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PetroFix Eliminates Hydrocarbon Plume Migration in Northern Italy

Permeable reactive barrier installed in underground car park positions site for regulatory closure

Highlights

Site Type:
Industrial

Project Goal:
Mitigate offsite plume migration, eneable site redevelopment

Contaminants:
Petroleum hydrocarbons, with concentrations up to 4,000 µg/L

Geology:
Sands and gravel

Treatment:
Sorption-enhanced anaerobic bioremediation

Technologies:
PetroFix

Quantity Injected:
≈2,500 kg / 28,000 L PetroFix

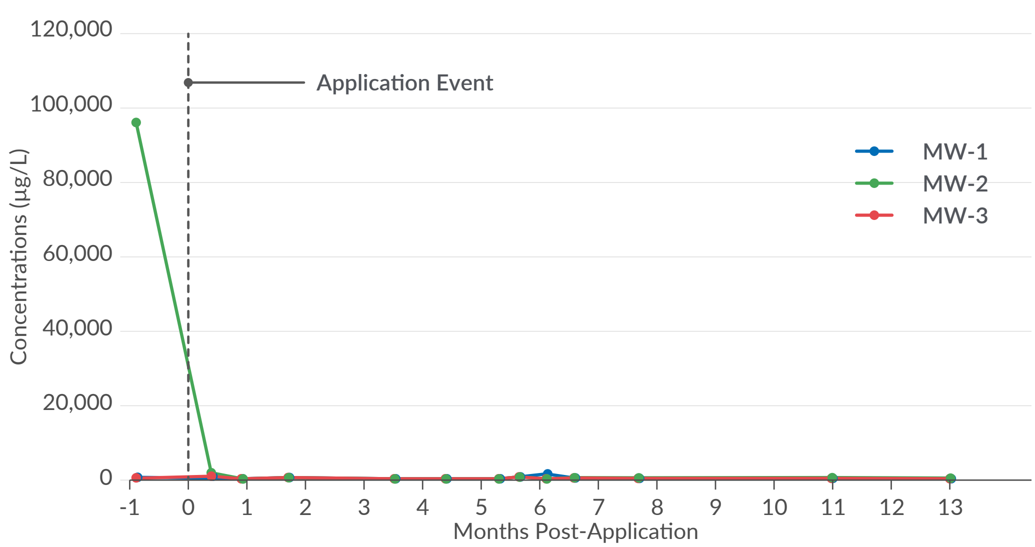
Other Site Considerations
Restricted access: work performed in underground car park

Summary

A PetroFix® barrier installed below a new office building in Northern Italy has stopped the offsite migration of a petroleum hydrocarbon plume. The in situ remediation has met the stringent cleanup target, positioning the site for regulatory closure.

Results

- **Hydrocarbon contaminants reduced below target levels, in regulatory review for site closure**



Background

A Solution is needed to prevent a contaminant plume from encroaching onto an archaeological site

In Northern Italy, a former power plant was redeveloped into an office building complex. Below the new office building, the historical use and spillage of petroleum hydrocarbons contaminated the soil and groundwater, requiring remediation to remove offsite liability.

An excavation was conducted over a limited footprint to remove some of the more highly impacted soils. Beyond the excavation limits, pressure grouting was conducted to stabilise the residual soil contamination. Following the limited source remediation, construction of the building was commenced. With soil contamination addressed and the building construction completed, Planeta Studio Associato, a leading environmental consultancy based in Italy, collaborated with REGENESIS to develop an *in situ* remediation plan for treating the groundwater contaminant plume.

The groundwater hydrocarbon plume was moving offsite onto a public road and a portion of the property containing important archaeological findings. Consequently, the injection works had to be performed within the building footprint, with access limited to an underground car park. During construction, injection wells were installed on the parking level in maintenance corridors for the building's ventilation and heating systems.

