GEO Environmental Engineering

PHASE 2: GROUND INVESTIGATION REPORT

PROPOSED VEHICLE BODY WORKSHOP

MILLOM ROAD, MILLOM

CUMBRIA

FOR:

W.MILLIGAN & SONS

GEO Environmental Engineering

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DOCUMENT CONTROL SHEET

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Client Title:	W.Milligan & Sons
Consultant:	RG Parkins & Partners Ltd

CONTENTS

1.0 Introduction

1.1 Brief

GEO Environmental Engineering Ltd (GEO) were commissioned by the Client, W.Milligan & Sons to carry out groundwater sampling and chemical laboratory screening as part of a Groundwater Risk Assessment. The Client plans to develop the land as a vehicle body workshop.

GEO have previously completed a Ground Investigation Report for the site and further details are provided below in Section 1.4. The Environment Agency indicated that the report did not address potential risks to groundwater and stated that groundwater quality laboratory analysis is required.

1.2 Site Location and Description

The site, occupying an area of c.320m^2 is located in the north eastern part of Millom as indicated on the site location plan included in Appendix I. Access to the site is from Millom Road to the south.

- National Grid Reference: 317802, 480278
- Post Code: LA18 4BW

The site is located adjacent to an existing vehicle servicing garage and is used for car parking. The ground is surfaced with gravel and occasional grass and scrub vegetation.

The site is generally flat. A topographical survey has not been provided, however, Ordnance Survey data suggests that the site is at an elevation of <10m OD.

1.3 Proposed Development

It is understood that the Client will construct a vehicle body workshop. A plan of the proposed layout has been provided and a copy is included in Appendix I. The plan indicates a portal framed warehouse with car parking and other associated infrastructure. There are no plans to incorporate any soft landscaping.

1.4 Other Reports/Studies

GEO have completed a Phase 2: Ground Investigation Report for the site, details of which are included below:

- Phase 2 Ground Investigation Report, ref: 2022-5585, dated: 02.03.2023.

A brief summary is included below, however, it is recommended that both reports are read in conjunction.

The investigation comprised 5 No. percussive boreholes to a maximum depth of c.3.45m bgl, gas and groundwater monitoring, in-situ geotechnical testing and chemical screening of soil samples.

Made ground was encountered within all of the boreholes to depths of between c.0.60m and in excess of c.1.73m bgl. The made ground was significantly deeper in boreholes BH01 and BH2. The made ground was predominantly granular and comprised gravel and cobble sized anthropogenic material including slag, concrete, brick, ash, limestone, slate and tile. Occasional inclusions of soft organic peaty deposits were also noted.

Reference to the BGS online database indicates that the site is located within an area of extensive and potentially deep made ground that covers a significant area beyond the site boundaries – See Figure 1.

Natural drift deposits were only encountered within borehole BH03. The deposits were noted as grey silty fine sand.

Reference to the BGS online database indicates that the site is located in an area which is potentially underlain by Raised Marine Deposits (sands and gravels) and Saltmarsh Deposits (clays and silts).

The BGS also hold historical borehole data for the existing garage immediately west of the site. The borehole was drilled to depth of c.3.40m bgl in 1972. The borehole recorded compressed silt, soft silty clay and soft sandy silt to a depth of 2.30m bgl. This was underlain by very soft clayey silt to a depth of c.3.40m bgl.

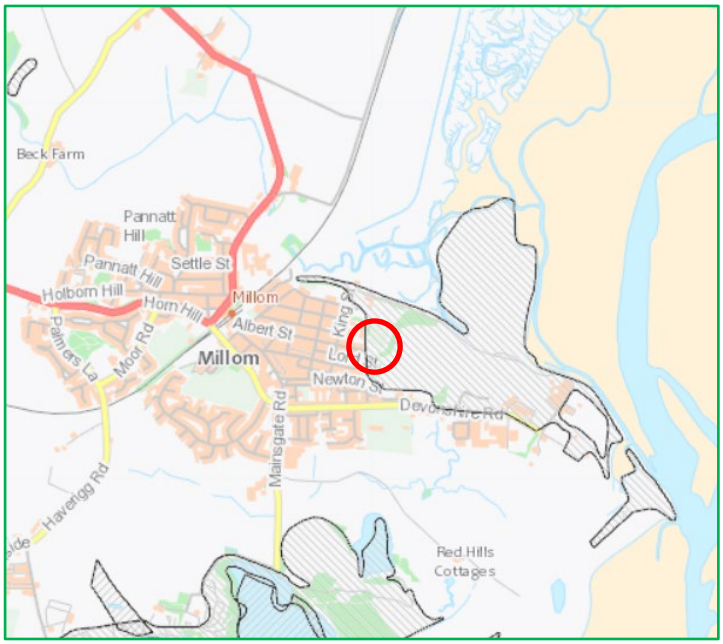


Figure 1 – Extensive Made ground to East of Millom

No visual or olfactory evidence of hydrocarbon contamination (fuels or oils) was encountered during the intrusive site works.

Samples of the made ground were scheduled for chemical laboratory screening and the results were assessed against generic assessment criteria for human health for a commercial development. None of the contaminants within the made ground exceeded the assessment criteria and asbestos fibres were not detected. The report indicated that remediation is not required with respect human health for a continued commercial/industrial end use.

2.0 Ground Investigation Reporting

2.1 Ground Investigation Aims and Objectives

The overall objective of this Ground Investigation is to provide information relating to the groundwater quality beneath the site to determine any potential risks to the surrounding environment.

2.2 Guidelines, Codes of Practice and Third-Party Accreditations

This report contains information relating to the geotechnical properties of the soils encountered on site to aid foundation and highway design by a Structural Engineer. The report also incorporates a Level 1 Ground Contamination and Ground Gas Risk Assessment for Human Health (Generic Quantitative Risk Assessment – GQRA).

The laboratory testing (geotechnical and ground contamination) was completed by UKAS and MCERTS accredited laboratories with details given in Sections 6, with copies of the test reports contained within Appendix III.

This Ground Investigation Report has generally been completed in accordance with the following documents:

- Land Contamination Risk Management Stages 1 to 4 (LCRM – www.gov.uk) – April 2021.
- BS10175: 2017: Code of Practice for the Investigation of Potentially Contaminated Sites.
- BS5930: 2020: Code of Practice for Site Investigations.
- BS1377: 1990: Methods of test for soils for civil engineering purposes.
- Eurocode 7 – Geotechnical Design (Part 1: General Rules and; Part 2: Ground Investigation and Testing).
- UK Specification for Ground Investigation, 2nd Edition. Site Investigation Steering Group, 2011.
- Effective Site Investigation. Site Investigation Steering Group, 2013.

