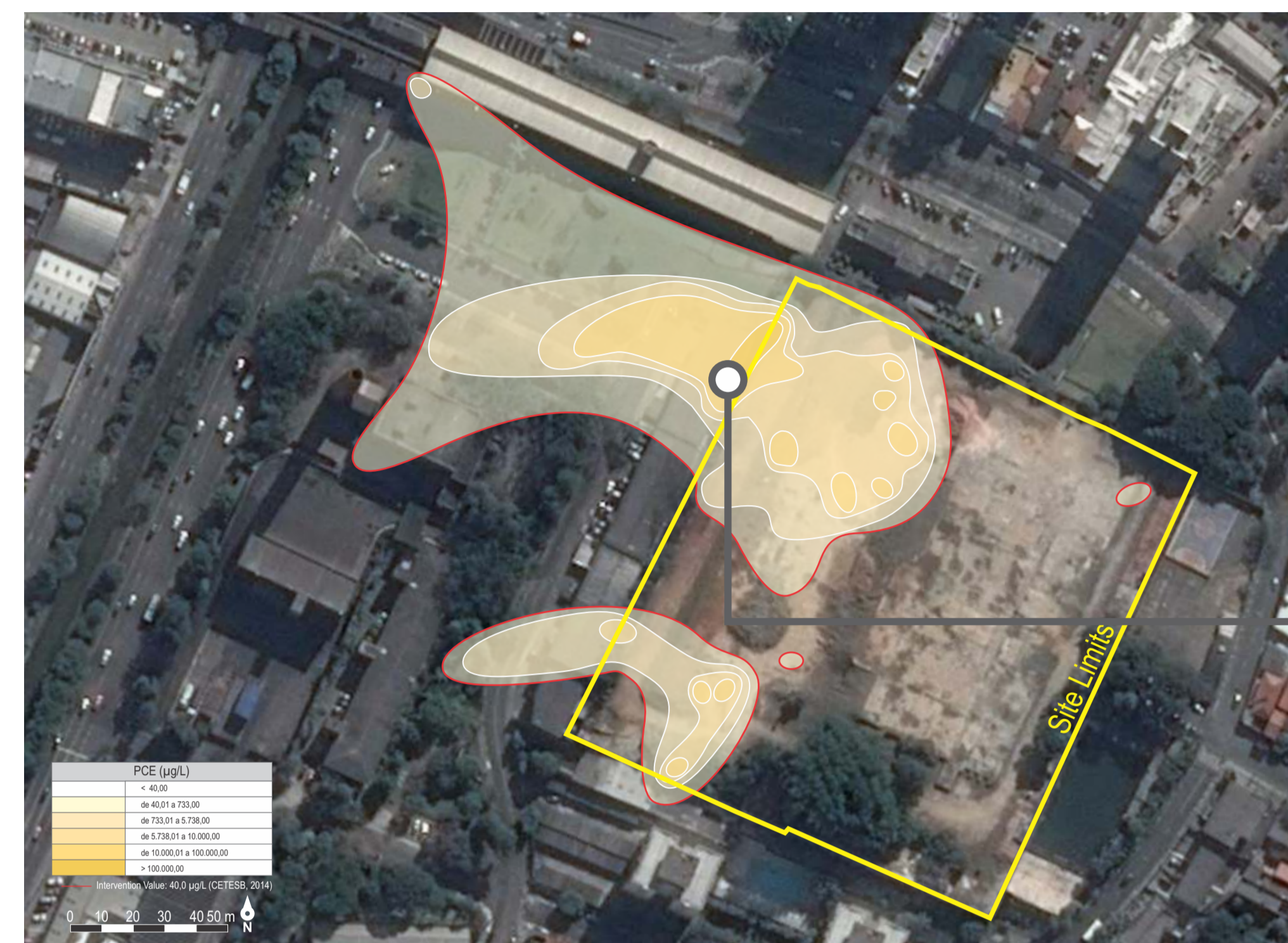


Remediation in High Complexity Site - Successful Combination of Different Technologies In a Chlorinated Solvent Contaminated Area

