

PROPOSED DEVELOPMENT AT HUNTER STREET, BRITON FERRY

REMEDIATION STRATEGY REPORT

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CONTENTS

0.0	FOREWORD	3
1.0	INTRODUCTION	4
1.1	General	4
1.2	Aims & Objectives of Report	4
2.0	BACKGROUND	5
2.1	Overview of Proposed Scheme	5
2.2	Site Location and Description	5
2.3	Past Studies	6
3.0	REMEDIATION STRATEGY	10
3.1	Derivation of Remediation Strategy	10
3.2	Summary of Risks	10
3.3	Remediation Design	11
3.4	General Contaminated Land Risk	18
3.5	Unexpected Contamination – General Advice	20
3.6	Verification of Remediation Works	21
4.0	GENERAL CONSIDERATIONS FOR REMEDIATION WORKS	23
4.1	General	23
4.2	Health and Safety Requirements	23
4.3	Environmental Requirements	23
5.0	REFERENCES	24

APPENDICES

APPENDIX I – PROPOSED DEVELOPMENT PLANS	25
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0.0 FOREWORD

The following Report is based on information gained from previous studies undertaken in relation to the site, supplemented by information and data provided by the Client in support of this Remediation Strategy Report.

Quantum Geotechnic Ltd have provided the Client with Consultancy support during these works, relating to the Intrusive Ground Investigation Interpretive Reports. Where referenced, past studies in relation to the site should be read in conjunction with this Report.

1.0 INTRODUCTION

1.1 General

Upon the instructions of Robert Bowen Planning and Development Ltd on behalf of the Client, Mr H Singh, Quantum Geotechnic Limited (QGL) has been commissioned to undertake a Remediation Strategy Report in relation to the proposed Nursing Home Development on Hunter Street, Briton Ferry.

As part of the Planning Conditions set out by the Local Planning Authority, this Report is produced to satisfy Planning Condition #8 which reads;

'Prior to the commencement of work on site a remediation scheme to bring the site to a condition suitable for the intended use by removing any unacceptable risks to human health, buildings, other property and the natural and historical environment shall be prepared and submitted to and agreed in writing with the Local Planning Authority. The scheme shall include all works to be undertaken, proposed remediation objectives, remediation criteria and site management procedures. The measures proposed within the remediation scheme shall be implemented in accordance with an agreed programme of works.'

Reason:

'To ensure that risks from land contamination to the future users of the land and neighbouring land are minimised, together with those to controlled waters, property and ecological systems, and to ensure that the development can be carried out safely without unacceptable risks to workers, neighbours and other offsite receptors.'

The following Report provides an overview of any past studies undertaken, and the methods or mechanism by which to either remove or reduce these risks to acceptable levels for the end-use receptors of the premises.

1.2 Aims & Objectives of Report

This Remediation Strategy updates the conceptual site model produced in both the 2019 and 2020 intrusive ground investigations (QGL Report Ref: G40104/IR and G40104/LR01Rev03) and outlines the proposed remedial measures to be implemented as the basis for a Remediation Method Statement.

The Remediation Strategy should be read in conjunction with the documents listed which are summarised in Section 2.3 of this Report.

2.0 BACKGROUND

2.1 Overview of Proposed Scheme

At time of writing, development proposals include the construction of a Nursing Home. The proposed building is to occupy the majority of the site with a parking area in the south eastern area of the site and a garden / soft landscaping in the western area of the site. A development proposal plan is presented within Appendix I.

2.2 Site Location and Description

The area under investigation lies within the former surgery, carpark and grassed area to the rear of the surgery, Hunter Street, Briton Ferry. The site comprises an irregular shaped parcel of land approximately 80m by 45m. The proposed site is currently a derelict former surgery, flat level carpark and with a flat (approximately 15m by 20m) grassed area to the rear of the building.

The approximate National Grid Reference of the site is SN 274093, 194193 with the nearest postcode being SA11 2SF. The area to which this Remediation Strategy relates is outlined for ease of reference in Figure 1 below with an aerial photograph of the site as Figure 2.

