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Proposed Redevelopment at Whitley Lower

Phase II Interpretative Report

March 2024

Proposed Development at Whitley Lower
Phase II Interpretative Report

RB Geotechnical

Document Control

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Client: Paul Collins

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Prepared and Issued by Ross Blake BSc MSc FGS, Engineer. Signed:



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DISCLAIMER

This report was produced by RB Geotechnical for Paul Collins (The client), for the specific purposes of a Phase II Intrusive Investigation and Interpretative Report, for the proposed residential development on the land at Whitley Lower in Dewsbury, West Yorkshire. This report may not be used by anyone else other than the client without their express permission. In any event, RB Geotechnical accepts no liability for any costs, liabilities or losses arising from the use of reliance upon the contents of this report by anyone other than the client.

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1.0 INTRODUCTION

1.1 Brief and Scope

RB Geotechnical was commissioned by the client, to carry out a Phase II Intrusive Site Investigation at Whitley Lower in Dewsbury, West Yorkshire. The site is intended to have two new houses constructed.

RB Geotechnical undertook an intrusive ground investigation on 30th January 2024, to gain the necessary information required to assess the underlying ground conditions around the proposed new building footprint, in addition to carrying out a soil contamination assessment and ground gas assessment.

This report discusses the findings of this ground investigation and provides an analysis which includes a series of conclusions and recommendations relating to the potential risks and constraints of the proposed development.

1.2 Terms and Conditions

This report has been prepared for Paul Collins, for the purpose of assessing the ground conditions at the proposed new development at Whitley Lower in Dewsbury.

1.3 Scope and Objectives of Report

The purpose of this report is to provide factual and interpretative information required to comply with the requirements of a Phase II Intrusive Site Investigation. The scope of the report is as follows:

- To provide general information on the site such as location and description;
- To summarise the ground investigation and its findings;
- Provide factual information and descriptions of ground conditions;
- To assess geotechnical parameters of the site;
- To assess the soil for contamination issues; and
- To provide recommendations for further works where necessary.

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1.4 Constraints and Limitations

This report is intended for the client for assisting them in assessing the ground conditions around the new proposed building for soil contamination issues and potential ground gas issues

RB Geotechnical has endeavoured to assess all information provided to them. The report includes summaries of information from external sources and cannot offer any guarantees or warranties for the completeness or accuracy of information relied upon.

The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

It should be noted that although every effort has been made to ensure the accuracy of the data obtained from the investigation, the possibility exists for variations in ground and groundwater conditions between and around the borehole locations. In addition, groundwater levels will vary seasonally and with changes in weather conditions.

1.5 Sources of information

The sources of information used for this report are:

- RB Geotechnical, Development at Lower Whitley, Phase I Desk Study Report, RBG379, February 2024;
- Windowless Sample Borehole Logs, January 2024; and
- Envirolab Analytical Test Report, 24/01031, February 2024.

Although every effort has been made to ensure the accuracy of the information contained herein, no checks have been carried out to ensure the accuracy of information obtained from third parties and no liability can be accepted for any errors or misinterpretation of the third-party information where it has been incorporated into this report.

2.0 SITE DETAILS

2.1 Site Location and Description

The 0.17ha sized site is situated at a small parcel of land between houses 'Rydal Mount' and 'Aquaville' on Whitley Road in Lower Whitley, Dewsbury, West Yorkshire. The site comprises a rectangular area of undeveloped grassland with the Eastern boundary marked by a wall and house, the Western boundary by a wooden fence and house, Southern boundary a wire fence and the Northern boundary Whitley Road. During the site walkover there were no signs of contamination sources.

The National Grid Reference for the centre of the site is 422045, 417752

2.2 Proposed Development

The site is proposed to have two detached houses constructed, with landscaped back gardens. The proposed development and exploratory hole location plan is included as Appendix A.

3.0 EXISTING INFORMATION

3.1 Site History

Historically . The surrounding area has always comprised farmland, which has steadily been developed over the years.

3.2 Site Geology

Geological maps indicate that the site is underlain by bedrock of the Lepton Edge Sandstone Formation.

3.3 Aquifers

The site is identified as being underlain by a Secondary A Aquifer.

3.4 Preliminary Contaminated Land Assessment

Potential on-site sources of contamination were identified as potential contaminants in the shallow soils associated with historical farming over the years, in addition to potential Made Ground associated with the construction of the properties adjacent to the site. Off-site sources of potential ground gases were identified due to partial backfilling of the large reservoir nearby in addition to nearby historical allotments.

A Phase II Intrusive Investigation was therefore recommended in order to assess the site for potential soil contamination and ground gas risks.

4.0 INTRUSIVE INVESTIGATION

4.1 Design

The Ground Investigation was designed by RB Geotechnical to investigate the ground conditions of the site.

4.2 Ground Investigation Activities

The Ground Investigation was undertaken in general accordance with:

- BS 5930 (1999). Code of Practice for Ground Investigation;
- BS1377. Methods of test for Soils for Civil Engineering Purposes; and
- BS 10175:2011 (2011). Investigation of Potentially Contaminated Sites – Code of Practice.

The Ground Investigation comprised the following:

- Four Windowless Sample Boreholes to obtain shallow soil samples for soil contamination I testing and for in-situ testing to allow for strength assessment of underlying soils; and
- Installation of ground gas monitoring standpipe in three Windowless Sample Boreholes;
- Ground Gas Monitoring Assessment; and
- Soil Contaminated Land Testing.

This Ground Investigation was undertaken on 30th January 2024 The exploratory holes were logged and sampled by a qualified engineer.

