



The site is shown in Figure 1 below.

Figure 1 – Aerial View of the Site (circa 1999-2000)



### Site Background & History

The site is located in Sherwood Road, Bromsgrove and was formerly occupied by a manufacturing facility, primarily producing automotive components between 1964 and 2002. The site comprises of a slightly elongated, irregularly shaped plot of land occupying approximately 1.7 hectares. The site is split into two distinct areas by the Spadesbourne Brook - the main body of the site (eastern side of the brook) was previously occupied by the former factory building and the remainder of the site (western side of the brook) was utilised as a parking area.

Site investigation works by GIP showed the south eastern area of the site to be significantly affected by historical contamination. The contamination is assumed to have arisen from spillages / leakages in the vicinity of the above ground fuel / lubricant storage tanks and filling pipework / valves located in this area and comprised of predominantly total petroleum hydrocarbon pollutants. A below ground swarf tank was also located in this area of the site - the tank was used to store swarf and associated cutting oils / lubricants.

The client had been granted planning consent for the redevelopment of the site for retail purposes (subject to the discharge of planning conditions) - commercial leases had previously been agreed with two national retailers, Homebase and Pets at Home. There were a number of planning conditions relating to land contamination – the pre-commencement conditions were addressed by the submission and approval by the regulatory bodies of an acceptable Remediation Strategy and Remediation Method Statement.

Planning Condition 21 stipulated that in the event that 'contamination not previously identified' is found on site then no further development would be permitted until written approval is obtained from the Council for an acceptable method of addressing the contamination. There was a significant risk that the project could be severely impacted as a consequence of this condition and henceforth Envirotreat designed and implemented a 'Discovery Strategy' to address such an eventuality. The strategy incorporated necessary protocols to be adopted and quarantine provisions to be implemented.

The strategy also required Enviro-treat to implement a 'watching brief' during the enabling / earthworks element of the project. These provisions were designed to negate the requirement to notify the local Authority and thereby mitigate the potential risk of project delays. To achieve this objective it was necessary to agree the provisions in advance with the regulatory bodies – these were agreed and incorporated into the Remediation Strategy and Remediation Method Statement as required.

The prime environmental concern was the protection of controlled waters and in particular the Spadesbourne Brook which flows through the centre of the site in a southerly direction. It was considered that the protection of human health would be achieved by the presence of hardstanding / car parking areas providing an effective pathway break.

An integrated remediation strategy was developed to address the identified contamination issues. The strategy incorporated source treatment of the prime contamination source in the south eastern area of the site and the installation of a reactive barrier system on the eastern side of the Spadesbourne Brook (in the centre of the site), continuing along the western and southern boundaries of the eastern section of the site. Provision was also made for the treatment or disposal of any free product identified during the remediation works.

The remediation works were complicated by the presence of a live foul sewer transversing the site from the south eastern corner to the western boundary. The presence of imported fill material surrounding the sewer was considered to be a preferential pathway for potentially contaminated groundwater (due to the relatively high permeability of the fill material). The top of the sewer was visible in the bed of the brook and henceforth the fill material was in direct continuity with the brook.

The surface of the sewer pipe can be seen in Figure 2 below.

Figure 2 – Surface of Sewer Pipe Transversing the Spadesbourne Brook



The existing factory building was demolished prior to Enviro-treat commencing operations on-site. The southern area of the site following demolition is shown in Figure 3 below.

Figure 3 – Southern Area of the Site Following Demolition



### Methodology

Enviro-treat were employed by Anglo Holt to undertake the requisite 'watching brief' during the lifting of the former building slab and the subsequent remediation works comprising of source treatment and the installation of a permeable reactive barrier. The watching brief was implemented by the investigation and validation of soils 'not previously investigated' underlying the concrete floor slab (using a 5m x 5m grid system). Any contaminated soils identified during this process were stockpiled for subsequent treatment.

No unexpected contamination was found during the demolition and lifting of the floor slab.

The initial remediation works involved the excavation of a trench to ascertain the extent of the free product (LNAPL) which had previously been identified in boreholes within the source contamination area. No LNAPL was observed after a period of 48 hours. It was therefore assumed that the LNAPL had collected in the borehole void spaces and was not present on the site to any significant extent. This was confirmed by subsequent remediation works.

The source treatment involved the excavation and subsequent *ex-situ* E-Clay stabilisation of contaminated soils (and associated groundwaters) from the south east corner of the site.

Contaminated soils were excavated and stockpiled pending treatment. The effective removal of contaminated soils was confirmed by validating the bases and sides of the excavations in accordance with pre-determined CLEA derived target criteria. The testing procedure involved a combination of visual / olfactory assessment and PID measurement to determine the extent of the initial excavations and sampling / analysis of the bases / sides of the full excavations to confirm compliance with the target criteria.

