



REMEDIATION STRATEGY
FORMER MONCKTON COKE WORKS,
NEAR BARNSELEY
for
HARGREAVES (UK) SERVICES Ltd

April 2017

Remediation Strategy
Former Monckton Coke Works, near Barnsley
for
Hargreaves (UK) Service Ltd

G15009		Remediation Method Statement		
Revision	Date of issue	Comments	Prepared by	Checked by
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1.0 Introduction

1.1 Commission

Patrick Parsons Ltd (PPL) has been appointed by Hargreaves (UK) Services Ltd (client) to produce a Remediation Strategy in relation to the proposed mixed land-use development at the site known as Monckton Coke Works. A site features plan is attached in Appendix A.

1.2 Proposed Development

The client proposes to redevelop the site for mixed land-use development comprising; residential and commercial facilities incorporating areas of public open space. The development also includes access roads and car parking.

1.3 Existing Site

The current site of the former Monckton Coke Works can be divided into three sections; stockyard area in the north, production and by-products area in the centre and the southern area which contains an effluent treatment plant, as illustrated in Drawing No. G15009_700.

1.4 Limitations

This report has been prepared for the client and their appointed agents only and should not be relied upon by any third party without the written permission of PPL. If any unauthorised third party comes into possession of this report, they rely on it at their own risk and the authors do not owe them any Duty of Care or Skill. It is based on and limited to an assessment of the information and ground conditions identified here. PPL is not responsible for ground conditions not revealed during investigations undertaken by third parties and have reviewed the information presented in good faith.

1.5 Aim of Remedial Strategy

The Remediation Strategy has been developed based on a review of previous investigations produced between 2001 to 2016, with PPL producing the latest and most up to date report.

This Remediation Strategy should be read in conjunction with previous reports, outlined in Section 1.5, enclosed in appendices to the Environmental Statement which accompanies the planning application.

The principal objectives of this report are as follows:

- Review the existing reports;
- Summarise the identified contamination hazards and where necessary undertake supplementary qualitative risk assessment;
- Provide recommendations for remediation, to reduce the risk to the identified receptors;
- Outline proposed validation works to confirm remediation works have been successfully completed.

1.6 Information Sources

This Remediation Method Statement is based on the information presented in the following reports:

- Monckton Coke and Chemical: Phase 1a Site Report. Reference ILM081/1a, Issue 1. ABB Eutech, 22 August 2001.
- Monckton Coke and Chemical: Phase 1b/2 Site Report. Reference ILM092/1b-2, Issue 1. ABB Eutech, 19 April 2002.
- Environmental Due Diligence: Monckton Coke and Chemical Works. Reference 12022228-001. WSP Environmental UK, June 2005.
- Environmental Assessment: Monckton Coke and Chemicals Limited. Reference 16492-R1(00). RSK STATS Geoconsult Limited, dated May 2011.
- RSK letter report on groundwater sampling, reference 321453(H)L01(00), dated 19 August 2013.
- Data Review and Preliminary Risk Assessment: Monckton Coke and Chemicals Limited. Reference 321789(H)-R1(00). RSK Environment Limited, dated November 2014.

The above reports were referred to in the design of the PPL phase of ground investigation, specifically RSK 2014 report. PPL issued the following reports:

- Ground Investigation Report: Former Monckton Coke Works, Nr Barnsley Issue 2, G15009. Patrick Parsons, Dated 24-11-2015.
- Ground Investigation Factual Report: Former Monckton Coke Works, near Barnsley Issue 2, G15009. Patrick Parsons, Dated 07-06-2016.

2.0 Summary of Previous Investigations

The following is a summary of the findings of the previous reports.

2.1 Phase 1B/2 Site Report, ABB Eutech (2002)

Establishment of baseline conditions with regard to soil and groundwater contaminant concentrations within the operational part of the site (re. IPC permitting).

Evidence of visual and olfactory hydrocarbon impact of soils and groundwater including free phase product.

Elevated concentrations of TPH, BTEX, PAHs, phenols and total sulphate within soils in the by-products area together with TPH, BTEX, PAHs, SVOCs and cyanide within groundwater (MWS) located close to the western site boundary within the by-products area. In addition, elevated leachate concentrations with respect to BTEX were recorded from the western boundary railway cutting.

2.2 Environmental Assessment, RSK (2011)

Assessment of the contamination status of soil and groundwater within the operational site area (production and by-products).

Visual and olfactory evidence of hydrocarbon impact on soils and the underlying solid strata was noted.

Elevated concentrations of TPH, PAHs and VOCs, with respect to the generic assessment criteria (GAC) for commercial land, were present within the soils and groundwater in and around the by-products area.

2.3 Additional Groundwater Sampling, RSK (2013)

Monitoring well BH205 located within the eastern part of the by-products area displayed a significant thickness of DNAPL, comprising PAHs possibly derived from coal tars. Elevated contaminant concentrations were similar to those recorded in 2011 groundwater results.

2.4 Ground Investigation Report, PPL (August 2015)

Further assessment of the ground conditions and assessment of the contamination status of the soils and groundwater in areas previously not studied.

Visual and olfactory evidence of potential hydrocarbon contamination noted in the soils and bedrock of the stock yard and by-products area from ground level to 1.8m bgl.

Elevated concentrations of heavy metals, cyanide, PAHs, TPH, potentially VOCs and SVOCs were recorded with respect to the GAC for residential end-use with home grown vegetables.

Elevated concentrations of metals, cyanide and PAHs were recorded with respect to the GAC for commercial end-use.

5 No. soil samples retrieved from within coal bearing made ground with high calorific values.

4 No. asbestos identifications within made ground soils (TP20@0.5m and 1.0m, TP107@0.5m and TP108@0.3m bgl).

It is considered that without remedial measures the previously mentioned contaminants present a risk to end-users of the proposed development. Risk to construction personnel can be mitigated by good working practices and proper PPE.

Migration of liquid phase contamination through made ground and natural soils into the underlying aquifer is considered to pose a moderate to high risk to the underlying solid strata aquifer and a low to moderate risk to the adjacent controlled waters of Lineside Dyke and Pools Dyke. Migration pathways to the surface waters may be viable if contaminated made ground soils were re-used and remained on site.

Gas monitoring in accordance with C665 has been completed. Carbon dioxide of up to 8.4%v/v, a maximum flow of 2.6l/hr and oxygen as low as 0.7%v/v have been recorded. Also recorded were elevated levels of methane (maximum 3%v/v), carbon monoxide (maximum 1% v/v) and hydrogen sulphide (maximum 1% v/v). Peak flow rates were recorded at a maximum of 2.6l/hr. Based on the elevated levels of carbon dioxide recorded the site has been characterised as Characteristic Situation 2/Amber 2.

3.0 Phase II Conceptual Model

The information from the previous reports has been assessed and a conceptual model developed following current relevant guidance.

3.1 Human health

The primary receptors are end-users of the proposed residential development and construction personnel. These are more sensitive than commercial site users and the assessment is therefore more conservative. The pathways include direct contact with contaminated soil and soil dust, ingestion of contaminated soil and dust, consumption of home grown vegetables and the indoor/outdoor inhalation of ground gas and soil vapour.

