Waterside Park, Hebburn
Phase 3 Remediation Statement
S170425
Hebburn Properties Limited

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PHASE 3 REMEDIATION STATEMENT

WATERSIDE PARK, HEBBURN

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Revision	Date	Prepared By	Signed
Final	April 2017	A Cutts *Senior Engineering Geologist*	
		Checked By	
		R Woods *Principal Geotechnical Engineer*	
		Approved By	
		R Woods *Principal Geotechnical Engineer*	

1 OBJECTIVES & PRINCIPLES OF REMEDIATION STATEMENT

Solmek have been commissioned by Hebburn Properties Limited to prepare a Remediation Statement for the redevelopment of a parcel of land at Waterside Park, Hebburn. A site location plan is presented in Appendix A, Figure 1.

The proposed development of the site is to involve the construction of three residential detached properties. The final development will also include hardstanding in the form of parking as well as areas of soft landscaping as front and rear gardens.

The following reports have already been issued and should be consulted in respect of the site:

- *Solmek Phase 1 Desk Study Report (S60330, April 2006).*
- *Solmek Phase 2 Site Investigation Report (S60330, May 2006).*
- *Solmek Phase 2 Contamination Assessment Report (S170121, January 2017).*

This Remediation Statement outlines the objectives of the remediation works that are required to render the site suitable for the proposed development and its immediate surroundings, which mainly comprises residential buildings and grassed open space.

Site works shall be supervised periodically by a suitably qualified engineer. Agreed dates and milestones for site visits can be agreed between Solmek and the contractor following approval of the Remediation Statement from the Local Authority.

2 REMEDIATION STRATEGY

2.1 Previous and Current Land Use

The site has been directly associated with heavy industrial activity in the past, this included an alkali works with railway lines from the late 1800's up to the 1940's. The site was also shown to contain an earth embankment from the 1970's onwards. Industry in the close vicinity included a rifle range, colour works, electrical engineering works, bauxite works, further railway lines and tanks.

The original site inspection, was undertaken in March 2006, no recent site visit has been undertaken. The site comprised an area of undeveloped overgrown scrubland to the south of a housing estate (Waterside Park). The entrance was accessed from the main road running through the housing estate and was generally flat however the site opened out to reveal a moderate slope trending south east to north west.

There were a number of plateaus along the south eastern third of the site and the slope gradient increased further to the east beyond this. A number of areas in the north and east were noted as boggy and moss had grown within the grass. A channel (running south east to north west) had been excavated down the slope near the northern boundary and this was issuing water indicating a possible spring further up the slope. Trees were located at the top of the slope to the east and along the bottom of the slope to the west.

The ground sloped down to the west beyond a line of trees to an open grassed area including a playing field and a series of footpaths. A footpath circled the southern boundary beyond some trees and continued along the eastern boundary. A large factory or works was located to the east and part of the building consisted of three tall chimneys.

No significant sources of contamination were observed during the site walkover however some general litter was located around the periphery of the site.

2.2 Fieldwork

Seven small percussion boreholes (BH1 to BH6 inclusive and BH4a) were drilled on 3rd April 2006 to depths of between 2.00 and 5.00m below ground level (bgl). Borehole 4 was attempted again after abandonment at 2.00mbgl (BH4A).

The boreholes were positioned across the site generally corresponding with the proposed locations of the proposed house plots at the time. Insitu hand vanes and standard penetration tests (SPT) were undertaken

within the small percussive boreholes and disturbed samples were retrieved for laboratory testing. A plan showing the location of all the exploratory positions undertaken can be found in Appendix A, Figure 2.

2.3 Ground Conditions

Made Ground

Made ground was encountered in all six of the boreholes across the site. Three boreholes in the north east of the site (BH3, BH4 and BH4A) were abandoned at shallow depths of between 2.00 and 3.60mbgl in the made ground. A 300mm layer of clayey sandy gravelly topsoil and slightly sandy gravelly clay was proven in these three boreholes with gravel fractions comprising glass fragments, wood, brick, concrete and sandstone. This overlay clayey ashy sandy gravel and cobbles of concrete, brick, coal, clinker and wood in BH4 to 0.60mbgl and BH4A to 1.00mbgl. Soft and firm ashy slightly sandy locally sandy gravelly clay fill was proven below the gravel in BH4, BH4A and below the topsoil in BH3 to the base of the boreholes. Borehole 3 was abandoned at 3.60mbgl due to a concrete obstruction. Borehole's 4 and 4A were abandoned at 2.00mbgl where rising groundwater led to the instability of the borehole side walls.

The remaining boreholes proved made ground to between 2.80mbgl in BH2 and 4.10mbgl in BH5, these were located over the central and southern areas of the site. The made ground soil profile comprised very soft to firm ashy slightly sandy gravelly clay fill. The gravel fraction consisted of coal, concrete, sandstone, clinker, chalk, brick and pockets of topsoil. In BH6 a layer of clayey slightly sandy slightly gravelly ash was proven between 0.25 and 1.00mbgl.

Natural Deposits

The natural ground was proven in only the southern four boreholes at depths ranging from 2.80 to 4.10mbgl. The natural ground consisted of firm and stiff locally very stiff brown and grey slightly sandy slightly gravelly clay. In boreholes 5 and 6 the clay was described as thinly laminated.

Groundwater

Groundwater was encountered in all of the boreholes apart from BH1 at the southern end of the site. The groundwater was struck at depths of between 1.00mbgl in BH4 and 4.00mbgl in BH5. Rising groundwater was encountered in boreholes 2, 3, 4 and 4A. In BH4 the groundwater rose to ground level from 1.00mbgl, in BH4A it rose from 2.00mbgl to 0.30mbgl and in BH3 it rose from 2.00mbgl to 1.00mbgl. These boreholes were located up the slope from boreholes 1, 5 and 6 and possibly above the line of the inferred spring.

