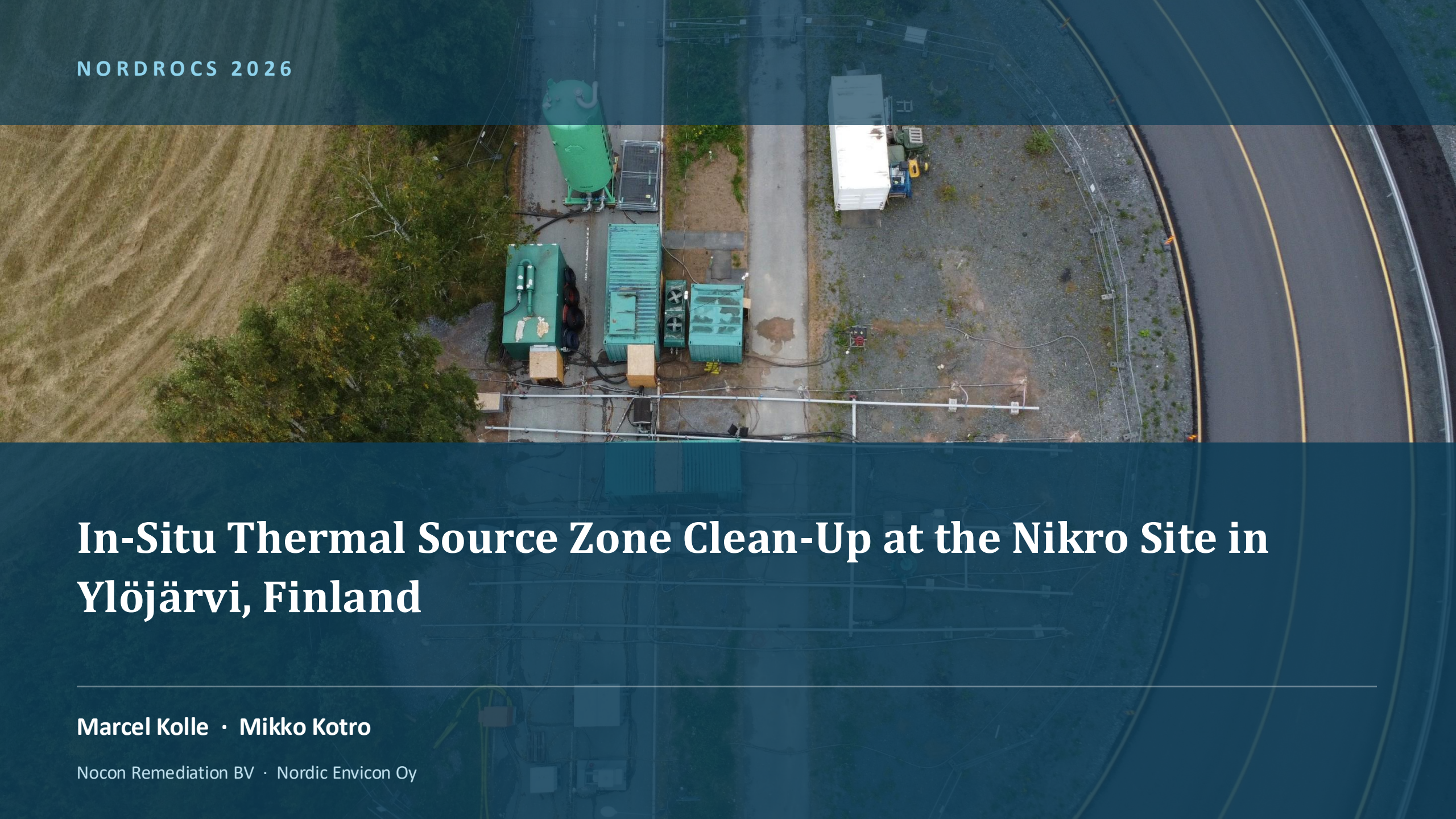


An aerial photograph of an industrial site. In the center, there are several green and blue storage tanks and containers. To the right, a white container is visible. The site is bordered by a road on the right and a field on the left. The image is overlaid with a dark blue semi-transparent layer.

NORDROCS 2026

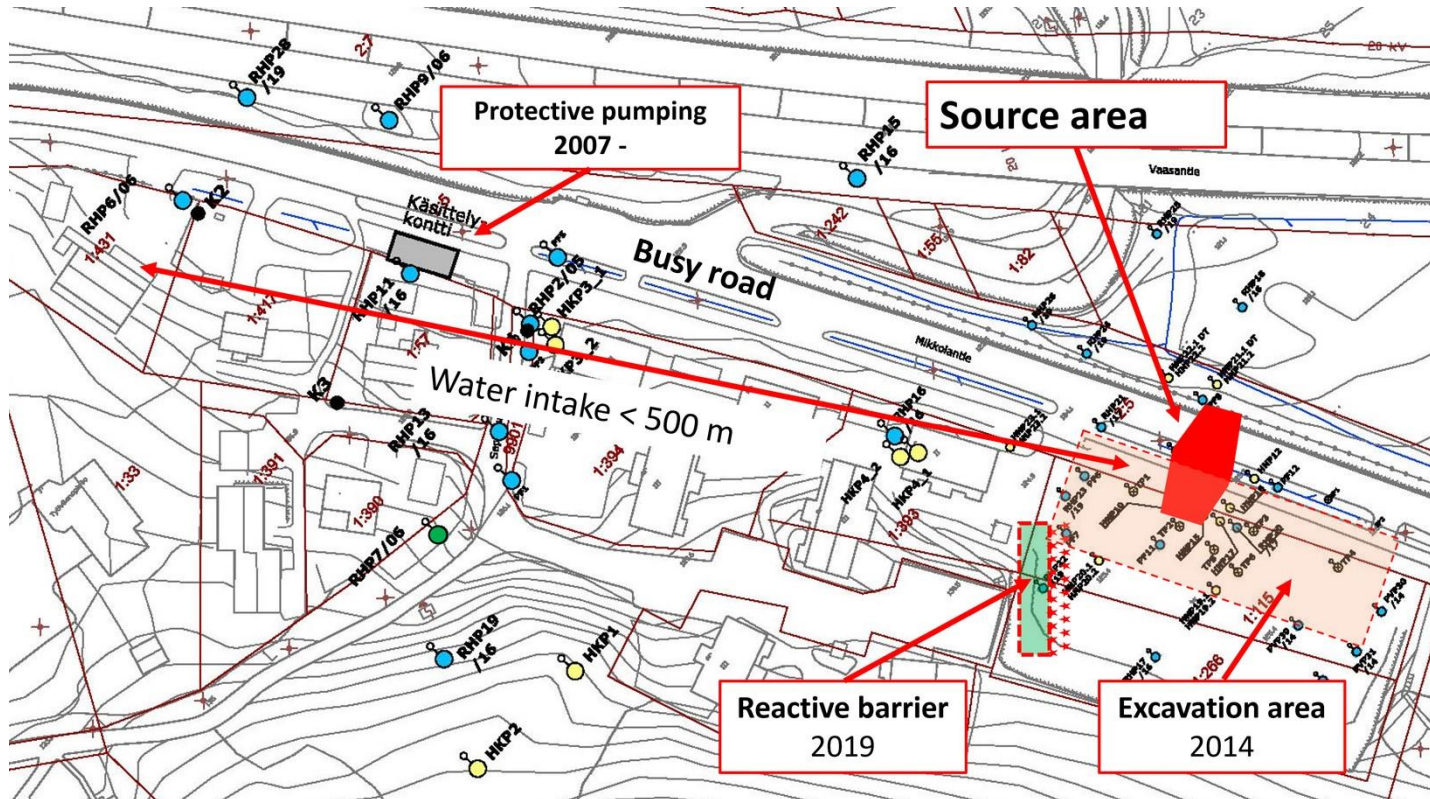
In-Situ Thermal Source Zone Clean-Up at the Nikro Site in Ylöjärvi, Finland