An exploratory hole location plan is shown in Appendix A.

4.3 Sampling and In-Situ Testing

Small, disturbed samples were recovered from the boreholes and stored in plastic pots and jars placed into a cool box.

The cool boxes were then sent to the laboratory and the samples stored appropriately in a refrigerator until testing.

4.4 Laboratory Testing – Environmental

All chemical (contamination) laboratory testing was scheduled by RB Geotechnical and was intended to provide contamination data for the specific areas sampled. The scope of the testing was designed to enable comments regarding characterisation of potential contamination on site.

A total of five soil samples were sent to Envirolab which is a registered UKAS Testing laboratory. Table 4.1 summaries the Laboratory Testing carried out. Full chemical laboratory testing results are shown in Appendix C.

Table 4.1 Summary of Chemical Laboratory Testing

Analysis	Total number of Samples
Heavy Metals	4
Cyanide	4
Speciated PAH	4
Total TPH	4
Asbestos	4

4.5 Ground Gas Monitoring Standpipe

Ground gas monitoring standpipe was installed in three Windowless Sample Boreholes (WS01, WS02 and WS03), with the construction details as follows:

- WS01: 0.50m plain pipe and 1.50m slotted, with bentonite seal to 0.50m and pea gravel from 0.50m to 2.00m;

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- WS02: 0.50m plain pipe and 1.50m slotted, with bentonite seal to 0.50m and pea gravel from 0.50m to 2.00m;
- WS03: 0.50m plain pipe and 1.50m slotted, with bentonite seal to 0.50m and pea gravel from 0.50m to 2.00m;

In-situ gas monitoring is to be carried out in each of these Boreholes, using a portable gas meter which measures Oxygen, Methane, Carbon Dioxide and air pressure. Ground gas monitoring was carried out by Geoenginseer, with the ground gas assessment included as Appendix D.

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5.0 INTRUSIVE GROUND INVESTIGATION FINDINGS

The exploratory hole location plan is shown in Appendix A and full exploratory hole logs are included as Appendix B.

5.1 Ground Conditions Encountered

5.1.1 Topsoil

The site was surfaced by turf over a brown clayey TOPSOIL within all exploratory holes from ground level to 0.25mbgl (metres below ground level).

5.1.2 Highly Weathered Bedrock (Sandy CLAY)

An orange, grey, brown slightly sandy CLAY was encountered from 0.25mbgl extending to a depth of 1.50mbgl in all boreholes.

5.1.3 Bedrock

Brown clayey MUDSTONE bedrock was identified at 1.50mbgl extending to the base of the boreholes at 2.0mbgl where refusal of solid intact bedrock was encountered.

5.2 Ground Gas Monitoring

Ground gas monitoring standpipe was installed into three boreholes (WS01, WS02 and WS03)

The risks associated with ground gases have been considered in accordance with British Standard BS 8485:2015+A1:2019 "Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings" and CIRIA Report C665 "Assessing Risks Posed by Hazardous Gases to Buildings".

Ground Gas Monitoring was carried out on six separate occasions following the intrusive Ground Investigation on the following dates: 9th February 2024, 13th February 2024, 19th February 2024, 26th February 2024, 8th March 2024 and 14th March 2024, ensuring that a range of Atmospheric Pressures were encountered in addition to differing pressure patterns. Full gas monitoring results are shown in Appendix D.

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The methodology used to carry out a semi-quantitative estimate of the risks from ground gas at the site is that described in BS8485:2015+A1:2019 and CIRIA Report C665 which recommends following the classification system proposed by Wilson and Card in CIRIA Report 149.

Gas Screening Values (GSV) for the site was calculated using the highest gas values (using both Methane and Carbon Dioxide) and flow rate. The highest measured gas value on this site was Carbon Dioxide of 1.10%, with a Flow Rate of 0.10l/hr. The GSV for the site can therefore be calculated as $0.011 \times 0.10 = 0.0011$ l/hr.

Using Table 2 from BS8485:2015+A1:2019, the site GSV of 0.0022/hr classifies it as having a 'Very Low' Hazard Potential, with a CS value of CS1.

Using Table 3 from BS8485:2015+A1:2019, the site can be defined as being building type 'Type A', which is defined as being a private building.

Using Table 4 from BS8485:2015+A1:2019, the gas protection score by CS and type of building, for this site is: 0, which means a minimum gas protection score of 0 points will be required and therefore no ground gas protective measures are necessary.

Groundwater was not encountered during the intrusive investigation or the following gas monitoring.

6.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

6.1 Foundations

Ground conditions are favourable for shallow strip or pad footings, placed into the sandy CLAY at depths from 1.0mbgl. At this depth an allowable bearing pressure in the region of 120kPa could be achievable.

All foundation excavations must be inspected to ensure that no footings are placed upon any existing weak Made Ground, softer materials, or any other weak materials that would be incapable of safely sustaining the applied foundation loads. This is particularly important wherever any appreciable amounts of Made Ground occur. Additionally, all foundation excavations should be inspected to confirm that the proposed bearing stratum is rid of any largely clayey spots and is uniformly compacted.

Wherever any suspect Made Ground is encountered at proposed foundation level, then that footing must be deepened until a satisfactory bearing medium is obtained.

6.2 Excavations

For any deep excavation in excess of 1.20m where vertical sides are necessary, the sides are expected to be stable due to the presence of stiff clays and shallow bedrock. No shoring support is likely to be required to this depth.