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PetroFix Remediation

Permeable barrier slows contaminant velocity allowing for complete contaminant treatment

The *in situ* remediation plan for groundwater entailed the installation of a PetroFix permeable reactive barrier (PRB) to retain and treat the contaminants migrating in groundwater. Degradation of these contaminants occurs via anaerobic bioremediation, aided by their adsorption onto carbon.

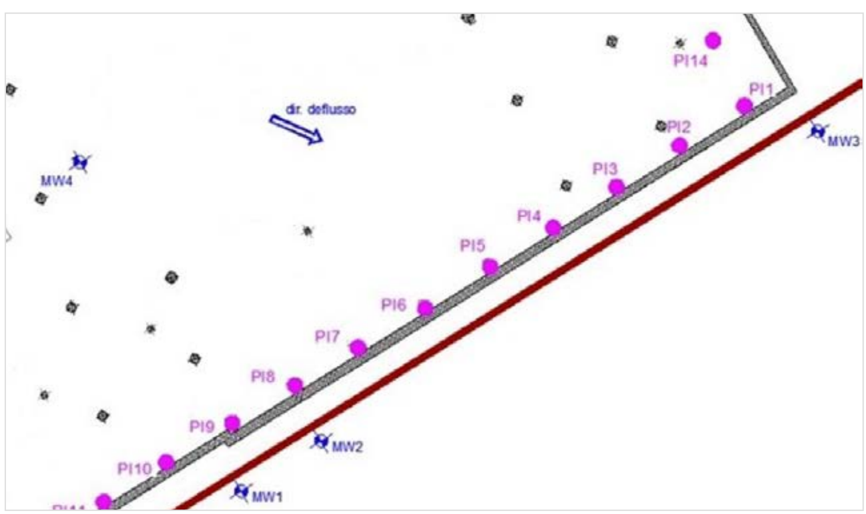
PetroFix Remediation Fluid

PetroFix comprises <2 micron-size particles of colloidal activated carbon, which coats the saturated soil matrix soon after injection. To form the PetroFix PRB, injection points are oriented across the contaminant flow path and the resulting CAC-coated matrix causes the contaminant velocity to be drastically slowed (i.e., retarded). With contaminant movement essentially halted, native soil bacteria are given the time to degrade the contaminants within the PRB. The native microbes degrade petroleum hydrocarbon contaminants by transferring electrons from the contaminants to common electron acceptors in the subsurface such as sulphate and nitrate. PetroFix contains a mixture of these electron acceptors to enhance (i.e., improve the reactivity) of this natural process.

In 2021, REGENESIS Remediation Services, under the direction of Studio Planeta, installed a 60m-long L-shaped PetroFix PRB under the building using the injection wells placed in the underground parking level. Groundwater was at 7m below street level, approximately 1 to 2m below the basement level. The 1.5m-thick PRB targeted the capillary fringe and the upper saturated zone where the highest contaminant levels were found.