Marcel Kolle · Mikko Kotro

Nocon Remediation BV · Nordic Envicon Oy

Site & Contamination

Mikkolantie 32, Ylöjärvi



EMISSION SOURCE

Metal workshop, 1938–1996

CONTAMINATION

PCE 500–1,000 mg/kg

Oil 500–1,000 mg/kg

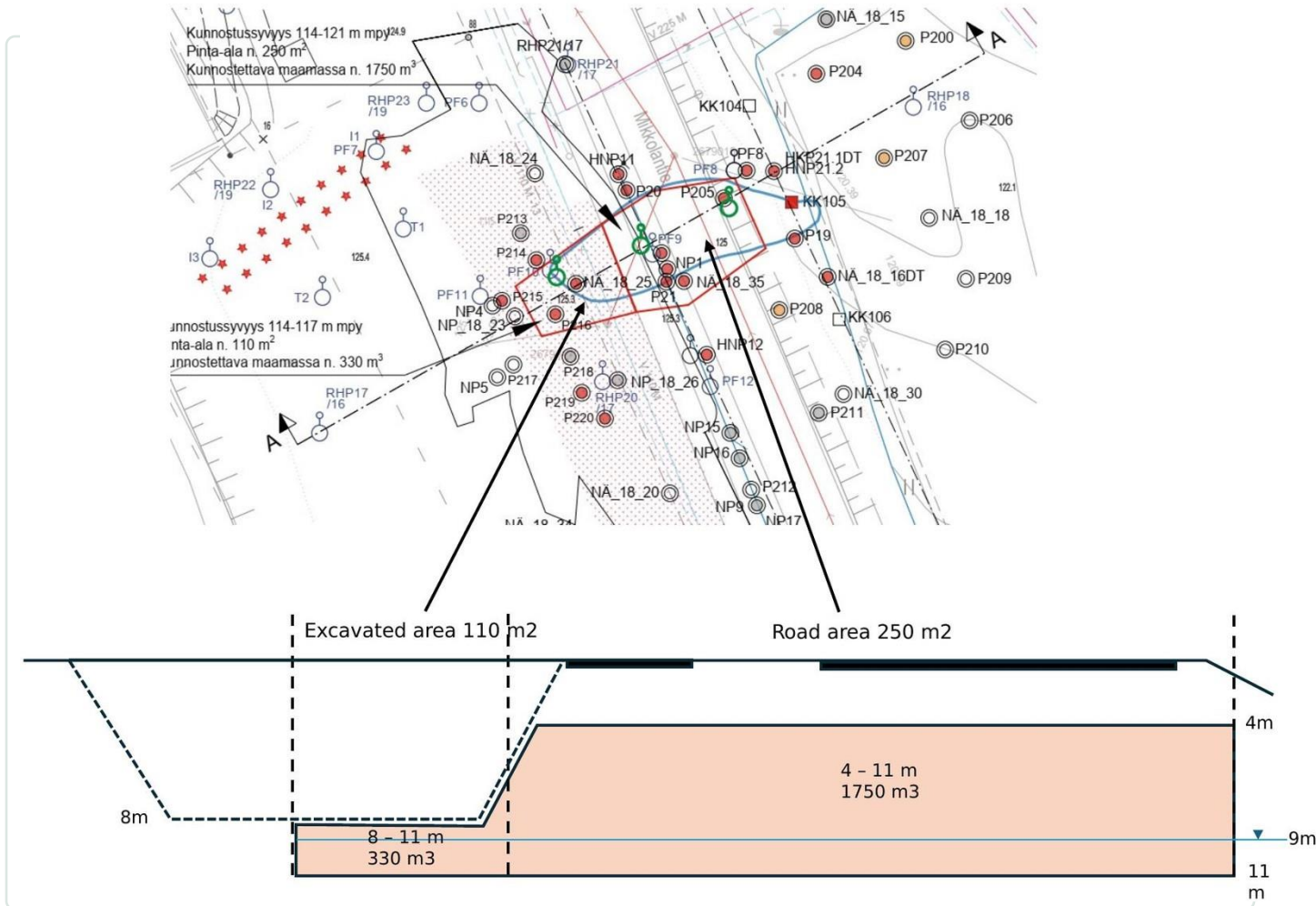
REMEDIATION HISTORY

Various activities 2013–2024

RISK

Water intake < 500 m · Lake 300 m

Remediation Area & Special Features



REMEDIATION AREA AND LAYERS

- Road area 250 m², 4 – 11 m, 1750 m³
- Excavated area 110 m², 8 – 11 m, 330 m³

SPECIAL FEATURES

- Beneath a busy public road → required a temporary detour
- PCE mass not fully known — estimated 200–1,000 kg
- Lots of underground infra — complicated installation
- Open question: heat tolerance of water main & sewer

Remediation Targets

GENERAL GOALS

- protect the water intake
- Stop GW protective pumping (2007 -)
- Enable house building to the site
- 95 % of PCE mass reduction