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Background / Objectives

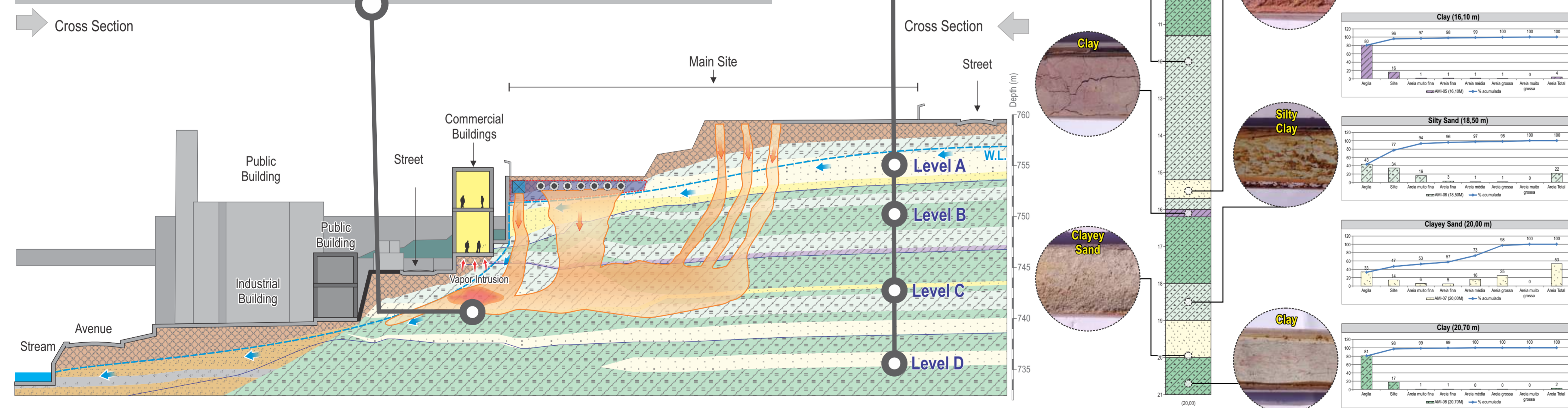


The area is a former small appliances plant located in Sao Paulo, with a complex hidrogeology and contaminated with **CVOC**, including **PCE**, **TCE**, **Cis1,2-DCE**, **VC** and **1,1,2,2-TeCA**.

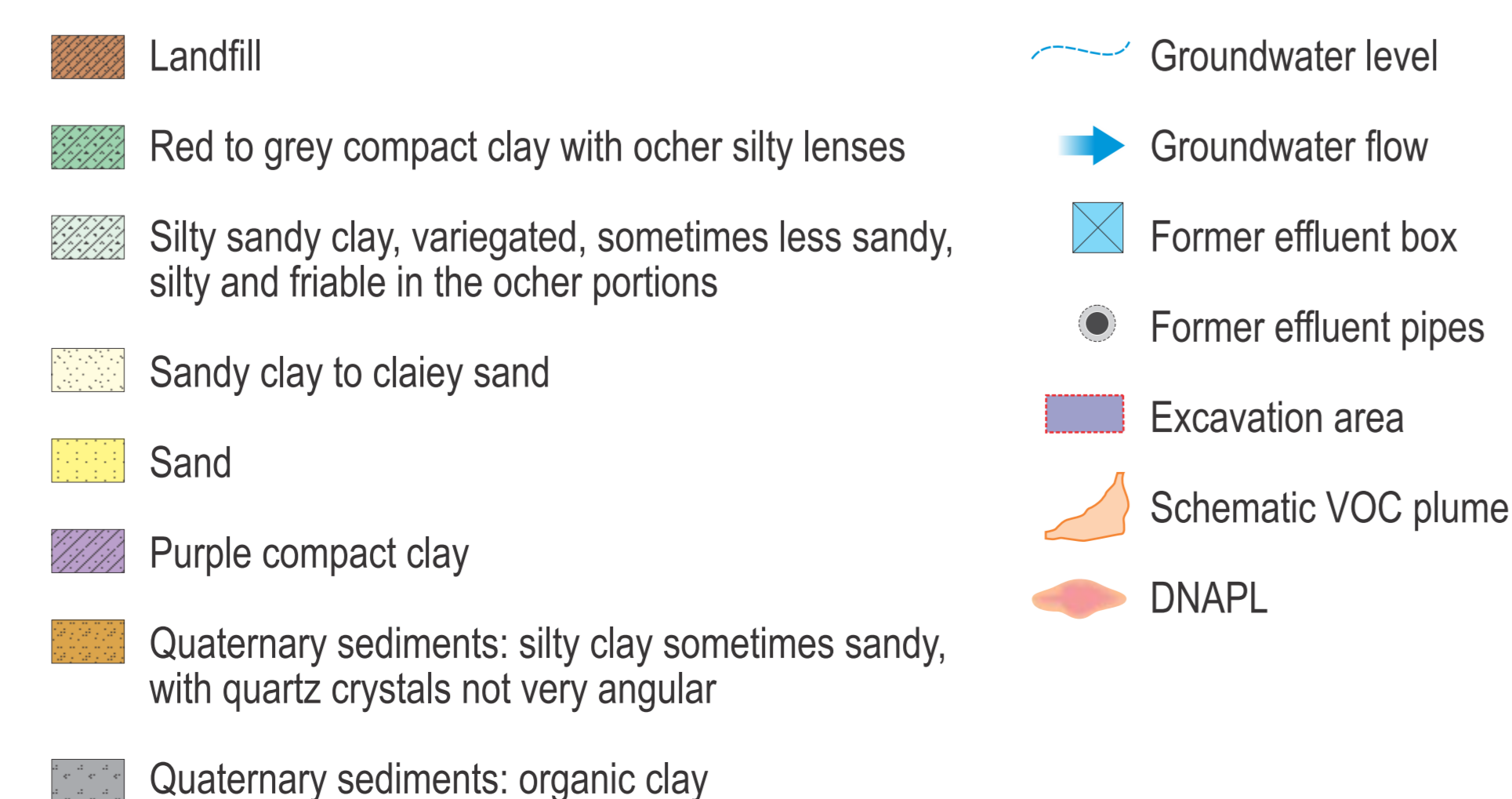
PCE was the most widespread compound and the one with the highest measured concentration in groundwater (> 200 mg/L) and in soil (26.7 g/kg).

