Accelerating Brownfield Revitalization with Thermal Processes

GMREMEDIATIONSYSTEMS

Thermal Remediation

Brownfield Revitalization

Brownfields are former industrial zones in urban centers which have to be requalified for residential an commercial use in order to increase the living quality and –standards in these areas.
But land developers are facing high costs and prolonged time lines in their attempt to decontaminate these contaminated brownfields.
Our solution addresses those major problems : Cost, time frame and project risks.
The target contaminants are volatile and semi-volatile chlorinated organic compounds (e.g. Perchloroethylene) and hydrocarbons (e.g. Benzene)

Our Solutions - Thermal Remediation

Process Principles:

Volatile and semi-volatile contaminants (BTEX, CHC) are evaporated heating the subsurface with heating elements or by injection of steam/air mixture into the saturated and non-saturated soil zone.

The soil vapor charged with the evaporated contaminants is removed from the subsurface by vacuum extraction systems and subsequently treated with active carbon filters or by catalytic incineration.

The process is in particular well suited for hotspot areas containing organic compounds with a boiling temperature below 211°C. Due to the almost complete removal of contaminants the contaminant flux into the groundwater discontinues and a feeding into the contaminant plume does not take place anymore. Moreover, known environmental risks for the reuse of brownfields, such as vapor intrusion, can be excluded. A variety of process alternatives has been included into the heater design, allowing to adjust the process during operation in order to optimize project results.

With our experienced team of engineers and our locally produced equipment, we are able to offer competitive service packages to our clients.

Our Solutions – Thermal Remediation

Soils with a low hydraulic conductivity can be heated instead of the steam/air mixture with electric heating elements.
Our unique design allows the sequencing of different processes in the same injection point, optimizing the operation. This is especially important in saturated zone remediation projects.

Heating Elements

Produced in a special alloy, temperatures up to 1,200°C are possible, the system is flexible. Usually, distances between 4-6m are the norm.

Control Panels

Designed for rough conditions in the field, they are continuously optimized for lower power consumption and higher automation integration.
Voltages range between 3x220/380/440V, 50-60Hz.