It should be noted the rapid rate of advancement of the exploratory holes may mask minor seepages and it should be borne in mind that water levels fluctuate with a number of influences including season, rainfall, dewatering and pumping activities. Therefore, water levels significantly higher than those found during this investigation may be encountered.

2.4 Historical Contamination Results

Five samples of made ground comprising ashy clay fill from ground level to 3.50mbgl were submitted for contamination testing. Three samples were also submitted for leachate testing. The samples were selected for a range of metals and cyanide with total Polyaromatic Hydrocarbons (PAH) and Total Petroleum Hydrocarbons (TPH). One sample was selected for asbestos identification (BH1 0.00-0.40mbgl).

Given the sites end use, the test results were compared to LQM/CIEH Suitable 4 Use Levels (S4UL) based on a residential with home grown produce land use. The latest LQM/CIEH S4UL were published in December 2014. In the absence of LQM/CIEH S4UL, Category 4 Screening Levels (March 2014), EA Lower Tier Threshold values and Inert Waste Acceptance Criteria (WAC) thresholds were adopted. Leachate results were compared against threshold values for UK Drinking Water Standards (DWS) or where applicable EA Leachate Quality Thresholds, EQS Freshwater and WHO Guidelines.

From the five samples tested to date, arsenic, cadmium, copper, lead, nickel and zinc were raised in the samples of ashy clay fill across the site to depths of 3.50mbgl. Soluble sulphates were recorded below the EA threshold value of 2000mg/l. Three elevated TPH results from depths of between 0.00 and 1.00mbgl in BH1, BH2 and BH6 were recorded along with PAH which was raised in one sample from BH2 between 0.50-1.00mbgl. No asbestos was recorded in the single sample tested.

Following comparison of the leachate results, the testing revealed three elevated concentrations of TPH and two elevated concentrations of PAH (BH2 0.50-1.00mbgl and BH5 3.00-3.50mbgl). In addition, one lead concentration (BH5 3.00-3.50mbgl) was raised along with two sulphates (BH2 0.50-1.00mbgl and BH5 3.00-3.50mbgl).

2.5 Previous Contamination Assessment

General

The most recent contamination assessment report highlighted an overall moderate to high risk from the conceptual model based on the contamination test results to date, past history of the site, depth of fill materials and presence of onsite receptors (human site users and groundwater springs). As such the current ground conditions are likely to pose a risk to the current and future users of the site especially in proposed exposed soft landscaped or garden areas.

To accommodate the house plots on the sloping site the ground will have to be levelled and excavated incorporating retaining walls. Given the elevated concentrations of potentially harmful contaminants across the site it would be prudent to remove excavated material to a licensed tip. The remaining material below the house footprints can remain in place. Similarly, where access roads and driveways are proposed the made ground can remain under the hard cover provided no major excavation is required.

Construction Workers

It was recommended that appropriate PPE in accordance with HSE and Environment Agency guidance is adopted for the duration of the contractor works and good practice is adopted to minimise the release of potential contaminants during ground works. This includes damping down the site as part of dust suppression measures.

Although asbestos was not detected from the soil sample subjected to testing within this investigation, the possibility exists that asbestos containing materials may still be present on site and currently lie undetected. It is therefore advised that a 'watching brief' is undertaken during the initial site strip and any excavation works and advice sought if asbestos is found or suspected.

Soft Landscaping

The heavy metals are above phytotoxic thresholds in the made ground to depths of up to 3.50mbgl; therefore the topsoil and subsoil across the site are unsuitable for reuse.

There are considerable proposed garden areas to the front and rear of the housing. Gardens and soft landscaping can provide a pathway to insitu contamination. A clean cover system should be adopted for the site given its past industrial use and deep made ground present across the site. All soft landscaped areas and gardens should be excavated to 0.60mbgl or natural ground whatever is the shallowest. The cover system should include clean imported topsoil to a depth of 300mm over clean imported subsoil to 300mm. In addition, a geofabric should be placed at the sides and base of the excavation.

Controlled Waters

The solid geology is classified as a Secondary Aquifer and there are no surface water features within 250m of the site. Groundwater was encountered in all of the boreholes apart from BH1 at the southern end of the site. The groundwater was struck at depths of between 1.00mbgl in BH4 and 4.00mbgl in BH5. Rising groundwater was encountered in boreholes 2, 3, 4 and 4A. In BH4 the groundwater rose to ground level from 1.00mbgl, in BH4A it rose from 2.00mbgl to 0.30mbgl and in BH3 it rose from 2.00mbgl to 1.00mbgl. These boreholes were located up the slope from boreholes 1, 5 and 6 and possibly above the line of the inferred spring.

Following comparison of the leachate results, the testing revealed three elevated concentrations of TPH and two elevated concentrations of PAH (BH2 0.50-1.00mbgl and BH5 3.00-3.50mbgl). In addition, one lead concentration (BH5 3.00-3.50mbgl) was raised along with two sulphates (BH2 0.50-1.00mbgl and BH5 3.00-3.50mbgl). The remaining leachate concentrations were below the leachate quality thresholds.

However, given the generally low leachate results, clayey made ground sub soil strata over natural

impermeable clay and lack of surface water receptors within the close vicinity, ground and surface water are unlikely to be at risk. Analysis of the groundwater on the site may be required by the regulatory bodies to disprove possible linkages between the lead, PAH and TPH in the soil and the leachate and groundwater concentrations of those determinands.