Figure 1 — Plan View Map of Injection Well Locations

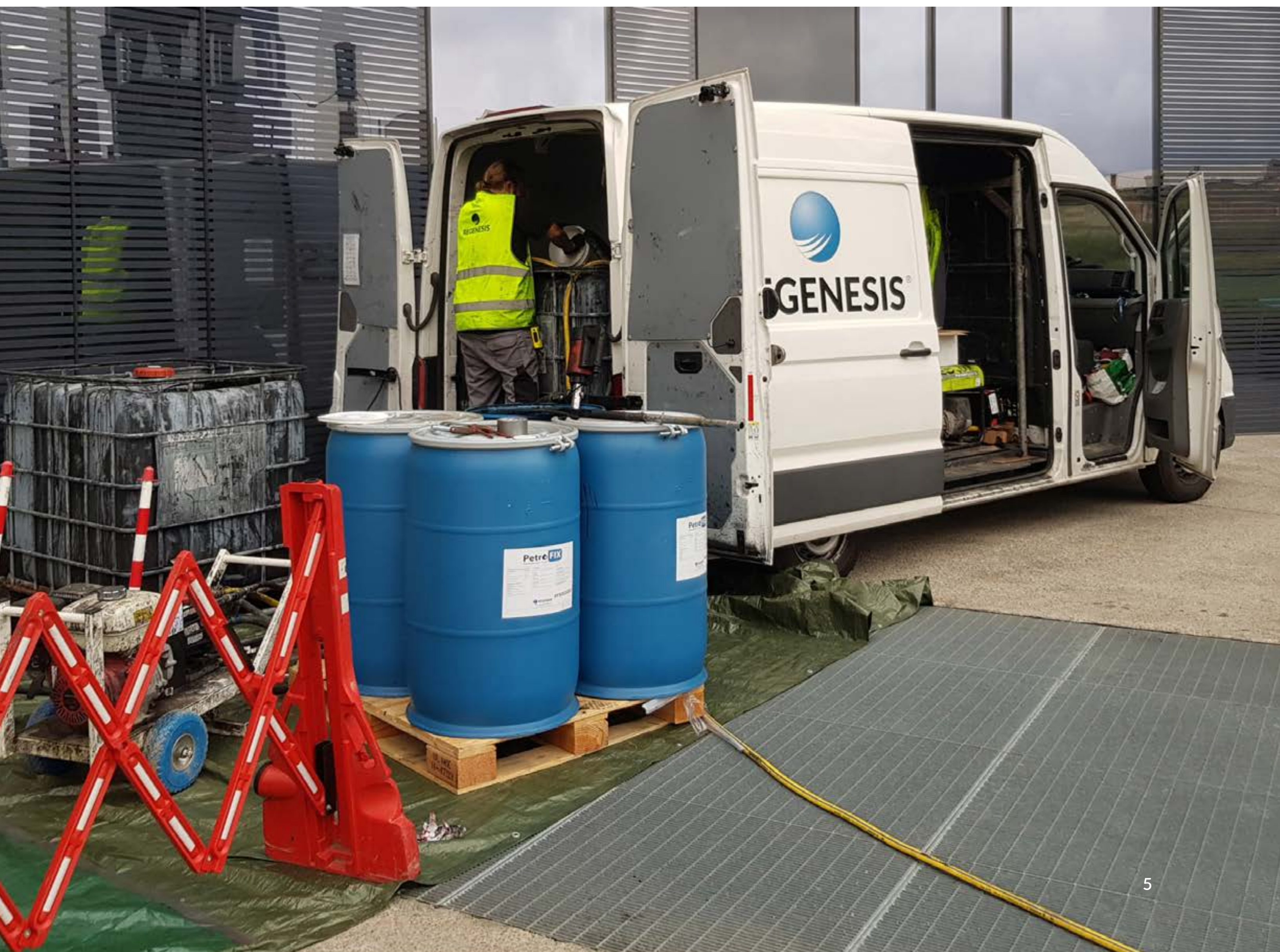
Plan view map of injection wells (shown in magenta) used to create the PetroFix PRB. The injection wells spacing is 4m.



The injection work was completed in a subterranean car park with precautions taken to ensure a clean working environment and no damage to the existing machinery.

Due to the limited access, the mixing and injection equipment was located on ground level in a courtyard outside the building, in view of the office workers. The injection hoses were run through the ventilation ducts to the parking/maintenance area. No rigs could be used as the ceiling was only 2m high. Packers were used in the wells to allow for low-pressure injection and control the vertical distribution of PetroFix. The injection needed to be completed without disturbing the office workers and the surrounding residential urban area.

The wells were installed before the remediation technology was specified. Therefore, injection volumes were calculated and adjusted in the field to achieve the overlapping distribution needed laterally for an effective PRB while accommodating the relatively wide injection well spacing. The remediation target for the PetroFix PRB was to reduce total hydrocarbon concentrations in groundwater to 350 micrograms per litre (µg/L) or lower.



Results

Successful remediation positions the site for regulatory closure

Following the application, the levels in the injection wells were significantly reduced and the concentrations in the downgradient wells were reduced below the 350 µg/L target. Additionally, a sheen that was consistently observed in the three downgradient wells previously, promptly disappeared. These results have been maintained with no rebound or fluctuations observed in the barrier or downgradient validation wells.