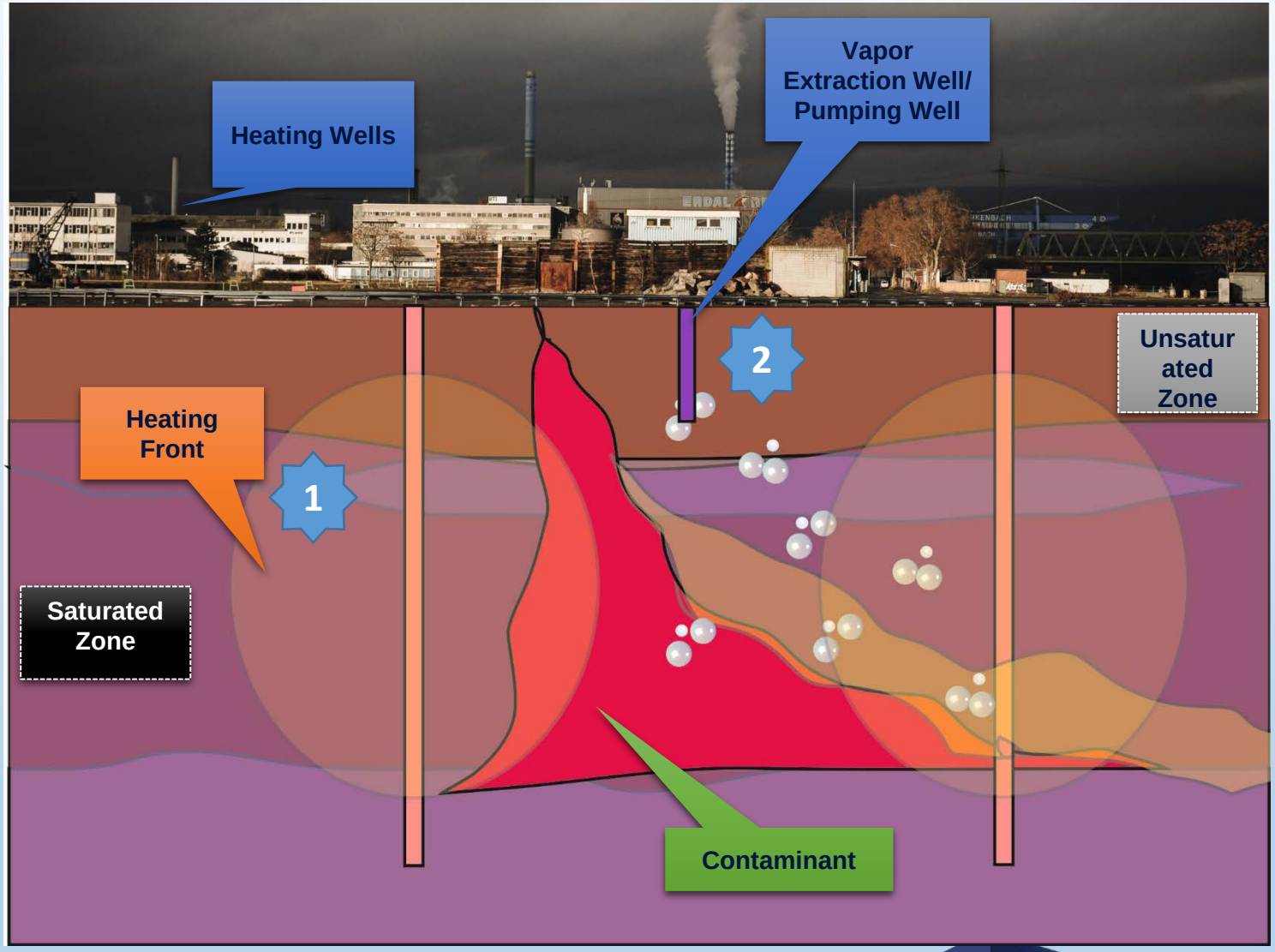
Instrumentation

A especially developed datalogger for the system enables us to measure 144 sensors with only 6 analogue I/O´s. Deployed in IP67 casings, they withstand rough conditions in the field.
A field GC measures the concentration of the outflowing contaminant vapour concentrations combined with a flowmeter in order to control the mass outflow.

Our Solution

1

Using thermal processes, the subsoil and ground water are heated in order to evaporate volatile and semi-volatile organic compounds in the saturated and unsaturated sub-soil. Temperatures over 100°C are possible, thus the possibility of extracting semi-volatile compounds with higher boiling points.



2

The contaminant mass in the soil is extracted by a soil vapor extraction equipment and the off-gas is treated by active carbon filters or catalytic oxidation.

Results:

- Fast extraction of the contaminant mass (after 3-5 months)
- No necessity of soil excavation

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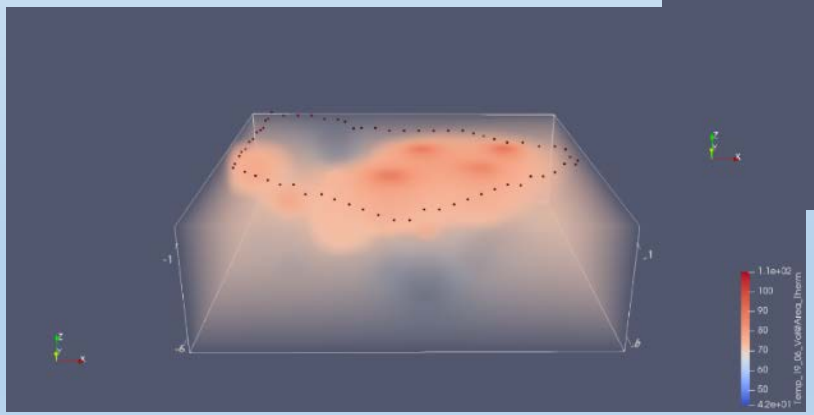
What makes us different?