Contamination sources have been identified in the made ground soils in the stockyard area and production and by-products area that pose a potential risk to end users. Assuming appropriate PPE is specified within the ground workers risk assessment, identified contaminants should not pose a significant risk to construction personnel.

The gas monitoring has recorded elevated levels of carbon dioxide and methane, in addition the site is located within a radon affected area.

3.2 Controlled waters

The primary receptor is the Secondary A Aquifer (Carboniferous Middle Coal Measures) which is considered to be at moderate to high risk from the identified contaminants. Chemical analysis of water samples retrieved from within the rock recorded several exceedances of heavy metals, cyanide, PAHs, TPH and SVOCs indicating the groundwater is currently contaminated and requiring remediation. Leaching and migration of the identified contaminants into Lineside Dyke, running parallel to the western boundary, and Pools Dyke, approximately 120m west of the site, is considered to pose a low risk. However, migration pathways to the surface waters may be viable if contaminated made ground soils were re-used and remained on site.

The Phase II conceptual model is illustrated below.

Human Health		
Source	Pathway	Receptor
Extensive significant soil contamination by heavy metals, cyanide, TPH, BTEX, PAHs, VOCs/SVOC, phenols and asbestos.	Indoor and outdoor inhalation of soil dust and vapours, the ingestion of contaminated soil, consumption of home grown vegetables and direct contact with contaminated soil and dust. Limited pathway due to appropriate PPE stipulated within groundworkers risk assessment.	End users Construction personnel
Asbestos recorded in shallow soils.	Indoor and outdoor inhalation of contaminated soil and dust.	End users
Asbestos recorded in shallow soils and silica bricks.	Indoor and outdoor inhalation of contaminated soil and dust. Limited pathway due to appropriate PPE stipulated within groundworkers risk assessment.	Construction personnel
Elevated levels of carbon dioxide and radon.	CO ₂ and CH ₄ migration through soils into enclosed spaces and buildings creating asphyxiating or explosive conditions.	Construction personnel End users
Controlled Waters		
Significant contamination of groundwater and potential surface water contamination by heavy metals, cyanide, TPH, BTEX, PAHs, SVOCs and phenols.	Leaching and migration into the groundwater or surface water. Migration of liquid phase contamination into groundwater and surface waters.	Secondary A Aquifer Lineside Dyke Pools Dyke

4.0 Remediation and Validation

4.1 Human Health – Soil Contamination

Remediation of the soils will be a prerequisite to development of the site due to significant contamination of the made ground deposits by heavy metals, TPH, BTEX, SVOCs, cyanide, PAHs, and asbestos.

Grossly contaminated soils will require treatment by a combination of bioremediation and stabilisation/solidification (S/S) techniques, permitting maximum reuse of material on site. Contaminated soils would be excavated and transferred to an onsite soils treatment area that would process the soils into the following streams:

- Soils that fail on VOC (treated using enhanced Soil Vapour Extraction (SVE)/bioremediation);
- Soils that fail on TPH/PAH (treated using bioremediation);
- 'Gross' soils which are not amenable to bioremediation or SVE (treated using a S/S approach).

4.1.1 Bioremediation

Biological treatment techniques rely on the natural metabolic processes of living organisms, such as bacteria and fungi, to destroy organic contaminants or convert them into less toxic forms. Soils that have been sentenced for bioremediation will be placed into a purpose built biopile. Contaminants that can be treated by bioremediation include:

- Petroleum, diesel, lubricating oils, kerosene, PAHs;
- Selected explosives;
- Phenols and cresols;
- Chlorinated hydrocarbons;
- Selected herbicides and pesticides.

The biopile will be constructed of an impermeable solid flat base with a sump for capturing runoff and leachate. The biopile will have a bund wall to contain the material and any potential liquids. A granular layer will be placed over the base of the biopile to allow the material to drain and the circulation of air. Additional pipework will be incorporated within the biopile as the soils are placed, in order to enhance aerobic biodegradation by applying a SVE system as required. Nutrients and amendments are also incorporated into the soils during placement to encourage aerobic microbial activity. Gas monitoring pipes will be installed into the material to monitor the respiration rates and identify dead spots where bio activity is not occurring. The material will be regularly analysed until it passes the set criteria for reuse on site. Material will be removed from the biopile and either sent back to the site for reuse as compliant validated material, or where required, if recalcitrant compounds are present, will be passed onto further S/S treatment.

4.1.2 Stabilisation/Solidification (S/S)

S/S comprises two simultaneous processes, chemical fixation and mass encapsulation, relying on the physico-chemical reaction between binders (e.g. Portland cement), reagents (e.g. clays and zeolites)

and contaminants in soil, sediments and groundwater to reduce mobility by mechanisms such as sorption, precipitation, complexation, hydrolysis, oxidation and reduction.

Soils that have been sentenced for S/S, will first be assessed to determine the required design mix formulation to be used, based on the results from treatability study works. This design mix will generate a treated material that will comply with site specific re-use leachate criteria. The S/S treatment area will generally comprise of a 50m x 50m impermeable pad. Impacted material will be placed directly onto the pad and spread out to a thickness of 300mm. The material will then be homogenised and mixed using a Wirtgen machine or similar, which will add water and the amendments (binders and reagents) at the required rates for the materials being treated. Samples will be taken at a specified rate from each wet batch for leachate testing to ensure compliance with the re-use leachate targets. Once the material is mixed and a sample has been collected and passed the relevant criteria, it can be removed from the pad using excavator and dumpers and taken to the intended location for final placement on the site.

S/S is suitable to target both granular and cohesive soils and sediments containing multiple contaminants including:

- Metals and metalloids;
- Corrosives;
- Coal tars;
- Asbestos;
- Petroleum hydrocarbons;
- Polyaromatic hydrocarbons;
- Radio nuclides;
- Dioxins;
- Cyanides and spent oxides;
- Polychlorinated Biphenyls;
- Chlorinated hydrocarbons.

The process can also be used simultaneously to improve the geotechnical properties of poor soils to meet bearing capacity and settlement specifications.

4.1.3 Encapsulation

Lesser contaminated soils and post treatment soils will require encapsulation beneath hardstandings or c. 600mm thick capping layer in all domestic gardens and c. 300mm thick capping layer in areas of public open space.

To form the capping layer it is likely to be necessary to import clean topsoil and subsoil material to the site as large volumes of chemically adequate site won material is unlikely to be available.

Any imported materials to be used within the cover system should be managed in accordance with the YAHPAC – 'Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners and Consultants'. The chemical testing validation rates are shown in the table below:

Source and Validation Rate	Chemical Analysis Suite		
	General Soil Suite	Asbestos	Hydrocarbons (TPHCWG)
Greenfield Source 1 per 150m ³	✓		
Brownfield Source 1 per 100m ³	✓	✓	✓
Generated Soil 1 per 50m ³	✓	✓	✓

Once the soil has been chemically validated and placed its depth will be checked by a PPL engineer to ensure that the required thickness of clean cover is present.