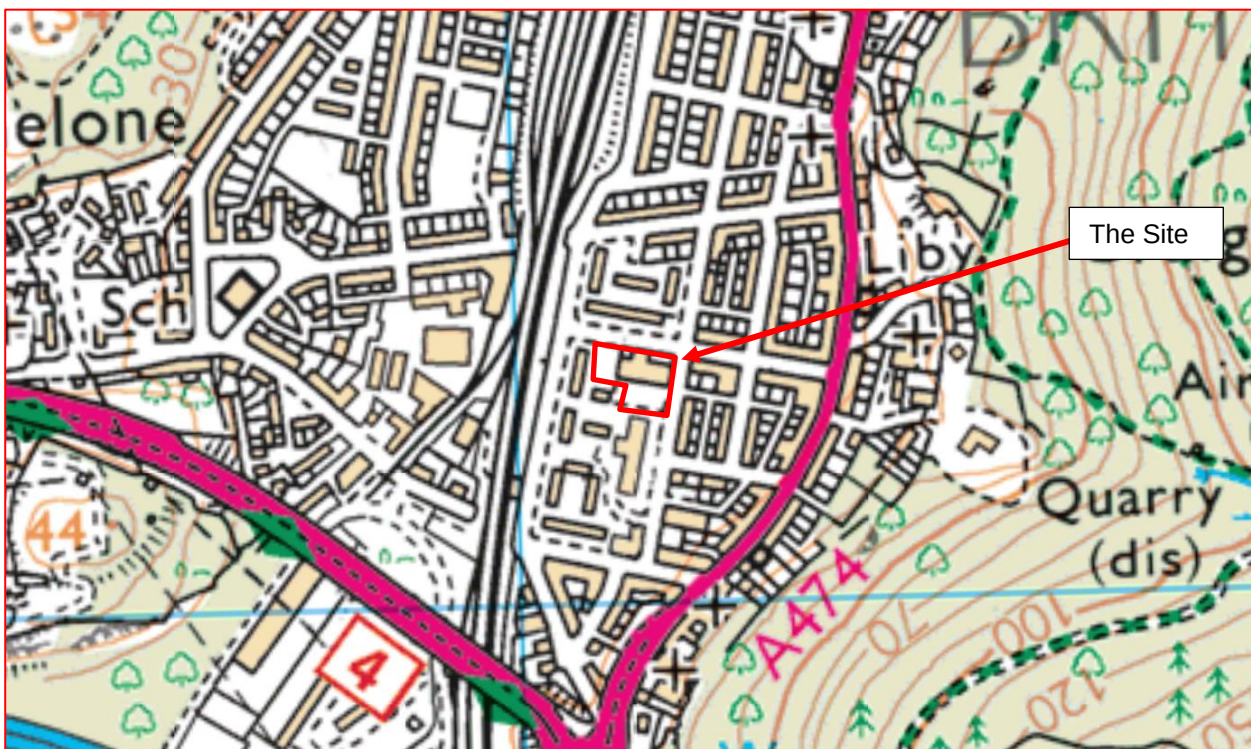


Figure 1: Site location indicating area under investigation. *Not to Scale* ©Bing



Figure 2: Aerial Ordnance Survey photograph of existing premises. *Not to Scale*

2.3 Past Studies

The site has been subject to a Phase 1 Desk Study undertaken by Phlorum, an initial intrusive ground investigation and an additional intrusive ground investigation once the demolition of the pre-existing building had been completed, both undertaken by QGL, as part of the ongoing process of contaminated land risk identification in order to derive a suitable Remediation Strategy.

Section 2.3.1 provides a synopsis of this previous studies highlighting the pertinent findings of the investigation and subsequent laboratory testing and risk assessments in relation to human health and the environment (controlled waters). This summary should be read in conjunction with the above reports to provide a comprehensive understanding and rationale behind the Remediation Strategy proposed within this Report;

2.3.1. Summary of Past Study Findings

Phlorum Phase 1 Investigation (2017)

Pertinent conclusions are provided below: In summary the Phlorum Phase 1 report written in Nov 2017 did not identify any specific / localised sources of contamination other than possible gas / air storage tanks associated with patient treatment within the existing building and fuel spillages within the car parking area.

The geological records indicate that the geology below the site is Rhondda Member Sandstone – Sandstone of Westphalian Age. The aquifer within the superficial deposits is designated as Secondary. The site is not within a Radon Protection Area as less than 1% of the properties are above the action level.

As the site is located within 100m of a nearby railway line it is expected that some historic contamination could exist in this area. The oldest available maps already show houses built near the line, along Railway Terrace, but it is possible that some historic contamination predates these houses. Both the sites most recent use and historic use dictate that it is unlikely that the site suffers from any major causes of contamination. Any contamination which may be uncovered during works is likely to be minimal and localised, such as finding an old air tank from inside the medical centre.

Identified receptors include future users of the site, the secondary aquifer beneath the site and the nearby residents and businesses. The future use of the site as a forty-bed nursing home has a Very Low contamination risk, as both the future use and historic use of the site has been either for residential properties or as a pub and a hall. The potential risks to the current or proposed future users of the site from any off-site contamination sources, either current or historical, are considered to be Low, due to the site being surrounded by a predominantly residential area. The Very High risk by Asbestos inhalation is very likely to be reduced by further surveying and best practice management of the construction and refurbishment process.

On the basis of the above they consider the risk of contamination at the site is Low. However, to confirm this they recommended that an initial site investigation is carried out. This would involve a rig/excavator and analysis of soil samples. We would also recommend that an asbestos survey is carried out of the site.

Quantum Geotechnical Ltd Ground Investigation & Mining Risk Assessment, Ref: G40104/IR (2019)

This intrusive investigation comprised a series of Trial Pits, Cable Percussive Boreholes and Dynamic Probing. Access was restricted due to the presence of a pre-existing building.

In summary, the intrusive ground investigation encountered Made Ground across the site to depths of up to 2.10mbgl. The Made Ground was found to be underlain by Peat and Alluvial Deposits to depths of up to 10.8 mbgl overlying dense Gravel.

In terms of contamination and risk to human health, there is the potential that concentrations of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene and Dibenzo(a,h)anthracene within the Made Ground deposits may pose a significant risk to future site users.

Although no statistical analysis was undertaken, the spread of potentially significantly elevated contaminant concentrations within the Made Ground was considered to be site wide. The PID measurements recorded indicate volatiles are unlikely to pose a risk to future site users.

The report recommended additional exploratory holes are undertaken post demolition / when access is available to the entire site, and additional sampling, testing and analysis undertaken to determine if any identified potential contamination sources and associated risk to receptors are present in areas of the site not previously investigated due to the access restrictions.

