

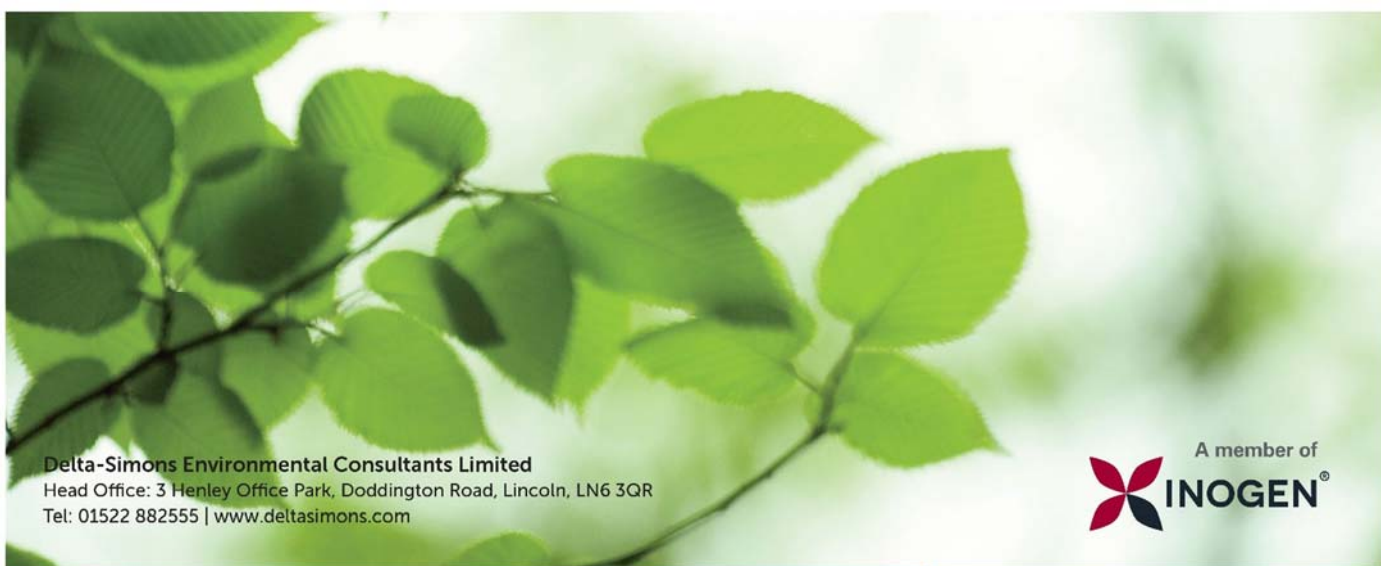
Preliminary Geo-Environmental Risk Assessment

Clitheroe Road, Whalley

Presented to Trafford Housing Trust

Issued: July 2018

Delta-Simons Project No. 18-0886.01






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Report Details

Client	Trafford Housing Trust
Report Title	Preliminary Geo-Environmental Risk Assessment
Site Address	Clitheroe Road, Whalley
Project No.	18-0886.01
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Quality Assurance

Issue No.	Status	Issue Date	Comments	Author	Technical Review	Authorised
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About us

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Specialising in Environment, Health & Safety and Sustainability, Delta-Simons provide support and advice within the property development, asset management, corporate and industrial markets. Operating from nine locations - Lincoln, Birmingham, Dublin, Durham, Leeds, London, Manchester, Norwich and Nottingham - we employ over 100 environmental professionals, bringing experience from across the private consultancy and public sector markets.

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Executive Summary

Brief	Delta-Simons was instructed by Trafford Housing Trust (THT) to produce a Preliminary Geo-Environmental Risk Assessment for a Site located adjacent to Clitheroe Road, Whalley to support a planning application for circa. 188 residential units.
Site Use & Surrounding Area	<p>The Site currently comprises an irregularly shaped, roughly vegetated plot of agricultural land, formerly used for sheep grazing.</p> <p>The buried Haweswater Aqueduct cuts through the central part of the Site and a tree lined track runs parallel to provide access to the aqueduct, a United Utilities maintenance building and the adjacent fields.</p> <p>A gated access track provides access to the northern field from the A671. An area of vacant hardstanding is present in the north-east of the Site, with the exception of some disregarded bales of silage/haylage. Immediately west and south of the Site are residential properties including a new Redrow development and houses along Woodlands Park and Sydney Avenue.</p> <p>The A671 and a small area of woodland forms the north-eastern Site boundary and immediately southeast of the Site is an undeveloped plot of roughly vegetated land. There is more roughly vegetated land to the north of the Site beyond which is Oakhill nursery and college.</p>
Environmental Setting	<p>The Site geology is shown as being Devensian Till underlain by the Bowland Shale Formation (mudstone). Both the superficial Devensian Till and the bedrock are classified as Secondary (Undifferentiated) Aquifers. Given the current Site condition (agricultural land) topsoil is likely to be present overlying the Devensian Till.</p> <p>The nearest major surface water feature is the River Calder which lies approximately 200m to the south of the Site. A brook is present immediately west of the Site.</p>
Contamination Potential Sources	Potential sources of contamination have been identified, comprising localised Made Ground deposits associated with a potentially infilled former reservoir and a former gasholder/gasworks works off-Site approximately 75 m to the south.
Contaminated Land Risk Associated with Ownership	There is considered to be a Low risk of enforcement action by the regulatory authorities under Part 2A of the Environmental Protection Act, the Water Resources Act or the Environmental Damage Regulations. The potential for legal action by surrounding landowners / third-parties based on the potential for contamination to migrate off-Site (ongoing or historically) is considered to be Low.
Development Considerations	<p>Based on this preliminary assessment and the absence of an intrusive ground investigation the risk of the Site requiring remediation to protect end users is considered to be generally Low. A Low to Moderate risk is considered appropriate for the infilled reservoir in the centre of the Site.</p> <p>It is considered likely that the topsoil will be able to be re-used upon validation testing. Provision of a clean cover layer for any proposed soft landscaping or gardens may be required in localised areas of Made Ground. Ground gas protection may be required within new buildings to mitigate potential risks from hazardous ground gases. Basic radon protection measures are required.</p> <p>There are no significant identified geohazards (e.g. collapsible ground, compressible ground, dissolution hazards, landslide stability, running sands, shrinking or swelling clays), within the Envirocheck Report.</p>

