



Terreco - ecological solutions that make economic sense

Content

- Terreco introduction
- PuriSoil®
 - ↳ Technology
 - ↳ Projects
 - ↳ Advantages
 - ⇒ Under infrastructure
 - ⇒ No nuisance
 - ⇒ Cost effective
 - ⇒ SHE
- Discussion



A cost breaking technology in soil remediation

developed
and proven
by



commercialised by



PuriSoil® the technology



PuriSoil[®]: aerobically biodegradable

PuriSoil can remove all volatile, aerobically biodegradable chemicals.

PuriSoil has already been used to successfully clean soil contaminated with the following chemicals:

Toluene

ACN

Hexane

Methanol

Benzene

ACH

Styrene

Phenol

BTEX

Acetone

MTBE

Mineral oil



PuriSoil[®]: soil conditions

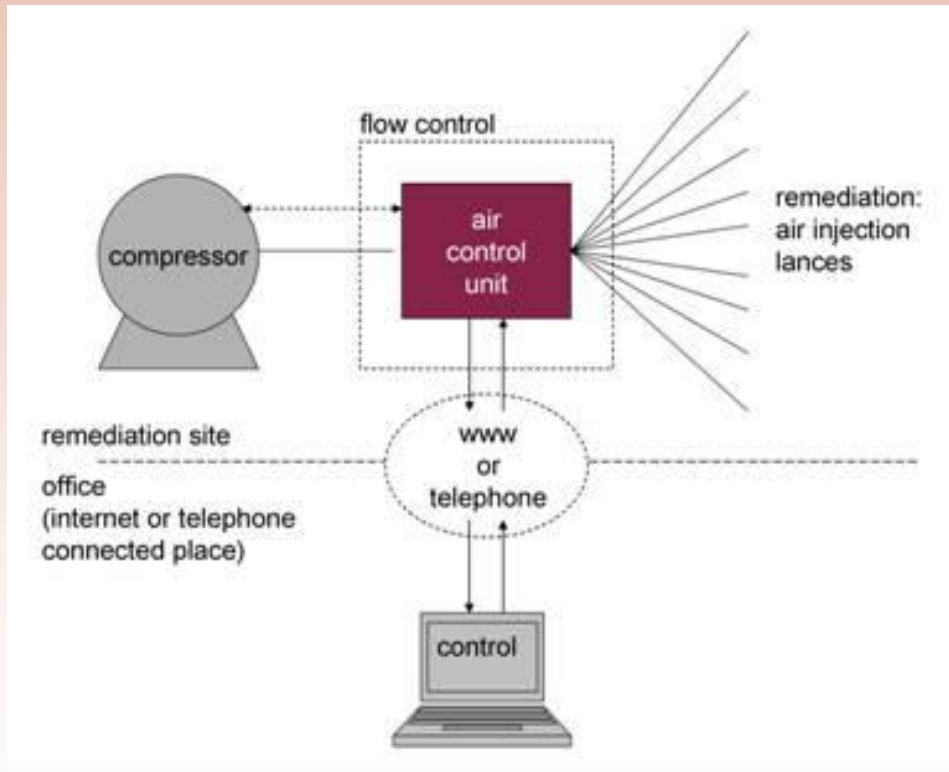
- Saturated and unsaturated soil
 - ↳ PuriSoil has proven its effectiveness in both saturated and unsaturated soil
- Many types of soil
 - ↳ In the projects carried out up to now, PuriSoil has proven to be suitable for any type of soil, including sand, loam and clay.
 - ↳ PuriSoil effective at $K_d > 0.001$ m/d
($K_d, \text{clay}: 0.0015\text{-}0.008$ m/d)



Process parameters PuriSoil®

- Biolayer
 - ↳ High (initial) conversion capacity
 - ↳ Stable: physical/microbial
 - ↳ Recovery after exposure to low temperatures
- (Re)direction of air
 - ↳ Under infrastructure
 - ↳ Large depths