CVOC dissolved phase plumes covered an area of about **10,474 m²** with a **thickness of 13 m** (between 4 and 17 meters below the water table).

Additionally, **DNAPL** was found in some parts of the area at different depths (from 4 to 10 m bgs).

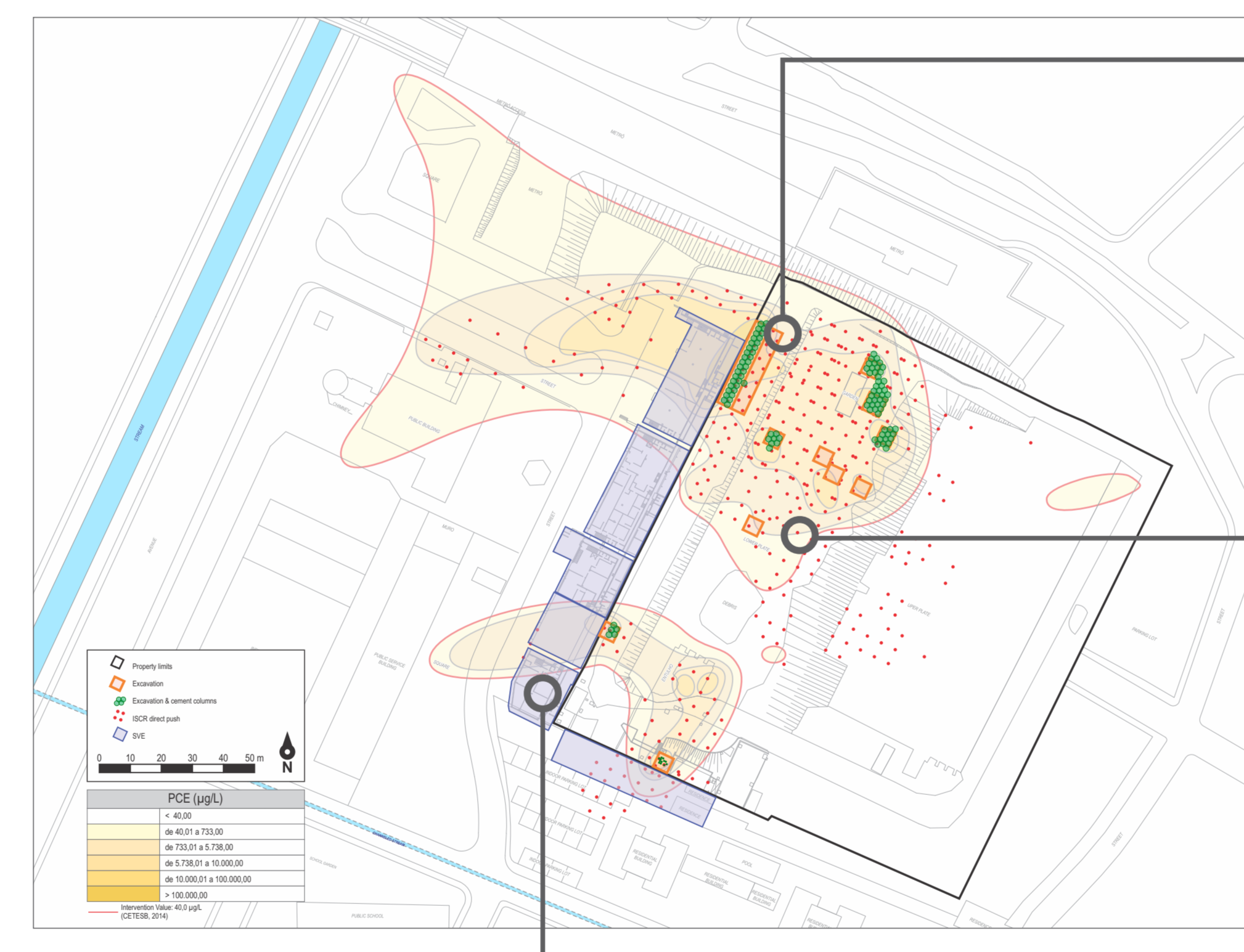


The **hydrogeological model** was found to be **very complex** with clayey layers highly contaminated crossed by sandy lenses with substantial horizontal continuity varying from 0.5 to 3 m thick. The sandy lenses dominate groundwater flow and contaminant transport.



Approach / Activities

After understanding the site's **complex hydrogeological model**, the aquifer was divided into four hydraulic levels, confined by the clayey layers. **The shallower level was considered the most important**, due to the potential of **vapor intrusion** and, consequently, human exposition to contamination.



MPE for DNAPL recovery and SVE



Prior to the beginning of the remediation, **ISCR bench and pilot scale tests** were performed, to evaluate the applicability of this technique and **optimize the full injection plan**.

The **remediation strategy** considered a synergistic combination of techniques: **soil removal and destination, multiphase extraction (MPE)** for DNAPL recovery and **in situ chemical reduction (ISCR)**, aiming the regeneration of the area for residential occupation. Additionally, **soil vapor extraction (SVE)** was employed to mitigate potential risks for the human receptors in the neighboring buildings.