Recommendations	It is recommended that an intrusive ground investigation is undertaken to assess the potential for contamination and ground gases to impact on the proposed development, with some locations specifically targeting an infilled reservoir, if possible.
This is intended as a summary only. Further detail and the limitations of the assessment is provided within the main body of the Report.	

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1.0 Introduction

1.1 Appointment

Delta-Simons Environmental Consultants Limited (“Delta-Simons”) was instructed by Trafford Housing Trust (the “Client”) to prepare a Preliminary Geo-Environmental Risk Assessment for a proposed residential development at Land off Clitheroe Road, Whalley (the “Site”).

1.2 Context & Purpose

The aim of this report is to assess likely environmental and geotechnical issues associated with soil and groundwater conditions that may affect the proposed development of the site. This report is designed in accordance with ‘the Model Procedures for the Management of Land Contamination (CLR 11)’ and the relevant Planning Practice Guidance (Land Affected by Contamination) <https://www.gov.uk/guidance/land-affected-by-contamination>.

The proposed development for the Site is the construction of up to 188 new residential units.

1.3 Scope of Works

- ▲ Review of the environmental setting of the Site, including the current use / status of the Site and surrounding area, and review of the geology, hydrogeology and hydrology;
- ▲ Review of the historical activities of the Site and surrounding area;
- ▲ Review of regulatory information relating to the Site;
- ▲ Review of the online planning records for the Site;
- ▲ Consult and review information from the Local Authority in relation to Part 2A of the 1990 Environmental Protection Act;
- ▲ Complete a Site reconnaissance by undertaking a visual inspection of readily accessible areas of the Site;
- ▲ Develop an outline Conceptual Site Model and undertake a Preliminary Risk Assessment with respect to potential contamination focussed on the proposed land use;
- ▲ Provide commentary on potential land contamination and geotechnical constraints in the context of the proposed development; and
- ▲ Summarise readily available data on the flood risk associated with the Site.

In completing this Assessment, Delta-Simons has utilised the following data sources and third party information:

- ▲ Current and Historical Ordnance Survey (OS) maps;
- ▲ British Geological Survey (BGS) data;
- ▲ Coal Authority (CA) online data;
- ▲ A Landmark Envirocheck Report for the Site (Ref. 172472445_1_1), dated 6th July 2018;
- ▲ Historical Maps included as part of the Envirocheck Report; and
- ▲ Information provided by Ribble Valley Borough Council.

1.4 Limitations

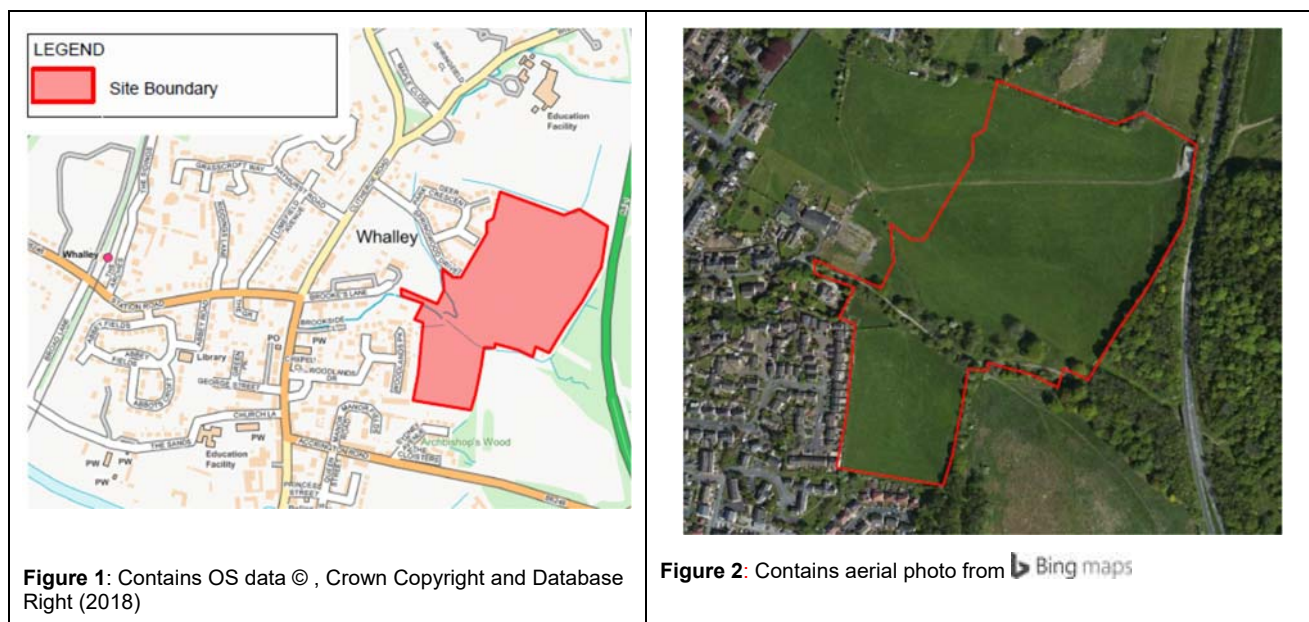
The standard limitations associated with this assessment are presented in Appendix A. In addition, there are the following specific limitations that apply to this assessment:

- ▲ The Consultant undertaking the Site reconnaissance will observe for evidence of invasive species, particularly Japanese Knotweed. It should be noted however that the Consultant is not a trained ecologist and a separate survey undertaken by an experienced Ecologist should be completed to provide a robust assessment;

- ▲ The report includes a preliminary assessment for the potential for radon gas hazards. A detailed radon assessment falls outside of the scope of this report, and the requirement for radon mitigation measures in the proposed development should be identified separately to the satisfaction of the appointed Building Control Agent; and
- ▲ Commentary has been provided regarding existing Site services in the context of assessing environmental and geotechnical issues, however a detailed review of all overhead or underground services is outside the scope of this assessment. Particular attention needs to be given to the aqueduct that crosses the Site.

2.0 Site Context & Data Review

2.1 Site information



Site Location		Site Layout	
Co-ordinates	Centred at approximate National Grid Reference 373760,436440	Elevation	Variable
		Area	10.34 Ha
Site Location	The Site is located to the west of (A671) on the eastern periphery of Whalley which is approximately 5 km south of Clitheroe. Please refer to Figure 1.		
Current Site Use	<p>The Site currently comprises an irregularly shaped, roughly vegetated plot of agricultural land, formerly used for sheep grazing.</p> <p>The buried Haweswater Aqueduct cuts through the central part of the Site and a tree lined track runs parallel to provide access to the aqueduct, a United Utilities maintenance building and the adjacent fields.</p> <p>A gated access track provides access to the northern field from the A671. An area of vacant hardstanding is present in the north-east of the Site, with the exception of some disregarded silage/haylage bales. Immediately west and south of the Site are residential properties including a new Redrow development and houses along Woodlands Park and Sydney Avenue.</p> <p>The A671 and a small area of woodland forms the north-eastern Site boundary and immediately southeast of the Site is an undeveloped plot of roughly vegetated land. There is more roughly vegetated land to the north of the Site beyond which is Oakhill nursery and college.</p>		
Proposed Development Description	The proposed development comprises up to 188 residential units considered to be standard two / three storey dwellings with private gardens and associated areas of public open space.		
Site Reconnaissance	Delta-Simons conducted a Site visit on Tuesday 10 th July 2018. A series of Site photographs are presented as Appendix C, and pertinent information that was observed or reported on-Site is summarised as follows:		

	<ul style="list-style-type: none"> ▲ In the northeast of the Site there is a small area of concrete hardstanding formerly used to store silage/haylage. A few disregarded silage/haylage bales were still present (Photo 1); ▲ At the time of the walkover a portion of the Site was occupied by a construction compound in operation by Urban Regen who were constructing attenuation basins for surface water run-off from the adjacent Redrow development and the Site (Photo 2); ▲ The Site can be accessed from the A671 or via a track off Brooke's Lane; ▲ The gravel access track from Brooke's Lane is lined with dense vegetation and mature trees (Photo 3); ▲ A below ground aqueduct (the Haweswater aqueduct) cuts through the central part of the Site and manhole covers and access points (manholes) are visible at the ground surface along the Site's eastern boundary; ▲ Adjacent to the aqueduct is a maintenance building owned by United Utilities and a telecoms mast (Photo 4); and ▲ Topographically the south of the Site is relatively level; however, to the north of the aqueduct the land rises to the north and east. 	
	There were no obvious visual sources of contamination; however, contamination may be present caused by activities in the construction compound.	
Current Surrounding Area	North	Agricultural land with Oakhill Nursery and College beyond.
	East	Woodland and the A671.
	South	Residential properties with agricultural land beyond.
	West	Residential properties.
	There are no current significant sources of contamination evident within the immediate surrounding area.	

2.2 Environmental Setting

Published Geology	British Geological Survey (BGS) data available online and from published BGS mapping (1:50,000 Sheet Number 68 Clitheroe) shows that the Site is underlain by superficial deposits comprising Devensian Till. The underlying bedrock comprises mudstones of the Bowland Shale Formation. Given the current Site conditions (agricultural land), topsoil is likely to be present overlying the Devensian Till.
Specific Ground Conditions	<p>There are no records of previous boreholes on the BSG online mapping service within the Site boundary.</p> <p>A borehole log dated from 1984 (BGS ID 25599), located approximately 95 m to the south-west of the Site (but within the same superficial and bedrock geology), recorded the following generalised geology:</p> <ul style="list-style-type: none"> ▲ Soft brown Peat to 2 m bgl; ▲ Very loose grey organic clayey Sand to 3.5 m bgl; ▲ Loose grey silty Sand to 8.5 m bgl; and ▲ Firm to stiff grey silty sandy Clay with occasional gravel to 12 m bgl. (thickness unproven).

