

# **PetroFix Eliminates Hydrocarbon Plume Migration**

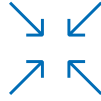
**Permeable reactive barrier installed in underground  
car park in Northern Italy**



# Highlights



**Site Type:**  
Redevelopment/  
Commercial



**Project Goal:**  
Mitigate offsite  
plume migration



**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



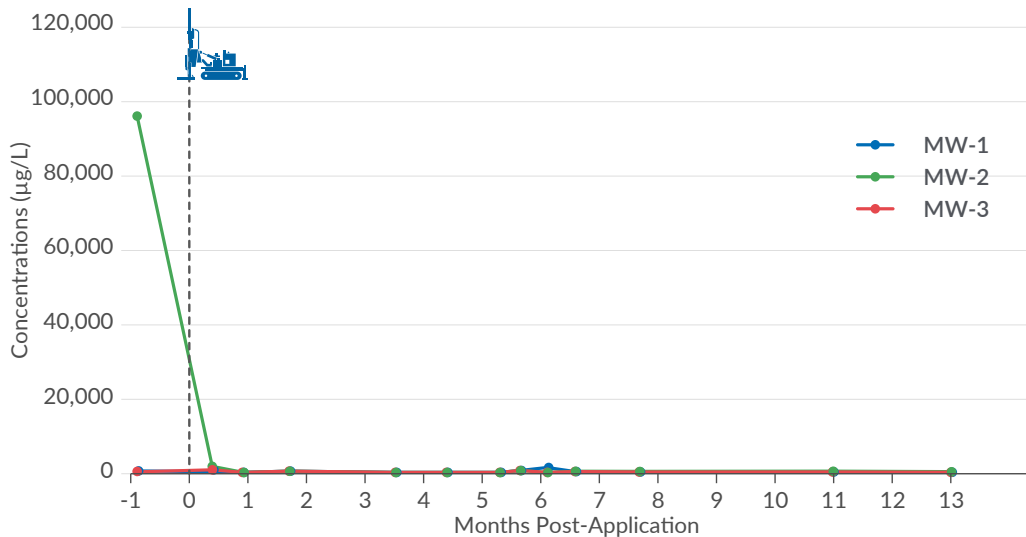
**Other Site Considerations**  
Restricted access:  
work performed in  
underground car park