- **Cost Effective:**
  - insitu thermal remediation has a 40% lower total cost versus excavation, transport and incineration, which means special permits, complicated logistics, possible complaints of the neighbors, elevated incineration costs, sheet pile walls, ground water pumping and treatment
- **Global Production Platform**
  - Parts and service supply, logistics and employee training are problems in developing countries, local supply is a must
  - Our core elements are supplied by a globally active corporation which will be responsible for warranty service and component supply.
- **Client Empowerment**
  - Instead of only turn-key projects we also show our clients/ partners interested in using our systems how to plan, install and operate our thermal remediation systems, in a mid-term GM mainly rents and sells the system, an unique business model
- **Highly Flexible Solution (>1,200°C)**
  - Due to the high temperature the system is able to reach, our system is able to treat most of the volatile and semi-volatile compounds in a variety of soil conditions
- **Scalability (Gas Station → Industry)**
  - One system fits all, beginning at gas stations, laundries up to big scale industry revitalization projects, the system components remain the same

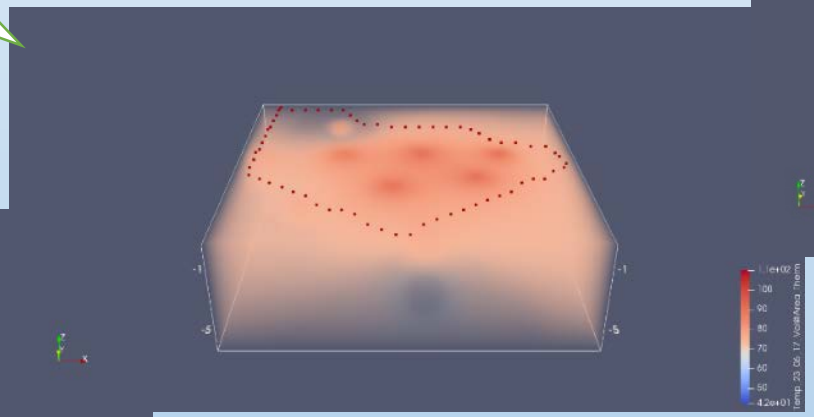
Example for Heat Propagation and Demand of Energy

Medium Heat Propagation: 4°C/ day

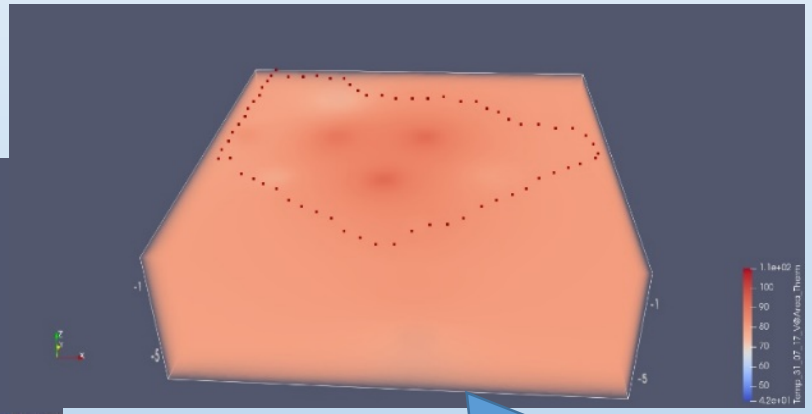
Startup Phase (+3 weeks)



Heating Phase (+5 weeks)



Target temperature (+8 weeks)



