



In-Situ Remediation of an Active DNAPL Legacy Site Posing a Serious Threat to Local Groundwater

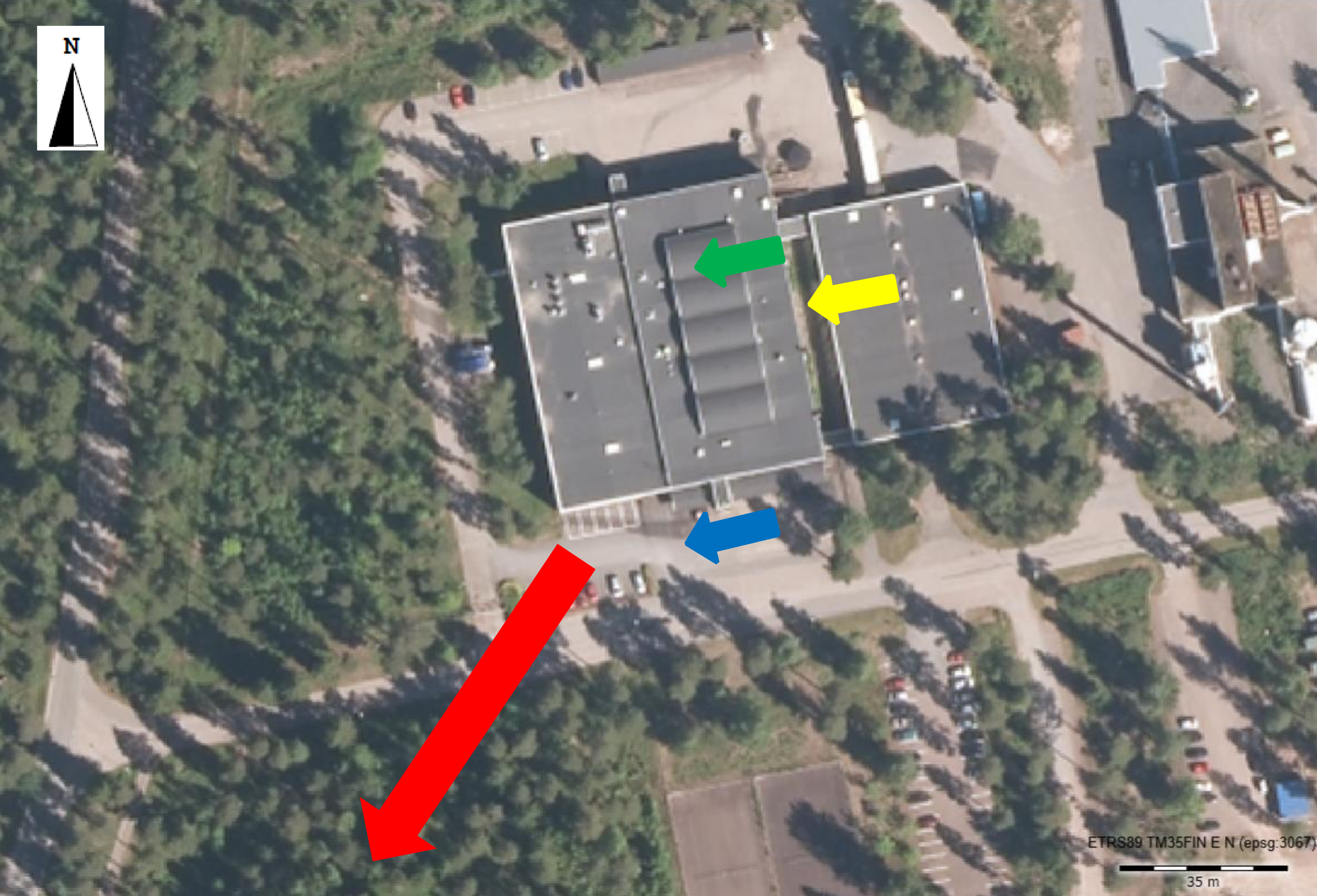


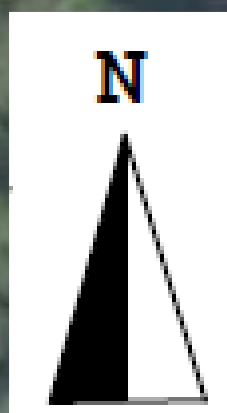
*Gabriele Giorgio Ceriani
In-Situ Remediation Services Team Leader
Ejlskov A/S*



Site History

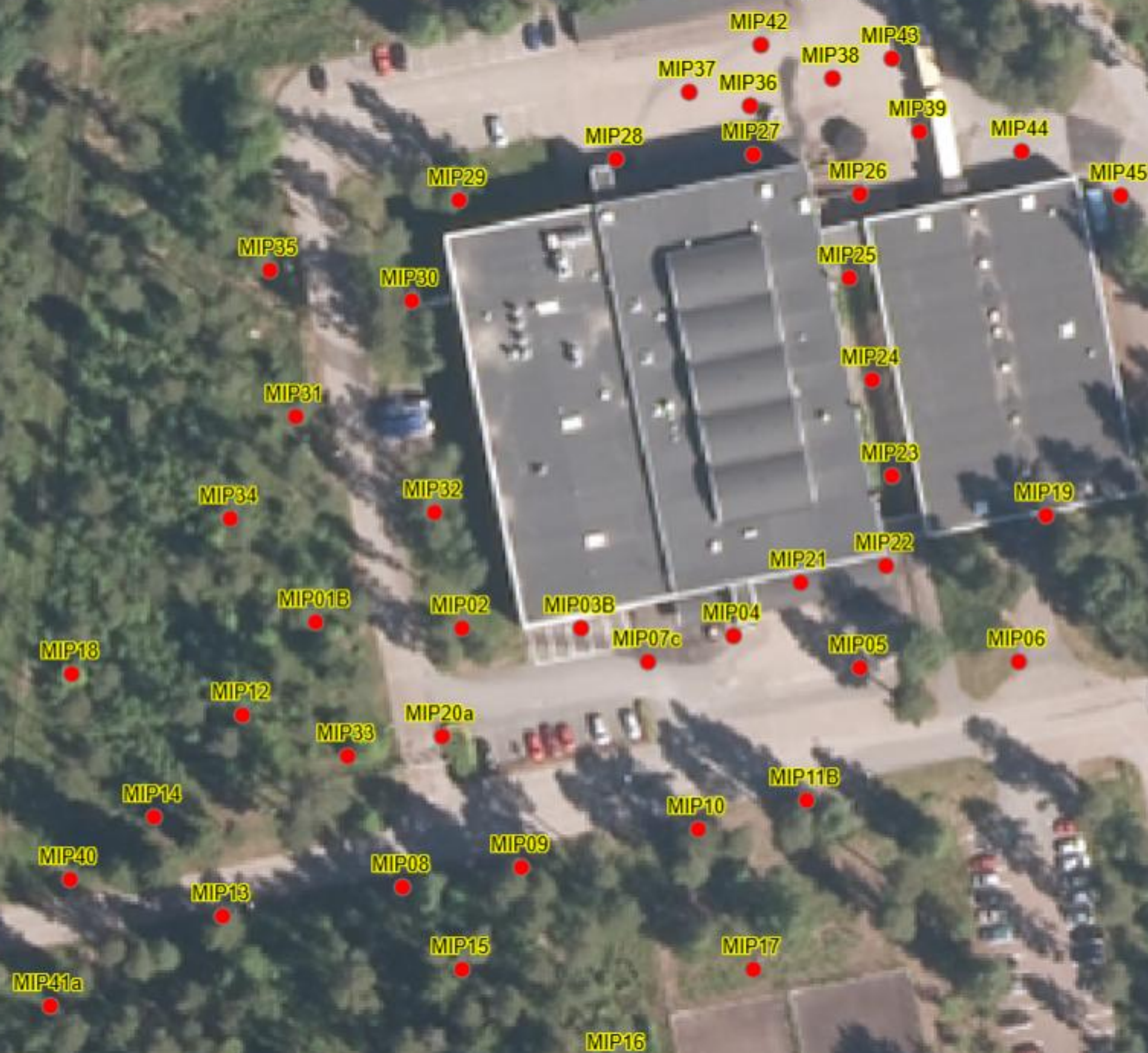
- Dry Cleaning / Repair Shop site active since the 1960s
- Excavation remediation in 2003 / 2004
- Pump & Treat active for 5 years
- Air/Bio Sparging active for few years post excavation works, then discontinued
- PCE plume forcing private house owners 2 km downgradient to discontinue pumping wells in their gardens





MIP Investigation

- Regular and Low Level MIP used to assess lateral and vertical extent of contamination
- MIP screening allowed to identify source zone located in area totally unknown to client and secondary off-site minor source zone
- Follow up soil sampling and GW wells installation based on MIP profile – TARGETED EFFORT



