In-situ bioremediation of Chlorinated Solvents in source areas

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Topics

- Introduction BioSoil
- General intro to in-situ bioremediation of Chlorinated Solvents
- Case 1: Remediation project in Germany
- Case 2: Remediation project in Finland
- Case 3: Remediation project in Italy
- Case 4: Remediation project in the Netherlands

Introduction BioSoil:

- All round remediation company, highly specialised and experienced in aerobic and anaerobic biodegradation
- World Wide solutions for soil and groundwater contaminations, e.g. Chile, Germany, Brazil, Japan, Italy, England, Finland etc.
- Offices in Germany and Chile, Joint Venture in Canada (AIM Environmental)
- Treatment of contaminants: oil, BTEX, PAH's, VOCH, metals etc.
- Clients various multinationals, Shell, Philips, VOPAK etc
- BioSoil will take on remediation projects risk based with a guaranteed end result.
- R&D department, about 10% of personnel

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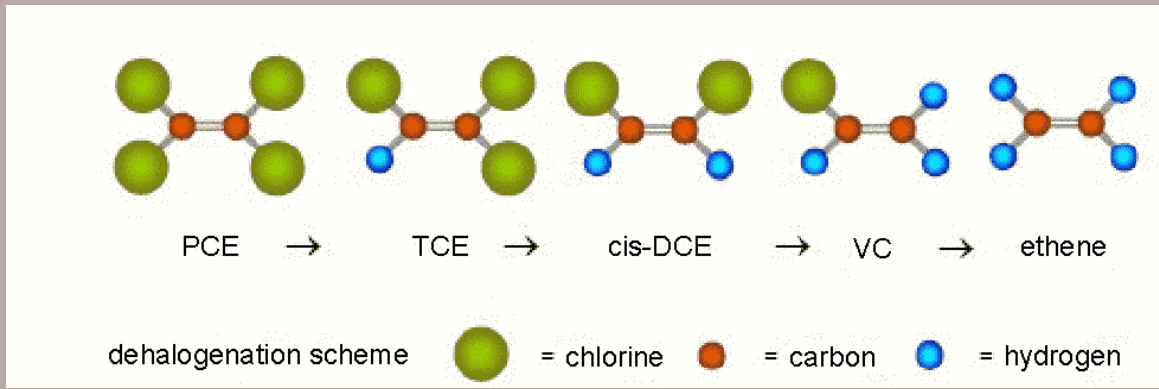
General Intro In-situ anaerobic Bioremediation of Chlorinated Solvents:

- Chlorinated solvents like PCE and TCE can be degraded:



- BioSoil uses an active circulation process to distribute the electrondonor in the subsurface, in-situ remediation is all about distribution
- BioSoil uses as electrondonor, the in-house developed Percol®
- In a biological active system mobilisation of the contamination from free phase to watery phase will increase with 7-14 fold.