NUMERICAL GOALS

1 Soil above the groundwater table

$\text{PCE} \leq 4 \text{ mg/kg}$

2 Below the groundwater table

$\text{Groundwater PCE} \leq 2 \text{ mg/l}$

Project Parties & Method

SELECTED REMEDIATION METHOD

In situ thermal treatment



CLIENT

Finnish Supervisory Agency

CLIENT PARTNER

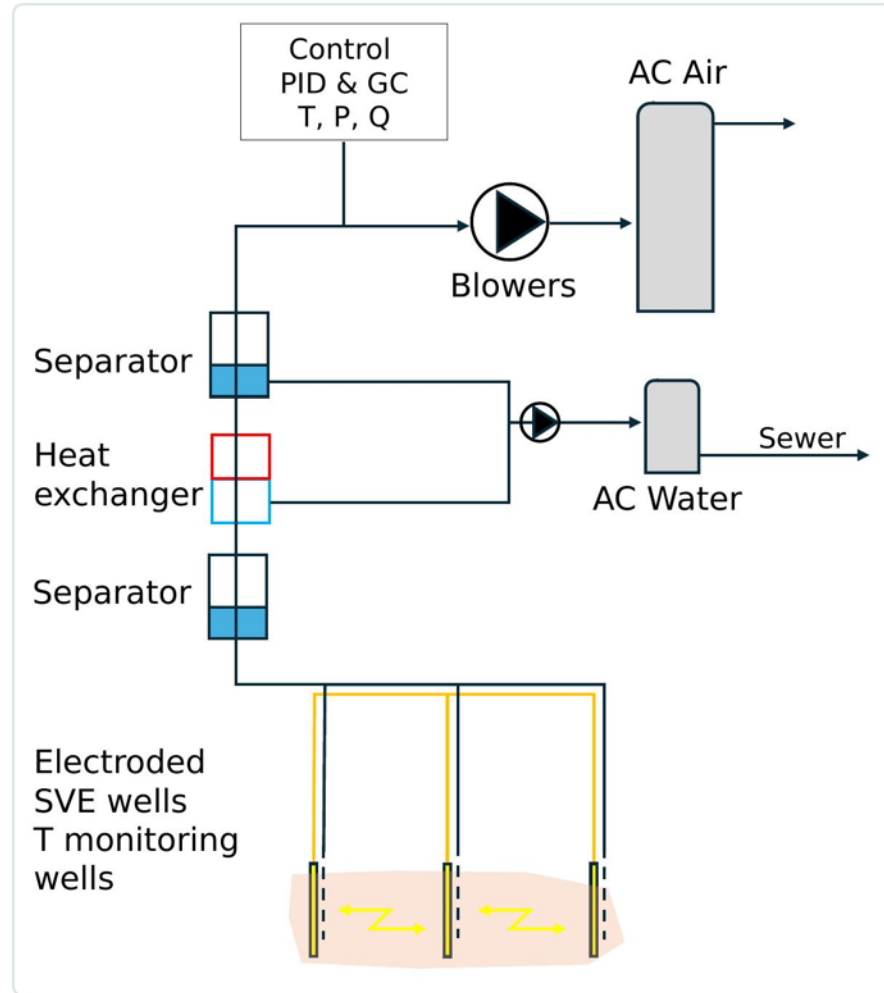
City of Ylöjärvi

CONTRACTOR

Työyhteisliittymä ENAS consortium

- Nordic Envicon Oy — preparatory works & monitoring
- Nocon Remediation BV — installation & execution
- AMX and Sheeba — consortium partners

How Electrical resistance heating works



4. Capture & treat on surface

Compounds are captured by AC filters (Air and water) before released to ambient air and sewer

3. Extract under vacuum

Volatile compounds are extracted by SVE

1. Heat the ground

Electrodes installed resistively heat soil and groundwater toward the boiling point:
PCE $\approx 88^{\circ}\text{C}$

2. Volatilize contaminants

PCE and C5–C16 evaporate out of the soil matrix.

Installations: temporary detour road



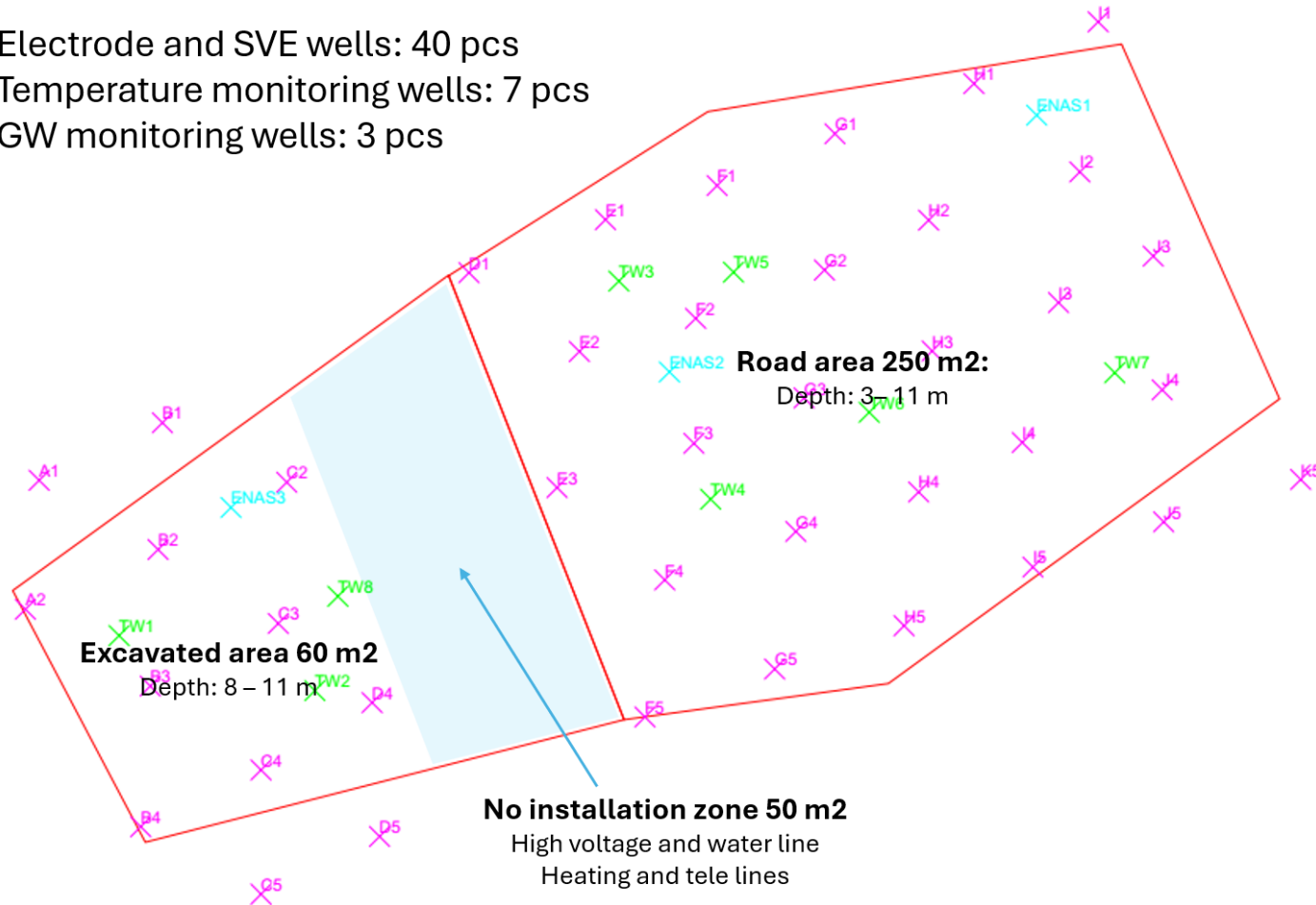
- Two-way vehicle lane, plus a cycle/pedestrian path
- Both surfaces asphalted with road markings

