PROPOSED RESIDENTIAL DEVELOPMENT,

HARTWELL, NEWBRIDGE ROAD, BATH

Geo-Environmental Site Assessment Report

PROJECT NO. SW-766

WORK CODE 1

REPORT NO. SW-766.1.1

REVISION 0

20th January, 2016

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DOCUMENT CONTROL

Project Title:	**Proposed Residential Development, Hartwell, Newbridge Road, Bath**
Document Title:	**Geo-environmental Site Assessment Report**

Rev	**Date**	**Filename:**	report.sw.766.1.1	
0	20/01/2016	**Description:**	Revision 0	
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1. Introduction

1.1 Terms of Reference

Ground Investigation (South West) Limited has been commissioned by Campbell Reith LLP, Consulting Engineers, acting on behalf of the Client, Oakhill Group Limited, to carry out an interpretative Geo-Environmental Site Assessment for the Hartwell site on Newbridge Road in Bath. The existing site layout is presented as the base to Figure 1.

A Geo-Environmental and Geotechnical Desktop Study for the site was issued by Campbell Reith Hill LLP in August 2014 (Ref. 1), the findings of which should be considered in conjunction with this report. The data and information provided by the earlier desk-based research and site walkover has been used in the planning of this Phase 2 intrusive investigation and assessment.

This report presents the findings of the Phase 2 investigation, together with a geotechnical interpretation, including preliminary advice concerning foundation and ground floor slab design and construction, and information to aid in the design of soakaways and pavements. A generic quantitative assessment of chronic human health risks associated with the presence of potentially contaminated soils, together with generic quantitative assessments of the potential risk to controlled waters and risks arising from potentially hazardous ground gas, are also presented.

1.2 Site Location

The site is situated on the southern side of Newbridge Road, opposite the junction with Charmouth Road, some 2.5 km to the west of Bath City Centre. The postcode for the site is BA1 2PP, and the approximate National Grid reference is 372600, 165100.

Details of the site boundaries, together with a full description of the site interior, based on a walkover undertaken prior to commencement of the fieldworks, are provided within Section 2.3 of this report.

1.3 Proposed Development

At the time of writing, development proposals have yet to be finalised. However, we understand that following demolition of the existing buildings, residential redevelopment is planned. This will most likely comprise a combination of terraced housing and blocks of flats, including possible student accommodation, together with associated access roads, car parking, amenity space and landscaping.

1.4 Objectives

The primary objectives of this ground investigation are summarised as follows.

(i) Examine the physical ground and groundwater conditions at the site.

(ii) Identify and investigate potentially significant geotechnical and geo-environmental hazards.

(iii) Consider ground contamination in relation to threats posed to human health and controlled waters.

(iv) Advise on the need for remedial actions, or further investigation, to address potentially unacceptable human health or environmental risks associated with identified ground contamination hazards.

(v) Advise on geotechnical conditions, identify foundation options, and provide preliminary advice relating to ground engineering matters in the context of the proposed development.

1.5 Scope of Work

In order to achieve the objectives summarised in Section 1.4 above, the following general scope of work has been carried out.

(i) The review and appraisal of data provided by the earlier desk study (Ref. 1), together with a walkover survey completed in conjunction with the subsequent fieldworks.

(ii) Fieldworks involving the drilling of cable percussion boreholes and dynamic percussive window sampler boreholes, together with the inspection of mechanically excavated trial pits, which were also used to undertake in-situ soil infiltration tests.

(iii) The installation of gas/groundwater monitoring wells at selected positions and in-situ monitoring of groundwater levels, gas concentrations and flow rates, following completion of the initial fieldworks.

(iv) Laboratory chemical analysis of selected soil samples, and groundwater samples recovered from the monitoring installations.

(v) Laboratory geotechnical classification testing of selected soil samples recovered from the exploratory holes.

(vi) Preparation of this Geo-Environmental Site Assessment Report addressing ground contamination and ground engineering issues relating to the proposed development.

1.6 Report Structure

This report is presented in six sections, the contents of which are summarised below.

- **Section 1** provides an introduction to the report. It identifies the site location, summarises the proposed development, and outlines the objectives of the study and the general scope of work.

- **Section 2** presents a summary of the findings of the desk-based research undertaken by others (Ref. 1), together with a description of the site, based on information gathered during the walkover survey.

