envirotreat®

Delivering land you can develop

CASE STUDY

Source Treatment / PRB Installation

Former GKN Stoke Works – Sheepbridge, Chesterfield

Client

SEAPOINT CAPITAL PARTNERS

Environmental Consultants

wardell armstrong

Site Background & History

The site is the former GKN Stoke Works, Sheepbridge, Chesterfield and is located to the north-west of Chesterfield Town Centre. The site previously comprised of ten factory buildings with various ancillary structures – the site was primarily used for the production of metal cylinders for the motor and marine industries. The site is bounded by industrial premises to the east, west and south and by the Barlow Brook to the north.

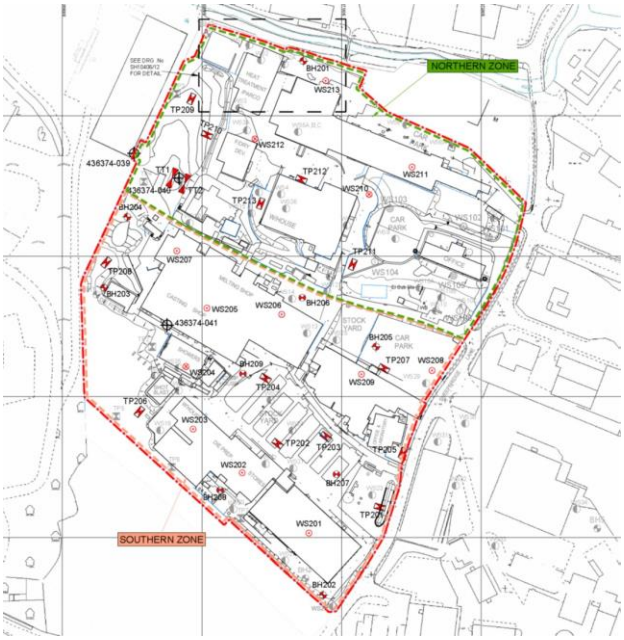
Historically the southern part of the site was utilised for agricultural purposes and the northern part was occupied by the Albert Colliery and Sheepbridge Iron Works until the 1920's – these works included railway sidings, reservoirs, shafts and filter beds. The colliery buildings were subsequently redeveloped (residential buildings were present in the centre of the site until the 1960's) - the entire site was subsequently redeveloped for industrial use.

Railway sidings and a gas holder were also present on the site from the 1960's until the 1980's. The sidings were subsequently dismantled and the gas holder was replaced by an administration building in the 1990's.

The GKN site operations were regulated by the Environment Agency under the auspices of a PPC Permit.

The site overview is shown in Figure 1 below.

Figure 1 – Site Overview



Seapoint Capital [Seapoint] had purchased the site with the intention of redeveloping the site for a commercial end use following satisfactory remediation of the site and the surrender of the PPC Permit (which was essential to enable the proposed redevelopment to proceed).

Seapoint engaged Wardell Armstrong [WA] as their appointed consultants with a remit to carry out necessary site investigations and to oversee the site remediation and PPC Permit surrender processes.

envirotreat®

Delivering land you can develop

CASE STUDY

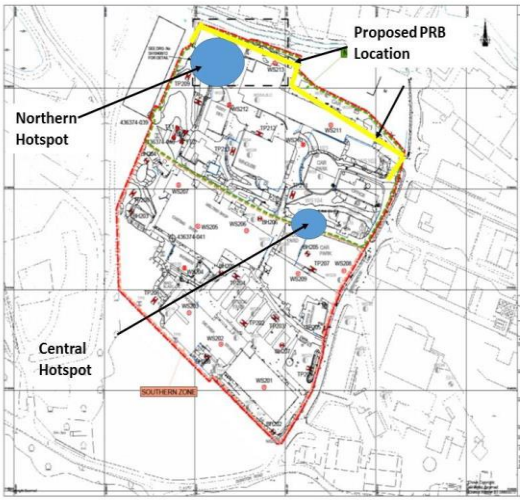
Source Treatment / PRB Installation

Former GKN Stoke Works – Sheepbridge, Chesterfield

Site Investigations

Site investigative works were undertaken by WA in 2016. WA essentially identified two contamination 'hot-spots' on the site referred to as the 'North Western Hot-Spot' and the 'Central Hot-Spot' respectively. The locations of these hot-spot areas are shown in Figure 2 below.