2.3 Ground Investigation Limitations of Use

Although every effort is made to ensure a full and comprehensive investigation has been completed, it should always be borne in mind that ground conditions have the potential to vary between exploratory hole locations and it is recommended that the developer adopt a “watching brief” during the redevelopment works to ensure that any potential variations encountered are identified and dealt with in an appropriate manner.

The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/or other key stakeholders, including warranty providers in order to seek their approval of the findings prior to undertaking any development works.

The Ground Investigation Report and its contents are limited to the boundaries of the site, as indicated on the Plans in Appendix I. Reliance on the report is for the named Client only. No reliance, copying or use of this report (in part or whole) by any Third Party is permitted without prior written approval from Geo Environmental Engineering Ltd, with intellectual copyright remaining the sole property of the author. Reliance on the report and its associated information is strictly in accordance with Geo Environmental Engineering Ltd Terms and Conditions, copies of which are available on request.

3.0 Ground Investigation Fieldwork

3.1 Intrusive Investigation Fieldworks Summary

Groundwater samples were recovered on the 6th June 2023 from wells that were installed in boreholes BH01, BH02 and BH03 during the previous investigation. Groundwater was purged from the wells using bailers prior to recovery of 'fresh' samples in amber glass bottles that were stored in chiller boxes.

The exploratory hole location plan is provided in Appendix I.

A copy of the borehole logs is included in Appendix II.

The previous investigation works were undertaken in accordance with BS5930:2020, BS1377:1990 and Eurocode 7 (Part I and II).

The chemical laboratory screening results for the groundwater samples are provided in Appendix III.

All depths included in the report are in metres below ground level (m bgl), unless stated otherwise.

4.0 Laboratory Testing

4.1 Controlled Waters Risk Assessment

4.1.1 Groundwater Sampling and Screening

To enable the completion of a Level 1 Generic Quantitative Risk Assessment (GQRA) for Controlled Waters, samples of groundwater were recovered from boreholes BH01, BH02 and BH03 on the 6th June 2023. Groundwater levels were noted to be relatively shallow (<1.00m bgl) during the sampling.

The samples were recovered in 1 litre amble glass bottles. The samples were screened at the following UKAS and MCERTS accredited laboratory:

- Chemtech Environmental Testing of Stanley, County Durham.

The samples were subjected to chemical screening for the following range of potential contaminants:

- **Inorganic Soil Suite:** Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium and Zinc), Cyanide (total), Hardness, pH, Sulphide and Sulphate.
- **Organic Soil Suite (Human Health Risk Assessment):** Speciated Polycyclic Aromatic Hydrocarbons (PAH – USEPA 16), Speciated Petroleum Hydrocarbons and BTEX.

The full catalogue of soil screening results and test detection limits can be seen in the Chemtech report (ref: 123511) contained in Appendix III.

5.0 Generic Quantitative Risk Assessment (GQRA)

5.1 Methodology for Assessing Risk to Controlled Waters

Groundwater screening has been completed in order to determine the quality of the groundwater beneath the site and therefore, determine potential risks to the wider environment.

The testing also provides a base line for any future assessments which may be required during construction.

The results of the groundwater screening have been assessed using UK published Generic Assessment Criteria (GAC) for freshwater were possible. Where suitable assessment criteria are not available for environmental receptors, the test results have been compared against assessment criteria for stringent Drinking Water Standards, Test Detection Limits (TDL) or other Environmental Guidelines where appropriate. Further details are provided below:

The GAC have been derived using the following guidance documents:

- EA Environmental Quality Standard (EQS) for Freshwater.
- EU Environmental Quality Standard (EQS) for Freshwater.
- The River Basin Districts Typology, Standard and Groundwater Threshold Values within the Water Framework Directive 2010 (updated values 2014).
- UK Drinking Water Standards taken for Water Supply (Water Quality) Regulations 1989 and 2000.
- World Health Organisation Drinking Water Standards
- Environmental Risk Limits (Netherlands National Institute for Public Health and the Environment).

The results of the analysis and chosen GAC are presented in the Contamination Assessment Sheet (waters) contained in Appendix IV. Where the results exceed the GAC values, the results are highlighted in yellow. Where exceedances are noted, they do not automatically indicate a significant risk to Controlled Waters, especially where the results are assessed against GAC for drinking water standards as the assessment criteria are very stringent.

5.2 Controlled Waters Risk Assessment – Comparison with Guidance Levels

The water samples were noted to be very cloudy with suspended sediment. This is likely due to disturbance caused during the investigation fieldworks and subsequent sampling. It is likely that the disturbance and release of particulates into the groundwater will significantly increase the contaminant concentrations within the groundwater samples. Therefore, the contaminant concentrations recorded during the chemical screening are likely to represent a worst-case scenario such as during construction or earthworks. It is likely that the contaminant concentrations will attenuate significantly once the ground has settled.

5.2.1 Inorganic Contaminant Concentrations

The results of the inorganic screening have been compared to published Generic Assessment Criteria (GAC). The pH values indicate typically alkali conditions.

The results of the inorganic screening were variable with elevated concentrations of copper, lead and zinc in borehole BH01. The concentration of sulphide exceeded the assessment criteria in boreholes BH01 and BH02.

None of the inorganic contaminant concentrations exceeded the assessment criteria in BH03.

5.2.2 Organic Contaminant Concentrations

The concentrations of Poly-Aromatic Hydrocarbons (PAH) were variable across the site with numerous exceedances in boreholes BH01 and BH02. However, none of the PAH concentrations exceeded the GAC in borehole BH03.

The concentrations of petroleum hydrocarbons and BTEX were low (typically below the level of detection) with none exceeding the assessment criteria. Low concentrations of heavy end aromatic compounds were detected in borehole BH02, however, the levels did not exceed the GAC.

5.2.3 Controlled Waters Risk Assessment – Summary

Based on the Controlled Waters Risk Assessment above, the following contaminants have been identified as exceeding the assessment criteria, and, therefore, potentially posing a risk to controlled waters:

- **Inorganic Contamination:** Elevated copper, lead, zinc and sulphide in BH01 and BH02 only.
- **Organic Contamination:** Elevated PAH compounds in BH01 and BH02 only.

The results indicated elevated concentrations of copper, lead, zinc, sulphide and PAH compounds in boreholes BH01 and BH02. No exceedances were encountered within BH03.

This is discussed further in Section 6.

6.0 Discussion and Recommendations

6.1 Contamination Risk Assessment and Discussion

During the ground investigation works, no visual or olfactory evidence of mobile contamination (fuels, oils, etc…) were encountered.