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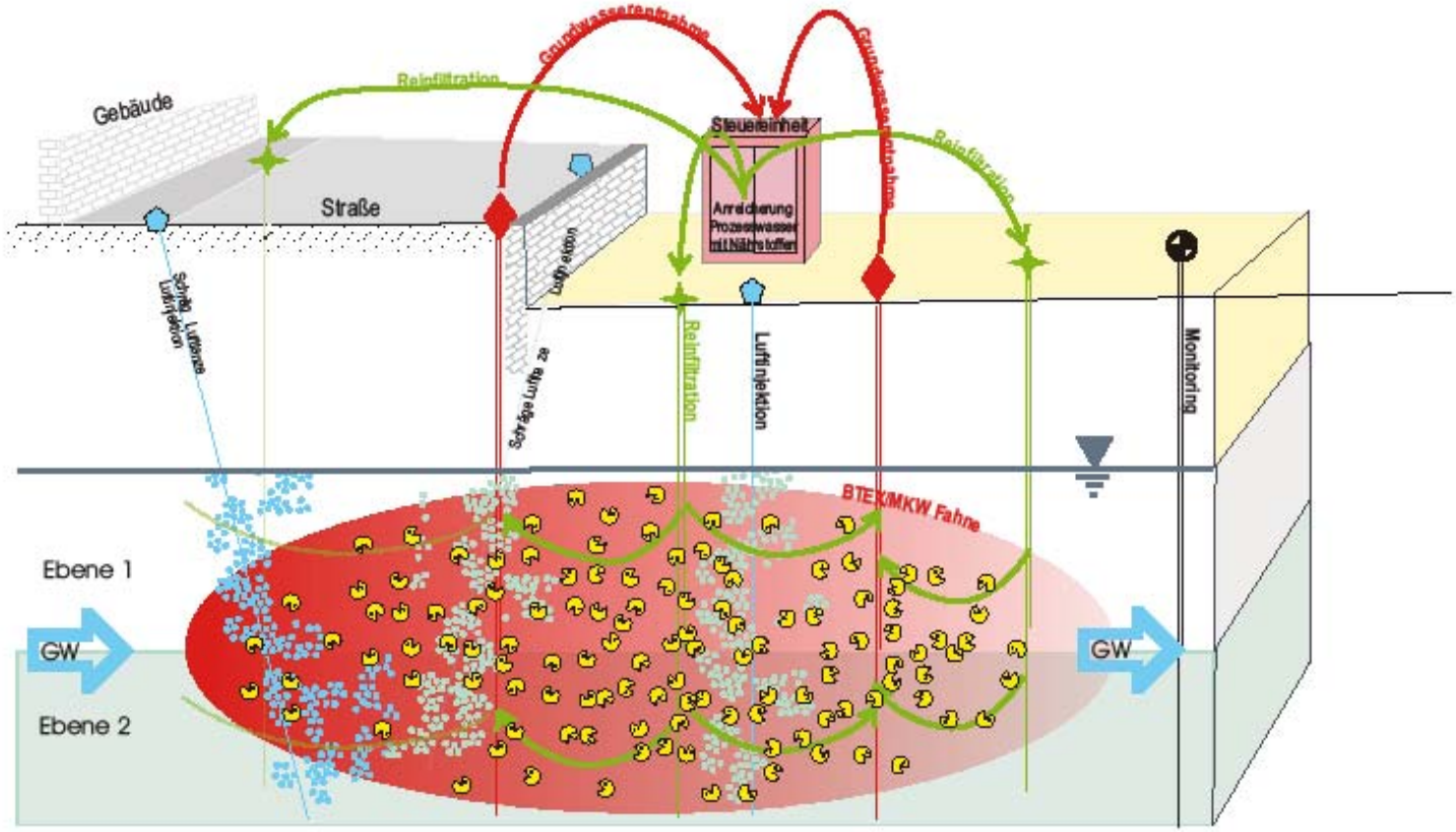
The Soil is the Bioreactor



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Case 1: Bioremediation project in Germany