In terms of risk to controlled waters, the single soil leachate test undertaken identified potentially significantly raised Copper concentration within the soil leachate from the sample of Made Ground from Trial Pit TP01. Although the concentration of Copper measured within the soil leachate from the Made Ground within TP01 only slightly exceeded the relevant EQS value, it may pose a risk to nearby controlled waters.

The investigation identified the risk from ground gases within the Made Ground and Alluvial Deposits (Peat, Silt and Clay) as being very low to low.

Quantum Geotechnic Ltd Geo-environmental Assessment, Ref: G40104/LR01Rev03 (2020)

This intrusive investigation comprised a series of Trial Pits and a Cable Percussive Boreholes, predominately across areas not previously investigated due to access restrictions.

In summary a regime of contaminated land testing of soils and soil leachates was undertaken, the results of which were used in a human health risk assessment and environmental assessment to identify unacceptable risks.

Several potential Heavy Metal and Polycyclic Aromatic Hydrocarbons (PAH) contaminants were recorded above the relevant Human Health Risk assessment criteria, notably published Soil Guideline Values (SGV) and Generic Assessment Criteria (GAC). Concentrations were compared against Residential with Plant Uptake scenario. Asbestos fibres were encountered in the Made Ground within a single Trial Pit at a quantity that may pose a risk to human health.

The risk to controlled waters including the underlying Secondary aquifer were also assessed with potentially significantly elevated Copper concentrations were measured within the soil leachate of each of the samples of Made Ground tested. Potentially significantly elevated Lead concentration was measured within the soil leachate of the sample obtained from TP8.

In terms of risk from ground gas and given the proposed foundation solution recommended within the February 2019 report (a piled foundation bearing on the underlying Gravels), an assessment of the ground gas generation potential and subsequent risk from the deposits at depth was undertaken. Based on the ground gas monitoring findings, the risk classification of the Gravels at depth is classified as Moderate to High Risk.

Based on the above, Remedial Measures are deemed necessary for the development in terms of the presence of contaminated land and ground gas generation potential, the risks posed to human health and potential risks posed to the environment/ controlled waters.

3.0 REMEDIATION STRATEGY

3.1 Derivation of Remediation Strategy

The past studies have revealed that remediation is required in relation to contaminated land and contaminated land related issues. The revised Conceptual Model following the intrusive ground investigations and subsequent further testing based on the comparisons between the measured potential contaminant concentrations and the relevant assessment criteria concluded that the Made Ground present across the site may pose a significant health risk to future site users and should therefore be considered a potential contaminant source unless remedial or protective measures are undertaken.

It is important to note that the development will entail hardstanding across the majority of the site, with the only area of soft landscaping located in the western area of the site.

3.2 Summary of Risks

The investigation and testing to date has identified the following risks:

- Several potential Heavy Metal and PAH contaminants were measured above the relevant SGV and GAC assessment values.
- In terms of assessment against Residential End Use without plant uptake Arsenic concentrations within samples of Made Ground from TP4 (Aug 2020) at 0.5mbgl, TP6 (Aug 2020) at 0.5mbgl and TP8 (Aug 2020) at 1.0mbgl were above the relevant assessment criteria. The Lead concentration within sample of Made Ground from TP8 (Aug 2020) at 1.0mbgl was above the relevant assessment criteria.
- Benzo(b)fluoranthene and Benzo(a)pyrene concentrations within samples of Made Ground from TP3 (Aug 2020) at 0.5mbgl and TP8 (Aug 2020) at 1.0mbgl were above the relevant assessment criteria. Dibenzo(a,h)anthracene concentrations within samples of Made Ground from TP1 (Aug 2020) at 0.5mbgl, TP3 (Aug 2020) at 0.5mbgl and TP8 at 1.0mbgl were above the relevant assessment criteria.
- In addition, the February 2019 investigations measured concentrations of Benzo(a)anthracene in Trial Pit TP02 (Feb 2019), Benzo(a)pyrene Trial Pits TP02 (Feb 2019) and TP03 (Feb 2019), Benzo(b)fluoranthene Trial Pits TP02 (Feb 2019) and TP03 (Feb 2019) and Borehole BH02 (Feb 2019) and Dibenzo(a,h)anthracene Trial Pits TP01 (Feb 2019), TP02 (Feb 2019), TP03 (Feb 2019) and Borehole BH02 (Feb 2019), within the Made Ground, exceeded the relevant assessment criteria for Residential Land Use with plant uptake. Further analysis found the majority of these potential contaminants also exceed the assessment criteria for Residential Land Use without plant uptake.
- The Asbestos quantity measured within the sample of Made Ground within TP1 (Aug 2020) at 0.5mbgl is at a level that may pose a risk to human health.