Figure 2 – Location of Hot-Spot Areas



The north western hot-spot area was heavily contaminated with total petroleum hydrocarbons [TPH], chlorinated hydrocarbons i.e. trichloroethene [TCE] and tetrachloroethene / perchloroethene [PCE] and hexavalent chromium [CrVI].

The central hot-spot area was contaminated with paraffin / kerosene which was assumed to be as a result of an historical spillage.

WA concluded that the elevated concentrations of identified contaminants presented a significant risk to both human health and controlled waters (particularly in relation to the Barlow Brook which was located in close proximity to the north western hot-spot area). WA therefore concluded that suitable remediation of the site would be required to address the identified concerns and to enable the permit to be surrendered.

Envirotreat proposed the following integrated remediation strategy to address the identified requirements:

- Delineation and source treatment [E-Clay Stabilisation] of identified contamination within the north-western area of the site i.e. the 'north-western hot-spot'
- Investigations in the central hot-spot area and the subsequent remediation if required of any residual paraffin [kerosene] contamination resulting from an historical leak / spillage
- The installation of a permeable reactive barrier [PRB] along the northern boundary of the site to protect the Barlow Brook (controlled waters)
- Necessary validation comprising, primarily, of groundwater monitoring by the installation of five boreholes equally spaced along the northern boundary
- The implementation of a 'Discovery Strategy' if required to address any contamination any contamination 'not previously identified' on the site

Prior to the commencement of the remediation works, buildings within the northern and southern areas of the site were demolished to slab level.

Delineation of the North Western Hot-Spot

Following the demolition of the building overlying the north western hot-spot and the breaking out / stockpiling of the concrete floor slab it was apparent that significant hexavalent chromium [CrVI] contamination was present in the soils underlying the building and within the stockpile concrete rubble as shown in Figures 3 and 4 below – yellow coloured surface water was also present in the vicinity of the stockpile as shown in Figure 4.

Trivalent chromium [CrIII] had been previously identified on the site – the presence of CrVI was only identified following demolition and slab removal.

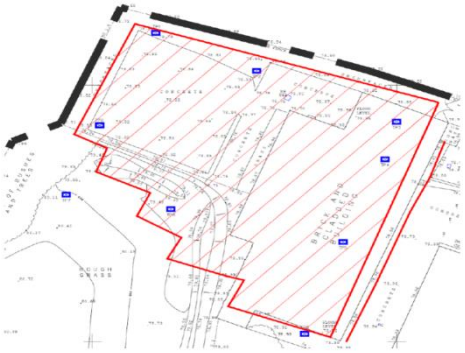
Figure 3 – Identified CrVI Contamination Following Floor Slab Removal

Figure 4 – Visible CrVI Contamination in Rubble and Surface Water

CrVI is a highly soluble and mobile pollutant across the whole pH range whereas CrIII is relatively insoluble at moderately alkaline pHs. The presence of CrVI posed a significant risk to human health and to controlled waters – the close proximity of the Barlow Brook was a prime concern, particularly given the high mobility, solubility and toxicity of CrVI. This was a key factor in determining the remediation strategy for this area of the site.

Envirotreat undertook a trial pitting exercise to determine / delineate the extent of the identified contamination (which was considered to be pervasive). The locations of the trial pits are shown in Figure 5 below.

Figure 5 – Trial Pitting Locations (North Western Hot-Spot)



The trial pitting exercise identified significant chromium contamination in two of the trial pits [TP4 and TP5 respectively]. Both of these trial pits were located under the former 'Parco Heat Treatment Unit.' It was therefore assumed that the identified CrVI contamination was associated with this former activity on the site. It was concluded that the hexavalent chromium [CrVI] contamination should be regarded as contamination 'not previously identified' which should be addressed through the provisions of the agreed 'Discovery Strategy'.

