DUMFRIES & GALLOWAY COUNCIL

SPARLING FOOTBRIDGE, NEWTON STEWART

REPORT ON GROUND INVESTIGATION

Contract: 31371

Date: July 2017

Ian Farmer Associates (1998) Limited
Unit 4 Faraday Close,
Washington, Tyne and Wear, NE38 8QJ
Tel: 0191 482 8500
Fax: 0191 482 8520

REPORT ON GROUND INVESTIGATION

Carried out at

SPARLING FOOTBRIDGE, NEWTON STEWART

Prepared for

DUMFRIES & GALLOWAY COUNCIL
Engineering Design
Cargen Tower
Garroch Business Park
Garroch Loaning,
Dumfries,
DG2 8PN

Contract No: 31371

Date: July 2017

Ian Farmer Associates (1998) Limited
Unit 4, Faraday Close,
Washington, Tyne and Wear, NE38 8QJ
Tel: 0191 482 8500
Fax: 0191 482 8520

Report Issue Log

Draft Issue	Issued By P. Challinor	Checked By
Issue Method E	Date 30/06/2017	Date

Revision	Issued	Checked By C. Lewis
Issue Method E	Date 03/07/2017	Date 03/07/2017

Revision	Issued By	Checked By
Issue Method E/P/D	Date	Date

Issue Method: E = Electronic
P = Paper
D = Disc

EXECUTIVE SUMMARY

On the instructions of Dumfries and Galloway Council, a ground investigation was undertaken to determine ground conditions to enable foundation design to be carried out, together with a contamination risk assessment, in respect to construction of a new footbridge over the River Cree, at Newton Stewart, Dumfries and Galloway.

The site is situated in the south of Newton Stewart on the western and eastern banks of the River Cree and can be located by National Grid Reference NX 412651.

To the immediate east of the proposed footbridge is agricultural land. To the west are commercial and residential areas of Newton Stewart.

Geological mapping indicates the site to be underlain by superficial deposits of Alluvium, associated with the River Cree, comprising silt, sand and gravel and is underlain by Wacke comprising sandstone, siltstone and mudstone in variable proportions.

On the western bank of the River Cree, and immediately east of the site, superficial deposits are indicated to be thin or absent and further to the east, superficial Alluvium is found overlying Wacke.

The site work was carried out between the 18th and 22nd May 2017 and consisted of three boreholes sunk by light cable percussion method and, designated BH1 to BH3.

Piezometers were installed in selected BH1 and BH2 and these were later monitored to determine ground water rest levels.

The ground conditions consist of near surface topsoil overlying alluvial sandy gravel. Ground water was encountered at a minimum depth of 1.8mbgl.

Consideration could be given to the adoption of shallow spread foundations to support the proposed structure. Spread foundations will be installed in the alluvial gravel at a minimum depth of 0.75mbgl.

To the eastern bank the ground conditions at foundation level consist of very dense/ medium dense sandy gravel and on the western bank loose/ medium dense sandy gravel.

On the basis of the corrected ‘N’ values recorded in the shallow stratum and in order to limit settlements to less than 25mm, an allowable bearing pressure of 110kPa could be adopted for design purposes. Settlements should be checked when the final structural loading is known.

It is likely that the settlement would be greater on the western bank foundations however settlement will be immediate within the construction period and using the above figure for design will limit the amount of differential movement to acceptable levels.

On the basis of the laboratory test results it is considered that a Design Sulphate Class for the site soils (silty sandy gravel) may be taken as DS-1. The site conditions would suggest that an ACEC class for the site of AC-1 would be appropriate.

The risk assessment has been based on guidelines for general open space (adjacent to dwellings).

The results of the soil analyses, with the exception of lead, have been compared to the recently published S4ULs (Suitable 4 Use Levels) determined by LQM and CIEH. As the CLEA SGV for lead was withdrawn in 2014, DEFRA have produced C4SLs (Category 4 Screening Levels) for lead and a number of other contaminants. As no S4UL has been produced for lead, the C4SL has been adopted.

As can be seen from the above tabulated results there were no determinants with values above the Guidance Values.

A conceptual model has been formed to reflect the findings of the contamination risk assessment and the revised conceptual model, detailing the relevant pollutant linkages, is tabulated below:

Source	Potential Contaminants of Concern	Potential Pathways	Receptor Group	Risk
Natural Alluvial soils	Heavy Metals (Copper & Zinc)	Surface runoff and drainage into the River Cree *2	Water Environment • Groundwater • Surface Water	Low/ Moderate
*2 – Pathway exists only during the construction period				

The results shows elevated levels of leachable copper and zinc, however the total concentrations were found to be low at 71mg/kg for copper and 1100mg/kg for zinc (below residential with gardens guidance) and therefore are unlikely to be of a concern.

To reduce the risk of leachate contaminating the River Cree it is suggested that any run off or drainage be directed away from the river and therefore any pumping of surface water from excavations into the river will need to be avoided.

CONTENTS

1.0 INTRODUCTION

1.1 On the instructions of Dumfries and Galloway Council, a ground investigation was undertaken to determine ground conditions to enable foundation design to be carried out, together with a contamination risk assessment, in respect to construction of a new footbridge over the River Cree, at Newton Stewart, Dumfries and Galloway.

1.2 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.

1.3 The comments given in this report and the opinions expressed herein are based on the information received, the conditions encountered during site works, and on the results of tests made in the field and laboratory. However, there may be conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report.

1.4 The comments on groundwater conditions are based on observations made at the time the site work was carried out. It should be noted that groundwater levels vary owing to seasonal or other effects.

2.0 SITE SETTING

2.1 Site Location

2.1.1 The site is situated in the south of Newton Stewart on the western and eastern banks of the River Cree and can be located by National Grid Reference NX 412651.

2.1.2 To the immediate east of the proposed footbridge is agricultural land. To the west are commercial and residential areas of Newton Stewart.

2.1.3 In the west the proposed new bridge will be situated in the vicinity of Goods Lane. In the east the bridge will connect with a footpath following the eastern bank of the River Cree.

2.1.4 A site location plan and aerial photograph of the site is presented in Appendix 1, Figures A1.1 and A1.2.

2.2 Geological Setting

2.2.1 Published geological information indicates the site to be underlain by superficial deposits of Alluvium, associated with the River Cree, comprising silt, sand and gravel.

2.2.2 On the western bank of the River Cree, and immediately east of the site, superficial deposits are indicated to be thin or absent. Bedrock is indicated to be Wacke comprising sandstone, siltstone and mudstone in variable proportions.

2.2.3 In the east, Wacke is also indicated to be present, underlying the superficial Alluvium.

3.0 SITE WORK

3.1 The site work was carried out between the 18th and 22nd May 2017, in general accordance with the practices set out in BS 10175:2011+A1:2013, ref. 9.2, BS 5930:2015, ref. 9.3, and ISO 1997:2007, ref. 9.4. The locations of the exploratory were determined by Dumfries & Galloway Council.

3.2 Three boreholes, designated BH1 to BH3, were sunk by light cable percussion method at the positions shown on the exploratory hole plan, Appendix 1, Figure A1.3. The depths of boreholes, descriptions of strata encountered and comments on groundwater conditions are given in the borehole records, presented in Appendix 2.

3.3 Representative samples were taken at the depths shown on the borehole records and despatched to the laboratory for examination and testing. Samples for environmental purposes were collected in amber glass jars and kept in a cool box.

3.4 Standard (split-barrel and cone) penetration tests, refs. 9.6 and 9.5, were carried out in the boreholes in the various strata to assess the relative density or consistency. The values of penetration resistance are given in the borehole records.

3.5 Piezometers were installed in selected BH1 and BH2 as detailed in the table below. . A visual representation of the piezometer installation is given in the borehole records.

Borehole Nº	Depth to base of borehole (m bgl)	Response Zone (m bgl)	Depth of piezometer (m bgl)	Nominal pipe diameter (mm)
BH1	4.60	3.00 – 4.60	4.50	19
BH2	5.00	2.00 – 5.00	3.50	19

3.6 Groundwater monitoring visits have been undertaken on one occasions to-date, the records of which are presented in Appendix 2.

3.7 The ground levels at the borehole locations were not determined.

4.0 LABORATORY TESTS

4.1 Geotechnical Testing

4.1.1 Geotechnical soil analysis was undertaken of samples obtained during the investigation as follows:

- 5 No. Particle Size Distributions (by Wet Sieving)
- 5 No. pH Values
- 5 No. Sulphate Contents (Water Soluble)

4.1.2 The laboratory test reports are presented in Appendix 3, Test Report 31371/1 and Certificate of Analysis 17-01408.

4.2 Chemical Testing

4.2.1 The chemical analyses were carried out on four soil samples. Leachate analysis was also conducted on one of the samples. The nature of the analyses is detailed below:

- **Metals** - arsenic, cadmium, chromium (total), copper, lead, mercury, nickel, selenium and zinc.
- **Inorganics** – cyanide (total)
- **Organics -** polycyclic aromatic hydrocarbons (PAH) – USEPA 16 suite.

4.2.2 The results of these tests are presented in Appendix 4, Certificate of Analysis 17-01474.

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Sequence

5.1.1 The sequence and indicative thicknesses of strata are provided below:

Strata Encountered	Depth Encountered (m bgl)		Strata Thickness (m)
	From	To	
Topsoil	0.00	0.10 – 0.60	0.10 - 0.60
Silty sandy gravel	0.10 - 0.60	2.40 – 5.00	1.80 – 4.80

5.2 Topsoil

5.2.1 Topsoil was encountered at the surface in all boreholes to a maximum thickness of 0.6m. (BH3)

5.2.2 Topsoil was predominantly a clayey gravelly sand with a dark colour suggesting an organic content.

5.3 Alluvium

5.3.1 The alluvium deposit consisted of a silty/clayey sandy gravel with a low to high cobble content.

5.3.2 In-situ penetration testing indicated predominantly a very dense relative density from 1.2mbgl in boreholes BH2 and 3 (eastern bank). However in borehole BH1 (western bank), the relative density was very dense below 4.20mbgl.

5.3.3 Testing in borehole BH1 indicated a loose relative density to a depth of 2.0mbgl becoming medium dense and then dense at 2.5mbgl.

5.3.4 Laboratory participle size distributions undertaken on bulk samples from boreholes BH1 and 2 indicated a gravel content of between 27% and 71%, averaging 52%, sand content of between 13% and 28%, averaging 22% and silt/clay content of between 7% and 18%, averaging 13%, and cobble content up to 29%, averaging 13%.

5.3.5 The soil description based upon these average values is ‘slightly clayey very sandy GRAVEL with a medium cobble content.

5.4 Groundwater

5.4.1 Groundwater was encountered at depths of 1.8, 2.7 and 4.3mbgl and the levels were found to rise by 0.1m in a 20minute rest period which would suggest that a minor hydraulic head being present.

5.4.2 On return visits to monitor the standpipes, groundwater levels were found at 0.84mbgl (BH2) and 3.19mbgl (BH1) which is a slight increase from the original strike level.

6.0 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS IN RELATION TO THE PROPOSED DEVELOPMENT

6.1 Structural Details

6.1.1 It is understood that the proposed development is to consist of the construction of a new footbridge over the River Cree.

6.1.2 The eastern approach is ramped up from BH3 to BH2, so as to provide a level access on the western bank. The west bank is circa 3.0m higher than the east bank so such construction will allow for wheel chair access.

6.1.3 Precise structural details and loadings were not available at the time of preparation of this report.

6.2 Assessment of Soil Condition

6.3 General

6.3.1 The soils encountered on the site was principally **coarse grained**, granular.

6.3.2 SPT 'N' values reported on the borehole logs are as measured and uncorrected.

6.3.3 However for general design in sands the 'N' values should be normalised to 60% by the following equation:-

6.3.4 $N_{60} = E_r/60.N$ where:-

N is the blow count and

E_r is the energy ratio of the specific test equipment

6.3.5 Further corrections for rod length and overburden pressure in sands may be applied in accordance with BS EN ISO 22476-3, ref. 9.5.

6.4 Foundation Options

6.4.1 On the basis of observations made on site together with results of in-situ and laboratory tests, together with empirical correlations, consideration could be given to the adoption of shallow spread foundations to support the proposed structure.

6.4.2 Spread foundations will be installed in the alluvial gravel at a minimum depth of 0.75mbgl.

6.4.3 To the eastern bank the ground conditions at foundation level consist of very dense/ medium dense sandy gravel and on the western bank loose/ medium dense sandy gravel.

6.4.4 On the basis of the corrected 'N' values recorded in the shallow stratum and in order to limit settlements to less than 25mm, an allowable bearing pressure of

110kPa could be adopted for design purposes. Settlements should be checked when the final structural loading is known.

6.4.5 It is likely that the settlement would be greater on the western bank foundations however settlement will be immediate within the construction period and using the above figure for design will limit the amount of differential movement to acceptable levels.

6.4.6 Alternatively, if spread foundations are considered to be unsuitable, pile foundations could be considered.

6.4.7 The carrying capacity of piles depends not only on their size and the ground conditions but also on their method of installation. Pile design and installation are continuously evolving processes and state-of-the-art techniques are often employed before they reach the public domain, perhaps several years down the line. Therefore, it is recommended that specialist Piling Contractors be contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

6.5 Excavations

6.5.1 On the basis of observations on site together with the results of in-situ and laboratory tests, it is considered that excavations to less than 1.20m would not stand unsupported in the short term.

6.5.2 Side support for safety purposes should of course be provided to all excavations which appear unstable, and those in excess of 1.20m deep, in accordance with Health and Safety Regulations, ref. 9.7.

6.5.3 Groundwater should be expected in shallow excavations for foundations due to the close proximity of the River Cree. It is considered that this could be dealt with by general site pumping without resulting in dewatering measures.

6.6 Chemical Attack on Buried Concrete

6.6.1 The results of chemical tests indicate sulphate concentrations in the soils of between 13mg/l and 29mg/l as a 2:1 water/soil extract, with pH values in the range of 7.6 to 8.1.

6.6.2 In the groundwater a sulphate concentration of 8.5mg/l with pH value of 6.2 was recorded.

6.6.3 It is recommended that for conventional shallow foundations the groundwater should be regarded as mobile.

6.6.4 On the basis of the laboratory test results it is considered that a Design Sulphate Class for the site soils (silty sandy gravel) may be taken as DS-1. The site conditions would suggest that an ACEC class for the site of AC-1 would be appropriate.

7.0 ENVIRONMENTAL RISK ASSESSMENT IN RELATION TO PROPOSED DEVELOPMENT

7.1 Contaminated Land

7.1.1 The statutory definition of contaminated land is given in Appendix 5.

7.2 Risk Assessment – Human Health

7.2.1 The proposed development consists of the installation of a footbridge with the associated construction of supporting foundations. To the immediate east of the proposed footbridge is agricultural land. To the west are commercial and residential areas of Newton Stewart.

7.2.2 The risk assessment has been based on guidelines for general open space (adjacent to dwellings).

7.2.3 The results of the soil analyses, with the exception of lead, have been compared to the recently published S4ULs (Suitable 4 Use Levels) determined by LQM and CIEH, ref. 10.13. As the CLEA SGV for lead was withdrawn in 2014, DEFRA have produced C4SLs (Category 4 Screening Levels) for lead and a number of other contaminants, ref 10.14. As no S4UL has been produced for lead, the C4SL has been adopted.

7.2.4 The Generic Assessment Criteria (GAC) used within this contamination assessment have been tabulated below, together with the chemical test results.

Open space (adjacent to dwellings)	Determinant	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source	Test Results (mg/kg)
		1% SOM	2.5% SOM	6% SOM		
Metals	Arsenic	79	79	79	LQM/CIEH S4UL	12 to 18
	Cadmium	120	120	120	LQM/CIEH S4UL	0.2 to 8.1
	Chromium (III)	1500	1500	1500	LQM/CIEH S4UL	46 to 79
	Copper	12000	12000	12000	LQM/CIEH S4UL	26 to 71
	Lead	630	630	630	DEFRA C4SL	27 to 270
	Mercury	16	16	16	LQM/CIEH S4UL	<0.05 to 5.2
	Nickel	230	230	230	LQM/CIEH S4UL	43 to 57
	Selenium	1100	1100	1100	LQM/CIEH S4UL	<0.5
	Zinc	81000	81000	81000	LQM/CIEH S4UL	96 to 1100
Other	Cyanide	10.8	10.8	10.8	PRG	<0.1 to 0.7
PAH	Acenaphthene	15000	15000	15000	LQM/CIEH S4UL	<0.1
	Acenaphthylene	15000	15000	15000	LQM/CIEH S4UL	<0.1

Open space (adjacent to dwellings)	Determinant	Guidance Value (mg/kg) 1% SOM	Guidance Value (mg/kg) 2.5% SOM	Guidance Value (mg/kg) 6% SOM	Primary Data Source	Test Results (mg/kg)
	Anthracene	74000	74000	74000	LQM/CIEH S4UL	<0.1
	Benzo(a)anthracene	29	29	29	LQM/CIEH S4UL	<0.1
	Benzo(a)pyrene	5.7	5.7	5.7	LQM/CIEH S4UL	<0.1
	Benzo(b)fluoranthene	7.1	7.1	7.1	LQM/CIEH S4UL	<0.1
	Benzo(ghi)perylene	640	640	640	LQM/CIEH S4UL	<0.1
	Benzo(k)fluoranthene	190	190	190	LQM/CIEH S4UL	<0.1
	Chrysene	57	57	57	LQM/CIEH S4UL	<0.1
	Dibenzo(ah)anthracene	0.57	0.57	0.57	LQM/CIEH S4UL	<0.1
	Fluoranthene	3100	3100	3100	LQM/CIEH S4UL	<0.1
	Fluorene	9900	9900	9900	LQM/CIEH S4UL	<0.1
	Indeno(123-cd)pyrene	82	82	82	LQM/CIEH S4UL	<0.1
	Napthalene	4900	4900	4900	LQM/CIEH S4UL	<0.1
	Phenanthrene	3100	3100	3100	LQM/CIEH S4UL	<0.1
	Pyrene	7400	7400	7400	LQM/CIEH S4UL	<0.1

7.2.1 Where the concentrations determined on site are at or below the respective Generic Assessment Criteria, they are considered not to pose a risk and are removed from further consideration, unless otherwise stated.