- Based on the laboratory test results from both investigations, there is the potential the concentrations of Arsenic, Lead, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene and Dibenzo(a,h)anthracene and the quantity of Asbestos within the Made Ground may pose a significant risk to future site users.
- Potentially significantly elevated Copper concentrations were measured within the soil leachate of each of the samples of Made Ground tested. Potentially significantly elevated Lead concentration was measured within the soil leachate of the sample obtained from TP8 (Aug 2020).
- In addition, the single soil leachate test undertaken within the February 2019 investigation identified potentially significantly raised Copper concentration with the soil leachate from the sample of Made Ground from Trial Pit TP01 (Feb 2019). The concentration of Copper measured within the soil leachate from the Made Ground within TP01 (Feb 2019) only slightly exceeded the relevant EQS value.
- Therefore, based on the findings, the potential for leachate generation which may contain concentrations of Copper and Lead and may pose a risk to controlled waters. Given the extensive current and historical land uses in the area, the presence of relatively impermeable Alluvial deposits underlying the Made Ground and the absence of nearby surface water bodies, it is likely the impact of potential leachate generation from the Made Ground present on site on controlled waters is low.
- In addition, based on the findings of the QGL (Feb 2019) report, a piling foundation system is likely to be utilised within the proposed development. The piles would be required to extend through the Made Ground and soft Alluvial Deposits to found / bear on the underlying dense gravels and may potentially create a pathway between any soil leachate generated within the Made Ground and groundwater within the underlying Gravel. Consideration should be given to the proposed piling technique to minimise the potential for the creation of a contamination pathway.
- The February 2019 QGL investigation identified the risk from ground gases within the Made Ground and Alluvial Deposits (Peat, Silt and Clay) as being very low to low. Based on the ground gas monitoring findings, the risk classification of the Gravels at depth is classified as Moderate to High Risk.

Therefore, remedial strategies must be adopted to manage items the aforementioned risks and these are set out within Section 3.3.

3.3 Remediation Design

3.3.1 Risk 1: Elevated Polycyclic Aromatic Hydrocarbons (PAH) in Soils

Several soil samples recorded raised PAH based contaminants, all from the shallow lying Made Ground to a maximum depth of 1.0m. The Made Ground predominantly comprised black slightly clayey sandy Gravel with occasional man-made inclusions of brick, clinker and slag. Table 1 summarises the elevated PAH test

results recorded from the various intrusive investigations.

Quantum Geotechnical Ltd 2019				
Determinand	SGV / GAC Value Residential End Use with Plant Uptake (mg/kg)	SGV / GAC Value Residential End Use without Plant Uptake (mg/kg)	Site Result Value (mg/kg)	Location of Raised Contaminant
Benzo(a)anthracene	7.2	11	10	TP02 0.3-0.5mbgl
Benzo(a)pyrene	2.2	32	7.8 5.0	TP02 0.3-0.5mbgl TP03 0.3-0.5mbgl
Benzo(b)fluoranthene	2.6	3.9	15 9.1 2.9	TP02 0.3-0.5mbgl TP03 0.3-0.5mbgl BH02 0.5mbgl
Dibenz(a,h)anthracene	0.24	0.31	0.32 1.8 1.2 0.35	TP01 1.0mbgl TP02 0.3-0.5mbgl TP03 0.3-0.5mbgl BH02 0.5mbgl
Quantum Geotechnic Ltd 2020				
Determinand	SGV / GAC Value Residential End Use with Plant Uptake (mg/kg)	SGV / GAC Value Residential End Use without Plant Uptake (mg/kg)	Site Result Value (mg/kg)	Exceedances
Benzo(b)fluoranthene	2.6-3.7	3.9-4.0	5.0 4.7	TP3 at 0.5mbgl TP8 at 1.0mbgl
Benzo(a)pyrene	2.2-3.0	3.2	3.8 3.5	TP3 at 0.5mbgl TP8 at 1.0mbgl
Dibenz(a,h)anthracene	0.24-0.3	0.31-0.32	0.3 0.85 0.69	TP1 at 0.5mbgl TP3 at 0.5mbgl TP8 at 1.0mbgl

Note: SGV / GAC values vary depending on Organic Matter Content

Table 1: Summary of elevated soil contaminants.

The Made Ground identified as containing the raised PAH concentrations was located below the proposed building, in the proposed parking area and the area of soft landscaping in the western area of the site.

Risk 1 Remediation Measures:

Risk to be remediated through an effective capping system across the site.

It is therefore determined that the new build and hardstanding cover of the proposed car park will form a comprehensive capping barrier between the raised Polycyclic Aromatic Hydrocarbons within the Made Ground soils and the site end user.

Within the area of proposed soft landscaping a cover system with an appropriate thickness of clean soil should be installed. Based on BRE 465 'Cover Systems for Land Regeneration', the Cover System should be 520mm thick. This thickness may be reduced by the installation of a suitable geotextile / membrane to reduce potential mixing of the soils and to act as a physical barrier against dermal contact, creating an Engineered Cover System.

Suppliers should be consulted to ensure suitability for use with the known contaminants.

The Geotextile / membrane should be covered with a suitable thickness of Topsoil to allow future plant growth. The geotextile / membrane should be installed in accordance with the manufacturer's instructions and may require treatment of the subgrade material (compaction, removal of debris etc).

A quality assurance programme should be followed, comprising a combination of quality control testing and observations to an agreed quality assurance plan. The quality assurance should contain elements that verify the proposed subgrade is acceptable (if required), materials used in construction are adequate and the methods of construction are acceptable.

3.3.2 Risk 2: Elevated Heavy Metals in Soils

Several soil samples recorded raised Heavy Metal contaminants, all from the shallow lying Made Ground to a maximum depth of 1.0m from the Quantum Geotechnic Ltd 2020 investigation. The Made Ground predominantly comprised black slightly clayey sandy Gravel with occasional man-made inclusions of brick, clinker and slag. No potentially significantly elevated Heavy Metals were identified during the Quantum Geotechnical 2019 investigation. Table 2 summarises the elevated Heavy Metal test results recorded from the various intrusive investigations.