It was necessary to implement an emergency Discovery Strategy to protect the Barlow Brook from the potential CrVI pollution risk – the solubility and mobility of CrVI within surface water / groundwater was clearly evident (see Figure 4 above). This was agreed with the EA.

The immediate objective was to treat the hot-spot area and surface waters with ChromeSorb®, a form of E-Clay designed to chemically sorb and immobilise both CrVI and CrIII. The treatment media was added in slurry form to the contaminated rubble and surface waters.

envirotreat®

Delivering land you can develop

CASE STUDY

Source Treatment / PRB Installation

Former GKN Stoke Works – Sheepbridge, Chesterfield

Source Treatment - North Western Hot-Spot

The source treatment was carried out *in-situ* for practical reasons and to minimise the potential release of CrVI into surface waters through potential disturbance.

The treatment was carried out by E-Clay Stabilisation incorporating ChromeSorb (for the treatment of CrVI / CrIII). The E-Clay formulation was designed to sorb and chemically immobilise the identified TPH and VOC pollutants. The treatment medium was added in slurry form.

The treatment was carried out using a conventional excavator down to a depth of 2m – it was decided to treat the area using a 5m x 5m grid system to tailor the treatment process accordingly based on the previous delineation exercise. The *in-situ* source treatment is shown in Figure 6 below.

Figure 6– *In-Situ* Source Treatment

Representative samples were taken from each batch of soil treated. Composite samples were produced to confirm the efficacy of treatment at an agreed frequency of one sample per 250m^3 of soils treated. In total seven composite samples were prepared for subsequent leachate testing, representative of one sample per 250m^3 treated. Samples were sent to an accredited laboratory for leach testing utilising the current CEN leaching methodology [BS EN 12547-2]. The leachate analysis results were below the agreed remediation target criteria.

On satisfactory completion of the leachate testing the north-western area was capped using a 600 mm capping layer of inert material. The completed source treatment area is shown in Figure 7 below.

Figure 7 – Completed Source Treatment Area

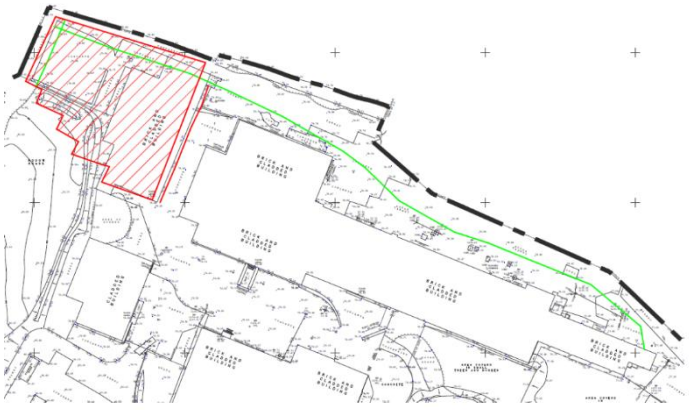
Permeable Reactive Barrier Installation

The permeable reactive barrier [PRB] was installed by a trenching methodology along the northern boundary of the site (directly upstream of the Barlow Brook).

The PRB formed part of the treatment strategy for the north-western hot-spot area – the PRB was designed to address the deeper groundwater contamination in this area.

The alignment of the PRB is shown in Figure 8 below. The PRB was installed into the north western hot-spot area as shown.

Figure 8 – Alignment of PRB (Green Colouration)



A pillared form of E-Clay was utilised for the PRB installation – the pillaring provided the necessary porosity / permeability to ensure that there was no adverse impact on the natural groundwater regime. The ChromeSorb form of E-Clay was pillared by design to provide the necessary reactivity with CrVI (and to provide the necessary porosity).

The PRB was installed in 6m sections for practical reasons. Each section was reinstated following installation.