- **Section 3** describes the fieldworks and laboratory testing that have been carried out.

- **Section 4** provides a description of the physical ground and groundwater conditions revealed by the investigation.

- **Section 5** considers ground contamination hazards at the site in respect of chronic human health risks, risks to controlled waters and risks arising from potentially hazardous ground gas, and discusses the potential aggressive environment for concrete used below ground level.

- **Section 6** considers the ground conditions at the site in relation to ground engineering and geotechnical matters of likely significance in the context of the proposed development. Preliminary advice is given for the design of foundations and ground floor slabs, together with parameters to aid in the design of soakaways and pavements.

2. Desk Study & Walkover Survey

2.1 General

The desk study review has examined information relating to the historical and present-day land uses in the vicinity of the site, together with geological, hydrogeological and environmental conditions from a variety of sources, as presented in the previous Geo-Environmental and Geotechnical Desktop Study prepared by Campbell Reith Hill LLP in 2014 (Ref. 1). This Desktop Study Report has previously been submitted to the Local Authority's Planning Department such that we have not appended it in this report, but have utilised the information and appropriately referenced the document.

A further walkover survey was carried out prior to commencement of the Phase 2 intrusive fieldworks and key observations made are presented.

The information furnished by this desk study is referred to in subsequent sections where it is significant, or has relevance, to consideration of the various issues addressed by this report.

2.2 Sources of Information

The principal sources of information appended or referred to in the Desktop Study (Ref. 1) are listed below.

- Historical Ordnance Survey Mapping
- Landmark Geology Report
- Landmark Envirocheck Report
- BGS Radon Report
- BANES Environmental Search
- BANES Trading Standards Petroleum Search
- BANES Planning History Search
- Landmark Underground Utilities Search
- Geological Mapping
- BGS Website and Historical Borehole Records
- CIRIA C681: UXO. A Guide for the Construction Industry
- Zetica Regional Unexploded Bomb Risk Map – Avon
- Environment Agency Website
- BR 211 Radon: Guidance on Protective Measures for New Buildings
- NRPB Radon Atlas

2.3 Walkover Survey

The desk study information referred to in this report (Ref. 1) was based around initial site walkovers conducted in April and June, 2012. The associated observations have been verified by further inspections undertaken during the course of the present phase of intrusive works undertaken in December, 2015. Significant observations are noted below.

The existing site layout is presented as the base to Figure 1, and comprises an extract from the Desktop Study Report (Ref. 1) which identifies pertinent features identified during the site reconnaissance.

The site is accessed directly off Newbridge Road and is currently occupied by the premises of an operational Citroen car dealership (Hartwell Bath Citroen). These premises comprise a main building within the northern area of the site that houses the car showroom, workshops and valeting services, each on a different level. An external car sales forecourt is located to the north-east of the building, fronting onto Newbridge Road, with further forecourt parking to the north-west, over the roof of an adjacent concrete batching plant. A second main building is located behind, and to the south of the showroom, which is used as a car body repair workshop. Areas of car parking and access roads are located around these two main buildings. To the east of the site, a bridge carries Osborne Road across the site. To the east of the bridge, the site lies in a former rail cutting, and is currently open and undeveloped.

At the entrance to the site off Newbridge Road, the site lies at an elevation of around 29 m AOD, whilst some 10-15 m to the south of Newbridge Road, the site levels fall steeply to around 23 m AOD as a result of former quarrying activities. Beyond this steep drop in level, the site generally falls very gently towards the River Avon, further to the south.

Fronting onto Newbridge Road, the area is generally hard surfaced and used for a combination of customer parking and retail sales. The main car dealership building is set back from Newbridge Road beyond the forecourt frontage and an access road. As discussed above, this building is set over three levels, with the car showroom on a level similar to that of Newbridge Road, whilst the vehicle servicing and valeting are located on levels -1 and -2, respectively, being at a lower level due to the difference in site elevation caused by the former quarrying activities. A ramp to the east and south of the car showroom building provides access to the rear of the building, together with further car parking and the car body repair workshop. It also provides access to the undeveloped eastern part of the site. Oil inlet pipes for oil tanks stored in the vehicle servicing area are located on the ramp, which splits to provide separate access to the vehicle servicing and valeting levels. The ground floor, understood to date from the 1960s, is occupied by the car showroom, together with reception, offices and toilets. The vehicle servicing floor below contains numerous lifting platforms, new and waste oil tanks and a waste skip. Drainage gullies in the floor slab apparently drain to a drainage network suspended beneath the floor. The valeting floor beneath is generally open and unoccupied, with detergents etc stored in a cupboard.