2.6 Objectives

Based on the Site Investigation Report, the following remediation targets have been determined:

- Safe excavation/strip of materials from slope profiling including stockpiling and transportation of ashy clay/gravel fill materials across the site.
- Provide suitable ground conditions (clean cover system) in proposed soft landscaped areas suitable for plant growth.
- To resolve contamination issues in order to protect those receptors identified to be at risk, and thereby render the site suitable for the proposed development.

A Remediation Statement comprising excavation, disposal, and inclusion of clean soils is to be adopted. The Site Investigation Reports contain information that can be used to gauge the typical quantities to be addressed.

2.7 General

The purpose of the remediation works is to:

- To reduce liabilities associated with ground conditions by reclaiming the site within a framework of risk assessment.
- To facilitate successful redevelopment of the site for residential development within the existing constraints.
- To ensure that the public and residents around the site are not exposed to contamination.
- To make the site safe for future occupiers.
- To enable the site ground quality to comply with UK environmental legislation.
- To provide a sustainable and cost effective solution.

2.8 Proposed Remediation Strategy

The objectives listed in 2.6 (above) will be achieved by undertaking the following remediation works prior to development taking place:

General Excavation of Fill Materials within the Slope to Allow a Stable Building Platform

- Contaminated clay/gravel fill containing elevated metals, PAH and TPH was encountered across the site at depths of up to 3.50mbgl and is not suitable for reuse. It is highly likely that given the nature and extent of made ground across the site and the site's past history there may be other contaminated areas of soil that have not been tested.
- Excavations into the slope for construction purposes is likely to generate excess spoil. Any excavated spoil should be stockpiled separately on visqueen to prevent cross contamination and tested for determinands listed in section 3.1 and Waste Acceptance Criteria (WAC0). These materials should be removed off site to a suitable waste facility.

Other Hard Landscaped Areas

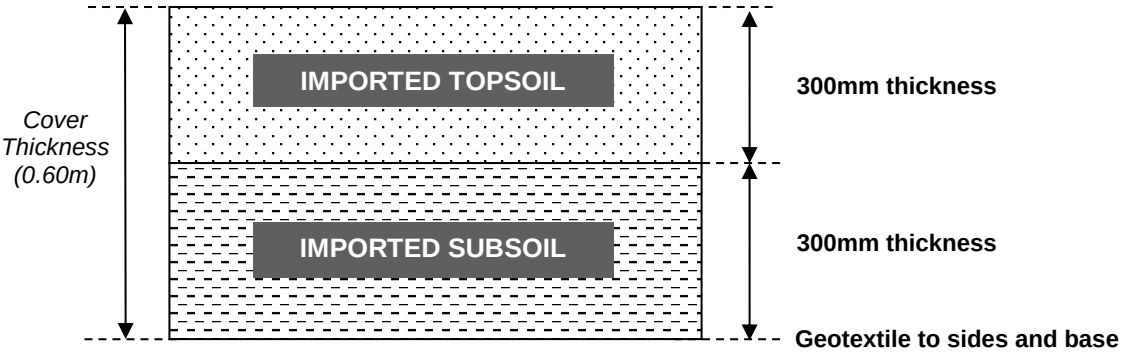
- Areas beneath proposed roads, parking zones, footpaths and other areas of hard landscape not on the slope including the building footprint itself (if applicable) will require little or no remediation other than removal of materials to satisfy appropriate formation levels for construction. This provides a barrier to potential underlying contamination within the made ground and protects ground water from surface infiltration.
- Any excavated spoil should be stockpiled separately on visqueen to prevent cross contamination and tested for determinands listed in section 3.1 and WAC. These materials should be removed off site to a suitable waste facility.

Controlled Waters (Springs)

- High groundwater tables and springs have been recorded on the site. The leachate results undertaken in the cay fill were generally low for metals but PAH and TPH proved to be mobile. Samples of groundwater will be required to assess the risk from the water being in contact with the existing fill materials.
- Measures to control groundwater behind retaining structures and foundations should be implemented so that they limit the impact of potential contamination from the fill.
- Groundwater samples should be tested for full suites of metals and organics and compared against threshold values for UK Drinking Water Standards (DWS), EA Leachate Quality Thresholds, EQS Freshwater or WHO Guidelines.
- Further remediation may be required should the groundwater contain high levels of contamination.

Soft Landscaped Areas

- Soft landscaped areas proposed around the majority of the site should implement a 600mm clean cover system. The clean cover system should be placed in order to break pathways between the contamination source and future site users. This cover layer should be placed over soft landscaped areas, and other parts of the site that will not be covered by buildings, roads, or hardstanding.
- There is no suitable topsoil or subsoil that can be sourced from the site.
- Topsoil and subsoil should be imported to the site from a reputable source. It would be prudent to test the topsoil and subsoil materials at source. Topsoil should be tested at a minimum of three samples or 1 per 100m^3 (whichever is the greater) and subsoil should be tested at a minimum of three samples or 1 per 250m^3 (whichever is the greater).
- The cover system should include clean imported topsoil to a depth of 300mm over clean imported subsoil to 300mm. In addition, a geofabric should be placed at the sides and base of the excavation.
- The imported materials and clean cover system **must** be tested, installed and verified in accordance with the Local Authority Guidelines '*Verification Requirements for Cover Systems, Technical Guidance for Developers, Landowners and Consultants'* (Yorkshire and Lincolnshire Pollution Advisory Group Version 3.3 – October 2016). Trial Pits will be excavated to allow measurement of depth by tape measure.
- Prior to installing the clean cover system, the site operatives must mitigate against potentially contaminating clean materials with soil and dust generated from underlying contaminated ground or any other stockpiled materials onsite.
- The diagram below gives an overview of the minimum thicknesses of clean cover that should be placed by the site operatives in soft landscaped or garden areas:



Asbestos

- Although asbestos was not detected from the soil sample subjected to testing within this investigation, the possibility exists that asbestos containing materials may still be present on site and currently lie undetected. It is therefore advised that a 'watching brief' is undertaken during the initial site strip and any excavation works and advice sought if asbestos is found or suspected.
- All excavated materials for removal off site should be tested for asbestos determination and asbestos quantification.
- If asbestos is suspected or found the impacted soils should be stockpiled and transported under special precautions to prevent asbestos fibres becoming airborne. The material must remain wet (moisture content of >15%) during transportation and construction workers should employ appropriate PPE in accordance with HSE guidelines.