The results of the chemical screening undertaken on the groundwater samples indicates elevated concentrations of metals, sulphides and PAH compounds within boreholes BH01 and BH02. These boreholes both encountered significant made ground comprising dark grey ash-clinker fill with coarse gravel of slag, concrete, slate, brick and tile. The boreholes were terminated in the made ground due to refusal (no further penetration possible).

No exceedances were recorded in the groundwater from borehole BH03 which comprised shallow made ground of concrete, slag and brick overlying possible relict foundations. This was underlain by natural silty sand deposits.

It is likely that the elevated contamination concentrations within the groundwater have resulted from leaching of the surrounding ashy made ground. There is no evidence of contamination originating from the adjacent garage.

Some of the results were assessed against stringent GAC for drinking water standards and do not necessarily indicate an elevated risk to environmental receptors.

Although the results indicate potential leaching from the surrounding soils, it is likely that the levels recorded are significantly higher than those typically present due to disturbance of the ground and groundwater during the site works and sampling. When taking into account dilution and dispersal factors, the groundwater is unlikely to pose a significant or widespread risk to the surrounding environment. It is unclear at this stage if there is any significant groundwater flow beneath the site, however, the groundwater appeared relatively static and possibly perched during the fieldworks.

The Client may wish to consider excavating and disposing of the ash-clinker materials encountered in boreholes BH01 and BH02 from the site as this would remove the source of the contamination. However, the ashy made ground materials probably extend well beyond the site boundary as records indicate that the site is located within an extensive area of made ground (the BGS record a significant area of made ground surrounding the site as noted in Section 1.4). Therefore, the overall effect on the surrounding environment from removing made ground from site is likely be very low, as the greater risk is likely from the surrounding area.

There is also a potential for temporarily increase in contamination concentrations within the groundwater during construction due to disturbance of the soils. The concentrations are likely to be similar to those seen during this investigation. However, concentrations are likely to attenuate quickly upon completion of the works once the ground has had chance to settle. Nonetheless, protection measures are recommended during construction to prevent excess risks to the surrounding environment and Controlled Waters. These are discussed below.

6.2 Contaminant Mitigation Measures

As discussed above, there is a potential risk to the underlying groundwater during construction due to disturbance of the made ground. Attenuation of contaminant concentrations is likely following completion of the development works once the disturbance has ceased and the soils have settled.

In order to reduce or mitigate the risks to groundwater and nearby watercourses during construction, the following precautions are recommended:

- Sediment filters/barriers (silt traps) should be adopted between any earthworks / construction and any nearby watercourses.
    - These should be periodically inspected and checked to ensure that they are appropriately located, have not become overloaded and are working as intended.
- Made ground materials should not be left exposed at the surface following completion of the development. Where possible, the ground should be surfaced with hardstanding (concrete) o prevent or reduce surface water infiltrations.
- Made ground materials excavated as part of the proposed works should be disposed of offsite immediately or reused and sealed as quickly as possible.
    - Unsealed stockpiles can significantly increase the risk of leaching or mobilisation of contaminated sediment and should be avoided.
- Groundwater control measures (pumping) may be required during construction where shallow groundwater is encountered. The water should be stored in sealed settlement containers and appropriately treated prior to discharge or disposed of offsite appropriately.
- The use of soakaway drainage should be prohibited within the development due to the potential for increased water flow through the made ground. Ideally, rainwater should be discharged directly to the existing stream via a drainage system with appropriate attenuation and oil/water separators.

The precautions noted above, and the use of good construction practices should ensure that the risk to the wider environment is reduced as much as reasonably possible.

6.3 General Comments

Consideration must be made for variations to occur in the ground conditions between the exploratory hole locations for which GEO holds no responsibility and areas where limited access was available. It is therefore recommended that a “watching brief” and “observational technique” be applied to this site to ensure that if ground conditions appear to vary from those identified within this investigation report then advice should be sought from a suitably qualified and experienced Engineering Geologist, Geotechnical or Geo-Environmental Engineer.

The recommendations and opinions expressed in this report are based on the strata observed within the exploratory holes in addition to the results of the site and laboratory tests commissioned by GEO. Consequently, GEO takes no responsibility for conditions that have not been revealed or which occur between them. GEO takes no responsibility for the accuracy of third party information provided by sub-contract drillers or laboratories.

The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/ or other key stakeholders including warranty providers in order to seek their approval of the findings prior to undertaking any works on site.

During the construction works it is likely that materials will be excavated on site (i.e. future foundations and buried utilities, etc.) that will not be able to be accommodated on site during to space and level constraints, ultimately requiring removal off site.

During the construction works, different materials should be stockpiled separately, and an appropriate waste disposal classification should be determined by the Design Team prior to removal. It may be the case that WAC testing is required to aid the assessment.

Where made ground materials or disturbed natural strata is to be removed, the results of the soil testing undertaken within this report can be used as a preliminary assessment and the anticipated waste disposal facility should be provided with a copy of the results for review. It may be the case that the waste facility requires additional contamination screening to aid the characterisation of the made ground for off-site disposal (i.e. Waste Acceptance Criteria – WAC) and it is recommended that this be confirmed by the design team prior to commencing on site.

During the construction phase, it may be the case that WAC screening is required to aid classification for disposal and it is recommended that all materials are classified prior to excavation and disposal off site.

Conversely, if materials are required to be brought to site to raise site levels or as part of a clean cover system then certification and/or soil testing results should be reviewed by a suitably experienced and qualified geo-environmental engineer to ensure that potentially contaminated materials are not being brought to site.

Any material movements may require a Material Management Plan (MMP) in accordance with CL:AIRE.