7.2.2 As can be seen from the above tabulated results there were no determinants with values above the Guidance Values.

7.3 Risk Assessment - Controlled Waters

7.3.1 The site is located next to the River Cree.

7.3.2 An initial assessment of the risk to controlled waters has been carried out on the basis of the results of one leachate analysis undertaken on samples from borehole BH3. The results have been screened against the Water Supply (Water Quality) Regulations 2000, ref. 9.16, and the *freshwater* Environmental Quality Standards (EQS), ref. 9.17.

Contaminant	Units	EQS [1]	Test Results
Arsenic	ug/l	50[2]	1.4
Cadmium	ug/l	0.45	0.05
Chromium III	ug/l	4.7[2*]	3.3
Copper	ug/l	1[2]	6.9
Lead	ug/l	7.2[2]	0.65
Mercury	ug/l	0.07	<0.01
Nickel	ug/l	20[2]	13

Contaminant	Units	EQS [1]	Test Results
Selenium#	ug/l	10	2.4
Zinc	ug/l	11.9	45
Polycyclic Aromatic Hydrocarbons (PAH)			
Anthracene	ug/l	0.4	0.02
- Benzo(a)pyrene	ug/l	0.1	<0.01
- Benzo(b)fluoranthene	ug/l	Σ=0.03[2]	<0.01
- Benzo(k)fluoranthene	ug/l		
- Benzo(ghi)perylene	ug/l	Σ=0.002[2]	<0.01
- Indeno(123-cd)perylene	ug/l		
Fluoranthene	ug/l	1	0.03
Naphthalene	ug/l	1.2[2] (2.4)	<0.01

[1] MAC – Maximum Allowed Concentration
[2] AA – Average Annualised
* Freshwater EQS used as no Saltwater EQS for chromium.
# Water Supply value used as no Saltwater EQS for selenium

7.3.3 The guidance levels used within the controlled waters assessment have been tabulated above and are detailed within Appendix 5.

7.3.4 The table shows elevated levels of leachable copper and zinc, however the total concentrations were found to be low at 71mg/kg for copper and 1100mg/kg for zinc (below residential with gardens guidance) and therefore are unlikely to be of a concern.

7.4 Risk Evaluation

7.4.1 A conceptual model has been formed to reflect the findings of the contamination risk assessment and the revised conceptual model, detailing the relevant pollutant linkages, is tabulated below:

Source	Potential Contaminants of Concern	Potential Pathways	Receptor Group	Risk
Natural Alluvial soils	Heavy Metals (Copper & Zinc)	Surface runoff and drainage into the River Cree *2	Water Environment • Groundwater • Surface Water	Low
*2 – Pathway exists only during the construction period				

7.5 Summary of Risk Evaluation

7.5.1 The above assessment identifies that the 'source – pathway – receptor' linkage potentially occurs with leachate from natural alluvial soils impacting upon the identified receptors. Therefore, it would be necessary to manage the risk at this location by either eliminating one of the links or by minimising the potential effects.

7.5.2 However the total concentrations were found to be low at 71mg/kg for copper and 1100mg/kg for zinc (below residential with gardens guidance) and therefore are unlikely to be of a concern.

8.0 MANAGEMENT OF CONTAMINATION

8.1 Remediation and Verification

8.1.1 The risk management framework set out in the Model Procedures for the Management of Land Contamination, CLR 11, ref. 9.18, is applicable to the redevelopment of sites that may be affected by contamination.

8.1.2 The risk management process set out in the Model Procedures has three main components:

- Risk assessment
- Options appraisal
- Implementation

8.1.3 The results shows elevated levels of leachable copper and zinc, however the total concentrations were found to be low at 71mg/kg for copper and 1100mg/kg for zinc (below residential with gardens guidance) and therefore are unlikely to be of a concern.

8.1.4 To reduce the risk of leachate contaminating the River Cree it is suggested that any run off or drainage be directed away from the river and therefore any pumping of surface water from excavations into the river will need to be avoided.

8.2 Management of Unidentified Sources of Contamination

8.2.1 There is the possibility that sources of contamination may be present on the site, which were not detected during the investigation. Should such contamination be identified or suspected during the site clearance or ground works, these should be dealt with accordingly. A number of options are available for handling this material, which include:

- The removal from site and disposal to a suitably licensed tip of all material suspected of being contaminated. The material would need to be classified prior to disposal.

- Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material under consideration, this could be either a skip or a lined area.

- Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

8.3 Consultation

8.3.1 During the development of a site, consultation may be required for a number of reasons with a number of regulatory Authorities. The following provides an indication as to the most likely Authorities with which consultation may be required.

- **Local Authority.** There may be a planning condition regarding contamination and consultation will be required with a designated Contaminated Land Officer within the Environmental Health Department. The Local Authority is generally concerned with human health risks. Some Authorities now require 'Completion Certificates' to be signed off following remediation works.

- **SEPA.** Where a site is situated above an aquifer, within a groundwater protection zone or has been designated as a special site, the Environment Agency is likely to be involved to ensure that controlled waters are protected.

8.3.2 Based on the results of any consultation, there may be specific remediation requirements imposed by one or more of the Authorities.

8.4 Risk Management During Site Works

8.4.1 During ground works, some simple measures may have to be put in place to mitigate the risk of any known or previously unidentified contamination affecting the site workers and the environs. The majority of the proposed measures represent good practice for the construction industry and include:

- Informing the site workers of the contamination on site and the potential health effects from exposure.

- Where appropriate, the provision of suitable Personal Protective Equipment (PPE) for workers who may be potentially impacted by working in areas of the contamination.

- Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating or drinking without washing their hands first.

- Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne.

- Site drainage should be prevented from entering any adjacent watercourse, ref. 9.19.

8.4.2 Where contaminated materials are being removed from the site they should be disposed of at a suitably licensed landfill, with a 'duty of care' system in place and maintained throughout the disposal operations.

9.0 REFERENCES

9.1 CLR 4, 'Sampling strategies for contaminated land'. Report by The Centre for Research into the Built Environment, the Nottingham Trent University, DoE, 1994.

9.2 British Standards Institute: BS 10175 'Code of practice for the investigation of potentially contaminated sites', BSI 2011+A1:2013.

9.3 British Standards Institute: BS 5930 'Code of practice for site investigations', BSi 2015.

9.4 ISO 1997, Part 2:2007, 'Eurocode 7 (incorporating corrigendum June 2010) – Geotechnical Design – Part 2, Ground Investigation and Design'.

9.5 ISO 22476 – 3:2005, 'Geotechnical Investigation and Testing – Field Testing' Part 3, Standard Penetration Test.

9.6 British Standard 1377:1990, Part 9, 'Methods of Test for Soils for Civil Engineering Purposes'.

9.7 Health and Safety Executive, 'Health and Safety in Excavations', HSG 185, 1999.

9.8 The Environmental Protection Act, Part IIA, Section 78, 1990.

9.9 Environment Act 1995, Section 57, DoE 1995.

9.10 Environment Agency Science Report SC050021/SR3, 2008, 'Updated technical background to the CLEA model'.

9.11 Environment Agency Science Report SC050021, 2009, 'Contaminants in Soil: Updated Collation of Toxicological Data and Intake Values for Humans'.

9.12 The LQM/S4ULs for Human Health Risk Assessment, Nathanail P, McCaffery C, Gillett A, Ogden R, and Nathanail J, Land Quality Press, Nottingham, published 2015.

9.13 DEFRA SP1010: Development of Category 4 Screening Levels for the Assessment of Land Affected by Contamination, published March 2014.

9.14 Environment Agency Science Report SC050021/SR2 'Human health toxicological assessment of contaminants in soil'.

9.15 Generic Assessment Criteria for Human Health Risk Assessment, Nathanial CP, McCaffery C, Ashmore M, Cheng Y, Gillett A, Hooker P and Ogden RC, Land Quality Press, Nottingham, published November 2006.

9.16 Water Supply (Water Quality) Regulations 2000, Statutory Instrument 2000 No. 3184, Crown Copyright 2000.

9.17 Directive 2008/105/EC of the European Parliament and of the Council on Environmental Quality Standards in the Field of Water Policy, amending and

subsequently repealing Directives 82/176/EEC, 83/513/EEC, 84/491/EEC and 86/280/EEC and amending Directive 2000/60/EC, December 2008.

9.18 CLR 11, 'Model Procedures for the Management of Contaminated Land', DEFRA and Environment Agency, 2004.

9.19 Environment Agency / SEPA Pollution Prevention Guidelines, PPG5, 'Works In, Near, or Liable to Affect Watercourses'.

9.20 ISO 22475-1:2006, 'Geotechnical Investigation and Testing – Sampling Methods and Groundwater Measurements' Part 1: Technical Principles for Execution.

9.21 ISO 14688 Part 1:2002 and Part 2:2004, 'Geotechnical Investigation and Testing – Identification and Classification of Soil'.

9.22 CLR 2, 'Guidance on preliminary site inspection of contaminated land', Report by Applied Environmental, DoE 1994.

9.23 CLR 3 'Documentary Research on Industrial Sites', Report by RPS Consultants Ltd., DOE, 1994.

9.24 CLR 8, 'Potential contaminants for the assessment of contaminated land'. DEFRA/EA, March 2002.

9.25 Environment Agency, 2003, 'Review of the Fate and Transport of Selected Contaminants in the Soil Environment'. Draft Technical Report P5-079/TR1. Bristol: Environment Agency.

For and on behalf of Ian Farmer Associates (1998) Limited

S Corrigan
BSc (Hons)
Senior Engineering Geologist

P G Challinor
BSc(Hons), MSc, CEng, CGeol, CSci, MIMMM, FGS
Director

APPENDIX 1

DRAWINGS

IAN FARMER ASSOCIATES

Contract: Proposed Sparing Footbridge
Contract No: 31371
Site Location Plan

Fig. A1.1

Licence No. LAN1001322

IAN FARMER ASSOCIATES

Contract: Proposed Sparing Footbridge
Contract No: 31371
Aerial Photograph

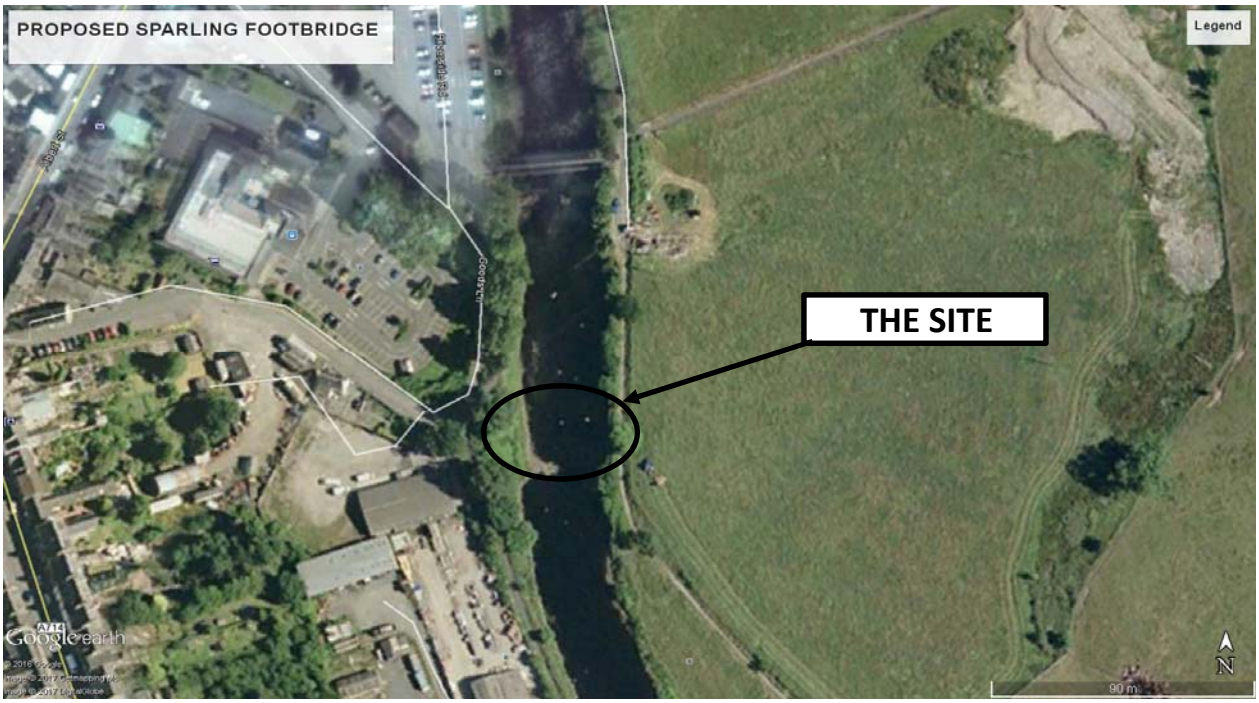


Fig. A1.2

IAN FARMER ASSOCIATES

Contract: Proposed Sparing Footbridge
Contract No: 31371
Exploratory Hole Plan

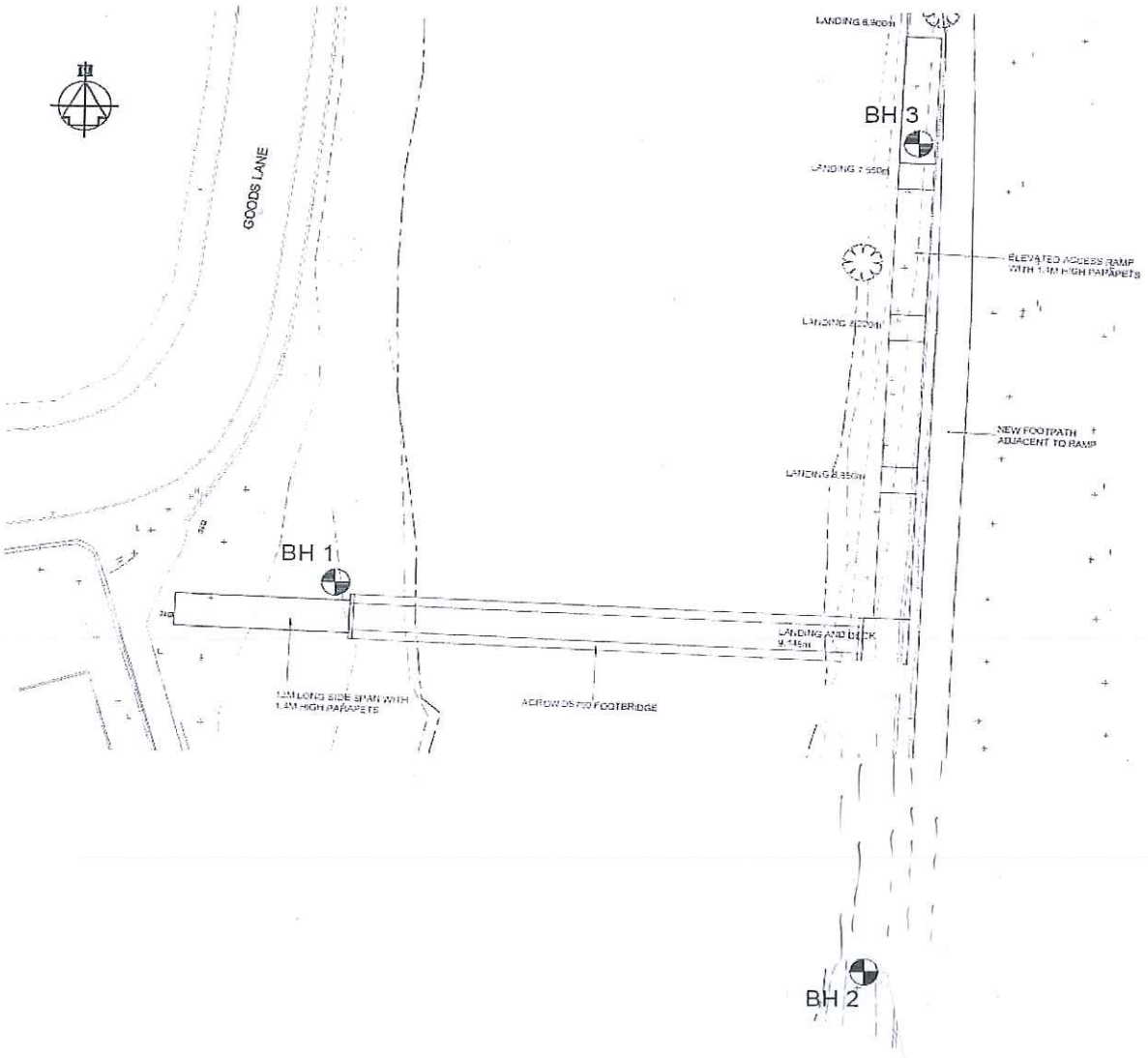


Fig. A1.3

APPENDIX 2

SITE WORK

APPENDIX 2

GENERAL NOTES ON SITE WORKS

A2.1 SITE WORK

A2.1.1 General

Site work is carried out in general accordance with the guidelines given in ISO 1997, 9.4 and BS 5930, ref. 9.3.