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7.0 GROUND CONTAMINATION – GENERIC QUANTITATIVE RISK ASSESSMENT

The following assessment was performed in the context of the planning regime and in line with current UK guidelines which follows the procedures set out in the Environmental Agency 'Land Contamination Risk Management' (LCRM) web pages which are accessible via the government website. LCRM provides the technical framework for structured decision making about land contamination and builds on previous work carried out under the Contaminated Land Research Programme of the former Department of the Environment. LCRM has adopted and refined the methodology and terminology that has been used in contaminated land risk assessment for a number of years.

This is used to determine if unacceptable risks to humans, vegetation or to specific parts of the wider environment are present on the site. The risk assessment follows the source, pathway, receptor methodology, as described in Contaminated Land Report (CLR) 11, which is used to build a conceptual site model to determine the presence of any pollutant linkages at the site. Should pollutant linkages exist at the site it is deemed necessary to further develop the risk assessment by comparing contamination test results with generic or site-specific assessment criteria in order to determine if an unacceptable level of risk is present at the site. If legislation or guidance changes, or the proposed end use is modified, then it will be necessary to reassess the risks which may require further sampling and testing.

We understand our brief to comprise the following items related to the contamination aspects of this investigation.

- Compare laboratory test results with generic assessment criteria;
- Determine a conceptual site model and identify any pollutant linkages at the site;
- Determine the level of risk posed by environmental hazards on site to human health, vegetation, controlled waters and structures; and
- Make recommendations for further work or remediation strategies.

Soil samples were recovered in accordance with current industry practice and were sent to Envirolab to be analysed for the determinants listed in section 4.1 of this report.

The results of these analyses are included in Appendix C of this report.

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7.1 Human Health Assessment

UK guidance recommends that a risk-based approach is taken for the assessment of contaminated land and as such, DEFRA have introduced the CLEA methodology, SGV's and Category 4 Screening Values (C4SL). The CLEA methodology is a deterministic risk assessment model that estimates the long-term exposure to contaminants in the soil for children and adults and predicts the amount of contaminant to which a person might be exposed based on a given soil concentration. By comparison with relevant health criteria on tolerable or acceptable intakes of various contaminants the model was used by DEFRA and the Environment Agency to generate SGV's and C4SL's.

At the time of writing this report the DEFRA and Environment Agency has not published SGV's/C4SL using the CLEA 1.071 software for all anthropogenic toxic substances with C4SL's for further contaminants due to be produced at some point in the future. As such, it was necessary to use other methods to generate target concentrations for contaminants of concern on site.

In order to generate generic assessment criteria which are protective of human health, for use in human health risk assessment, where CLEA SGV's and C4SL's are not available the Environment Agency recommends the use of the CLEA 1.071 software in conjunction with advice found on the GOV.UK CLEA web pages. Accordingly, the Chartered Institute of Environmental Health (CIEH) in partnership with Land Quality Management (LQM) derived a set of Generic Assessment Criteria Values following the approach set out in the DEFRA research project SP1010, C4SL. The GAC for missing contaminants of concern were calculated using the CLEA 1.06 software released in July 2009 and termed Suitable 4 Use Levels (S4UL's). The input parameters used for calculating each S4UL value are listed in the substance specific chapters of the reference document associated with the S4UL's, namely 'The LQM/CIEH S4ULs for Human Health Risk Assessment (Land Quality Press, 2015). Where published UK guidance values are not available (i.e., for TPH), the results have been determined in-house using published toxicological data and UK government endorsed risk models.

The current view of the Environment Agency is that the C4SL's are considered to be a trigger value at which an exceedance may cause concern for human health and generally requiring further investigation and/or assessment.

The DEFRA C4SL and LQM/CIEH S4UL's for a commercial land use has been selected as this matches the proposed future land use.

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8.0 DISCUSSION OF RESULTS**8.1 Human Health Hazards**

The results shown in Table 8.1, confirm that no elevated levels of contamination were identified above the allowable screening levels from any of the samples tested.

Table 8.1 Comparison of Soil Test Results with Commercial End Use C4SI/S4UL

Determinant	Assessment Criteria (mg/kg)		Recorded Concentrations Across The Site (mg/kg)	
	C4SL Screening Levels	S4UL Generic Assessment Criteria/RB Geotechnical Generic Assessment Criteria	Highest Recorded Value	Location of Highest Recorded Value and other Exceedances
Metals, semi- metals and non-metals				
Arsenic	37	37	19	WS02
Cadmium	17	11	0.7	WS02
Copper	NC	2400	33	WS02
Chromium Total	NC	910	24	WS04
Lead	210	NC	59	WS04
Mercury (elemental)	NC	1.2	<0.17	All
Nickel	NC	130	19	WS04
Selenium	NC	250	1	WS03/WS04
Zinc	NC	3700	105	WS02
PAH (total)	NC	NC	<5.41	WS02
TPH (total)	NC	NC	78	WS02
Naphthalene	NC	1.5	<0.03	All
Acenaphthylene	NC	170	<0.01	All
Acenaphthene	NC	210	0.03	WS02
Fluorene	NC	170	<0.01	All
Phenanthrene	NC	95	0.25	WS02
Anthracene	NC	2400	0.06	WS01/WS02
Fluoranthene	NC	280	0.85	WS02
Pyrene	NC	620	0.79	WS02
Benzo(a)anthracene	NC	7.2	0.53	WS02
Chrysene	NC	15	0.57	WS02
Benzo(b)fluoranthene	NC	2.6	0.64	WS02
Benzo(k)fluoranthene	NC	77	0.24	WS02
Benzo(a)pyrene	3.2	2.2	0.61	WS02
Indeno(1,2,3-c,d)Pyrene	NC	2.3	0.40	WS02