Quantum Geotechnic Ltd 2020				
Determinand	SGV / GAC Value Residential End Use with Plant Uptake (mg/kg)	SGV / GAC Value Residential End Use without Plant Uptake (mg/kg)	Site Result Value (mg/kg)	Exceedances
Arsenic	37	40	56 44 51	TP4 @ 0.5mbgl TP6 @ 0.5mbgl TP8 @ 1.0mbgl
Lead ⁽⁴⁾	200	310	370	TP8 @ 1.0mbgl

Table 2: Summary of elevated soil contaminants.

The Made Ground identified as containing the raised Heavy Metal concentrations was located below the proposed building.

Risk 2 Remediation Measures:

Risk to be remediated through an effective capping system which will comprise the new build structure. The Risk will be 'built-out' of the development through the construction process.

3.3.3 Risk 3: Asbestos Fibres in Soils

Loose fibrous debris asbestos in the form of Amosite was identified within one sample of Made Ground from TP1 (Aug 2020) at 0.5mbgl within the Quantum Geotechnic 2020 investigation, located below the existing hardstanding / former carpark in the southern area of the site. Asbestos quantification undertaken on the sample measured 0.011% fibres within the sample.

Risk 3 Remediation Measures:

Risk to be remediated through an effective capping system which will comprise the hardstanding cover of the proposed car park. The Risk will be 'built-out' of the development through the construction process.

3.3.4 Risk 4: Leachate Chemical Analysis in Soils

Each of the samples of Made Ground tested in the Quantum Geotechnical Ltd 2020 investigation and a single sample from the Quantum Geotechnical Ltd 2019 investigation recorded raised leachate based contaminants, all from the shallow lying Made Ground to a maximum depth of 1.00m. The Made Ground predominantly comprised black slightly clayey sandy Gravel with occasional man-made inclusions of brick, clinker and slag. Table 3 summarises the elevated Heavy Metal test results recorded from the various intrusive investigations.

Quantum Geotechnical Ltd 2019					
Determinand	Environmental Quality Standards – Freshwater (µg/l)	Environmental Quality Standards – Saltwater (µg/l)	UK Drinking Water Standards (µg/l)	Site Results Value (µg/l)	Location of Raised Contaminant
Copper	6	5	2000	14	TP01 at 0.3-0.5m
Quantum Geotechnical Ltd 2020					
Determinand	Environmental Quality Standards – Freshwater (µg/l)	Environmental Quality Standards – Saltwater (µg/l)	UK Drinking Water Standards (µg/l)	Site Results Value (µg/l)	Location of Raised Contaminant
Copper	1-28	5	2000	7.6 7.2 13	TP2 at 0.5mbgl TP6 at 0.5mbgl TP8 at 1.0mbgl
Lead	4 - 250	25	10	11	TP8 at 1.0mbgl

Table 3: Summary of elevated soil leachate contaminants.

Based on the findings, the potential for leachate generation which may contain concentrations of Copper and Lead and may pose a risk to controlled waters. Given the extensive current and historical land uses in the area, the presence of relatively impermeable Alluvial deposits underlying the Made Ground and the absence of nearby surface water bodies, and the removal of any pollutant linkage by the site being capped with hardstanding, it is considered that the impact of any potential leachate generation from the Made Ground present on site on controlled waters is low.

A piling foundation system is likely to be utilised within the proposed development. The piles would be required to extend through the Made Ground and soft Alluvial Deposits to found / bear on the underlying dense gravels and may potentially create a pathway between any soil leachate generated within the Made Ground and groundwater within the underlying Gravel.

The risk associated with the Made Ground below the proposed car park will be significantly reduced due to the impermeable hardstanding. The Risk below the proposed car park will be built-out of the development through the construction process.

The risk associated with the Made Ground below the proposed area of soft landscaping in the western area

of the site is considered low due to presence of the relatively impermeable Alluvium underlying the Made Ground.

Risk 4 Remediation Measures:

Consideration should be given to the proposed piling technique to minimise the potential for the creation of a contamination pathway below the proposed new build.

There is a body of evidence that demonstrates that driven piles through potentially contaminated Made Ground do not constitute or create an increased risk to controlled waters. The EA document Piling into Contaminated Sites (2002) gives advice on differing scenarios relating to potential hazards when piling on contaminated sites. This reference indicates that the use of displacement (driven) piles was considered most appropriate based on avoiding contamination arisings.

Furthermore, the use of displacement piles also results in local compaction of the soil surrounding the pile, generally leading to a reduction in permeability of the penetrated soil (Federation of Piling Specialists, 2000). The radial movement of the soil from the driving process will also create a stress field in the zone of influence that will tend to make the soil close up and 'seal' around the pile after driving is complete, especially in cohesive material (National Groundwater & Contaminated Land Centre Report NC/99/73).

The thickness of the cohesive layer that currently (in theory) acts as a barrier between the Made Ground and Gravels varies greater across the site and should be taken into account when designing the pile diameter as Environment Agency Report SC020074/SR states that a minimum thickness of 2 pile diameters of ductile or plastic clay will provide an effective seal.

In addition, the piles should be designed to minimise the low risk associated with slender piles taking material down in a blunt ended piling shoe with the use if a pointed driving shoe.

3.3.5 Risk 5: Risk to Potable Water Supply

The elevated hydrocarbons within the shallow soils may pose a risk to potable water supply pipes and therefore an assessment must be undertaken to determine the most appropriate pipe material for this scheme.