Installations: electrode, temp. monitoring and GW wells

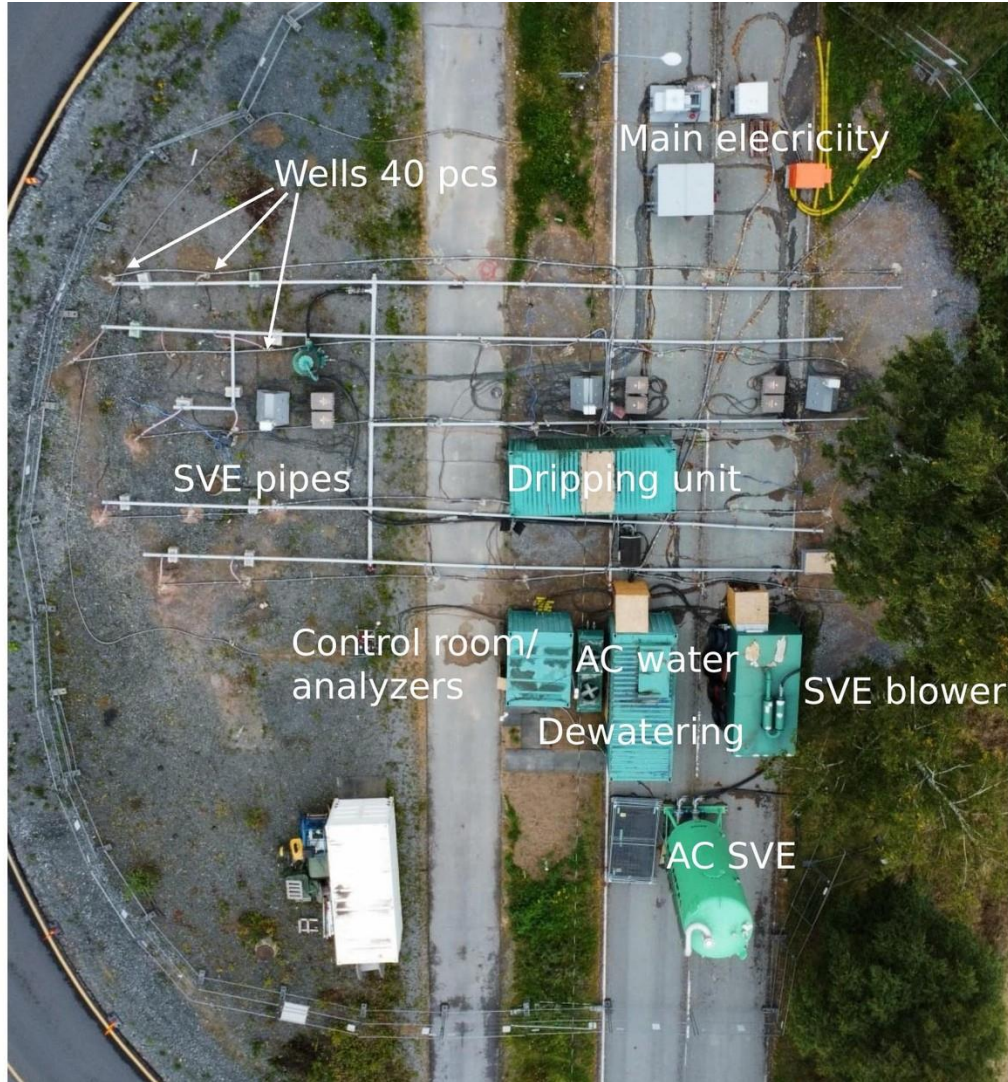
Electrode and SVE wells: 40 pcs

Temperature monitoring wells: 7 pcs

GW monitoring wells: 3 pcs



Installations: SVE system and control



Wells (40)