Medium Energy Demand: **260 – 300kWh/ m³**

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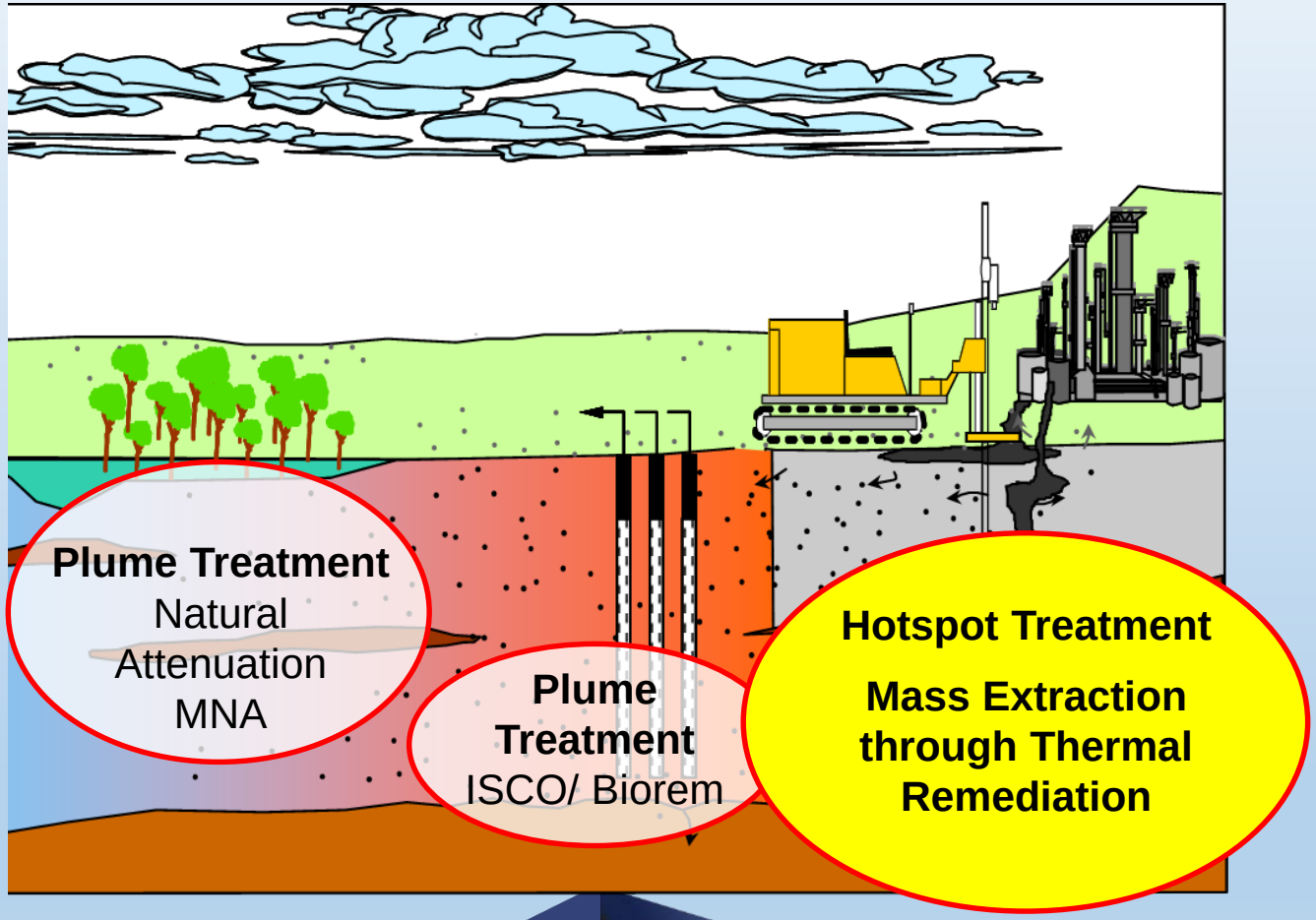
Window of Application

Hotspot Treatment:

Application Parameters:

- Volatile and semi-volatile compounds
- Low Hydraulic Conductivity (<1.0E-5m/s)
- Low Ground Water Velocity (<20m/y)



Our Business

Our business is built on our R+D capacity in thermal remediation.

