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Princedom Street, Manchester

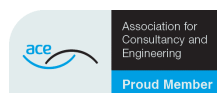
Remedial Strategy Report

For: John Southworth Builders Ltd



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1.0 INTRODUCTION

This *Remedial Strategy Report (4048-01)* has been prepared at the request of John Southworth Builders Ltd. Instructions to proceed with this report were received in August 2024. This report follows and should be read in conjunction with the following reports:

- **Brownfield Solutions Ltd** *Phase 2 Geo-Environmental Investigation Report* (Ref. PH/C4656/10673, March 2022).
- **Sladen Associates** *Phase 1 Geo-Environmental Study* (Ref. 20 2776, December 2020).

This report pertains to a c. 0.52 Ha site located either side of Princedom Street, Manchester at the approximate post code M9 4JR. The National Ordnance Survey Grid Reference for the centre of the site is 386432E, 401698N. A site location plan is included in Appendix 2 (Drawing ref. *SI-01*).

The site currently comprises 2 No. separate parcels of grassed, vacant land, bisected by Princedom Street. The southern site section is accessed via Princedom Street and the northern site section via Jonas Street. The northern site section is bound by Sequoia Street to the north, Jonas Street to the west, Simister Street to the east and Princedom Street to the south. The southern site section is bound by Princedom Street to the north and residential properties to the east, south and west. An aerial photo of the site is included below:



Figure 1: Aerial image of the site dated September 2024.



Figure 2: Extract of the Proposed Site Layout (July 2023).

1.1 Scope

This Remedial Strategy Report has been undertaken to determine the remedial requirements of the site based upon the existing site investigation works. It is the Client's intention to develop the site into a low-rise residential development comprising 22 No. dwellings with associated private gardens, soft landscaping and access roads. The proposed development plan is contained in Appendix 2. An extract of the proposed development plan is on Figure 2.

1.2 Brief

This report has been undertaken following the findings and recommendations of the *Brownfields Solutions Ltd Phase 2 Geo-Environmental Investigation Report (Ref. PH/C4656/10673, March 2022)*. Based on the Brownfield Solutions Ltd Phase 2 Report findings, this report will outline the remedial strategy with regard to human health, controlled waters and ground gas risk on site.

The limitations of the report are contained in Appendix 1.

1.3 Summary of Previous Phase 2 Investigation Findings

Brownfield Solutions Ltd (BSL) undertook an intrusive investigation of the site in December 2021, comprising 11 No. dynamic sample boreholes to a depth of between 4.44m and 5.45m bgl, including the installation of 4 No. gas and groundwater monitoring wells. 6 No. Made Ground samples from across site have been submitted for environmental analysis. Elevated concentrations of metals have been recorded, with 6 No. human health GAC exceedances recorded in 5 No. samples. Trace asbestos was also detected in 1 No. sample. The below table summarises the recorded exceedances:

Exploratory Hole	Depth (m bgl)	Determinand	Concentration (mg/kg*)	GAC (mg/kg*)
WS03	0.2	Lead	280	200
		Asbestos	<0.001%	Detected
WS04	0.90	Arsenic	47	37
WS05	0.20 – 0.40	Lead	220	200
WS09	0.00 – 0.05	Arsenic	230	37
		Cadmium	11	11
WS11	0.30	Lead	320	200

*Excluding asbestos. Units = % by weight.

9 No. PAH (Polyaromatic Hydrocarbons) Human Health GAC exceedances were also recorded within 3 No. Made Ground samples, when assessed against individual S4ULs. However, the 'surrogate marker' approach was instead used to assess PAHs based on Benzo(a)pyrene (BaP) representing a complex mixture of PAHs, using the Culp et al. (1998)¹ study, the pivotal toxicity study from which the surrogate marker approach was derived. Based on the chemical testing results and the PAH data from the Culp et al. (1998)¹ study, it was deemed appropriate to use the surrogate marker approach. The concentrations for BaP were below the pC4SL surrogate marker GAC.

No TPH (Total Petroleum Hydrocarbons) testing was undertaken as part of the Phase 2 site investigation works.

¹ Culp et al. (1998), *A comparison of the tumors induced by coal tar and benzo[a]pyrene in a 2-year bioassay*, **Carcinogenesis**, vol.19, no.1, pp.117–124.

As a result of the BSL works, remedial measures are required within the proposed private gardens and soft landscaped areas to negate exposure pathway risks with existing site materials.

The risk of VOCs is regarded as negligible due to the lack of evidence for the potential sources on site, consequently contaminative pathways for vapours were not considered.