Electrode/SVE wells feeding the system from below ground

SVE pipes

Soil-vapour extraction piping running across the well field

Dripping unit

Water back into the soil to balance moisture removed as vapour

Main electricity

Grid connection and switchgear powering the whole plant

Control room / analyzers

PID, GC and process control system, on-line monitoring

Dewatering

Separates water from the extracted vapour stream

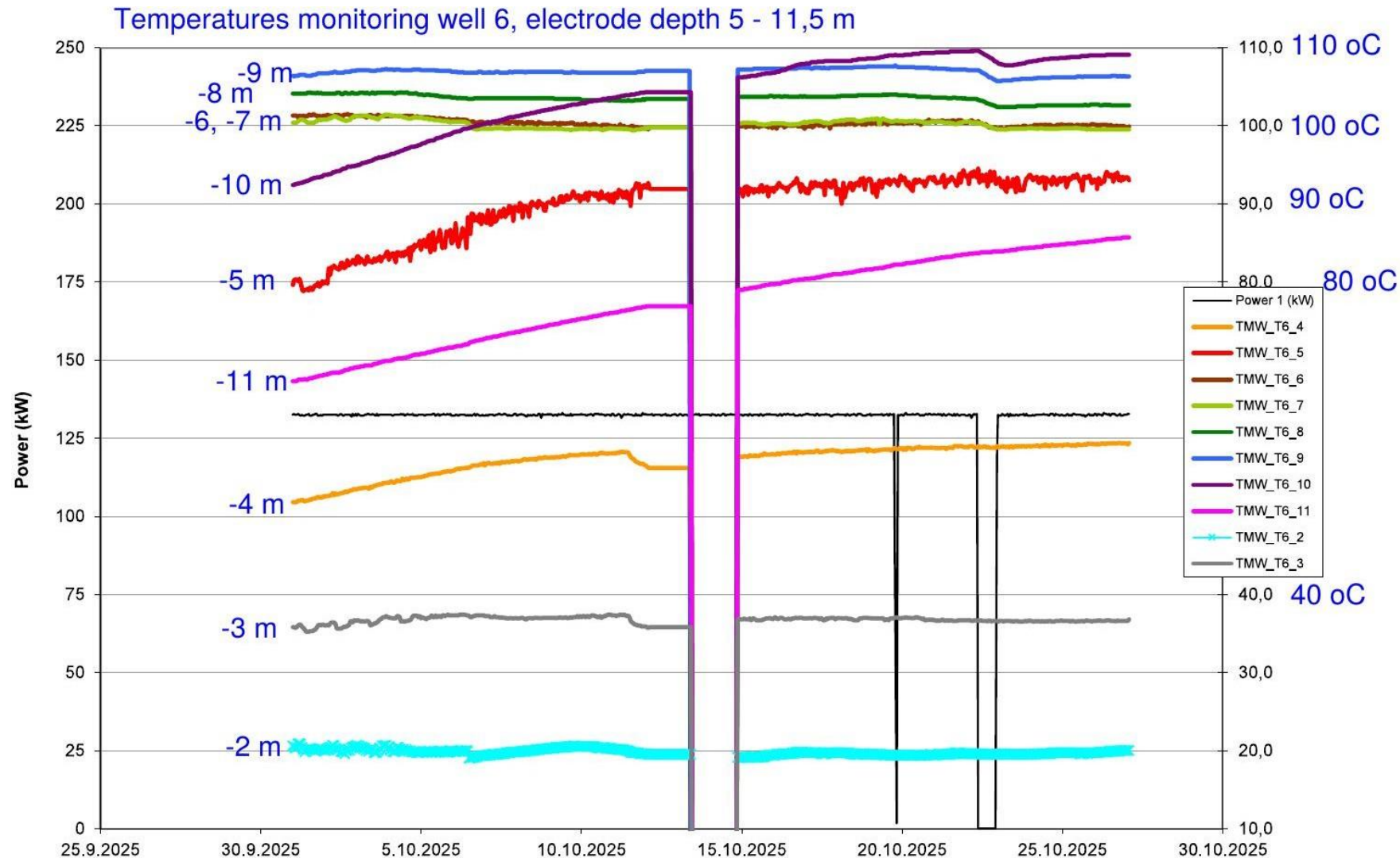
AC water / AC SVE

Activated-carbon filtration for recovered water and soil vapour

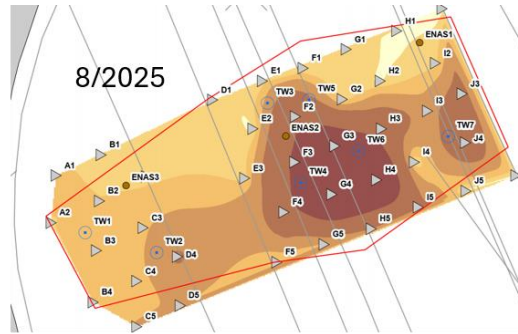
SVE blower

Draws vacuum through the well network to extract vapour

Monitoring results: Temperature Development

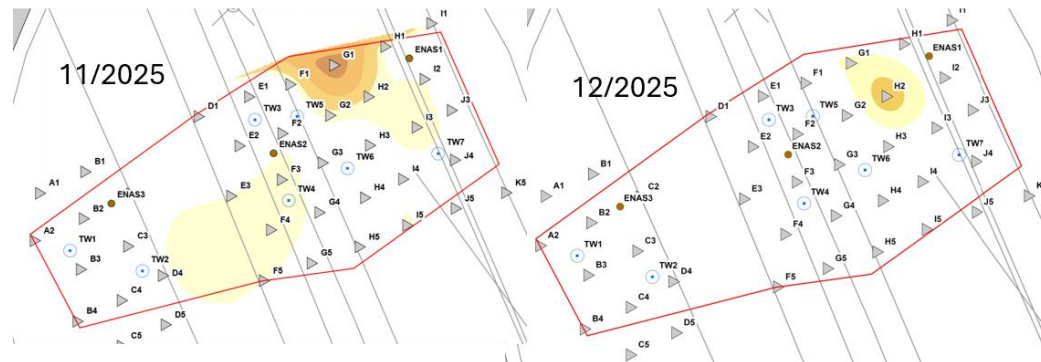
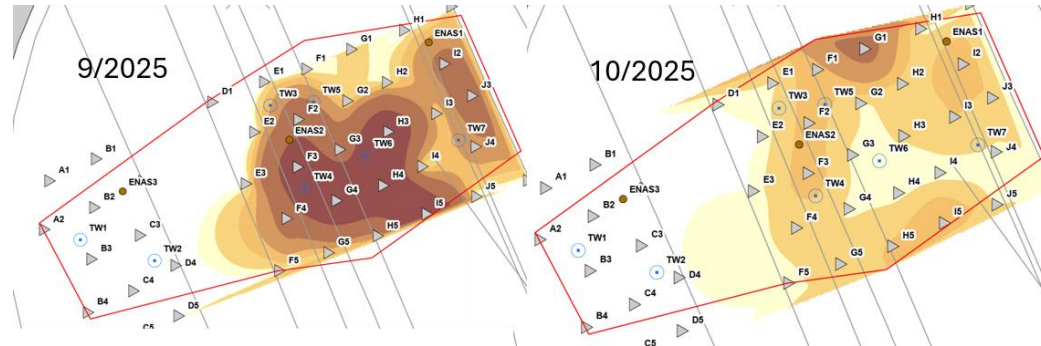