	<p>There are another five boreholes associated with this record which record similar ground conditions and the following water level remarks:</p> <ul style="list-style-type: none"> ▲ Water strike at 1.2 m bgl; ▲ Standing level at 0.2 m bgl; ▲ Water at ground level; and ▲ Strong water strike at 12 m bgl. (which rose to ground level within 20 minutes). <p>The above water strikes, and rising groundwater may suggest artesian/sub-artesian groundwater conditions and shallow groundwater.</p>
Hydrogeology	<p>The Environment Agency (EA) classify the superficial deposits (Devensian Till) and the bedrock (Bowland Shale) as Secondary Aquifers (Undifferentiated).</p> <p>The EA data also indicates that the Site is not in a designated groundwater Source Protection Zone. According to the Envirocheck Report, there are no licensed abstraction records from groundwater located within 1 km of the Site.</p>
Hydrology	<p>The nearest surface water feature is a brook located immediately west of the Site. The River Calder is approximately 200 m to the south of the Site.</p> <p>According to the Envirocheck Report, there are three licensed abstraction records from surface water located within 1000 m of the Site.</p> <p><u>River Calder</u></p> <ul style="list-style-type: none"> ▲ License No. Nw/071/0329/001 for Energy production (336 m to SW). <p><u>Spring Fed</u></p> <ul style="list-style-type: none"> ▲ Licence No. 26713360 for household water supply (730 m to NE); and ▲ Licence No. 2671336001 for agricultural purposes (791 m to NE).
EA & BGS Flood Mapping	<p>A review of mapping provided by the Environment Agency (EA) indicates that the Site is within Flood Zone 1 and therefore has a low probability of flooding. The surrounding area (south and west) is identified to be within Flood Zone 2 & 3 and could be at risk from flooding.</p> <p>The EA's Long-Term Flood Risk Map further indicates the Site to have a very low risk of flooding from the sea or rivers as well as being at a low risk from reservoir flooding. Generally, the Site is at a very low risk from surface water flooding.</p> <p>According to the Envirocheck® Report, there is a potential for groundwater flooding to occur at the surface across the majority of the Site.</p>
Coal Mining	<p>Reference to the Coal Authority on-line viewer indicates that the Site is not with a Coal Mining Reporting Area and is not within a Development High Risk Area. Consequently, a Coal Mining Risk Assessment (CMRA) is unlikely to be required under the planning regime.</p>
Radon Gas	<p>The property is an Intermediate probability radon area (3 to 5 % of homes are estimated to be at or above the Action Level)</p> <p>Based on the higher risk level of 3 – 5 % BRE211 (2007) it is recommended that a Site-specific radon risk report is produced and the provision of basic radon protection measures within buildings is allowed for.</p>
Ecological Receptors	<p>It is understood from information provided within the Envirocheck® Report, there are no statutory ecological receptors located within 500 m of the Site.</p>
Heritage Interest	<p>There are no registered heritage sites at the Site or within 100m of the Site boundary.</p>

Environmental Sensitivity	The Site is considered to be of a low environmental sensitivity given the presence of Secondary (Undifferentiated) aquifer designations, the absence of any ecological receptors and the agricultural use of the Site and surrounding area.
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2.3 Historical Use of the Site & Surrounding Area

Approach	The historical development of the Site and surrounding area has been assessed through a review of historical OS maps contained within the Envirocheck Report. A summary of the key historical Site uses and developments in the surrounding area is presented below. Copies of pertinent historical maps are included as Appendix D.
Historical Features On-Site	<p>The Site use appears to be predominantly agricultural from the earliest reviewed historical map dated 1848 until the present day. A reservoir is shown on this map in the centre of the Site although it is not explicitly identified as such until later mapping.</p> <p>Although not shown on historical mapping, it is understood¹ that Haweswater Aqueduct was constructed between 1935 to 1955.</p> <p>The 1968 map suggests that the reservoir has been drained and a depression is evident in this location (potentially infilling occurring).</p> <p>The 1992 map shows the access track from Brooke's Lane through the centre of the Site and a second track is shown in the northern field from an area of hardstanding in the north-east heading west.</p> <p>By 1970 there is no evidence of the infilled reservoir and there are no other significant changes shown on maps from this time to the present day.</p> <p>The key potential contamination source is therefore:</p> <ul style="list-style-type: none"> ▲ Infilled former reservoir (on-Site).
Potentially Contaminative Historical Features Off-Site	<p>Potential sources of contamination within 100 m of the Site include:</p> <ul style="list-style-type: none"> ▲ A former gasholder/gasworks approximately 75 m to the south of the Site is shown on historical maps from 1932 to sometime prior to 1989. The 1989 map shows the gasholder/gasworks has been redeveloped into residential housing.

2.4 Environmental Database Review

Approach	The Landmark Envirocheck [®] Report provides a database of environmental information held by various statutory bodies including the EA, Local Authority (LA), Health & Safety Executive (HSE) and HPA amongst others. A full copy of the Envirocheck [®] Report is provided in Appendix E and the most relevant information is summarised below.
Features On-Site	The Landmark Envirocheck [®] Report lists an area of potentially infilled land (water, unknown filled ground – pit/quarry etc) on-Site. This is thought likely to be associated with the former reservoir shown on the historical mapping between 1848 and 1970.
Potentially Contaminative Features Off-Site	<p>Pertinent entries included within the Landmark Envirocheck[®] Report located within 100 m from the Site include:</p> <ul style="list-style-type: none"> ▲ Carpet & Upholstery Cleaners – 27m south-west (Contemporary Trade Directory Entry). <p>There are no BSG, LA and EA registered landfill sites on or within 500 m of the Site.</p>