2.0 GROUND GAS RISK ASSESSMENT

Previous Ground Gas and Groundwater Monitoring

As part of the BSL Phase 2 Geo-Environmental investigation works, a ground gas monitoring programme was undertaken with 6 No. visits between 13th December 2021 and 22nd February 2022. 4 No. boreholes were installed with a combined ground gas and groundwater monitoring well. The response zones of the installed wells are detailed below.

Exploratory Hole	Response Zone Depth (m bgl)
WS02	1.00 – 3.00
WS06	0.50 – 4.00
WS09	1.00 – 3.00
WS10	2.00 – 4.00

The results of a programme of 6 No. ground gas and groundwater monitoring visits undertaken by BSL over 3 No. months are detailed in the below tables.

Gas Monitoring Well	Steady O ₂ Concentration (%)	Peak CO ₂ Concentration (%)	Peak CH ₄ Concentration (%)	Peak H ₂ S Concentration (ppm)	Atmospheric Pressure (mbar)	Steady Gas Flow (l/hr)
WS02	19.9 – 21.0	<0.1	<0.1	<0.1	997 - 1026	<0.1
WS06	19.4 – 20.2	<0.1 – 1.8	<0.1	<0.1	997 - 1026	0.6 – 3.1
WS09	17.5 – 20.5	0.2 – 2.0	<0.1	<0.1	997 - 1026	<0.1
WS10	19.7 – 20.6	0.8 – 2.3	<0.1	<0.1	997 - 1026	<0.1

WS10 was flooded during all visits and WS06 was flooded during all visits apart from one, as indicated in blue.

Monitoring Well	Response Zone (m bgl)	Water Levels (m bgl)
WS02	1.00 – 3.00	1.01 – 1.58
WS06	0.50 – 4.00	0.00 – 0.70
WS09	1.00 – 3.00	1.55 – 1.73
WS10	2.00 – 4.00	1.34 – 1.56

The results of the 4 No. ground gas monitoring visits undertaken by BSL have been assessed in accordance with BS 8485 (2015) + A1 (2019). The characteristic Gas Screening Value (GSV) is calculated by dividing the maximum methane or carbon dioxide concentration by 100 and multiplying by the maximum steady flow rate recorded at the same monitoring point (the instrument detection limit of 0.1 l/hr is utilised when below detection limit flow rates are recorded). If required, the worst case

GSV can be calculated by dividing the maximum carbon dioxide and methane concentration by 100 and multiplying by the maximum steady flow rate on-site.

Ground gas monitoring has recorded a maximum peak carbon dioxide concentration of 2.0% v/v within WS09. No methane concentrations of steady flow rates above detection limits were recorded. The results from flooded wells have not been included in the assessment.

As no steady flow rates were recorded on-site, the GSV and the worst case GSV for carbon dioxide at the site can be calculated as $(2.0/100) \times 0.1 = 0.002 \text{ l/hr}$. The GSV and the worst case GSV for methane can be calculated as $(0.1/100) \times 0.1 = 0.0001 \text{ l/hr}$.

Conclusions

Therefore, based on the ground gas monitoring undertaken by BSL and the lack of significant ground gas sources identified within the Sladen Associates Phase 1 Geo-Environmental Study, the ground gas risk on-site is deemed **low** and in-line with Characteristic Situation 1 (CS1). Consequently, no ground gas protection measures are deemed necessary in the proposed development, in-line with BS8485 + A1 (2019).

Proposed foundations are piled and trench as such no preferable pathways will be created i.e. via vibro stone columns within the proposed development.

Radon

According to the Sladen Associates Phase 1 report, the site is not in an area where radon protection measures would normally be required for any new buildings.

3.0 REMEDIAL STRATEGY

The proposed development is to include private gardens and areas of soft landscaping. The BSL Phase 2 Report recommended a clean cover system in these areas to break any pathways between the existing site soils and the end user.

3.1 Installation of a Clean Cover System

The following Landscaping Plan shows the proposed plots (blue), private rear gardens (green), private front gardens (orange) and soft landscaping (yellow). The below remedial recommendations will refer to the landscaping designations detailed in the below extract.