At the north-western corner of the site, a former fuel filling station is known to have been present. The pumps that formerly stood along the frontage with Newbridge Road have been removed, although it is understood that the underground fuel storage tanks still remain, with a series of manhole covers observed at the surface. The former kiosk building for the fuel filling station also still remains in this area of the site, which now forms part of the sales forecourt.

The car body repair workshop to the rear of the site is a portal frame shed type of building and houses equipment for repairing and spraying vehicles. Numerous skips, tanks and drums are stored around the building and include waste materials such as antifreeze, paint tins, plastics and spray booth filters.

Beyond the bridge to the east of the site, a cutting associated with a former railway is present, which lies some 5-6 m lower than the housing to the north and south. The heavily vegetated slopes appear to be inundated with fly-tipping materials. The earlier desk study also identified Japanese Knotweed on the northern side of the former railway cutting, on either side of the northern bridge abutment of Osborne Road.

The surrounding land is dominated by residential use to the north and east. To the south, however, the premises are bounded by The Maltings Industrial Park, which is accessed off Brassmill Lane, further to the south. There is a secure gated entrance into the rear of the site from The Maltings Industrial Park, which provides access for large vehicles e.g. car transporters delivering the vehicle stock. To the west, the premises directly adjoin a concrete batching plant operated by Hanson. As mentioned above, the car sales forecourt extends over the roof of this adjacent building, which is accessed via a ramp leading down to a concrete surfaced yard at the rear, from an entrance off Newbridge Road, to the north-east of the forecourt. Residential development lies beyond the batching plant further to the west.

2.4 Recent History

A detailed description of the history of the site, and the surrounding land uses, is presented in the Desktop Study (Ref. 1). For ease of reference, pertinent information within the boundary of the site, as indicated on the historical maps, is summarised below.

- The earliest edition of the historical maps dated 1888 shows that a railway line bisects the site, and runs in an east-west direction. The northern part of the site is labelled as a quarry, whilst the southern part remains open and undeveloped. A bridge and a cutting are present towards the east, as existing.

- By 1903, the quarry is labelled as an ‘Old Quarry’, with rough pasture shown within the quarry area. Railway sidings are by this time shown to the south of the railway line, associated with ‘Bath Brewery’ which abuts the southern boundary.

- The 1932 edition of the maps shows that the site is largely unchanged, however, the railway is now labelled as ‘London, Midland & Scottish Railway’.

- The 1947 aerial photography shows a similar layout to the 1951 and 1952 editions of the maps. The railway is still present, as are the sidings in the southern part of the site. However, within the ‘Old Quarry’ to the north are numerous small buildings, arranged in blocks and terraces, of unknown usage.

- Subsequent to the map editions from the early 1950s there appear to be no significant changes to the site until the 1977 edition of the maps, which by this time labels the site as a ‘Garage’. The existing buildings of the vehicle dealership are by this time shown in the northern part of the site, to the north of what is now the ‘Dismantled Railway’.

- By 1988, a large rectangular building occupies the southern part of the site, in the position of the existing car body repair workshop.

- The 1992 edition of the maps, show a site layout similar to the present day.

2.5 Geology

The geology of the site has been assessed on the basis of an examination of geological mapping and local knowledge, together with information included within the Desktop Study (Ref. 1) and other sources, as summarised below.

- The eastern part of the site, together with the extreme northern frontage along Newbridge Road, is indicated to be underlain by the Langport Member and Blue Lias Formation (undifferentiated) (also known as the Blue Lias Formation), whilst the western part of the site is indicated to be underlain by Westbury Formation and Cotham Member (undifferentiated) (also known as the Penarth Group). The geological boundary with the Mercia Mudstone Group is located just to the west and south of the site, such that these deposits would be expected to underlie the site at depth. The upper boundary of the Mercia Mudstone Group with the overlying Penarth Group is often marked by an abrupt upward transition of the Blue Anchor Formation (of which the Mercia Mudstone is the Parent Unit), to the darker shales of the overlying Penarth Group. In this regard, the presence of the Blue Anchor Formation would not be unexpected between the Penarth Group and the underlying Mercia Mudstone Group.