¹ <http://hidden-manchester.org.uk/waterways/haweswater-aqueduct.html>

Implications for Land Contamination Risk	Potential sources of contamination have been identified at the Site from the regulatory information, specifically the infilled ground (former reservoir) which will be considered in the preliminary risk assessment. No potential off-Site sources of contamination have been identified.
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2.5 Planning Review / Regulatory Enquiries

On-line Planning Portal	Ribble Valley Borough Council	Date Accessed	16/07/2018
Findings	<p>There are two recent planning applications for the Site listed as:</p> <ul style="list-style-type: none"> ▲ Ref. 3/2013/0137 which comprises an outline application for a residential development. The application was approved subject to conditions in October 2013; and ▲ Ref. 3/2015/0489 which comprises reserved matters in relation to the approved outline planning application above. <p>Pertinent points from the above file are as follows:</p> <ul style="list-style-type: none"> ▲ There were no reports in these planning files relating to land contamination; ▲ The EA did not specifically comment in relation to land contamination; and ▲ The reserved matters application included a technical consultee response from an officer responsible for contaminated land detailing full conditions in this respect. The first part of the condition relates to the provision of a Phase I Desktop Study. 		
Part 2A of the Environmental Protection Act (EPA) 1990	<p>The Contaminated Land Officer (CLO) confirmed that the Site has not been determined as Contaminated Land and will not be subject to investigation under Part 2a of the EPA 1990 in the future.</p> <p>Copies of the pertinent information is appended as Appendix F.</p>		

2.6 Previous Reports

List of Reports	<p>Delta-Simons have been provided with the following reports;</p> <ul style="list-style-type: none">▲ Preliminary Assessment of Ground Conditions, Land East of Clitheroe Road, Whalley for Commercial Estates Group, Report C4023 Rev 3, dated February 2013. <p>The report identified the requirement for basic radon protection measures and further site investigation works to assess ground conditions. The aqueduct and existing footpath were considered as potential development constraints.</p> <ul style="list-style-type: none">▲ Geoenvironmental Appraisal of land to the east of Clitheroe Road, Whalley for Commercial Estates Group, C4023A, dated January 2013. <p>The site investigation covered a plot of land adjacent to the current subject site. This area is currently being developed for traditional low rise residential properties. The investigation comprised 19 trial pit to a maximum depth of 4.2mbgl and six window sample boreholes to a maximum depth of 6.45m bgl. Ground conditions comprised topsoil over Glacial Till (firm to stiff gravelly clay) to the east of the brook where traditional strip/pad foundations were considered suitable. An upper layer of very soft silt was identified in one area of the site noted to be waterlogged.</p> <p>West of the brook, topsoil was underlain by very soft to soft clay and piles were recommended.</p> <p>Marginally elevated concentrations of benzo(a)pyrene were detected within natural topsoil. This was considered likely attributable to fragments of coal within the sample. Further analysis of topsoil was considered necessary to inform suitability for re-use.</p> <p>Basic radon protection measures were required. However, no sources of ground gas were identified.</p> <ul style="list-style-type: none">▲ Geotechnical Assessments of Ponds A and B – various authors, 2014 – 2018. <p>BWB Consulting, Sirius Geotechnical and GRM Development have been involved in the ground investigation and design of surface water attenuation ponds on Site. Numerous assessments have been made with regards slope stability and artesian water, and associated potential uplift of the base of the pond, which was raised as a concern.</p> <p>Artesian water was encountered within granular strata at c. 8m depth. Up to 2.1m and 1m of impermeable material was recommended at the base of Pond A and Pond B respectively to prevent uplift.</p> <p>Slope stability of gradients of up to 1 in 3 were modelled for the retention pond sides and considered stable when recommended mitigation measures with respect to artesian groundwater were implemented.</p> <p>The risk of settlement of the aqueduct as a result of dewatering during construction of the ponds was also considered and predicted settlement values were within acceptable limits.</p>
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3.0 Conceptual Site Model

3.1 Introduction

A Conceptual Site Model (CSM) represents the relationships between contaminant sources, pathways and receptors, to support the identification and assessment of Possible Contaminant Linkages (PCL).

3.2 Potential Contamination Sources

Identified potential contamination sources are presented in the following table:

Reference	Source	Location	Dates Present	Potential Associated Contaminants of Concern
S1	Possible Made Ground	In vicinity of access tracks and area of hardstanding in the north-east of the Site.	1992 – Present day	Asbestos, heavy metals, TPH, PAHs
S2	Urban Regen Construction Compound	Centre	Present	TPH
S3	Potential infilled reservoir	Centre	Reservoir evident from 1848 to 1968 (covered or filled)	Asbestos, heavy metals, TPH, PAHs, ground gases
S4	Gasholder / gasworks	Off Site (50 m South)	1932 to 1975	Spent oxides, cyanide, phenols, petroleum hydrocarbons, VOC, SVOC's

* Based on UK Department of the Environment Industry Profiles

3.3 Potential Receptors

- ▲ R1 - Construction workers;
- ▲ R2 - Third parties during construction (adjacent Site users and adjacent residents);
- ▲ R3 - Future Site users and maintenance workers;
- ▲ R4 – River Calder (200 m to the south);
- ▲ R5 - The underlying aquifers; and
- ▲ R6 - The Built Environment (new buildings and infrastructure / utilities) including Haweswater Aqueduct.