Figure 2 Total PHCs in PRB Injection Wells

Total hydrocarbons in the PRB wells show the elimination of contaminant flux in the barrier.

- PI-1
- PI-2
- PI-3
- PI-4
- PI-5
- PI-6
- PI-7
- PI-8
- PI-9
- PI-10
- PI-11
- PI-12
- PI-13
- PI-14

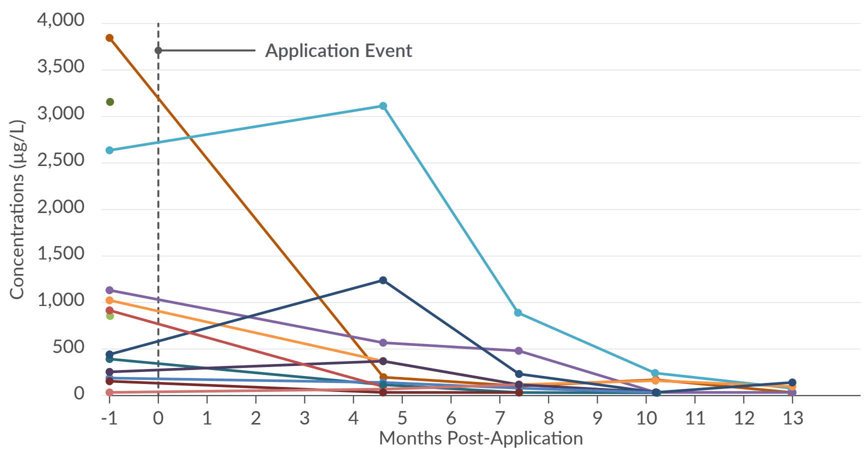
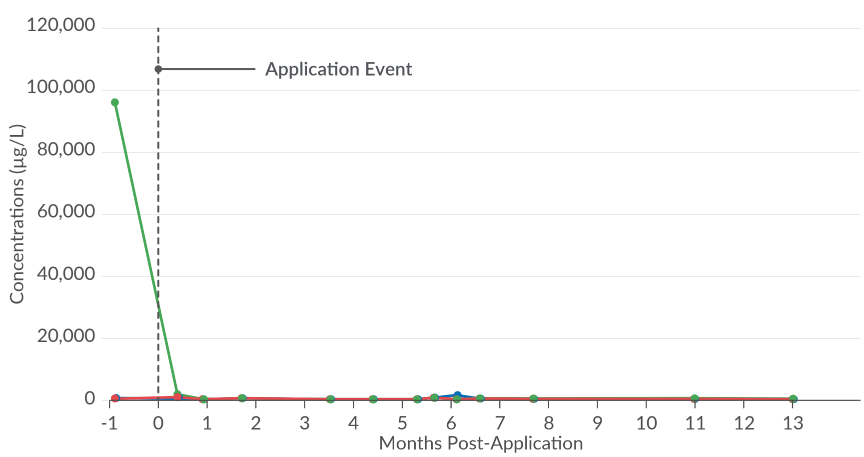


Figure 3 Total PHCs in Downgradient Validation Wells

Total petroleum hydrocarbons in the downgradient validation wells demonstrate that plume migration has been stopped by the PetroFix barrier.

- MW-1
- MW-2
- MW-3



The site continues to be monitored to confirm the stability of results in the far-downgradient validation wells. Once achieved, the site will be reviewed by the local environmental authorities (ARPA) to determine site closure.