A2.1.2 Light Cable Percussion Boring

For routine soil exploration to depths in excess of 3m, the light cable percussion rig is generally employed for boring through soils and weak rocks, refs 9.3 and 9.4 It consists of a powered winch and tripod frame, with running wheels that are permanently attached so that the rig may be towed behind a suitable vehicle. The rig is towed into position and set up using its own winching system.

The locations of services are checked to make sure the borehole is not situated unacceptably near any services. Regardless of the proximity of services, a CAT scan is undertaken at the borehole location and a trial hole dug to 1.20m by hand.

Boreholes are advanced in soil by the percussive action of the cable tool. The force of the cylindrical tool as it is dropped a short distance cuts a plug of cohesive soil that is removed by the tool.

In non-cohesive soils, the borehole is advanced by a 'shell', otherwise known as a 'bailer' or 'sand pump', which incorporates a clack valve. Material is transferred into the shell and retained by the clack valve. The water level in a borehole is maintained above that in the surrounding granular soil to allow for temporary reductions in the head of water as the shell is withdrawn from the borehole. Water should flow from the borehole into the surrounding soil at all times to prevent 'piping' and loosening the soil at the base of the hole. The casing is always advanced with the borehole in granular soil so that material is drawn from the base rather than the borehole sides.

Obstructions to boring are overcome by fitting a serrated chiselling ring to the base of the percussion tool. For large obstructions, a heavy chisel with a hardened cutting edge may have to be used.

Disturbed samples are taken in polythene bags, jars or tubs that are sealed against air or water loss.

Undisturbed samples are generally taken in cohesive materials at changes in strata and at one metre intervals to 5 metres then at 1.5 metre intervals to the full depths of the borehole. The general purpose open-tube sampler is suitable for firm to stiff clays, but is often used to retrieve disturbed samples of weak rocks, soft or hard clay and also clayey sand or silts. This has been adopted for routine use, and usually consists of a 100mm internal diameter tube (U100), which is capable of taking soil samples up to 450mm in length. The undisturbed samples are sealed at each end using micro-crystalline wax to prevent drying.

Standard penetration tests are generally carried out in non-cohesive soils but also in stiff clays and soft rocks at frequencies similar to that of undisturbed sampling.

A2.2 IN-SITU TESTS

A2.2.1 Standard Penetration Test

The Standard Penetration Test is carried out in accordance with the proposals recommended by ISO 1997, ref. 9.4, BS 1377, Part 9, 1990 ref. 9.7.

The standard penetration test, **SPT**, covers the determination of the resistance of soils to the penetration of a split barrel sampler. A 50mm diameter split barrel sampler is driven 450mm into the soil using a 63.5kg hammer with a 760mm drop. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows to achieve the standard penetration of 300mm is reported as the 'N' value.

The test is generally carried out in fine soils, however, it may also be carried out in coarse granular soils, weak rocks and glacial tills using the same procedure as for the SPT but with a 50mm diameter, 60° apex solid cone replacing the split spoon sampler, **CPT.**

When attempting the standard penetration test in very dense material or weathered rocks it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner:

- Where the seating drive has been completed, the test drive is terminated if 50 blows are reached before the full penetration of 300mm is achieved. The penetration for 50 blows is recorded and an approximate N value obtained by linear extrapolation of the number of blows for the partial test drive.

- If the seating drive of 150mm is not achieved within the first 25 blows, the penetration after 25 blows is recorded and the test drive then commenced.

- For tests in soft rocks, the test drive should be terminated after 100 blows where the penetration of 300mm has not been achieved.

The N-value obtained from the Standard Penetration Test may be used to assess the relative density of sands and gravels as follows:

Term	SPT N-Value : Blows/300mm Penetration
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

A2.3 SAMPLES

A2.3.1 General

Samples have been recovered and stored in accordance with the guidelines given in ISO 22475-1:2006, ref. 9.47 and BS 5930, ref. 9.3.

The undisturbed samples recovered from the percussive sampler were of varying diameters depending upon the depth taken and the ground conditions encountered.

In accordance with EN ISO 22475, ref. 9.47, and BS 5930, ref. 9.3, the thick walled U100 sample is considered as a Class B sampling technique and will only produce Class 3 to 5 quality samples in accordance with EN 1997-2:2007, ref. 9.4. A similar assumption can be made from samples tested from the percussive window sample probing.

Laboratory strength and consolidation testing can only be carried out on Class 1 quality samples, which can be obtained from a Class A sampling technique, ref. 9.4. This is due to possible disturbance during sampling, giving a weaker strength in testing.

Therefore values for c_u and mv derived for use in this report can only be used as guidance and not used to determine the shear strength properties of the clay and is not used to give a descriptive strength in the borehole records.

UT represents undisturbed 100mm diameter samples taken in thin walled sample tubes, the number of blows to obtain the sample also recorded.

U represents undisturbed 100mm diameter sample, the number of blows to obtain the sample also recorded.

U fail indicates undisturbed sample not recovered

ES represents sample recovered in an amber jar, generally for environmental analysis

HV represents Hand Vane test with equivalent undrained shear strength in kPa.

PP represents Pocket Penetrometer test with equivalent undrained shear strength in kPa.

CBR represents California Bearing Ratio test

B represents large bulk disturbed samples

D represents small disturbed sample

W represents water sample

$\underline{\nabla}$ represents water strike

$\underline{\blacktriangledown}$ represents level to which water rose

A2.4 DESCRIPTION OF SOILS

A2.4.1 General

The procedures and principles given in ISO 14688 Parts 1 and 2, ref. 9.48, supplemented by section 6 of BS 5930, ref. 9.3 have been used in the soil descriptions contained within this report.

BOREHOLE LOGS

BH1 to BH3

IAN FARMER ASSOCIATES

Contract Name:		Client:			Borehole ID:
Sparling Footbridge, Newton Stewart		Dumfries and Galloway Council			BH1
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
31371	18/05/2017	R. Shepherd	CL	DRAFT	
Cable Percussion Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 30/06/2017
					Scale: 1:50
Weather:	Termination:	SPT Hammer: N/R, Energy Ratio: N/R			

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00	ES1			0.10		Grass over dark brown clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium including sandstone. (Topsoil)		
0.10 - 0.50	B2							
0.50	ES3					Loose becoming medium dense dark brown silty very sandy GRAVEL with low to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded including sandstone and siltstone.		
0.50 - 1.00	B4							
1.20	ES5	SPT(S) N=7 (6,4/3,2,1,1)		(2.40)				
1.20 - 1.65	D6							
1.20 - 1.70	B7							
1.20								
1.85	D8							
2.00	ES9	SPT(S) N=13 (2,3/3,3,4,3)						
2.00 - 2.45	D10							
2.00								
				2.50		Dense brown silty sandy GRAVEL with high cobble content of subangular sandstone. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded including sandstone and siltstone.		
2.75	D12							
3.00	ES15	SPT(S) N=33						
3.00 - 3.45	D13	(3,22/18,7,4,4)						
3.00 - 3.50	B14			(1.70)				
3.00								
3.75	D16							
4.00 - 4.45	D17	SPT(S) 50 (25 for						
4.00 - 4.50	B18	75mm/50 for 225mm)						
4.00				4.20 (0.30) 4.50		Very dense brown silty sandy GRAVEL with low cobble content of subangular sandstone. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded including sandstone and siltstone.		
4.60	D19			4.60		Very dense dark grey black slightly sandy GRAVEL. Gravel is fine to coarse subangular to subrounded including limestone.		
						End of Borehole at 4.600m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
18-05-2017	00:00	4.60	4.00		4.60	150	4.60	150

Chiselling			
From (m)	To (m)	Duration	Remarks
2.60	2.80	00:30	

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	4.20	PLAIN	19
4.20	4.50	PIEZOMETER	19

Remarks:

Inspection pit to 1.20m. Piezometer installed to 4.50m.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.30	4.30		20	4.20	

IAN FARMER ASSOCIATES

Contract Name:		Client:			Borehole ID:
Sparling Footbridge, Newton Stewart		Dumfries and Galloway Council			BH2
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
31371	19/05/2017	R. Shepherd		DRAFT	
Cable Percussion Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 30/06/2017
					Scale: 1:50
Weather:	Termination:	SPT Hammer: N/R, Energy Ratio: N/R			

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00	ES1			0.20		Grass over black clayey slightly gravelly SAND. Sand is fine to medium. Gravel is fine to medium subangular to subrounded including sandstone. (Topsoil)		
0.10 - 0.50	B2							
0.50	ES3			(0.90)		Grey brown mottled brown green clayey very sandy GRAVEL with low cobble content of subangular sandstone. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded including sandstone, limestone and coal.		
0.50 - 1.00	B4							
1.20	ES5	SPT(S) N=50 (11,12/12,12,13,13)		1.10		Very dense becoming medium dense grey and brown slightly silty/slightly clayey sandy becoming very sandy GRAVEL with low cobble content of subangular sandstone. Sand is fine to coarse. Gravel is fine to coarse subrounded to angular including limestone and coal.		
1.20 - 1.65	D6							
1.20 - 1.70	B7							
1.20								
1.80	W8							
1.85	D9	SPT(C) N=22 (6,6/6,6,5,5)		(1.80)				
2.00 - 2.50	B10							
2.00								
2.70	EW13							
2.75	D11			2.90				
3.00 - 3.40	D12	SPT(S) N=50 (3,9/50 for 295mm)				Very dense and dense multicoloured dark sandy GRAVEL. Gravel is fine to medium subangular to subrounded including sandstone, limestone, coal, slate and chert.		
3.00 - 3.50	B14							
3.00								
3.75	D15							
4.00 - 4.50	B16	SPT(C) N=37 (9,14/10,8,9,10)		(2.10)				
4.00								
4.75	D17							
5.00		SPT(C) 50 (25 for 75mm/50 for 225mm)		5.00		End of Borehole at 5.000m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
19-05-2017	00:00	5.00	5.00	1.40	5.00	150	5.00	150

Remarks:
Inspection pit to 1.20. Piezometer installed to 3.50m

Chiselling			
From (m)	To (m)	Duration	Remarks
1.50	2.50	02:00	
3.80	4.00	00:20	

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	3.20	PLAIN	19
3.20	3.50	PIEZOMETER	19

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
1.80	1.50	2.30	20	1.70	
2.70	2.50		20	2.60	

IAN FARMER ASSOCIATES

Contract Name:		Client:			Borehole ID:
Sparling Footbridge, Newton Stewart		Dumfries and Galloway Council			BH3
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
31371	22/05/2017	R. Shepherd		DRAFT	
Cable Percussion Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 30/06/2017
					Scale: 1:50
Weather:	Termination:	SPT Hammer: N/R, Energy Ratio: N/R			

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.20	ES1			0.10 (0.50)		Grass over black clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium subrounded to subangular including sandstone (Topsoil)		
0.60	ES2			0.60		Black dark brown clayey gravelly SAND. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded including sandstone, limestone and coal (Topsoil)		
1.20 1.20 - 1.70 1.20	ES3 B4	SPT(C) 50 (25 for 80mm/50 for 235mm)		(1.80)		Very dense dark brown sandy GRAVEL with low to medium cobble content of subangular sandstone. Gravel is subangular to subrounded including sandstone.		
2.00		SPT(C) 50 (25 for 125mm/50 for 295mm)		2.40		End of Borehole at 2.400m		

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
22-05-2017	00:00	2.40	1.90		1.90	150	1.90	150

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)
1.20	1.20	01:15					
2.10	2.40	01:00					

Remarks:
Inspection pit dug to 1.20m.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		

PIEZOMETER GROUNDWATER READINGS

BH1 & BH2

IAN FARMER ASSOCIATES

Gas and Groundwater Monitoring Results

Contract No:	31371
Contract Name:	SPARLING FOOTBRIDGE NEWTON STWEART
Date:	30/06/2017

Background Readings:						
	O_2 % v/v	20.6	**CO_2 % v/v**	ND	**CH_4 % v/v**	ND
	Atmospheric Pressure (Start):			1010mb		
	Atmospheric Pressure (Finish):			1010mb		

Hole No:	Time (hh:mm)	O_2 % v/v		CO_2 % v/v		CH_4 % v/v		CO ppm		H_2S ppm		VOCs ppm		Gas Flow Rate (l/hr)	SWL	Base of Pipe	Comments
		Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Steady	mBGL	mBGL	
BH1															3.19		
BH2															0.84		

Remarks:

ND = Below detection limit of instrument. NR = Not Recorded.

Readings Taken By:	**RS**	
Checked By:		

APPENDIX 3

LABORATORY TESTS

APPENDIX 3

GENERAL NOTES ON LABORATORY TESTS ON SOILS

A3.1 GENERAL

A3.1.1 Where applicable all tests are carried out in accordance with the relevant British Standard. The laboratory test procedures are given in the laboratory test reports.

A3.1.2 Any discussion in this report is based on the values and results obtained from the appropriate tests. Due allowance should be made, when considering any result in isolation, of the possible inaccuracy of any such individual result. Details of the accuracy of results are included in this section, where applicable.

A3.2 SOIL CLASSIFICATION

A3.2.1 Classification of soils is usually undertaken by means of the Plasticity Classification Chart, sometimes called the A-Line Chart. This is graphical plot of PI against LL with the A-Line defined as PI = 0.73(LL - 20).

A3.2.2 This line is defined from experimental evidence and does not represent a well-defined boundary between soil types, but forms a useful reference datum. When the values of LL and PI for inorganic clays are plotted on the chart they generally lie just above the A-Line in a narrow band parallel to it, while silts and organic clays plot below this line.

A3.2.3 Clays and silts are divided into five zones of plasticity:

Low Plasticity (L)	LL less than 35
Intermediate Plasticity (I)	LL between 35 and 50
High Plasticity (H)	LL between 50 and 70
Very High Plasticity (V)	LL between 70 and 90
Extremely High Plasticity (E)	LL greater than 90

A3.2.4 In general, clays of high plasticity are likely to have a lower permeability, are more compressible and consolidate over a longer period of time under load than clays of low plasticity. Clays of high plasticity are more difficult to compact as fill material.

TEST REPORT 31371/1

IAN FARMER ASSOCIATES

Unit 4 Faraday Close, Pattinson North Industrial Estate, Washington, Tyne & Wear, NE38 8QJ
Tel. 0191 482 8500 Fax. 0191 482 8520 Email. washington@ianfarmer.co.uk Internet. www.ianfarmer.co.uk

F.A.O.

Test Report - 31371 / 1

Site:	Sparling Footbridge, Newton Stewart
Job Number:	31371
Originating Client:	Dumfries and Galloway Council 31371
Originating Reference:	31371
Date Sampled:	Not Given
Date Scheduled:	31/05/2017
Date Testing Started:	13/06/2017
Date Testing Finished:	21/06/2017
Remarks:	

Authorised By:

Paul Cathcart
Quality Manager

Date: 21/06/2017

IAN FARMER ASSOCIATES

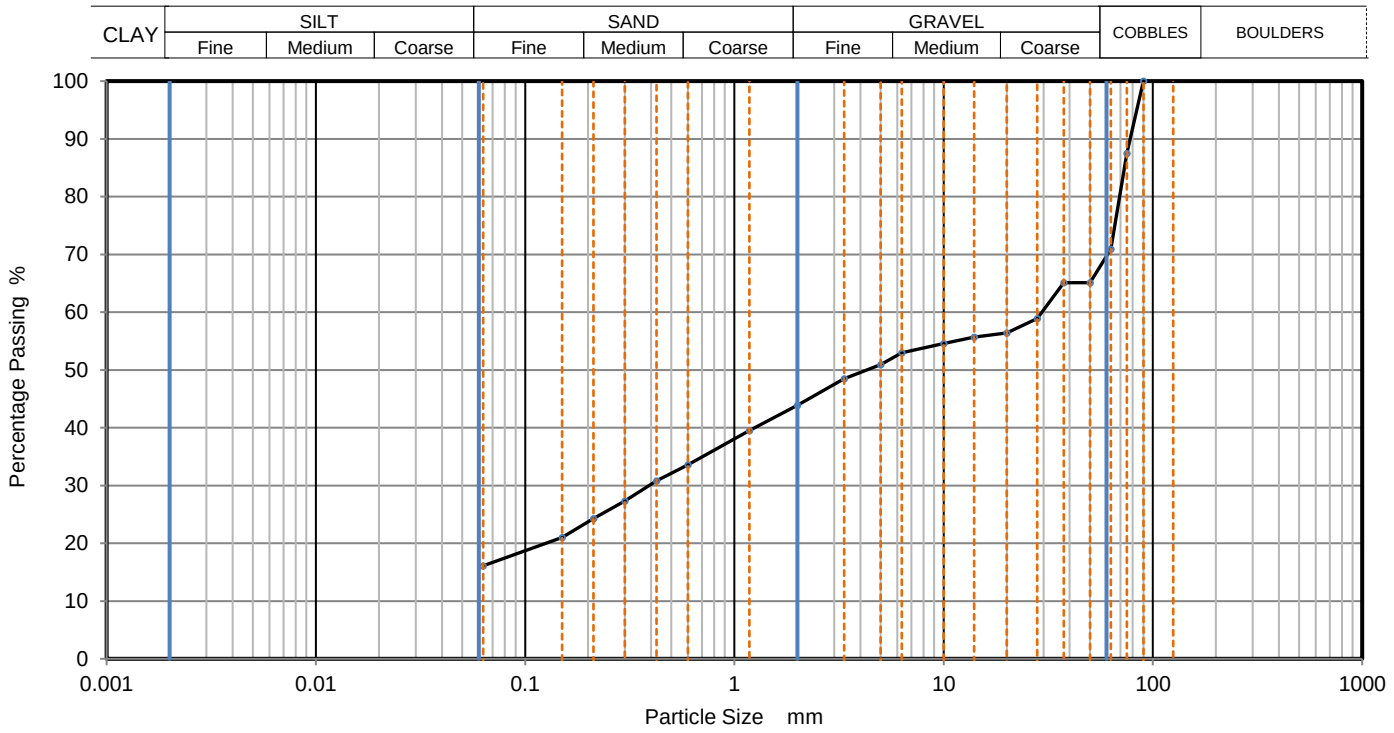
Laboratory Test Report | 31371 / 1

Site: Sparling Footbridge, Newton Stewart | **Job Number:** 31371

Client: Dumfries and Galloway Council | **Page:** 2

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH1	0.10	B2	Wet Sieve	Brown silty very sandy GRAVEL with high cobble content