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Determinant	Assessment Criteria (mg/kg)		Recorded Concentrations Across The Site (mg/kg)	
	C4SL Screening Levels	S4UL Generic Assessment Criteria/RB Geotechnical Generic Assessment Criteria	Highest Recorded Value	Location of Highest Recorded Value and other Exceedances
Dibenzo(a,h)anthracene	NC	0.24	0.07	WS02
Benzo(g,h,i)perylene	NC	320	0.35	WS02
Others				
Cyanide (total)*	NC	5	<1	All
Asbestos	NC	NC	Not Detected	All

NOTES:

(1) C4SL/LQM S4UL 2015 for Residential with gardens land use scenario at 1% organic matter content
(2) *= Dutch Target value used as screening value for cyanide.
(3) NC = No criterion.

9.0 CONCEPTUAL SITE MODEL

9.1 Introduction

The information obtained from this investigation has been collated and evaluated to develop a refined Conceptual Model for the site.

The following assessment was performed in the context of the planning regime and in line with current UK guidelines which follows the procedures set out in the Environmental Agency 'Land Contamination Risk Management' (LCRM) web pages which are accessible via the government website. LCRM provides the technical framework for structured decision making about land contamination and builds on previous work carried out under the Contaminated Land Research Programme of the former Department of the Environment. LCRM has adopted and refined the methodology and terminology that has been used in contaminated land risk assessment for a number of years.

The site has been assessed in line with current UK guidelines, namely the 'Land Contamination Risk Management' (LCRM) web pages which are accessible via the government website and Part IIA of the Environmental Protection Act 1990 and follows the procedures set out in the Environmental Agency 'Model Procedures for the Management of Land Contamination – Contamination Land Report (CLR).11'.

CLR.11 provides the technical framework for structured decision making about land contamination and builds on previous work carried out under the Contaminated Land Research Programme of the former Department of the Environment. CLR 11 has adopted and refined the methodology and terminology that has been used in contaminated land risk assessment for a number of years.

CLR.11 defines the three essential elements to any risk:

- A contaminant **source** - a substance that is in, on or under land and has the potential to cause harm or to cause pollution of controlled waters;
- A **receptor** – in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property or a water body; and
- A **pathway** - a route or means by which a receptor can be exposed to or affected by a contaminant.

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Each of these elements can exist independently, but they create a risk only where they are linked together, so that a particular contaminant affects a particular receptor through a particular pathway. This kind of linked combination of source-pathway-receptor is described as a **pollutant linkage**.

This report presents a Phase 2 Conceptual Model and Quantitative Risk Assessments for the site, based on the proposed residential end use.

9.2 Hazard Identification

9.2.1 Potential Contamination Sources

Historically the site has been open fields with development of residential properties adjacent to the site boundaries. Therefore potential risks of on-site contamination were identified as any possibly contaminated soils associated with historical farming over the years. Potential off-site sources of contamination have been identified as possible accumulations of ground gases associated with the Made Ground around the Reservoir, and also the historical allotment gardens mapped nearby.

No elevated levels of contaminants were however identified. A summary of potentially significant sources of contamination encountered are presented in Table 9.1.

Table 9.1 Summary of Contaminant Sources & Contaminants

Structure / Process	Contaminants Present on Site
Shallow Soils	<ul style="list-style-type: none"> • No elevated levels of soil contamination • No elevated levels of Carbon Dioxide or Methane

9.2.2 Potential Receptors

The following are considered as potential receptors in relation to the current and proposed use of the site.

- **Future Residential users** – Female child aged 0-6 years using communal gardens;
- **Utility / Construction / Demolition / Site Investigation workers** – Workers undertaking routine / non-routine work involving ground disturbance works and maintenance of below ground services (assuming workers are only wearing standard construction / utility worker PPE);

- Underlying **Aquifer** – Underlying bedrock
- **New potable water supply pipes**
- **Ingress of ground gases into structures**

9.2.3 Potential Contamination Pathways

The following are considered plausible contamination pathways given the nature of the site and the potential contaminative sources identified, and assuming a continued current use.

- Dermal contact and ingestions of soils;
- Inhalation of dust/fibres and vapours;
- Ingestion of home grown produce; and
- Risk from ground gases, asphyxiation or explosion.

9.2.4 Quantitative Risk Assessment

By considering the sources, pathways and receptors, an assessment of the environmental risks is made with reference to the significance and degree of the risk. This assessment is based on consideration of whether the source contamination can reach a receptor and hence whether it is of major or minor significance.

An initial conceptual model of the source-pathway-receptor linkages has been developed based on the information derived from the Phase I Desk Study and this intrusive investigation. The Conceptual Site Model has been used to identify Relevant Pollutant Linkages for the current and proposed end uses which have been assessed quantitatively and qualitatively using CIRIA 552 guidance, as described in Table 9.2 and Table 9.3.

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Table 9.2 Methodology for Assessing Consequence of Harm

Consequence	Criteria
Severe	Short term (acute) risk to Human Health likely to result in “significant harm” as defined by the Environmental Protection Act 1990, Part IIa. Short term risk of pollution of sensitive water resource. Catastrophic damage to buildings / property
Moderate	Chronic damage to Human Health likely, over a long term, to result in “significant harm” as defined by the Environmental Protection Act 1990, Part IIa. Pollution of sensitive water resources
Mild	Health effects to Human Health that are unlikely to result in “significant harm” as defined by the Environmental Protection Act 1990, Part IIa. Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings / structures / services or the environment
Negligible	Non-permanent health effects to Human Health that are unlikely to result in “significant harm” as defined by the Environmental Protection Act 1990, Part IIa. Those that are easily prevented by means such as personal protective clothing. Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve.