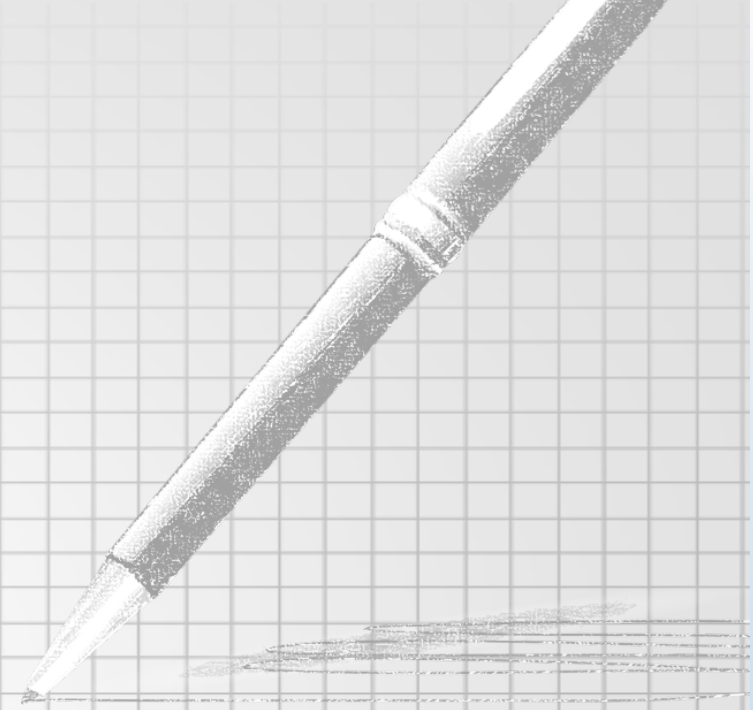
Thermal Remediation Kits

- Rental and Sale of Kits
- Planning and Onsite Services
- Partner Training
- Maintenance and Spare Parts

Turn-Key Revitalization Projects

- Complete Turn-Key Projects for Land Developers
- Startup Projects together with new Partners
- Entry Strategy for New Markets

Reference Projects



Time Line 2010-2013

2010

- Stripp Tower forPump and Treat Project at automotve supplier

2011

- Combined Stripp Tower with soil vapor extraction, automotive supplier

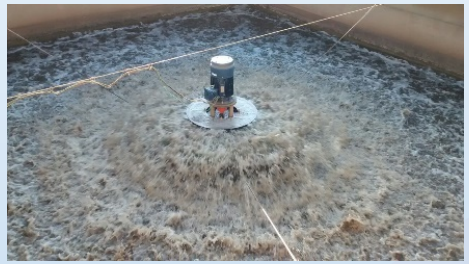
2012

- ISCO Remediation, refrigerator industry, Brazil

2013

- Thermal Remediation Pilot Project, construction ompany

Time Line 2014 - 2017



2014

- Active sludge waste water treatment station for a chemical industry

2015

- Municipal active sludge waste water treatment station

2016

- Launch of new thermal remediation system, revitalization project for a land developer

2017

- Combined thermal and ISCO revitalization project, glass industry

Selected Reference

The Project

A former welding machine manufacturer used organochlorides in its production process.
The contaminant hotspot showed concentrations up to 10mg/l of trichloroethene, in lower concentrations dichloroethene and also vinyl chloride.

The Objective

Requalification of the area to become a commercial area.
Concentration Limit:
Trichloroethene 35µg/l
Timeline: 24 meses

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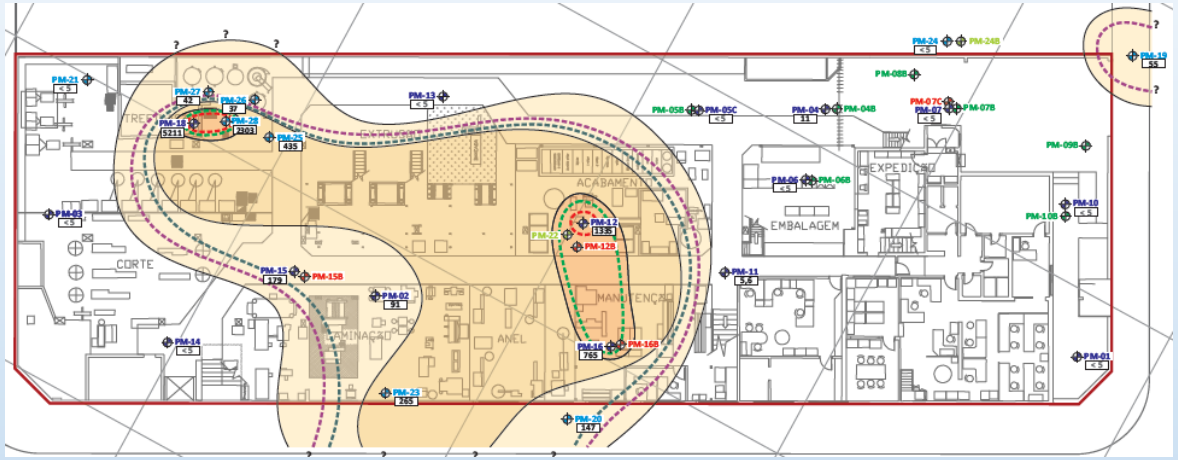
Our Approach

According to the investigation, a smaller portion of the hotspot area showed a risk of residual contaminant phase the rest was a low concentration plume area. Eventhough, all areas needed to be thermally remediated.