Control of air injection



Projects



MTBE



under railroad



under houses



acetone/cyanide



Rotterdam



under infrastructure

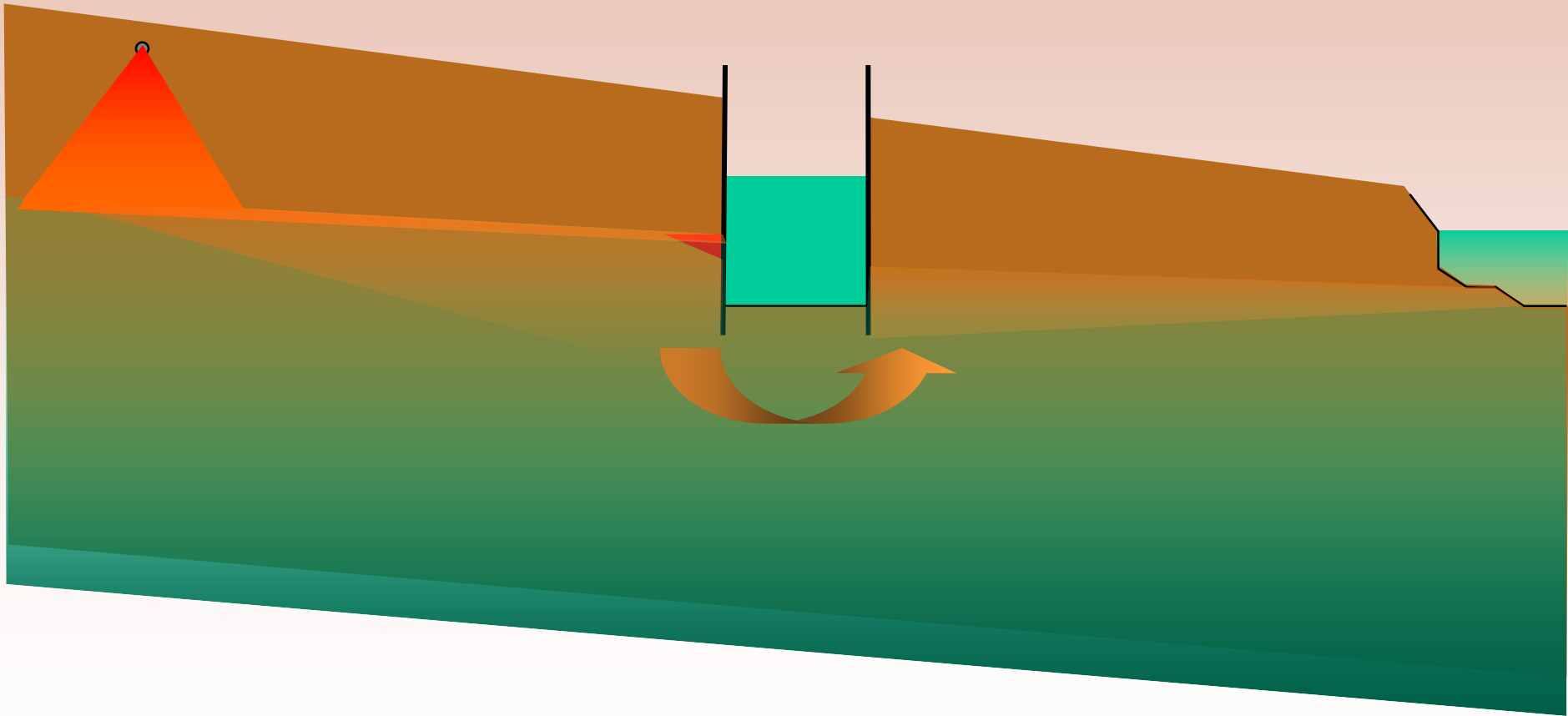


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MTBE pipeline

Juliana channel

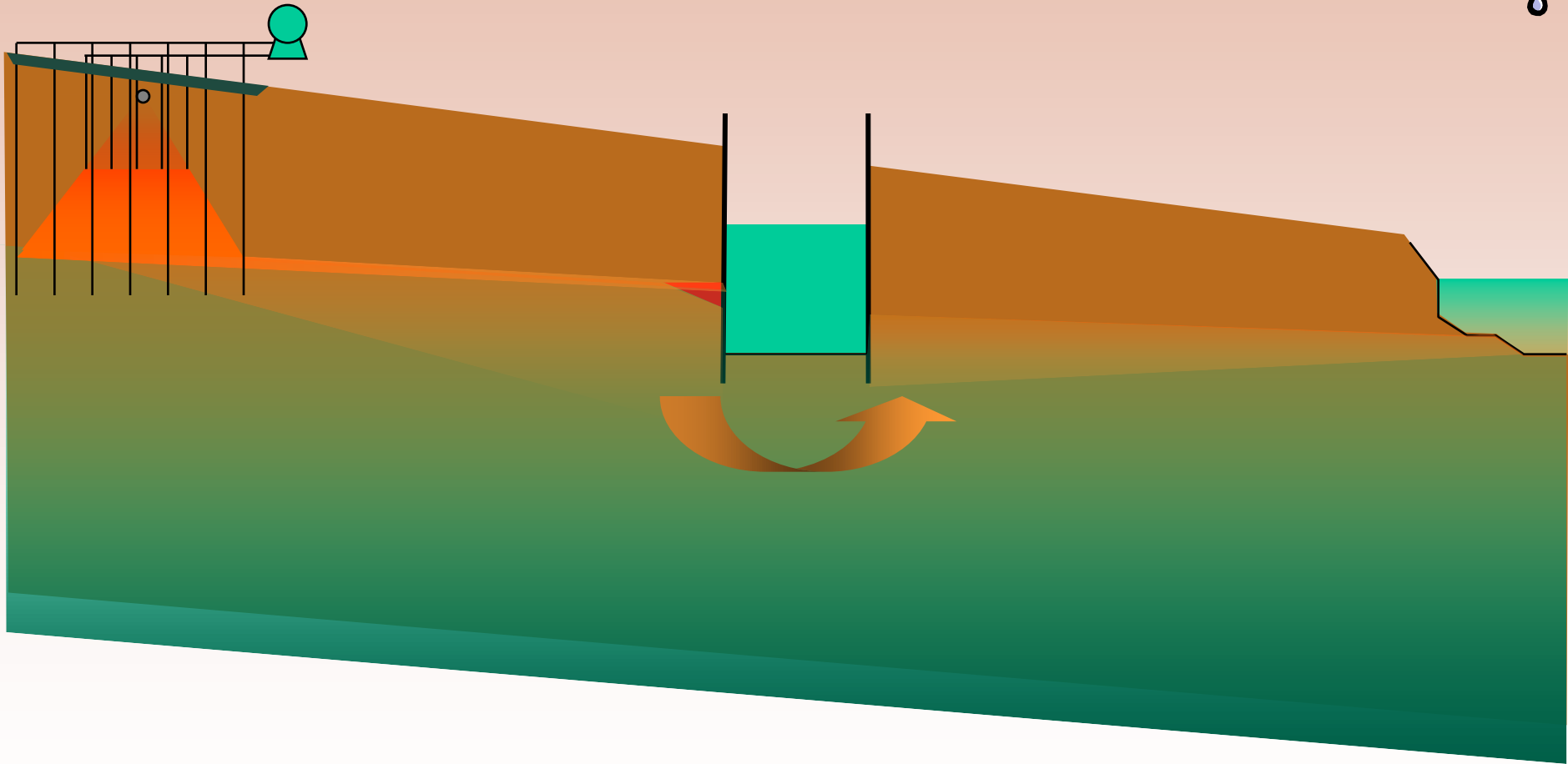