- The Blue Lias Formation is likely to comprise interbedded mudstone and limestone, whilst the Penarth Group is likely to comprise grey to black mudstones, with subordinate limestones and sandstones. The Blue Anchor Formation would be expected to comprise pale green-grey silty mudstones and siltstones, whilst the Mercia Mudstone Group would be expected to comprise red and less commonly green-grey mudstones.

- Historical BGS borehole records, located at the site, indicate that around 1 m of ashy clay Made Ground overlies around 1.5 m of interbedded clay and limestone, interpreted as the Cotham Member. Shaley mudstone, interpreted as the Westbury Formation was then found to 4 m depth. The blue/green/grey mudstone of the Blue Anchor Formation was then encountered to around 5.5 m depth. Deposits of the Mercia Mudstone Group are then indicated to underlie the site at depth.

- Due to the site history, including quarrying activities and railway use, together with subsequent development, the presence of Made Ground would be expected.

- There are several entries under the heading of BGS Recorded Mineral Sites relating to the site, associated with the open cast historic quarrying activities for the extraction of limestone, clay and shale. Locksbridge Cement Works, historically located some 30 m to the south-east, also extracted limestone by open cast methods. Further afield, numerous open cast limestone quarries were located within around a 100-400 m radius.

- According to the Envirocheck report, the site is located in a radon affected area, such that basic radon protection measures are required for new dwellings or extensions.

- The site is indicated to lie in an area that might not be affected by coal mining and in an area of no hazard from non-coal mining. In this regard, based on the anticipated geology, Coal Measures strata would not be expected to underlie the site within the likely depth of influence of the surface. However, quarrying activities are known to have taken place at the site.

- The site is indicated to lie in an area of no hazard from compressible ground, ground dissolution and running sand, very low hazard from collapsible ground and landslides, and low hazard from shrinking/swelling clays. However, in this regard, fine-grained soils

exhibiting intermediate to very high plasticity were encountered during the subsequent fieldworks.

- Ancient sedimentary mudstones and clays, such as those expected to underlie the site, are indicated by the BRE (Ref. 2) as potentially containing elevated levels of pyrite, which may oxidise to sulphates and lead to aggressive attack on buried concrete. Depending on its origin, the Made Ground could also possibly contain elevated levels of pyrite.

- The Envirocheck Report indicates that based on the BGS Estimated Soil Chemistry database, concentrations of arsenic, cadmium, chromium, lead and nickel may be within acceptable limits for a residential land use.

2.6 Hydrology, Hydrogeology and Environmental Setting

Key points relating to the hydrology of the site, together with its hydrogeology and environmental setting are summarised as follows.

- The Envirocheck report ascribes bedrock aquifer designations of Secondary 'A' and Secondary 'B' Aquifers to the underlying strata, with soils of high leaching potential. The latter is a worst case classification, however, based on fewer observations being undertaken within restored mineral workings and urban areas.

- The site does not lie in close proximity to a source protection zone and there are no surface water or groundwater abstractions in its immediate vicinity. The nearest licensed surface water abstraction relates to the River Avon, some 300 m to the south-west, for hydraulic testing purposes. There are no licensed groundwater abstractions identified within a 2 km radius.

- The nearest surface water feature, identified as the Weston Cut, lies approximately 150 m to the south, and is associated with the River Avon.

- The nearest Waste entry, is a historical landfill, located some 150 m to the west, known as Brassmill Lane. This landfill apparently deposited industrial and household waste in the late 1940s to early 1950s.

- Under the heading of Industrial Land Use, a significant number of potentially contaminative land uses are present in the surrounding area, consistent with the site's urban setting. The most significant of these however, relates to the existing/recent use as a garage with a historical fuel filling station and associated underground fuel tanks.

- The site is not located within an indicative floodplain.

2.7 Underground Fuel Storage Tanks (USTs)

Information provided by Trading Standards of BANES (Ref. 1) suggests that a number of underground fuel storage tanks are or were present beneath the site, located along the frontage of Newbridge Road, towards the north-west of the site.

