



### Site Background & History

The former JCB Heavy Products Manufacturing Site is located at the southern end of Uttoxeter town centre and covers an area approximately 700m long east to west by 200m north to south. The former manufacturing facility is shown in Figure 1 below [2005] and the current site prior to remediation is shown in Figure 2 below – the site was vacated by JCB in 2008 – the buildings were subsequently demolished and the site was cleared. The north-eastern area of the site was recently sold off by JCB and has subsequently been developed as a Waitrose Supermarket.

Figure 1 – Former JCB Manufacturing Site



Figure 2 – Site Prior to Remediation



The overall site can be split into areas as shown in Figure 3 below. The remediation works focused on the areas to the west and east of Pinfold Street (which bisects the site).

Figure 3 – Site Overview



The main manufacturing area of the site was located to the west of Pinfold Street as shown in Figure 1 above. This area of the site was previously occupied by the 'Leighton Iron Works' and a tannery.

The eastern areas of the site were previously occupied by depots and railway sidings – the railway line runs along the southern boundary of the site.

The Picknal Brook flows through the site in an easterly direction.

The site is being redeveloped for a mixture of residential housing and open space following completion of the remediation and enabling works.

The proposed 'Bamford Park' development is shown in Figure 4 below – the realignment of the Picknal Brook and the design of the landscaping area and the pond is currently under review.

Figure 4 – Proposed Development [Bamford Park]



### Identified Site Contamination

The site was subjected to an intrusive site investigation by Ground Investigation & Piling Limited [GIP] in 2011.

West of Pinfold Street:

Elevated concentrations of total petroleum hydrocarbons [TPH], polycyclic aromatic hydrocarbons [PAH] and heavy metals were identified within both the soil and groundwater. The prime contaminants of concern were TPH and PAH - the maximum identified soil concentrations were 24,800 mg/kg TPH and 575mg/kg PAH respectively. The maximum identified groundwater concentrations were 1,200ug/l TPH and 80ug/l PAH respectively.

East of Pinfold Street:

Elevated concentrations of total petroleum hydrocarbons [TPH], polycyclic aromatic hydrocarbons [PAH] and heavy metals were identified within both the soil and groundwater. The prime contaminants of concern were TPH and PAH - the maximum identified soil concentrations were 1,500 mg/kg TPH and 150mg/kg PAH respectively. The maximum identified groundwater concentrations were 1,200ug/l TPH and 0.5ug/l PAH respectively.

Asbestos Contamination:

Asbestos contamination was also identified on-site at certain locations. Two former machine pits had been infilled with asbestos containing materials [ACM] - the ACM comprised of chrysotile, crocidolite and amosite forms of asbestos.

### Remediation Strategy

Following the completion of a remediation options appraisal and taking into account the project size, timeframes, affordability and remediation objectives (essentially to protect human health and groundwater / controlled water receptors i.e. the Picknal Brook) it was agreed with the client and the local authority to implement an integrated treatment approach comprising of combined source and pathway treatment, designed to provide a synergistic remediation solution for the site as whole. The source treatment was designed to protect both human health and groundwater and the pathway treatment was essentially designed to protect the Picknal Brook.

The source treatment involved the use of E-Clay Stabilisation and the pathway treatment involved the installation of a E-Clay Permeable Reactive Barrier System [PRB].

The remediation strategy comprised of the following key elements:

- Delineation and source treatment [E-Clay Stabilisation] of previously identified contamination 'hot-spot' areas on the 'Main Site' (west of Pinfold Street) – these were previously identified and assessed by GIP
- Source treatment [E-Clay Stabilisation] of contamination not previously identified – additional contaminated areas were identified during the remediation works - these areas were delineated and treated as required