The pipe material assessment should be undertaken in accordance with UK Water Industry Research (UKWIR) document 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'. (Ref 10/WM/03/21; the 'UKWIR Guidance'). This document sets out the procedures by which an assessment should be undertaken to ensure that the correct materials are selected for water pipes and components to be used below ground in brownfield sites to protect the quality of the drinking water whilst taking into account the service life of the water distribution system.

Based solely on the chemical results obtained from the ground investigation for this scheme, it is recommended that Barrier Pipe material be utilised due primarily to the raised hydrocarbons within the soils.

3.3.6 Risk 6: Land Gas Emissions

The Quantum Geotechnical Ltd investigation identified the risk from ground gases within the Made Ground and Alluvial Deposits (Peat, Silt and Clay) as being very low to low (Characteristic Situation 1). However, given the foundation solution for the proposed new build is likely to be a piled foundation bearing on the underlying Gravels, which was found to have a significantly higher potential for gas generation, the site was classed as Characteristic Situation No. 4 (Moderate to High Risk), requiring gas protection remediation measures to be incorporated into any new build on site, based on CIRIA Report C665 and BS8485.

The results of the land gas monitoring show Methane (CH₄) concentrations of between 7 and 57.8%v/v and Carbon Dioxide (CO₂) concentrations of between 4.0 and 10.6%v/v. Methane concentrations were found to generally drop over the monitoring period. Maximum measured flow rate was recorded as 20.6l/hr whilst Oxygen (O₂) levels ranged between 3.7 and 10.5%v/v. No Hydrogen Sulphide (H₂S) or Carbon Monoxide (CO) was recorded.

The potential risks posed by any recorded presence of potentially harmful gases can be assessed on a semi-quantitative basis by reference to the guidance in documents CIRIA 665 and BS8485. The assessment comprises multiplying the maximum measured steady gas flow rate (expressed as litres per hour) by the maximum steady gas concentration (expressed as percentage-by-volume; divided by 100) to derive a Gas Screening Value (GSV). The GSV can then be used to determine a risk classification and a Characteristic Situation for the site as defined in the Table below.

Characteristic Situation	Risk Classification	Gas Screening Value (l/hr) – GSV
1	Very low	<0.07
2	Low	>0.07, <0.7
3	Moderate	>0.7, <3.5
4	Moderate to High	>3.5, <15
5	High	>15, <70
6	Very High	>70

Table 4: Gas Screening Value and Characteristic Situation Classification

The gas screening value is defined as a product of the gas concentration and gas flow, the worst case scenario being established from the highest of each. For a carbon dioxide value of 10.6%, and a gas flow value of 20.6 l/hr, then the gas screening value is 2.12 l/hr. The maximum methane value was 57.8% and, again using a flow rate of 20.6 l/hr, the gas screening value would be 11.9 l/hr. The gas screening value for the measured methane concentrations are within the range for Characteristic Situation 4 (after CIRIA R149), which is regarded as 'Moderate to High Risk'.

The general objective of gas protection measures is to break the source-pathway-receptor linkage by creating a barrier between the source and the receptor and forming a controlled pathway along which the gas can vent to the atmosphere. Such measures should be designed in accordance with British Standard BS8485: Code of Practice for the Characterisation and Remediation from Ground Gas in Affected Developments (BS 8485:2015). This standard uses a scoring system to rate the effectiveness of various construction techniques and specific gas protection measures. Typically, a combination of measures might be adopted to provide adequate gas protection.

Risk 6 Remediation Measures:

If a piled foundation system is to be used for the development, as indicated by the Client, this may potentially create a migration pathway from the Gravels (ground gas source) at depth up to the proposed development level.

Based on BS 8485, the proposed development is classified as a Type B Building characterised as *“private or commercial property with central building management control of any alterations to the building of its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas”*. Given the site is determined to be Characteristic Situation 4 and the proposed building type is Type B, the gas protection score for the site is 5.5. Based on the proposed use and the gas protection score, additional levels of protection will be required such as high-performance ventilation or pathway intervention measures, and an associated sustainable system of management or maintenance of the gas control system.

Considering the determined Characteristic Situation of the site (CS4) and the gas protection score (5.5) the following protective measures will be required, based on BS 8485:

Table 5: Protective measures requirements

Type and Use of Building	Minimum Score	Structural Barrier (score)	Ventilation / Dilution (score)	Gas Membrane (score)	Total achieved score
Building Type B	5.5	Reinforced concrete cast in-situ suspended slab with minimal service penetrations and water bars around all slab penetration and at joints (1.5)	Passive subfloor ventilation – ventilated void (very good performance) (2.5)	Propriety gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation (2)	6.0 (pass)

Notes: Ventilation performance to be assessed in accordance with Annex A of BS 8485 and CIRIA 149 based on proposed building design.

Poor ventilation is unacceptable. If very good performance is not possible subfloor ventilation with active abstraction / pressurisation would be required. Should include robust management systems to ensure the

continued maintenance of ventilation system.

Gas Membrane should have appropriate hydrocarbon resistant properties and should be installed to manufacturer's recommendations.

BS 8485:2007 should be consulted for guidance on possible alternative options.

The gas protection measures are to be installed by certified professionals (NVQ level 2) who should carry out appropriate integrity testing.

Validation of the membrane installation, floor slab installation and underfloor venting is required by an independent third party. This should include inspection during and post installation / construction, a photographic record of completed installation, post completion verification gas monitoring in underfloor voids and performance testing.