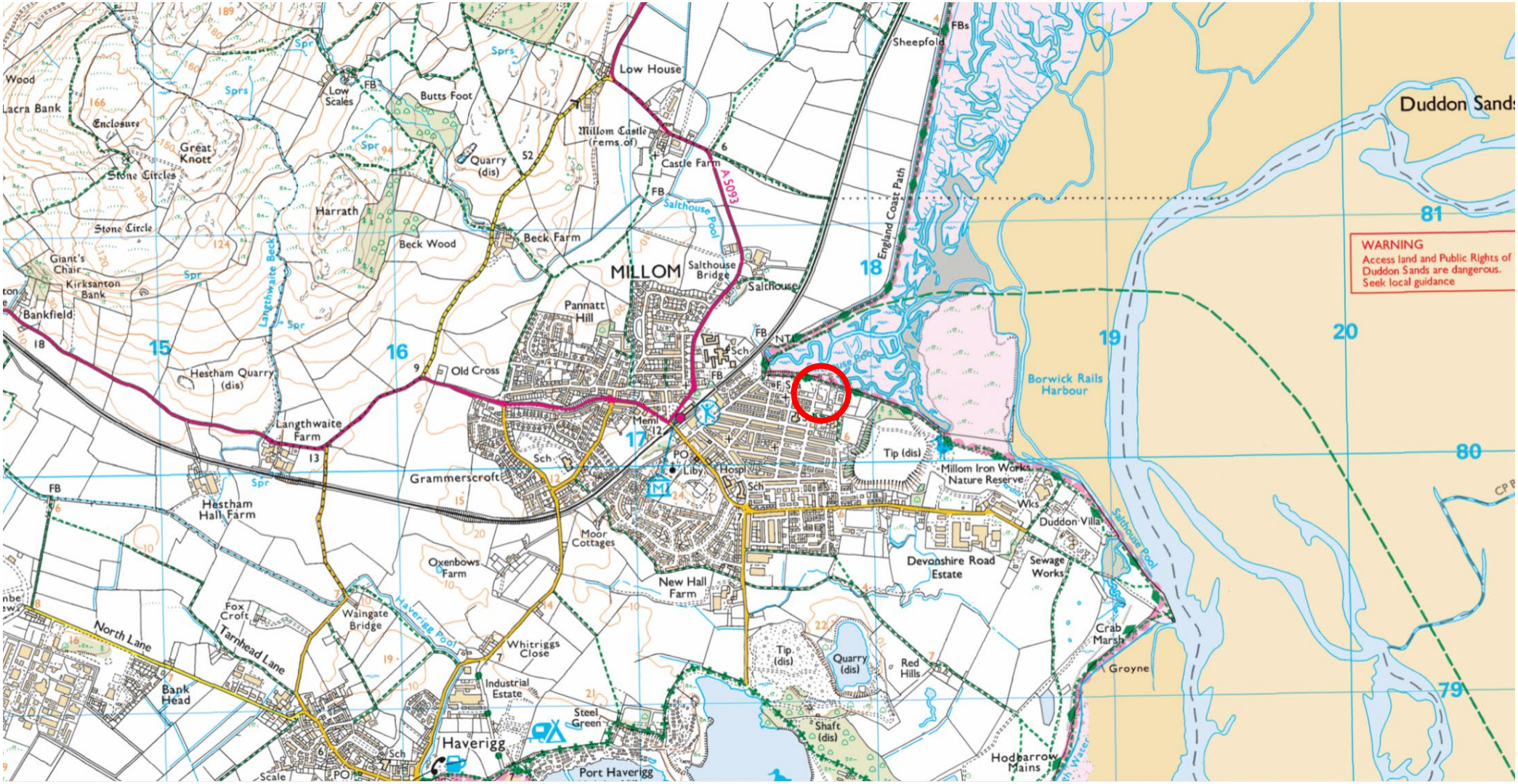
End of Report

Appendix I

- Site Location Plan
- Exploratory Hole Location Plan
- Proposed Site Layout Plan

GEO Environmental Engineering

GEO2022-5901: Millom Road, Millom – Site Location



Website: www.geoenvironmentalengineering.com
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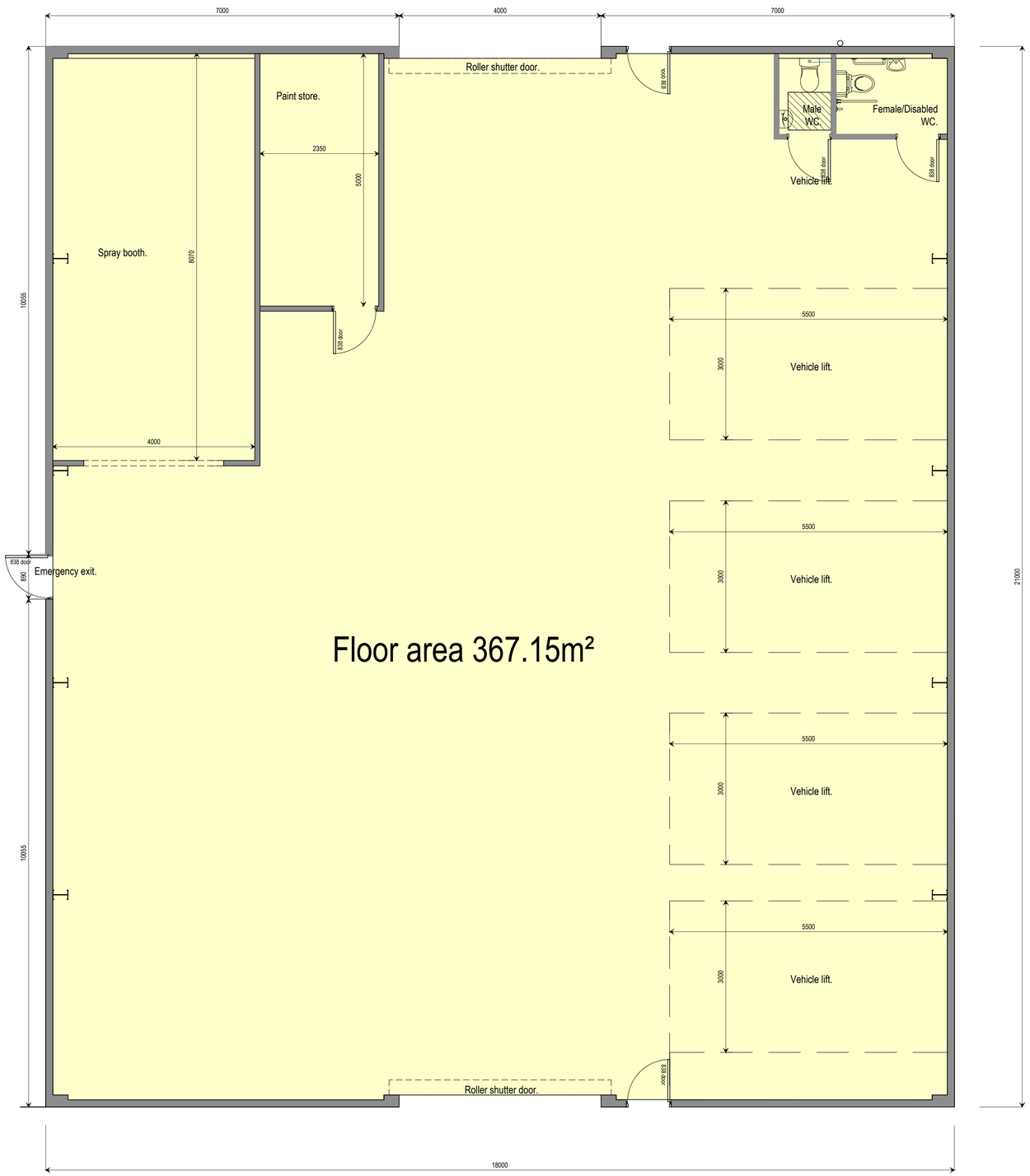
Telephone: 07883 440 186