Treating Unknown Contamination

- During the initial site strip, clean cover system excavations or any other site excavations; should any zones of odorous, brightly coloured or suspected contaminated ground be encountered then work should cease immediately in that area until Solmek have been contacted and visited site. Further contamination testing may be required. The results of the tests will determine whether or not material may remain on site or be disposed of in a safe manner.

2.9 Importation of Materials

The importation of soils may be undertaken as part of the contract for the preparatory and remedial works, in which case imported soils will be stockpiled in a location agreed with Solmek and the Client. Alternatively, the developer may choose to import soil at a later stage in the development. Sources, types of suitable material and the moisture content at which they may be placed and compacted shall be approved by Solmek.

The fill shall consist of materials that are selected to be free from deleterious materials. Any imported material shall NOT contain the following:

- Colliery shales.
- Ironstone shales.
- Materials containing sulphates.
- Any Japanese Knotweed fragments (rhizomes, leaves, stems etc).
- Materials susceptible to frost damage, weathering and mechanical damage.

The Contractor shall have delivered to site sample loads of any imported material proposed for use for the approval of Solmek before any filling material is placed in position.

Fill areas shall be built up evenly over the full area of each phase, unless the Contract requires otherwise, and sufficient camber shall be maintained at all times to enable surface water to drain from them. The containment or disposal of surface water during the construction period shall be the Contractor's responsibility. The Contractor shall ensure that excavations and areas to be filled are free from organic material, loose soil, rubbish and standing water.

Material in fill areas which has deteriorated due to the ingress of surface/ground water or the trafficking of the Contractor's plant shall be removed and replaced.

Following placement, the clean cover layer needs to be verified by a Solmek Engineer to ensure that the cover layer is formed from appropriate materials and is of sufficient thickness.

3 VALIDATION TESTING

On satisfactory completion of the works Solmek will provide a Validation Report to the Client. The Validation Report will provide certification that the remediation works have been carried out in accordance with this Remediation Statement. The Validation Report will include a summary of the remediation works undertaken, laboratory test results, drawings supplied by the Contractor's surveyor, and details of any other relevant matters.

A Validation Report will be issued on completion of works that will cover the following elements:

- Volumes of materials excavated from the remediation area.
- Standard requirements for insitu validation of garden areas is for material in gardens to be tested at a ratio of at least one sample (both topsoil and subsoil) location for every 3 gardens however in this case a minimum of 3no topsoil and 3no subsoil samples should be taken.
- Validation testing in accordance with the Local Authority Guidelines '*Verification Requirements for Cover Systems, Technical Guidance for Developers, Landowners and Consultants'* (Yorkshire and Lincolnshire Pollution Advisory Group Version 3.3 – October 2016).
- Clean cover thickness in soft landscaped areas with photographic evidence (trial pits).
- Evidence of waste disposal records.

- Confirmation of haulier and disposal facilities.
- Records of environmental issues.
- Diary/log sheets of Part time supervision/visits by suitably qualified Engineer.

The contractor will be responsible for providing the necessary site information for use in the Validation Report. This will include volumes of materials, waste disposal records, surveys for base digs etc.

Based on the findings presented within the Site Investigation Report; the clean cover system materials for soft landscaped areas will undergo the following suite of testing:

3.1 Soils Analysis

- Inorganic determinants (metals, semi-metals and non-metals)
- Total Petroleum Hydrocarbons (TPHs) aliphatic and aromatic fractions.
- Speciated Polyaromatic Hydrocarbons (PAHs)
- Phenol
- pH
- Organic Matter Content
- Asbestos and Asbestos Quantification

Soil test results will then be compared against a series of LQM/CIEH Suitable 4 Use Levels (S4UL) based on a residential land use with home grown produce. The latest LQM/CIEH S4UL were published in December 2014. In the absence of LQM/CIEH S4UL, Category 4 Screening Levels (March 2014), EA CLEA Thresholds (from Version 1.06, May 2011) and EA Lower Tier Threshold values shall be adopted.