River Maas



MTBE pipeline

Juliana channel

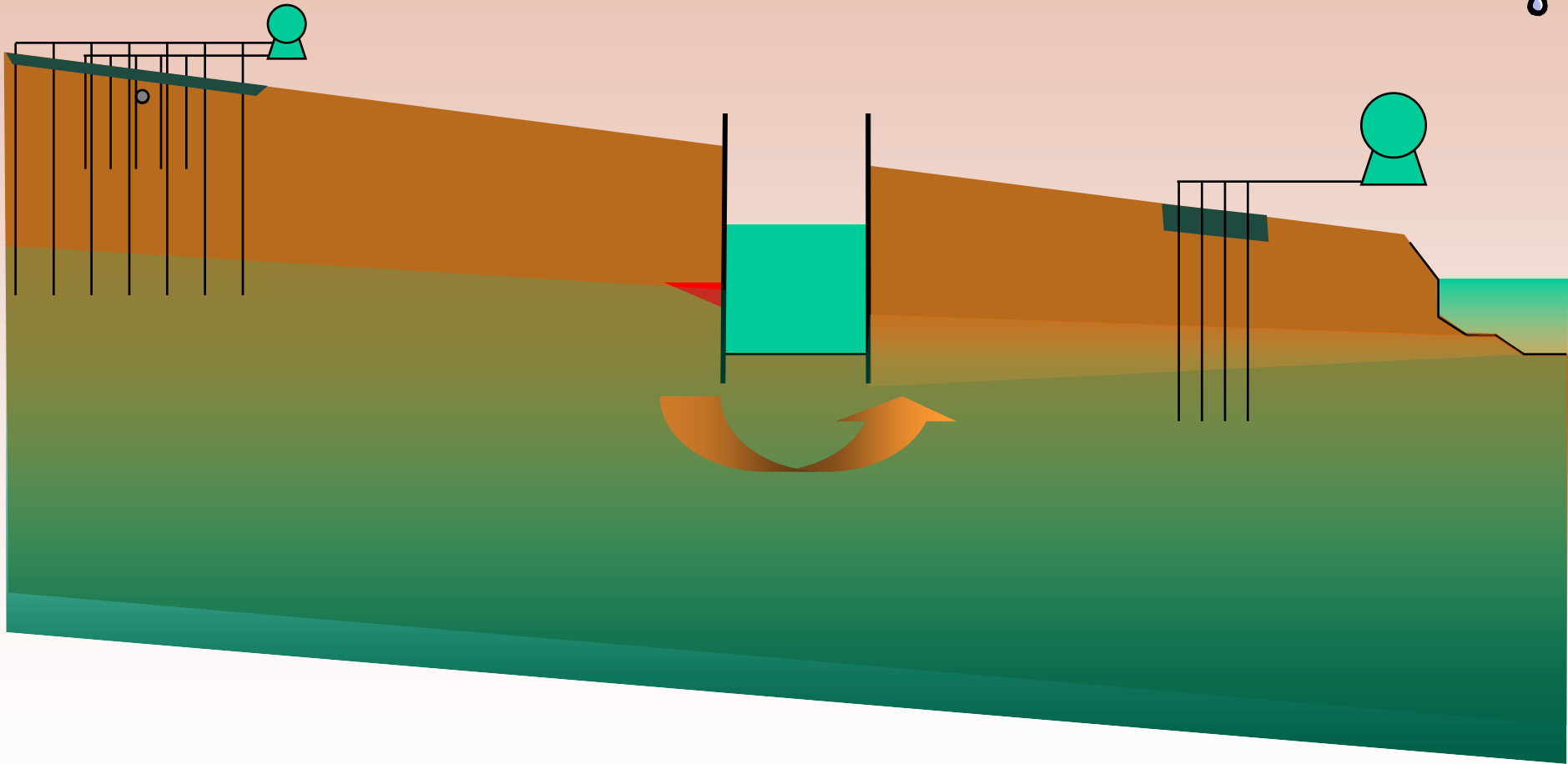
River Maas



MTBE pipeline

Juliana channel

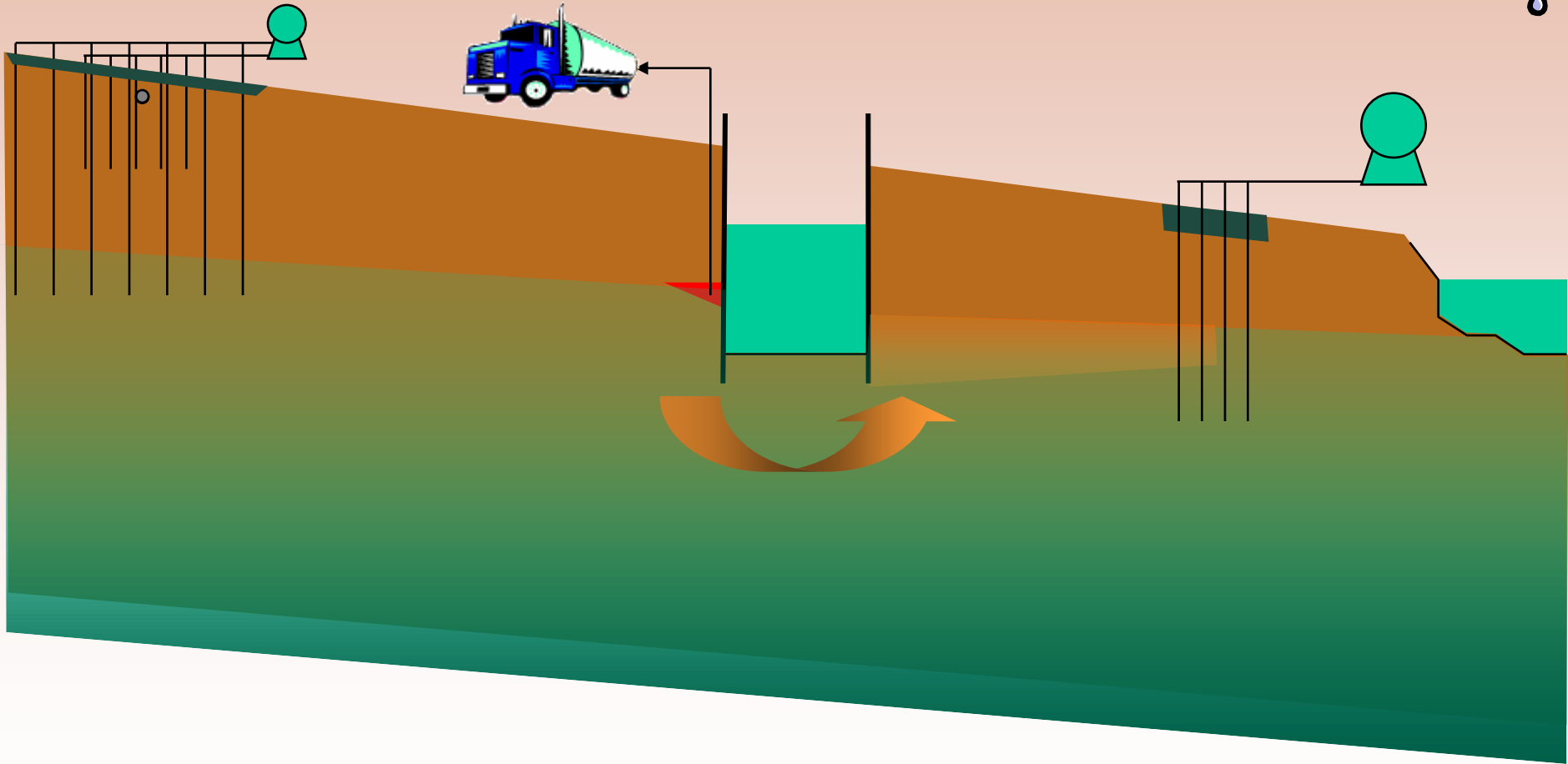