4.1.4 Silica bricks

Silica bricks and associated airborne dust pose a risk to construction personnel and require remediation. HBR Report "Stockpile Sampling Investigation Report – Monckton Coke Works (November 2016)" confirms that the silica bricks are suitable for reuse on site beneath hardstandings. HBR Report is appended (Appendix B).

4.2 Human Health – Ground Gas

The site has been classified as 'Characteristic Situation 2/Amber 2' in accordance with CIRIA C665 and NHBC guidance due to the presence of elevated carbon dioxide and methane, derived from on site deep made ground and potentially mining, together with off site migration of landfill gas and radon. As such gas protection measures are required and should comprise;

Under floor venting (below either a precast or cast in-situ suspended floor);

A radon, carbon dioxide and hydrocarbon resistant membrane installed, fully sealed around service entries, extended across the cavities with all joints fully sealed with doubled sided gas proof butyl tape with a minimum 150mm overlap.

As the site is classified as 'Amber 2', validation of the installed gas protection measures is required. The membrane for each plot will be visually inspected by a suitably experienced PPL engineer to ensure it has been correctly installed to high standard. The visual inspection will include but not be limited to the following checks:

- Visual inspection to check for presence of tears and holes in the membrane;
- Inspection of service entries to make sure a full seal has been achieved;
- Checking of joints to ensure correct tape and minimum overlap has been achieved;
- Checking of air bricks to ensure underfloor venting has been provided.

In accordance with BS8485 and CIRIA Guidance 735 a Gas Strategy Report should be provided for regulatory approval.

4.3 Controlled Waters

Remediation of groundwater will be a precondition to site development. Though it is envisaged that soil remediation and dewatering excavations where gross contamination is present will effectively

remove the source of groundwater contamination and allow (monitored) natural attenuation to progress.

4.3.1 Source removal and treatment

Chemical analysis of the groundwater recorded several exceedances based on GAC for surface waters (EQS) and ground waters (Drinking Water Standards) of heavy metals, cyanide, inorganics, TPH, PAHs, BTEX and SVOCs. All water samples were retrieved from within rock and therefore indicated contamination of groundwater. As such, localised groundwater remediation is likely to be required where gross contamination is encountered and dealt with separately to the wider contamination which will be subject to monitored natural attenuation.

Localised gross contamination will be remediated either by dewatering excavations or by employing a Multiphase Extraction (MPE) approach both of which ultimately will utilise a combination of on-site/off-site treatment.

MPE aims to remove dissolved phase contaminants from groundwater in the saturated zone, together with vapours in the unsaturated zone (by vacuum enhanced recovery (VER)) and non-aqueous phase liquid (NAPL or free phase product) perched on the water table (known as the smear zone).

The light non-aqueous phase liquids(LNAPL), contaminated groundwater and vapours will be abstracted from recovery wells, located where gross contamination was encountered, and will be pumped to an on-site water treatment system. This will typically comprise of a settlement tank, an oil/water separator, a sand filter and then at least two Granular Activated Carbon (GAC) vessels. LNAPL is recovered by skimmer units as it flows towards the recovery point and oil/water separators are utilised to separate out the water. The vapour extracted is normally treated by stripping GAC units and dissolved phased contaminants in the water are treated onsite using a variety of physical, chemical and biological techniques. The treated water will be pumped either to a foul sewer under a discharge consent or it will be recirculated into the site via infiltration trenching under an Environmental License from the Environmental Agency. All discharged treated water will be routinely tested and analysed to ensure compliance with set discharge criteria. LNAPL collected in the oil/water separator will be siphoned off into a secure vessel within a bund. The stored LNAPL will be disposed off-site, preferentially to be used as a secondary fuel, in accordance with waste licensing regulations.

4.4 Additional Development Constraints

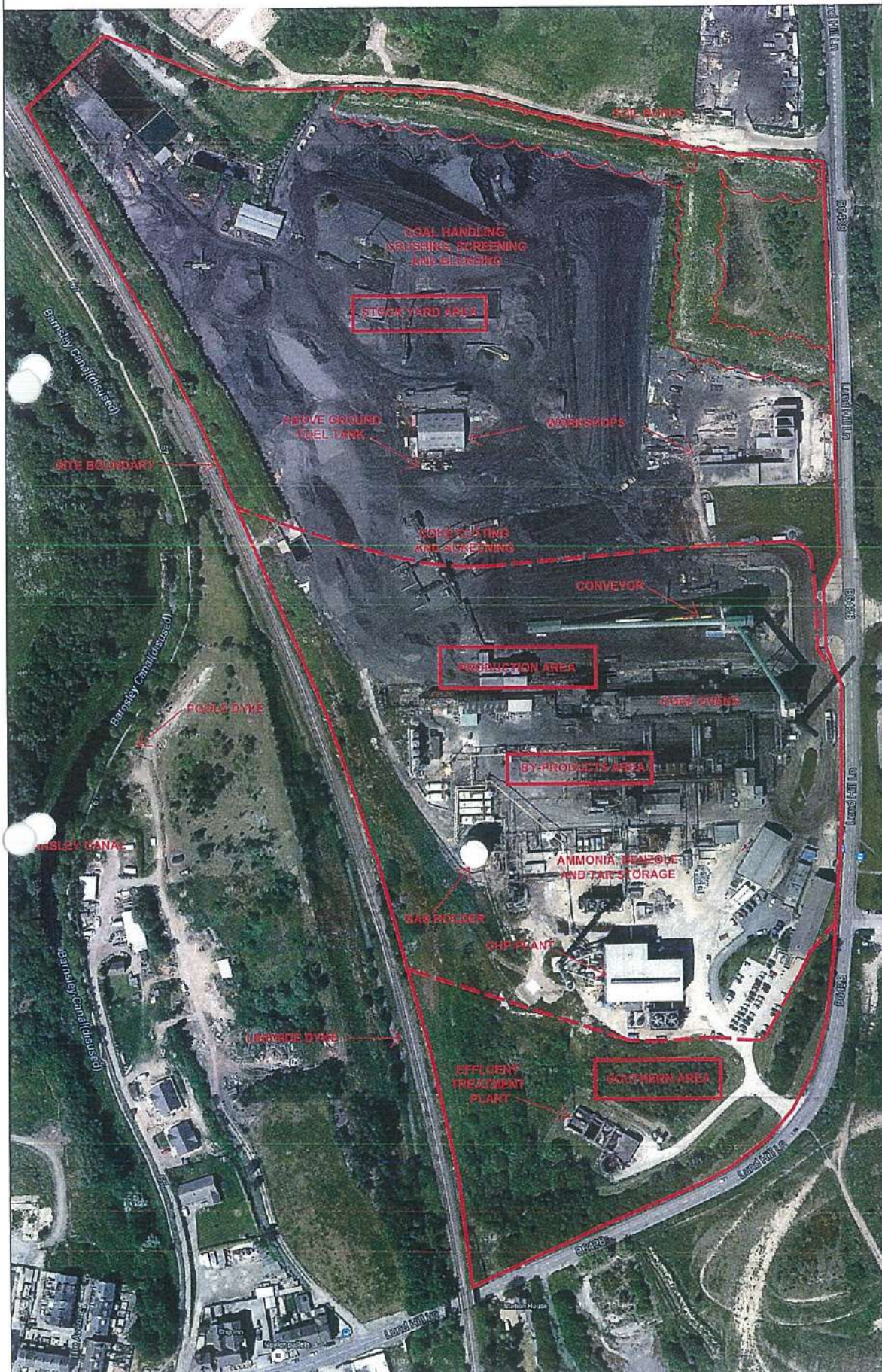
The following have been highlighted as potential constraints to the proposed development or are areas requiring further investigation and potential subsequent remediation, refer to Drawing No. G15009_702:

- Several areas of deep made ground of variable chemical and geotechnical quality.
- Possible railway tunnel in northern region of site. This area requires further investigation to confirm location, depth and associated nature if any of constraint. Further ground investigation may remove this constraint or highlight necessary abnormal foundations. Provisionally, this area may have to be excluded from structural development.
- 3 No. capped mine shafts in the northern section of the site that require locating and capping competence assessments (refer to Drawing No. G15009_703). Provisionally, this area may have to be excluded from structural development, however, potential exclusion would be minimal as rockhead is shallow in this area.

- Potential shallow coal mining beneath the southern section of the site that requires further investigation and possible treatment (grouting) or exclusion from structural development.
- Former infilled clay pit in the extreme north and former infilled sandstone quarry in the south-eastern edge of the site. Gas monitoring and more detailed investigations required to confirm the nature and ground gas regime of both constraints. Potentially abnormal foundations.
- Soil bund of unknown composition within the north/north eastern section of the site requires further investigation to ascertain contamination and geotechnical properties for reuse on site.
- Remnant buried foundations and substructures will likely significantly hinder earthworks and impede foundation construction. All buried foundation and structures should be excavated, crushed and reused on site for a pile mat and/or capping materials.
- All above ground and subsurface fuel storage tanks will be emptied and removed as part of decommissioning and demolition of the site.
- High calorific soils, as a result of coke/coal contamination, will be required to be excavated and compacted at depth to eliminate oxygen flow and prevent contact with combustion sources.
- Potential presence of Japanese Knotweed was identified adjacent to the north-eastern corner boundary. Invasive weeds survey required and if necessary herbicide treatment commenced at the earliest opportunity (spraying season is April to October).
- Further detail assessment of the impacts of aggressive ground conditions on buried concrete will be necessary to mitigate potential structural damage.
- Further detail assessment of the impacts of aggressive ground conditions on buried water supply pipes will be necessary to mitigate potential damage and contamination of potable water.

Appendix A
Drawings

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Client:
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Project:
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Drawing:
SITE FEATURES AND ZONING PLAN

Scales: NTS At original size A2

Drawn: AL
Date: AUG '15
Checked: JH

Status: **INFORMATION**

Drawing No. **G15009-700** Rev.



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Drawing
MINE SHAFT CONJECTURED LOCATION PLAN

Scales NTS At original size A2

Drawn AL	Checked JH
Date AUG '15	

Status INFORMATION

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Appendix B
Stockpile Sampling Investigation Report (November 2016)

Stockpile Sampling Investigation Report

Monckton Coke Works

Prepared for:
Hargreaves

Prepared by:
HBR Limited

Date:
November 2016

Document Reference:
1012.C.C060.SI

DOCUMENT INFORMATION AND CONTROL SHEET

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Date	:	November 2016
Prepared by	:	Suzanne Thorpe.....
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Approved by	:	Chris Evans

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Appendix A Chemical Laboratory Reports

1. INTRODUCTION

HBR Limited were commissioned by Hargreaves Environmental Services, to carry out characterisation works on a stockpile of bricks and demolition material at the Monckton Coke Works, herein known as 'the site'. The works were carried out under Purchase order PO-3131-034680 issued on 20/09/16.

The site is a former Coke Works that has been in the process of closing down and going through a staged decommissioning and demolition. However, parts of the site remain operational. As part of the demolition works, a number of buildings were brought down and the material stockpiled and covered with a liner. It was thought likely that a proportion of the bricks in the stockpile were silica bricks used in thermal processes formally undertaken on site.

HBR excavated into the stockpile to attempt to characterise the material, identify any potential signs of contamination, carry out a crushability study of the silica bricks to determine if the stockpile material could be processed for a reusable material during the future development works.

The site is located on Lund Hill Lane, Royston, north east of Barnsley, South Yorkshire at National Grid reference 437460 412020.

The stockpile is situated in the middle of the site, within the now closed part. The stockpile is located adjacent parts of the boundary with the operational part of the site.

The former Coke Works, housed coke ovens, quenching tower, workshops and production process buildings (which produced tar, benzole and ammonia as by-products). These have all been demolished and may form part of the makeup of the stockpile in question.

The observations and chemical and geotechnical testing, were designed and carried out to characterise the material to ensure its reuse in the proposed redevelopment of the site would be appropriate. Hargreaves intend to retain the material on site, with some processing (e.g. crushing) and incorporate it into the final development design in line with current construction best practice.

A potential health and safety issue was noted with regards to the bricks in the stockpile as it has been assumed that many of the bricks are old process bricks with a high silica content to withstand elevated temperatures. The high silica content would only become an issue once the bricks are broken, cut or crushed, where the silica dust particles could be released and potentially enter the respiratory system, and thus potentially cause long-term health issues.

2. INVESTIGATION

HBR carried out the stockpile sampling and characterisation works at the Monckton site on Tuesday 4th October 2016. The investigation comprised of the excavation of seven trenches cut into the stockpile, locations shown in Figure 1.

As the stockpile was situated above ground and known to be made up of demolition rubble and bricks, it was determined that no service or utility scans were required.

Through the risk assessments, it was determined that there was a potential risk of disturbing the silica brick and breaking them while excavating through with the JCB, creating potential harmful silica dust. Measures were put in place to prevent exposure to the operatives carrying out the works such as the use disposable overalls and FFP3 dust masks. During the investigation no visible dusts were observed. Moreover, an easterly wind would have carried any dusts formed away from operational staff towards the vacant non-operational areas of the site.

The works were carried out using a JCB 3CX, fitted with an 18" excavation bucket. After being shown the location by the HBR engineer, the JCB operator used the bucket to rip the covering sheeting and excavate a strip into the stockpile. The material and bricks within the stockpile were exposed and pulled out to be examined. Excavations into the stockpile were only possible along the southern flank.

A description was made of each of the trenches cut into the stockpile, along with a photographic record of the excavation.

A number of bricks were collected for subsequent laboratory testing. In total, three brick samples and one sample of fines associated with the stockpiled bricks were sent to a UKAS accredited laboratory for subsequent chemical analysis. The rationale for the choice of chemical testing was based on the former uses of the buildings at the site and potential contaminants associated with this.