A significant volume of contaminated groundwater was identified within the excavations – this groundwater was removed and utilised within the treatment process.

The *ex-situ* remediation works involved the treatment of the stockpiled contaminated soils in batches of known volume. The treatment process involved mixing the contaminated soils with the designated E-Clay slurry and cement. In total approximately 1,500m<sup>3</sup> of hydrocarbon impacted soils were treated on-site.

The hydrocarbon impacted soils are shown in Figure 4 below.

Figure 4 – Hydrocarbon Impacted Soils



The permeable reactive barrier was installed along the southern and western boundaries of the main part of the site and along the eastern side of the Spadesbourne Brook. The barrier was designed to intercept and treat the natural flow of contaminated groundwater migrating from the site in a generally southerly direction and to address the potential pollution risks to the brook from the identified preferential pathway associated with the infill material surrounding the sewer and other potential groundwater pathways (including former river meanders underlying the factory building).

The barrier installation involved a combination of *ex-situ* treatment of the shallower soils with the designated pillared E-Clay (the shallower soils were excavated and re-replaced following treatment) and *in-situ* [in place] treatment of the deeper soils with the pillared E-Clay to depths of 4.2m bgl - the *in-situ* installation is shown in Figure 5 below. The installed barrier length was circa 175m.

Figure 5 – *In-situ* Installation of E-Clay Permeable Reactive Barrier



The remediation works were completed within a five week timescale.

### Environmental Monitoring

A comprehensive environmental monitoring programme was implemented due to the close proximity of several sensitive receptors. Dust, odours, noise and VOCs were monitored around the site during the remediation works. Additionally the water quality of the Spadesbourne Brook was monitored before, during and post remediation.

### Validation

Representative samples were taken from the treated batches and combined to form composite samples for validation purposes (representative of one sample for every 250m<sup>3</sup> treated). Following a suitable period of “curing” the composite samples were leach tested and compared with the designated leachate target criteria.

All leachate values were compliant with the designated leachate remediation target criteria.

The treated material was therefore considered suitable for reuse on site as a substitute for imported fill.

Ongoing groundwater monitoring is being undertaken.

The remediation works are summarised in Figure 6 below.

The retail development is shown in Figure 7 below. The service yard (overlying the treated source contamination area) is shown in Figure 8 below. The Spadesbourne Brook is shown in Figure 9 below.

### Conclusions

Envirotrete were able to demonstrate through a comprehensive Validation Report that the remediation strategy had been successfully implemented.

The prime driver for the remediation works was the protection of human health and controlled waters.

Figure 6 – Summary of Remediation Works

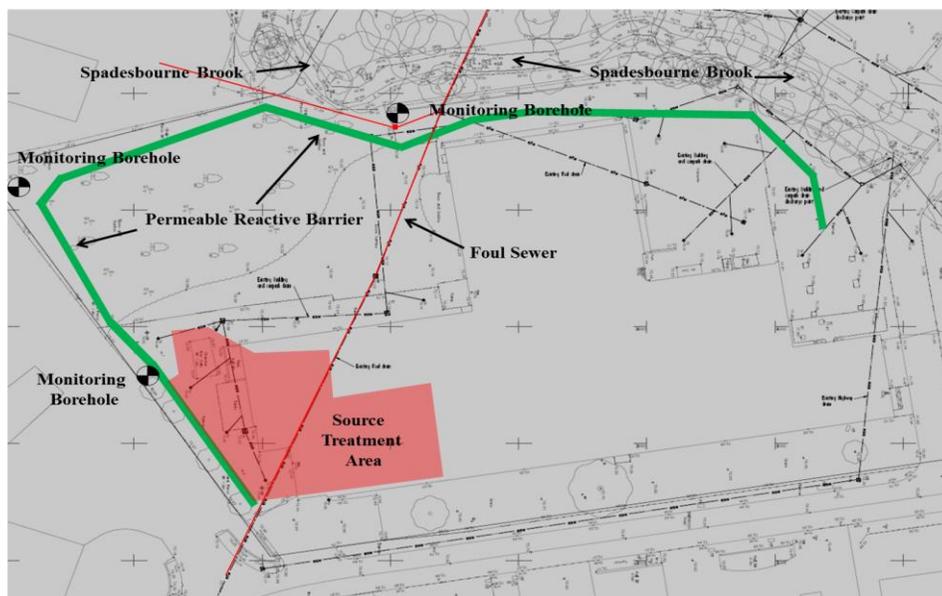


Figure 7 – Retail Development



Figure 8 – Service Yard



Figure 9 – Spadesbourne Brook



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