River Maas



MTBE pipeline

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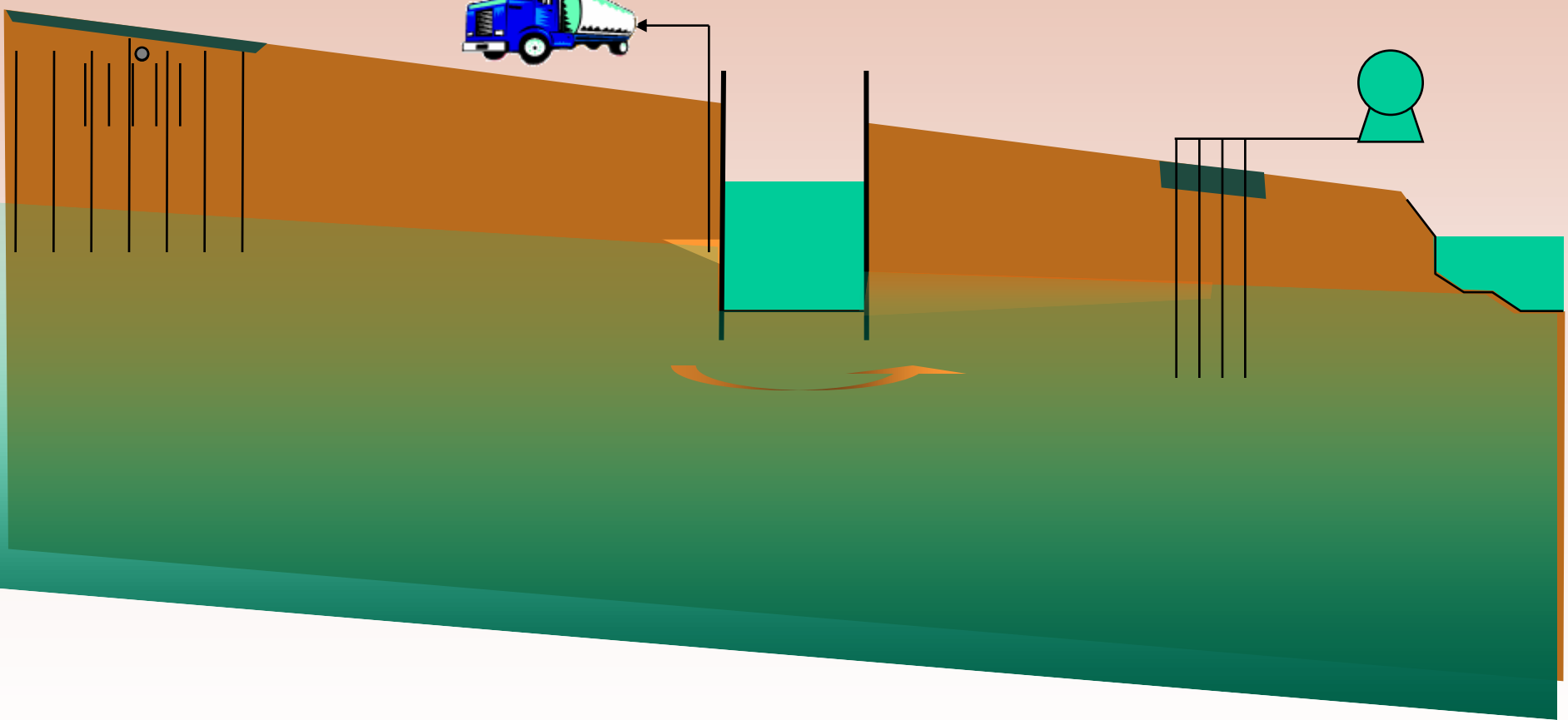
River Maas