3.4 Potential Pathways

The potential pathways are considered to be as follows:

- ▲ P1 - Direct contact, ingestion or inhalation of soil bound contaminants / dust during or following redevelopment;
- ▲ P2 - Inhalation of organic vapours associated with contamination;
- ▲ P3 - Migration of ground gas / vapours into on-site buildings causing asphyxiation or risk of explosion;
- ▲ P4 - Leaching of contamination into groundwater followed by migration of groundwater to the wider groundwater environment or discharge to surface waters; and
- ▲ P5 - Direct contact between aggressive ground conditions and new infrastructure.

Contaminant Linkage Assessment					
Source(s)	Pathway(s)	Receptor(s)	Risk Rating	Justification & Mitigation (if required)	Requires Investigation
S1 Possible Made Ground	P1, P2, P4, P5	R1, R3, R4, R5, R6	Low Risk	Locally Made Ground, of unknown composition, is likely to be present. This may require removal or incorporation of overlying clean cover where the material may be present within future garden or landscaped areas.	Y
S2 Construction Compound	P1, P2, P4, P5	R1, R3, R4, R5, R6	Low Risk	Part of the site is currently in use as a construction compound for surface water attenuation. Assuming appropriate environmental control measures are in place by the contractor undertaking this work, this is not considered to represent a significant source.	N
S3 Infilled Reservoir	P1, P2, P3, P4, P5	R1, R2, R3, R5, R6	Low to Moderate Risk	<p>The infilled reservoir is considered to be a potential source of ground gas and ground gas monitoring should look to target this area if possible; however, it is understood no dwellings are proposed in the vicinity.</p> <p>It is considered unlikely that there will be a plausible significant contaminant linkage between infill material (Made Ground) and the underlying groundwater / nearby watercourse due to the presence of cohesive glacial deposits, which are anticipated to be of low permeability. This will offer protection to deeper groundwater within the bedrock. Furthermore, sub-artesian conditions may also help mitigate contaminant migration to deeper groundwater within bedrock.</p> <p>However, this would need to be reassessed should significant contamination be encountered during the ground investigation, and once the nature / thickness of the glacial deposits has been investigated.</p>	Y
S4 Off-site Gasworks	P2, P3, P4, P5	R1, R3, R4, R5, R6	Low Risk	<p>It is considered to be unlikely that contaminated groundwater could migrate onto the Site as the anticipated hydraulic gradient is to the south, away from Site, towards the River.</p> <p>However, it would be prudent to include assessment of this potential pollutant linkage via investigation in this part of the Site.</p>	Y

- ▲ R1 - Construction workers;
- ▲ R2 - Third parties during construction (adjacent Site users and adjacent residents);
- ▲ R3 - Future Site users and maintenance workers;
- ▲ R4 – River Calder (200 m to the south);
- ▲ R5 - The underlying aquifers; and
- ▲ R6 - The Built Environment (new buildings and infrastructure / utilities) including Haweswater Aqueduct.

4.0 Preliminary Ground Engineering Appraisal

4.1 Preliminary Ground Model

Based on the available information, it is anticipated that the Site is likely to be underlain by a sequence of Topsoil and locally Made Ground (associated with former reservoir), Devensian Till and Bowland Shale (mudstone). Shallow groundwater (possibly artesian / sub-artesian) is expected at the Site.

4.2 Plausible Geohazards

There are no identified geohazards included within the Envirocheck Report with hazards report as “No Hazard” or “Very Low Risk”. The following substantial Site-specific geohazards are considered to be relevant. A substantial risk is defined by Delta-Simons in Appendix B.

The following hazards may be considered a substantial risk:

- ▲ Made Ground – There is the potential for localised areas of Made Ground On-Site in the vicinity of access tracks, the area of hardstanding and the infilled reservoir. The Made Ground is likely to be unsuitable for founding upon and depending on it’s depth, extents and contamination status may require excavating and replacing;
- ▲ Shallow and Artesian Groundwater – Shallow groundwater has been recorded on historical and third party borehole records in the area together with reports of artesian and sub-artesian conditions. If present, this may dictate the requirement for upgraded foundations and may pose construction difficulties;
- ▲ Existing Infrastructure – The Haweswater Aqueduct is buried through the central part of the Site and has an associated easement where no development is permitted. The aqueduct also has weight restrictions (maximum 6 tonne unprotected). A detailed design for a protection slab will be required for approval by United Utilities to enable the scheme;
- ▲ Topography – The elevation of the Site varies. Earthworks will be required to create level development platforms;
- ▲ Heave / Subsidence – The cohesive glacial deposits have the potential to shrink or swell; and
- ▲ Mudstone has the potential to be pyritic in nature and dictate the requirement for a more robust concrete class.