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
90	100		
75	88		
63	71		
50	65		
37.5	65		
28	59		
20	56		
14	56		
10	55		
6.3	53		
5	51		
3.35	49		
2	44		
1.18	40		
0.6	34		
0.425	31		
0.3	27		
0.212	24		
0.15	21		
0.063	16		

Dry Mass of sample, g: 3554

Sample Proportions	% dry mass
Very coarse	29
Gravel	27
Sand	28
Fines <0.063mm	16

Grading Analysis		
D100	mm	90
D60	mm	29.5
D30	mm	0.394
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7 3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

UKAS TESTING
1464

IAN FARMER ASSOCIATES

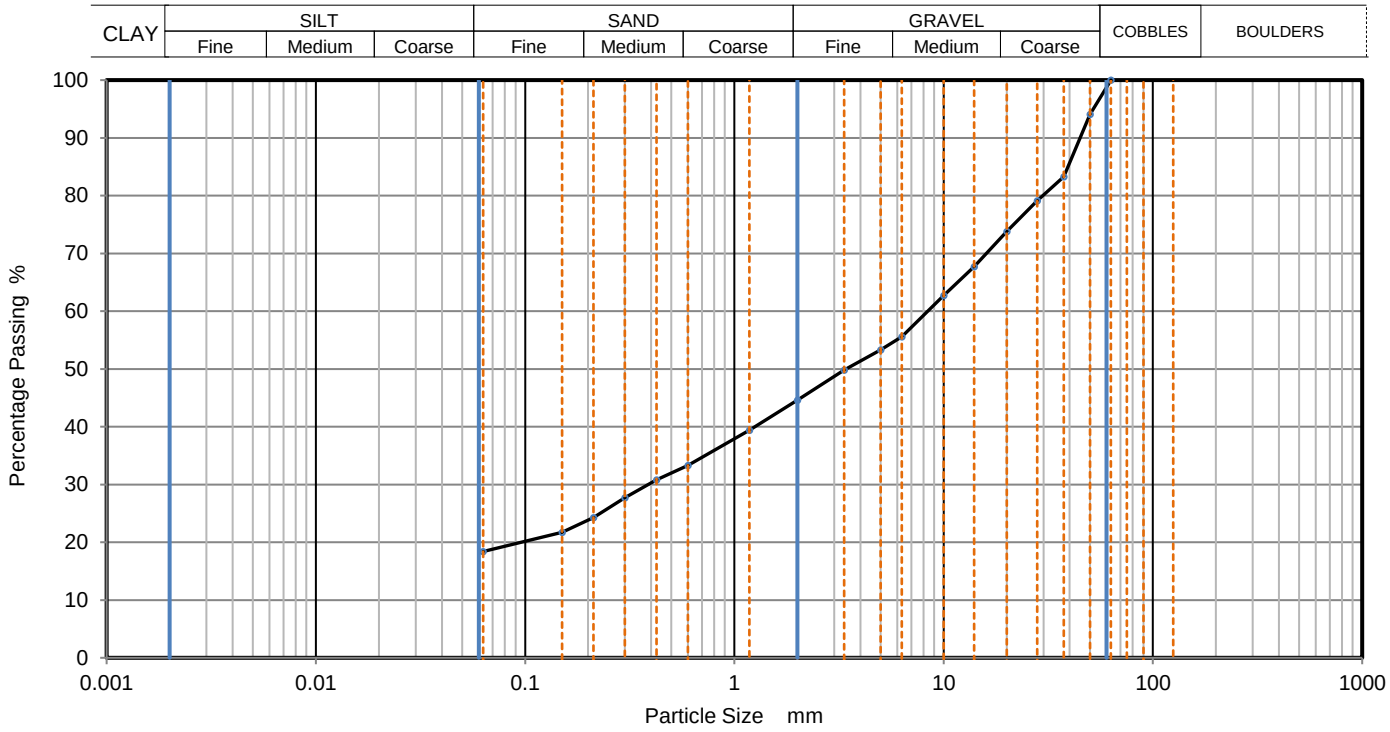
Laboratory Test Report | 31371 / 1

Site: Sparling Footbridge, Newton Stewart | **Job Number:** 31371

Client: Dumfries and Galloway Council | **Page:** 3

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH1	1.20	B7	Wet Sieve	Brown silty very sandy GRAVEL



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
63	100		
50	94		
37.5	83		
28	79		
20	74		
14	68		
10	63		
6.3	56		
5	53		
3.35	50		
2	45		
1.18	39		
0.6	33		
0.425	31		
0.3	28		
0.212	24		
0.15	22		
0.063	18		

Dry Mass of sample, g: 10817

Sample Proportions	% dry mass
Very coarse	0
Gravel	55
Sand	26
Fines <0.063mm	18

Grading Analysis		
D100	mm	63
D60	mm	8.39
D30	mm	0.39
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7 3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

UKAS TESTING
1464

IAN FARMER ASSOCIATES

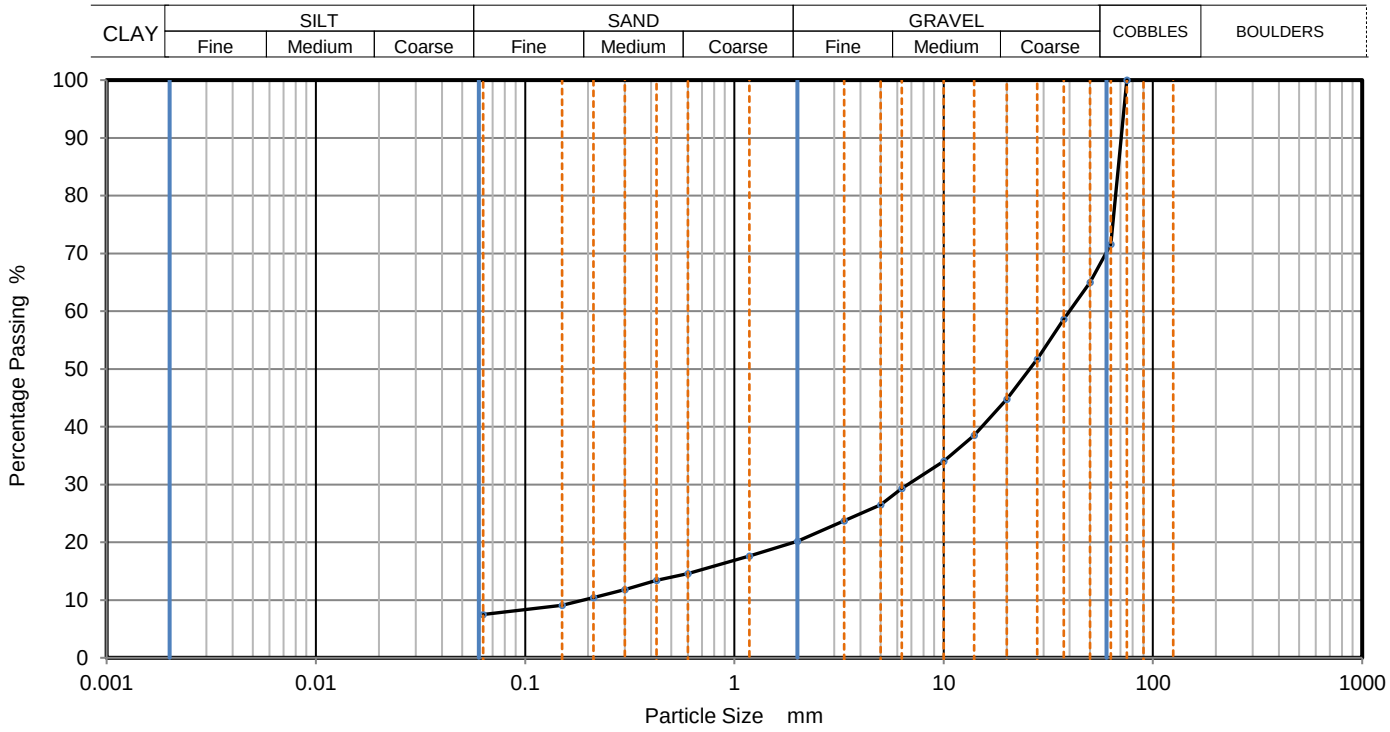
Laboratory Test Report | 31371 / 1

Site: Sparling Footbridge, Newton Stewart | **Job Number:** 31371

Client: Dumfries and Galloway Council | **Page:** 4

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH1	3.00	B14	Wet Sieve	Brown silty sandy GRAVEL with high cobble content



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	72		
50	65		
37.5	59		
28	52		
20	45		
14	39		
10	34		
6.3	29		
5	27		
3.35	24		
2	20		
1.18	18		
0.6	15		
0.425	13		
0.3	12		
0.212	10		
0.15	9		
0.063	8		

Dry Mass of sample, g: 6270

Sample Proportions	% dry mass
Very coarse	28
Gravel	51
Sand	13
Fines <0.063mm	7

Grading Analysis		
D100	mm	75
D60	mm	39.9
D30	mm	6.76
D10	mm	0.191
Uniformity Coefficient		210
Curvature Coefficient		6

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7 3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

UKAS TESTING
1464

IAN FARMER ASSOCIATES

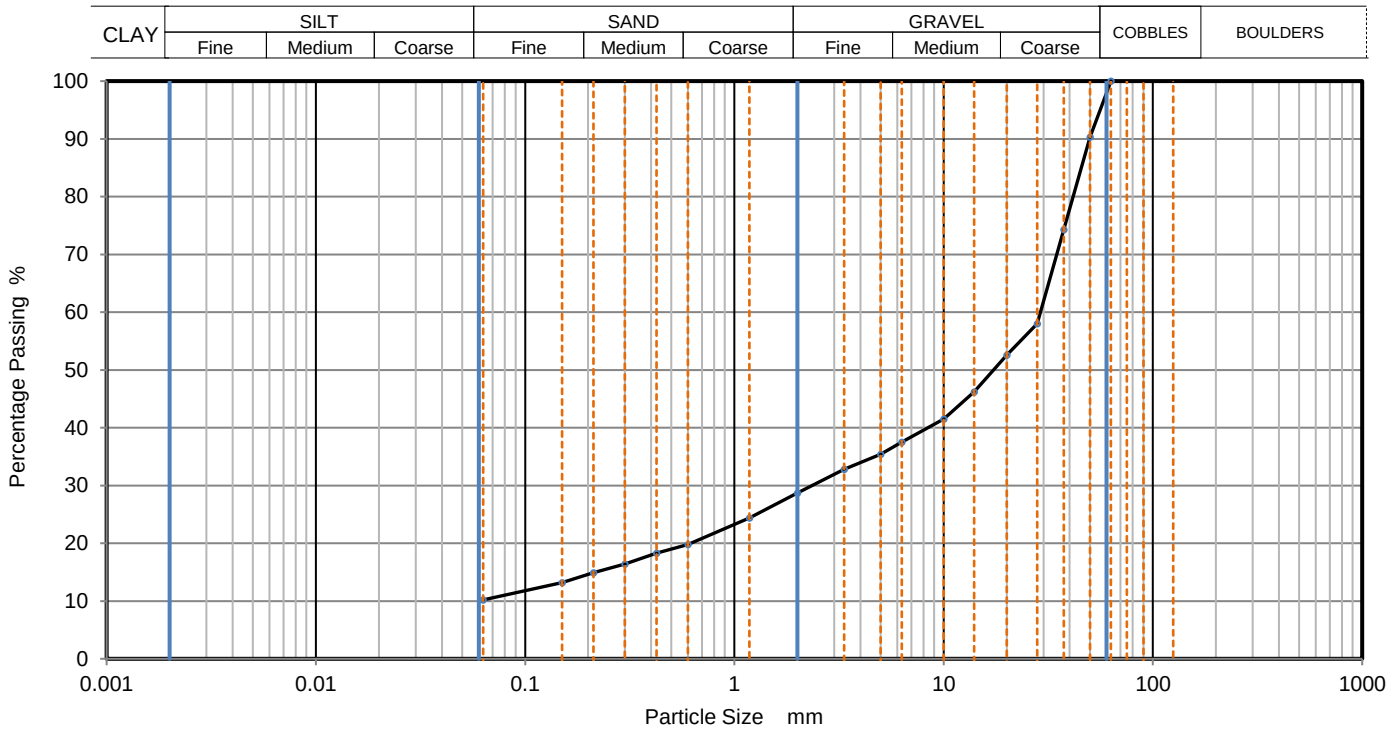
Laboratory Test Report | 31371 / 1

Site: Sparling Footbridge, Newton Stewart | **Job Number:** 31371

Client: Dumfries and Galloway Council | **Page:** 5

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH2	1.20	B7	Wet Sieve	Brown slightly silty sandy GRAVEL



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
63	100		
50	90		
37.5	74		
28	58		
20	53		
14	46		
10	42		
6.3	38		
5	35		
3.35	33		
2	29		
1.18	24		
0.6	20		
0.425	18		
0.3	16		
0.212	15		
0.15	13		
0.063	10		

Dry Mass of sample, g: 8519

Sample Proportions	% dry mass
Very coarse	0
Gravel	71
Sand	19
Fines <0.063mm	10

Grading Analysis		
D100	mm	63
D60	mm	29
D30	mm	2.37
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7 3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

UKAS TESTING
1464

IAN FARMER ASSOCIATES

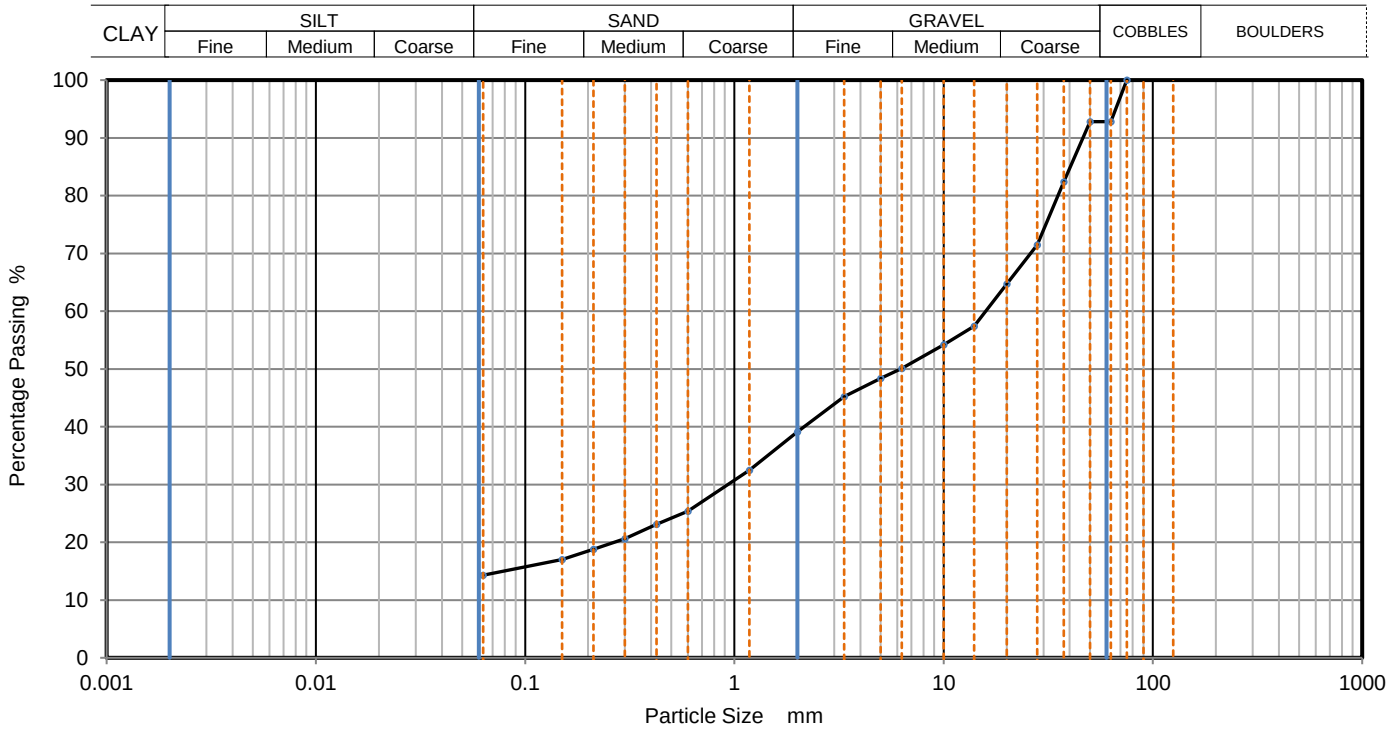
Laboratory Test Report | 31371 / 1

Site: Sparling Footbridge, Newton Stewart | **Job Number:** 31371

Client: Dumfries and Galloway Council | **Page:** 6

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH2	2.00	B10	Wet Sieve	Brown slightly clayey very sandy GRAVEL with low cobble content