- Delineation and removal of identified contamination 'hot-spots' in the identified contamination area on the site east of Pinfold Street. The contaminated soils / materials were relocated to the 'Main Site' (i.e. west of Pinfold Street) for subsequent treatment using E-Clay Stabilisation and deposition in designated areas following validation
- The installation of a PRB on the 'Main Site' (i.e. west of Pinfold Street) to address the identified potential pollution risks to controlled waters and to the Picknal Brook in particular. The PRB was installed in close proximity to the Picknal Brook
- Groundwater monitoring downstream of the PRB to confirm the efficacy of the PRB installation comprising of five equidistant boreholes installations
- Groundwater monitoring on the site east of Pinfold Street (four borehole installations) - these boreholes were utilised to monitor the levels of residual groundwater contamination following source removal undertaken in this area of the site – it was decided that there would be no requirement to install the PRB on the eastern side of the site providing that the groundwater contamination had been effectively addressed by the source removal
- Excavation of asbestos containing materials [ACM] from the machine pits followed by 'hand picking' of the ACM from the excavated materials followed by disposal at a suitably licensed facility. Treatment of residual materials by E-Clay Stabilisation and redeposition in a bespoke borrow pit outwith of the proposed residential redevelopment area

The Remediation Strategy is summarised in Figure 5 below (integrated treatment approach):

Figure 5 – Remediation Strategy



The remediation scheme was implemented under the auspices of Envirotreat's Mobile Treatment Permit authorised by the Environment Agency. The treatment process is licensed as a waste recovery operation enabling reuse of treated [recovered] materials on-site (as a substitute for imported fill) in accordance with the Materials Management Plan [MMP] for the site.

### PRB Installation

The alignment of the PRB was 'set out' on site in accordance with the agreed alignment as specified in the Remediation Strategy - the alignment of the PRB varied slightly in practice to take account of local conditions and constraints (e.g. the existing STWA foul drain).

A site-specific pillared form of E-Clay was utilised for the barrier installation – the pillaring provided the necessary porosity and additional reactivity. The E-Clay was added in a slurry form.

The barrier was installed in nominal six metre long sections utilising a trenching methodology. Soils were excavated to a depth just above the groundwater depth - the excavated soils were set aside for later reinstatement. E-Clay slurry was then pumped into each open trench excavation followed by thorough mixing of the in-situ soils (sands & gravels) with the added slurry using the excavator bucket.

The mixing was extended to the required depth to key into the underlying impermeable Boulder Clay / Mercia Mudstone layer (circa 5m bgl) - the depth of the installation was confirmed by withdrawing the excavator bucket and assessing the nature of the soils on the bucket.

The PRB installation is shown in Figures 6,7 and 8 below.

Figure 6 – PRB Installation – Addition of E-Clay Slurry



Figure 7 – PRB Installation - Soil Mixing



Figure 8 – PRB Installation - Soil Mixing



On completion of each trench section the previously set aside soils were re-emplaced on top of the treated soils used to create the permeable reactive barrier. The reinstated PRB is shown in Figure 9 below.

Figure 9 – Reinstated PRB Trench



### Source Treatment - E-Clay Stabilisation

The site investigation reports had identified a number of contamination 'hot-spots' across the site (predominantly on the 'Main Site' to the west of Pinfold Street). These hot-spots were treated by E-Clay Stabilisation comprising of a site-specific formulation of the designated E-Clay and cementitious materials - additional source treatment areas were identified following additional trial pitting / information provided by the demolition contractor and former employees who had indicated possible 'high risk areas' where contamination would likely to be present.

Soils identified on the east side of Pinfold Street were removed and treated using E-Clay Stabilisation for subsequent reuse on the main site (west of Pinfold Street). In total seven hot spots areas were identified and subsequently treated. Following successful validation the treated soils were reused on the main site for infilling purposes.

The soils were initially treated with E-Clay slurry and subsequently mixed with cementitious materials to provide the overall stabilisation process. The source treatment operation is shown in Figures 10, 11 and 12 below.

Figure 10 – Source Treatment – Addition of E-Clay Slurry



Figure 11 – Source Treatment – Mixing Process



Figure 12 – ‘Main Site’ Following Source Treatment



### Asbestos Contamination [ACM]

The former machine pits containing ACM are shown in Figure 13 below:

Figure 13 – Asbestos / ACM Contamination in Former Machine Pits



The demolition contractor had previously identified the presence of asbestos contaminated soils and ACM within the machine pits. The ACM contained within the machine pits comprised of cement bound sheeting fragments and insulation board (chrysotile and crocidolite forms of asbestos in the cement board sheeting and chrysotile and amosite forms of asbestos in the insulation board).

The removal works are shown in Figure 14 below – the excavated ACM contaminated soils were stockpiled as shown for assessment / separation of visible ACM.