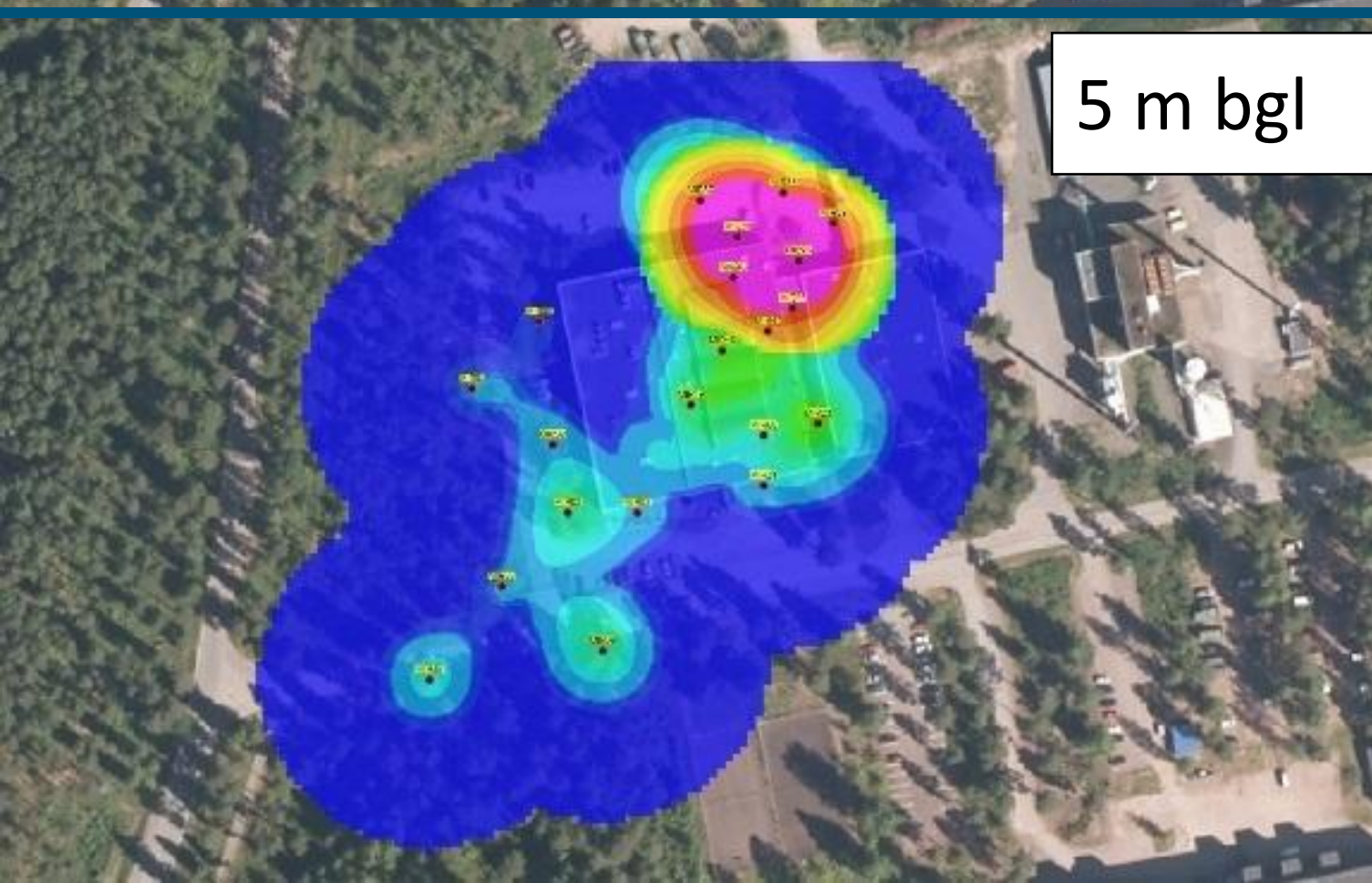
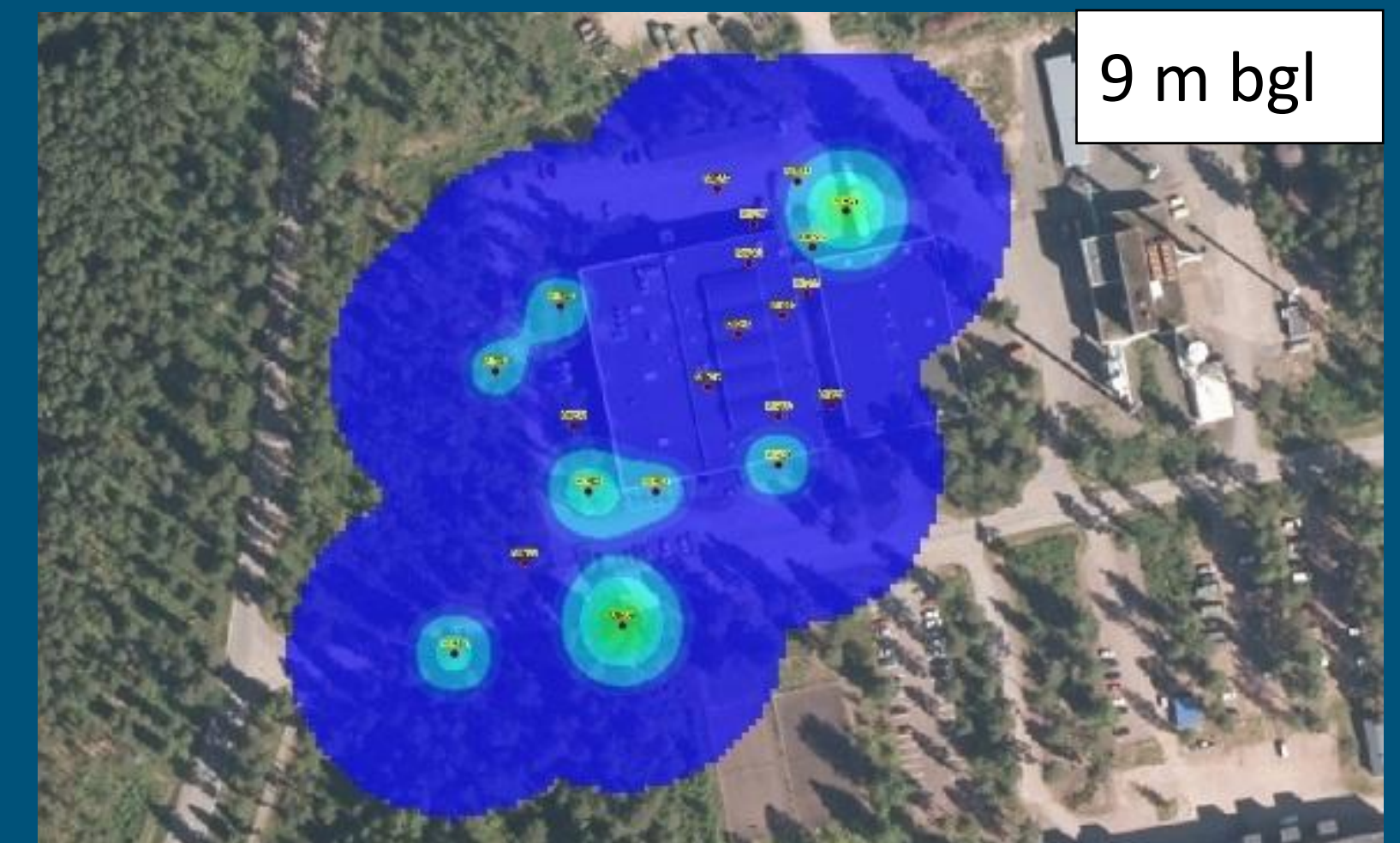
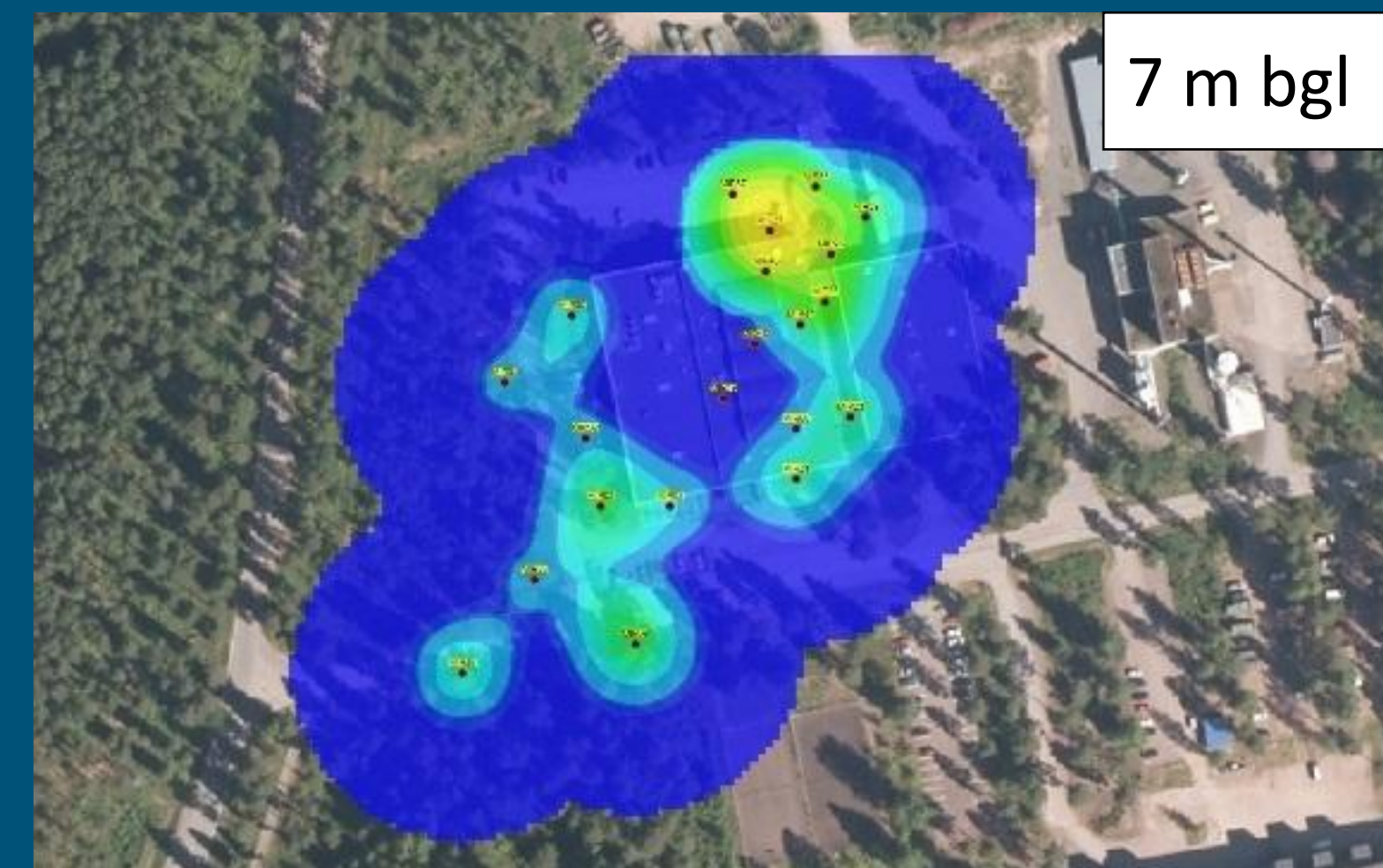