# 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



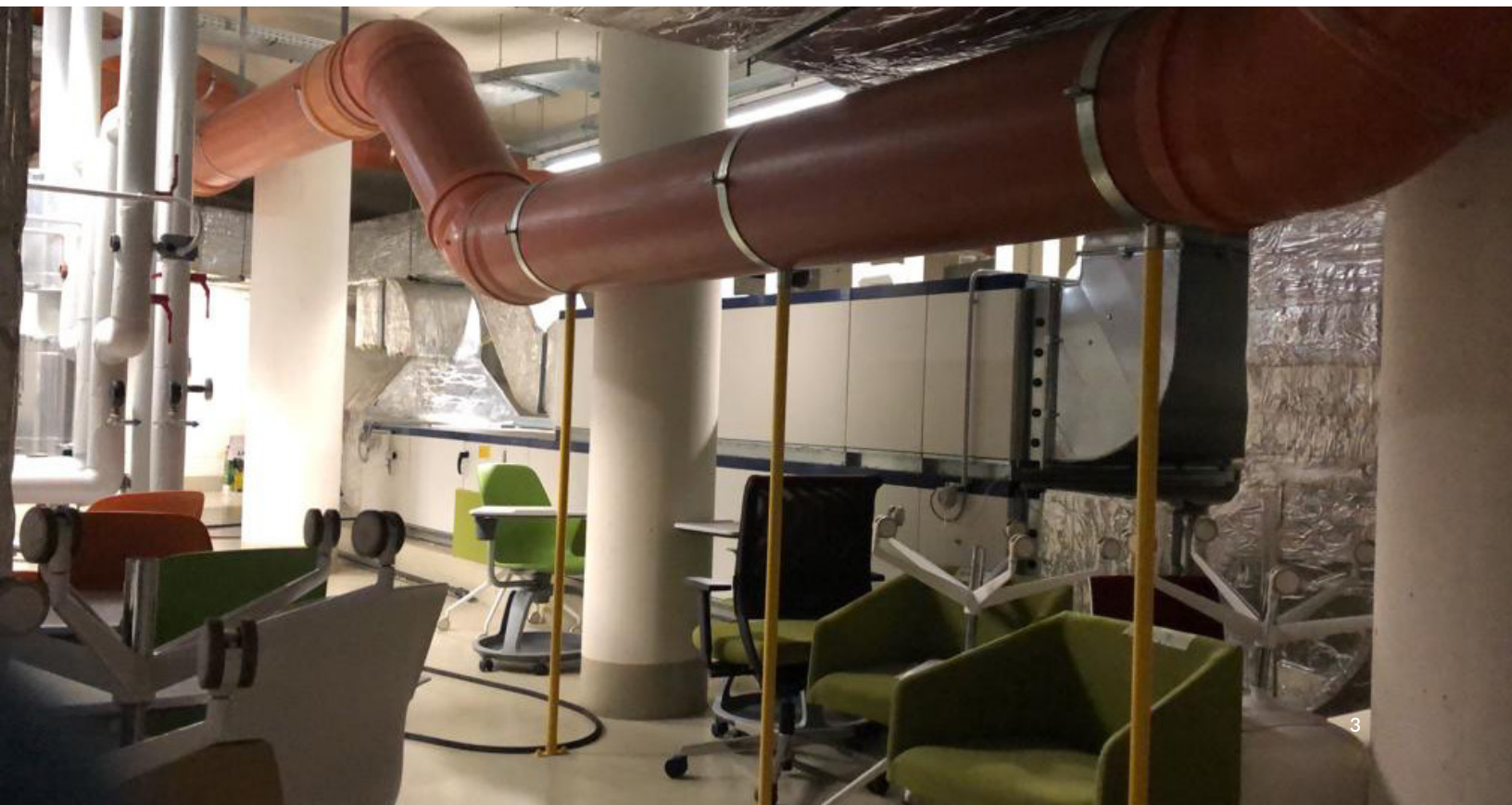
## Background

### Preventing a contaminant plume from encroaching on a public road and 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, prior to construction commencing. Once construction was 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.

A residual groundwater hydrocarbon plume was found to be moving offsite and immediately under 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 had been installed on the parking level.



## Remediation

The in situ remediation plan for groundwater entailed the installation of a PetroFix permeable reactive barrier (PRB) to adsorb and anaerobically biodegrade the contaminants migrating in groundwater.

PetroFix comprises <math>2\mu\text{m}</math> particles of colloidal activated carbon, which coat the saturated soil matrix after injection. To form the PetroFix PRB, injection points were oriented across the contaminant flow path and the resulting CAC-coated matrix sorbs the contamination while allowing groundwater to continue to flow through the treatment area.



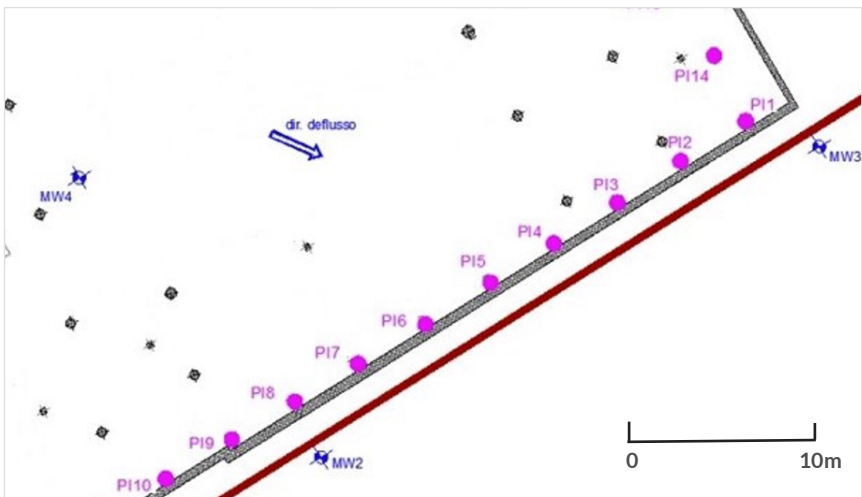
PetroFix contains a mixture of sulphate and nitrate nutrients. These promote rapid microbial growth that biologically degrades the adsorbed contamination. This allows further contaminant influx to be adsorbed and degraded.