The Solution

The contaminant mass calculated in the area was 8kg in the hotspot area, the plume areas together only 2kg .
A combined remediation process using thermal remediation in the hotspot area and oxidants injection in the plume area would be the selection of choice. Cause of doubts about areas with a lower investigation density, the client opted for a complete thermal remediation of the area.



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Selected Reference

The Project

Layout

In two stages, 18 heating elements, 6 soil vapor extraction wells and groundwater lowering since the water level was 1m below ground where installed.

Operation and Performance Control

A temperature array of 96 PT100-Sensors installed in sensor wells in the heating zones showed the expansion velocity of the heat front.

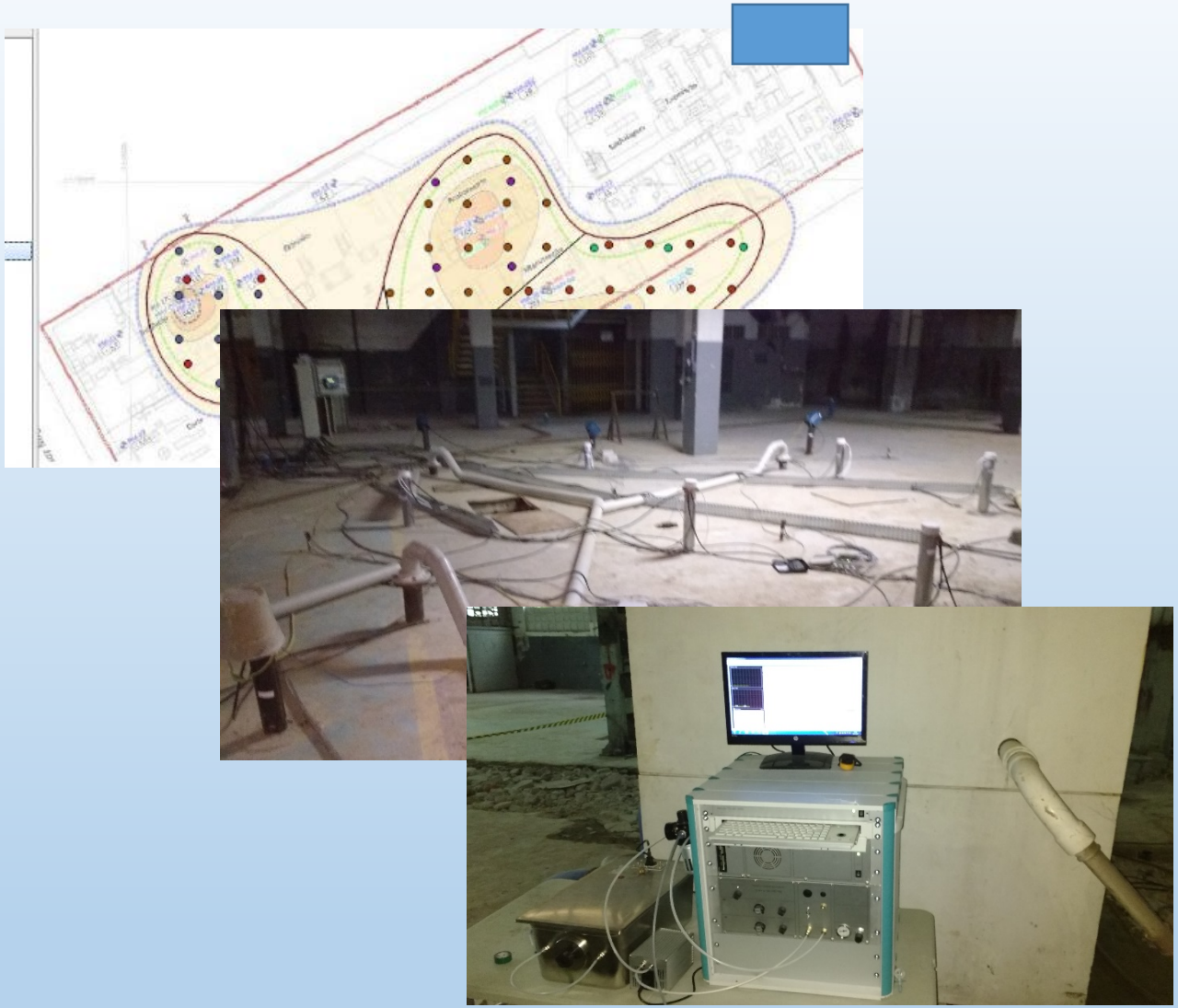
A gas chromatograph was installed to measure the contaminant mass extraction.

