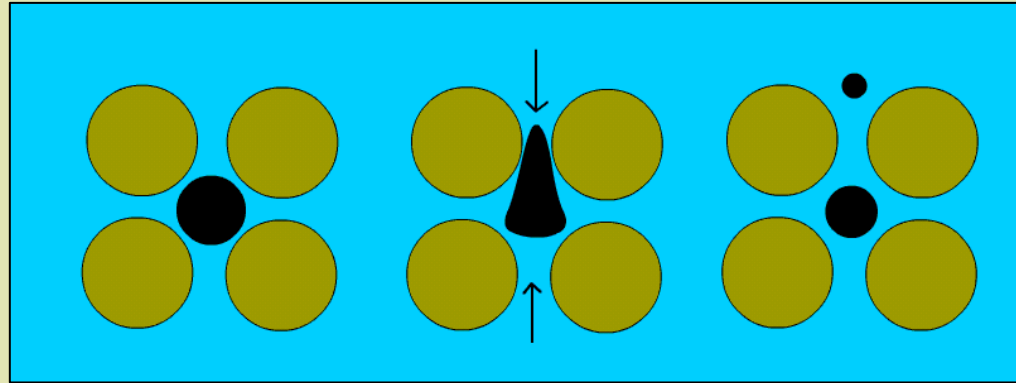
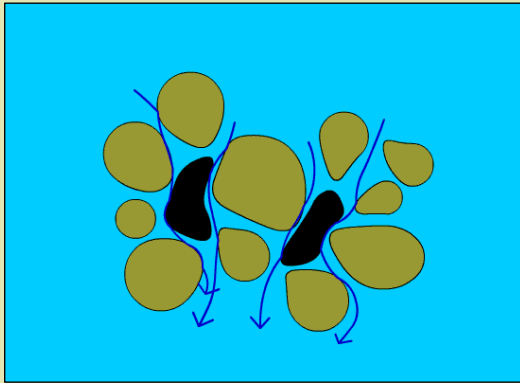
Acoustic, sonic Effects?

- After placing of ca. 70 ISCO filters
- Placed by Sonic Drilling
- Unexpected, worrying results
- Increase in concentration: factor 7-12

Effects Acoestic remediation Dellen Wuyts					
filter	actualisation survey	after acoustic enhancement * after 3th injection round			
	7	12.000	n.b.	61.000	*
	9	1.350	n.b.	5.060	*
	10	39.700	n.b.	81.500	*
	11	24.300	n.b.	5.300	*
	201		150.000		
	201		150.000		
	204		240.000		
	205		140.000		
	208		240.000		
	401		170.000		
	403		160.000		
	408		190.000		
	410		53.000		
	502		50.000		
	602		130.000		
	604		100.000		
	606		88.000		
	612		2.200		
	701		210.000		
	801		200.000		
	809		120.000		
	810		210.000		
	average:	19.338		144.622	
	av. increasement (factor):			7	
	max. increasement (factor):			12	
	n.s. not analysed				

Remediation project 'Dellen Wuyts'

Acoustic, sonic Effects?



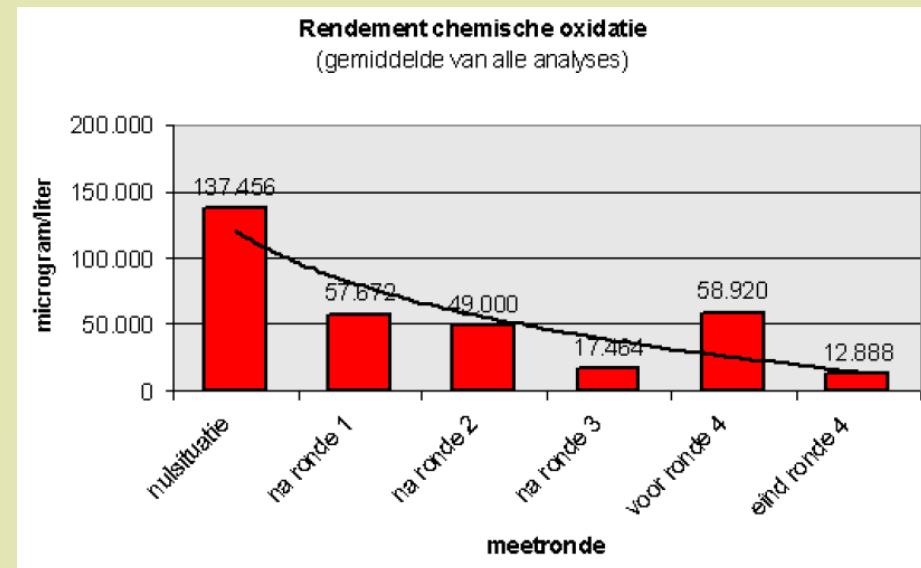
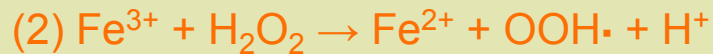
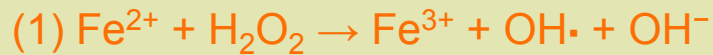
Results:

- To meet sanitation goals: need for a much more intensive source area treatment
- A much higher remediation result / efficiency
- Start of further 'acoustic' pilot studies, together with TNO (Dutch Research Institute)

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Chemical oxidation in source area

- Using Fenton's Reagents
- Four oxidation rounds - dec '03 - sept '04 (in stead of two)
- Results: >90% reduction



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Chemical oxidation in source area