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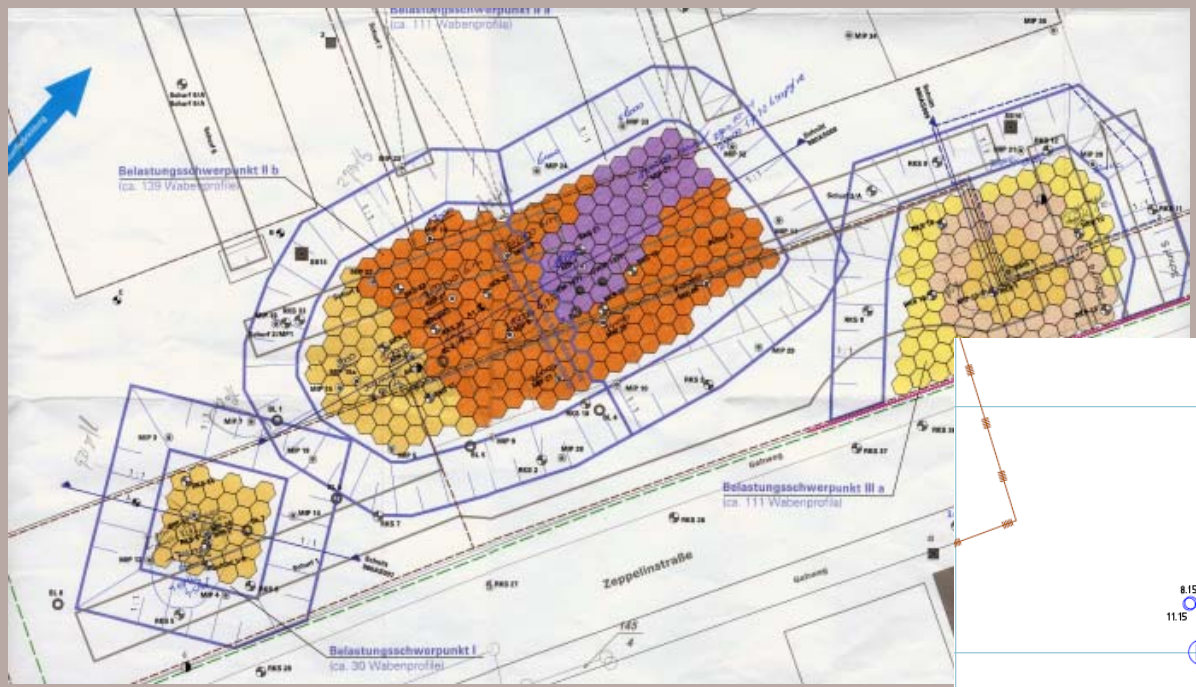
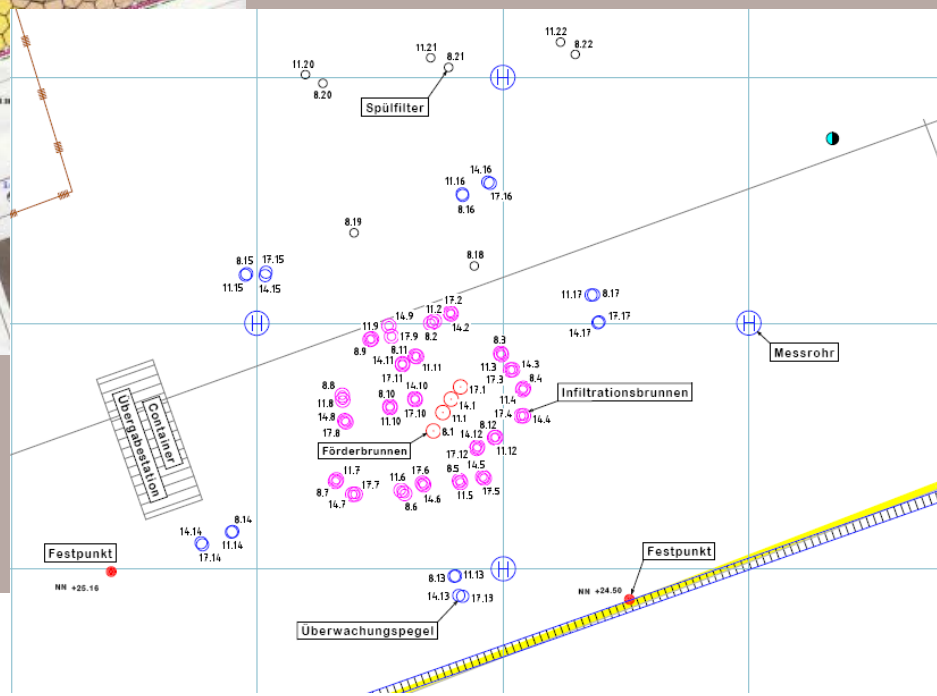
Location Remediation project and system