Soil removal and destination



300 ton of Provect-IR® ISCR injected

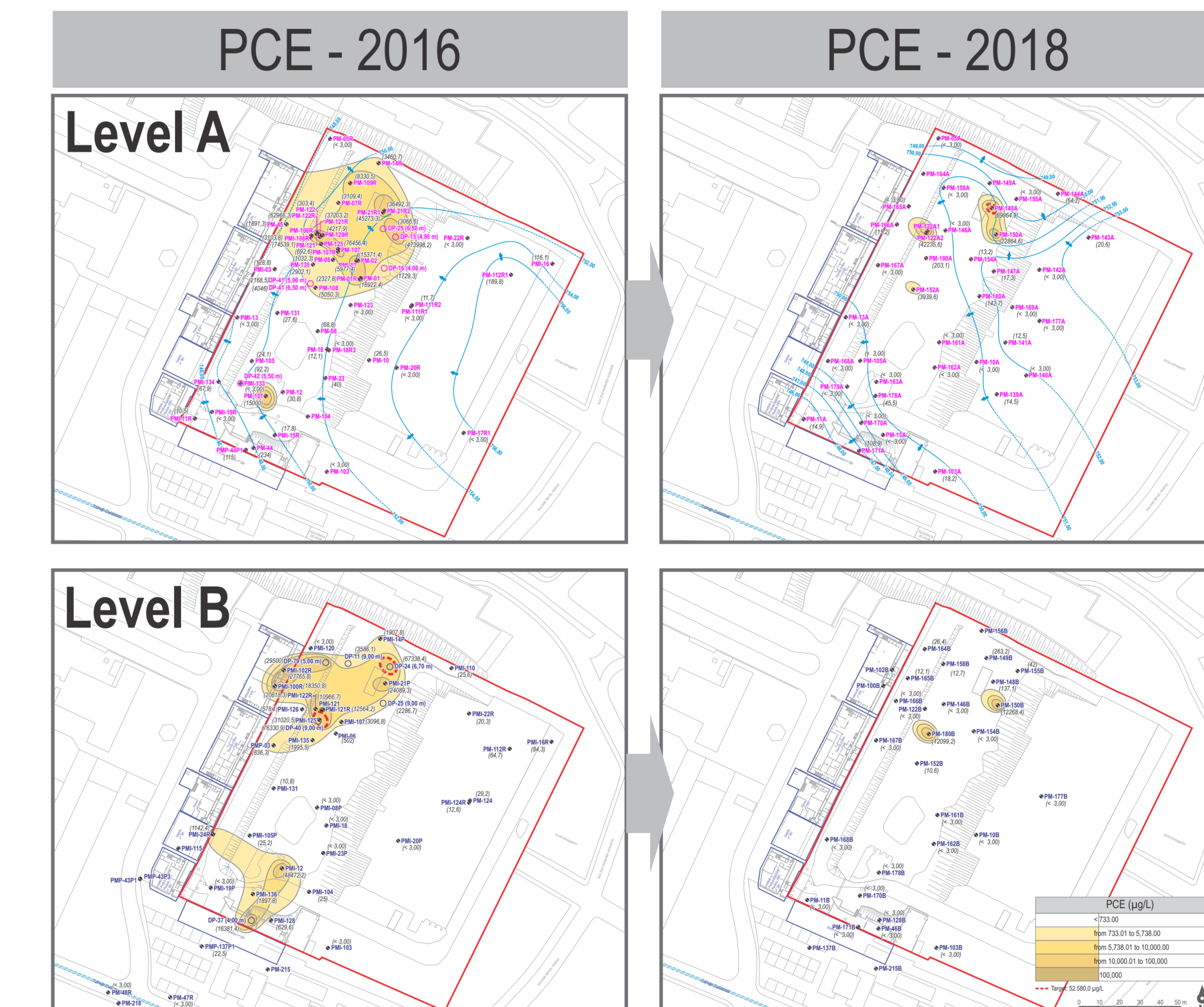


The **field scale remediation** included the **removal and off-site disposal of 24,300 ton** of contaminated soil (mainly clay, in which ISCR wouldn't be effective) and **in situ groundwater treatment** through the injection of **300 ton of antimethanogenic Provect-IR®** in **537 points** with multiple injection layers, due to contaminant distribution. **Monthly measurements of pH and ORP** were performed to evaluate the formation of the reactive zones.

Results / Lessons Learned

After 3 years since the beginning of the remediation a **reduction of 89% in the total VOC mass** was observed. Most of monitoring wells had concentrations of all COCs below the calculated SSTLs.

Only a few still showed **1,2-DCE** and **VC** concentrations above target levels, but below 10,000 µg/L (much lower than baseline concentrations) and **without parent compounds rebound**.



Fine adjustments have been made in the last year (groundwater pH buffering) aiming to create an ideal environment for **1,2-DCE** and **VC dechlorinating bacteria**. The latest results have been promising, **showing a decrease of remaining**

Now, after almost 5 years since the beginning, **the main lessons learned** from this project includes:

- ✓ The importance of **fully understanding** the contaminant and hydrogeological model.
- ✓ The capability of **compact clay to retain contamination** even after interventions.
- ✓ The **benefits of combining different techniques** in complex cases.
- ✓ The need for keeping the environment **ideal for microorganisms** to grow for ISCR.



SGW Services is a Brazilian environmental consultancy specialized in engineering, assessment and remediation of contaminated areas, audit and licensing. With solid technical skills and large experience in environmental projects in Brazil and Latin America, operates in the most diverse sectors of market in an efficient, transparent and responsible way.

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