

Treatment of Pharmaceutical Contamination Using PetroFix

Remediation of 2-chloropyridine in a fractured bedrock aquifer



Challenge



The injections took place into pre-installed wells



PetroFix (drums and tubs) and ORC Advanced (sacks) stored onsite

At a former chemical manufacturing facility in Swords, Ireland, a range of pharmaceutical and agrochemical products were historically produced. Over time, spills and leakages resulted in subsurface contamination beneath the site. The contaminant of concern is 2-chloropyridine (2-PCl), a chlorinated derivative of pyridine used mainly as an industrial intermediate in the synthesis of specialty chemicals.

Although contaminated soils had already been excavated from the source area, residual 2-PCl contamination had impacted the underlying fractured limestone aquifer, creating a potential risk to downgradient receptors.

Pilot Design & Implementation

REGENESIS' Remediation Services team implemented a three-part pilot using PetroFix® to treat the dissolved plume between approximately 4 and 12 m below ground level.

PetroFix was selected to distribute and coat the fractured bedrock with micron-scale colloidal activated carbon to adsorb the contamination. PetroFix incorporates an electron acceptor blend to enhance the biodegradation of the adsorbed contamination. One pilot included ORC Advanced® to evaluate whether strongly aerobic conditions would further improve treatment of 2-PCl.



One pilot location comprised a source-area injection grid inside one of the existing buildings, where a residual 2-PCI hotspot remained. The other pilot locations consisted of two downgradient barriers, one with ORC Advanced to compare results.

REGENESIS completed the pilot programme safely and on schedule, after which AWN monitored the site for one year to track the performance of each of the treated pilot areas.

Figure 1

Contamination and pilot test areas

Plan view of contamination and location of pilot test areas. Credit: AWN, updated by REGENESIS

Proposed Pilot Test Wells

-  Pilot 1 Injection Wells
-  Pilot 2 Injection Wells
-  Pilot 2 Shallow MW
-  Pilot 2 Shallow/Int. MWs
-  Pilot 3 Injection Wells
-  Pilot 3 Shallow/Int. MWs

Active Monitoring Wells

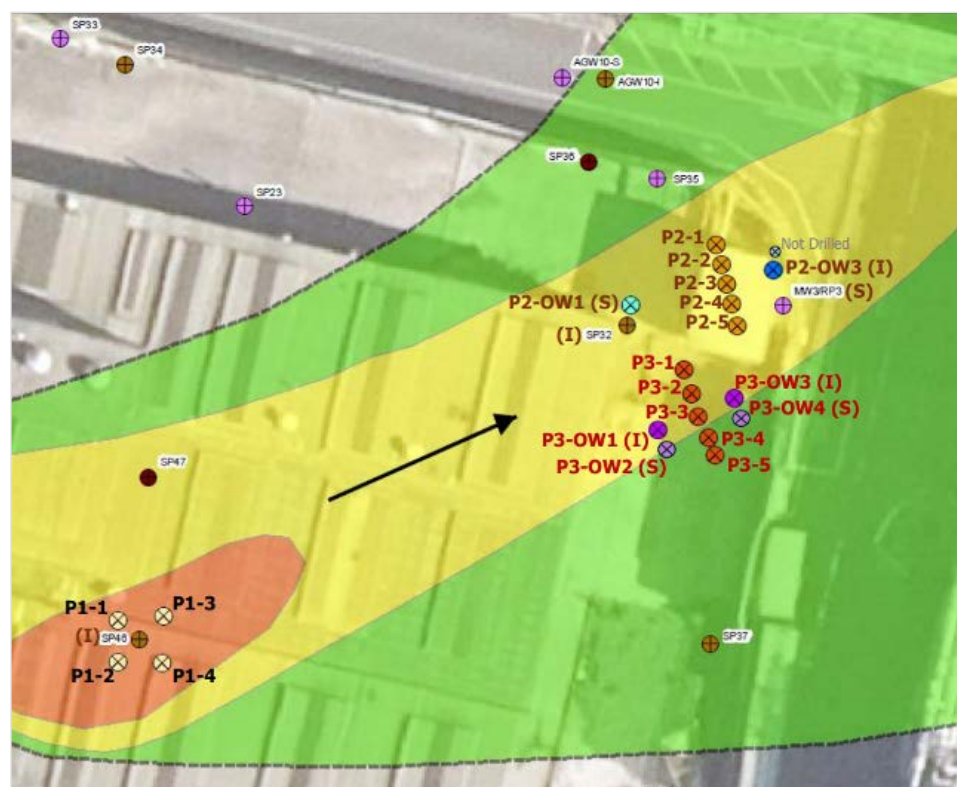
-  Shallow
-  Intermediate
-  Deep

Int. GW - 2PCL (Q1 2022)

-  1.0 to 10 mg/l
-  0.1 to 1.0 mg/l
-  < 0.1 mg/l

 Int. Zone GW Flow Direction

0 5 10
Meters



Results

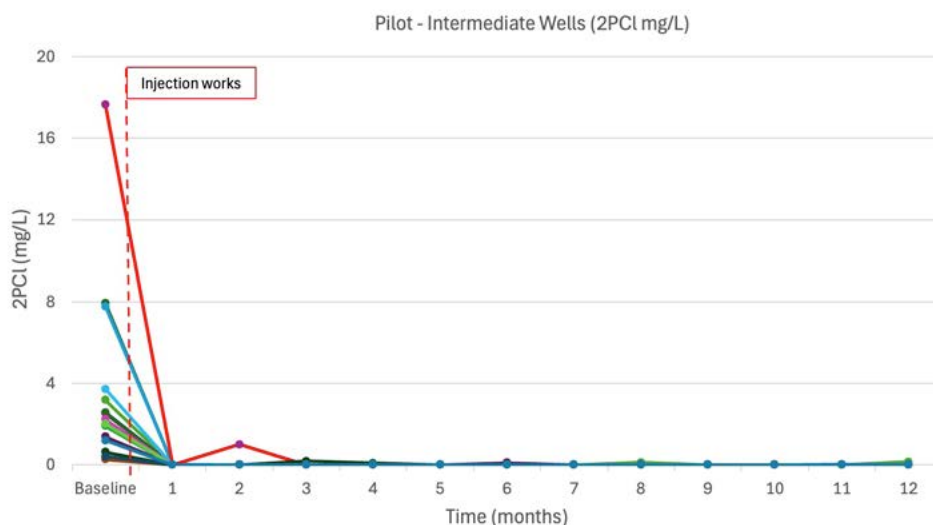
All three pilot locations performed well, rapidly reducing 2-PCI to very low concentrations with no rebound. The PetroFix-only applications were effective in both the source-area grid and downgradient barrier configurations. The combined PetroFix and ORC Advanced barrier also performed well, however the addition of ORC Advanced did not provide a clear additional benefit under the pilot conditions.

Figure 2

Pilot performance data

2-PCI concentrations before and after the triple pilot injection works.

- P1-1
- P1-2
- P1-3
- P1-4
- P2-1
- P2-2
- P2-3
- P2-4
- P2-5
- P2-OW3
- P3-1
- P3-2
- P3-3
- P3-4
- P3-5
- P3-OW3



Full-scale Treatment

The applications demonstrated the efficacy of PetroFix for the remediation of 2-PCI and its suitability for full scale treatment of the site. The three-part pilot provided information on product mix, dose, spacing and injection configuration. This is now being used in the development of an accurate and cost effective full-scale remedial design for the site.