- Natural gas condensates (Oosterhout - Netherlands)
- Other volatile oils (Antwerp - Belgium)
- Btex (Roermond - Netherlands)
- Chloride compounds (Saint Pazanne - France)



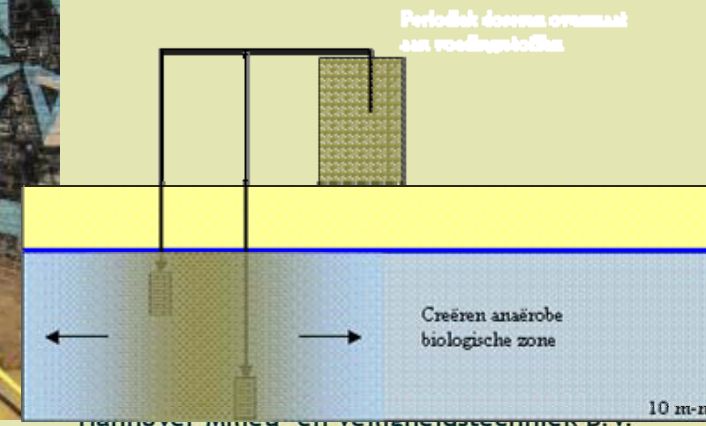


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Enhancement biological degradation

- Remaining source area & plume area
- 1st Shock load injection of molasses (Jan '05)
- Including 'enting the site with water from an other site with high concentrations of dehalogenating bacteria
- 2nd Shock load injection of ENNA (June '05)

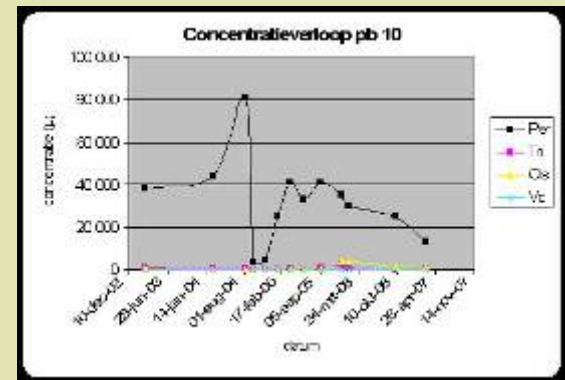
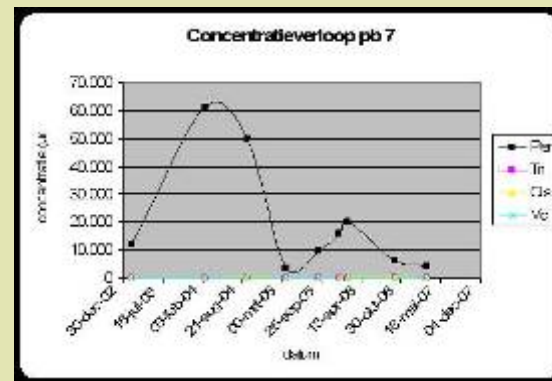
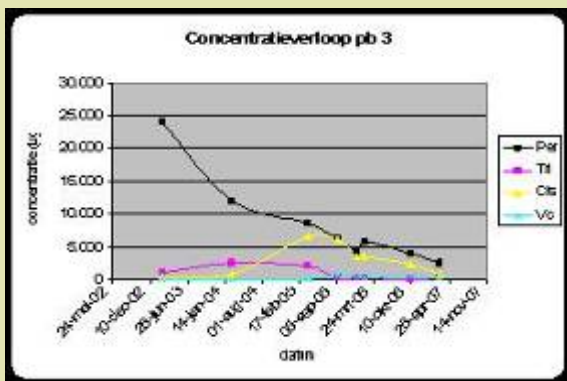
ENNA: very fine emulsion of Soya-oil (long lasting carbon source)



Remediation project 'Dellen Wuyts'

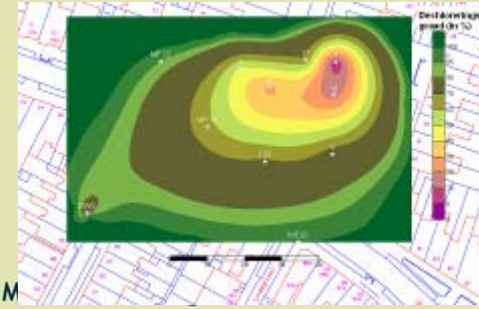
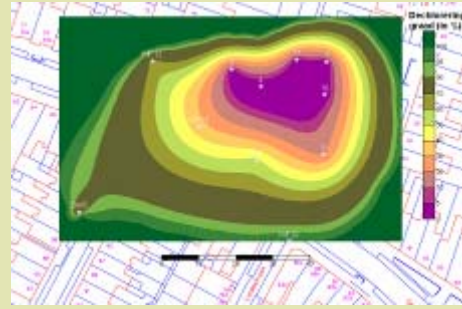
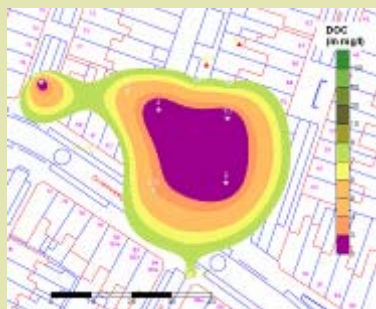
Enhancement biological degradation - results

- Clear improvement of 'degradation environment' (DOC)
- Clear increase in harmless rest products (ethene, ethane)
- Spreading of pollutants is stabilized



DOC after ISCO and after shock load

Dechlorination index after ISCO & stimulation NA





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Thanks for your attention !

Klaas de Jong

Questions?