GEO Environmental Engineering

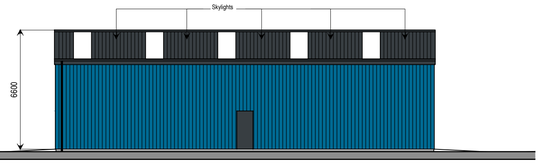
GEO2022-5901: Millom Road, Millom – Exploratory Hole Location Plan

Website: www.geoenvironmentalengineering.com
Email: info@geoenvironmentalengineering.com
Telephone: 07883 440 186

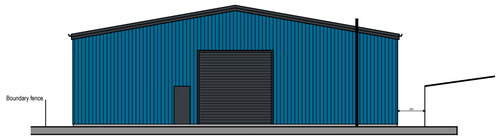


Proposed floor plan

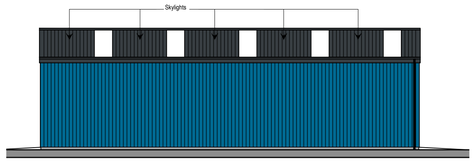
Proposed front elevation



Proposed West elevation



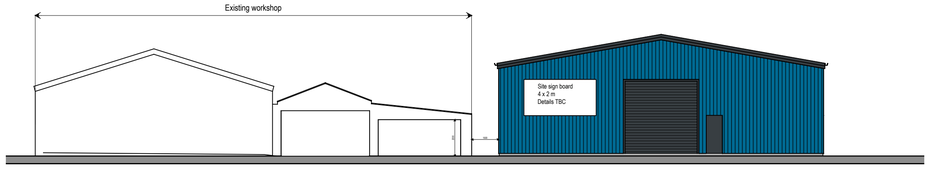
Proposed rear elevation



Proposed east elevation

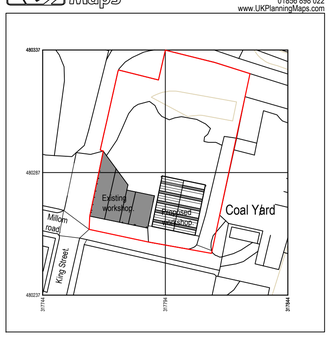
Materials.

Roof. Profiled metal sheets colour Anthracite.RAL 7016
Walls. Profiled metal sheets colour Solent Blue.RAL CLASSIC 240 40 40
Doors. Coated steel colour Anthracite.RAL 7016
Fascias,gutters and downpipes. Coated steel colour Anthracite.RAL 7016



Millom Road street scene.

UK Planning Maps
01856 898 022
www.UKPlanningMaps.com



Location plan 1:1250 scale
Total site area = 3847m²
Site boundary shown

FOR PLANNING PURPOSES ONLY.

Rev.B.Internal alterations.Sept 2022.
Rev.A.Building flipped back to front.Sept 2022.

Proposed Vehicle body workshop at Millom Road,Millom.Cumbria.LA18 4BW.
For Mr.J.Milligan.
General arrangement drawing.

Scales 1:50,1:1250 @A1
June 2022.
Dwg No.MIL.JM.01(B).

N

Existing post and wire fence 1200mm high.

New saddle connection to existing sewer by specialist contractor.

New FW IC

Existing waste storage area.

Gravel Parking Area

New FW IC

Existing post and wire fence 1200mm high.

New SW IC

New Concrete ramp.

New access gate.

Ex.S.W. mh C.L. = 4.511

New FW IC

rwg

rwg

Ex.M.H. c.l. = 4.813

Ex.M.H. c.l. = 4.878

Gully

Ex.IC c.l. = 4.816

EFL = 4.990

Shipping Containers

KING STREET

EXISTING SERVICE AREA

Eaves Height = 8.688

Ridge Height = 10.760

EXISTING WORKSHOP AREA

Ridge Height = 8.830

Eaves Height = 7.120

EFL = 5.010

EFL = 4.910

EFL = 4.795

EFL = 4.813

Ex.IC c.l. = 4.974

Ex.M.H. c.l. = 4.855

Gravel Parking Area

Parking (New)

Parking (New Disabled)

New Concrete ramp.

Parking (New)

MILLOM ROAD

Ex 1200mm Ø Combined sewer.

Existing unadopted Macadam Road.

Gully

Lamp Post

WA 1

Gully

Existing unadopted Pavement.

MILLOM ROAD

WA 2

Ex.S.W. mh C.L. = 5.148

Unable to access to check invert depth

225 Dia SW drain

225 Dia SW drain

225 Dia SGW drain

225 Dia SW drain

Palisade fencing

Palisade Fencing

Ex.S.W. mh c.l. = 5.130 i.l. = 3.795

KING STREET

Palisade fencing

Gravel Parking Area

CONCRETE FLAGGED PATHS - 450 x 450 x 35mm concrete flags on 25mm sand/cement bedding on min. 100mm compacted stone base.
DRAINAGE All pipes for private (not adopted) drainage to be uPVC, with 100mm deep bedding + fill to top of pipe in 10mm granular material, and backfilled with selected fill free from stones larger than 40mm. Concrete bed and surround to pipes required where cover is less than 900mm under roads and drives.
INSPECTION CHAMBERS to be 320mm dia. (max depth 600mm) or 460mm dia. (max depth 1200mm) or 460mm dia with max 350mm dia. cover to restrict access (depth greater than 1200mm).
INSPECTION CHAMBERS & COVERS are designed to be appropriate for their location and traffic load - these should be re-assessed if drainage design is changed on site.

NOTES:- Finished floor level of the proposed building to be determined from the result of the Flood Risk Assessment.
All new drainage,falls,pipe sizes and invert and cover levels to be determined by the result of the Drainage Strategy.

FOR PLANNING PURPOSES ONLY.

Rev.C.Foul drainage updated.Sept.2022
Rev.B.Plan based on topo survey.New unit moved back 1.0m.
Drainage updated.Sept.2022

Proposed Vehicle body workshop at Millom Road,Millom.Cumbria.LA18 4BW.

For Mr.J.Milligan.

Site layout plan.

Scales 1:200 @A2
June 2022.
Dwg No.MIL.JM.02(C).

Appendix II

- Exploratory Hole Logs

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom - BH01 (Rear left Corner).