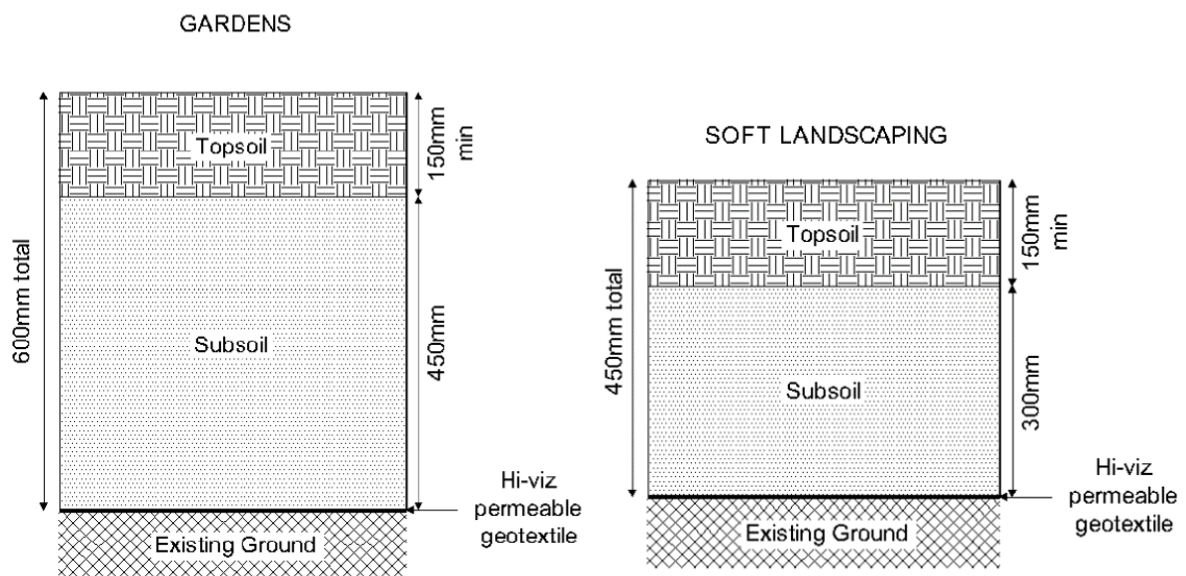


Figure 3: Extract of SI-02 Landscaping Plan (September 2024). Blue = proposed plots, green = proposed private rear gardens, orange = proposed front gardens, yellow = proposed soft landscaping.

Made Ground containing human health GAC exceedances is present below finalised rear garden levels at depths shallower than 600mm (450mm in front gardens and areas of soft landscaping) across the site. The following procedure is outlined for use in all private gardens and in areas of soft landscaping:

1. Excavate to 600mm bgl in private rear gardens (450mm in front gardens and soft landscaping areas).
2. A 600mm clean cover system is recommended to be added to the proposed private rear gardens (450mm in front gardens and soft landscaping areas). This is to consist of:
 - No less than 150mm and no more than 300mm suitable topsoil, underlain by;
 - Suitable subsoil to a total (topsoil + subsoil) depth of 600mm (450mm in front gardens and areas of soft landscaping), underlain by;
 - A high vis geotextile marker;
 - Validate in line with the below strategy.

This is shown diagrammatically below:



Where Made Ground is shallower than 600mm in rear garden areas or shallower than 450mm in front gardens or soft landscaped areas, excavating to the required depth for a cover system in these areas would constitute source removal. Therefore, where this is the case, the following procedure is proposed:

- Excavate to the base of the Made Ground (less than 600mm in rear gardens and less than 450mm in front gardens or soft landscaping areas). A clean cover system is not necessary.
- Add suitable subsoil and topsoil to create a garden / soft landscaping to the client's specification.
- Validate in line with the below strategy.

Guidance for the correct installation of cover systems is contained in Appendix 3.

Soils for use in the above recommended cover system must be validated as detailed below to ensure their suitability for use.

3.2 Validation of Clean Cover System

Once the 600mm clean cover system is installed to break contaminative linkages (450mm in areas of soft landscaping), validation requirements include:

- Details of the source of the cover material;
- Chemical test results to demonstrate that the soil is free from contamination and 'suitable for use' in-line with the below chemical testing suites and rates.
- Waste transfer notes to provide evidence of source;
- Confirmation of cover depth by either measurement tape or topographical survey with photographs at a frequency of one pit per three plots.

Imported topsoil and subsoil must be validated as detailed below to ensure its suitability for use (i.e., no glass or plastic is to be included and meets chemical testing acceptability criteria). Imported topsoil and subsoil is required to be tested at source prior to import to confirm suitability. All topsoil and subsoil, whether site-won or imported is required to be tested at the following frequency, in line with Manchester City Council guidance:

End-Use	Greenfield Soils	Remediated Soils	Brownfield Soils	Unknown Soil Source
Residential Gardens	1:200m ³	1:100m ³	1:50m ³	1:50m ³
Soft Landscaping	1:200m ³	1:150m ³	1:150m ³	1:150m ³
Other	1:200m ³	1:200m ³	1:200m ³	1:200m ³

Minimum 3 samples regardless of volume.