Figure 14 – Removal of Asbestos / ACM Contamination from the Machine Pits



Based on the physical condition and the type of asbestos, the potential quantity and the fact that some of the asbestos material was 'clearly identifiable', it was considered that any works would be both 'Licensed' and 'Notifiable', in accordance with the Control of Asbestos Regulations [CAR] 2012.

The area was therefore quarantined pending the adoption and implementation of a suitable remediation strategy to address the asbestos contaminated soils / ACM. The agreed strategy was to remove the ACM from the asbestos contaminated soils by 'hand picking' and then to remove the ACM from site for disposal at a suitably licensed facility; the residual soils would then be managed / retained on-site (subject to being acceptable for retention on-site) and deposited in a borrow pit located outwith of the proposed residential development area on the 'Main Site'.

Enviro-treat were instructed by the Client to manage these works as Principal Contractor. Enviro-treat commissioned Monolithic Environmental Services [Monolithic], a licensed asbestos removal contractor, to prepare all the documentation (i.e. the required Method Statement etc) / inform the Health and Safety Executive (in accordance with the requirements of CAR 2012) and undertake the removal works.

Monolithic attended site and undertook the following works:

- excavation the contents of both machine pits
- sorting through the excavated material and hand-picking all ACM
- separating all wood, metal and soils accordingly
- physically inspecting the pits for any evidence of residual ACM
- signing off both machine pits as being 'clean' following removal
- confirmation that there was no residual ACM left on the surrounding ground

The residual soils were tested for asbestos and for chemical contamination. Asbestos levels were shown to be very low or not quantifiable (below detection limits) and most importantly below the 0.1% hazardous threshold; the soils were however visibly contaminated and were subsequently shown to be contaminated above threshold reuse criteria. It was therefore considered necessary to treat the chemical contamination within the soils to enable reuse on-site in the designated borrow pit (as shown in Figure 5 above).

The machine pits were subsequently infilled with treated material from the eastern side of the site.

### 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 Picknal Brook was monitored before and during the remediation works.

All of the environmental monitoring confirmed compliance with the specified requirements as summarised in the Remediation Method Statement for the works.

## Validation

### PRB

The agreed remediation target criteria for the barrier installation (and for the site as a whole in relation to the protection of the Picknal Brook) were Environmental Quality Standards [EQS] and Drinking Water Standards [DWS] for the identified contaminants of concern – naphthalene (as a ‘marker’ contaminant for polycyclic aromatic hydrocarbons) and total hydrocarbon petroleum bandings respectively.

Five boreholes were installed along the length of the barrier installation with the purpose of monitoring groundwater quality both during and after the remediation works. Monitoring was carried out on a regular basis for nine months following installation. All monitoring results were well below the agreed remediation target criteria.

### Source Treatment

The agreed leachate remediation target criteria for the source treatment were 20x EQS and 20 x DWS for the identified contaminants of concern respectively. These target values were derived on the conservative basis that the barrier system would remove 95% of the contamination potentially migrating through the barrier. This approach demonstrated the integrated treatment approach combining source treatment with the PRB to achieve the overall remediation solution for the site as a whole. There were no specific requirements for the protection of human health as the intention is to emplace a suitable capping / cover layer on the surface of the ‘Main Site’ in advance of the site being developed for residential purposes.

Representative samples were taken from the treated soils for validation purposes. A composite sample was prepared representative of every 250m<sup>3</sup> treated.

Following a suitable period of ‘curing’ the composite samples were sent for leach testing at an accredited laboratory 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.

### Asbestos / ACM Removal (Machine Pits)

The ACM were successfully removed and disposed of at a suitable hazardous landfill facility. The remaining soils were analysed for residual asbestos fibres - all results were below the agreed <0.1% threshold enabling redeposition into the borrow pit.

### Site East of Pinfold Street

Monitoring of the installed boreholes during and after remediation works demonstrated that source removal / treatment was successful and no additional remediation measures would be required (i.e. a possible extension of the PRB on the eastern side of the site).

## Conclusions

Envirotrat demonstrated that the remediation objectives for the site had been achieved through the submission and approval of a comprehensive Validation / Verification Report for the Site. The Environment Agency confirmed that the works had been undertaken satisfactorily through the formal planning process.

The remediation works enabled the relevant planning condition on land contamination to be discharged and the site can now be progressed in terms of the development objectives.