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	93		
50	93		
37.5	82		
28	72		
20	65		
14	57		
10	54		
6.3	50		
5	48		
3.35	45		
2	39		
1.18	33		
0.6	25		
0.425	23		
0.3	21		
0.212	19		
0.15	17		
0.063	14		

Dry Mass of sample, g: 9326

Sample Proportions	% dry mass
Very coarse	7
Gravel	54
Sand	25
Fines <0.063mm	14

Grading Analysis		
D100	mm	75
D60	mm	15.9
D30	mm	0.928
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7 3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

UKAS TESTING
1464

IAN FARMER ASSOCIATES

Test Report - 31371 / 1

Site:	Sparling Footbridge, Newton Stewart
Job Number:	31371
Originating Client:	Dumfries and Galloway Council

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

Date: 21/06/2017

CERTIFICATE OF ANALYSIS 17- 01408

Certificate of Analysis

Certificate Number	17-01408
	07-Jun-17
Client	Ian Farmer Associates 4 Faraday Close District 15 Pattinson North Industrial Est Washington Tyne & Wear NE38 8QJ
Our Reference	17-01408
Client Reference	31371
Order No	92376
Contract Title	Sparling Footbridge
Description	4 Soil samples, 1 Water sample.
Date Received	01-Jun-17
Date Started	01-Jun-17
Date Completed	07-Jun-17
Test Procedures	Identified by prefix DETSn (details on request).
Notes	Opinions and interpretations are outside the laboratory's scope of ISO 10725 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Adam Fenwick
Contracts Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 17-01408
Client Ref 31371
Contract Title Sparling Footbridge

	Lab No	1182167	1182168	1182170	1182171
	Sample ID	BH1	BH1	BH2	BH3
	Depth	1.20	1.85	3.75	1.20
	Other ID				
	Sample Type	SOIL	SOIL	SOIL	SOIL
	Sampling Date	18/05/17	18/05/17	19/05/17	22/05/17
	Sampling Time	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Inorganics					
pH	DETSC 2008#			7.6	7.9	8.1	7.8
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	13	27	29	16

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Water Samples

Our Ref 17-01408
Client Ref 31371
Contract Title Sparling Footbridge

Lab No	1182169
Sample ID	BH2
Depth	1.80
Other ID	
Sample Type	WATER
Sampling Date	19/05/17
Sampling Time	n/s

Test	Method	LOD	Units	
Inorganics				
pH	DETSC 2008			6.2
Sulphate as SO4	DETSC 2055	0.1	mg/l	8.5

Key: n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 17-01408
Client Ref 31371
Contract Sparling Footbridge

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1182167	BH1 1.20 SOIL	18/05/17	PT 1L	pH + Conductivity (7 days)	
1182168	BH1 1.85 SOIL	18/05/17	PT 1L	pH + Conductivity (7 days)	
1182169	BH2 1.80 WATER	19/05/17	PB 1L	pH/Cond/TDS (7 days)	
1182170	BH2 3.75 SOIL	19/05/17	PT 1L	pH + Conductivity (7 days)	
1182171	BH3 1.20 SOIL	22/05/17	PT 1L	pH + Conductivity (7 days)	

Key: P-Plastic T-Tub B-Bottle

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

APPENDIX 4

CHEMICAL TESTS

CERTIFICATE OF ANALYSIS 17-01474

Certificate of Analysis

Certificate Number	17-01474	08-Jun-17
Client	Ian Farmer Associates 4 Faraday Close District 15 Pattinson North Industrial Est Washington Tyne & Wear NE38 8QJ	
Our Reference	17-01474	
Client Reference	31371	
Order No	92378	
Contract Title	Sparling Footbridge	
Description	4 Soil samples, 1 Leachate sample.	
Date Received	02-Jun-17	
Date Started	02-Jun-17	
Date Completed	08-Jun-17	
Test Procedures	Identified by prefix DETSn (details on request).	
Notes	Opinions and interpretations are outside the laboratory's scope of ISO 10725 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.	

Approved By

Adam Fenwick
Contracts Manager

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING
2139

Summary of Chemical Analysis
Matrix Descriptions

Our Ref 17-01474
Client Ref 31371
Contract Title Sparling Footbridge

Sample ID	Depth	Lab No	Completed	Matrix Description
BH1	0.5	1182456	08/06/2017	Dark brown gravelly, sandy CLAY including odd rootlets
BH2	0.00-0.20	1182457	08/06/2017	Dark brown gravelly, sandy CLAY including numerous rootlets
BH2	1.2	1182458	08/06/2017	Dark brown gravelly, very sandy CLAY including odd rootlets
BH3	0.6	1182459	08/06/2017	Dark brown gravelly, very clayey SAND including odd rootlets

Summary of Chemical Analysis
Soil Samples

Our Ref 17-01474
Client Ref 31371
Contract Title Sparling Footbridge

			Lab No	1182456	1182457	1182458	1182459
			Sample ID	BH1	BH2	BH2	BH3
			Depth	0.50	0.00-0.20	1.20	0.60
			Other ID				
			Sample Type	SOIL	SOIL	SOIL	SOIL
			Sampling Date	18/05/17	19/05/17	19/05/17	22/05/17
			Sampling Time	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	18	18	14	12
Cadmium	DETSC 2301#	0.1	mg/kg	8.1	0.6	0.4	0.2
Chromium	DETSC 2301#	0.15	mg/kg	46	52	79	69
Copper	DETSC 2301#	0.2	mg/kg	71	28	38	26
Lead	DETSC 2301#	0.3	mg/kg	270	62	37	27
Mercury	DETSC 2325#	0.05	mg/kg	5.2	0.12	0.25	< 0.05
Nickel	DETSC 2301#	1	mg/kg	56	43	57	49
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	1100	120	120	96
Inorganics							
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.7	0.4	< 0.1	< 0.1
PAHs							
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Chrysene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Phenanthrene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
Pyrene	DETSC 3301	0.1	mg/kg	< 0.1		< 0.1	
PAH Total	DETSC 3301	1.6	mg/kg	< 1.6		< 1.6	

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Leachate Samples

Our Ref 17-01474
Client Ref 31371
Contract Title Sparling Footbridge

Lab No	1182460
Sample ID	BH3
Depth	0.60
Other ID	
Sample Type	LEACHATE
Sampling Date	22/05/17
Sampling Time	n/s

Test	Method	LOD	Units	
Preparation				
NRA Leachate Preparation	DETS 036*			Y
Metals				
Arsenic, Dissolved	DETSC 2306	0.16	ug/l	1.4
Cadmium, Dissolved	DETSC 2306	0.03	ug/l	0.05
Chromium, Dissolved	DETSC 2306	0.25	ug/l	3.3
Copper, Dissolved	DETSC 2306	0.4	ug/l	6.9
Lead, Dissolved	DETSC 2306	0.09	ug/l	0.65
Mercury, Dissolved	DETSC 2306	0.01	ug/l	< 0.01
Nickel, Dissolved	DETSC 2306	0.5	ug/l	13
Selenium, Dissolved	DETSC 2306	0.25	ug/l	2.4
Zinc, Dissolved	DETSC 2306	1.3	ug/l	45
Inorganics				
Cyanide, Total	DETSC 2130	40	ug/l	< 40
PAHs				
Acenaphthene	DETSC 3304	0.01	ug/l	0.02
Acenaphthylene	DETSC 3304	0.01	ug/l	< 0.01
Anthracene	DETSC 3304	0.01	ug/l	0.02
Benzo(a)anthracene	DETSC 3304	0.01	ug/l	0.01
Benzo(a)pyrene	DETSC 3304	0.01	ug/l	< 0.01
Benzo(b)fluoranthene	DETSC 3304	0.01	ug/l	< 0.01
Benzo(g,h,i)perylene	DETSC 3304*	0.01	ug/l	< 0.01
Benzo(k)fluoranthene	DETSC 3304	0.01	ug/l	< 0.01
Chrysene	DETSC 3304	0.01	ug/l	0.01
Dibenzo(a,h)anthracene	DETSC 3304	0.01	ug/l	< 0.01
Fluoranthene	DETSC 3304	0.01	ug/l	0.03
Fluorene	DETSC 3304	0.01	ug/l	0.02
Indeno(1,2,3-c,d)pyrene	DETSC 3304*	0.01	ug/l	< 0.01
Naphthalene	DETSC 3304	0.01	ug/l	< 0.01
Phenanthrene	DETSC 3304	0.01	ug/l	0.07
Pyrene	DETSC 3304	0.01	ug/l	0.03
PAH Total	DETSC 3304	0.04	ug/l	0.21

Key: * -not accredited. n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 17-01474
Client Ref 31371
Contract Sparling Footbridge

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1182456	BH1 0.50 SOIL	18/05/17	GJ 250ml, GJ 60ml, PT 1L	Naphthalene (14 days), PAH FID (14 days)	
1182457	BH2 0.00-0.20 SOIL	19/05/17	GJ 250ml, GJ 60ml, PT 1L		
1182458	BH2 1.20 SOIL	19/05/17	GJ 250ml, GJ 60ml, PT 1L		
1182459	BH3 0.60 SOIL	22/05/17	GJ 250ml x2, PT 1L		
1182460	BH3 0.60 LEACHATE	22/05/17	GJ 250ml x2, PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETSC 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETSC 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETSC 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETSC 2076	Sulphate Aqueous Extract as SO4	mg/l	10	Air Dried	No	Yes	Yes
DETSC 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETSC 2321	Total Sulphate as SO4	%	0.01	Air Dried	No	Yes	Yes
DETSC 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETSC 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETSC2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETSC2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETSC2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETSC2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETSC2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETSC2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETSC2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETSC 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

APPENDIX 5

CONTAMINATION ASSESSMENT

APPENDIX 5

GENERAL NOTES ON CONTAMINATION ASSESSMENT

A5.1 STATUTORY FRAMEWORK AND DEFINITIONS

A5.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref. 9.25, which was introduced by the Environment Act 1995, ref. 9.26;

'Land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) pollution of controlled waters is being, or is likely to be, caused.'

A5.1.2 The UK guidance on the assessment of contaminated has developed as a direct result of the introduction of these two Acts. The technical guidance supporting the new legislation has been summarised in a number of key documents collectively known as the Contaminated Land Reports (CLRs), a proposed series of twelve documents. Seven were originally published in March 1994, four more were published in April 2002, while the last remaining guidance document, CLR 11, ref. 9.43 was published in 2004. In 2008 CLR reports 7 to 10 were withdrawn by DEFRA and the Environment Agency and updated version of CLR 9 and 10 were produced in the form of Science Reports SR2, ref. 9.33 and SR3, ref. 9.27.

A5.1.3 In establishing whether a site fulfils the statutory definition of 'contaminated land' it is necessary to identify, whether a pollutant linkage exists in respect of the land in question and whether the pollutant linkage:

- is resulting in significant harm being caused to the receptor in the pollutant linkage,
- presents a significant possibility of significant harm being caused to that receptor,
- is resulting in the pollution of the controlled waters which constitute the receptor, or
- is likely to result in such pollution.

A5.1.4 A *'pollutant linkage'* may be defined as the link between a contaminant *'source'* and a *'receptor'* by means of a *'pathway'*.

A5.2 ASSESSMENT METHODOLOGY

A5.2.1 The guidance proposes a four-stage assessment process for identifying potential pollutant linkages on a site. These stages are set out in the table below:

No.	Process	Description
1	Hazard Identification	Establishing contaminant sources, pathways and receptors (the conceptual model).
2	Hazard Assessment	Analysing the potential for unacceptable risks (what linkages could be present, what could be the effects).
3	Risk Estimation	Trying to establish the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it).
4	Risk Evaluation	Deciding whether the risk is unacceptable.

A5.2.2 Stages 1 and 2 develop a *'conceptual model'* based upon information collated from desk based studies, and frequently a walkover of the site. The walkover survey should be conducted in general accordance with CLR 2, ref. 9.50. The formation of a conceptual model is an iterative process and as such, it should be updated and refined throughout each stage of the project to reflect any additional information obtained.

A5.2.3 The extent of the desk studies and enquiries to be conducted should be in general accordance with CLR 3, ref. 9.51. The information from these enquiries is presented in a desk study report with recommendations, if necessary, for further work based upon the conceptual model. CLR 8, ref. 9.52, together with specific DoE 'Industry Profiles' provides guidance on the nature of contaminants relating to specific industrial processes. Although CLR 8 has been withdrawn, no replacement guidance has been published that lists the contaminants likely to be present on contaminated sites and as such the guidance relating to this issue of CLR 8 is considered to still be relevant.

A5.2.4 If potential pollutant linkages are identified within the conceptual model, a Phase 2 site investigation and report will be recommended. The investigation should be planned in general accordance with CLR 4, ref. 9.1. The number of exploratory holes and samples collected for analysis should be consistent with the size of the site and the level of risk envisaged. This will enable a contamination risk assessment to be conducted, at which point the conceptual model can be updated and relevant pollutant linkages can be identified.

A5.2.5 A two-stage investigation may be more appropriate where time constraints are less of an issue. The first stage investigation being conducted as an initial assessment for the presence of potential sources, a second being a more refined investigation to delineate wherever possible the extent of the identified contamination.

A5.2.6 All site works should be in general accordance with the British Standards, BS 5930:1999, ref. 9.3, ISO 1997, ref. 9.4 and BS 10175:2001, ref. 9.2.

A5.2.7 The generic contamination risk assessment screens the results of the chemical analysis against generic guidance values which are dependent on the proposed end-use of the development.

A5.2.8 The end-use may be defined as one of the following ref. 9.31;

- Residential with homegrown produce – domestic low rise and low density housing with gardens where vegetable may be grown for home consumption
- Residential without homegrown produce – domestic low density and low density housing where no gardens are present.
- Allotments – specific areas where vegetables are grown for home consumption.
- Public open space in close proximity to residential housing – includes the predominantly grassed area adjacent to high density housing and the central green area around which houses are developed. This land-use includes the

smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting.

- Public open space in use as general parkland – provided for recreational use and may be used for family visits and picnics, children's play area, sports grounds and dig walking.

- Commercial – industrial premises where there is limited exposure to soil.

A5.2.9 Exposure pathways for each type of end-use are given below:

Standard Land Use	Oral Routes			Dermal Routes		Inhalation Routes			
	Direct soil & dust ingestion	Consumption of homegrown produce	Soil attached to homegrown produce	Indoor	Outdoor	Indoor dust	Outdoor dust	Indoor vapour	Outdoor vapour
Residential with homegrown produce	✓	✓	✓	✓	✓	✓	✓	✓	✓
Residential without homegrown produce	✓	X	X	✓	✓	✓	✓	✓	✓
Allotments	✓	✓	✓	X	✓	X	✓	✓	✓
Public open space – adjacent to dwellings	✓	X	X	✓	✓	✓	✓	X	✓
Public open space – parkland	✓	X	X	X	✓	X	✓	X	✓
Commercial	✓	X	X	✓	X	✓	X	✓	X

A5.2.10 Soils will be compared to Suitable 4 Use Levels (S4ULs) published by LQM ref. 9.29 Assessment Criteria. Where no S4UL is available, the assessment criteria (AC) are generated using the Contaminated Land Exposure Assessment (CLEA) Software Version 1.06, ref. 9.29. Toxicological and physico-chemical/fate and transport data used to generate the AC has been derived from a hierarchy of data sources as follows:

1. Environment Agency or Department of Environment Food and Rural Affairs

   (DEFRA) documents;

2. Other documents produced by UK Government or state organisations;

3. European institution documents;

4. International organisation documents;

5. Foreign government institutions.

A5.2.11 In the case of the majority of contaminants considered, the toxicological data has been drawn from the relevant CLR 9 TOX report, or updated toxicological data published by the Environment Agency (2009), ref. 9.28, where available. Where no TOX report is available reference has been made to the health criteria values, derived for use in Land Quality Press (2006), ref. 9.34, as this is considered to represent a peer reviewed data source. Similarly, fate and transport data has been derived in the first instance from

Environment Agency (2003), ref. 9.53 and for contaminants not considered in this document the fate and transport data used in previous versions of the CLEA model has been used.

A5.2.12 Chemical laboratory test results are processed as follows. A statistical analysis of the results is conducted, as detailed in CIEH and CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', ref. 9.29. Individual concentrations are compared to the selected guideline values to identify concentrations of contaminants that are above the selected screening criteria.

A5.2.13 Initially the distribution of the data set is to determine if the data set is, or is not, normally distributed. Where the distribution of the data is shown to be normal, the mean value test is applied to determine whether the mean characteristics of the selected soil unit present a significant possibility of significant harm to human health. Where the data is not normally distributed a method based on the Chebychev Theorem can be applied to test the same hypothesis. The significance of the data is further tested using the maximum value test. This determines whether the highest recorded contaminant concentrations are from the same statistical distribution or whether they may represent a 'hot spot'.

A5.2.14 Where the risk estimation identifies significant concentrations of one or more contaminants, a further risk evaluation needs to be undertaken.