Monitoring results: PID maps over time

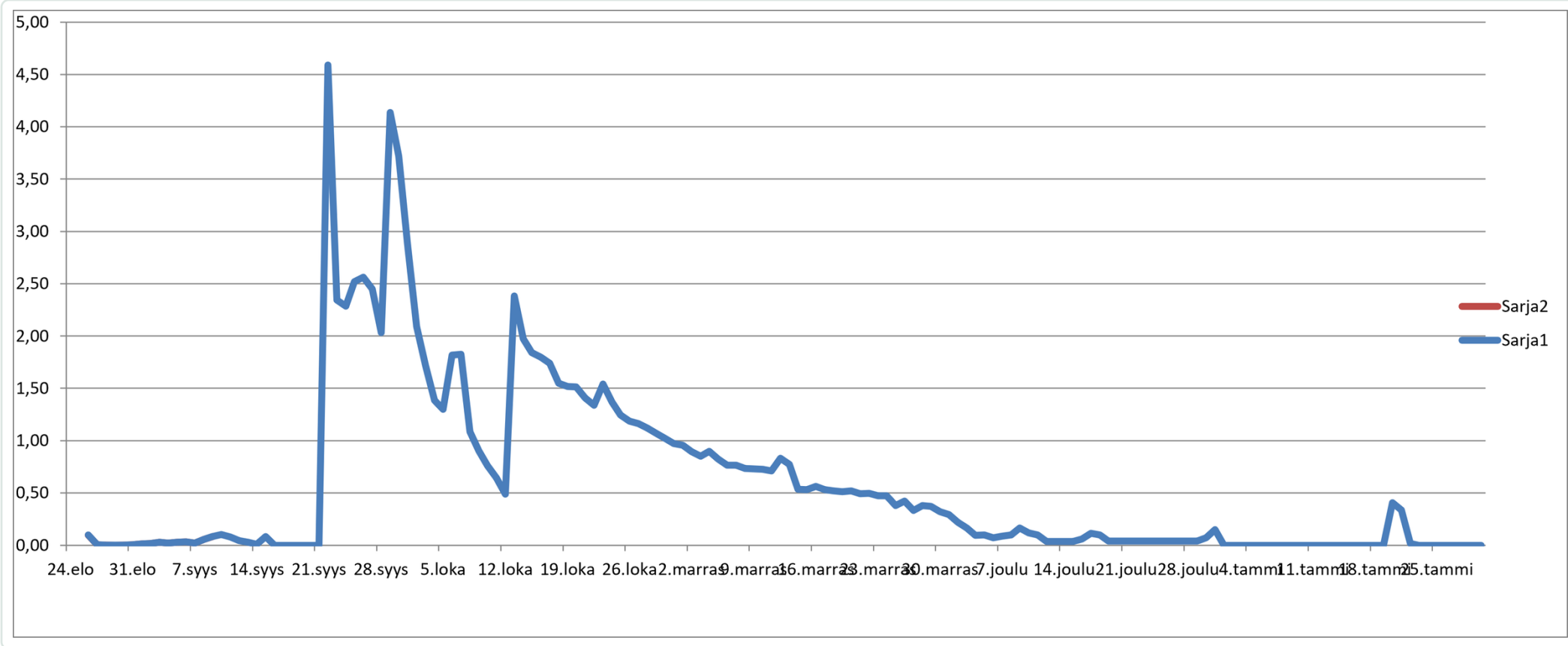


WHAT IT SHOWS

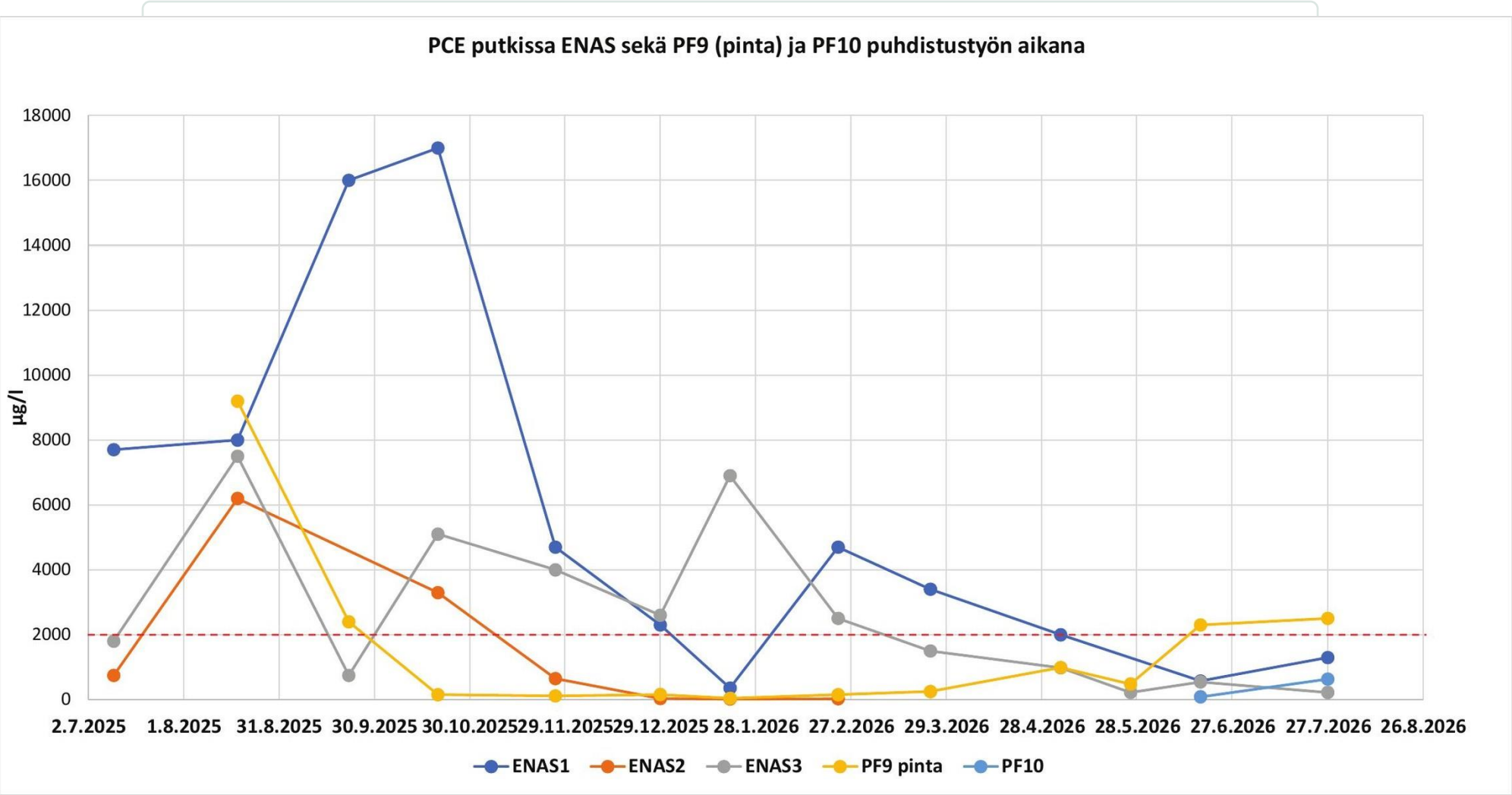
- PID readings from every SVE well measured on weekly basis
- The PID readings 8/2025 from individual boreholes closely reflected the PCE concentrations detected in the soil
- By 12/2025 PID readings close to zero