The chemical analysis schedules for the samples was speciated Total Petroleum Hydrocarbons (TPH), speciated Poly-aromatic Hydrocarbons (PAH), metals suite, cyanide suite, total phenol, asbestos ID. One of the brick samples (CS2) was scheduled for a leachate preparation and testing for speciated TPH, PAH, metals, cyanide and phenol.

Six rubble sacks full of a selection of the bricks, including silica bricks were sent to Geofima Geotechnical laboratory for testing. Wet crushing trials were carried out on these samples of bricks.

3. RESULTS

3.1 Site Observations

The stockpile was large and covered with a black sheeting. It is estimated that approximately 10,000 m³ of material is contained within the stockpile.

A description of the seven trial trench is provided in Table 1.

Table 1. Trench Hole photographs and descriptions

	Photograph	Description
TH1		Mostly light grey to yellow coloured whole and partially broken bricks, especially in the top two thirds of the exposed stockpile. Occasional red bricks. The bottom third was also made up of the same bricks but with a fine dark brown fill material around the bricks. The odd brick within the stockpile had a black face showing potential signs of contamination.
TH2		Mostly light grey coloured whole and partially broken bricks, especially in the top two thirds of the exposed stockpile. Occasional red bricks. The bottom third was also made up of the same bricks but with a fine dark brown, slightly ashy fill material around the bricks. The odd brick within the stockpile had a black face showing potential signs of contamination.

TH3



Mostly light grey and yellow coloured whole and partially broken bricks, especially in the top two thirds of the exposed stockpile. Occasional red bricks. The bottom third was also made up of the same bricks but with a fine dark brown, slightly ashy fill material around the bricks. The odd brick within the stockpile had a black face showing potential signs of contamination.

TH4



Mostly light grey and yellow coloured whole and partially broken bricks, especially in the top two thirds of the exposed stockpile. Occasional red bricks. The bottom third was also made up of the same bricks but with a fine dark brown to grey, slightly ashy fill material around the bricks. Some of the bricks looked dirty with dark brown to grey. The odd brick within the stockpile had a black face showing potential signs of contamination. Some metal and wood debris noted within the stockpile material.

TH5		<p>Mostly light grey coloured whole and partially broken bricks, especially in the top two thirds of the exposed stockpile. Occasional red bricks. The bottom third was also made up of the same bricks but with a fine dark brown, slightly ashy fill material around the bricks. The odd brick within the stockpile had a black face showing potential signs of contamination.</p> <p>While safe to do so this trench was excavated more deeply than the rest to further understand the nature of the brick stockpile..</p>
TH6		<p>Mostly light grey and yellow coloured whole and partially broken bricks, especially in the top two thirds of the exposed stockpile. Occasional red bricks. The bottom third was also made up of the same bricks but with a fine dark brown, fill material around the bricks. The odd brick within the stockpile had a black face showing potential signs of contamination. Some metal, wood and plastic debris noted within the stockpile material.</p>
TH7		<p>Mostly light grey and yellow coloured whole and partially broken bricks, especially in the top two thirds of the exposed stockpile. Occasional red bricks. The bottom third was also made up of the same bricks but with a fine dark brown, fill material around the bricks. The odd brick within the stockpile had a black face showing potential signs of contamination.</p>

3.2 Chemical Analysis

Based on visual indications of potential contamination, three worse case examples of bricks were selected (CS2, CS3 and CS4) for subsequent laboratory chemical analysis.

A composite sample of the dark ashy fill associated with the bricks in the stockpile (CS1) was also sent to the laboratory for the same analysis as brick samples CS2, 3 and 4.

All of the samples were tested for a range of potential contaminants including metals, speciated total petroleum hydrocarbons, speciated polyaromatic hydrocarbons, asbestos, cyanide and phenol in both solid samples and leachates derived from the solid materials (CS2). A description of the bricks and fine material selected are described in Table 2 below.

Table 2. Brick samples and descriptions

Sample ID	Photograph	Description	Chemical Analysis
CS1	None taken	Fine black and dark brown sandy silty material with some small gravel and brick fragments within the matrix.	Soil suite
CS2		Possible concrete broken brick or fragment. The brick was coated in a black material in patches, thought to be a heavy hydrocarbon. The fragment could have formed part of an oven or storage wall.	Soil suite and leachate suite
CS3		Red broken house brick with a black coating on one face. It possibly could have been part of an oven wall.	Soil suite
CS4		Black lump of hard material, possibly a broken brick or could be a solidified mass of finer material. The material looked impacted with hydrocarbon staining and left a black residue on white paper. Slightly damp to the touch, with a coating of very fine, silty material.	Soil suite

The results from the crushed brick and fine material analysis were screened against industry standard generic assessment criteria, with the results of this analysis presented in Table 3.

For the purpose of this assessment criteria known as Suitable for Use Levels (S4UL) were used, which were developed by Land Quality Management Ltd and the Chartered Institute of Environmental Health¹.

The analysis results were screened against two potential end use criteria - residential with gardens with plant uptake and commercial, as the masterplan for the site has not yet been fully developed.

The results of the screening show that some of the observed analytical values exceeded individual screening criteria used as discussed in the bullets below (see also Table 3):

- Chromium failed the screening criteria on all four samples for both the residential and the commercial screening criteria. This was because they were screened using the limit for Chromium IV as there is no current screening target for total Chromium. The use of the Chromium IV screening target is considered a very conservative approach. It is likely that further human health and controlled water risk assessments will be carried out for the redevelopment of the site, where a site specific target would be determined for the chromium and this could be applied to the results derived here.
- Only brick sample CS2 failed the residential screening for nickel but not the commercial screening level.
- Only the fine material sample, CS1, failed for TPH aromatic split C16 – 21 and also for phenanthrene for the residential screening targets but not the commercial targets.
- Both CS1 and CS3 failed the residential targets for a number of the PAH compounds including benzo(a)pyrene. As there are over 100 PAH compounds, usually found as mixtures, benzo(a)pyrene is commonly used a surrogate marker for all genotoxic PAHs. This is because benzo(a)pyrene is considered the most potent PAH and has plenty of research and information available. If PAHs are present in a soil, it is highly likely Benzo(a)pyrene will be present (SP1010, CL:AIRE, 2014)².
- The commercial screening targets were not exceeded for PAHs.
- Both samples CS1 and CS3 failed the residential and the commercial screening targets for dibenz(a,h)anthracene. As mentioned for chromium, these contaminants could be modelled within a site specific risk assessment and the results compared again to the data derived herein.

¹ The LQM/CIEH S4ULs for Human Health Risk Assessment', LQM/CIEH, ISBN 9780-9931084-0-2, 2015 (Copyright Land Quality Management Ltd reproduced with permission; publication number S4UL 3574)

² SP101 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, Final Project Report, Version 2, CL:AIRE, 2014.