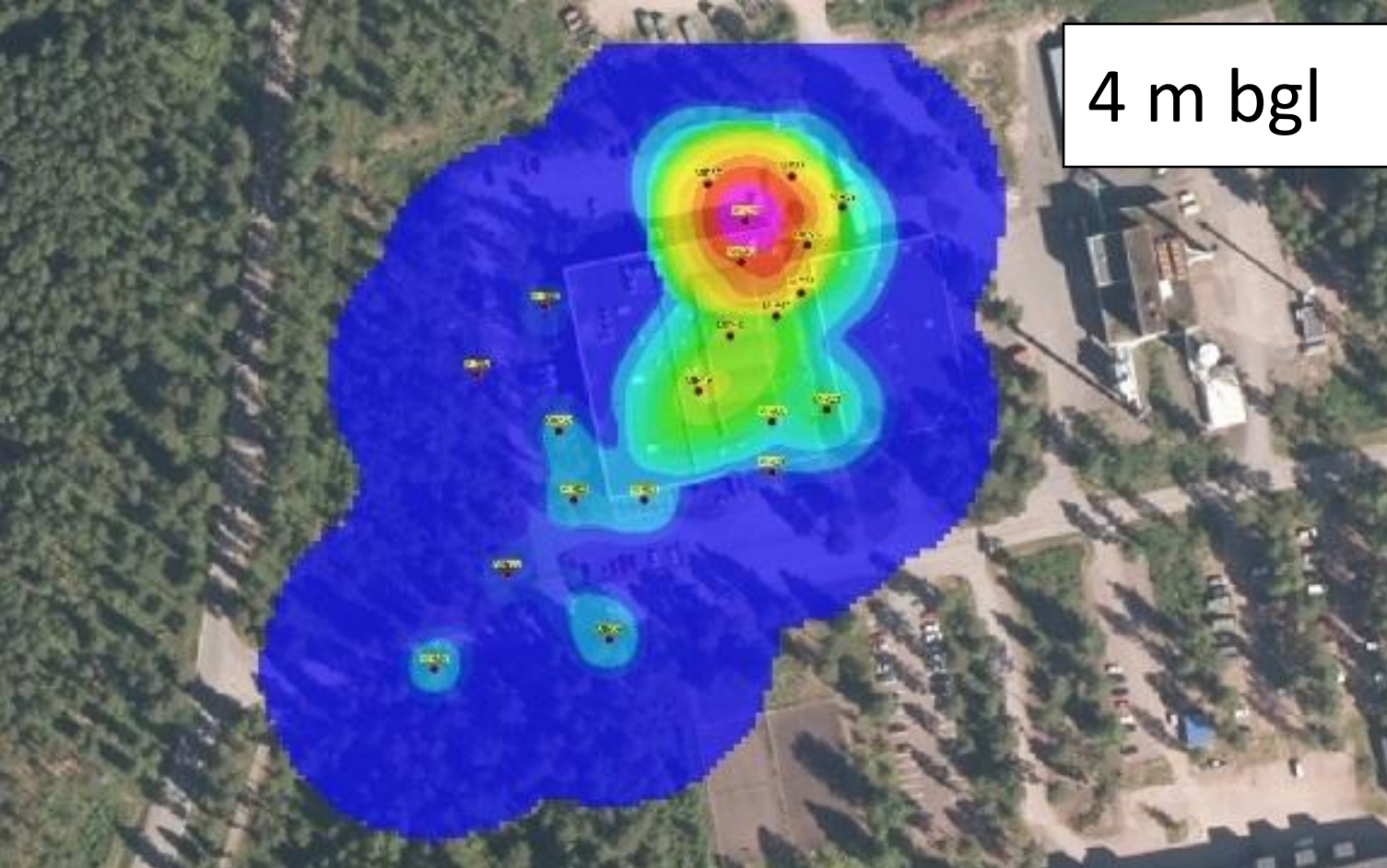
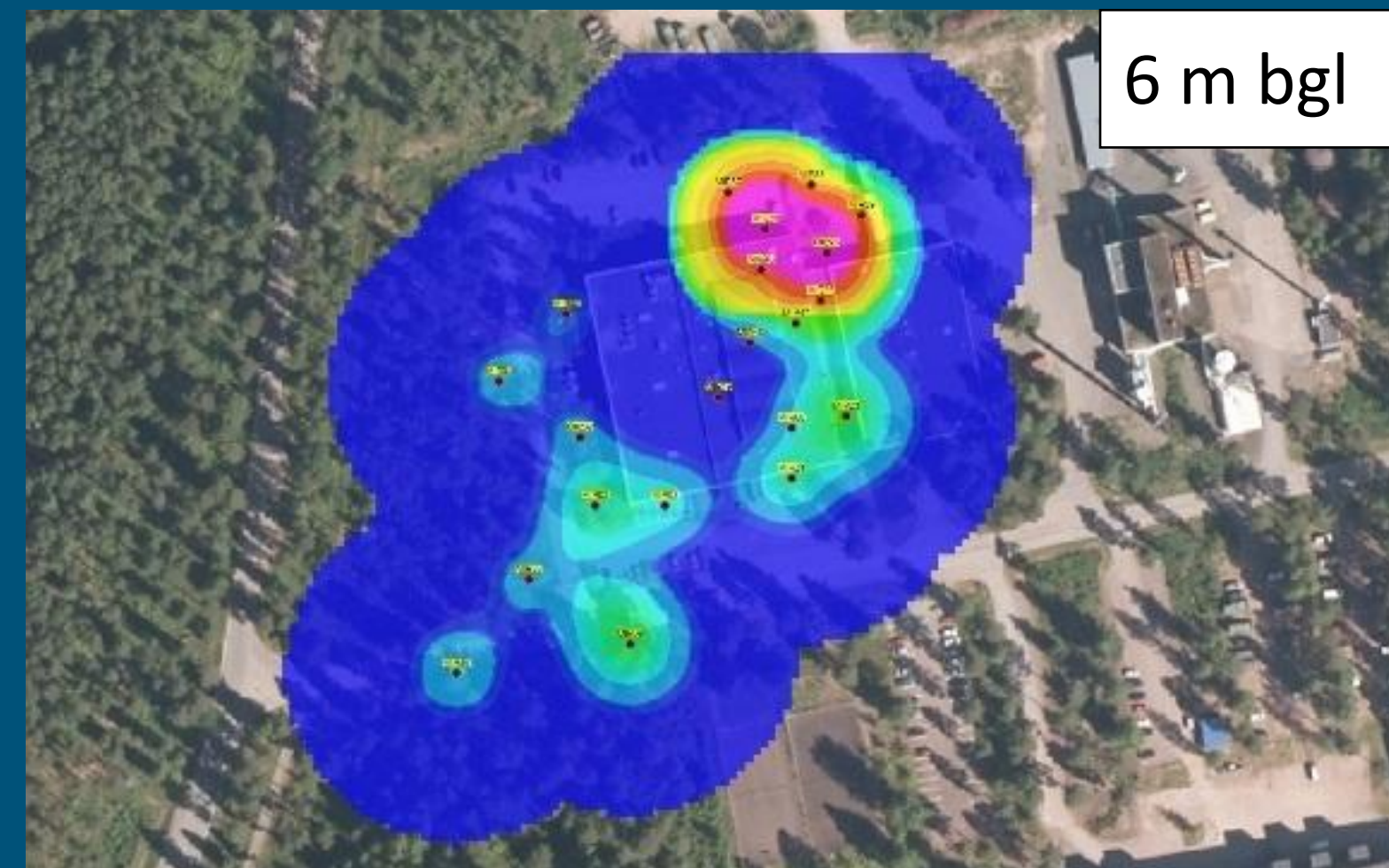
ETRS89 TM35FIN E N (epsg:3067)