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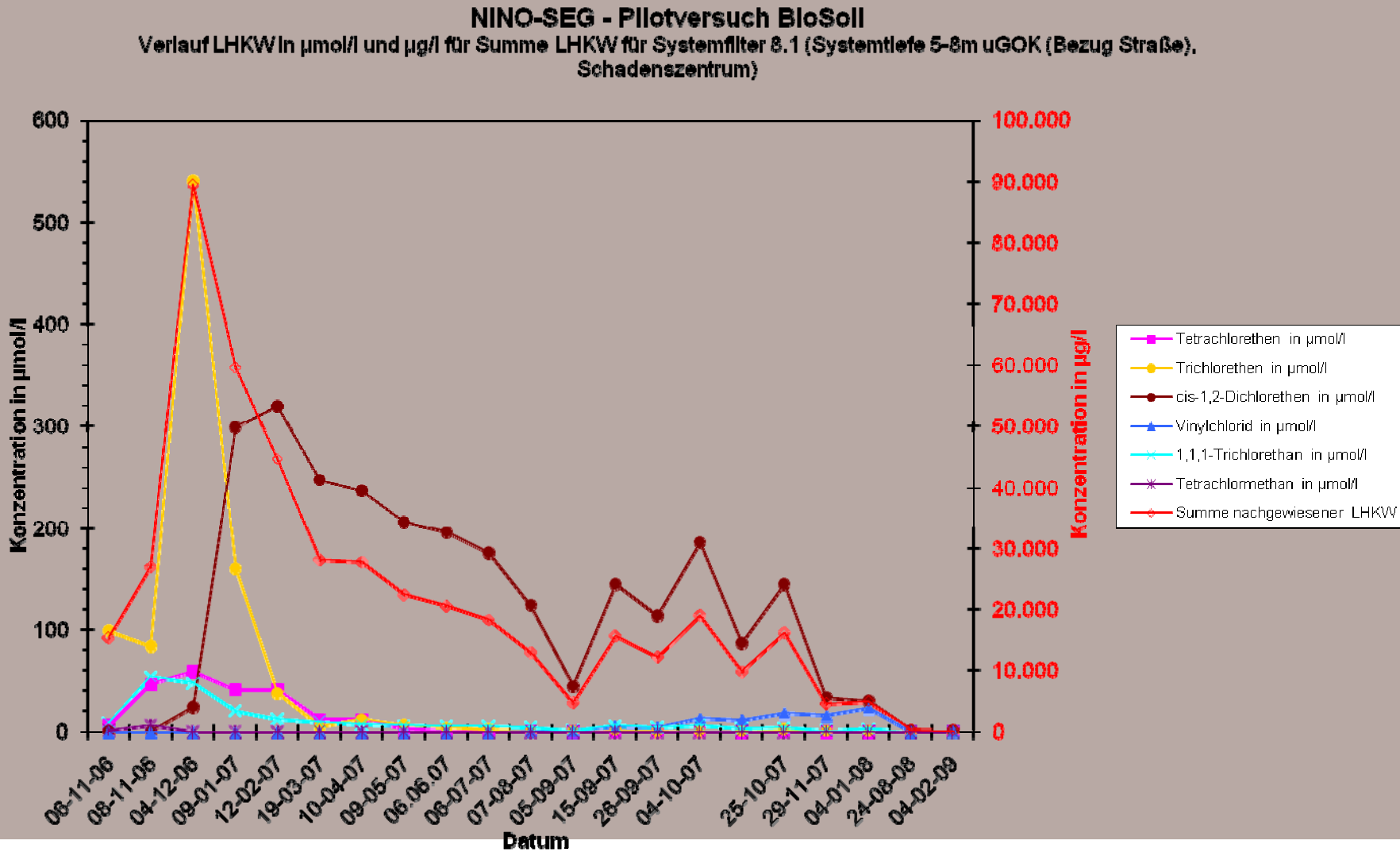
Results



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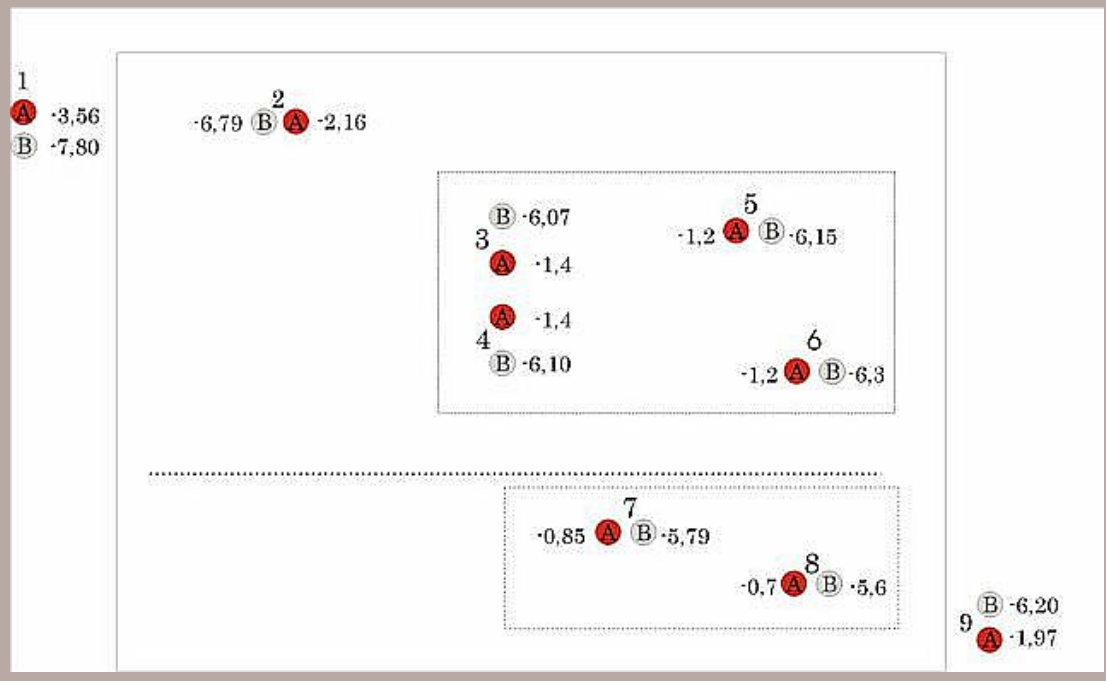
Case 2: Remediation project in Finland