MTBE pipeline

Juliana channel

River Maas



Projects

continue



PuriSoil® project: under railroad

- Remediation under railway lines
 - ↳ leakage pygas pipeline
 - ↳ organic pollution
 - ↳ BTEX
 - ↳ volume: 325 m²
 - ↳ depth 8 m
 - ↳ also pollution in ground water



PuriSoil® project: under railroad



PuriSoil® project: under railroad

Remediation under railway lines

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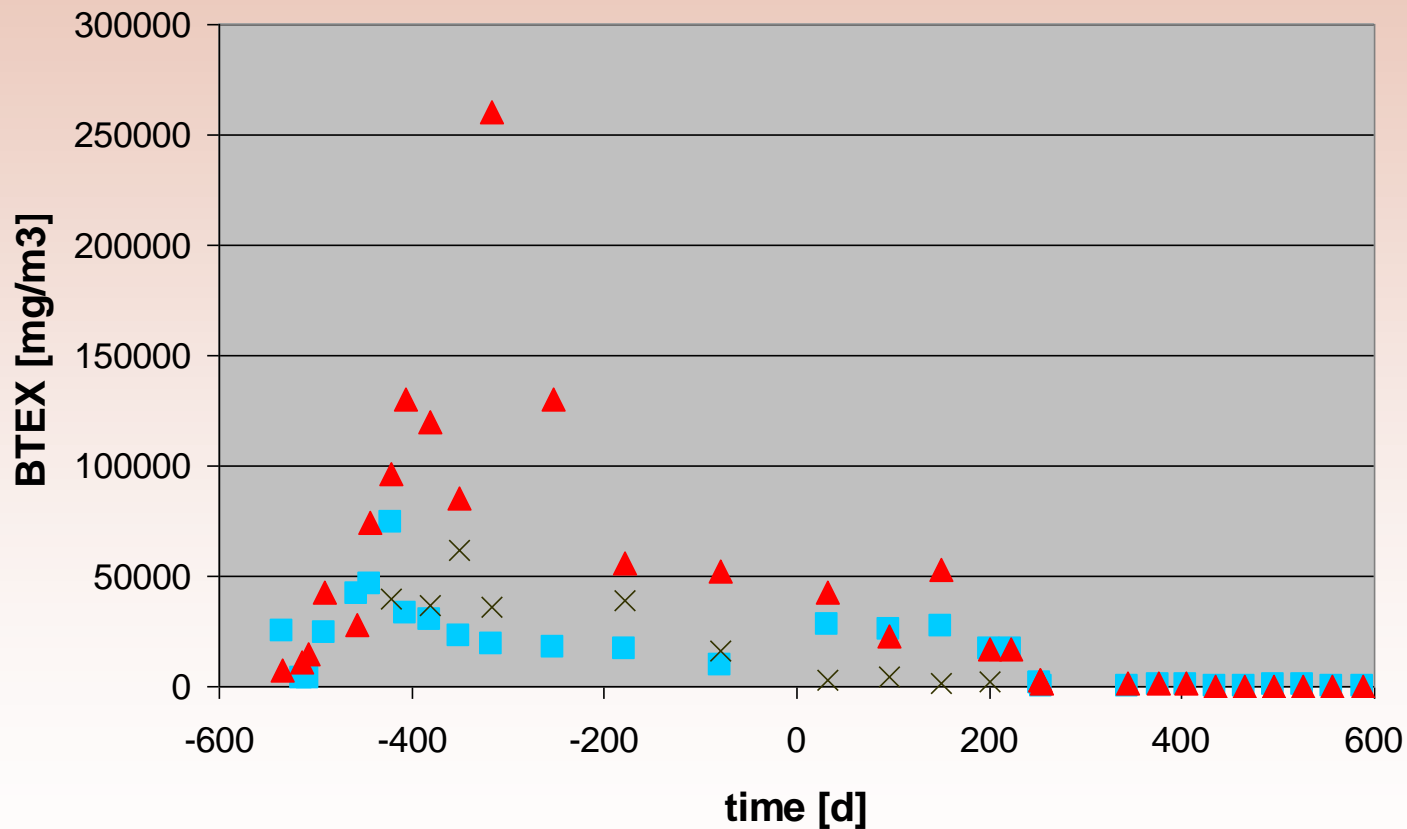
Results

- ↳ groundwater clean within 1 year
- ↳ unsaturated zone clean within 4 years
- ↳ no nuisance



PuriSoil[®] project: under railroad

- Concentration groundwater (mg/m³)