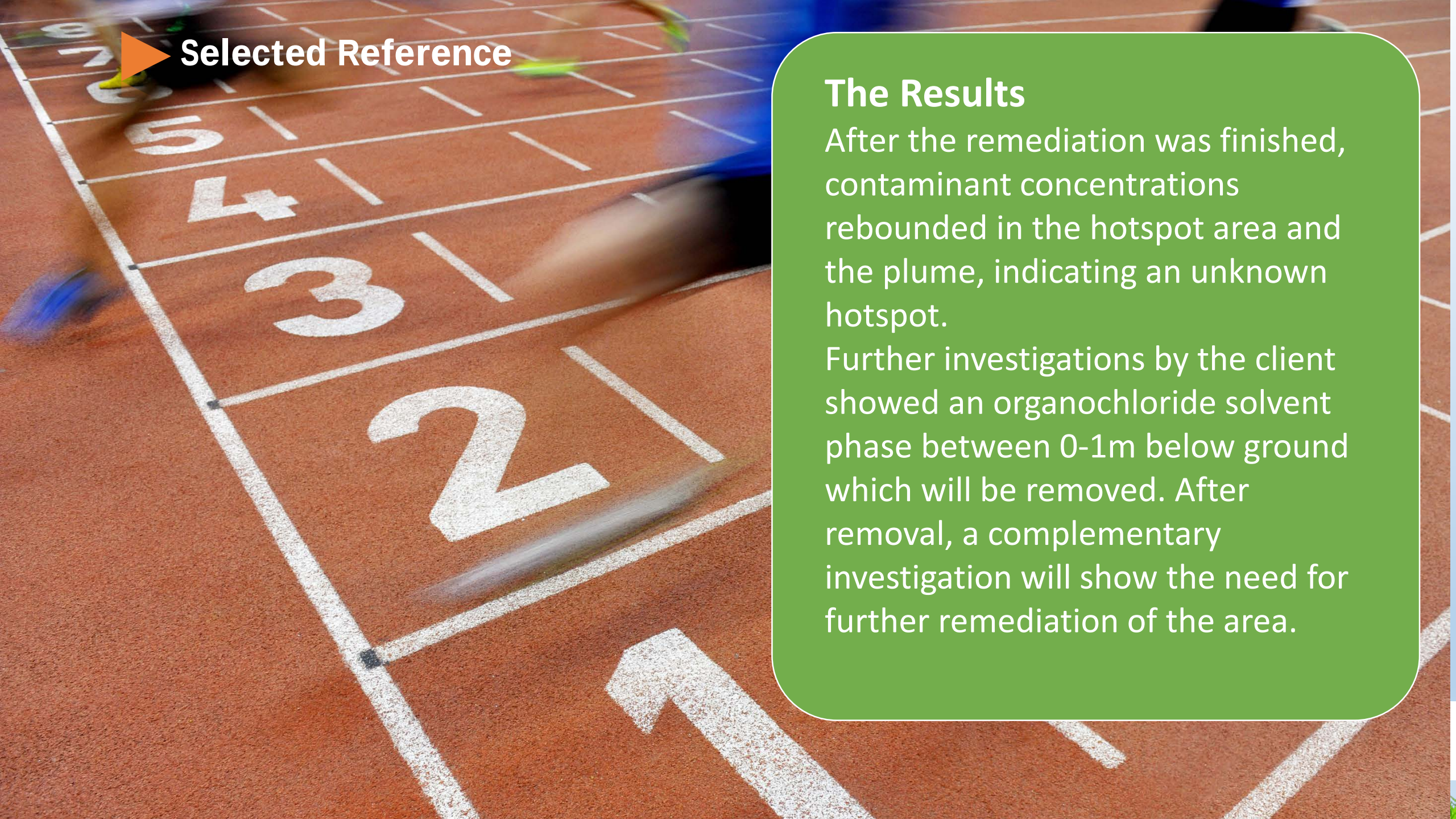
Duration

In total the operation demanded 3 months in the first hotspot stage and 2 months in the plume areas.