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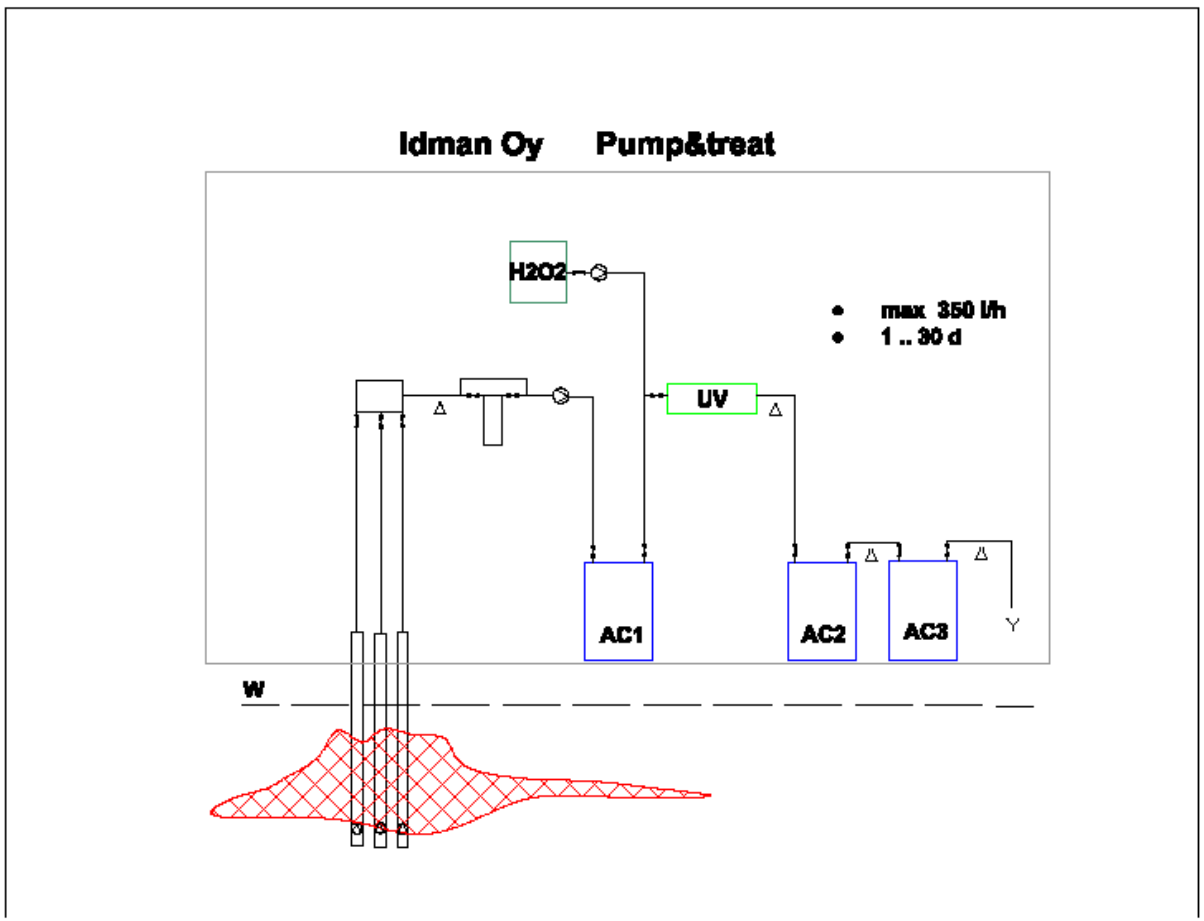
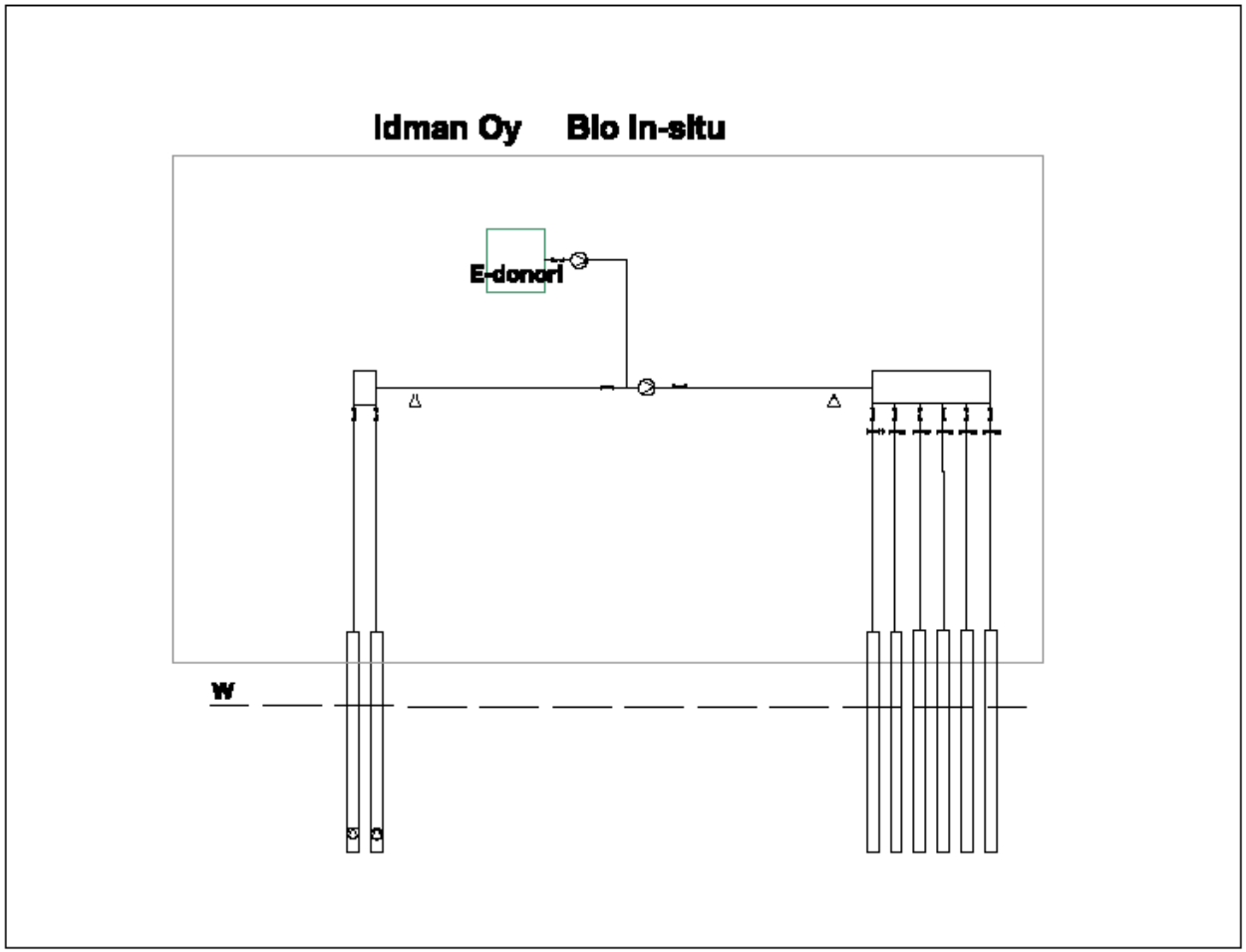