PuriSoil[®] project: under railroad

- Concentration soil (mg/kg), unsaturated zone

depth (m-mv)	start	end	removal
0-3	470.5	0.09	99.98%
3-6	1200	<0.05	100.00%
6-9	2.1	<0.05	100.00%



PuriSoil[®] project: Acetone/Cyanide

Chemelot, Geleen

- ↪ leakage acetone and free cyanide
- ↪ area: 300 m²
- ↪ depth 12 m
- ↪ unsaturated zone



PuriSoil[®] project: Acetone/Cyanide



PuriSoil[®] project: Acetone/Cyanide

Chemelot, Geleen

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Results

- ↪ clean within 4 years



PuriSoil[®] project: Acetone/Cyanide

Diepte	Start concentration December 1999		Removal July 2003	
	Acetone	Cyanide	Acetone	Cyanide
0-3	n.a.	4200	-	99%
3-6	n.a.	590	-	99%
6-9	1050	131	100%	98%
9-12	180	5	100%	100%



PuriSoil[®] project: Rotterdam

- DSM Special Products Rotterdam
 - ↪ organic pollution (mainly BTEX)
 - ↪ area: 12.000 m²
 - ↪ depth 13 m
 - ↪ groundwater at surface level



PuriSoil[®] project: Rotterdam



PuriSoil[®] project: Rotterdam

- DSM Special Products

- ↳ organic pollution (mainly BTEX)

- ↳ area: 10.000 m²

- ↳ depth 13 m

- ↳ groundwater at surface level



- Results

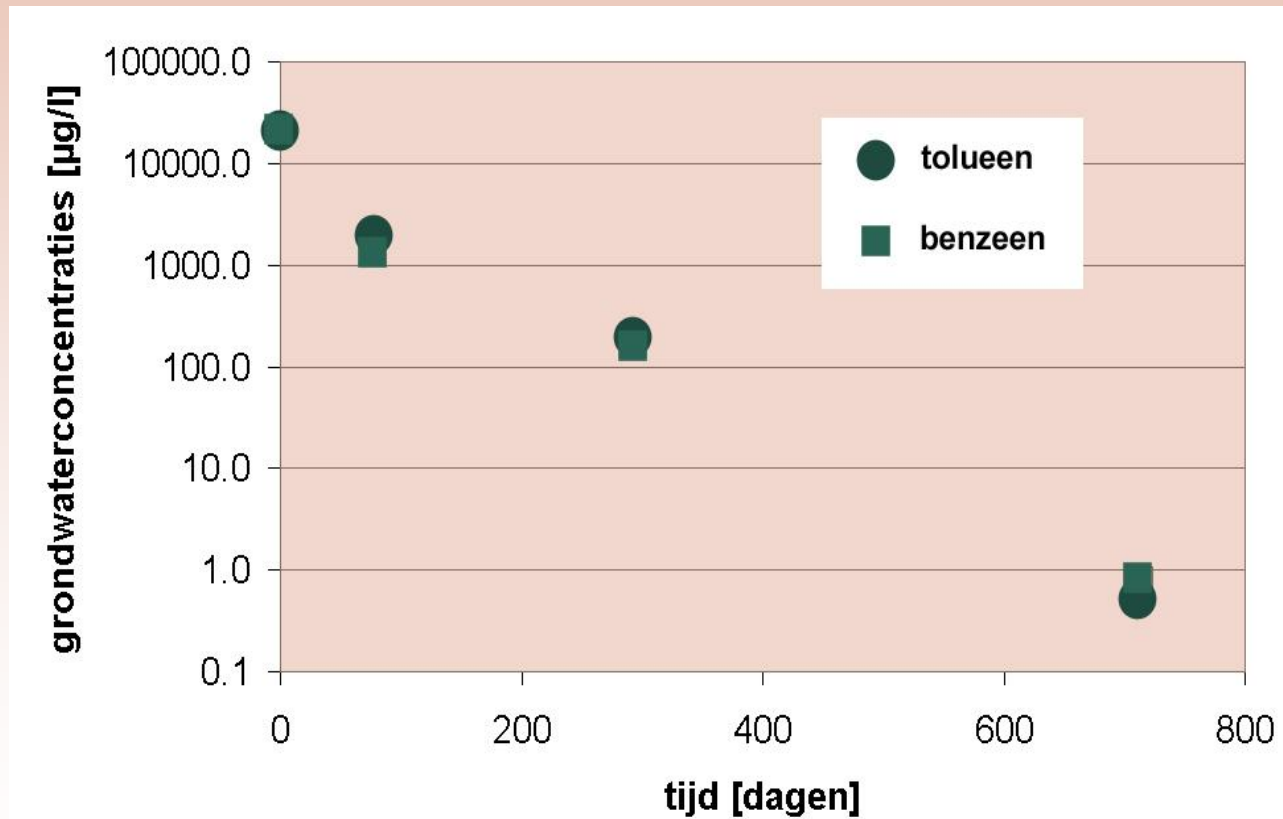
- ↳ within 6 months sufficient clean to obtain a building permit

