



Plate 1 - Foundations of development being emplaced following installation of Enviro-treat SMRBS

Completion Date:	October 2004
Development:	Commercial
Developer:	Prime UK Developers
Remediation Contractor:	Enviro-treat Ltd.

Site Overview

The site was previously an operational gas works owned by British Gas Properties, manufacturing town gas between approximately 1859 and the mid 1970. The site is located adjacent to the River Eden and is approximately 0.6 hectares. Site Investigations identified significant concentrations of Anthracene, Fluoranthene, Phenanthrene, Benzo(a)anthracene, Chrysene, Benzo(k)Fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)Pyrene, Benzo(g,h,i)Pyrene, Benzene, o-Xylene, Ethyl Benzene and Naphthalene. List II substances included Ammoniacal Nitrogen (Ammonia), Arsenic, Copper and Naphthalene, and non-listed substances included phenol within the soil and groundwater underlying the site. During the late 1990's remedial works took place on site which are believed to have involved the excavation and removal of significant volumes of contaminated material, however, this methodology resulted in residual contamination remaining at depth on site.

Objective

The overall remediation strategy proposed by Enviro-treat was designed to address pathway contamination issues, with the intention of protecting surface water and groundwater receptors, namely the River Eden. The remedial operation involved the installation of an Enviro-treat Soil Mixed Reactive Barrier System (SMRBS) utilising proprietary E-clays®, comprising two sections of passive and one of active. The objective of the barrier system is to treat contaminated groundwater as it migrates off-site towards the River Eden (Plate 2), a well known good quality Trout River.

The groundwater simulation program MODFLOW was utilised in order to demonstrate that there would be a minimal effect on the groundwater regime whilst effectively intercepting and treating the contaminated groundwater.



Plate 2 - The River Eden

SMRBS Installation

The SMRBS installation was carried out over a 3 week period, incorporating the installation of both the passive and active sections. Passive sections of barrier are designed to 'funnel' migrating groundwater towards the active section of the barrier system, where any contaminants within the groundwater are 'filtered out'.

The Enviro-treat Technology was applied at the Appleby site using a Continuous Flight Auger (CFA)

(Plate 3) system based on advanced soil mixing techniques.

Pennine Vibropiling provided the plant and equipment and the means of applying the technology, whilst Envirotreat designed the scheme and provided the proprietary technology for remediation.

The SMRBS comprised two sections of passive (impermeable) barrier and one downstream section of permeable reactive barrier. The permeable reactive sections contain the modified pillared E-clays, which are designed to chemically immobilise the prime pollutants of concern from within the ground water, whilst the passive sections of barrier comprise a combination of bentonite and OPC in varying ratios.

The barrier system was keyed into the underlying clay layer, to a nominal depth of 7.0m to intercept migrating ground water off-site (towards the river).



Plate 3 - SMRBS Installation

Validation

Validation of the Envirotreat SMRBS was undertaken through the installation of five monitoring boreholes, these being located downstream of the barrier, as well as at the corners as a measure to ensure that no contamination is circumnavigating the barrier system.

Samples were obtained from each of the boreholes by Envirotreat on a monthly basis for an initial period of one year and submitted to a UKAS accredited laboratory (Plate 4).



Plate 4 - Sample collection during validation period

Results

Following the twelve months of monitoring, the Envirotreat SMRBS was demonstrated to be successfully immobilising the identified contaminants of concern, whilst having a negligible effect on the groundwater regime of the site.

Summary

Through SMRBS installation, Envirotreat enabled development to take place on this previously contaminated site, as well as protecting surrounding receptors from off-site migration of contaminated groundwater.