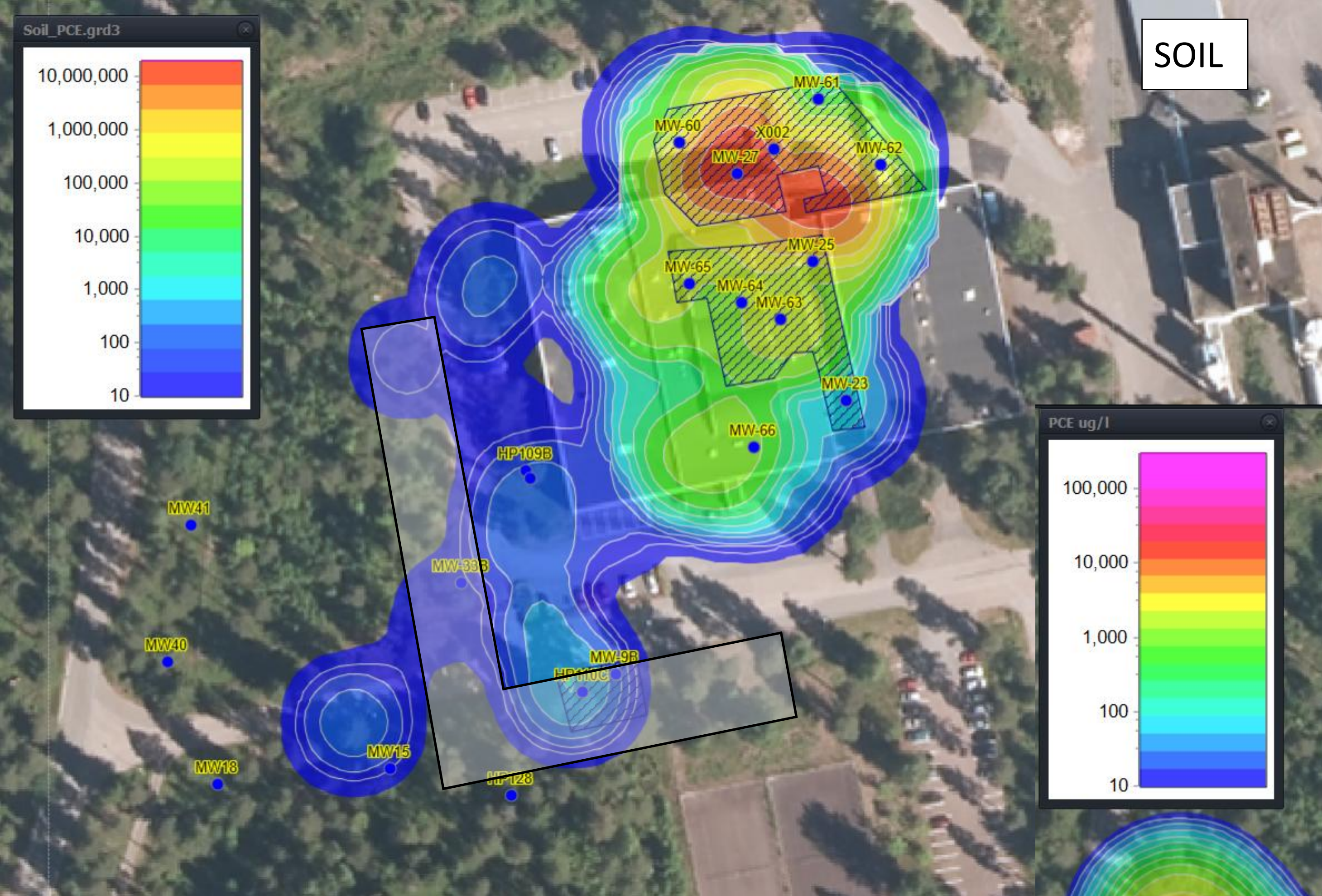
35 m

PCE Soil and MIP Data Interpolation

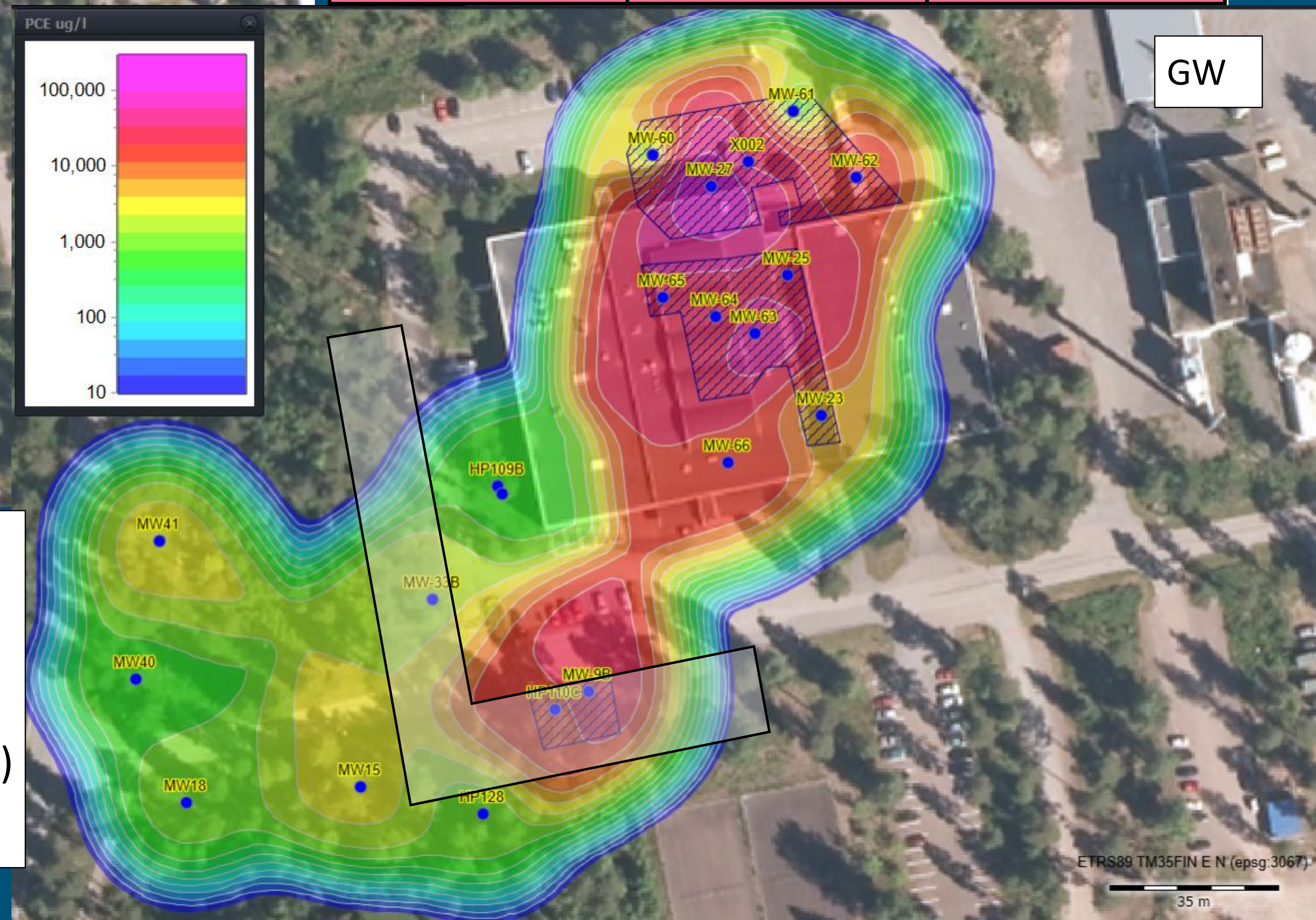
Total of >300 soil samples collected across 25 soil cores

EJLSKOV
Cleaning up the earth





<i>SUBAREA ID</i>	<i>AREAL EXTENT (m2)</i>	<i>PCE MASS (kg)</i>
AREA A	350	16,000
AREA B	500	250
AREA C	250	150
AREA D	800	1,000
AREA E	250	50

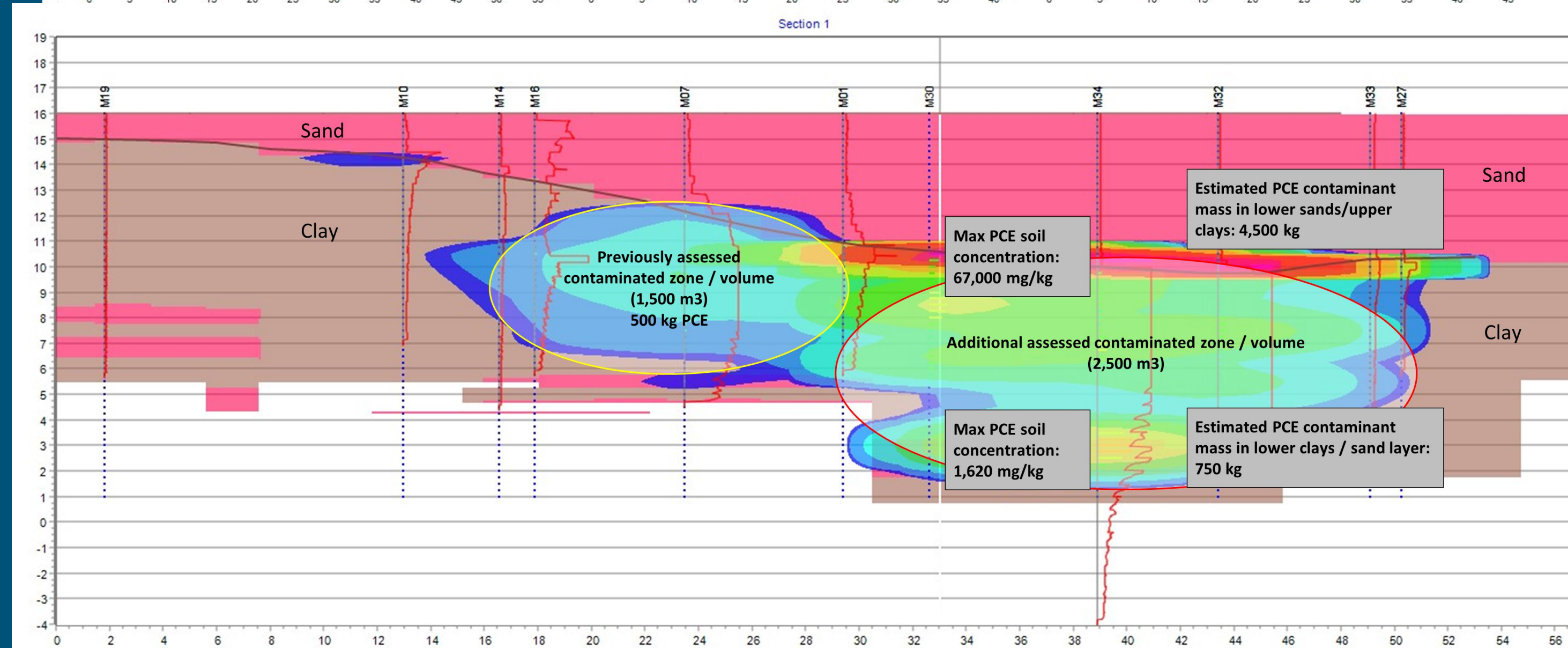
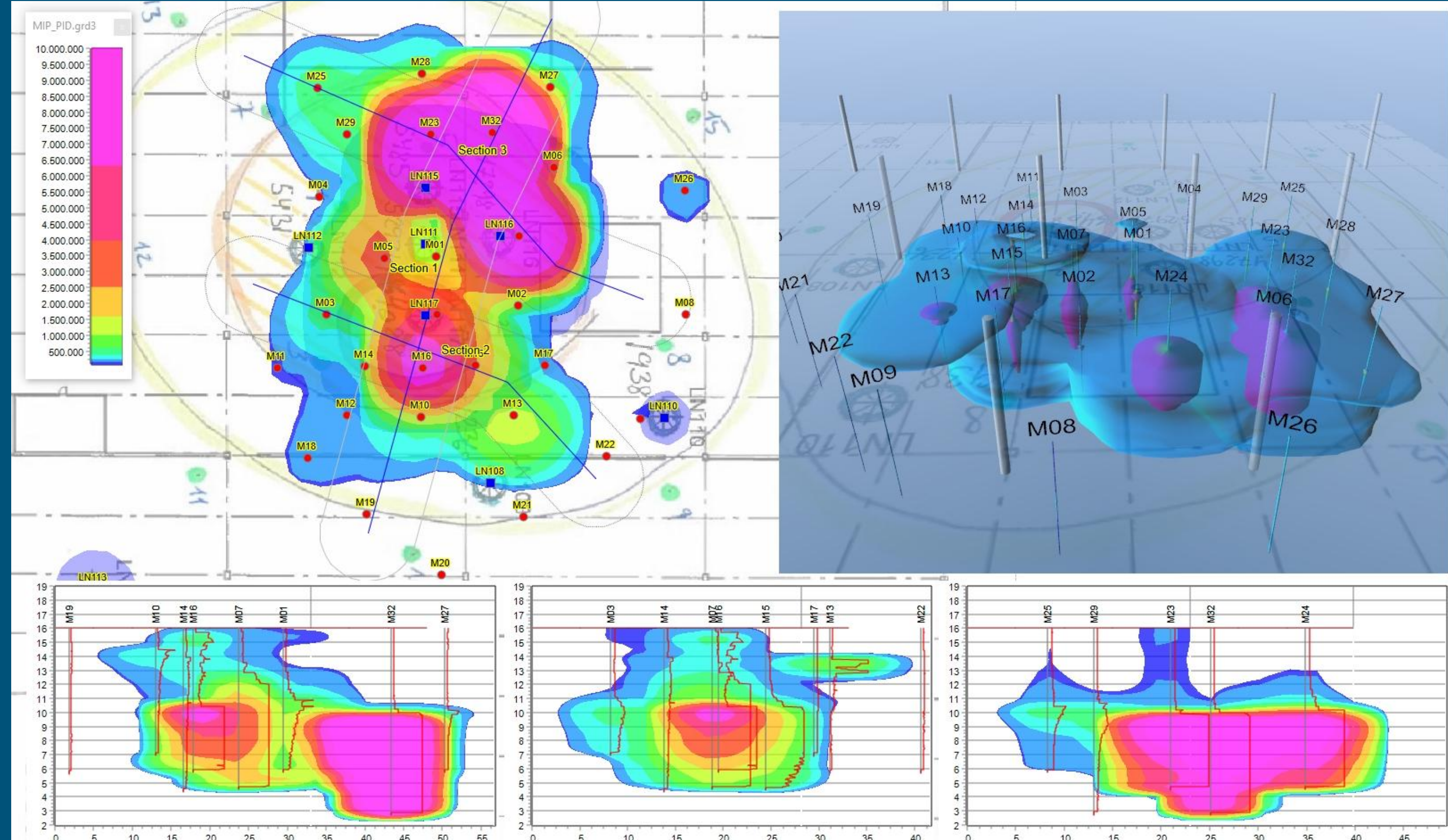


Injection works completed between April and August 2017. A total of 702 injection points were completed across subareas A through E.