Following the installation / construction of the gas protection measures, membranes and potentially sensitive features should be protected after laying to avoid post installation damage. All membranes should be inspected immediately before they are covered up.

A verification report should be produced upon completion of installation / construction.

3.4 General Contaminated Land Risk

3.4.1 Construction Workers

The geo-environmental laboratory testing showed raised potential contamination concentrations within the Made Ground deposits, therefore a risk to construction operatives from chemical contaminants from the shallow ground may exist. In addition, given a single sample of Made Ground contained Asbestos fibres, a risk to construction workers and neighbouring site users will exist from air borne migration.

Operatives working with, or likely to come into contact with Made Ground with the potential to harness raised concentrations of contaminants, should observe particular precautions concerning personal hygiene. They should be issued with the appropriate personal protective equipment and should be instructed in safe working methods.

The potential exists for asbestos fibres to be present across the site that may pose a risk to human health. Further detail regarding working on potentially Asbestos contaminated soils/ sites is provided in Section 3.4.2.

3.4.2 Asbestos Mitigation Measures

The presence of Asbestos fibres suggests there is a potential risk, particularly during any groundworks, including post construction if the Made Ground is to remain on site. It is recommended that the guidelines given in CIRIA Report C733 'asbestos in soil and made ground: a guide to understanding and managing

risks' (2014) is consulted as regards risks to workers from ACM.

It is anticipated a piling foundation system will be utilized within the proposed development. Displacement (driven piles) would be most appropriate in reducing the potential for the airborne mobilisation of contaminated arisings.

In addition, instructions should be issued in the recognition of potentially hazardous materials including oily and odorous soil and water and also any discoloured or fibrous substances for example. Operatives should be warned to avoid contact between hands and mouth before washing. The consumption of food must be confined to designated clean areas with suitable welfare including washing facilities should be provided.

- The Contractor is referred to the following guidance documents in relation to works impacted by asbestos:
 - a. Control of Asbestos Regulations 2012 (SI 2012/2675)
 - b. Asbestos (Licensing) Regulations 1983 (SI 1983/1649), as amended in 1998 (SI 1998/3233)
 - c. Asbestos: Exposure Limits and Measurement of Airborne Dust Concentrations (EH10 and MDHS 39/4), 1996. Health and Safety Executive.
 - d. Asbestos: The survey guide (HSG 264), 2010. Health and Safety Executive
 - e. CIRIA C765: Asbestos in soil and made ground good practice site guide, 2017. CIRIA.
- The Contractor shall employ a watching brief by a suitably qualified person(s) to oversee higher risk activities (such as shallow excavations through Made Ground). Risks associated with excavating asbestos impacted soils will be included in the Contractors Risk Assessments and Method Statements.
- If asbestos is identified a procedure for dealing with potentially suspect materials exposed requiring sampling and analysis will be produced.
- The contractor will undertake specific precautions if materials containing asbestos are present or encountered during works, in order to comply with the Control of Asbestos Regulations 2012, and adhering to relevant guidance, including Asbestos: Exposure Limits and Measurement of Airborne Dust Concentrations (EH10 and MDHS 39/4) and Managing Asbestos in Workplace Buildings 1988.
- Specialist measures may be required such as dampening down of excavations, adoption of specialist PPE and RPE, air monitoring, waste segregation and labelling and specialist waste disposal. Works may need to be undertaken by a specialist licenced asbestos contractor if significant quantities of fibrous materials are encountered.
- The Contractor must ensure that the HSE is informed if the asbestos is classified as notifiable.
- Transport of asbestos containing materials will be undertaken in accordance with Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (SI 2009/1348). Disposal of asbestos containing materials to licensed waste sites in accordance with Hazardous Waste (England and Wales) Regulations 2005, as amended (SI 2005/894).
- All records to be kept by the Contractor for verification purposes.

3.5 Unexpected Contamination – General Advice

On any previously developed site there is the potential to encounter areas or types of contamination including asbestos not identified through previous site investigations. Underground structures may also be encountered e.g. storage tanks, that may contain unknown fluids which may require specialist treatment or disposal. If unforeseen contamination in the form of suspicious odour, colour or staining is encountered during excavations, works in that area should be halted immediately.

In the case that unexpected contamination is identified then further risk assessments to receptors will be carried out as necessary and reported to the employer, the local authority (NPTCBC) and Natural Resource Wales (NRW). Should unacceptable risks be identified, the contractor shall submit to and agree a revised remediation method statement with the local authority, in consultation with NRW.

The discovery strategy and management of potentially impacted soils should be dealt with on a case-by-case basis in order to address the specific nature of the ground conditions uncovered. A general approach to the discovery strategy is provided below. Visual and olfactory inspection shall be used to identify potentially impacted soils. Following agreement on a plan of action it is likely that a conventional delineation exercise will be used to segregate impacted soil from the surrounding material.