Energy Demand

The total energy demand was 1,300MWh





Selected Reference

The Results

After the remediation was finished, contaminant concentrations rebounded in the hotspot area and the plume, indicating an unknown hotspot.

Further investigations by the client showed an organochloride solvent phase between 0-1m below ground which will be removed. After removal, a complementary investigation will show the need for further remediation of the area.

Selected Reference

The Project

On a 100,000m² area, a glass manufacturer used organochlorides in its production process.
The contaminant hotspot showed concentrations up to 120mg/l VOCtotal.

The Objective

Requalification of the industrial area to become commercially usable.
The identified contaminated area was 2,200m².
Concentration Limits:
Trichloroethene 50µg/l
Vinylechloride 193µg/l
Timeline: 24 months

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Selected Reference

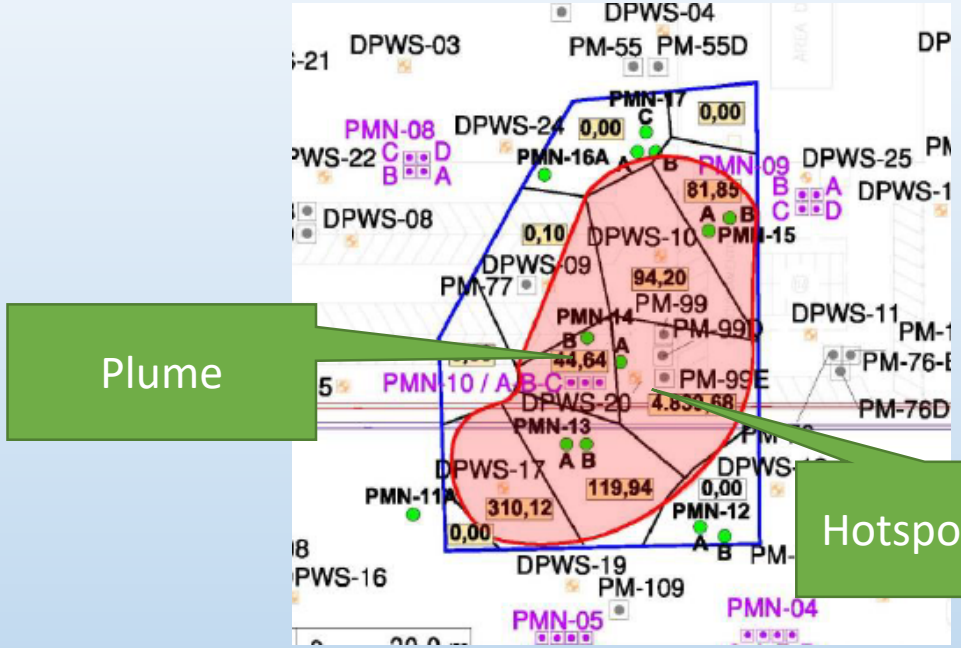
Our Approach

According to the investigation, a smaller portion of the hotspot area showed a risk of residual contaminant phase the rest was a low concentration plume area.

The Solution

The contaminant mass calculated in the area was approximately 500kg in the hotspot area, the plume areas together 1,200kg .

A combined remediation process using thermal remediation in the hotspot area and oxidants injection in the plume area were the selection of choice.



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Selected Reference

The Project

Layout

In two stages, 18 heating elements, 6 soil vapor extraction wells and 18 groundwater lowering wells where installed.

Operation and Performance Control

A temperature array of 96 PT100-Sensors installed in sensor wells in the heating zones showed the expansion velocity of the heat front.

A gas chromatograph was installed to measure the contaminant mass extraction.

Duration

After 6 months if planning and parts production, the operation demanded 3 months in the first hotspot stage and 3 months in the plume areas.

Energy Demand

The total energy demand was 1,000MWh

Selected Reference

The Results

The project was successfully delivered.

The target temperatures where reached, a contaminant mass of 308kg was extracted.
The limit concentrations in the hotspot zones accomplished and some polishing jobs are yet to be done in the plume zone.

Thank You!

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