5.0 Development Considerations

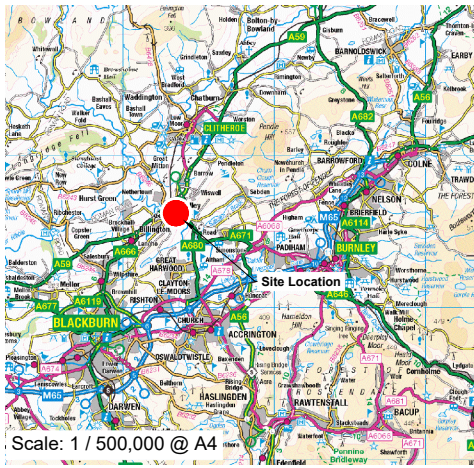
5.1 Geotechnical Considerations

<p>Foundations & Floor Slabs</p>	<p>Based on the reviewed information, it is anticipated that the Site is likely to be underlain by a sequence of Topsoil and locally Made Ground (associated with former reservoir and tracks), Devensian Till and Bowland Shale (mudstone). Shallow groundwater is expected at the Site with potentially artesian or sub artesian groundwater at depth.</p> <p>The underlying clay deposits at the Site may pose a risk to the foundations of the proposed development due to the effects of frost heave and shrink and swell associated with trees.</p> <p>Foundations and floor design would require a detailed Site investigation to assess the nature and extent of ground conditions.</p>
<p>Groundworks</p>	<p>The borehole logs from the surrounding area indicate resting shallow groundwater levels and artesian water in granular strata which may cause problems with excavations.</p>
<p>External Works</p>	<p>California Bearing Ratio testing will be required to determine road construction thickness. Consideration will need to be given for the potential for differential settlement to affect road surfaces and services and appropriately mitigated within the design.</p>
<p>Ground Instability</p>	<p>There are no significant ground instability hazards recorded in the Envirocheck report.</p>

6.0 Conclusions & Recommendations

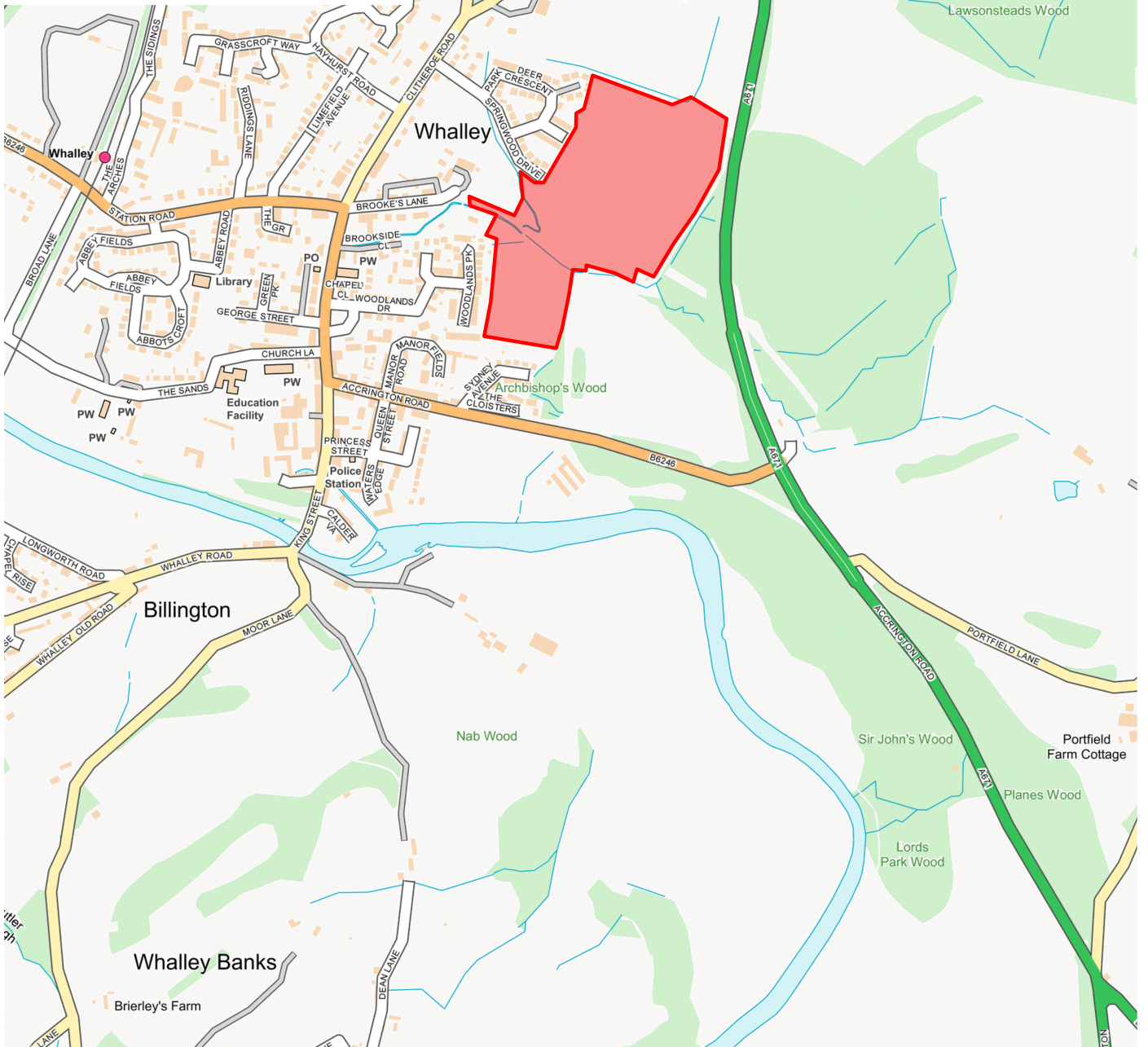
<p>Contamination Risks Associated with Ownership (Current Use)</p>	<p>There is considered to be a Low risk of enforcement action by the regulatory authorities under Part 2A of the Environmental Protection Act, the Water Resources Act or the Environmental Damage Regulations, whilst the Site remains in its current agricultural use. The potential for legal action by surrounding landowners / Third Parties based on the potential for contamination to migrate off-Site (ongoing or historically) is considered to be Low.</p>
<p>Potential Contaminated Land Development Risks</p>	<p>Widespread contamination is considered unlikely based on the predominantly agricultural use of the Site. Based on this the preliminary risk assessment has identified that most of the Site is considered Low risk with regards soil/groundwater contamination and hazardous ground gas. Locally, in the area of the infilled former reservoir, a Low to Moderate risk is considered appropriate due to the potential for ground gases and unknown Made Ground to be present. Asbestos containing materials may be present within areas of Made Ground.</p>
<p>Plausible Geotechnical Development Risks</p>	<p>There are locally potentially substantial geotechnical development risks at the Site related to deep Made Ground in the area of the potentially infilled former reservoir. The underlying clay deposits at the Site may pose a risk to the foundations of the proposed development due to the effects of heave and shrink associated with mature trees. Potential shallow groundwater may be a risk during and post development.</p>
<p>Recommendations</p>	<p>It is recommended that a Site Investigation is undertaken to assess;</p> <ul style="list-style-type: none"> ▲ Presence, thickness and nature of Made Ground; ▲ Assess the suitability of soils on site for reuse in residential gardens; ▲ Presence, concentrations of substances of concern in shallow soils (including Made Ground) on-Site; ▲ Presence of substances of concern in perched water/soil pore water or shallow groundwater beneath Site (specifically in the area of the potentially infilled reservoir and south of the Site which is the closest proximity to the former gasworks); ▲ Likelihood of significant ground gas and/or soil vapour intrusion into future on-Site buildings (specifically in the area of the potentially infilled reservoir); ▲ Presence of geotechnical risks to the future buildings and roads; and ▲ Engineering properties of the underlying soils and bedrock to inform foundation design.