Based on the previous site investigation findings, all site-won soils should be classified as 'brownfield soils' within the above table.

The samples should be tested for the following testing suites:

- Asbestos ID, Asbestos quantification.
- pH, total and free cyanide, soluble sulfate, TOC.
- Arsenic, Beryllium, Boron, Cadmium, Chromium (III and VI) Copper, Lead, Inorganic Mercury, Nickel, Selenium, Vanadium, Zinc.
- Speciated PAHs: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, Benzo(ghi)perylene.
- Total (non-speciated) PAHs.
- Speciated Total Petroleum Hydrocarbons (TPH): Aliphatic >EC5 - EC6, >EC6 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, and > EC35 - EC44, and Aromatic >EC5 - EC7, >EC7 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, >EC35 - EC44.
- Total Petroleum Hydrocarbons (TPH): TPH EC6 – EC40.
- BTEX: Benzene, Toluene, Ethylbenzene, p- & m-xylene, o-xylene. Methyl tertiary butyl ether (MTBE).

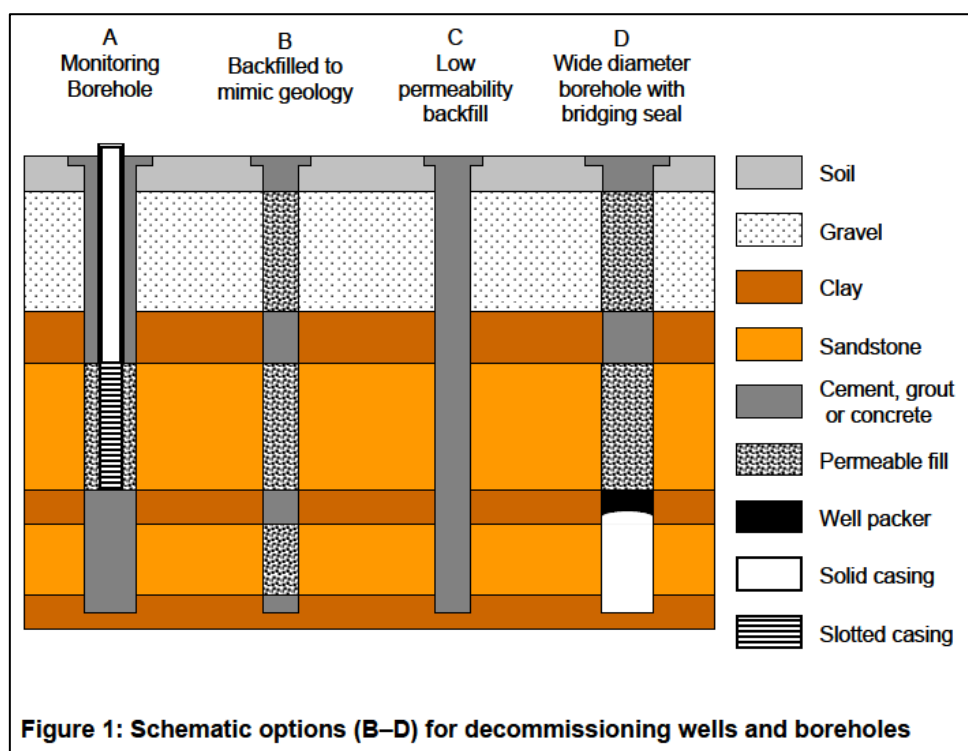
In addition to the standard suites given, the laboratory testing suite should include any additional contaminants of concern based on the source of the samples. Imported topsoil and subsoil is also required to be tested at source prior to import to confirm suitability.

Once tested, the results are to be compared against the Acceptability Criteria contained in Appendix 3.

4.0 OTHER REMEDIAL REQUIREMENTS

4.1 Decommissioning of Boreholes

It is imperative that all boreholes drilled into the site are located and appropriately grouted to negate any possible preferential ground gas pathways. Utilising guidance provided in the Environment Agency's '*Good practice for decommissioning redundant boreholes and wells*' (October 2012), it is prudent to secure redundant borehole to ensure that no groundwater pollution can occur. The Environment Agency (EA) offer advice on the methods of sealing wells to ensure that the preferential pathway is removed. The following diagram taken from the EA guidance shows a monitoring well (A) and 3 No. options for decommissioning (B, C and D):



It is considered prudent to utilise Option C – low permeability backfill, shown in the diagram above, to adequately seal the borehole. The guidance recommends that ‘the backfill materials must be clean, inert and non-polluting’, e.g. bentonite. It is recommended to remove the standpipe and seal with bentonite to ground level. This will be sufficient to prevent contaminant transport.