Monitoring results: Mass Removal Rate Over Time



Monitoring results: PCE-trends in Source-Area Wells



Monitoring results: Final soils samples 3-5/2026

Nikro, Ylöjärvi Maaperätutkimukset 2025 ja 2026

Jäännöspitoisuuspisteiden sijainti puhdistusalue ja analyysituloksia

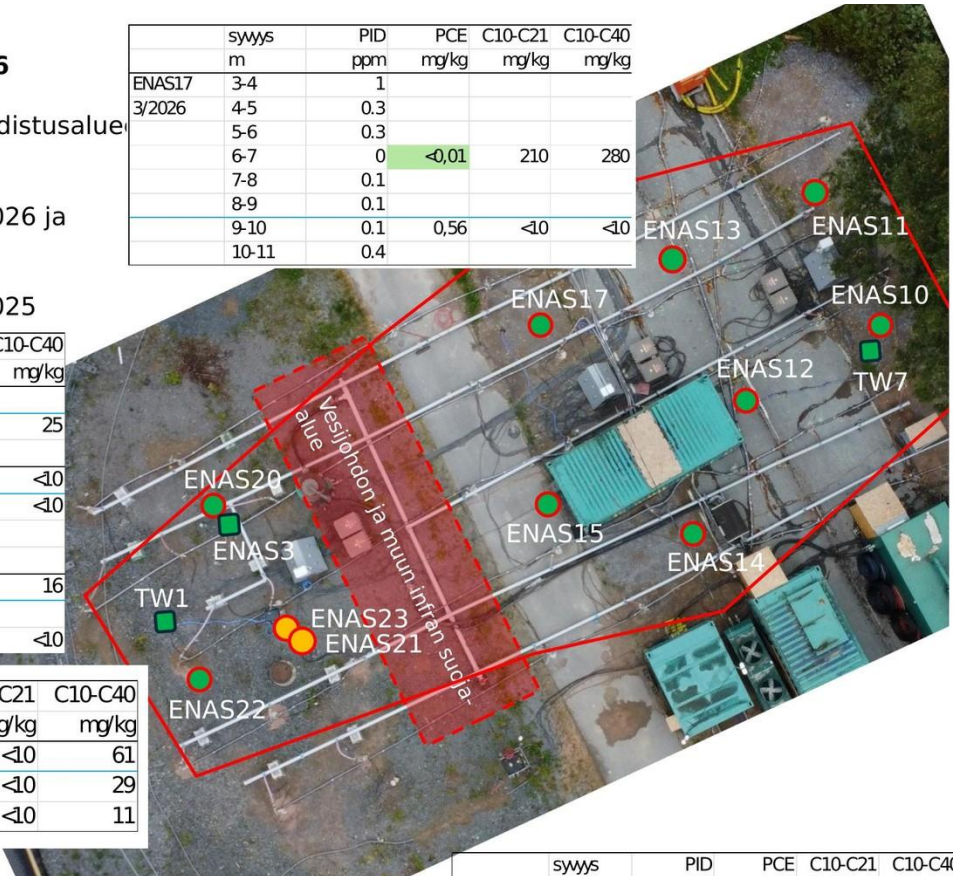
- Jäännöspitoisuuspisteet 3/2026 ja 5/2026
- Jäännöspitoisuuspisteet 6/2025

	syvyys m	PID ppm	PCE mg/kg	C10-C21 mg/kg	C10-C40 mg/kg
ENAS20	8-9	0.3			
3/2026	9-10	0.1	0,45	20	25
	10-11	0.2			
ENAS3	8-9		1,2	<10	<10
6/2025	9-10		0,04	<10	<10
	10-11				
	11-	eps			
TW1	8-9		<0,01	<10	16
6/2025	9-10				
	10-11		<0,01	<10	<10

	syvyys m	PID ppm	PCE mg/kg	C10-C21 mg/kg	C10-C40 mg/kg
ENAS22	7,7-8,5	0	<0,01	<10	61
5/2026	8,5-9,6	10	<0,01	<10	29
	9,6-10,8	5	0,01	<10	11

	syvyys m	PID ppm	PCE mg/kg	C10-C21 mg/kg	C10-C40 mg/kg
ENAS21	7,7-8,5	271	10	270	290
5/2026	8,5-9,6	4	0,48	42	62
	9,6-10,8	17	7,5	190	220
ENAS23	7,7-8,5	20	7,8	770	930
5/2026	8,5-9,6	25	26	97	130
	9,6-10,1*	10	0,81	20	83
*eps. Kivi					