Table 3. Screened results for brick analysis

Sample ID		CS1		CS2		CS3		CS4	
Date		05/10/2016		05/10/2016		05/10/2016		05/10/2016	
Determinand		Screening Criteria							
		CIEH/LQM S4UL screening residential with plant uptake	CIEH/LQM S4UL screening Commercial						
ACM Type				-	-	-	-	-	-
Asbestos Identification	%			No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	%			11	3.2	17	3.7		
Cyanide (Complex)	mg/kg			14	1.5	18	< 0.50		
Cyanide (Free)	mg/kg			2.2	< 0.50	3.4	< 0.50		
Cyanide (Total)	mg/kg			16	1.5	21	< 0.50		
Arsenic	mg/kg	37	640	10	6.8	12	3.5		
Cadmium	mg/kg	11	190	0.32	0.12	0.18	< 0.10		
Chromium	mg/kg	6	33	35	88	30	14		
Copper	mg/kg	2400	68000	34	22	44	6.5		
Mercury	mg/kg	1.2	25.8	0.62	0.19	0.38	< 0.10		
Nickel	mg/kg	180	990	75	260	47	5.1		
Lead	mg/kg	450*	750*	230	33	120	19		
Selenium	mg/kg	250	12000	< 0.20	< 0.20	< 0.20	< 0.20		
Zinc	mg/kg	3700	730000	89	92	170	11		
Aliphatic TPH >C5-C6	mg/kg	42	3200	< 1.0	< 1.0	< 1.0	< 1.0		
Aliphatic TPH >C6-C8	mg/kg	100	7800	< 1.0	< 1.0	< 1.0	< 1.0		
Aliphatic TPH >C8-C10	mg/kg	27	2000	< 1.0	< 1.0	< 1.0	< 1.0		
Aliphatic TPH >C10-C12	mg/kg	130	9700	< 1.0	< 1.0	< 1.0	< 1.0		
Aliphatic TPH >C12-C16	mg/kg	1100	59000	< 1.0	< 1.0	< 1.0	< 1.0		
Aliphatic TPH >C16-C21	mg/kg			< 1.0	< 1.0	< 1.0	< 1.0		
Aliphatic TPH >C21-C35	mg/kg	65000	1600000	< 1.0	< 1.0	< 1.0	< 1.0		
Aliphatic TPH >C35-C44	mg/kg	65000	1600000	< 1.0	< 1.0	< 1.0	< 1.0		
Total Aliphatic Hydrocarbons	mg/kg			< 5.0	< 5.0	< 5.0	< 5.0		
Aromatic TPH >C5-C7	mg/kg	70	26000	< 1.0	< 1.0	< 1.0	< 1.0		
Aromatic TPH >C7-C8	mg/kg	130	56000	< 1.0	< 1.0	< 1.0	< 1.0		
Aromatic TPH >C8-C10	mg/kg	34	3500	< 1.0	< 1.0	< 1.0	< 1.0		
Aromatic TPH >C10-C12	mg/kg	74	16000	2.5	< 1.0	< 1.0	< 1.0		
Aromatic TPH >C12-C16	mg/kg	140	38000	45	15	< 1.0	< 1.0		
Aromatic TPH >C16-C21	mg/kg	260	28000	290	23	1.7	11		
Aromatic TPH >C21-C35	mg/kg	1100	28000	270	40	< 1.0	18		
Aromatic TPH >C35-C44	mg/kg	1100	28000	21	< 1.0	< 1.0	< 1.0		
Total Aromatic Hydrocarbons	mg/kg			620	78	< 5.0	29		
Total Petroleum Hydrocarbons	mg/kg			620	78	< 10	29		
Naphthalene	mg/kg	2.3	190	10	1.1	5.8	< 0.10		
Acenaphthylene	mg/kg	170	83000	19	0.45	3.4	< 0.10		
Acenaphthene	mg/kg	210	8400	5.8	0.66	7.1	< 0.10		
Fluorene	mg/kg	170	63000	31	0.47	4.7	< 0.10		
Phenanthrene	mg/kg	95	22000	110	2.0	21	0.25		
Anthracene	mg/kg	2400	520000	37	0.77	8.3	< 0.10		
Fluoranthene	mg/kg	280	23000	86	2.9	34	0.34		
Pyrene	mg/kg	620	54000	67	2.4	33	0.29		
Benzo[a]anthracene	mg/kg	7.2	170	34	1.3	22	0.12		
Chrysene	mg/kg	15	350	35	1.6	24	0.15		
Benzo[b]fluoranthene	mg/kg	2.6	44	32	1.4	26	0.26		
Benzo[k]fluoranthene	mg/kg	77	1200	13	0.44	10	< 0.10		
Benzo[a]pyrene	mg/kg	2.2	35	27	1.0	20	0.23		
Indeno(1,2,3-c,d)Pyrene	mg/kg	27	500	14	0.54	13	< 0.10		
Dibenz[a,h]Anthracene	mg/kg	0.24	3.5	3.8	< 0.10	3.9	< 0.10		
Benzo[g,h,i]perylene	mg/kg	320	3900	12	0.57	11	< 0.10		
Total Of 16 PAH's	mg/kg			540	18	250	< 2.0		
Total Phenols	mg/kg	280	760	< 0.30	< 0.30	< 0.30	< 0.30		

* SGV used rather than S4UL

Brick sample CS2 was considered to be the most impacted from visual observations, so was selected to also undergo leachate testing. A leachate sample was prepared from the crushed brick sample and tested for the same determinands as used for analysing the solid samples. The leachate analysis results were screened against Environmental Quality Standards (EQS) freshwater targets (Directive 76/464/EEC and daughter directives), WHO Drinking Water Standard (WHO, 2004) and UK Drinking Water Standards (DWS) (Water supply (Water Quality) Regulations 2000). The screened results are presented in Table 4.

The screening was carried out against these generic targets to determine if there would be any potential risks to controlled waters at the site if the material was utilised within the redevelopment.

The leachate generated from sample CS2 failed the screening criteria for lead on all three criteria, EQS, WHO and the UK DWS standards with the latter two marginally elevated above the screening criteria.

Table 4. Screened leachate analysis for CS2

Sample ID					CS2
Date					05/10/2016
		ESQ Freshwater	WHO	UK Drinking Water Standards	
Cyanide (Total)	mg/l				< 0.050
Cyanide (Free)	mg/l				< 0.050
Cyanide (Complex)	mg/l				< 0.050
Arsenic (Dissolved)	µg/l	50	10	10	3.4
Cadmium (Dissolved)	µg/l	5	3.00	5.00	< 0.080
Chromium (Dissolved)	µg/l	5	50	50	< 1.0
Copper (Dissolved)	µg/l	1	2000	2000	< 1.0
Mercury (Dissolved)	µg/l	1	1	1	< 0.50
Nickel (Dissolved)	µg/l	50	20	20	< 1.0
Lead (Dissolved)	µg/l	4	10	10	12
Selenium (Dissolved)	µg/l		10	10	1.4
Zinc (Dissolved)	µg/l	8		5000	< 1.0
Total Petroleum Hydrocarbons	µg/l				< 10
Total Of 16 PAH's	µg/l				< 2.0
Total Phenols	mg/l	30.00		0.50	< 0.030

The full chemical reports for the soil and leachate analysis from the laboratory are presented in Appendix A.

3.3 Geotechnical Testing

A range of bricks were selected from the trenches and sent to a geotechnical laboratory for crushability trials. The purpose of the crushing trials, was to determine if the bricks present within the stockpile could be crushed and be re-used in the redevelopment.