Approx. 52,000 Kg of CAT100 (incl. 3,800 kg of BOS100®) were installed

Qualification vs. Quantification

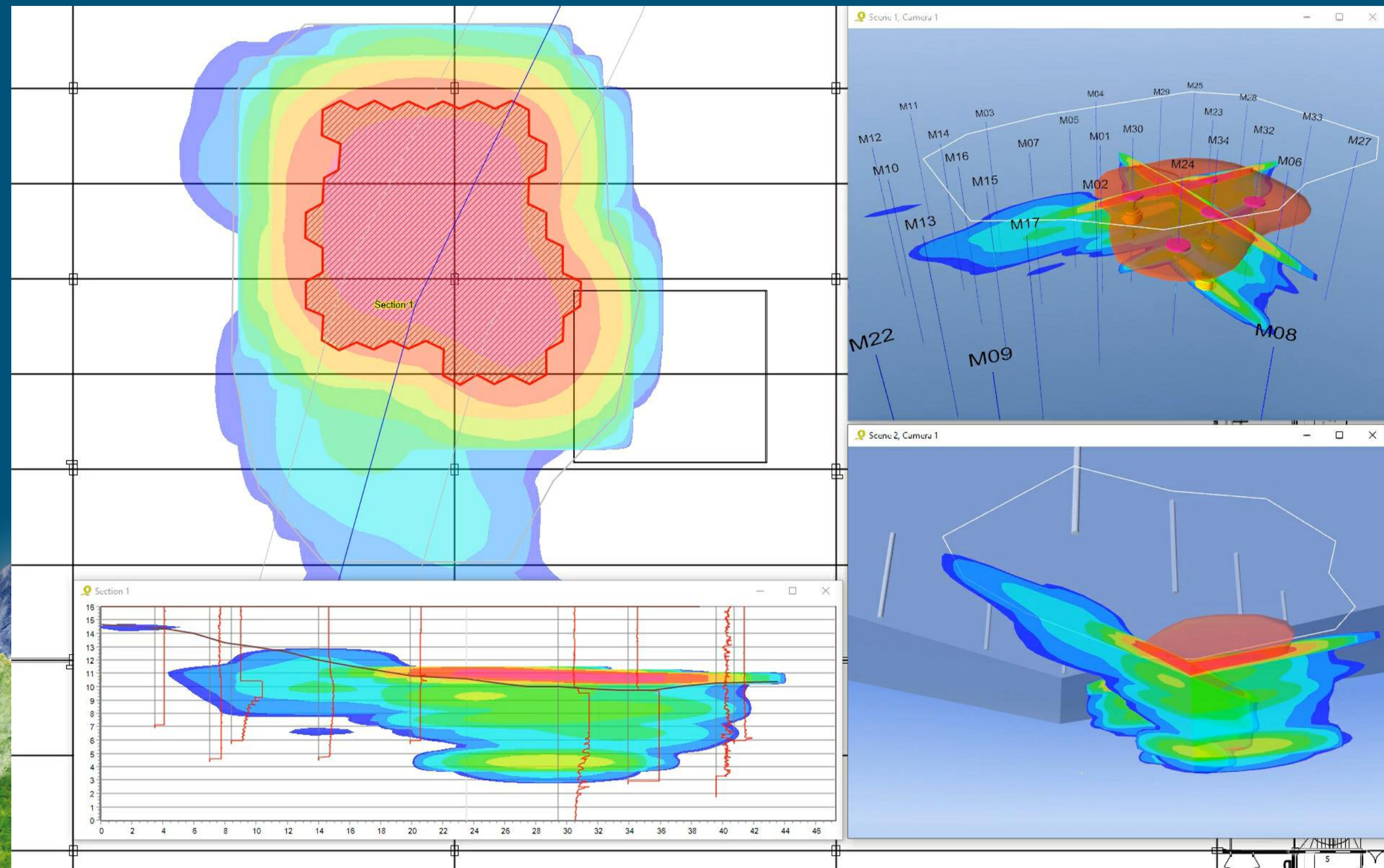
- Use of MIP investigation is highly efficient for delineating the vertical and lateral extent of the contamination at a site and guiding where samples collection should occur (soil and GW)
- MIP investigation only should never be considered a way to assess the amount of contamination at a site. **MIP results cannot be used to estimate soil or groundwater concentrations for REMEDIATION DESIGN PURPOSES!**
- MIP results can be prone to false positives, “tailing” effect and other instrumentation bias which can mislead the assessment of the actual level of contamination



Installation / Injection Features – Key to success

- Mixing of slurry on site
- Top down injections - one for every 0,5-0,6 meter
- Different system pressure settings from 0 to 170 bar and flow rates varying from 30 lpm to 920 lpm
- Nozzles set ups allowing for 40 to 220 km/h exit velocity
- Soil separation (clayey soils) vs. turbulent mixing (sandy soils)
- Injection Hoses – no loss of product in rod joints

- Pressure
- Flow & Exit Velocity
- Injection Volume vs. Slurry Density



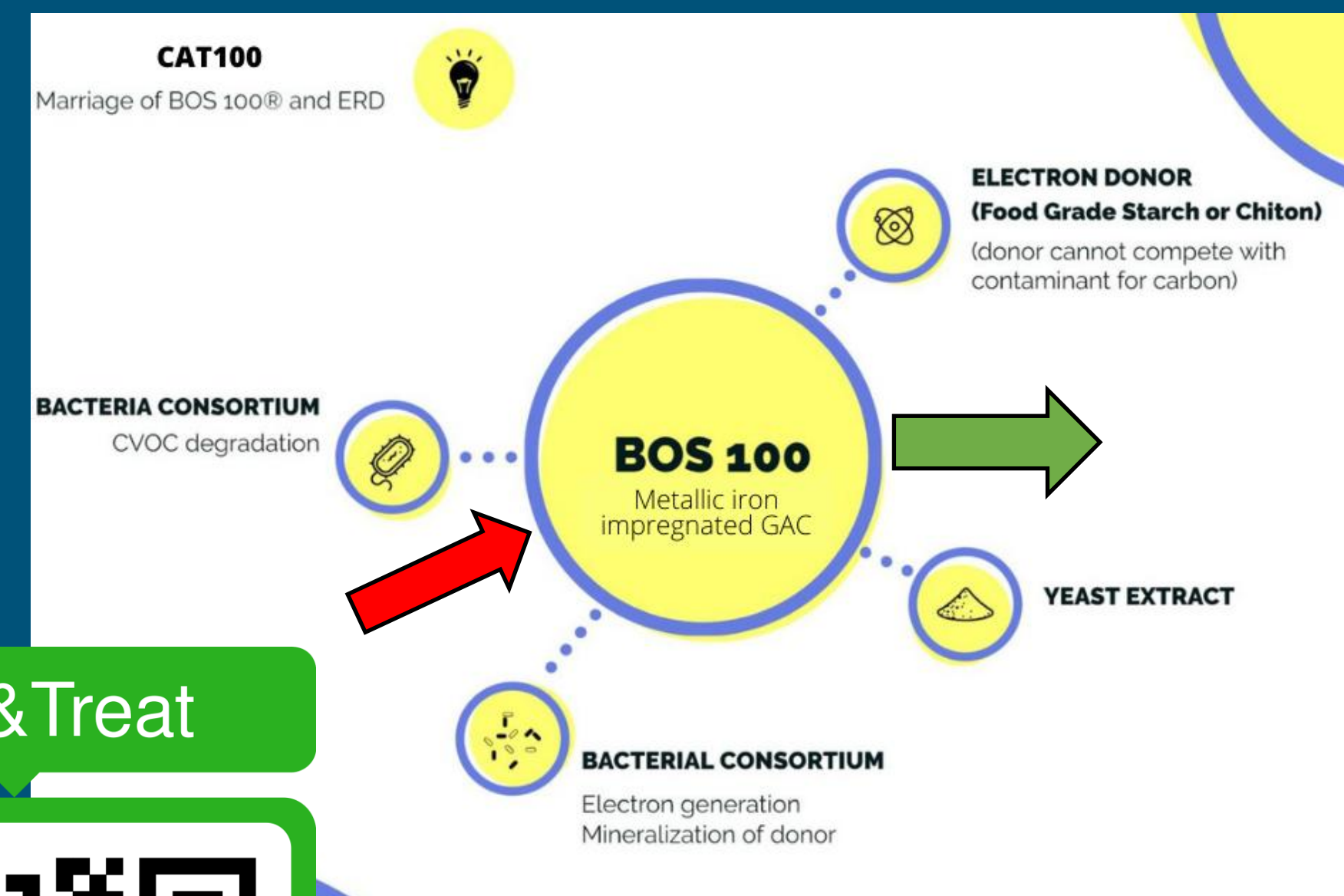
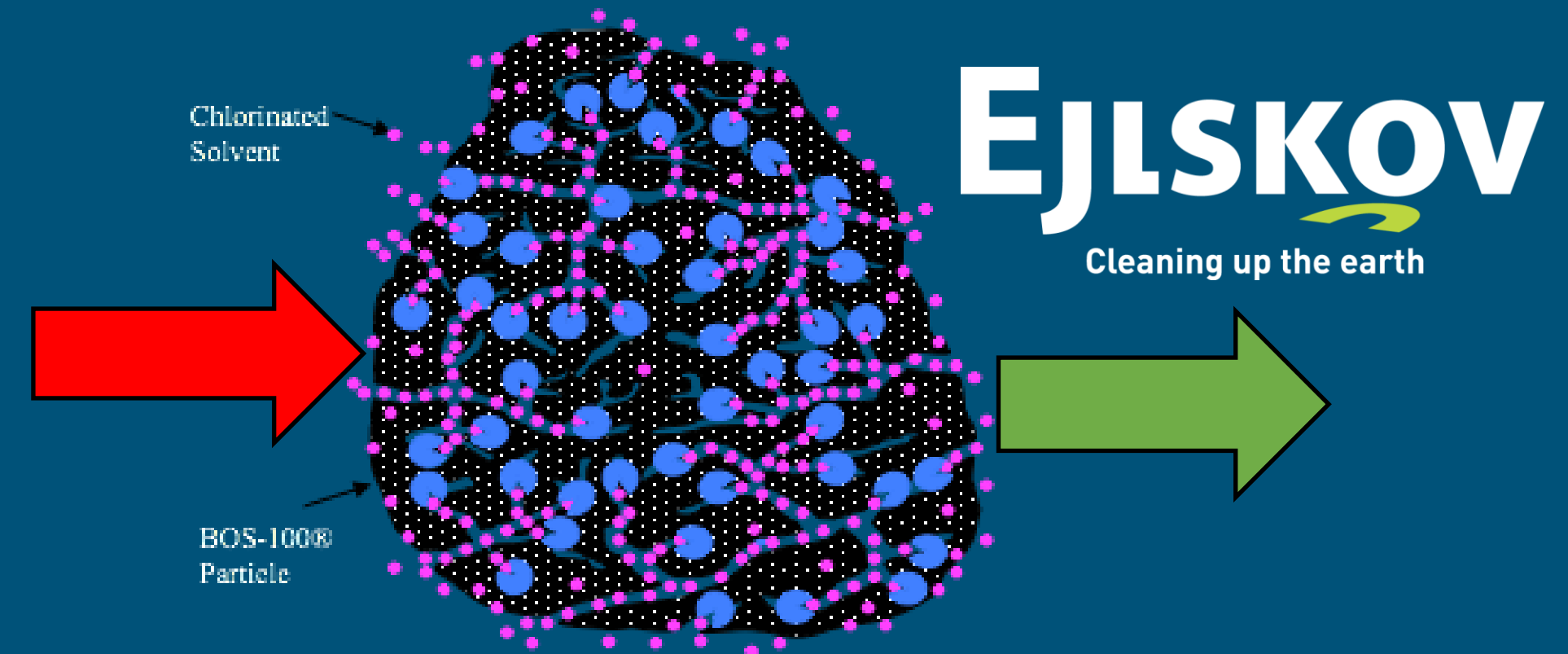
< 2.1 m (7 ft) clearance