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	MADE GROUND: Grey and dark brown sandy fine to coarse GRAVEL of slag, concrete and brick with many slag cobbles.		0.15 T&J
0.30	1.73	MADE GROUND: Loose becoming very dense dark grey ash-clinker FILL with much fine to coarse gravel of slag, concrete, occasional slate, limestone, brick and tile. Some softer organic peaty inclusions around 0.95m.		1.00 T&J 1.10 SPT: 1/1/1/2/5/6. N14 1.50 T&J 1.65 SPT: N50/30mm
		End of borehole due to sample tube and SPT refusal. Water strike at 0.70m and SWL at 0.55m after 20 minutes. Borehole installed: GL to 0.45m plain pipe 0.45m to 1.45m slotted pipe		Hand dug before drilling. Cased to 1.50m.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom - BH02 (Central).

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.35	MADE GROUND: Grey sandy fine to coarse GRAVEL of slag, concrete and brick with occasional slag and brick cobbles.		0.20 TJ
0.35	1.30	MADE GROUND: Very dense dark grey ash-clinker FILL with much fine to coarse gravel of slag, concrete, occasional slate, limestone, brick and tile.		0.70 TJ 1.10 SPT: N50/70mm
		End of borehole due to sample tube and SPT refusal. Water strike and SWL at 0.55m after 20 minutes. Borehole installed: GL to 0.50m plain pipe 0.50m to 1.0m slotted pipe		Hand dug before drilling. Cased to 1.20m.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
HSV = Hand Shear Vane (result in kN/m^2)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom. BH03 (Front Left).

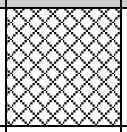
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.35	MADE GROUND: Grey sandy fine to coarse GRAVEL of slag, concrete and brick with occasional slag and brick cobbles.		0.30 TJ
0.35	0.45	MADE GROUND: CONCRETE.		
0.45	0.60	MADE GROUND: Cemented brick. Possible old foundation.		
0.60	3.45	Medium dense becoming very loose grey silty fine SAND.		0.60 TJ 1.00 T 1.10 SPT: 3/3/4/4/3/4. N15 2.00 T 2.00 SPT: 1/1/2/2/2/3. N9 3.00 T 3.00 SPT: 1/1/1/0/0/0. N1
		End of borehole due to sand blowing up casing to 2.25m. Water strike at 0.60m and 1.55m. SWL at 0.75m after 20 minutes. Borehole installed: GL to 0.50m plain pipe 0.5m to 2.5m slotted with geosock.		Hand dug before drilling. Cased to 2.50m. Sand blowing up casing to 2.25m.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom - BH04 (Rear Right).

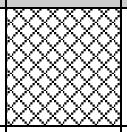
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	MADE GROUND: Grey slightly sandy fine to coarse GRAVEL and COBBLES of slag, concrete and brick.		0.20 TJ
		End of borehole due to high water table - unable to excavate. Water strike and SWL at 0.20m. Borehole backfilled with arisings on completion.		Hand dug.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom - BH05 (Front Right).

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.45	MADE GROUND: Dark grey slightly sandy fine to medium GRAVEL of tarmac, slag, brick, clinker and coal.		0.25 TJ
		End of borehole due to high water table - unable to excavate. Water strike and SWL at 0.15m. Borehole backfilled with arisings on completion.		Hand dug.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

Appendix III

- Laboratory Test Results

2531

ANALYTICAL TEST REPORT

Contract no: 123511

Contract name: Foundy Road Garage, King Street, Millom

Client reference: GEO2023-5901

Clients name: Geo Environmental Engineering

Clients address: 4 Culgarth Avenue
Cockermouth
Cumbria
CA13 9PL

Samples received: 07 June 2023

Analysis started: 07 June 2023

Analysis completed: 23 June 2023

Report issued: 23 June 2023

Key

U	UKAS accredited test
M	MCERTS & UKAS accredited test
$	Test carried out by an approved subcontractor
I/S	Insufficient sample to carry out test
N/S	Sample not suitable for testing

Approved by: E. McCulloch

Ellis McCulloch
Senior Reporting Administrator

Chemtech Environmental Limited

GROUNDWATERS

Lab number			123511-1	123511-2	123511-3
Sample id			BH01	BH02	BH03
Depth (m)			-	-	-
Date sampled			05/06/2023	05/06/2023	05/06/2023
Time sampled			-	-	-
Test	**Method**	**Units**			
Arsenic (dissolved)	$	µg/l As	42	46	24
Boron (dissolved)	$	µg/l B	360	190	180
Cadmium (dissolved)	$	µg/l Cd	< 0.11	< 0.11	< 0.11
Chromium (dissolved)	$	µg/l Cr	8.1	1.9	0.98
Copper (dissolved)	$	µg/l Cu	27	6.6	7.0
Lead (dissolved)	$	µg/l Pb	66	1.6	0.51
Mercury (dissolved)	$	µg/l Hg	0.07	< 0.05	< 0.05
Nickel (dissolved)	$	µg/l Ni	8.7	2.4	2.2
Selenium (dissolved)	$	µg/l Se	2.6	6.1	1.3
Zinc (dissolved)	$	µg/l Zn	35	11	< 2.5
Hardness (by calculation)	$	mg/l $CaCO_3$	170	60	210
pH	CE213 [U]	units	9.0	10.0	8.3
Sulphate	CE049 [U]	mg/l SO_4	95	174	81
Sulphide	CE249	µg/l S^{2-}	8119	2970	<100
Cyanide (total)	CE147	µg/l CN	382	<5	36
PAH					
Naphthalene	CE051	µg/l	0.5	2.3	<0.1
Acenaphthylene	CE051	µg/l	<0.1	1.6	<0.1
Acenaphthene	CE051	µg/l	<0.1	1.9	<0.1
Fluorene	CE051	µg/l	<0.1	2.2	<0.1
Phenanthrene	CE051	µg/l	0.7	19.1	<0.1
Anthracene	CE051	µg/l	<0.1	6.4	<0.1
Fluoranthene	CE051	µg/l	1.3	50.4	<0.1
Pyrene	CE051	µg/l	1.1	44.6	<0.1
Benzo(a)anthracene	CE051	µg/l	0.3	27.5	<0.1
Chrysene	CE051	µg/l	0.4	30.2	<0.1
Benzo(b)fluoranthene	CE051	µg/l	0.5	33.5	<0.1
Benzo(k)fluoranthene	CE051	µg/l	<0.1	13.7	<0.1
Benzo(a)pyrene	CE051	µg/l	0.3	32.4	<0.1
Indeno(123cd)pyrene	CE051	µg/l	<0.1	19.3	<0.1
Dibenz(ah)anthracene	CE051	µg/l	<0.1	2.9	<0.1
Benzo(ghi)perylene	CE051	µg/l	0.2	20.3	<0.1
PAH (total of USEPA 16)	CE051	µg/l	5.2	308.3	<1.6
BTEX & TPH					
Benzene	CE057 [U]	µg/l	<1	<1	<1
Toluene	CE057 [U]	µg/l	1	1	<1
Ethylbenzene	CE057 [U]	µg/l	<1	<1	<1
m & p-Xylene	CE057 [U]	µg/l	2	<2	<2
o-Xylene	CE057 [U]	µg/l	1	<1	<1
VPH Aromatic (>EC5-EC7)	CE175	µg/l	<1	<1	<1