A5.2.15 The risk evaluation will address the potential pollutant linkages between an identified source of contamination and the likely receptors both on and off site.

A5.2.16 The potential receptors include:

1) Humans – current site occupants, construction workers, future site users and neighbouring site users.

2) Controlled Waters – surface water and groundwater resources

3) Plants – current and future site vegetation

4) Building materials

A5.2.17 The potential hazards to be considered in relation to contamination are:

a) Ingestion and inhalation.

b) Uptake of contaminants via cultivated vegetables.

c) Dermal contact

d) Phytotoxicity (the prevention or inhibition of plant growth)

e) Contamination of water resources

f) Chemical attack on building materials and services

g) Fire and explosion

A5.2.18 Dependent on the outcome of the initial, generic contamination risk assessment, further detailed assessment of the identified risks may be required.

A5.3 Generic Guidance Values Used Within Contamination Risk Assessment

General Open Space (adjacent to dwellings)

General Open Space	Determinant	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source
		1% SOM	2.5% SOM	6% SOM	
PAH	Acenaphthene	15000	15000	15000	LQM/CIEH S4UL
	Acenaphthylene	15000	15000	15000	LQM/CIEH S4UL
	Anthracene	74000	74000	74000	LQM/CIEH S4UL
	Benzo(a)anthracene	29	29	29	LQM/CIEH S4UL
	Benzo(a)pyrene	5.7	5.7	5.7	LQM/CIEH S4UL
	Benzo(b)fluoranthene	7.1	7.1	7.1	LQM/CIEH S4UL
	Benzo(ghi)perylene	640	640	640	LQM/CIEH S4UL
	Benzo(k)fluoranthene	190	190	190	LQM/CIEH S4UL
	Chrysene	57	57	57	LQM/CIEH S4UL
	Dibenzo(ah)anthracene	0.57	0.57	0.57	LQM/CIEH S4UL
	Fluoranthene	3100	3100	3100	LQM/CIEH S4UL
	Fluorene	9900	9900	9900	LQM/CIEH S4UL
	Indeno(123-cd)pyrene	82	82	82	LQM/CIEH S4UL
	Naphthalene	4900	4900	4900	LQM/CIEH S4UL
	Phenanthrene	3100	3100	3100	LQM/CIEH S4UL
	Pyrene	7400	7400	7400	LQM/CIEH S4UL
Other Organics	Phenol	760	1500	3200	LQM/CIEH S4UL
Metals	Arsenic	79	79	79	LQM/CIEH S4UL
	Beryllium	2.2	2.2	2.2	LQM/CIEH S4UL
	Boron	21000	21000	21000	LQM/CIEH S4UL
	Cadmium	120	120	120	LQM/CIEH S4UL
	Chromium (III)	1500	1500	1500	LQM/CIEH S4UL
	Chromium (VI)	23	23	23	LQM/CIEH S4UL
	Copper	12000	12000	12000	LQM/CIEH S4UL
	Lead	630	630	630	DEFRA C4SL
	Mercury	16	16	16	LQM/CIEH S4UL
	Nickel	230	230	230	LQM/CIEH S4UL
	Selenium	1100	1100	1100	LQM/CIEH S4UL
	Vanadium	2000	2000	2000	LQM/CIEH S4UL
	Zinc	81000	81000	81000	LQM/CIEH S4UL

General Open Space	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source
	1% SOM	2.5% SOM	6% SOM	
Aliphatic				
EC 5-6	570000 (304)	590000	600000	LQM/CIEH S4UL
EC >6-8	600000	610000	620000	LQM/CIEH S4UL
EC >8-10	13000	13000	13000	LQM/CIEH S4UL
EC >10-12	13000	13000	13000	LQM/CIEH S4UL
EC >12-16	13000	13000	13000	LQM/CIEH S4UL
EC >16-35	250000	250000	250000	LQM/CIEH S4UL
EC >35-44	250000	250000	250000	LQM/CIEH S4UL
Aromatic				
EC 5-7 (benzene)	56000	56000	56000	LQM/CIEH S4UL
EC >7-8 (toluene)	56000	56000	56000	LQM/CIEH S4UL
EC >8-10	5000	5000	5000	LQM/CIEH S4UL

EC >10-12	5000	5000	5000	LQM/CIEH S4UL
EC >12-16	5100	5100	5000	LQM/CIEH S4UL
EC >16-21	3800	3800	3800	LQM/CIEH S4UL
EC >21-35	3800	3800	3800	LQM/CIEH S4UL
EC >35-44	3800	3800	3800	LQM/CIEH S4UL
Aliphatic and Aromatic				
EC >44-70	3800	3800	3800	LQM/CIEH S4UL
BTEX				
Benzene	72	72	73	LQM/CIEH S4UL
Toluene	56000	56000	56000	LQM/CIEH S4UL
Ethylbenzene	24000	24000	25000	LQM/CIEH S4UL
m/p Xylenes	41000	42000	43000	LQM/CIEH S4UL
o Xylene	41000	42000	43000	LQM/CIEH S4UL

SOM = Soil Organic Matter
Values in brackets indicate the solubility or vapour saturation limit where this is exceeded by the GAC

A5.4 Guidance Values Used For Assessment of Risk To Controlled Waters

Contaminant	Units	EQS Freshwater[1]	EQS Saltwater[1]	Water Supply[5]
Alachlor	ug/l	0.7	0.7	
Abamectin	ug/l	0.03	0.01	
Acrylamide	ug/l			0.1
Aluminium	ug/l	10[3]	25	200
Ammonia (unionised)	ug/l	15	21[2]	
Ammonium (as NH4)	mg/l			0.5
Anthracene	ug/l	0.4	0.4	
Antimony	ug/l			5
Arsenic	ug/l	50[2]	25[2]	10
Atrazine	ug/l	2	2	
Azamethiphos	ug/l	0.05	0.05	
Barium	ug/l			1000
Benzene	ug/l	50	50	1
Benzyl-butyl-phthalate	ug/l	7.5[2]	0.75[2]	
Boron	mg/l	2	7	1
Brominated Diphenylether	ug/l	0.0005[2]	0.0005[2]	
Bromine	ug/l	5	10	
Bromoxynil	ug/l	1000	1000	
Cadmium	ug/l	0.45[3]	0.2[2]	5
Calcium	*mg/l*			*250*
Carbon Tetrachloride	ug/l	12[2]	12[2]	
Carbendazin	ug/l	0.15[2]	-	
C10-C13 Chloroalkanes	ug/l	1.4	1.4	
Chlorenvinphos	ug/l	0.3	0.3	
Chlorpyrifos (Chlorpyrifos-ether)	ug/l	0.1	0.1	
Chlorothalonil	ug/l	0.035[2]	-	
Cyclodiene Pesticides (aldrin, Dieldrin, Endrin, Isodrin)	ug/l	Σ=0.01[2]	Σ=0.005[2]	
Chloride	mg/l	250	-	400
Chlorpropham	ug/l	40	40	
Chlortoluron	ug/l	20	-	
Chromium III	ug/l	4.7[2]	-	50
Chromium VI	ug/l	3.4[2]	0.6[2]	
Cobalt	ug/l	100	100	
Copper	ug/l	1[2]	3.76[2]	2
Coumaphos	ug/l	0.1	0.1	
Cyanide (hydrogen cyanide)	ug/l	1[2]	1[2]	50
Cypermethrin	ug/l	0.1[2]	0.1[2]	
Cyfluthrin	ug/l	0.001	0.001	
1,2-Dichloroethane	ug/l			3
2,4-Dichlorophenoxyacetic acid (2,4-D)	ug/l	0.3[2]	0.3[2]	
2,4-Dichlorophenol	ug/l	4.2[2]	0.042[2]	
3,4-Dichloroaniline	ug/l	0.2[2]	0.2[2]	
DDT (total)	ug/l	0.025[2]	0.025[2]	
Diazinon	ug/l	0.01[2]	0.01[2]	
Dibutylphthalate (DBP)	ug/l	40	40	
Dichlorobenzenes (all isomers)	ug/l	200	200	
para, para-DDT	ug/l	0.01[2]	0.01[2]	
Diethylphthalate (DEP)	ug/l	1000	1000	
Dimethylphthalate (DMP)	ug/l	4000	4000	
Dioctylphthalate (DOP)	ug/l	40	40	
Dimethoate	ug/l	0.48[2]	0.48[2]	
Diflubenzuron	ug/l	0.015	0.1	
Doromectin	ug/l	0.01	0.01	
Diuron	ug/l	1.8	1.8	
Endosulfan	ug/l	0.01	0.004	
Epichlorohydrin	ug/l			0.1
EDTA	ug/l	4000	4000	
Ethylbenzene	ug/l	200	200	
Fenchlorphos	ug/l	0.1	0.1	
Flucofuron	ug/l	1	1	
Fluoride	mg/l	3[4]	15	1.5
Fluoranthene	ug/l	1	1	
Formaldehyde	ug/l	50	-	

Contaminant	Units	EQS Freshwater[1]	EQS Saltwater[1]	Water Supply[5]
Glyphosate	ug/l	196[2]	196[2]	
Hexachlorobenzene	ug/l	0.05	0.05	
Hexachlorobutadiene	ug/l	0.6	0.6	
Hexachlorocyclohexane (lindane)	ug/l	0.04	0.02	
Hydrogen Sulphide	ug/l	1	10	
Ioxynil	ug/l	100	100	
Iron	ug/l	1000[2]	1000[2]	200
Isoproturon	ug/l	1	1	
Ivermectin	ug/l	0.001	0.001	
Kjeldahl Nitrogen (as N)	mg/l			1
Lead	ug/l	7.2[2]	7.2[2]	10
Linuron	ug/l	0.5[2]	0.5[2]	
Malachite Green	ug/l	100	100	
Magnesium	*mg/l*			*50*
Manganese	ug/l	123[2]	-	50
Mecoprop	ug/l	18[2]	18[2]	
Methiocarb	ug/l	0.01[2]	-	
Mancozeb	ug/l	20	20	
Maneb	ug/l	30	30	
MCPA	ug/l	120[3]	800	
Methylphenols	ug/l	300	300	
Mevinphos	ug/l	0.02	-	
Monochlorophenols	ug/l	250	250	
Mercury	ug/l	0.07	0.07	1
Naphthalene	ug/l	2.4[2]	1.2[2]	
Nickel	ug/l	20[2]	20[2]	20
NTA	ug/l	10000	30000	
Nitrate (as N)	mg/l			50
Nitrite (as NO2)	mg/l			0.5
Nonylphenol (4-nonylphenol)	ug/l	2	2	
Oils/hydrocarbons	ug/l			10
Pendimethylin	ug/l	0.3[2]	-	
Permethrin	ug/l	0.001[2]	0.0002[2]	
Polycyclic Aromatic Hydrocarbons (PAH)	ug/l			0.1
- Benzo(a)pyrene	ug/l	0.1	0.1	0.01
- Benzo(b)fluoranthene	ug/l	Σ=0.03[2]	Σ=0.03[2]	
- Benzo(k)fluoranthene	ug/l			
- Benzo(ghi)perylene	ug/l	Σ=0.002[2]	Σ=0.002	
- Indeno(123-cd)perylene	ug/l			
Pentachlorobenzene	ug/l	0.007[2]	0.0007[2]	
Pentachlorophenol	ug/l	1	1	
Pesticides (individual)	ug/l			0.1
- Aldrin	ug/l			0.03
- Dieldrin	ug/l			0.03
- Heptachlor	ug/l			0.03
- Heptachlor epoxide	ug/l			0.03
Pesticides (total)	ug/l			0.5
Phenol	ug/l	7.7[2]	7.7[2]	0.5
PCSDs	ug/l	0.05	0.05	
Pirimicarb	ug/l	5	5	
Pendimethalin	ug/l	6	6	
Primaphos-methyl	ug/l	0.05	0.05	
Prochloraz	ug/l	40	40	
Propetamphos	ug/l	0.1	0.1	
Propyzamide	ug/l	1000	1000	
Phosphorous	ug/l			2200
Potassium	mg/l			12
Selenium	ug/l			10
Silver	ug/l	0.1	1	10
Simizine	ug/l	4	4	
Styrene	ug/l	500	500	
Sulcofuron	ug/l	25	25	
Sulphate	mg/l	400	-	250
Surfactants (as lauryl sulphate)	ug/l			200
Tecnazene	ug/l	10	10	
Tetrachloromethane (PCM)	ug/l	2.5[2]	2.5[2]	3

Contaminant	Units	EQS Freshwater[1]	EQS Saltwater[1]	Water Supply[5]
Tetrachloroethylene (PCE)	ug/l	10[2]	10[2]	10
Tetrachloroethane	ug/l	140[2]	-	
Trichloroethylene (TCE)	ug/l	10[2]	10[2]	10
Thiabendazole	ug/l	50	50	
Tin (inorganic)	ug/l	25[2]	10[2]	
Trihalomethanes	ug/l			100
Trichlorobenzenes	ug/l	0.4[2]	0.4[2]	
Toluene	ug/l	74[2]	74[2]	
Tributyl phosphate	ug/l	500	500	
Tributyltin	ug/l	0.0015	0.0015	
Trifluralin	ug/l	0.03[2]	0.03[2]	
Vanadium	ug/l	20[4]	100	
Vinyl chloride	ug/l			0.5
Zinc	ug/l	11.9[2]	7.9[2]	5000

[1] MAC – Maximum Allowed Concentration
[2] AA – Average Annualised
[3] Dependant on pH
[4] Dependant on water hardness
[5] For sample taken at consumers' taps

BGS ID: 620801 : BGS Reference: NX46NW7
British National Grid (27700) : 241087,566149
Report an issue with this borehole

BOREHOLE RECORD

LOCATION: Old Cornmill, "Minnigaff", Newton Stewart JOB NO.: 6257 DATES: COMMENCED: 19.7.88 WATER LEVELS: INITIAL: 5.45 m
BOREHOLE NO.: 1 DIAMETER: 150 mm SURFACE LEVEL: ..... m COMPLETED: 19.7.88 (Depth bgl) FINAL: 5.45 m

Description	Depth (m)	Thick-ness (m)	Level (m)	Samples	N	w (%)	ρ (Mg/m³)	c (kN/m²)	ø (deg.)	LL (%)	PL (%)	PI (%)	Indicated Safe Bearing Capacity (kN/m²) Strip	Square
Filling:- Brick,sand and boulders	0.25	0.25		D 0.50										
Filling:- Medium dense dark brown clayey sand and gravel with sandy rubble and pockets of clay	3.90	3.65		D 2.00 D 3.00										
Medium dense dark brown clayey sand and gravel	5.45	1.55		D+B 4.00	15 4.15									
Loose fine uniform brown clayey silty sand and gravel	5.80	0.35		D+B 5.50	7 5.65									
Medium dense coarse sand and fine to coarse gravel	7.00	1.20 pen.		D+B 6.50	15 6.65									

Remarks: Water sample taken

SO_3 at 3.00 metres = 0.05% pH at 3.00 metres = 7.0
SO_3 on water sample = 0.11g/litre pH on water sample = 7.5

Symbols: N - Number of blows in Standard Penetration Test w - Natural moisture content ρ - Natural bulk density c - Apparent cohesion ø - Angle of internal friction
LL - Liquid limit PL - Plastic limit PI - Plasticity index U - 100 mm diameter undisturbed sample D - Disturbed sample B - Bulk sample

NICHOLSON (SITE INVESTIGATION) LIMITED, BATHGATE ROAD, ARMADALE

BGS ID: 620802 : BGS Reference: NX46NW8
British National Grid (27700) : 241097,566143
Report an issue with this borehole

BOREHOLE RECORD

LOCATION: Old Cornmill, "Minnigaff", Newton Stewart JOB NO.: 6257 DATES: COMMENCED: 20.7.88 WATER LEVELS: INITIAL: 4.80 m

BOREHOLE NO.: 2 DIAMETER: 150 mm SURFACE LEVEL: m COMPLETED: 20.7.88 (Depth bgl) FINAL: 4.50 m

Description	Depth (m)	Thickness (m)	Level (m)	Samples	N	w (%)	ρ (Mg/m³)	c (kN/m²)	ø (deg.)	LL (%)	PL (%)	PI (%)	Indicated Safe Bearing Capacity (kN/m²) Strip	Square
Filling:- Bricks, gravel, boulders and sand	2.00	2.00		D 0.50										
Filling:- Medium dense dark brown clayey sand, gravel, boulders with pockets of clay	4.10	2.10		D 2.50										
Medium dense dark brown clayey sand and gravel	4.80	0.70		D+B 4.20	16 4.35									
Medium dense coarse sand and fine to coarse gravel	7.00	2.20 pen.		D+B 5.00 D+B 6.50	16 5.15 17 6.65									

Remarks: Water sample taken SO_3 at 2.50 metres = 0.09% pH at 2.50 metres = 7.5

Symbols: N - Number of blows in Standard Penetration Test w - Natural moisture content ρ - Natural bulk density c - Apparent cohesion ø - Angle of internal friction
LL - Liquid limit PL - Plastic limit PI - Plasticity index U - 100 mm diameter undisturbed sample D - Disturbed sample B - Bulk sample

NICHOLSON (SITE INVESTIGATION) LIMITED, BATHGATE ROAD, ARMADALE

BGS ID: 620803 : BGS Reference: NX46NW9
British National Grid (27700) : 241088,566125
Report an issue with this borehole