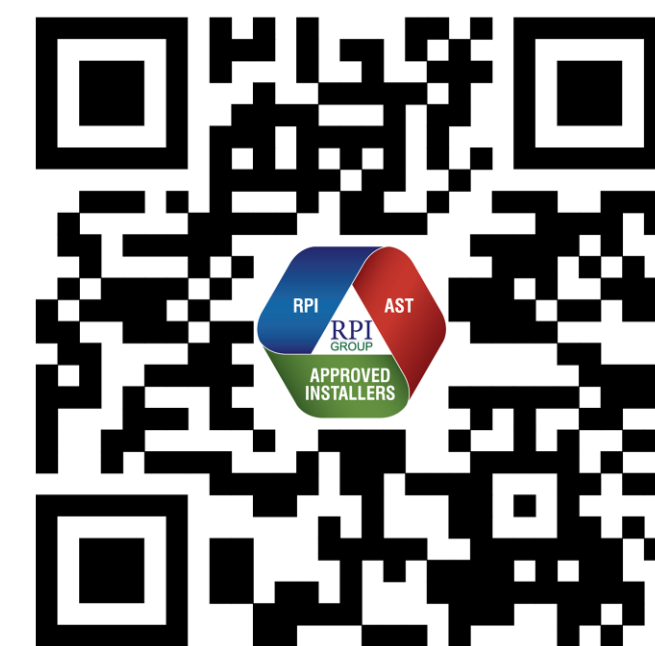
Trap & Treat Technologies (Since 2002)

BOS 100® - Granulated Activated Carbon (GAC) heated to 867 C with an iron salt solution. Mossbauer Spectroscopy shows that at that temperature, the salt is reduced, metallic iron forms, and iron is partially dissolved into the carbon lattice of the GAC. The interaction between the carbon and the metal creates unique properties not shared by ZVIs. BOS 100 degrades chlorinated solvents and other halogenated compounds (e.g., PCBs, Phenols, Lindane, pesticides, 1,4-Dioxane).

CAT 100 is an augmentation of BOS 100 that adds biological reductive dechlorination, enabling reduction through both abiotic and biotic mechanisms. To drive reductive dehalogenation, RPI adds carbon sources that, when fermented, yield electrons, hydrogen, acetate, and reduced electron carriers (e.g., NADH, reduced ferredoxin). Sources of vitamin B12 are added, as well as microbes that drive fermentation, B12 production, and contaminant degradation.