Idman Oy Pump&treat
H2O2
max 350 l/h
1 .. 30 d
UV
AC1
AC2
AC3
W



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Results

	Start	End
PCE	91	< 10
TCE	30.000	15.000
DCE	6.500	16.000
VC	660	4.500
Ethylene	87	2.700

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Results

- Complete mineralisation took place
- In the source areas concentration levels are still high
- In the wells around the source areas a steadily decrease is visible.
- The approach is focussed on mass reduction and reduction of risks/spreading.

Case 3: Pilot Remediation Cassinetta

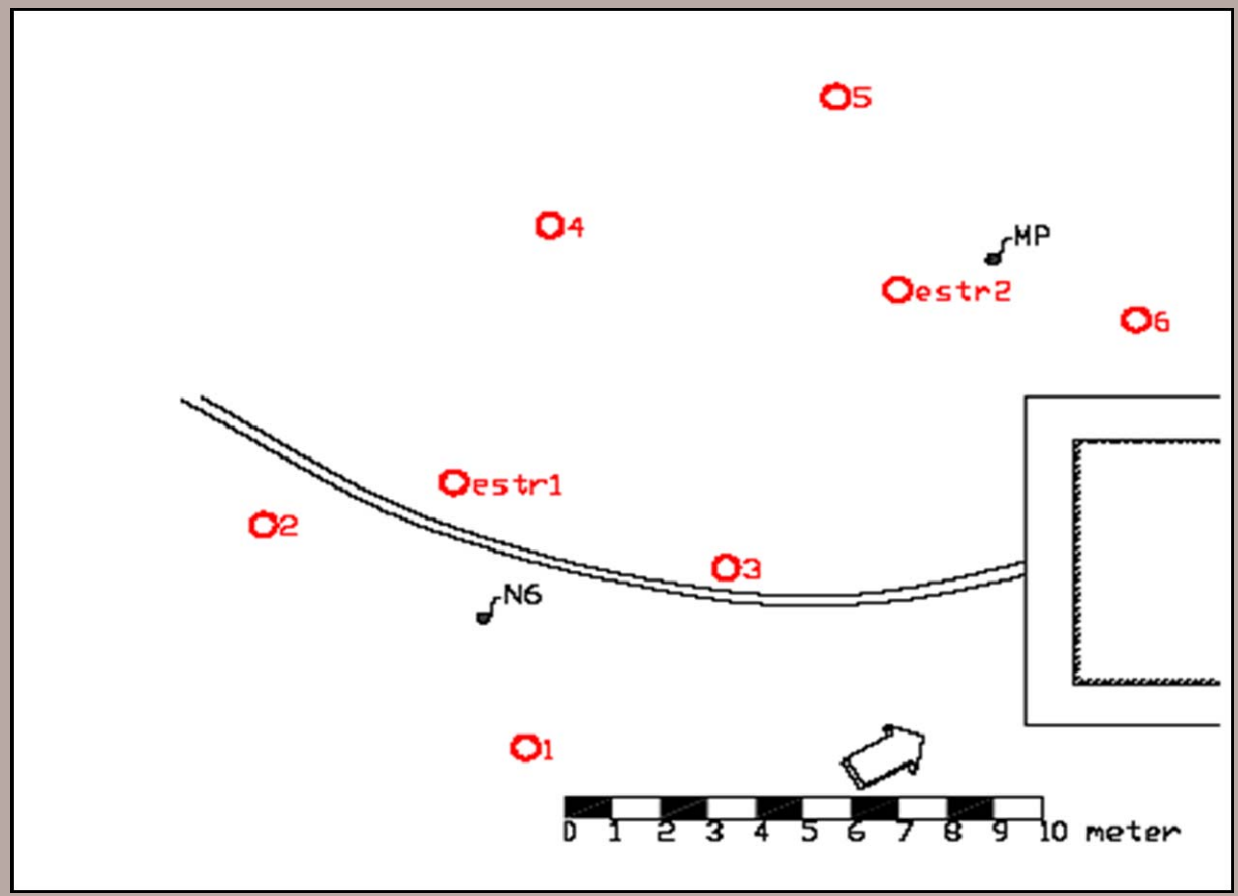
Intro

- Soil and groundwater contamination PCE, TCE, cis-DCE, VC, DCA, DCP)
- Contaminated area: 1.5 ha. until 30 m-gl

Pilot system:

- 2 extractionwells at 25.0 – 30.0 m-gl
- 6 infiltrationwells 25.0-30.0 m-gl

Overview of Pilot System



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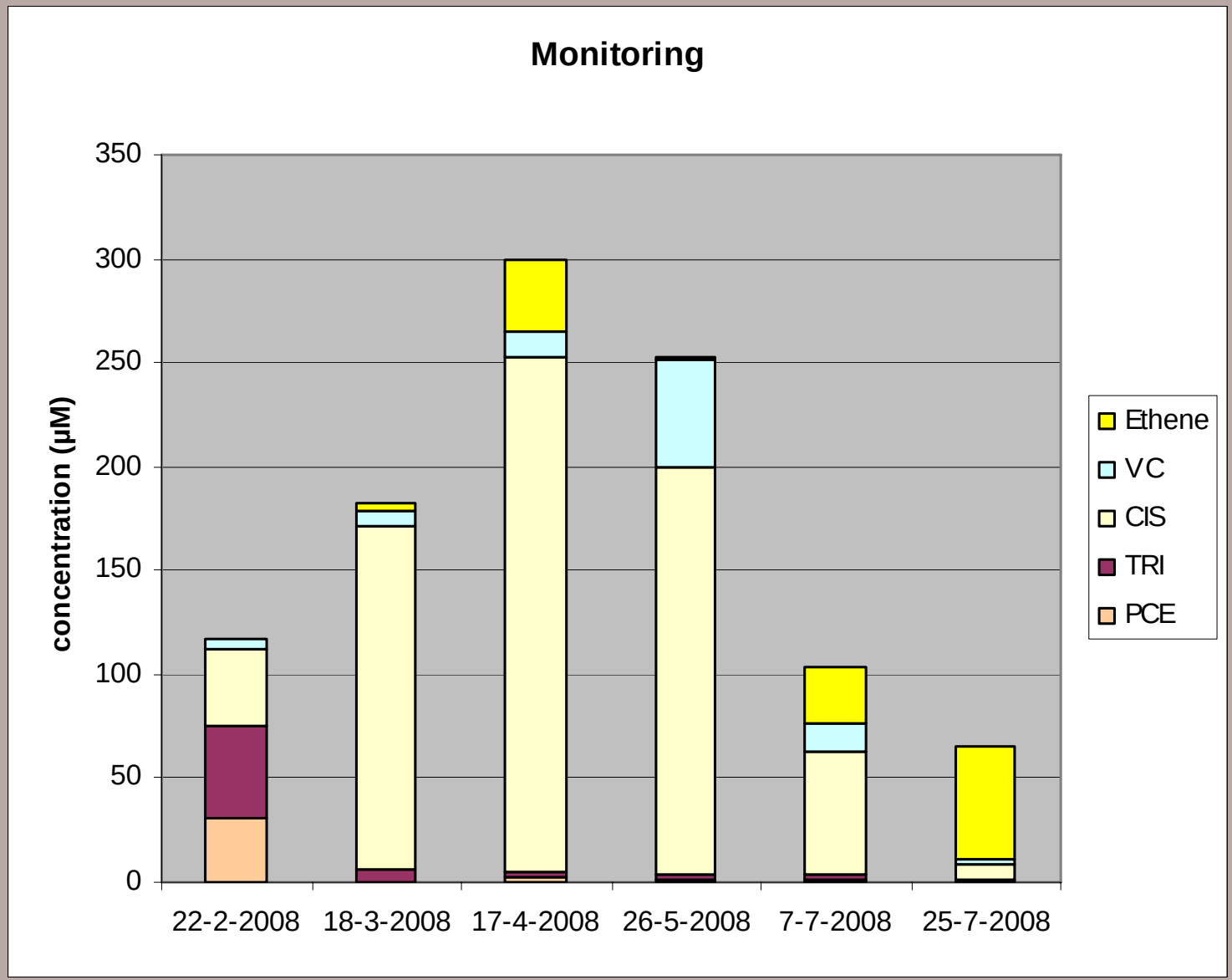
Monitoring
concentration (µM)
350
300
250
200
150
100
50
0
22-2-2008
18-3-2008
17-4-2008
26-5-2008
7-7-2008
25-7-2008
Ethene
VC
CIS
TRI
PCE

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Degradation of DCA and DCP

Date	DCA	DCP	
2005	87,900	87,900	µg/l
Feb. 08	8,400	13,000	µg/l
March 08	9,300	11,000	µg/l
April 08	3,600	1,300	µg/l
May 08	460	14	µg/l
June 08	110	5.9	µg/l
July 08	300	54	µg/l
September 08	400	200	µg/l

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Conclusion

- The analytical results show a fast and complete degradation
- The complete degradation was also verified by Stabel Isotope Analysis
- Redox potential: between -120 en -257 mV.
- Currently the pilot system is up scaled to cover the whole contaminated area.

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Case 4:

In-situ remediation of chlorinated hydrocarbon contamination in The Hague

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The Hague

- Old industrial area with small enterprises
- metal working, chemical cleaning
- 3 contaminated sections

Sandy soil down to about 20 m-gl
a peat layer at about 3 m-gl

improper excavation section A

target 3 µg/l

Concentration VOCl (µg/l)	Section A		Section B		Section C	
	Start	End	Start	End	Start	End
0-3 m-gl	100	< 0.5	10.0	< 0.5	460	< 0.5
4-7 m-gl	DNAPL	< 10	80.0	1.0	11,060	< 10
10-12 m-gl	1,000	< 0.5	5.4	< 0.5	306	< 0.5
12-15 m-gl	800	< 0.5	1.0	< 0.5	1.9	< 0.5
15-19 m-gl	100	< 0.5	0.6	< 0.5	5.0	< 0.5

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Conclusion

- Anaerobic Biological degradation of chlorinated solvents in source areas is very well usable
- Acceptable timeframe
- Important: active circulation, dosing of the electron donor, the right electron donor

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