BOREHOLE RECORD

LOCATION: Old Cornmill, "Minnigaff", Newton Stewart JOB NO.: 6257 DATES: COMMENCED: 21.7.88 WATER LEVELS: INITIAL: 5.20 m

BOREHOLE NO.: 3 DIAMETER: 150 mm SURFACE LEVEL: ..... m COMPLETED: 21.7.88 (Depth bgl) FINAL: 5.00 m

Description	Depth (m)	Thick-ness (m)	Level (m)	Samples	N	w (%)	ρ (Mg/m³)	c (kN/m²)	ø (deg.)	LL (%)	PL (%)	PI (%)	Indicated Safe Bearing Capacity (kN/m²) Strip	Square
Topsoil	0.10	0.10												
Filling:- Firm clay, clayey sand and medium to coarse gravel	1.10	1.00		D+B 0.50	20									
					0.65									
Dense fine to coarse brown clayey sand and gravel	2.40	1.30		D+B 1.50	40*									
					1.65									
Medium dense fine to coarse greenish brown clayey sand and gravel with traces of clay	5.20	2.80		D+B 2.50	19									
				D+B 4.00	24									
					4.15									
Medium dense greenish brown medium to coarse sand and fine to coarse gravel	7.00	1.80 pen.		D+B 5.50	20									
					5.65									

Remarks: Water sample taken
* N value at 1.65 metres = 40 for 95mm below seating drive

Symbols: N - Number of blows in Standard Penetration Test w - Natural moisture content ρ - Natural bulk density c - Apparent cohesion ø - Angle of internal friction
LL - Liquid limit PL - Plastic limit PI - Plasticity index U - 100 mm diameter undisturbed sample D - Disturbed sample B - Bulk sample

NICHOLSON (SITE INVESTIGATION) LIMITED, BATHGATE ROAD, ARMADALE

BGS ID: 620804 : BGS Reference: NX46NW10
British National Grid (27700) : 241077,566121
Report an issue with this borehole

BOREHOLE RECORD

LOCATION: Old Cornmill, "Minnigaff", Newton Stewart JOB NO.: 6257 DATES: COMMENCED: 20.7.88 WATER LEVELS: INITIAL: 5.30 m
BOREHOLE NO.: 4 DIAMETER: 150 mm SURFACE LEVEL: m COMPLETED: 20.7.88 (Depth bgl) FINAL: 4.90 m

Description	Depth (m)	Thickness (m)	Level (m)	Samples	N	w (%)	ρ (Mg/m³)	c (kN/m²)	ø (deg.)	LL (%)	PL (%)	PI (%)	Indicated Safe Bearing Capacity (kN/m²) Strip	Square
Filling:- Dense brown, dark brown and grey sandy clay with fine to coarse gravel	2.30	2.30		D+B 0.50	39									
				D+B 2.00	0.65 22									
					2.15									
Medium dense brown clayey sand and fine to coarse gravel	5.30	3.00		D+B 2.50	17									
				D+B 4.00	2.65 17									
					4.15									
Medium dense coarse sand and fine to coarse gravel	7.00	1.70 pen.		D+B 5.50	21									
					5.65									

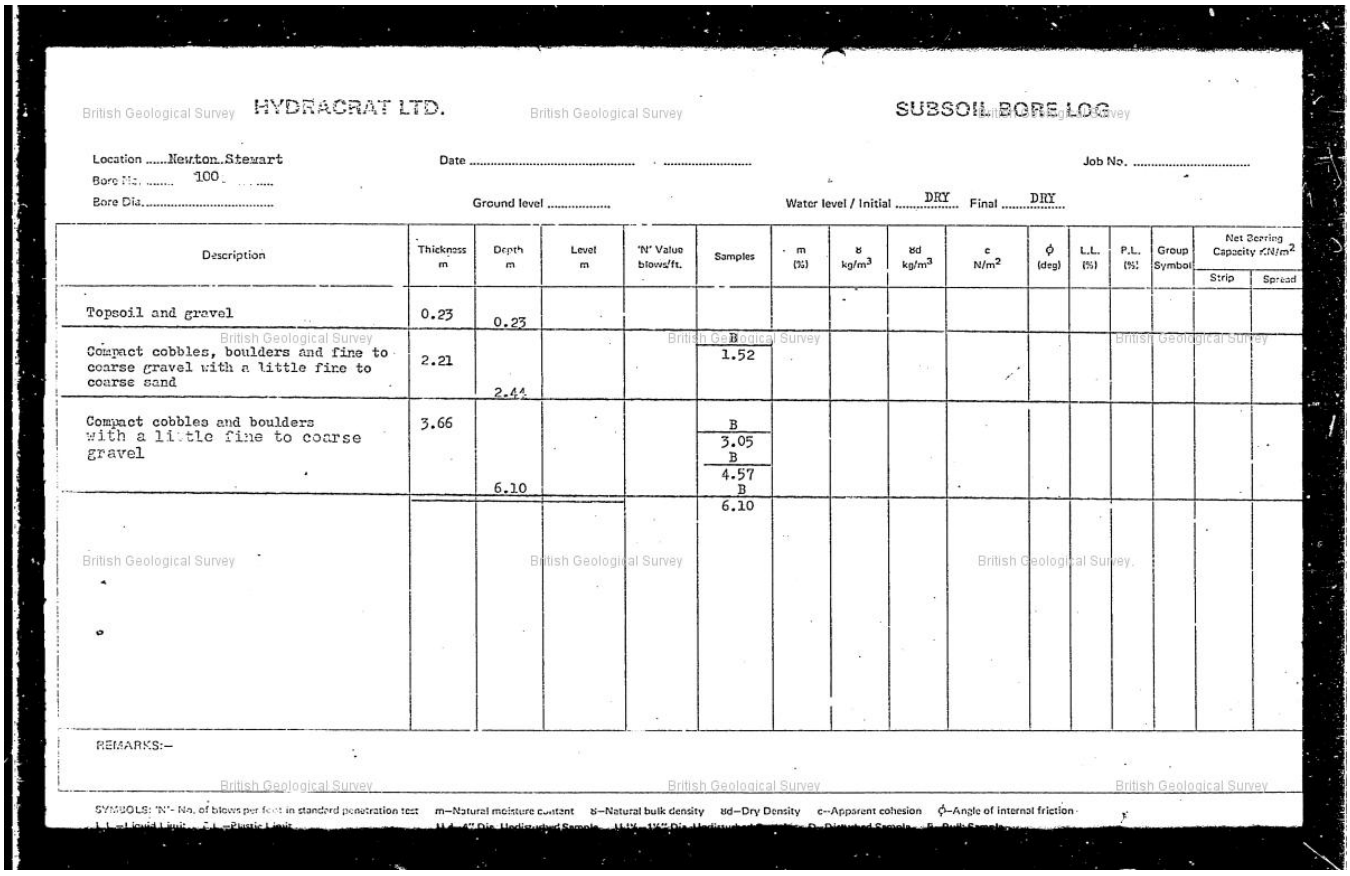
Remarks: Water sample taken SO₃ at 0.50 metre = 0.06% pH at 0.50 metre = 7.0

Symbols: N - Number of blows in Standard Penetration Test w - Natural moisture content ρ - Natural bulk density c - Apparent cohesion ø - Angle of internal friction
LL - Liquid limit PL - Plastic limit PI - Plasticity index U - 100 mm diameter undisturbed sample D - Disturbed sample B - Bulk sample

NICHOLSON (SITE INVESTIGATION) LIMITED, BATHGATE ROAD, ARMADALE

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 630924 : BGS Reference: NX46SW742/100
British National Grid (27700) : 241943,564832
Report an issue with this borehole



HYDRACRAT LTD. SUBSOIL BORE LOG

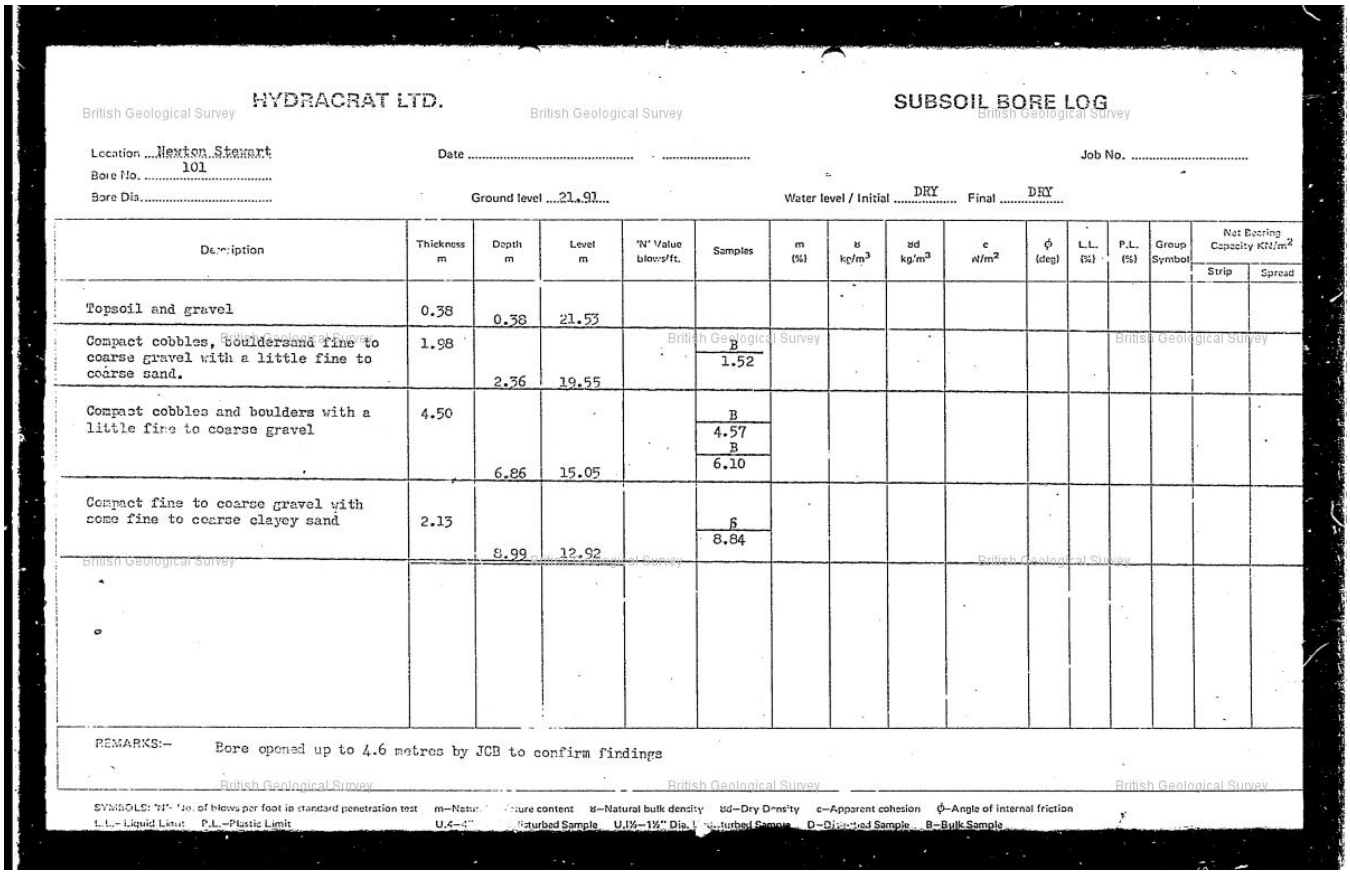
Location ....Newton.Stewart Date ..... Job No. .....
Bore No. ..... 100 .....
Bore Dia. ..... Ground level ..... Water level / Initial ..... DRY Final ..... DRY

Description	Thickness m	Depth m	Level m	'N' Value blows/ft.	Samples	m (%)	γ kg/m³	γd kg/m³	c N/m²	ϕ (deg)	L.L. (%)	P.L. (%)	Group Symbol	Net Bearing Capacity kN/m² Strip	Net Bearing Capacity kN/m² Spread
Topsoil and gravel	0.23	0.23													
Compact cobbles, boulders and fine to coarse gravel with a little fine to coarse sand	2.21	2.44			B 1.52										
Compact cobbles and boulders with a little fine to coarse gravel	3.66	6.10			B 3.05 B 4.57 B 6.10										

REMARKS:-

SYMBOLS: 'N'- No. of blows per foot in standard penetration test m—Natural moisture content γ—Natural bulk density γd—Dry Density c—Apparent cohesion ϕ—Angle of internal friction
L.L.—Liquid Limit P.L.—Plastic Limit U.4—4" Dia. Undisturbed Sample U1½—1½" Dia. Undisturbed Sample D—Disturbed Sample B—Bulk Sample

BGS ID: 630925 : BGS Reference: NX46SW742/101
British National Grid (27700) : 241806,564763
Report an issue with this borehole



HYDRACRAT LTD.

SUBSOIL BORE LOG

Location Hexton Stewart
Bore No. 101
Bore Dia.

Date

Job No.

Ground level 21.91

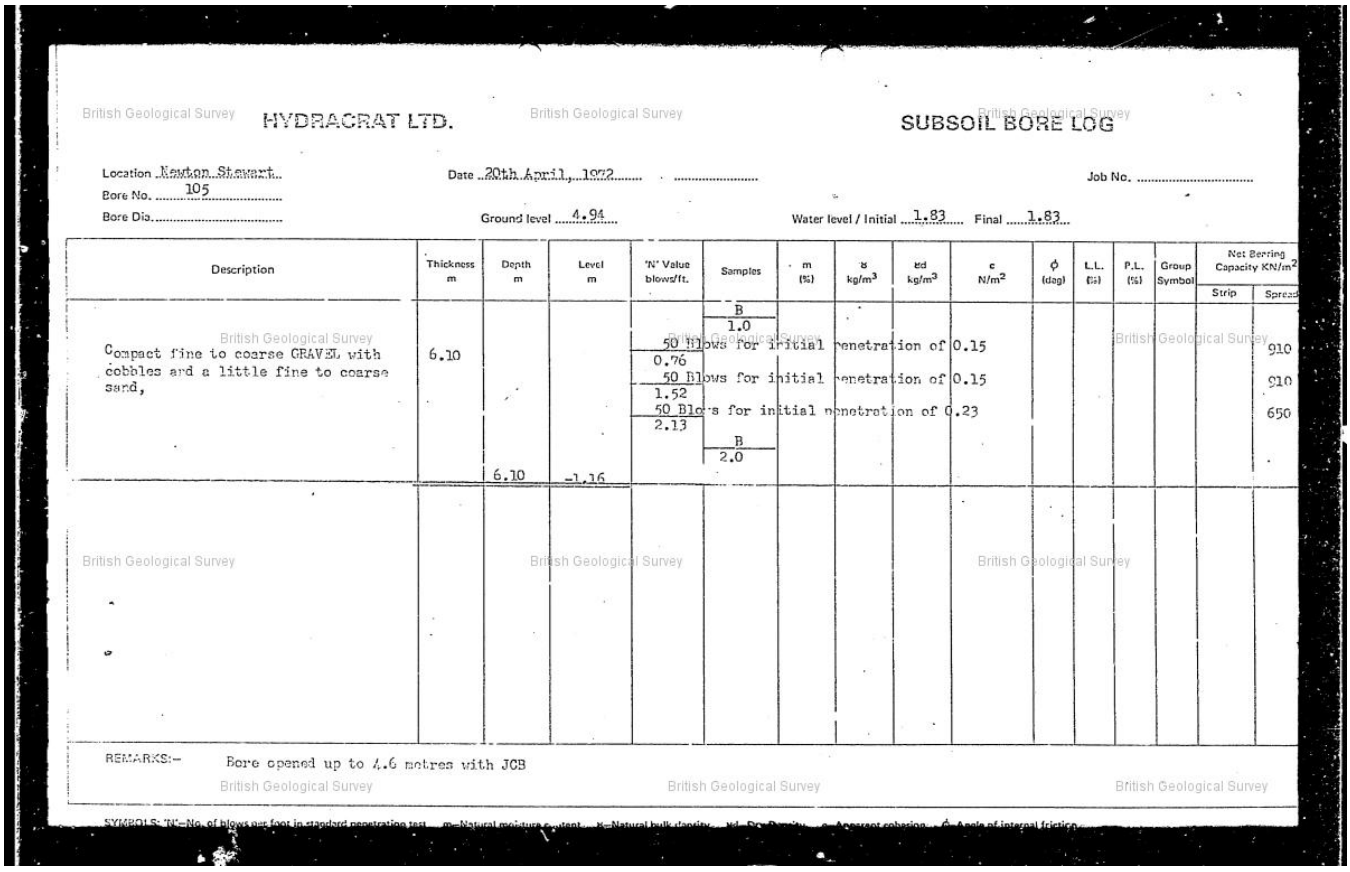
Water level / Initial DRY Final DRY

Description	Thickness m	Depth m	Level m	'N' Value blows/ft.	Samples	m (%)	ϱ kg/m³	ϱd kg/m³	c kN/m²	ϕ (deg)	L.L. (%)	P.L. (%)	Group Symbol	Net Bearing Capacity KN/m² Strip	Net Bearing Capacity KN/m² Spread
Topsoil and gravel	0.38	0.38	21.53												
Compact cobbles, boulders and fine to coarse gravel with a little fine to coarse sand.	1.98	2.36	19.55		B 1.52										
Compact cobbles and boulders with a little fine to coarse gravel	4.50	6.86	15.05		B 4.57 B 6.10										
Compact fine to coarse gravel with some fine to coarse clayey sand	2.13	8.99	12.92		B 8.84										

REMARKS:- Bore opened up to 4.6 metres by JCB to confirm findings

SYMBOLS: "N"- No. of blows per foot in standard penetration test m–Natural moisture content ϱ–Natural bulk density ϱd–Dry Density c–Apparent cohesion ϕ–Angle of internal friction
L.L.–Liquid Limit P.L.–Plastic Limit U.4–4" Undisturbed Sample U.1½–1½" Dia. Undisturbed Sample D–Disturbed Sample B–Bulk Sample

BGS ID: 630929 : BGS Reference: NX46SW742/105
British National Grid (27700) : 241606,564663
Report an issue with this borehole



HYDRACRAT LTD.