The following general sequence should be adopted for managing suspicious ground conditions:

1. Suspicious ground conditions are identified by groundworker(s) and the affected works are halted;
2. Contractor assesses the requirement for any additional health and safety or environmental management control measures;
3. Control measures, if required, are implemented;
4. Contractor notifies the Contractor's Land Quality Specialist;
5. Contractor's suitably qualified person records the extent of 'contamination' and nature of stratigraphy;
6. Findings are discussed with the Contractor's Land Quality Specialist and a way forward is ascertained e.g. sampling and testing requirements, special measures required during excavation etc.;
7. Contractor's Land Quality Specialist suitably qualified person collects samples and schedules the agreed laboratory analysis;
8. Details of samples collected and tests scheduled are recorded;
9. Contractor's Land Quality Specialist notifies Local Planning Authority and provides a copy of the records;
10. Contractor provides the test results to the Contractor's Land Quality Specialist for review;
11. Remedial action, if necessary, and programming of the works are agreed with the Local Planning Authority;
12. Contractor is informed of the remedial action required;

13. Contractor prepares a Method Statement that details how the agreed remedial action will be carried out;
14. Method Statement is agreed by Contractor's Land Quality Specialist;
15. Works proceed and Contractor's Land Quality Specialist provides a copy of the Method Statement to the Local Planning Authority.
16. Evidence of work carried out is collated for inclusion in the Close Out Report.

The following sequence outlines the approach to be adopted for a conventional delineation exercise:

1. Strip the overlying soil that does not appear to be impacted ('clean') and stockpile separately.
2. Collect 1no. sample from the stockpile. Schedule for analyses to be advised by the Contractor's Land Quality Specialist.
3. Collect 1no. sample from the impacted soil horizon per 25m² (or part thereof). Schedule for analyses to be advised by the Contractor's Land Quality Specialist.
4. Continue the delineation exercise, appropriately separating the impacted soil from the 'clean' soil.
5. Upon exposing 'clean' soil at the extents of the excavation, halt the delineation.
6. From each side of the excavation collect 1no. sample within 1m above the impacted horizon, 1no. sample at the depth of the impacted horizon, and 1no. sample within 1m below depth of impacted horizon. Schedule for analyses to be advised by the Contractor's Land Quality Specialist
7. Across the base of the excavation collect 1no. sample per 25m² (or part thereof). Schedule for analyses advised by the Contractor's Land Quality Specialist.
8. All results and evidence of the work carried out should be collated for inclusion in the Verification Report.

3.6 Verification of Remediation Works

All remediation works completed at the site will be documented within a Verification Report. The Verification Report should detail the remediation works carried out; including any variation from the Clients / Principal Contractors approved remediation method statement, and also validation evidence to prove that remediation works had been successfully completed. Typical validation evidence to be included in the report should include photos, chemical analysis, logs, as-built drawings, delivery notes and import/ export soil audit trail.

Verification of the capping layer on this development will principally comprise evidence that the areas where raised contaminants were recorded are indeed capped by the proposed hardstanding and clean soil / geotextile / membrane in areas of soft landscaping, thereby forming a physical barrier between the Made Ground soils (source) and site end users.

Validation of the gas protection measures, in particular the membrane installation, floor slab installation and underfloor venting is required by an independent third party. Validation should be undertaken in accordance

with a suitable verification plan. This should include inspection during and post installation / construction, a photographic record of completed installation, post completion verification gas monitoring in underfloor voids and performance testing. All membranes should be inspected immediately before they are covered up.

A verification report should be produced upon completion of installation / construction.

In terms of the identified risk to controlled waters in the environment, albeit low, from potential leaching of contaminants held within the Made Ground into the surrounding soils, soakaways to manage storm water should not be employed as this could contribute to focussed collection and dispersal of waters through the shallow soils and influence the rate at which any leaching of the soils could happen. The soakaway testing within the ground investigation did however reveal the shallow natural soils to have a very low permeability and as such soakaways may not be feasible.

Any additional contamination identified and remediation works carried out will be recorded in the Verification Report. The Verification Report will be required by the Client in order to discharge planning conditions.

4.0 GENERAL CONSIDERATIONS FOR REMEDIATION WORKS

4.1 General

The Remediation Works shall constitute the development itself whereby the risks realised will be built out during the proposed development i.e. capping barrier being formed by way of constructing hard standing, however the following points should also be considered. During any works.

4.2 Health and Safety Requirements

Any Remediation Method Statement should consider health and safety for workers at the site, and suitable arrangements made to comply with contemporary health and safety legislation. All works will be carried out by suitably qualified and experienced staff including supervision by an Environmental Engineer / Site Manager.

4.3 Environmental Requirements

4.3.1 Soil Management

The Contractor should operate a soil audit during the works. Any waste materials generated during the works will be classified as waste and recovered/disposed at suitably licensed/declared sites. All waste classified as hazardous, leaving the site will be transported with Hazardous Waste Consignment Notes. All non-hazardous and inert waste will be transported with suitable waste transfer notes. All waste will be removed by a licensed waste carrier.

4.3.2 Pollution Control

The Contractor should consider and detail in their Remediation Method Statement the control measures for potential environmental pollution during the remediation works, including cross-contamination of soil, mud and silt, noise, dust, etc.

4.3.3 Environmental Management System

The Contractor should have an Environmental Management System in accordance with BS EN ISO14001 accreditation. The procedures and records contained should therein ensure all works are carried out in a manner that minimises impact on the environment and generates adequate and accurate records to demonstrate remediation works have been carried out to the required standard and in accordance with all applicable legislation.

5.0 REFERENCES

Past Studies:

- Quantum Geotechnic Ltd (2020) Geoenvironmental Assessment, Ref: G40104/LR01Rev03
- Quantum Geotechnical Ltd (2019) Ground Investigation & Mining Risk Assessment, Ref: G40104/IR (2019)
- Phlorum (2017) Phase 1 Investigation

APPENDIX I – PROPOSED DEVELOPMENT PLANS