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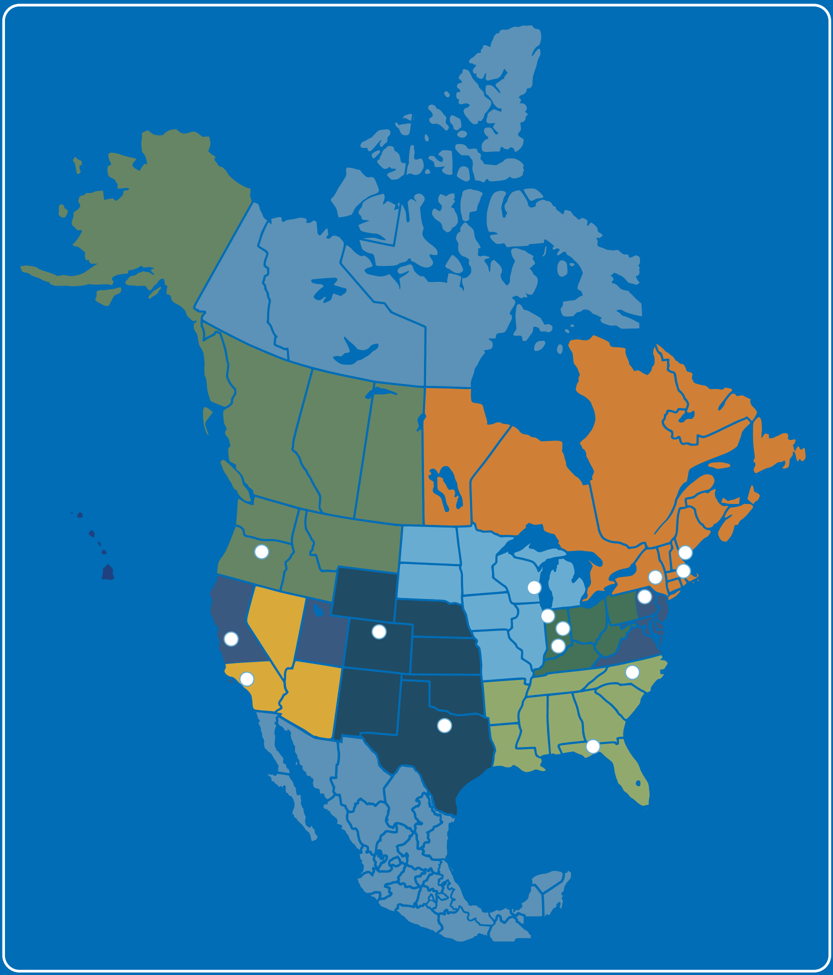
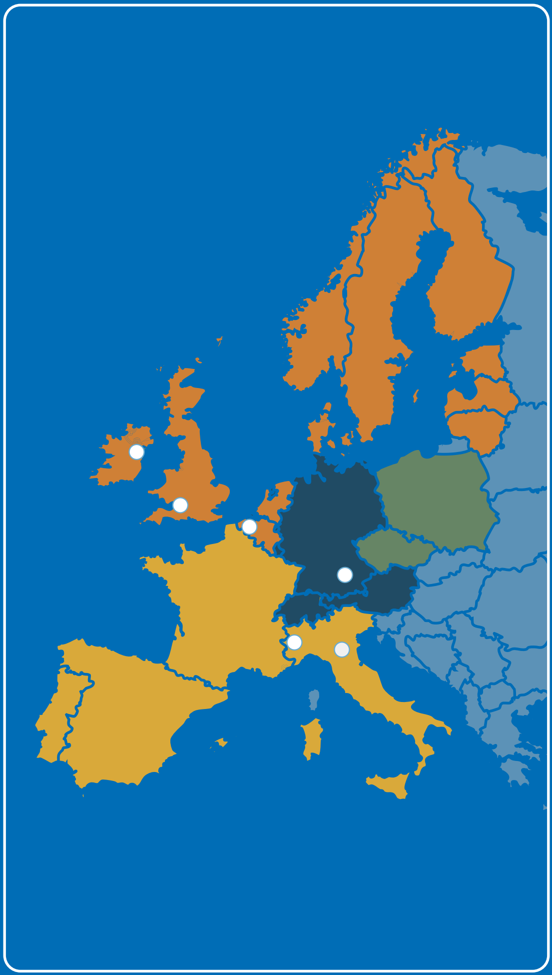
We're Ready to Help You Find the Right Solution for Your Site





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