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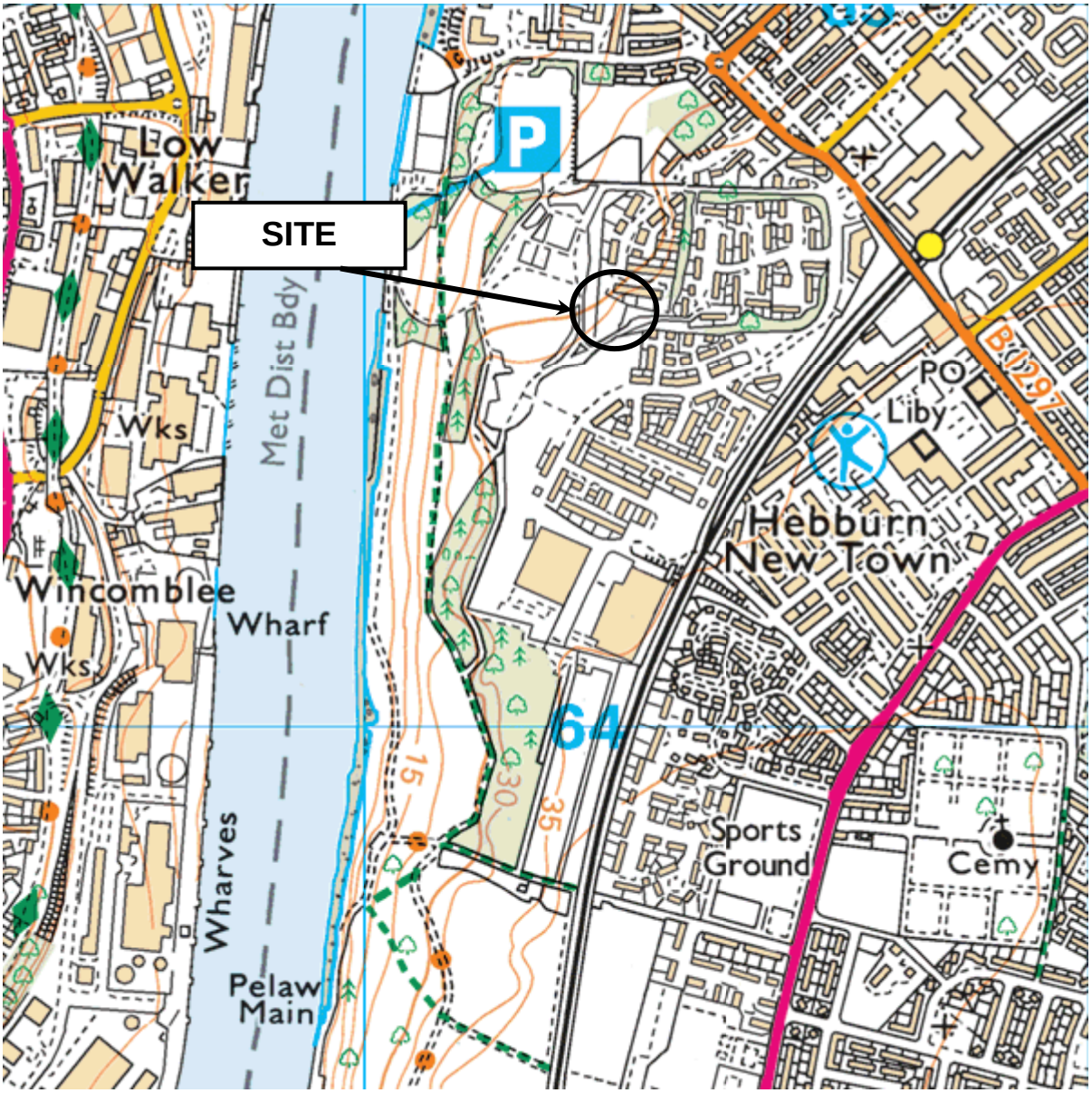
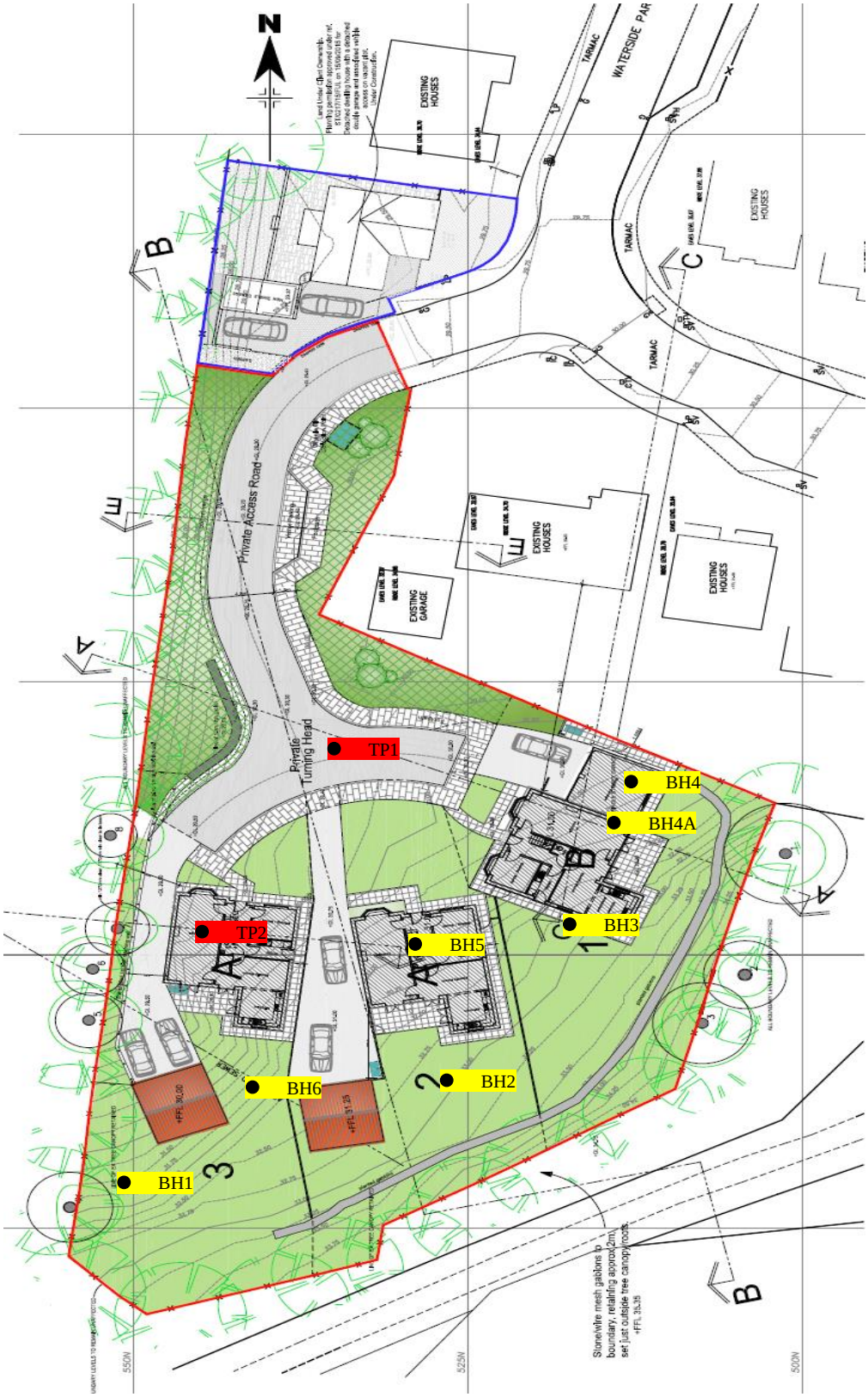
APPENDIX A