SUBSOIL BORE LOG

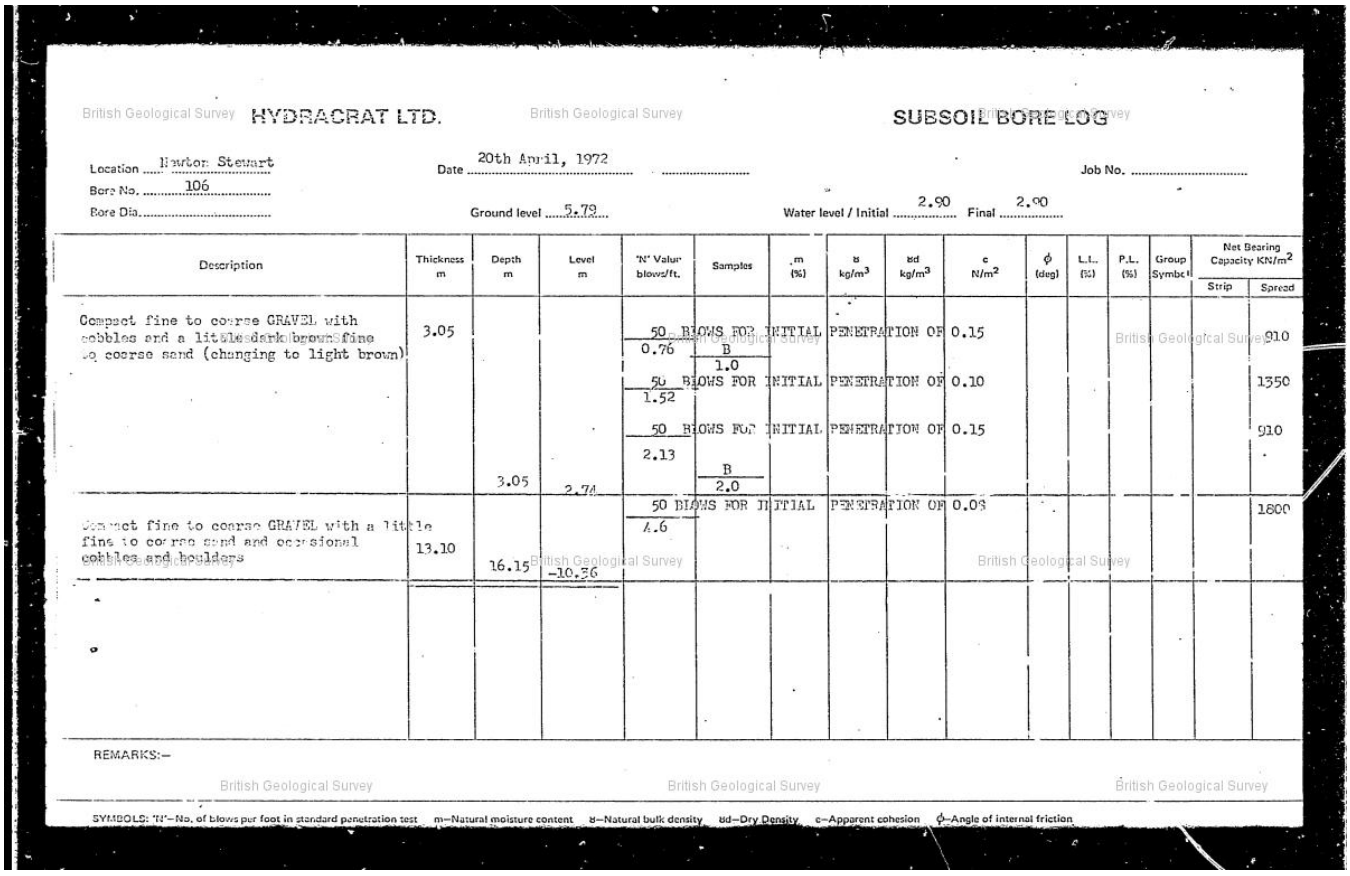
Location Newton Stewart. Date 20th April, 1972. Job No. .....
Bore No. 105
Bore Dia. ..... Ground level 4.94 Water level / Initial 1.83 Final 1.83

Description	Thickness m	Depth m	Level m	'N' Value blows/ft.	Samples	m (%)	ρ kg/m³	ρd kg/m³	c N/m²	φ (deg)	L.L. (%)	P.L. (%)	Group Symbol	Net Bearing Capacity KN/m² Strip	Spread
					B 1.0										
Compact fine to coarse GRAVEL with cobbles and a little fine to coarse sand,	6.10			50 blows for initial penetration of 0.15	0.76										910
				50 Blows for initial penetration of 0.15	1.52										910
				50 Blows for initial penetration of 0.23	2.13										650
					B 2.0										
		6.10	-1.16												

REMARKS:- Bore opened up to 4.6 metres with JCB

SYMBOLS: 'N'=No. of blows per foot in standard penetration test m=Natural moisture content ρ=Natural bulk density ρd=Dry density c=Apparent cohesion φ=Angle of internal friction

BGS ID: 630930 : BGS Reference: NX46SW742/106
British National Grid (27700) : 241564,564657
Report an issue with this borehole



HYDRACRAT LTD. SUBSOIL BORE LOG

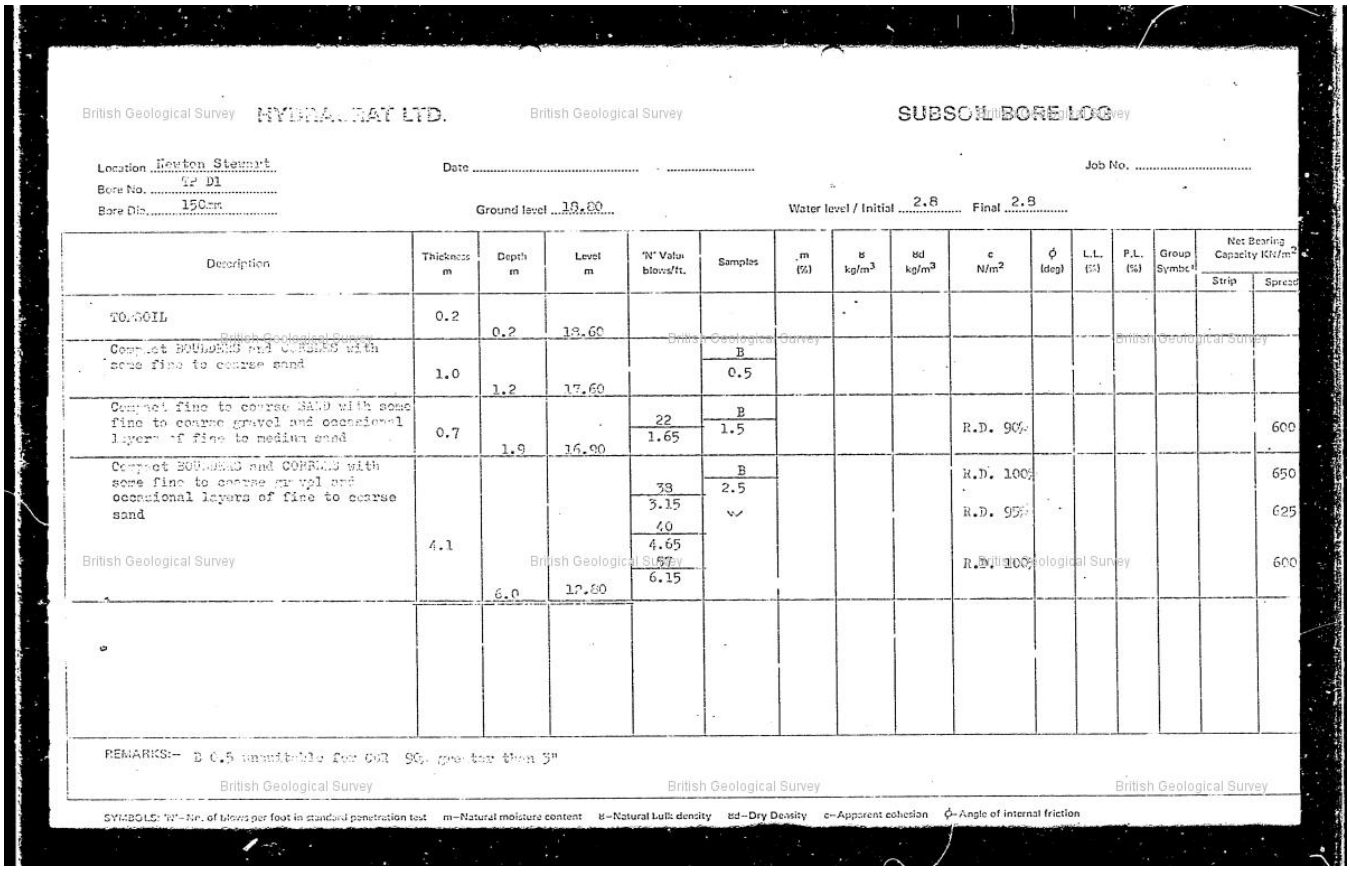
Location Hawtor Stewart Date 20th April, 1972 Job No.
Bore No. 106
Bore Dia. Ground level 5.79 Water level / Initial 2.90 Final 2.90

Description	Thickness m	Depth m	Level m	'N' Value blows/ft.	Samples	m (%)	ρ kg/m³	ρd kg/m³	c N/m²	ϕ (deg)	L.L. (%)	P.L. (%)	Group Symbol	Net Bearing Capacity KN/m² Strip	Net Bearing Capacity KN/m² Spread
Compact fine to coarse GRAVEL with cobbles and a little dark brown fine to coarse sand (changing to light brown)	3.05			50 BLOWS FOR INITIAL PENETRATION OF 0.15 0.76 B 1.0 50 BLOWS FOR INITIAL PENETRATION OF 0.10 1.52 50 BLOWS FOR INITIAL PENETRATION OF 0.15 2.13 B 2.0											910 1350 910
		3.05	2.74												
Compact fine to coarse GRAVEL with a little fine to coarse sand and occasional cobbles and boulders	13.10			50 BLOWS FOR INITIAL PENETRATION OF 0.03 4.6											1800
		16.15	-10.36												

REMARKS:-

SYMBOLS: 'N'-No. of blows per foot in standard penetration test m-Natural moisture content ρ-Natural bulk density ρd-Dry Density c-Apparent cohesion ϕ-Angle of internal friction

BGS ID: 630933 : BGS Reference: NX46SW742/TPD1
British National Grid (27700) : 242129,564943
Report an issue with this borehole



NYMA...RAT LTD. SUBSOIL BORE LOG

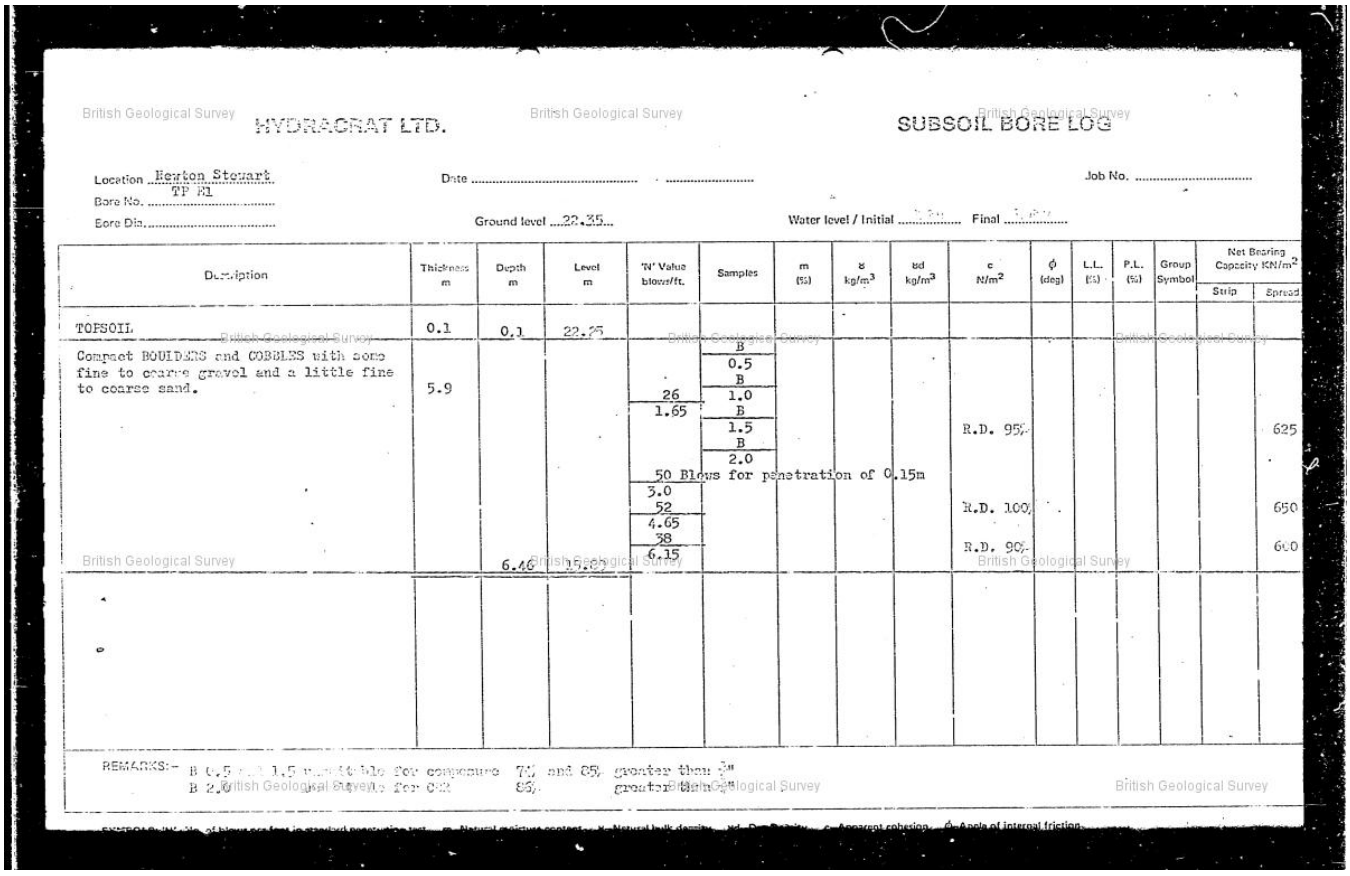
Location Newton Stewart Date ..... Job No. .....
Bore No. TP D1
Bore Dia. 150mm Ground level 18.00 Water level / Initial 2.8 Final 2.8

Description	Thickness m	Depth m	Level m	'N' Value blows/ft.	Samples	m (%)	ρ kg/m³	ρd kg/m³	c N/m²	ϕ (deg)	L.L. (%)	P.L. (%)	Group Symbol	Net Bearing Capacity KN/m² Strip	Spread
TOPSOIL	0.2	0.2	18.60												
Compact BOULDERS and COBBLES with some fine to coarse sand	1.0	1.2	17.60		B 0.5										
Compact fine to coarse SAND with some fine to coarse gravel and occasional layers of fine to medium sand	0.7	1.9	16.90	22 1.65	B 1.5				R.D. 90%						600
Compact BOULDERS and COBBLES with some fine to coarse gravel and occasional layers of fine to coarse sand	4.1	6.0	12.80	38 3.15 40 4.65 57 6.15	B 2.5 ~~				R.D. 100% R.D. 95% R.D. 100%						650 625 600

REMARKS:- B 0.5 unsuitable for CBR 90% greater than 3"

SYMBOLS: 'N'-No. of blows per foot in standard penetration test m-Natural moisture content ρ-Natural bulk density ρd-Dry Density c-Apparent cohesion ϕ-Angle of internal friction

BGS ID: 630934 : BGS Reference: NX46SW742/TPE1
British National Grid (27700) : 241991,564861
Report an issue with this borehole



HYDRAGRAT LTD.

SUBSOIL BORE LOG

Location Newton Stewart
Bore No. TP #1
Bore Dia.

Date

Job No.

Ground level 22.35

Water level / Initial Final

Description	Thickness m	Depth m	Level m	'N' Value blows/ft.	Samples	m (%)	γ kg/m³	γd kg/m³	c N/m²	ϕ (deg)	L.L. (%)	P.L. (%)	Group Symbol	Net Bearing Capacity KN/m² Strip	Net Bearing Capacity KN/m² Spread
TOPSOIL	0.1	0.1	22.25												
Compact BOULDERS and COBBLES with some fine to coarse gravel and a little fine to coarse sand.	5.9			26 1.65	B 0.5 B 1.0 B 1.5 B 2.0				R.D. 95%						625
				50 Blows for penetration of 0.15m 3.0											
				52 4.65					R.D. 100%						650
				38 6.15					R.D. 90%						600
		6.40	15.95												

REMARKS:- B 0.5 m - 1.5 m suitable for compaure 7% and 8% greater than 2"
B 2.0 suitable for 8%