4.2 Definition of Waste: Code of Practice

Due to the anticipated handling of excavated site-won materials, it is possible to avoid complex waste legislation by utilising the Definition of Waste: Code of Practice (2011, DoW:CoP). This allows assessment of whether or not excavated materials are waste, and when excavated and treated waste can be classified as 'no longer waste'.

It is recommended that in line with DoW:CoP, a robust, site-specific material management plan (MMP) may need to be emplaced and adhered to and verified in an appropriate verification report. This must be reviewed by a 'Qualified Person' who must provide a Declaration to the EA prior to works within the MMP being commenced.

4.3 Material Management

4.3.1 Export of Materials

Any soils to be removed from site must be classified in accordance with WM3 under the definition of waste and chemically tested to determine their destination, i.e. reuse or landfill. Waste ticket records must also be retained as proof of the export of materials from site.

4.3.2 Stockpile Management

During the course of the development there will be areas of stockpiled soils intended for use within private gardens and areas of soft landscaping. These will have been subjected to off-site testing and approved for use on site.

It is imperative that the stockpiles are well managed to avoid inadvertent mixing or depositing of surplus or deleterious materials that would compromise the continued use. We would recommend that the site management reviews the proposed positions for placement of stockpiles and places either fencing or warning signs to ensure compliance.

4.4 Discovery Strategy

In the event of unexpected contamination being discovered, the Discovery Strategy must be followed – this is contained in Appendix 4.

4.5 Design Variation

Following any variation in a finalised proposed development layout and / or detailed design including earthworks design it is recommended that the above conclusions are re-appraised to determine their suitability.

5.0 VERIFICATION REQUIREMENTS

Following on from the requirements detailed above, the below verification checklist in line with Manchester City Councils guidance should be included within the final verification report:

- Details of works carried out and contamination encountered during investigation.
- Details and justification of any changes from the original remediation strategy.
- Demonstration of compliance and description of validation methods.
 - Laboratory and in-situ results.
 - Monitoring results for groundwater and gases.
 - Summary data plots and tables relating to clean up criteria.
 - Plans showing treatment areas and details of any differences from the original remediation strategy.
 - Photographic and other media records.
 - Waste management details and records.
- Ongoing environmental monitoring or works to be carried out.
- Confirmation that remediation objectives have been met.

APPENDIX 1

LIMITATIONS OF INVESTIGATION WORK AND REPORT

LIMITATIONS OF REPORT

This consultancy report was compiled and carried out by IGE Consulting Limited ('IGE') for the client, as defined in the main report (the 'client'), on the basis of a defined programme and scope of works and the terms of a contract between IGE and the client. IGE undertook this with all reasonable skill and care, taking into account the limits of the scope of works required by the client, the prevailing site conditions, the time scale involved and the resources, including financial and manpower resources, agreed between IGE and the client. IGE cannot accept responsibility to any parties whatsoever, following the issue of this report, for any matters arising which may be considered outwith the agreed scope of works.

Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices. This report may not be relied upon, or transferred to, by any other party without the written agreement of its author. If a third party relies on this report, it does so wholly at its own and sole risk and IGE disclaims any liability to such parties.

It is IGE's understanding that this report is to be used for the purpose described in the 'Brief' section of this report. That purpose was a significant factor in determining the scope and the services to be provided. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without IGE's review and advice shall be at the client's sole and own risk.

The information contained in this report is protected by disclosure under Part 3 of the Environmental Information Regulations 2004 pursuant to the provisions of Regulation 12(5) without the consent in writing of a Director of IGE.

This report is a function of the date it was written and should be read in light of any subsequent changes in legislation, statutory requirements and industry practices. Ground conditions can also change over time and further investigations or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal

provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of IGE. In the absence of such written advice of IGE, reliance on the report in the future shall be at the client's own and sole risk. Should IGE be requested to review the report in the future, IGE shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between IGE and the client.

The observations and conclusions described in this report are based solely upon the scope of works agreed between the client and IGE. IGE has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report. IGE is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the agreed scope of works. For the avoidance of doubt, this report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of invasive species (e.g. Japanese Knotweed). It is recommended that the client appoints a specialist in this subject to carry out a detailed inspection / survey of the site if its presence is suspected. Where mention has been made to the identification of asbestos or asbestos-containing materials this is for indicative purposes only and does not constitute or replace full and proper surveys.

LIMITATIONS OF INVESTIGATION WORK

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable and as investigation excavations only allow examination of the ground at discrete locations, the potential exists for ground conditions to be encountered which are different to those considered in this report. The explored extent of the site area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site.