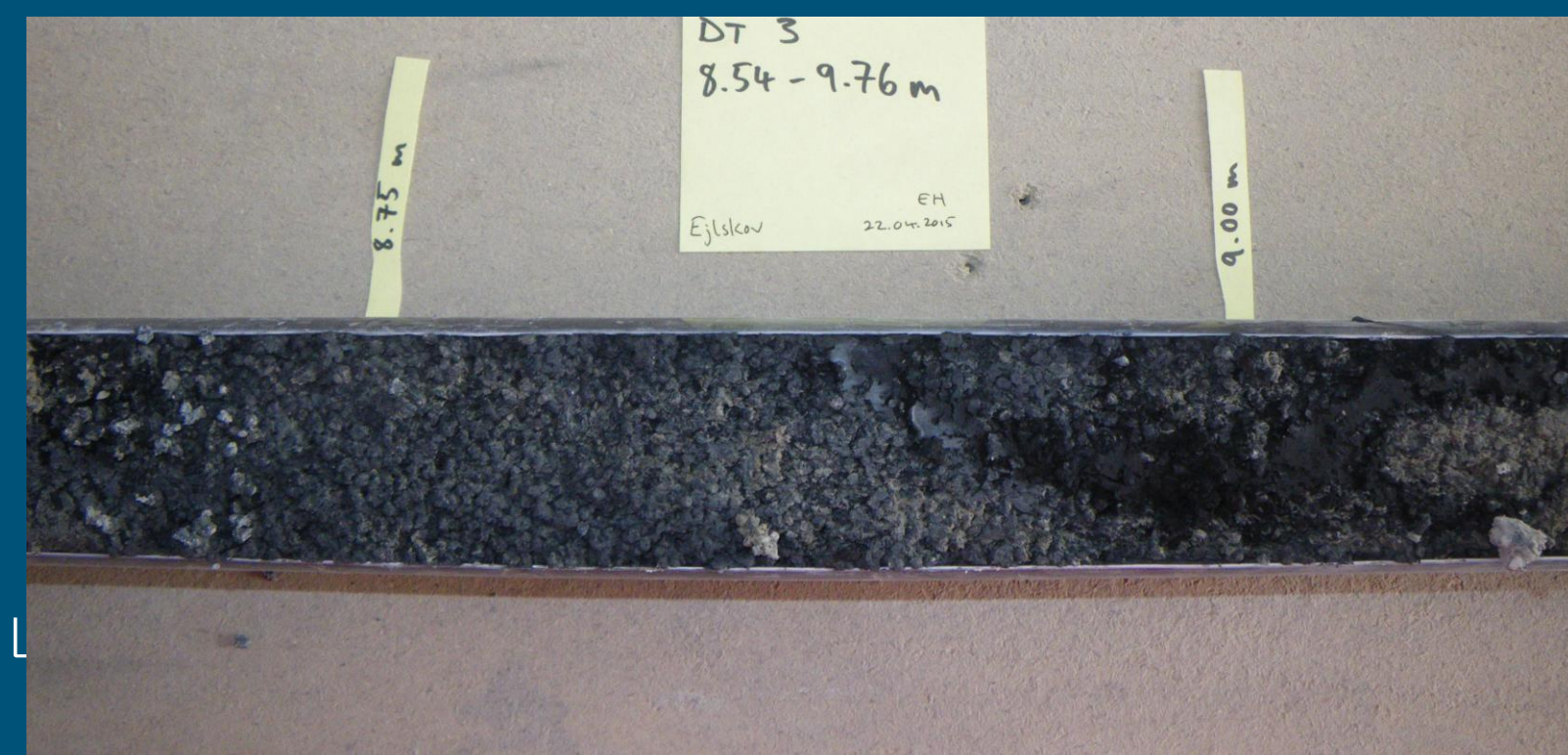


Trap&Treat

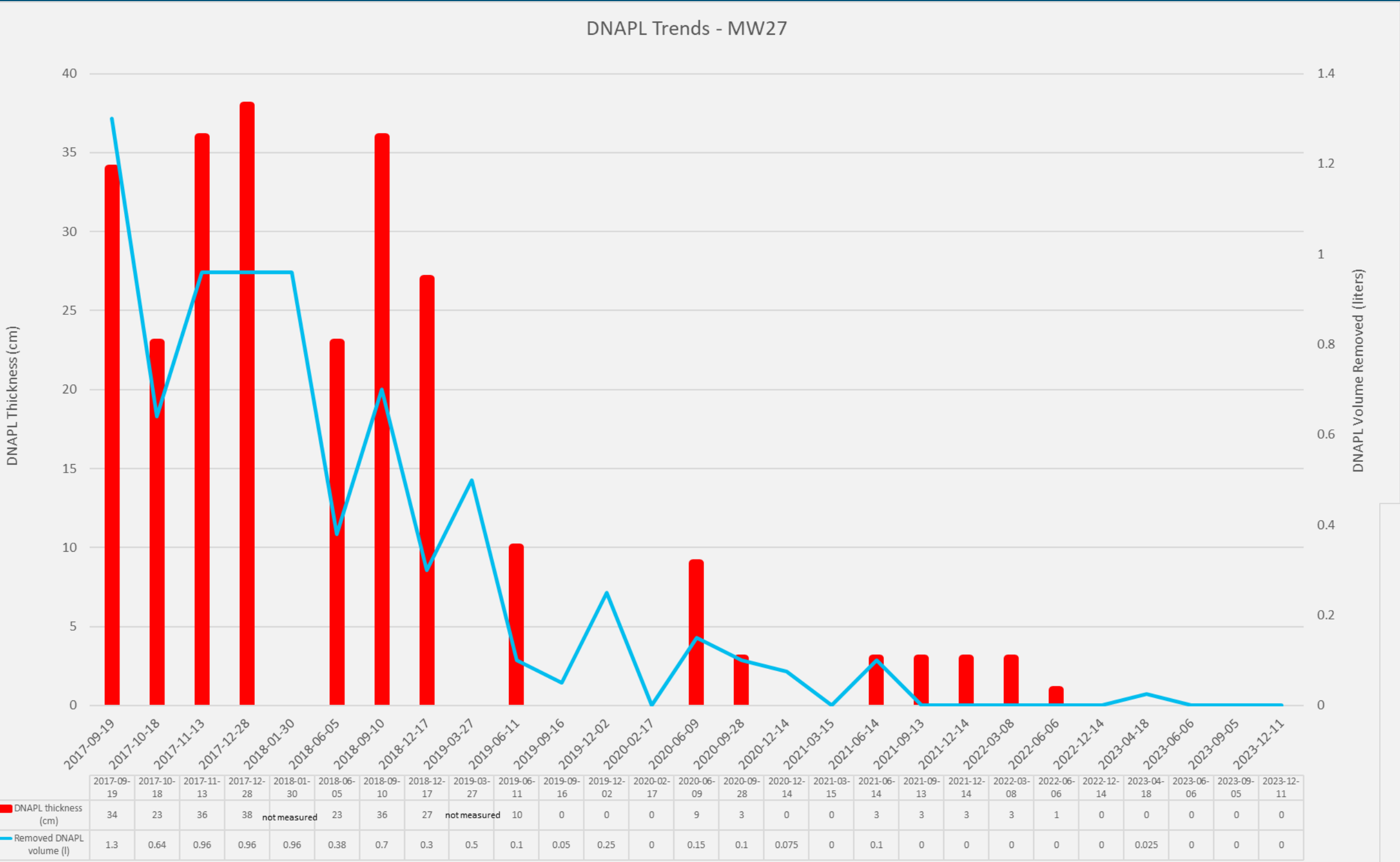


JOIN OUR MISSION - CLEANING UP THE EARTH

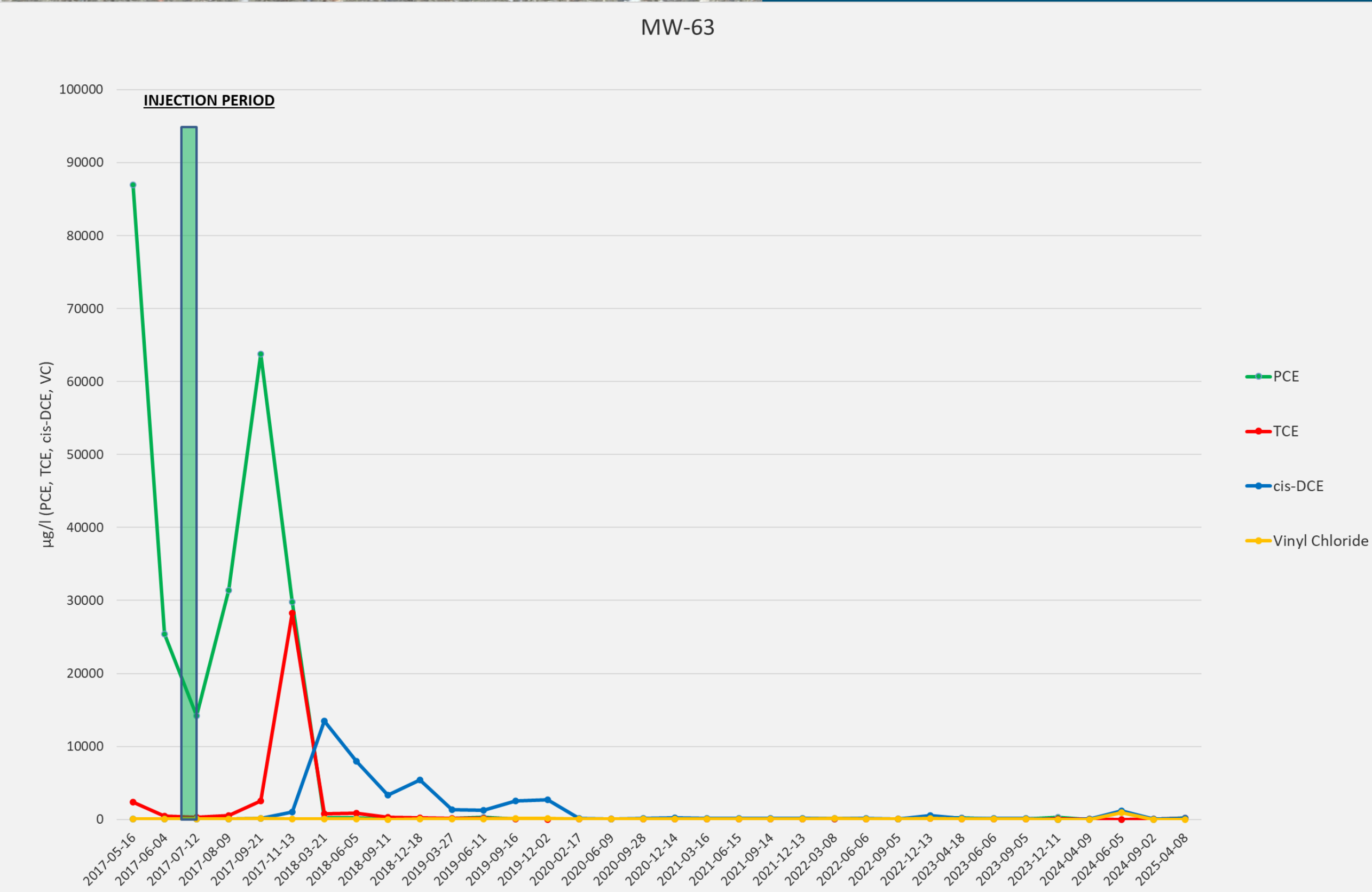
Installation evidence



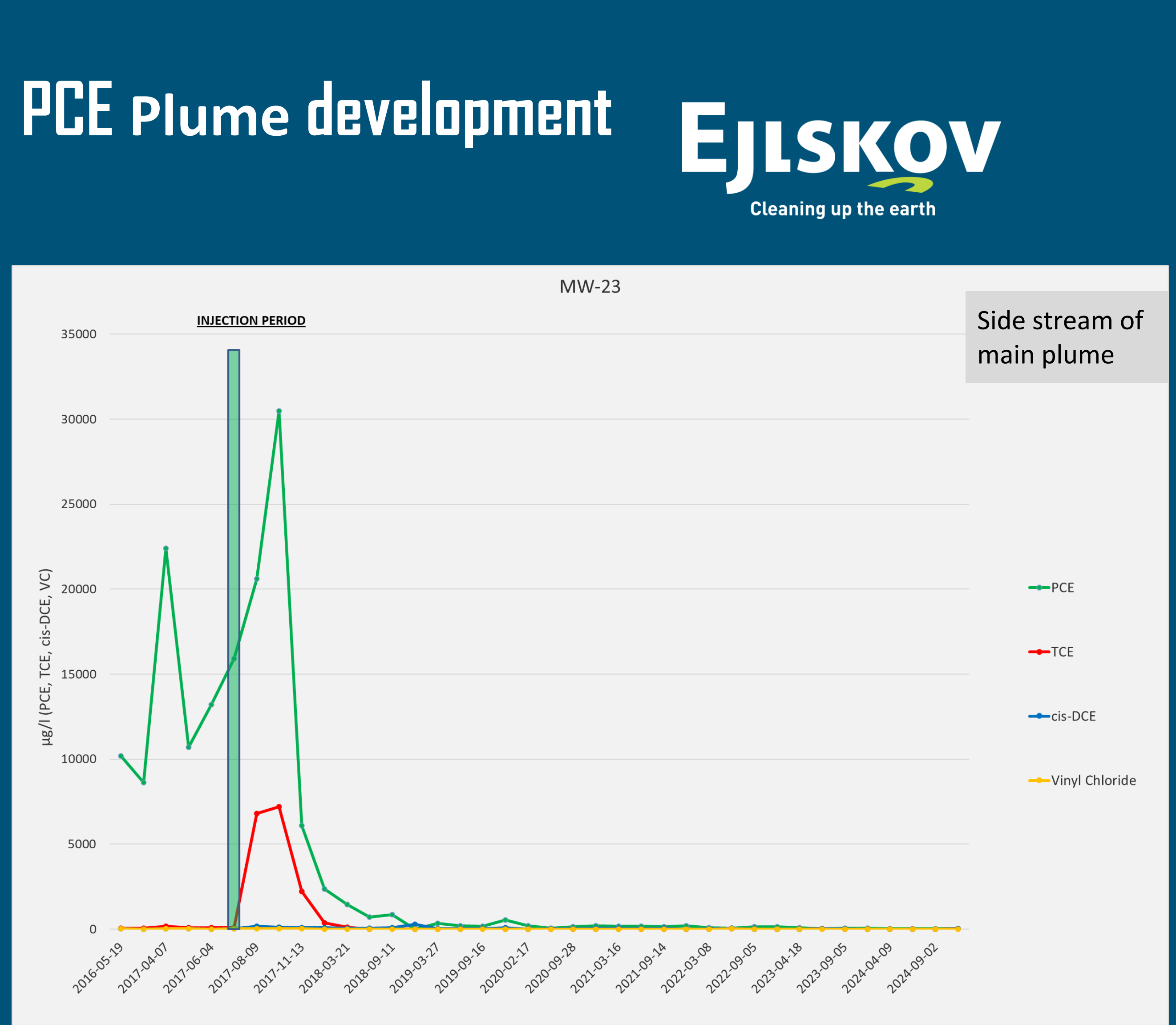
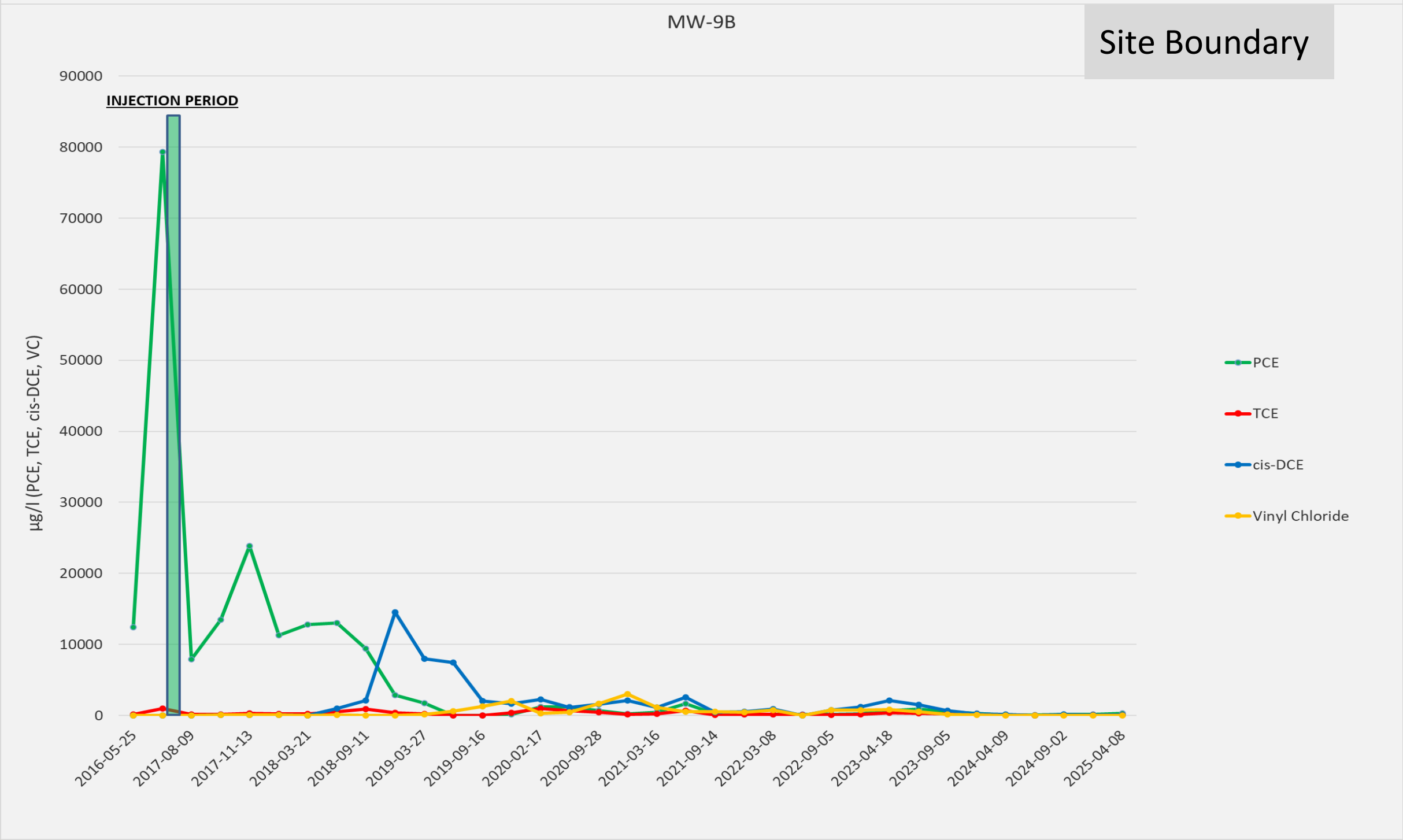
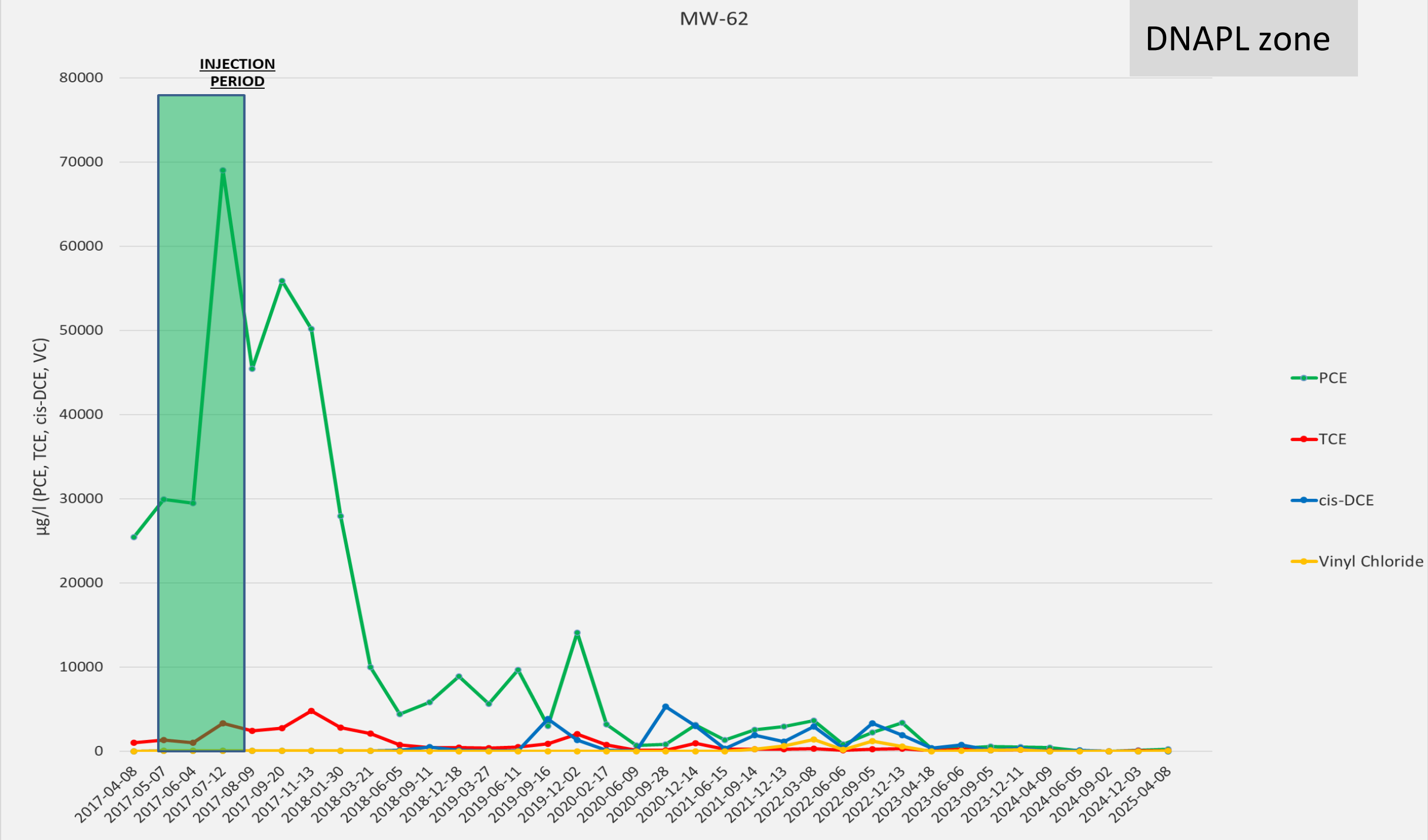
Source and Plume Treatment – DNAPL Site Treated with CAT100



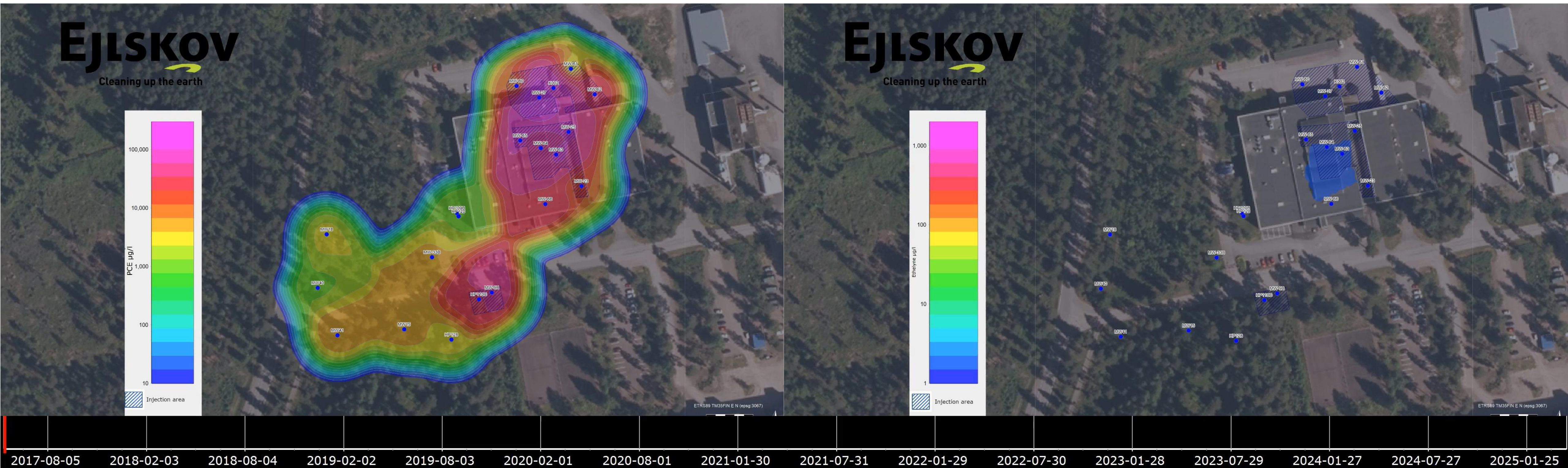
DNAPL evidence
MW27 soil core



- PCE Concentrations in soil found at 50-60,000 mg/kg Remedial Design Phase (16,000 kg of PCE in soil estimated in source area)
- Soil Validation event in Q1 2022 showed based on 1:1 comparison soil samples an estimated PCE soil mass reduction between 40 and 50% compared to pre-remediation conditions
- DNAPL no longer observed in MW27
- An extra GW well was installed close to the original MW27 showing >90% less dissolved PCE than pre-remediation level
- MW63 located directly downstream of DNAPL source area



PCE conversion to Ethylene



PCE trends

Ethylene trends



Giorgio Ceriani



EJLSKOV
ejlskov.com