Due to the potential high silica content of the bricks and potential detrimental health effects from silica dust, a dust suppression unit was set up over the crushing test area to dampen the dust. The operative carrying out the crushing test also wore a FFP3 filter mask and a disposable dust overall. The works area was washed down following the crushing tests.

The crushing tests involved breaking up the bricks using a large metal hammer. The hammering action was used to replicate the hammering of the crushing plates on material within a large scale crushing unit. Two examples of the crushed products can be seen in Plate 1 and Plate 2.

All of the bricks broke down easily with hammering to crush them, which would mean in the full-scale works, there would not be a problem crushing all of the bricks to a reusable size. The lack of detritus and fines within the stockpile means that the stockpile will require little or no screening prior to processing for reuse. On the full scale works as part of the redevelopment, the bricks would be crushed and then potentially graded which would enable use as graded fill. However, further assessment of the risks of grading would be required e.g. requirements for dust suppression and the protection of the health of the operatives.



Plate 1 – crushed brick



Plate 2 – crushed brick

4. DISCUSSION

An investigation was carried out on a stockpile thought to be comprised of a range of bricks including silica bricks from the decommissioning works at the Monckton Coke works site. Following the visual inspections made of the bricks during the site investigation, it was observed that the vast majority of the bricks in the stockpile, approximately 75 – 85 %, appeared free of visual and olfactory signs of contamination. However, a number of worst-case examples of the bricks were selected for subsequent laboratory analysis. The analysis results demonstrated that the worst-case examples chosen only marginally exceeded the generic assessment criteria for human health and controlled waters selected to assess the significance of the laboratory data for only a small number of the potential contaminants being analysed.

The primary failures were for certain PAHs, particularly within the fine material collected.

During the proposed development and remediation of the site, it would be expected that further assessment of the bricks would be carried out once the masterplan has been finalised. A site specific risk assessment would determine site specific contaminant target criteria for any potential contamination that could then be applied to the brick stockpile data. However, it should be reiterated that the laboratory data collected here relates to worst case examples that have been directly compared to the generic assessment criteria.

It The investigation has confirmed that the bricks samples from the stockpile can be crushed using a conventional construction scale crusher to provide a graded material for reuse at the site.

The primary concern with the bricks in the stockpile is that upon crushing they may generate silica-containing dusts which are known to be harmful to health. There are a number of steps that can be implemented to reduce the dust emissions while crushing the bricks to provide a usable fill material. Mitigation methods should include the use of water sprayers and misters to dampen the bricks while moving and crushing the bricks thereby reducing the production of dusts. It is common to provide a boundary wide dust suppression system while employing such activities. All operatives working within the brick movement and crushing area should wear disposable dust overalls and FFP3 rated respirator.

The placement of the processed bricks would also require consideration, to ensure the protection of the health of the end users of the site. A geo-textile marker membrane may be required over the placed brick material to prevent future users from disturbing the placed material and causing harm to health.

Summary and Next Steps

Based on the assessments, we consider the bricks assessed as part of this investigation would be suitable to retain on site as part of any future development subject to the end uses of the site being confirmed. It is thought that once the bricks are crushed, they could be used as a graded fill for example underneath slabs, roadways and pavements.

It is considered appropriate to include the silica brick stockpile within the design of the remediation strategy and consider the placement of the bricks in the development masterplan with regards to exposure to human health and potential controlled waters for any stabilised material.

Should the concentrations of potential contaminants determined in this study fail the criteria set out in a site specific risk assessment then further assessment may be required. This could include that a stabilisation/ solidification (S/S) treatability study is carried out. The S/S treatability study would be carried out to determine what additive and amendments would be required to ensure that the stabilised material could be retained on site. The S/S study could be carried alongside treatability studies of other known contaminated material present at the site.

FIGURES

Trial Trench 7
 Trial Trench 6
 Trial Trench 5
 Trial Trench 4
 Trial Trench 3
 Trial Trench 2
 Trial Trench 1



Brick stockpile
 showing location of
 each trial trench
 excavation

<div> <div>REV</div> <div>DATE</div> <div>DESCRIPTION</div> </div>	<div> <div>A</div> <div>25/10/16</div> <div>Final Issue</div> </div>	<div> <div>ST</div> <div>CE</div> <div>CE</div> </div>	<div> <div>Legend:</div> </div>	<div> <div>Client:</div> <div>Hargreaves E&C</div> </div>	<div> <div>Project:</div> <div>Monckton Coke Works</div> </div>	<div> <div> <div> <div> <div> <div>HBR</div> <div> HBR Limited, Registered Office, Unit 10, Epsom, COB 3M Tel: 01753 222968 Fax: 01753 222932 </div> </div> </div> <div> <div>Scale: as All</div> <div>Shims</div> <div>Issue</div> </div> </div> <div> <div>Drawing Title:</div> <div>Stockpile schematic</div> </div> <div> <div> <div>HBRC060.D01</div> <div>A</div> </div> </div> </div> </div>
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APPENDIX A

Chemical Laboratory Reports



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Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL

Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report No.: 16-24282-1

Initial Date of Issue: 14-Oct-2016

Client: HBR

Client Address: Coggeshall Road
Earls Colne
Essex
CO6 2JX

Contact(s): Suzanne Thorpe

Project: HBRC060 Monckton

Quotation No.: Q16-07491

Date Received: 07-Oct-2016

Order No.:

Date Instructed: 07-Oct-2016

No. of Samples: 4

Turnaround (Wkdays): 5

Results Due: 13-Oct-2016

Date Approved: 14-Oct-2016

Approved By:

Details: Martin Dyer, Laboratory Manager

Client: HBR		Chemtest Job No.: 16-24282			
Quotation No.: Q16-07491		Chemtest Sample ID.: 362118			
		Client Sample ID.: CS2			
		Sample Type: SOIL			
		Date Sampled: 05-Oct-2016			
Determinand	Accred.	SOP	Units	LOD	
Cyanide (Total)	U	1300	mg/l	0.050	
Cyanide (Free)	U	1300	mg/l	0.050	
Cyanide (Complex)	U	1300	mg/l	0.050	
Arsenic (Dissolved)	U	1450	µg/l	1.0	
Cadmium (Dissolved)	U	1450	µg/l	0.080	
Chromium (Dissolved)	U	1450	µg/l	1.0	
Copper (Dissolved)	U	1450	µg/l	1.0	
Mercury (Dissolved)	U	1450	µg/l	0.50	
Nickel (Dissolved)	U	1450	µg/l	1.0	
Lead (Dissolved)	U	1450	µg/l	1.0	
Selenium (Dissolved)	U	1450	µg/l	1.0	
Zinc (Dissolved)	U	1450	µg/l	1.0	
Aliphatic TPH >C5-C6	N	1675	µg/l	0.10	
Aliphatic TPH >C6-C8	N	1675	µg/l	0.10	
Aliphatic TPH >C8-C10	N	1675	µg/l	0.10	
Aliphatic TPH >C10-C12	N	1675	µg/l	0.10	
Aliphatic TPH >C12-C16	N	1675	µg/l	0.10	
Aliphatic TPH >C16-C21	N	1675	µg/l	0.10	
Aliphatic TPH >C21-C35	N	1675	µg/l	0.10	
Aliphatic TPH >C35-C44	N	1675	µg/l	0.10	
Total Aliphatic Hydrocarbons	N	1675	µg/l	5.0	
Aromatic TPH >C5-C7	N	1675	µg/l	0.10	
Aromatic TPH >C7-C8	N	1675	µg/l	0.10	
Aromatic TPH >C8-C10	N	1675	µg/l	0.10	
Aromatic TPH >C10-C12	N	1675	µg/l	0.10	
Aromatic TPH >C12-C16	N	1675	µg/l	0.10	
Aromatic TPH >C16-C21	N	1675	µg/l	0.10	
Aromatic TPH >C21-C35	N	1675	µg/l	0.10	
Total Aromatic Hydrocarbons	N	1675	µg/l	5.0	
Total Petroleum Hydrocarbons	N	1675	µg/l	10	
Naphthalene	U	1700	µg/l	0.10	
Acenaphthylene	U	1700	µg/l	0.10	
Acenaphthene	U	1700	µg/l	0.10	
Fluorene	U	1700	µg/l	0.10	
Phenanthrene	U	1700	µg/l	0.10	
Anthracene	U	1700	µg/l	0.10	
Fluoranthene	U	1700	µg/l	0.10	
Pyrene	U	1700	µg/l	0.10	
Benzofluoranthene	U	1700	µg/l	0.10	
Chrysene	U	1700	µg/l	0.10	
Benzo[b]fluoranthene	U	1700	µg/l	0.10	

Client: HBR	Chemtest Job No.:				16-24282
Quotation No.: Q16-07491	Chemtest Sample ID.:				362118
	Client Sample ID.:				CS2
	Sample Type:				SOIL
	Date Sampled:				05-Oct-2016
Determinand	Accred.	SOP	Units	LOD	
Benzo[k]fluoranthene	U	1700	µg/l	0.10	< 0.10
Benzo[a]pyrene	U	1700	µg/l	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1700	µg/l	0.10	< 0.10
Dibenz[a,h]Anthracene	U	1700	µg/l	0.10	< 0.10
Benzo[g,h,i]perylene	U	1700	µg/l	0.10	< 0.10
Total Of 16 PAH's	U	1700	µg/l	2.0	< 2.0
Total Phenols	U	1920	mg/l	0.030	< 0.030

Client: HBR		Chemtest Job No.:		16-24282		16-24282		16-24282		16-24282	
Quotation No.: Q16-07491		Chemtest Sample ID.:		362117		362118		362119		362120	
		Client Sample ID.:		CS1		CS2		CS3		CS4	
		Sample Type:		SOIL		SOIL		SOIL		SOIL	
		Date Sampled:		05-Oct-2016		05-Oct-2016		05-Oct-2016		05-Oct-2016	
		Asbestos Lab:						COVENTRY			
Determinand	Accred.	SOP	Units	LOD							
ACM Type	U	2192	%	N/A							
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	11	3.2	17	3.7			
Cyanide (Complex)	U	2300	mg/kg	0.50	14	1.5	18	< 0.50			
Cyanide (Free)	U	2300	mg/kg	0.50	2.2	< 0.50	3.4	< 0.50			
Cyanide (Total)	U	2300	mg/kg	0.50	16	1.5	21	< 0.50			
Arsenic	U	2450	mg/kg	1.0	10	6.8	12	3.5			
Cadmium	U	2450	mg/kg	0.10	0.32	0.12	0.18	< 0.10			
Chromium	U	2450	mg/kg	1.0	35	88	30	14			
Copper	U	2450	mg/kg	0.50	34	22	44	6.5			
Mercury	U	2450	mg/kg	0.10	0.62	0.19	0.38	< 0.10			
Nickel	U	2450	mg/kg	0.50	75	260	47	5.1			
Lead	U	2450	mg/kg	0.50	230	33	120	19			
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20			
Zinc	U	2450	mg/kg	0.50	89	92	170	11			
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aliphatic TPH >C9-C10	N	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	[C] < 5.0	[C] < 5.0	[C] < 5.0			
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	2.5	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	45	[C] 15	[C] < 1.0	[C] < 1.0			
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	290	[C] 23	[C] 1.7	[C] 11			
Aromatic TPH >C21-C35	N	2680	mg/kg	1.0	270	[C] 40	[C] < 1.0	[C] 18			
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	21	[C] < 1.0	[C] < 1.0	[C] < 1.0			
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	620	[C] 78	[C] < 5.0	[C] 29			
Total Petroleum Hydrocarbons	N	2680	mg/kg	10	620	[C] 78	[C] < 10	[C] 29			
Naphthalene	U	2700	mg/kg	0.10	10	1.1	5.8	< 0.10			
Acenaphthylene	U	2700	mg/kg	0.10	19	0.45	3.4	< 0.10			
Acenaphthene	U	2700	mg/kg	0.10	5.8	0.66	7.1	< 0.10			
Fluorene	U	2700	mg/kg	0.10	31	0.47	4.7	< 0.10			
Phenanthrene	U	2700	mg/kg	0.10	110	2.0	21	0.25			

Client: HBR		Chemtest Job No.: 16-24282		16-24282		16-24282	
Quotation No.: Q16-07491		Chemtest Sample ID.: 362117		362118		362119	
		Client Sample ID.: CS1		CS2		CS3	
		Sample Type: SOIL		SOIL		SOIL	
		Date Sampled: 05-Oct-2016		05-Oct-2016		05-Oct-2016	
		Asbestos Lab:				COVENTRY	
Determinand	Accred.	SOP	Units	LOD			
Anthracene	U	2700	mg/kg	0.10	37	0.77	8.3
Fluoranthene	U	2700	mg/kg	0.10	86	2.9	34
Pyrene	U	2700	mg/kg	0.10	67	2.4	33
Benzo[a]anthracene	U	2700	mg/kg	0.10	34	1.3	22
Chrysene	U	2700	mg/kg	0.10	35	1.6	24
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	32	1.4	26
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	13	0.44	10
Benzo[a]pyrene	U	2700	mg/kg	0.10	27	1.0	20
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	14	0.54	13
Dibenz[a,h]Anthracene	U	2700	mg/kg	0.10	3.8	< 0.10	3.9
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	12	0.57	11
Total Of 16 PAH's	U	2700	mg/kg	2.0	540	18	250
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30

Report Information

Key

-
- U UKAS accredited
 - M MCERTS and UKAS accredited
 - N Unaccredited
 - S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
 - SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
 - T This analysis has been subcontracted to an unaccredited laboratory
 - I/S Insufficient Sample
 - U/S Unsuitable Sample
 - N/E not evaluated
 - < "less than"
 - > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

-
- A - Date of sampling not supplied
 - B - Sample age exceeds stability time (sampling to extraction)
 - C - Sample not received in appropriate containers
 - D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.co.uk



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