Client:	Hebburn Properties Ltd	
Project:	Waterside Park, Hebburn	
Title:	Site Location Map	
Drawing No:	Figure 1	Scale: NTS
Date	April 2017	

SOLMEK



Client:	Hebburn Properties Ltd	
Project:	Waterside Park, Hebburn	
Title:	BH/TP Location Map	
Drawing No:	Figure 2	Scale: NTS
Date	April 2017	

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APPENDIX B

SOLMEK NOTES ON CONTAMINATION GUIDANCE (REF: VERSION 2/2017)

UK BACKGROUND

Environmental Protection Act 1990: Part 2A Revised Statutory Guidance (April 2012)

This revised document explains how the Local Authority should decide if land, based on a legal interpretation, is contaminated. The document replaces the previous guidance given in Annex 3 of DEFRA Circular 01/2006, issued in accordance with section 78YA of the 1990 Environmental Protection Act.

The main objectives of the Part 2A regime are to *"identify and remove unacceptable risks to human health and the environment" and* to *"seek to ensure that contaminated land is made suitable for its current use".*

Part 2A uses a risk based approach to defining contaminated land whereby the "risk" is interpreted as *"the likelihood that harm, or pollution of water, will occur as a result of contaminants in, on or under the land"* and by *"the scale and seriousness of such harm or pollution if it did occur".*

For a relevant risk to exist a contaminant, pathway and receptor linkage must be present before the land can be considered to be contaminated. The document explains that *"for a risk to exist there must be contaminants present in, on or under the land in a form and quantity that poses a hazard, and one or more pathways by which they might significantly harm people, the environment, or property; or significantly pollute controlled waters."*

A conceptual model is used to develop and communicate the risks associated with a particular site.

To determine if land is contaminated the local authority use various categories from 1 to 4. Categories 1 and 2 include *"land which is capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health."*

Categories 3 and 4 *"encompass land which is not capable of being determined on such grounds".*

PRELIMINARY CONCEPTUAL MODEL

Preliminary Conceptual Models are undertaken in accordance with CIRIA C552. The Preliminary Conceptual Model assesses the consequence and the likelihood of a risk being realised to provide a risk classification, using the tables detailed below.

CONSEQUENCE OF RISK BEING REALISED (Based on C552 CIRIA, 2001)

Classification	Definition	Example
Severe	Short-term (acute) risk to human health, the environment, an element of the development or other aspect with is likely to result in *significant harm*, damage or both.	High concentrations of cyanide on the surface of an informal recreational area. Major spills of contaminants from site into controlled water. High concentrations of explosive gas in the subsurface environment that have a clear unobstructed pathway into buildings.
Moderate	Chronic damage to human health, a plausible chance that an event will occur, although the timeline is not immediate to be in the short-term.	Appreciable concentration of contamination that over the longer-term will cause significant harm i.e. high lead concentration in topsoil. Shallow mine workings that are potentially unstable but may remain in a satisfactory or stable conditions for a number of years.
Mild	Low level pollution of non-sensitive water, a feasible hazardous scenario although the timeline of such occurring can probably be considered in 10's of years.	The effect of high sulphate concentrations on structural concrete. Pollution of non-classified groundwater.
Minor	Harm, although not necessarily significant to human health, or with respect to other aspects of the development, which are considered implausible in terms of occurrence, or will have little consequential impact.	The presence of contaminants at such low concentrations that protective equipment is required during site works. Any damage to structures is minimal and will not be structural in characteristics.

PROBABILITY OF RISK BEING REALISED (C552 CIRIA, 2001)

Classification	Definition
High Likelihood	There is a viable pollutant linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence that the receptor has been harmed or polluted.
Likely	There is a viable pollutant linkage and all elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a viable pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a viable pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

RISK CLASSIFICATION MATRIX (C552 CIRIA, 2001)

Risk = Probability x Consequence		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

HUMAN RECEPTORS

Human exposure to contaminants present in soils can occur via several pathways. Direct exposure pathways include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatised compounds, and inadvertent soil ingestion (or deliberate soil ingestion in the case of some children). Other indirect pathways include human ingestion of plants grown in contaminated soil or contaminated ground or surface water. Contaminants associated with wind blown dust can affect humans on surrounding sites.

VEGETATION

Plants can be affected by soil contamination in a number of ways resulting in growth inhibition, nutrient deficiencies and yellowing of leaves. Contaminants are taken up by plants through the roots and through foliage. Contaminants identified as being highly phytotoxic include boron, cadmium, copper, lead, nickel, and zinc.

To establish if the levels of contaminants present on a site may pose a risk to vegetation the results of the contamination testing are compared to a series of threshold values published in 'Code of Good Agricultural Practice for the Protection of Soil'.