- ↳ completely remediated within 2 years (BTEX)



PuriSoil[®] project: Rotterdam

- Concentration groundwater (mg/m³)

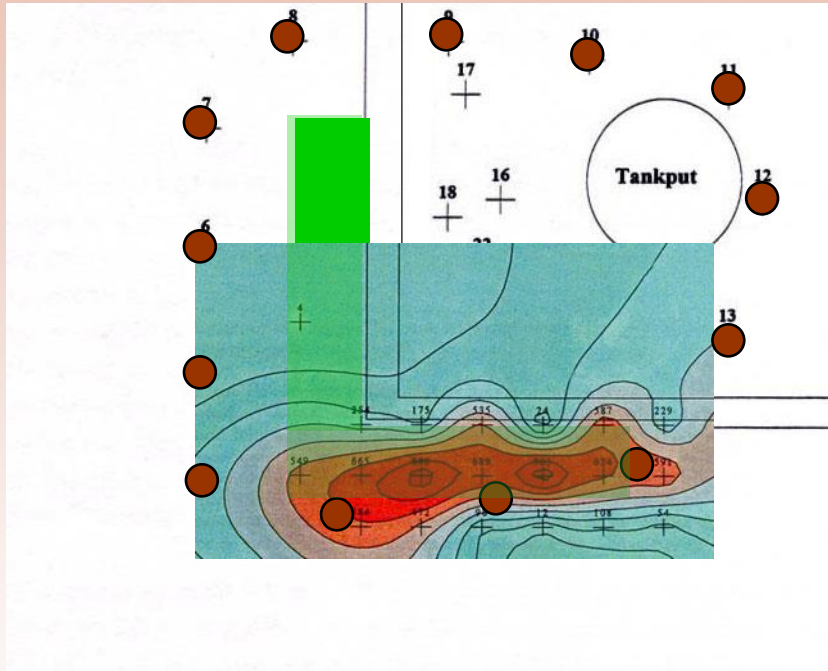


PuriSoil[®]: under infrastructure (tankpit)

- 1000 m²; 8 m-m.v.
- BTEX
- spill of catchpot in tank area



PuriSoil[®]: under infrastructure (tankpit)



PuriSoil[®]: under infrastructure (tankpit)

Depth	BTEX		MTBE	
	1998	2005	1998	2005
m-mv	mg/kg	mg/kg	mg/kg	mg/kg
0.0-2.5	6630.3	18	213	<d
2.5-4.5	310.2	<d	17	<d
4.5-6.5	729.2	<d	Nb	<d
7.5-9.0	0.6	<d	Nb	<d
9.0-11.0	0.2	<d	Nb	<d
11.0-12.5	0.4	2.0	Nb	<d



Projects



continue

PuriSoil[®]: under infrastructure (houses)



Projects

continue

PuriSoil®: price competitive

	PuriSoil	Alternative technology	Price
Delft Toluene	€ 82.000	Air Sparging Soil Vapour Extraction	€ 150.000
Sprang Capelle Gasoline station	€ 320.000	Digging	€ 900.000
Rotterdam BTEX	€ 1.300.000	Excavation + Pump & Treat	€ 2.900.000
Geleen Gasoline	€ 250.000	Chemical oxidation	€ 1.000.000
Geleen Tankpit BTEX/MTBE	€ 225.000	Excavation	€ 675.000



PuriSoil[®]: pricing

- depth and size
- type of pollutant
- ground water level
- obstacles at the site

SHE & Terreco

- Safety Statement

- ↳ Safety, health and environment are priority no.1

- ↳ Terreco respects and adheres to the SHE procedures of her customers

- Terreco is the direct result of the continues effort of the petrochemical multinational DSM to improve on SHE issues

- Terreco is VCA** and ISO 9001 certified



SHE Operating Guidelines/Procedures

- Risk analysis and evaluations prior to the execution of the work
- Construction managers are VCA certified
- Subcontractors are competent and VCA certified
- Zero-emission during the remediation, measurement
- Immediate report of incidents
- Investigation of causes and effects of incidents
- “Lessons learned” program for continuous improvement

Summary

- Safe
- Environmental friendly
- Limited impact
- Under infrastructure
- Applicable up to large depths

- Proven technology
- Low costs/fixed price





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Terreco - ecological solutions that make economic sense