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GROUNDWATERS

Lab number			123511-1	123511-2	123511-3
Sample id			BH01	BH02	BH03
Depth (m)			-	-	-
Date sampled			05/06/2023	05/06/2023	05/06/2023
Time sampled			-	-	-
Test	**Method**	**Units**			
VPH Aromatic (>EC7-EC8)	CE175	µg/l	<1	1	<1
VPH Aromatic (>EC8-EC10)	CE175	µg/l	4	<1	<1
EPH Aromatic (>EC10-EC12)	CE251	µg/l	<1	<1	<1
EPH Aromatic (>EC12-EC16)	CE251	µg/l	<1	<1	<1
EPH Aromatic (>EC16-EC21)	CE251	µg/l	<1	19	<1
EPH Aromatic (>EC21-EC35)	CE251	µg/l	<1	31	<1
EPH Aromatic (>EC35-EC44)	CE251	µg/l	<1	<1	<1
VPH Aliphatic (>C5-C6)	CE175	µg/l	<1	<1	<1
VPH Aliphatic (>C6-C8)	CE175	µg/l	<1	<1	<1
VPH Aliphatic (>C8-C10)	CE175	µg/l	<1	<1	<1
EPH Aliphatic (>C10-C12)	CE251	µg/l	<1	<1	<1
EPH Aliphatic (>C12-C16)	CE251	µg/l	<1	<1	<1
EPH Aliphatic (>C16-C35)	CE251	µg/l	<1	<1	<1
EPH Aliphatic (>C35-C44)	CE251	µg/l	<1	3	<1

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METHOD DETAILS

METHOD	GROUNDWATERS	METHOD SUMMARY	STATUS	LOD	UNITS
$	Arsenic (dissolved)	ICP-MS	U	0.2	µg/l As
$	Boron (dissolved)	ICP-MS	U	10	µg/l B
$	Cadmium (dissolved)	ICP-MS	U	0.11	µg/l Cd
$	Chromium (dissolved)	ICP-MS	U	0.5	µg/l Cr
$	Copper (dissolved)	ICP-MS	U	0.5	µg/l Cu
$	Lead (dissolved)	ICP-MS	U	0.5	µg/l Pb
$	Mercury (dissolved)	ICP-MS	U	0.05	µg/l Hg
$	Nickel (dissolved)	ICP-MS	U	0.5	µg/l Ni
$	Selenium (dissolved)	ICP-MS	U	0.5	µg/l Se
$	Zinc (dissolved)	ICP-MS	U	3	µg/l Zn
$	Hardness (by calculation)	Calculation from Ca (dissolved) & Mg (dissolved)		15	mg/l $CaCO_3$
CE213	pH	Based on BS 1377, pH Meter	U	-	units
CE049	Sulphate	Ion Chromatography	U	1.7	mg/l SO_4
CE249	Sulphide	Distillation, Titration		100	µg/l S^{2-}
CE147	Cyanide (total)	Continuous Flow Colorimetry		5	µg/l CN
CE051	Naphthalene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Acenaphthylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Acenaphthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluorene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Phenanthrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Chrysene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(b)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(k)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Indeno(123cd)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Dibenz(ah)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(ghi)perylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	PAH (total of USEPA 16)	Solvent extraction, GC-MS		1.6	µg/l
CE057	Benzene	Headspace GC-FID	U	1	µg/l
CE057	Toluene	Headspace GC-FID	U	1	µg/l
CE057	Ethylbenzene	Headspace GC-FID	U	1	µg/l
CE057	m & p-Xylene	Headspace GC-FID	U	2	µg/l
CE057	o-Xylene	Headspace GC-FID	U	1	µg/l
CE175	VPH Aromatic (>EC5-EC7)	Headspace GC-FID		1	µg/l
CE175	VPH Aromatic (>EC7-EC8)	Headspace GC-FID		1	µg/l
CE175	VPH Aromatic (>EC8-EC10)	Headspace GC-FID		1	µg/l
CE251	EPH Aromatic (>EC10-EC12)	Solvent extraction, GCxGC-FID		1	µg/l
CE251	EPH Aromatic (>EC12-EC16)	Solvent extraction, GCxGC-FID		1	µg/l
CE251	EPH Aromatic (>EC16-EC21)	Solvent extraction, GCxGC-FID		1	µg/l
CE251	EPH Aromatic (>EC21-EC35)	Solvent extraction, GCxGC-FID		1	µg/l

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METHOD DETAILS

METHOD	GROUNDWATERS	METHOD SUMMARY	STATUS	LOD	UNITS
CE251	EPH Aromatic (>EC35-EC44)	Solvent extraction, GCxGC-FID		1	µg/l
CE175	VPH Aliphatic (>C5-C6)	Headspace GC-FID		1	µg/l
CE175	VPH Aliphatic (>C6-C8)	Headspace GC-FID		1	µg/l
CE175	VPH Aliphatic (>C8-C10)	Headspace GC-FID		1	µg/l
CE251	EPH Aliphatic (>C10-C12)	Solvent extraction, GCxGC-FID		1	µg/l
CE251	EPH Aliphatic (>C12-C16)	Solvent extraction, GCxGC-FID		1	µg/l
CE251	EPH Aliphatic (>C16-C35)	Solvent extraction, GCxGC-FID		1	µg/l
CE251	EPH Aliphatic (>C35-C44)	Solvent extraction, GCxGC-FID		1	µg/l

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DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
123511-1	BH01	-	Y	Cyanide (NCF), Sulphide (NCF)
123511-2	BH02	-	Y	Cyanide (NCF), Sulphide (NCF)
123511-3	BH03	-	Y	Cyanide (NCF), Sulphide (NCF)

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ADDITIONAL INFORMATION

Notes

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

This report shall not be reproduced except in full, without prior written approval.

Samples will be disposed of 4 weeks from initial receipt unless otherwise instructed.

BTEX compounds are identified by retention time only and may include interference from co-eluting compounds.