GROUNDWATER AND SURFACE WATER RECEPTORS

The principal pathway by which soil contamination may reach the water environment is through a slow seepage or leaching to groundwater or surface water. The potential for contaminants to migrate along such pathways is dependent on the chemical and physical characteristics of the contaminants and the local hydrogeology. Surface watercourses may also accumulate contamination as contaminated sediments are deposited within the water body.

Where the site investigated overlies major/principal aquifers (and in some cases minor/secondary aquifers depending on certain conditions), groundwater Source Protection Zones and areas in close proximity to groundwater abstractions, contamination test results have been compared with the Water Supply (Water Quality) Regulations 1989 and The Water Supply (Water Quality) Regulations 2000.

Should a surface water receptor, such as a fresh water environment (river, canal, stream, lake etc), or marine environment be considered sensitive in relation to a site, then test results are compared with DEFRA & SEPA Environmental Quality Standards (2004). Many of the Environmental Quality Standards are hardness ($CaCO_3$) depended. Where no hardness values are available, Solmek assume conservative values (of between 0 and 50mg/l).

In the absence of vulnerable ground and surface water environments, Solmek may compare any test results with the Environment Agency Leachate Quality Threshold Values.

DETAILED QUANTITATIVE RISK ASSESSMENT (DQRA)

In line with CLR 11- Model Procedures, a DQRA for groundwater/human health may be required following a Phase 2 investigation and before the preparation of a Phase 3 Remediation Strategy. For human health DQRA, a site specific assessment criteria is undertaken using CLEA Software Version 1.06. For groundwater DQRA, the Environment Agency Remedial Targets Worksheet Version 3.1 is used.

WASTE ACCEPTANCE CRITERIA

The WAC testing relates to materials that are to be exported from a site/development to landfill, and do not directly relate to human health specifically. The WAC test categorises materials as either inert waste, non-reactive hazardous waste, and hazardous waste.

The testing results are generally presented as certificates which can be used by site owners/contractors etc, which should be presented to the accepting waste facility or waste contractor.

CONSTRUCTION MATERIALS

Materials at risk from possible soil contaminants include inorganic matrices such as cement and concrete and also organic material such as plastics and rubbers. Acid ground conditions and high levels of sulphates can accelerate the corrosion of building materials. Where pH and soluble sulphate analysis has been undertaken, Solmek compare the test results with the guidelines presented within BRE Special Digest 1, 2005 (3rd Edition) 'Concrete in Aggressive Ground'. Plastics and rubbers are generally used for piping and service ducts and are potentially attacked by a range of chemicals, most of which are organic, particularly petroleum based substances. Drinking water supplies can be tainted by substances that can penetrate piping and water companies enforce stringent threshold values.

The levels of potential contaminants should be compared to thresholds supplied in the UK Water Industry Research (UKWIR) publication "Guidance for the selection of Water Supply Pipes to be used in Brownfield Sites" (January 2011). A Brownfield Site is defined in the document as "Land or premises that have not previously been used or developed that may be vacant or derelict". It should be noted that Brownfield sites may not be contaminated. The guidance does not apply to Greenfield Sites however water companies may have their own assessment criteria which should be checked by the developer. The table below outlines the pipe material selection threshold concentrations.

	Pipe Material (Threshold concentrations in mg/kg)					
Parameter group	**PE**	**PVC**	**Barrier pipe (PE-AL-PE)**	**Wrapped Steel**	**Wrapped Ductile Iron**	**Copper**
Extended VOC suite by purge and trap or head space and GC-MS with TIC	0.5	0.125	Pass	Pass	Pass	Pass
+ BTEX + MTBE	0.1	0.03	Pass	Pass	Pass	Pass
SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C5-C10)	2	1.4	Pass	Pass	Pass	Pass
+ Phenols	2	0.4	Pass	Pass	Pass	Pass
+ Cresols and chlorinated phenols	2	0.04	Pass	Pass	Pass	Pass
Mineral oil C11-C20	10	Pass	Pass	Pass	Pass	Pass
Mineral oil C21-C40	500	Pass	Pass	Pass	Pass	Pass
Corrosive (Conductivity, Redox and pH)	Pass	Pass	Pass	Corrosive if pH <7 and conductivity >400µS/cm	Corrosive if pH <5, Eh not neutral and conductivity >400µS/cm	Corrosive if pH <5 or >8 and Eh positive
Specific suite identified as relevant following site investigation						
Ethers	0.5	1	Pass	Pass	Pass	Pass
Nitrobenzene	0.5	0.4	Pass	Pass	Pass	Pass
Ketones	0.5	0.02	Pass	Pass	Pass	Pass
Aldehydes	0.5	0.02	Pass	Pass	Pass	Pass
Amines	Fail	Pass	Pass	Pass	Pass	Pass

REQUIREMENTS OF PARTIES WITHIN THE DEVELOPMENT PROCESS

Interested parties involved in the development process may use the data in different ways and there may be varying views and interpretation of the factual data. Local Authority staff may have a view on contamination and human health and the wider environment. The Environment Agency are concerned principally with the protection of Controlled waters. Building insurers, funders and purchasers may be primarily concerned with issues of potential commercial blight. Purchasers are also not always fully informed, and perceptions on issues associated with risk can affect the decision to purchase. Developers and construction organisations will focus on financial aspects of dealing with the contamination in the context of the development and construction programme.

RISKS & LIABILITIES FROM CONTAMINATION

In simple terms, risks associated with contamination may be considered in terms of 1) statutory risks and 2) development related risks. If contamination is severe or forms a potential hazard based on its potential to affect groundwater, surface water or human health, a statutory risk may be present, and as such, if the risk is not reduced, criminal proceedings may be instigated by a government body or local authority.