The E-Clay and Chromesorb reagents were added in slurry form following the excavation of each barrier section. The excavator bucket was used to mix the treatment reagents with the remaining soils *in-situ* and with subsequently reinstated soils to form the PRB. The PRB was installed to the required depth, i.e. 'keyed' into the underlying bedrock.

On completion of reinstatement the PRB was capped with inert materials.

The barrier installation process is shown in Figures 9 and 10 below. The completed PRB is shown in Figure 11 below.

Figure 9 – Fully Excavated Barrier Section

Figure 10 – Installation of PRB / Mixing of Soils with Treatment Media

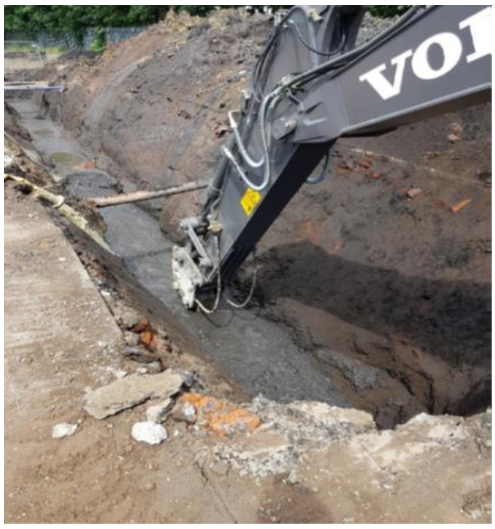


Figure 11 – Completed PRB Installation

The PRB was validated by groundwater monitoring downstream of the barrier. Five groundwater monitoring boreholes were installed at 100m intervals for monitoring purposes. Eight rounds of groundwater monitoring were undertaken to demonstrate compliance with the agreed remediation target criteria [RTC] for the necessary protection of the Barlow Brook. The results demonstrated satisfactory compliance with the RTC confirming the efficacy of the PRB installation and the overall integrated remediation strategy.

Investigation of the Central Hot Spot

It was necessary to carry out investigative trial pitting in the central 'hot-spot' area to confirm that the paraffin [kerosene] spillage was no longer present – the spillage is reported to have occurred subsequent to the formal permit deployment on the site [Permit Reference BK 6777].

This confirmation was required by the Environment Agency to enable the formal surrender of the existing permit (in addition to the satisfactory remediation of other identified site contamination).

Trial pitting was carried out across the central hot-spot area and samples were collected to verify the absence of the kerosene contamination. All analysis confirmed that kerosene was no longer present and therefore the permit surrender could effectively be progressed. No remediation was necessary.

Conclusions

The works were carried out within the required timeframes and in full accordance with the agreed Remediation Strategy and Method Statement.

The remediation works as implemented provided a very cost-effective remediation solution and ensured that the project remained on track throughout. The Envirotreat Discovery Strategy allowed the effective implementation of a treatment solution without any disruption to the project timescales or budget. This was carried out with the necessary liaison with the appropriate regulatory bodies (in particular the EA) who fully supported the actions taken.

Envirotreat provided a comprehensive Validation and Verification Report fully documenting all of the remediation works undertaken and confirming compliance with the agreed RTC.

The provision of the Validation / Verification Report (in combination with the Remediation Strategy and Method Statement) enabled the full discharge of the relevant planning conditions and the full surrender of the permit (carried out by WA in conjunction with Envirotreat).

WA provided a separate summary of the remediation works as follows:

'After conducting several phases of site investigation over a ten-year period, Wardell Armstrong supervised remediation work to clean up two hotspots of contamination at the site. Formerly comprising ten factory buildings, the site previously produced metal cylinders for the motor and marine industries. A DQRA identified hotspots of TPH, TCE and Chromium (VI). Following guidance within CLR 11 a remediation options appraisal was carried out to determine the most effective method of treatment. Remediation was successfully undertaken through installation of a Permeable Reactive Barrier to protect the adjacent watercourse along with localised excavation of the hotspots and ex-situ treatment with E-Clay/ChromeSorb'.

The remediation works are shown in Figure 12 below (photo provided by WA).

Figure 12 – Remediation Works