In addition, chemical analysis was carried out for a limited number of parameters, based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Exploratory Holes

Where exploratory holes have been carried out as part of this investigation, the spacing has been determined to provide a reasonable indication of the general ground conditions across the site, but the number has ultimately been limited by commercial constraints. The findings of the exploratory holes relate specifically to the exploratory hole locations and are no absolute guarantee of the ground conditions between such locations. Due allowance should be made for the possibility of variation in conditions between exploratory hole locations.

Extent of Contamination Testing

The extent of contaminated land testing carried out on samples obtained from the site has been determined in accordance with the latest legal guidance issued by the government to provide, with reasonable certainty, the probable general levels of contamination present on site that could pose a significant hazard to human health or waters. The extent of site investigation works including chemical testing has also been limited by reasonable commercial constraints. Although extensive testing of samples has been carried out, the volume of samples taken for testing are a minute fraction of the total volume of soils and groundwater present on site. Therefore, there is a residual risk that undetected pockets of contamination may be present on site, situated between testing locations.

When investigating or developing potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and temporally. The absence of certain ground, ground gas, contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

Extent of Geo-Environmental Studies

This report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of invasive species e.g. Japanese Knotweed. It is recommended that the Client appoints a specialist in this subject to carry out a detailed inspection / survey of the site if its presence is suspected. Where mention has been made to the identification asbestos or asbestos-containing materials this is for indicative purposes only and does not constitute or replace a full and proper survey. If an Unexploded Ordnance (UXO) report has been obtained within the report, it has been so on the basis of Health and Safety concerns and no assessment has been made other than transcribing the recommendations of the sub-contractor contained within the report. In terms of a potential contaminative source, unless ordnance has been manufactured / stored on site, UXOs will only be determined as a contaminative source following a positive identification on site.

APPENDIX 2

FIGURES AND DRAWINGS

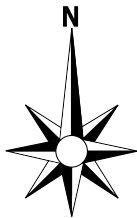




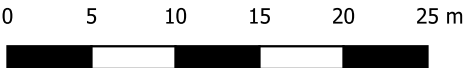
FOR GUIDANCE PURPOSES ONLY

Approximate Site Boundary

Rev	Drawn	Date	Description
Drawing Status: Information			
Contract: Princesdom Street, Harpurhey For: John Southworth Builders Ltd			
Drawing Title: Site Location Plan			
IGE consulting Office 16, Bartle House, Manchester, M2 3WQ Email: contact@igeconsulting.co.uk Web: www.igeconsulting.co.uk Tel: 0161 914 9170			
Scale: 1:1500 @A3		Date: Sept 2024	
Drawn: JH		Checked: AE	
Contract No. 4048		Drawing No. SI-02	P1



FOR GUIDANCE PURPOSES ONLY



- Approximate Site Boundary
- Proposed Plots
- Proposed Rear Gardens
- Proposed Front Gardens
- Proposed Soft Landscaping

Rev	Drawn	Date	Description
Drawing Status: Information			
Contract:			
Princesdom Street, Harpurhey			
For: John Southworth Builders Ltd			
Drawing Title:			
Landscaping Plan			
IGEconsulting Office 16, Bartle House, Manchester, M2 3WQ Email: contact@igeconsulting.co.uk Web: www.igeconsulting.co.uk Tel: 0161 914 9170			
Scale: 1:450 @A3		Date: Sept 2024	
Drawn: JH		Checked: AE	
Contract No. 4048		Drawing No. SI-02	P1

APPENDIX 3

ACCEPTABILITY CRITERIA AND EXAMPLE OF CORRECT COVER SYSTEM INSTALLATION

CLEAN COVER SYSTEM ACCEPTABILITY CRITERIA

Office 16, Bartle House
Oxford Court
Manchester
M2 3WQ

Tel: 0161 914 9171
Email: contact@igeconsulting.co.uk
Web: www.igeconsulting.co.uk

Soils intended for use in private gardens, public open space, and soft landscaping must be tested at the rates outlined above and compared to the following acceptability criteria, to confirm their suitability for use:

Suite	Determinand (mg/kg unless stated)	Acceptability Criteria for:			
		Private Gardens	Public Open Space (residential)	Soft Landscaping or Public Open Space (Park)	General Fill
A	Asbestos (%)	ND	ND	ND	<0.001 – 0.01%
B	pH	>6 - <8 ⁽³⁾	>6 - <8 ⁽³⁾	>6 - <8 ⁽³⁾	>5 - <10 ⁽³⁾
	Total Cyanide	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾
	Free Cyanide	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾
	Soluble Sulphate (mg/l)	500 ⁽³⁾	500 ⁽³⁾	500 ⁽³⁾	500 ⁽³⁾
C	Arsenic	37	79	170	640
	Beryllium	1.7	2.2	63	12
	Boron	290	21000	46000	240000
	Cadmium	11	120	560	190
	Chromium (III)	910	1500	33000	8600
	Chromium (VI)	6	7.7	220	33
	Copper	2400	12000	44000	68000
	Lead	200 ⁽¹⁾	630 ⁽¹⁾	1300	2330 ⁽¹⁾
	Inorganic Mercury	40	120	240	1100
	Nickel	130	230	800	980
	Selenium	250	1100	1800	12000
	Vanadium	410	2000	5000	9000
	Zinc	3700	81000	170000	730000
D	Naphthalene	2.3	4900	1200	
	Acenaphthylene	170	15000	29000	
	Acenaphthene	210	15000	29000	
	Fluorene	170	9900	20000	
	Phenanthrene	95	3100	6200	
	Anthracene	2400	74000	150000	
	Fluoranthene	280	3100	6300	
	Pyrene	620	7400	15000	
	Benzo(a)anthracene	7.2	29	49	
	Chrysene	15	57	93	
	Benzo(b)fluoranthene	2.6	7.1	13	
	Benzo(k)fluoranthene	77	190	370	
	Benzo(a)pyrene	2.2	5.7	11	
	Indeno(1,2,3-cd)pyrene	27	82	150	
	Dibenz(a,h)anthracene	0.24	0.57	1.1	
	Benzo(ghi)perylene	320	640	1400	
E	Total PAHs				1000 ⁽⁴⁾
F	TPH-CWG - Aliphatic >EC5 - EC6	42	570000	95000	
	TPH-CWG - Aliphatic >EC6 - EC8	100	600000	150000	
	TPH-CWG - Aliphatic >EC8 - EC10	27	13000	14000	
	TPH-CWG - Aliphatic >EC10 - EC12	130	13000	21000	
	TPH-CWG - Aliphatic >EC12 - EC16	1100	13000	25000	
	TPH-CWG - Aliphatic >EC16 - EC21	65000	250000	450000	

	TPH-CWG - Aliphatic >EC21 - EC35				
	TPH-CWG - Aliphatic > EC35 - EC44	65000	250000	450000	
	TPH-CWG - Aromatic >EC5 - EC7	70	56000	76000	
	TPH-CWG - Aromatic >EC7 - EC8	130	56000	87000	
	TPH-CWG - Aromatic >EC8 - EC10	34	5000	7200	
	TPH-CWG - Aromatic >EC10 - EC12	74	5000	9200	
	TPH-CWG - Aromatic >EC12 - EC16	140	5100	10000	
	TPH-CWG - Aromatic >EC16 - EC21	260	3800	7600	
	TPH-CWG - Aromatic >EC21 - EC35	1100	3800	7800	
	TPH-CWG - Aromatic > EC35 - EC44	1100	3800	7800	
G	TPH > EC6 - EC40				5000 ⁽⁴⁾
H	Benzene	0.087	72	90	
	Toluene	130	56000	87000*	
	Ethylbenzene	47	24000	17000*	
	p & m-xylene	56	41000	17000**	
	o-xylene	60	41000	17000*	
	MTBE (Methyl Tertiary Butyl Ether)	LOD ⁽³⁾	LOD ⁽³⁾	LOD ⁽³⁾	

LQM/CIEH S4ULs for Human Health Risk Assessment (3rd edition, 2015) used unless stated:

- 1) Category 4 Screening Levels (March 2014)
- 2) CL:AIRE Soil GAC for Human Health Assessment (January 2010)
- 3) In-house screening criteria used as no GAC methodology currently exists
- 4) Hazardous waste thresholds. This limit only applies to imported material, not to in-situ soil.

Assumed 1% SOM (most conservative) for those values dependent upon SOM.

ND = Not Detected

LOD = Limit of Detection

*Exceeds vapour saturation limit

**Exceeds solubility saturation limit

EXAMPLE INSTALLATION OF CLEAN COVER SYSTEM

The following example shows the clean cover system installation in line with the following requirements:

- A 600mm clean cover system comprising:
 - A minimum of 150mm topsoil, underlain by
 - 300mm subsoil, underlain by
 - 150mm gravel break layer
 - A hi-viz geotextile marker

It should be noted that most cover systems require **either** a gravel break layer **or** a hi-viz geotextile marker, but the below example uses both:

Figure 1: First, the gardens are dug out to 600mm below FFL and lined with a hi-viz geotextile marker:



Figure 2: The geotextile is overlain by a 150mm clean stone break layer.