Table 9.3 Methodology for Assessing Likelihood of Consequence Occurring

Probability	Criteria
Almost Certain	Circumstances are such that an event either appears very likely in the short term and almost inevitable over the long term or there is evidence of currently harm occurring
Likely	Circumstances are such that an event, whilst not inevitable, is possible in the short term and is likely to occur over the long term
Unlikely	Circumstances are such that it is possible an event could occur, but it is by no means certain to occur even over a longer period, and it is less likely in the shorter term
Very Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable even in the medium to long term
Extremely Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are highly improbable even in the long term

The risk assessment table and apportioned scores presented in Table 9.4 are in general accordance with CIRIA 552. The main exception is that irreversible risks to human health are considered to have a severe consequence irrespective of whether the effects are chronic or acute in nature.

Table 9.4 Comparison of Consequence and Likelihood

Consequence Probability	Severe	Moderate	Mild	Negligible
Almost Certain	Very High Risk	High Risk	Moderate Risk	Low Risk
Likely	High Risk	Moderate Risk	Moderate/ Low Risk	Low Risk
Unlikely	Moderate Risk	Moderate/ Low Risk	Low Risk	Very Low Risk
Very Unlikely	Low Risk	Low Risk	Very Low Risk	Very Low Risk
Extremely Unlikely	Very Low Risk	Very Low Risk	Very Low Risk	Very Low Risk

The categories of risk are defined as follows:

Very High Risk: There is a probability that severe harm is almost certain to arise to a designated receptor from an identified source, or there is evidence that severe harm to a designated receptor is currently occurring.

High Risk: There is a probability that severe harm is likely to arise to a designated receptor from an identified source, or there is a probability that moderate harm is almost certain to arise.

Low Risk: There is a possibility that harm could arise to a designated receptor from an identified source, but it is likely that this harm, if realised, would be mild at worst.

Very Low Risk: There is a very low possibility that harm could arise to the receptor, but it is likely that this harm, if realised, would be mild at worst.

In accordance with CLR11, professional judgement has been employed to evaluate the risk on a qualitative basis using available information.

A summary of the pollution linkages is provided in Table 9.5

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Table 8.5 Conceptual Site Model

Source	Receptor	Pathway	Risk	Pollutants Encountered/Chemicals of Concern	Remedial Option(s)/Next Steps
<p>On Site:</p> <p>Possible Soil Contaminants</p> <p>Ground Gases</p>	Residential Homeowners	<ul style="list-style-type: none"> • Dermal contact or ingestion contaminants in soil-derived dust and entrained surface water run-off from areas where soil is exposed at the surface or where excavation takes place and in shallow groundwater in the natural strata if excavation takes place below the water table. • Inhalation of contaminants in soil derived dust from areas where soil is exposed at the surface of where excavation takes place. 	Low	No elevated levels of soil contamination measured above the allowable SGV.	No further works required.
	Construction Workers		<ul style="list-style-type: none"> • Inhalation of soil and water derived vapours and ground gas outdoors • Inhalation of soil derived, and water derived vapours and ground gas indoors where it may have accumulated in buildings and enclosed spaces. 	Low	
	Groundwater within the underlying superficial soils and bedrock	<ul style="list-style-type: none"> • Leaching of contaminants and/or migration of free phase contaminants from the unsaturated zone soils to groundwater in the natural strata • Vertical migration of contaminants in shallow groundwater to deeper strata and aquifer. 	Low	No Further Assessment Required	
	Surface Water	<ul style="list-style-type: none"> • Lateral migration of contaminants and/or migration of free phase contaminants present in the Made Ground via groundwater to surface water discharge • Lateral migration of contaminants and/or migration of free phase contaminants present in the Made Ground and entrained in surface water runoff 	Low	No Further Assessment Required	

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	Building	<ul style="list-style-type: none"> Accumulation of soil and water derived vapours/and or ground gas in enclosed spaces 	Low	No elevated levels of ground gas	No ground gas protective measures necessary
	Potable Water Supply Routes	<ul style="list-style-type: none"> Migration of contaminants into newly placed potable water supply routes 	Low	No elevated levels of Heavy Metals in the shallow soils	No further measures required

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9.3 Discussion of Risks

The risk assessment presented in the above sections and summarised within the CSM presented in Table 9.5 shows that Contaminant Linkages have been identified at the site from on-site sources. The following sections provide a discussion of the environmental risks based on the ground investigation and laboratory data.

9.3.1 Human Health

Proposed property users

The ground investigation and laboratory testing showed that no elevated levels of soil contamination was measured on site. Additionally no elevated levels of ground gases were recorded. Therefore no remedial measures necessary.

Therefore, the current risks to human health has currently been assessed to be **LOW**

Utility / Construction / Demolition / Site Investigation (i.e. Ground Disturbance) Workers

The probability of contact with contaminated soils increases for workers involved with ground excavation (e.g. during development, site investigation or maintenance works). However, due to the exposure time to contaminants on site and the assumption that appropriate PPE will be worn the risks to site operatives is considered **LOW**.

9.3.2 Aquifer

The risks to the underlying aquifer has been assessed to be **LOW**.

9.3.3 Surface Water

The risk of contaminants to controlled waters is considered to be **LOW**.

9.3.4 Potable Water Supply Pipes

The current risk to proposed new utility routes is **LOW**, due to the absence of any identified contaminants in the soils.