Appendix IV

- GEO Chemical Assessment Sheet

Geo Environmental Engineering Ltd

Chemical Assessment Sheet - Groundwater

Lab number			123511-1	123511-2	123511-3	GAC Value	GAC Exceeded?	GAC Ref
Sample id			BH01	BH02	BH03			
Depth (m)			-	-	-			
Date sampled			05/06/2023	05/06/2023	05/06/2023			
Time sampled			-	-	-			
Test	**Method**	**Units**						
Arsenic (dissolved)	$	µg/l As	42.00	46.00	24.00	50.0	No	WFD
Boron (dissolved)	$	µg/l B	360	190	180	1000	No	EQS Fresh
Cadmium (dissolved)	$	µg/l Cd	< 0.11	< 0.11	< 0.11	5	No	EQS Fresh
Chromium (dissolved)	$	µg/l Cr	8.1	1.9	1.0	50	No	UK DWS
Copper (dissolved)	$	µg/l Cu	27.0	6.6	7.0	10	YES	EQS Fresh
Lead (dissolved)	$	µg/l Pb	66.0	1.6	0.5	25	YES	UK DWS
Mercury (dissolved)	$	µg/l Hg	0.070	< 0.05	< 0.05	1	No	EQS Fresh
Nickel (dissolved)	$	µg/l Ni	8.7	2.4	2.2	20	No	UK DWS
Selenium (dissolved)	$	µg/l Se	2.60	6.10	1.30	10	No	UK DWS
Zinc (dissolved)	$	µg/l Zn	35	11	< 2.5	30	YES	EQS Fresh
Hardness (by calculation)	$	mg/l CaCO3	170	60	210	N/A	N/A	N/A
pH	CE213 U	units	9.0	10.0	8.3	N/A	N/A	N/A
Sulphate	CE049 U	mg/l SO4	95	174	81	N/A	N/A	N/A
Sulphide	CE249	µg/l S2-	8119	2970	<100	250	YES	UK DWS
Cyanide (total)	CE147	µg/l CN	382	<5	36	20	No	TDL
PAH								
Naphthalene	CE051	µg/l	0.5	2.3	<0.1	2.0	YES	EU EQS
Acenaphthylene	CE051	µg/l	<0.1	1.6	<0.1	0.1	YES	UK DWS
Acenaphthene	CE051	µg/l	<0.1	1.9	<0.1	0.1	YES	UK DWS
Fluorene	CE051	µg/l	<0.1	2.2	<0.1	0.1	YES	UK DWS
Phenanthrene	CE051	µg/l	0.7	19.1	<0.1	1.9	YES	ERL
Anthracene	CE051	µg/l	<0.1	6.4	<0.1	0.1	YES	UK DWS
Fluoranthene	CE051	µg/l	1.3	50.4	<0.1	0.1	YES	UK DWS
Pyrene	CE051	µg/l	1.1	44.6	<0.1	0.1	YES	UK DWS
Benzo(a)anthracene	CE051	µg/l	0.3	27.5	<0.1	0.1	YES	UK DWS
Chrysene	CE051	µg/l	0.4	30.2	<0.1	0.1	YES	UK DWS
Benzo(b)fluoranthene	CE051	µg/l	0.5	33.5	<0.1	0.1	YES	UK DWS
Benzo(k)fluoranthene	CE051	µg/l	<0.1	13.7	<0.1	170	No	EU EQS
Benzo(a)pyrene	CE051	µg/l	0.3	32.4	<0.1	170	No	EU EQS
Indeno(123cd)pyrene	CE051	µg/l	<0.1	19.3	<0.1	170	No	EU EQS
Dibenz(ah)anthracene	CE051	µg/l	<0.1	2.9	<0.1	0.1	YES	UK DWS
Benzo(ghi)perylene	CE051	µg/l	0.2	20.3	<0.1	170	No	EU EQS
PAH (total of USEPA 16)	CE051	µg/l	5.2	308.3	<1.6	-	-	-
BTEX & TPH								
Benzene	CE057 U	µg/l	<1	<1	<1	3	No	WHO-DWQ
Toluene	CE057 U	µg/l	1	1	<1	500	No	WHO-DWQ
Ethylbenzene	CE057 U	µg/l	<1	<1	<1	500	No	WHO-DWQ
m & p-Xylene	CE057 U	µg/l	2	<2	<2	10	No	WHO-DWQ
o-Xylene	CE057 U	µg/l	1	<1	<1	700	No	WHO-DWQ
VPH Aromatic (>EC5-EC7)	CE175	µg/l	<1	<1	<1	10	No	UK DWS
VPH Aromatic (>EC7-EC8)	CE175	µg/l	<1	1	<1	10	No	UK DWS
VPH Aromatic (>EC8-EC10)	CE175	µg/l	4	<1	<1	300	No	WHO-DWQ
EPH Aromatic (>EC10-EC12)	CE251	µg/l	<1	<1	<1	90	No	WHO-DWQ
EPH Aromatic (>EC12-EC16)	CE251	µg/l	<1	<1	<1	90	No	WHO-DWQ
EPH Aromatic (>EC16-EC21)	CE251	µg/l	<1	19	<1	90	No	WHO-DWQ
EPH Aromatic (>EC21-EC35)	CE251	µg/l	<1	31	<1	90	No	WHO-DWQ
EPH Aromatic (>EC35-EC44)	CE251	µg/l	<1	<1	<1	10	No	UK DWS
VPH Aliphatic (>C5-C6)	CE175	µg/l	<1	<1	<1	15000	No	WHO-DWQ
VPH Aliphatic (>C6-C8)	CE175	µg/l	<1	<1	<1	15000	No	WHO-DWQ
VPH Aliphatic (>C8-C10)	CE175	µg/l	<1	<1	<1	300	No	WHO-DWQ
EPH Aliphatic (>C10-C12)	CE251	µg/l	<1	<1	<1	300	No	WHO-DWQ
EPH Aliphatic (>C12-C16)	CE251	µg/l	<1	<1	<1	300	No	UK DWS
EPH Aliphatic (>C16-C35)	CE251	µg/l	<1	<1	<1	10	No	UK DWS
EPH Aliphatic (>C35-C44)	CE251	µg/l	<1	3	<1	10	No	UK DWS

EQS Fresh = Environmental Quality Standards for Freshwater
EU EQS - EU Environmental Quality Standards for Freshwater
WFD = Water Framework Directive 2014: standards to protect the water environment
UK DWS = UK Drinking Water Standards
WHO DWS = World Health Organisation Drinking Water Standards
TDL - Test Detection Limits
ERL - Envrionmental Risk Limits (Netherlands National Institute for Public Health and the Environment).

GEO Environmental Engineering Ltd

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