A 60m long, L-shaped PetroFix PRB was installed by REGENESIS Remediation Services, under the direction of Studio Planeta. Application was via previously installed injection wells located in the underground parking area. The PRB targeted target the upper saturated zone and capillary fringe (1-2m below basement level, 7mBGL), 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. The remedial works needed to be completed without disturbing the office workers in the building and residents of nearby properties. 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 to control the vertical distribution of PetroFix.

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 ( $\mu\text{g/L}$ ) or lower.



# Results

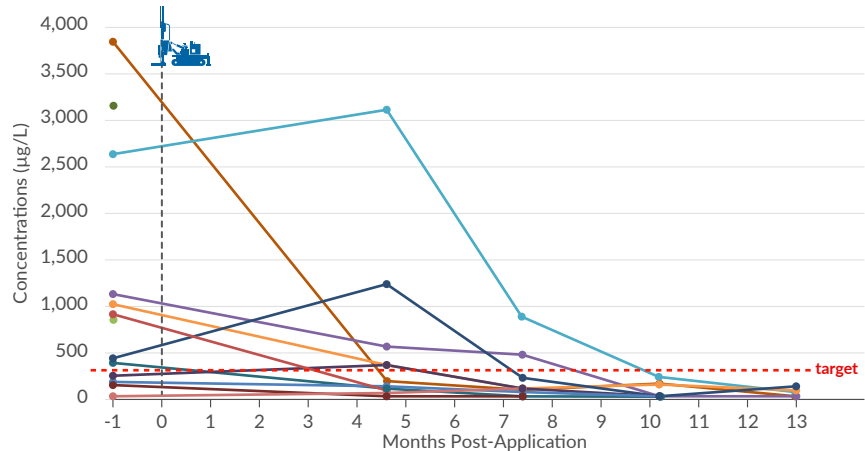
Following the application, the contaminant concentrations in the injection wells were significantly reduced and the concentrations in the downgradient wells were reduced below the 350 µg/L target. Additionally, a sheen that was consistently observed in the three downgradient wells previously, was no longer observed.

**Figure 2**

## Total Petroleum Hydrocarbon Concentrations in PRB Injection Wells

Total petroleum 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

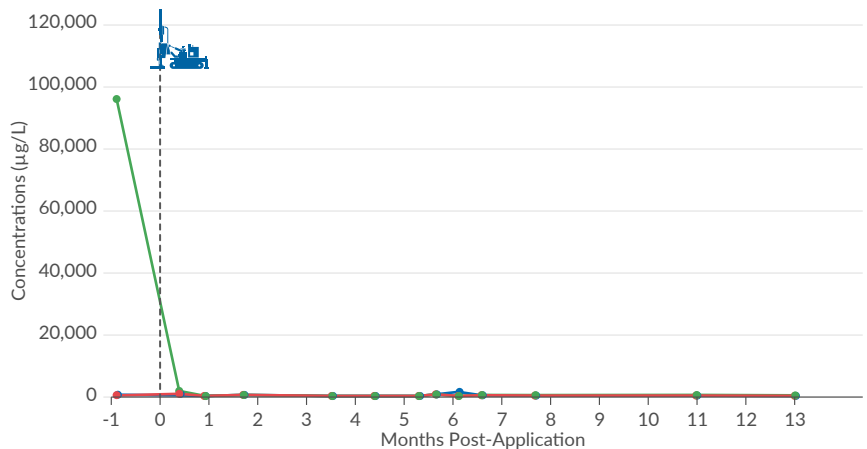


**Figure 3**

## Total Petroleum Hydrocarbon Concentrations 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.

## Conclusion

The treatment demonstrates that a PetroFix PRB can effectively remediate high levels of petroleum hydrocarbons to low target levels. Treatment occurred rapidly to address the residual plume.

The in situ treatment is passive and requires no ongoing equipment, cost or site disturbance. Application is quick and versatile, being applied through ducting under a building and avoiding any impact on site activities or local residents.





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