If the contamination is less severe or not considered to be mobile, it may be considered a commercial liability which could, in theory remain untreated, but which may at a later date affect the value of the property, or, with changing legislation, become a statutory risk. Commercial liabilities could give rise to civil proceedings by third parties if there are grounds for action.

♠Solmek conditions of offer, notes on limitations & basis for contract (ref: version1/2017)

These conditions accompany our tender and supercede any previous conditions issued. Solmek will prepare a report solely for the use of the Client (the party invoiced) and its agent(s). No reliance should be placed on the contents of this report, in whole or in part by 3rd parties. The report, its content and format and associated data are copyright, and the property of Solmek. Photocopying of part or all of the contents, transfer or reproduction of any kind is forbidden without written permission from Solmek. A charge may be levied against such approval, the same to be made at the discretion of Solmek. Solmek was a trading name of Hymas Geoenvironmental Ltd.

Solmek cannot be held liable and do not warrant, or otherwise guarantee the validity of information provided by third parties and subsequently used in our reports. Solmek are not responsible for the action negligent of otherwise of subcontractors or third parties.

Site investigation is a process of sampling. The scope and size of an investigation may be considered proportional to levels of confidence regarding the ground and groundwater conditions. The exploratory holes undertaken investigate only a small volume of the ground in relation to the overall size of the site, and can only provide a general indication of site conditions. The opinions provided and recommendations given in this report are based on the ground conditions as encountered within each of the exploratory holes. There may be different ground conditions elsewhere on the site which have not been identified by this investigation and which therefore have not been taken into account in this report. Reports are generally subject to the comments of the local authority and Environment Agency. The comments made on groundwater conditions are based on observations made at the time that site work was carried out. It should be noted that mobile contamination, ground gas levels and groundwater levels may vary owing to seasonal, tidal and/or weather related effects. Solmek cannot be held liable for any unrecorded or unforeseen obstructions between exploratory boreholes and trial pits. This includes instances where previous structures on the site (buried man made structures) or the presence of boulder clay (cobbles and/or boulder obstructions) have been anticipated. All types of piling operations should make allowance for obstructions within the construction budget to accommodate this. Unrecorded ancient mining may occur anywhere where seams that have been worked and influence the rock and soil above. Dissolution cavities can occur where gypsum or chalk is present. Rotary drilling is the recommended technique to prove the integrity of the rock.

Where the scope of the investigation is limited via access to information, time constraints, equipment limitations, testing, interpretation or by the client or his agents budgetary constraints, elements not set out in the proposal and excluded from the report are deemed to be omitted from the scope of the investigation.

Desk studies are generally prepared in accordance with RICS guidelines. Environmental site investigations are generally undertaken as 'exploratory investigations' in accordance with the definitions provided in paragraph 5.4 of BS 10175:2001 in order to confirm the conceptual assumptions. You are advised to familiarize yourself with the typical scope of such an investigation. No pumping of water will be undertaken unless a licence or facilities/equipment have been arranged by others.

Where the type, number or/and depth of exploratory hole is specified by others, Solmek cannot and will not be responsible for any subsequent shortfall or inadequacy in data, and any consequent shortfall in interpretation of environmental and geotechnical aspects which may be required at a later date in order to facilitate the design of permanent or temporary works.

All information acquired by Solmek in the course of investigation is the property of Solmek, and, only also becomes the joint property of the Client only on the complete settlement of all invoices relating to the project. Solmek reserve the right to use the information in commercial tendering and marketing, unless the Client expressly wishes otherwise in writing. The quoted rates do not include VAT, and payment terms are 30 days from dispatch of invoice from our offices. Quotes are subject to a site visit.

We have allowed for 1 mobilisation and normal working hours unless otherwise stated. The scope of the investigation may be reviewed following the desk study and/or fieldwork. The presence or otherwise of Japanese Knotweed or other invasive plants can be difficult to identify especially during winter months. If Japanese Knotweed or other invasive species are suspect, it should be confirmed by an ecologist. We have not allowed for acquiring services information, and cannot be responsible for damage to underground services or pipes not shown to us or not clearly shown on plans. Costs incurred will be passed on to you, and in commissioning Solmek you understand and accept that you/your agent have a contractual relationship with Solmek & you accept this. Our rates assume unobstructed, reasonably level and firm access to the exploratory positions and adequate clear working areas and headroom. We have priced on the basis that you or your client have the necessary permissions, wayleaves and approvals to access land. All boreholes and pits are backfilled with arisings except where gas monitoring pipes are installed with stopcock covers. Solmek are not responsible for any uneven surfaces as a result of siteworks and rutting and backfilled excavations may require re-levelling and/or making good by others after fieldwork is complete, and Solmek has not allowed for this. No price has been provided or requested for a return visit to remove pipework and covers. Hourly rates apply to consultancy only and do not include expenses unless otherwise shown. If warranties are required, legal costs incurred will be passed on to you assuming Solmek agree to complete such warranties, modified or otherwise and you understand and agree to pay all costs.

We reserve the right to pursue full payment of the invoice prior to release of any information including reports. We advise you/your client that we may elect to pursue our statutory rights under late payment legislation, and will apply 8% to the base rate for unreasonably late payments. Solmek are exempt from the CIS Scheme. Solmek offer to undertake work only in strict accordance with conditions covered by our current insurances, which are available for inspection. Solmek are not responsible for acts, negligent or otherwise of subcontractors and as a matter of policy cannot indemnify any other parties. Professional indemnity Insurance is limited to ten times the invoice net total except where stated otherwise by Solmek. Solmek give notice that consequential loss as a direct or indirect result of Solmek's activities or omission of the same are excluded.