9.3.5 Buildings

Ground gas monitoring identified no elevated levels of Carbon Dioxide or Methane and therefore no ground gas protective measures are required. The risk of ground gases into the new building are therefore currently considered to be **LOW**.

10.0 CONCLUSIONS AND RECOMMENDATIONS

Potential on-site sources of contamination were identified as possibly contaminated soils associated with historical farming and from possible Made Ground associated with construction of adjacent houses. Possible off-site sources of ground gases were identified due to nearby allotment gardens and backfilling of areas around the reservoir near to the site.

An intrusive investigation was therefore carried out across the site comprising four Windowless Sample Boreholes to allow for collection of shallow soil samples to be tested for a range of soil contaminants in addition to installation of ground gas monitoring standpipe to allow for a ground gas assessment.

Soil contamination testing was carried out and no elevated levels of contaminants were recorded within any of the samples tested. No remedial measures will therefore be required.

Upon carrying out ground gas and groundwater monitoring, it was evident that no elevated levels of ground gases were measured, and therefore no ground gas protective measures are required. Additionally no groundwater was encountered.

Shallow strip or pad footings placed into the underlying stiff clays at a depth of around 1.00m will suffice for the proposed new buildings, where an allowable bearing pressure in the region of 120kPa could be achieved.

Although no elevated levels of soil contamination was identified, it is recommended that in any proposed soft landscaped garden area, any Made Ground soils should be replaced with clean imported topsoil.

Phase II Interpretative Report

11.0 REFERENCES

- BRE Special Digest 1:2005: Concrete in aggressive ground, BRE Construction Division
- BS 5930: (2015): Code of Practice for Site Investigation. British Standards Institution
- BS 10175: (2011): Code of Practice for the Investigation of Potentially Contaminated Sites. British Standards Institution
- BS 8485: (2015); Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings
- CIRIA Special Publication (2002) Construction over abandoned mine workings.
- CIRIA C665 (2007) Assessing risks posed by hazardous ground gases to buildings
- CL:AIRE (2013) SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination
- DEFRA and Environment Agency (2004) Model Procedures for the Management of Land Contamination, R&D Publication CLR11.
- Environment Agency (2009) CLEA Software (Version 1.06) Handbook, Scientific Report SC050021/SR4
- Environment Agency (2009) Updated technical background to the CLEA Model, Scientific Report SC050021/SR3
- Environment Agency (2000) Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination, R&D Technical Report P5-066/TR.
- Interim Advice Note 73/06 (2009) Design Guidance for Road Pavement Foundations, Draft HD25.
- Meyerhof, G (1957) The Ultimate Bearing Capacity of Foundations on Slopes, Proceedings of the 4th International Conference, Vol. 3, pp. 384 – 386.

Phase II Interpretative Report

- Ministry of Agriculture, Fisheries and Food (1998) Code of Good agricultural Practice for the Protection of Soil. MAFF Publications, London
- Nathanail, C.P., McCafferey. C., Gillett, A., Ogden, R.C., and Nathanail, J.F. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham.
- NHBC (2007) Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present, Report Edition No. 4.
- NHBC (2008) Guidance for the Safe Development of Housing on Land Affected by Contamination.
- NHBC (2022) Part 4 Building Near Trees



Boreholes



Project: Whitley Lower			Type: Windowless Sampling	Hole Number: WS01	
Date: 30 th January 2024				Terrier Rig Used	Sheet Number: 1 of 4
TESTS			SAMPLES	STRATA	
Depth (m)	Test type and depth (m)	Test Result	Sample type and depth (m)	Thickness (m)	Description
0.00 – 0.25	-	-	ES1@0.10	0.25	Brown clayey TOPSOIL
0.25 – 1.50	-	-	-	1.25	Orange, grey, brown slightly sandy CLAY
1.50 – 2.00	-	-	-	0.50	Brown clayey MUDSTONE
General Remarks					
<ul style="list-style-type: none"> • No groundwater encountered • Standpipe Installed. 0.50m plain pipe, 1.50m slotted • Samples: ES = Environmental Sample. D = Disturbed Geotechnical Sample. B = Bulk Sample. • Tests: HV = Hand Vane. CBR = Insitu CBR Test. SPT = Standard Penetration Test 					

Project: Whitley Lower			Type: Windowless Sampling	Hole Number: WS02	
Date: 30 th January 2024				Terrier Rig Used	Sheet Number: 2 of 4
TESTS			SAMPLES	STRATA	
Depth (m)	Test type and depth (m)	Test Result	Sample type and depth (m)	Thickness (m)	Description
0.00 – 0.25	-	-	ES1@0.20	0.25	Brown clayey TOPSOIL
0.25 – 1.50	-	-	-	1.25	Orange, grey, brown slightly sandy CLAY
1.50 – 2.00	-	-	-	0.50	Brown clayey MUDSTONE
General Remarks					
<ul style="list-style-type: none"> • No groundwater encountered • Standpipe Installed. 0.50m plain pipe, 1.50m slotted • Samples: ES = Environmental Sample. D = Disturbed Geotechnical Sample. B = Bulk Sample. • Tests: HV = Hand Vane. CBR = Insitu CBR Test. SPT = Standard Penetration Test 					