Figure 3: The break layer is overlain by 300mm sub-soil, seen here before spreading across the garden:



Figure 4: The sub-soil is overlain by 150mm topsoil to FFL:



Figure 5: The gardens are finished with turf. The overall cover system depth is 600mm:



EXAMPLE CLEAN COVER SYSTEM VALIDATION

The following example shows validation of a clean cover system in line with the following requirements:

- A 600mm clean cover system comprising:
 - A minimum of 150mm topsoil, underlain by
 - 450mm subsoil

Best practice requires three photos as follows:



Photograph 1 – Identifies the plot number and shows the validation dig location in relation to the plot.

Photograph 2 – Shows the validation depth clearly, using a staff and a marker which crosses the hole. Shows the topsoil and subsoil, and the base of the hole.

Photograph 3 – Shows the validation hole in context. The plot being validated can be seen, along with nearby plots.

The validation should be written up into a Verification Log, shown below:



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Verification Log

Project Name:

Project Number:

Location:

Client:

Remediation Requirements:

Validation Requirements:

Plot Number:

Grid reference:

Inspection date:

Engineer:

Photographs:

Photographs shows

This plot has PASSED / FAILED* verification (*delete as appropriate*)

*Proposed further remedial works (if FAILED):

An additional inspection IS / IS NOT required for this plot (*delete as appropriate*)

APPENDIX 4

DISCOVERY STRATEGY



DISCOVERY STRATEGY

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What to Look Out For

Potentially contaminative material can be identified as follows:

- Appears oily / has an iridescent sheen
- Hydrocarbon odour e.g., oily or petroleum odour
- Solvent odour e.g., sharp or sweet odour
- Waste materials e.g., metals, plastic etc.
- Asbestos e.g., fibrous sheeting / roofing / board / lagging etc.
- 'Landfill' odour e.g., rotten / putrefying / leachate odour

Or any other material that looks man-made or does not match its surroundings – if in doubt, check.

Procedure for Discovery of Unexpected Contamination

If any of the above material is discovered, the following procedure must be carried out:

- a) Stop works in the area of the contamination discovery.
- b) Inform the Site Manager.
- c) Record the visual and olfactory evidence of contamination.
- d) Suitably qualified geo-environmental engineer to investigate the contamination; take samples, photographs and in-situ tests and discover the extents of the contamination, and to identify potential contaminants and specify chemical testing, if necessary.
- e) Either dig out the contaminated material and stockpile, on an impermeable membrane if necessary, or leave in-situ whilst awaiting chemical test results, if needed – whichever presents the least risk.



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- f) Suitably qualified geo-environmental engineer to re-visit the site's risk assessment, taking into account the newly discovered contamination and recommend remediation, if necessary, or other next steps.
- g) If the risk assessment and remediation strategy is changed as a result, the Local Authority and/or the Environment Agency should be informed and/or consulted.
- h) Lastly, undertake remediation of the affected area if this has been deemed appropriate.

Procedure for Discovery of an Unexpected Tank

Former industrial sites may contain unrecorded underground storage tanks (USTs).

Follow the below steps if a UST is found:

- a) Stop works in the area of the UST discovery.
- b) Inform the Site Manager.
- c) Suitably qualified geo-environmental engineer to investigate the tank, including measuring the size, contents, condition, and visual and olfactory evidence of contamination. Geo-environmental engineer to record the location of the tank on a site plan, take photographs, and sample the contents to send for chemical testing to determine the contents.
- d) Suitably qualified contractor to empty the tank and dispose of contents at a suitably licensed disposal facility.
- e) Suitably qualified contractor to undertake integrity testing in line with the 'Blue Book' method (APEA / EI '*Design, Construction, Modification, Maintenance and Decommissioning of Petrol Filling Stations*' 4th ed. (April 2018)), to determine whether the tank is intact or has been compromised.
- f) Suitably qualified geo-environmental engineer to undertake a risk assessment based on the contents of the tank and the results of the integrity testing, to determine whether to decommission the tank and leave in-situ or to remove the tank.
- g) Suitably qualified contractor to clean and 'inert' the tank, and provide a gas safe certificate, in line with the 'Blue Book' method.

- h) Suitably qualified contractor to either decommission the tank in-situ in line with the 'Blue Book' method or remove the tank and dispose of at an appropriate facility.
- i) If excavated and removed, suitably qualified geo-environmental engineer to investigate the base and the sides of the resultant excavations and if any contamination is found, undertake the Procedure for Discovery of Unexpected Contamination above.

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