Figure 1 – Site Location Plan



LEGEND

Site Boundary



Scale: 1 / 10,000 @ A4

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Figure 2 – Site Plan



Bing maps

Appendix A – Limitations

Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

Appendix B – Risk Definitions

Land Contamination Risk Definitions

The following methodology is based on the methodology presented in CIRIA C552 Contaminated Land Risk Assessment: A Guide to Good Practice 2001. It requires the classification of the:

- ▲ Magnitude of the potential consequence (severity) of the Risk occurring: and
- ▲ Magnitude of the Probability (likelihood) of the Risk occurring.

The classifications are then compared to indicate the risk presented by each pollutant linkage.

Consequence to Receptor Definition Matrix

	Human Health	Controlled Waters	Buildings/Services
Severe Consequence	Acute or chronic permanent impact on human health.	Sensitive controlled water pollution ongoing, or just about to occur.	Catastrophic collapse
Medium Consequence	Chronic permanent impact on human health	Gradual pollution of sensitive controlled water	Degradation of materials
Mild Consequence	Chronic temporary impact on human health	Gradual pollution of non-sensitive controlled water	Damage to building rendering it unsafe to occupy (eg foundation damage resulting in instability).
Minor Consequence	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc).	Slight discoloration of water	Easily repairable effects of damage to buildings, structures and services, i.e discoloration of concrete

Probability Definitions

Probability	Definition in Context
High	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution. Positive evidence of source, pathway and receptor.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term. Suspect source, pathway, and receptor
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term No evidence of hazard, pathway, and receptor

Standard Risk Matrix

		Consequence/ Magnitude of impact			
		Severe	Medium	Mild	Minor
Probability	High	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/low	Low
	Low Likelihood	Moderate	Moderate/low	Low	Very Low
	Unlikely	Moderate/low	Low	Very Low	Very Low

Classified risks and likely action

Significance Level	Definition/Comments
Very High Risk	<p>There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening.</p> <p>This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.</p> <p>Demonstrable contaminated land situation, highest threat & liability level, urgent action recommended.</p>
High Risk	<p>Harm is likely to arise to a designated receptor from an identified hazard.</p> <p>Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.</p> <p>Likely contaminated land situation, risk assessment and action recommended.</p>
Moderate	<p>It is possible that harm could arise to a designated receptor from an identified hazard. However, if is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild</p> <p>Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.</p> <p>Plausible contaminated land situation, risk assessment and possible action recommended.</p>
Low Risk	<p>It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.</p> <p>Unlikely contaminated land situation, possible risk assessment and possible action.</p>
Very Low Risk	<p>There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.</p> <p>Negligible risk, no action recommended except vigilance for changes in conditions.</p>

Geotechnical Risk Definitions

The geohazards listed in the report within Section 4 follow guidance presented in Clayton, C.R.I. (2001) *Managing Geotechnical Risk*, Thomas Telford and the Highways Agency document HD22/08 'Managing Geotechnical Risk' (2008) which aims to identify and manage the geotechnical risks associated with a scheme throughout its lifespan, from planning to construction to maintenance.

For each geohazard the probability of the hazard occurring (P) has been considered together with the impact it would have (I) if it were to happen to calculate the risk rating between 1 and 25.

Risks that fall within Moderate, Significant and Severe categories below are considered to be substantial and are therefore listed within the report.

Probability	(P)		Impact	(I)		(R)	Risk
Very Likely (VLk)	5	X	Very High (VH)	5	=	20 – 25	Severe
Likely (Lk)	4		High (H)	4		15 – 19	Substantial
Plausible (P)	3		Medium (M)	3		10 – 14	Moderate
Unlikely (U)	2		Low (L)	2		5 – 9	Minor
Very Unlikely (VU)	1		Very Low (VL)	1		1 – 4	Negligible

Appendix C – Site Photographs

Site Photographs



Photograph 1: Silage/Haylage Bales



Photograph 2: Attenuation pond being constructed