Project: Whitley Lower			Type: Windowless Sampling	Hole Number: WS03	
Date: 30 th January 2024				Terrier Rig Used	Sheet Number: 3 of 4
TESTS			SAMPLES	STRATA	
Depth (m)	Test type and depth (m)	Test Result	Sample type and depth (m)	Thickness (m)	Description
0.00 – 0.25	-	-	-	0.25	Brown clayey TOPSOIL
0.25 – 1.50	-	-	0.40	1.25	Orange, grey, brown slightly sandy CLAY
1.50 – 2.00	-	-	-	0.50	Brown clayey MUDSTONE
General Remarks					
<ul style="list-style-type: none"> • No groundwater encountered • Standpipe Installed. 0.50m plain pipe, 1.50m slotted • Samples: ES = Environmental Sample. D = Disturbed Geotechnical Sample. B = Bulk Sample. • Tests: HV = Hand Vane. CBR = Insitu CBR Test. SPT = Standard Penetration Test 					

Project: Whitley Lower			Type: Windowless Sampling	Hole Number: WS04	
Date: 30 th January 2024				Terrier Rig Used	Sheet Number: 4 of 4
TESTS			SAMPLES	STRATA	
Depth (m)	Test type and depth (m)	Test Result	Sample type and depth (m)	Thickness (m)	Description
0.00 – 0.25	-	-	ES1@0.15	0.25	Brown clayey TOPSOIL
0.25 – 1.50	-	-	-	1.25	Orange, grey, brown slightly sandy CLAY
1.50 – 2.00	-	-	-	0.50	Brown clayey MUDSTONE
General Remarks					
<ul style="list-style-type: none"> • No groundwater encountered • Samples: ES = Environmental Sample. D = Disturbed Geotechnical Sample. B = Bulk Sample. • Tests: HV = Hand Vane. CBR = Insitu CBR Test. SPT = Standard Penetration Test 					

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 24/01031
Issue Number: 1
Date: 19 February, 2024

Client: RB Geotechnical
7 Carr Manor View
Leeds
UK
LS17 5AG

Project Manager: Ross Blake
Project Name: Whitley
Project Ref: Not specified
Order No: N/A
Date Samples Received: 31/01/24
Date Instructions Received: 02/02/24
Date Analysis Completed: 17/02/24

Approved by:



Richard Wong
Client Manager

Envirolab Job Number: 24/01031

Client Project Name: Whitley

Client Project Ref: Not specified

Lab Sample ID	24/01031/1	24/01031/2	24/01031/3	24/01031/4				Units	Limit of Detection	Method ref
Client Sample No	1	2	3	4						
Client Sample ID	WS01	WS02	WS03	WS04						
Depth to Top	0.10	0.20	0.40	0.15						
Depth To Bottom										
Date Sampled	30-Jan-24	30-Jan-24	30-Jan-24	30-Jan-24						
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES						
Sample Matrix Code	4E	4E	3	4						
% Stones >10mm _A	<0.1	<0.1	<0.1	<0.1						
Cyanide (free) _A ^{M#}	<1	<1	<1	<1				mg/kg	1	A-T-042sFCN
Cyanide (total) _A ^{M#}	<1	<1	<1	<1				mg/kg	1	A-T-042sTCN
Arsenic _D ^{M#}	13	19	4	18				mg/kg	1	A-T-024s
Cadmium _D ^{M#}	0.5	0.7	<0.5	0.7				mg/kg	0.5	A-T-024s
Copper _D ^{M#}	25	33	12	29				mg/kg	1	A-T-024s
Chromium _D ^{M#}	18	21	20	24				mg/kg	1	A-T-024s
Lead _D ^{M#}	50	58	23	59				mg/kg	1	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17				mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	13	17	13	19				mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	<1	1	1				mg/kg	1	A-T-024s
Zinc _D ^{M#}	103	105	81	96				mg/kg	5	A-T-024s
TPH total (>C6-C40) _A ^{M#}	54	78	<10	29				mg/kg	10	A-T-007s

Envirolab Job Number: 24/01031

Client Project Name: Whitley

Client Project Ref: Not specified

Lab Sample ID	24/01031/1	24/01031/2	24/01031/3	24/01031/4				Units	Limit of Detection	Method ref
Client Sample No	1	2	3	4						
Client Sample ID	WS01	WS02	WS03	WS04						
Depth to Top	0.10	0.20	0.40	0.15						
Depth To Bottom										
Date Sampled	30-Jan-24	30-Jan-24	30-Jan-24	30-Jan-24						
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES						
Sample Matrix Code	4E	4E	3	4						
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD						A-T-045
Asbestos Matrix (visual) _D	-	-	-	-						A-T-045
Asbestos Matrix (microscope) _D	-	-	-	-						A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	N/A	N/A						A-T-045

Envirolab Job Number: 24/01031

Client Project Name: Whitley

Client Project Ref: Not specified

Lab Sample ID	24/01031/1	24/01031/2	24/01031/3	24/01031/4				Units	Limit of Detection	Method ref
Client Sample No	1	2	3	4						
Client Sample ID	WS01	WS02	WS03	WS04						
Depth to Top	0.10	0.20	0.40	0.15						
Depth To Bottom										
Date Sampled	30-Jan-24	30-Jan-24	30-Jan-24	30-Jan-24						
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES						
Sample Matrix Code	4E	4E	3	4						
PAH-16MS										
Acenaphthene _A ^{M#}	0.01	0.03	<0.01	<0.01				mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	0.01	<0.01	<0.01				mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	0.06	0.06	<0.02	<0.02				mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.37	0.53	<0.04	0.16				mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.44	0.61	<0.04	0.17				mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.44	0.64	<0.05	0.19				mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	0.28	0.35	<0.05	0.11				mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	0.17	0.24	<0.07	<0.07				mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	0.42	0.57	<0.06	0.20				mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A	<0.04	0.07	<0.04	<0.04				mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	0.61	0.85	<0.08	0.28				mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	<0.01	0.01	<0.01	<0.01				mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.31	0.40	<0.03	0.12				mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	<0.03				mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	0.21	0.25	<0.03	0.11				mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	0.57	0.79	<0.07	0.25				mg/kg	0.07	A-T-019s
Total PAH-16MS _A	3.89	5.41	<0.08	1.59				mg/kg	0.01	A-T-019s