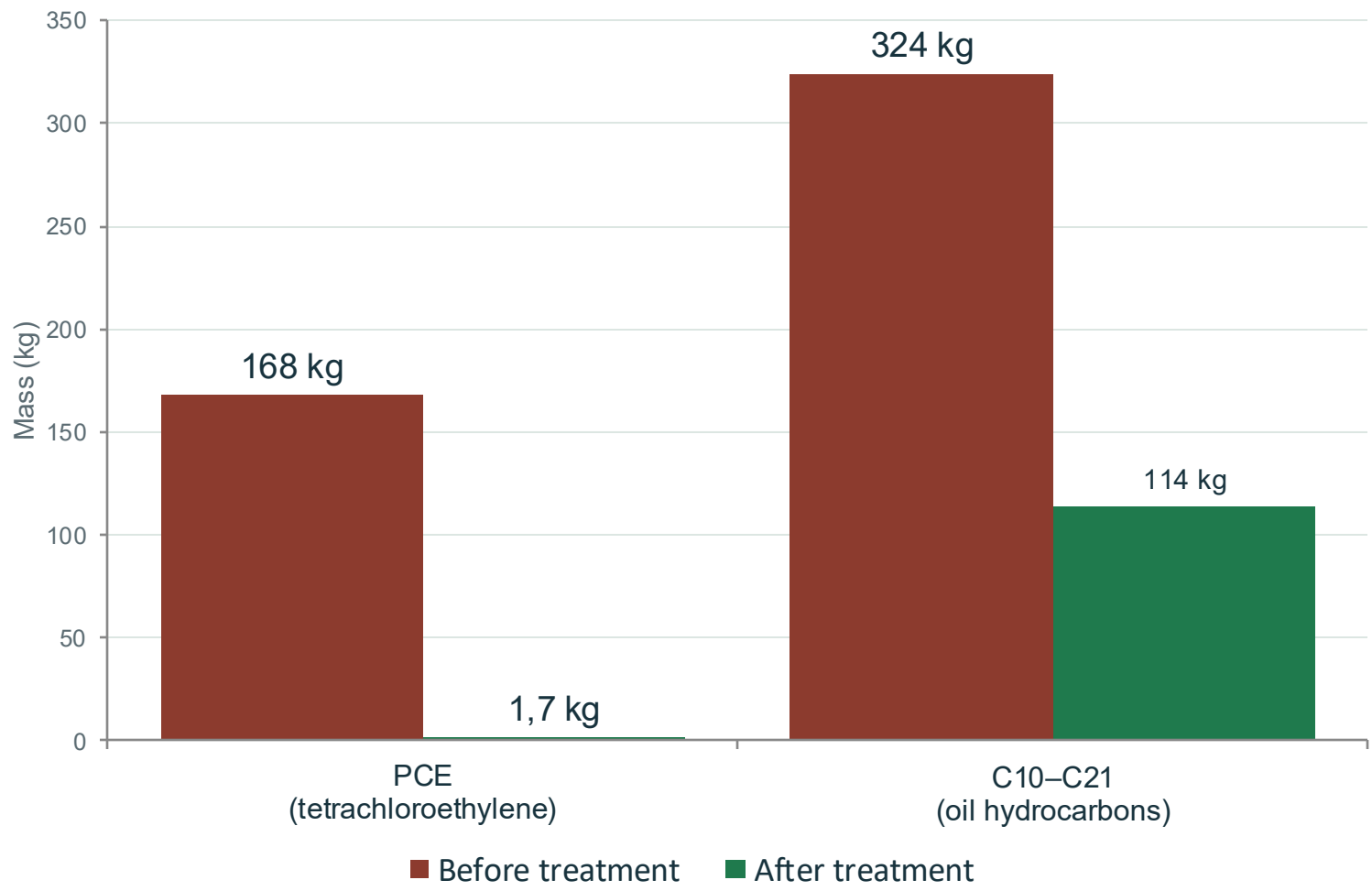
	syvyys m	PID ppm	PCE mg/kg	C10-C21 mg/kg	C10-C40 mg/kg
ENAS17	3-4	1			
3/2026	4-5	0.3			
	5-6	0.3			
	6-7	0	<0,01	210	280
	7-8	0.1			
	8-9	0.1			
	9-10	0.1	0,56	<10	<10
	10-11	0.4			



	syvyys m	PID ppm	PCE mg/kg	C10-C21 mg/kg	C10-C40 mg/kg
TW7	3-4	0	<0,01	<10	<10
6/2025	4-5	1			
	5-6	8			
	6-7	6			
	7-8	8			
	8-9				
	9-10				
	10-11				
	11-12	10			

	syvyys m	PID ppm	PCE mg/kg	C10-C21 mg/kg	C10-C40 mg/kg
ENAS10	3-4	0			
3/2026	5-6	0.2			
	6-7	1,3	0,06	<10	10
	7-8	0.2			
	8-9	0.6			
	9-10	0.8	<0,01	<10	<10
	10-11	0.3			
ENAS11	3-4	32	<0,01	<10	20
3/2026	4-5	0.3	0,05	<10	<10
	5-6	2	0,37	<10	15
	6-7	0.3	0,17	<10	<10
	7-8	10	<0,01	96	130
	8-9		<0,01	130	170
	9-10	0.3	0,1	110	160
	10-11		2,2	<10	<10
ENAS12	3-4	33			
3/2026	4-5	1			
	5-6	3			
	6-7		<0,01	<10	13
	7-8	28	<0,01	11	29
	8-9	0.7			
	9-10	0.1	0,07	<10	14
	10-11	0.4			
ENAS13	4-5	1,30	<0,01	<10	<10
3/2026	5-6	0.9			
	8-9	0.1			
	9-10	0.2			
	10-11	2,4	3,2	<10	<10
ENAS14	3-4	2,9	<0,01	<10	<10
3/2026	4-5	3,5	<0,01	13	44
	5-6	2,5	<0,01	<10	15
	6-7		<0,01	<10	10
	7-8	1,4	<0,01	<10	11
	8-9		0,01	<10	<10
	9-10		0,06	<10	<10
	10-11				
ENAS15	3-4		<0,01	<10	72
3/2026	4-5	1,5	<0,01	<10	<10
	5-6	1,3	<0,02	<10	42
	6-7	0,2	<0,01	760	970
	7-8		0,03	95	200
	8-9	0,9	1,3	<10	<10
	9-10	10,8	0,12	<10	16
	10-11	1,3	2,1	<10	44

Monitoring results: Contaminant Mass Reduction



Mass removals in remediated areas:

99% **PCE removed**

168 kg → 1.7 kg

65% **C10-C21 removed**

324 kg → 114 kg

If no installation area is included

96 – 98 % **PCE removed***

*Estimated residual PCE in no installation area: 2 – 6 kg based on one inclined sample drilling

Targets Achieved

General and numerical remediation targets both confirmed met

GENERAL GOALS

95% → 99%

PCE mass reduction achieved — exceeds the 95% threshold

✓ **"Site suitable for residential construction"** — client's consultant

→ **Protective pumping** — to be assessed later

NUMERICAL TARGETS

✓ **PCE ≤ 4 mg/kg**

soil above the groundwater table

✓ **Groundwater PCE ≤ 2 mg/l**

below the groundwater table

Key Findings & Next Steps

What worked, what to watch, and what happens next

KEY FINDINGS

- **PCE mass: lower than predicted** (own pre-work estimate 300–500 kg, actual ≈180 kg)
- **Well drilling: excellent in the road area; harder in the excavated area** (coarse fill incl. railway ballast, stony moraine)
- **Heating: very effective in the road area (silt); slower under the excavation pit** due to soil type
- **PCE removal: excellent** — project highly successful
- **No installation zone: seems no significant risk** (estimated later)
- **GW: dropped below targets, but slight rebound effect can be observed** months after the treatment — within the area and somewhat downgradient

NEXT STEPS

1. Contract negotiations
2. Decommissioning the treatment system
3. Restore Mikkolantie
4. Move traffic back to Mikkolantie
4. Update risk assessment

Thank you!