Report Notes

General

This report shall not be reproduced, except in full, without written approval from Envirolab.
 The results reported herein relate only to the material supplied to the laboratory.
 The residue of any samples contained within this report, and any received within the same delivery, will be disposed of **four weeks** after the initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of **six months** after the initial Asbestos testing is completed.
 Analytical results reflect the quality of the sample at the time of analysis only.
 Opinions and Interpretations expressed are outside our scope of accreditation.
 The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client.
 A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Key

Superscript "#"	Accredited to ISO 17025
Superscript "M"	Accredited to MCertS
Superscript "U"	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript "A"	Analysis performed on as-received Sample
Subscript "D"	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript "A"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
N/A	Not applicable

Asbestos

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
 Stones etc. are not removed from the sample prior to analysis
 Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing, and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5	SAND/CLAY			E	Contains roots / twigs

Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.

Soil Chemical Analysis:

All results are reported as dry weight (<40°C).
 For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
 For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts
 All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH by method A-T-007:

For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.
 Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:

EPH CWG results have humics mathematically subtracted through instrument calculation.
 Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

Electrical Conductivity of water by method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the accreditation range and as such are unaccredited.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: RB Geotechnical, 7 Carr Manor View, Leeds, UK, LS17 5AG

Project No: 24/01031

Project: Whitley

Date Received: 02/02/2024 (am)

Clients Project No:

Cool Box Temperatures (°C):

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples $5 \pm 3^{\circ}\text{C}$), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	24/01031/1	24/01031/2	24/01031/3	24/01031/4
Client Sample No	1	2	3	4
Client Sample ID/Depth	WS01 0.10m	WS02 0.20m	WS03 0.40m	WS04 0.15m
Date Sampled	30/01/24	30/01/24	30/01/24	30/01/24
A-T-007s	13/02/2024	13/02/2024	13/02/2024	13/02/2024
A-T-019s	14/02/2024	14/02/2024	14/02/2024	14/02/2024
A-T-024s	17/02/2024	17/02/2024	17/02/2024	17/02/2024
A-T-042sFCN	15/02/2024	15/02/2024	15/02/2024	15/02/2024
A-T-042sTCN	15/02/2024	15/02/2024	15/02/2024	15/02/2024
A-T-044	12/02/2024	12/02/2024	12/02/2024	12/02/2024
A-T-045	08/02/2024	08/02/2024	08/02/2024	08/02/2024

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

GAS MONITORING RESULTS

Date	Hole	Flow Range (L/hr)	CH4 (% v/v)		CO2 (% v/v)		O2 (% v/v)		Atmospheric Pressure (Mb)	Pressure Pattern	Groundwater Level
			Peak	Steady	Peak	Steady	Peak	Steady			
3 rd February 2024	WS01	0.00-0.10	0.00	0.00	1.00	1.00	17.90	17.90	975	Rising	Dry
	WS02	0.00 - 0.10	0.00	0.00	0.20	0.20	18.20	18.20	975	Rising	Dry
	WS03	0.00 – 0.10	0.00	0.00	0.60	0.60	18.10	18.10	975	Rising	Dry
13 th February 2024	WS01	0.00-0.10	0.00	0.00	0.90	0.90	18.90	18.90	1007	Steady	Dry
	WS02	0.00 - 0.10	0.00	0.00	0.10	0.10	18.00	18.00	1007	Steady	Dry
	WS03	0.00 – 0.10	0.00	0.00	0.50	0.50	18.20	18.20	1007	Steady	Dry
19 th February 2024	WS01	0.00-0.10	0.00	0.00	0.80	0.80	18.90	18.90	1005	Steady	Dry
	WS02	0.00 - 0.10	0.00	0.00	0.10	0.10	18.00	18.00	1005	Steady	Dry
	WS03	0.00 – 0.10	0.00	0.00	0.00	0.00	18.20	18.20	1006	Steady	Dry
26 th February 2024	WS01	0.00-0.10	0.00	0.00	0.70	0.70	17.90	17.90	1021	Rising	Dry
	WS02	0.00 - 0.10	0.00	0.00	0.00	0.00	18.30	18.30	1021	Rising	Dry
	WS03	0.00 – 0.10	0.00	0.00	0.60	0.60	19.20	19.20	1021	Rising	Dry
8 th March 2024	WS01	0.00-0.10	0.00	0.00	0.80	0.80	18.90	18.90	1006	Falling	Dry
	WS02	0.00 - 0.10	0.00	0.00	0.10	0.10	17.00	17.00	1006	Falling	Dry
	WS03	0.00 – 0.10	0.00	0.00	0.50	0.50	19.30	19.30	1006	Falling	Dry
14 th March 2024	WS01	0.00-0.10	0.00	0.00	1.10	1.10	17.90	17.90	984	Rising	Dry
	WS02	0.00 - 0.10	0.00	0.00	0.10	0.10	18.00	18.00	984	Rising	Dry
	WS03	0.00 – 0.10	0.00	0.00	0.70	0.70	19.10	19.10	984	Rising	Dry