Based on the recent site walkover, the decommissioned tanks remain in-situ, beneath the concrete surfaced area of the sales forecourt. The information provided by the Desktop study is summarised below.

Tank No.	Capacity (L)	Fuel stored	Date installed	Decommissioned
1	27,200	U/L	1989	22/3/2005 with RG22 Foam
2	13,600	4*	1989	22/3/2005 with RG22 Foam
3	27,200	Diesel	1989	22/3/2005 with RG22 Foam
4	13,600	U/L	1989	22/3/2005 with RG22 Foam

2.8 Local Authority Environmental Search

An Environmental Search carried out by BANES is presented in the Desktop Study (Ref. 1) and confirms that site is on an area of historical potentially contaminative uses such as infilled ground (old quarry), railway and petrol filling station, whilst recently the site has been used for car sales/repairs etc. A number of land uses are also present within 250 m of the site which are considered as potentially contaminative, and there are a number of known areas of infilled ground in the vicinity.

However, the Local Authority go on to say that *'The Council have not identified the Property or the surrounding area as Contaminated Land under Part II A of the Environmental Protection Act 1990. The Council are not currently planning to take any action under Part II A of the Environmental Protection Act 1990 in relation to the above reference Property.'*

2.9 Unexploded Ordnance (UXO)

The Desktop Study states that '…the risk of encountering aerial delivered UXO at the site is considered to be low. Further details are presented in more detail in the Desktop Study.

3. Fieldworks & Laboratory Testing

3.1 General

The general scope of the fieldworks and laboratory testing is summarised below.

- The intrusive investigatory works comprised the drilling of three (3 no.) cable percussion boreholes, extending to between approximately 4.3 and 7.3 m below existing ground level, and twelve (12 no.) dynamic percussive sampler boreholes, extending to between approximately 0.75 and 2.15 m below existing ground level, together with the excavation of four trial pits, extending to depths of between 0.8 and 2.3 m below existing ground level.
- In-situ soil infiltration tests were attempted in three of the four trial pits.
- Disturbed samples of the strata revealed within the boreholes and trial pits have been extracted.
- In-situ standard penetration tests (SPTs) were completed at 1 m intervals in the boreholes.
- Where practicable within the trial pits, estimations of in-situ CBR value and apparent cohesion were recorded using a Mexecone penetrometer and calibrated Pilcon hand-vane, respectively.
- General observations have been recorded concerning the incidence and behaviour of groundwater seepages, together with any obvious visual or olfactory evidence of ground or groundwater contamination.
- Groundwater/gas monitoring wells have been installed in six of the window sampler boreholes and all three of the cable percussion boreholes, and three subsequent monitoring visits have been undertaken prior to the date of this report.
- Laboratory chemical analysis has been carried out on selected soil samples recovered from the exploratory holes, together with groundwater samples recovered from the monitoring wells.
- Laboratory geotechnical testing has been carried out on selected samples recovered from the exploratory holes.

This section of the report describes the fieldworks and provides details of the subsequent laboratory testing.

3.2 Intrusive Investigatory Works

The intrusive investigatory works were carried out in three phases under the supervision of Ground Investigation (South West) Limited. The window sampler boreholes were completed on 9th and 10th December, the cable percussion boreholes were completed between 15th and 17th December, whilst the trial pits and in-situ soil infiltration tests were completed on 22nd December, 2015.

The positions of investigation were determined on the basis of the proposed architectural layout, also taking into consideration the findings of the desk-based research and site walkover, paying particular attention to the point sources of potential contamination identified by the Desktop Study (Ref. 1). It should be appreciated, however, that the site remained operational throughout the investigative works.

Figure 1 presents the approximate borehole and trial pit positions, whilst the rationale for the locations is summarised below.

Borehole Number	Reason for Location
WS01	Target the underground storage tanks and dispenser pumps of the former fuel filling station.
WS02	Provide spatial coverage of forecourt parking area.
WS03	Provide spatial coverage of forecourt parking area.
WS04	Provide spatial coverage and target area down gradient from oil inlet pipes.
WS05	Target the oil store and skip.
WS06	Provide spatial coverage of lower yard.
WS07	Provide spatial coverage down gradient from concrete batching plant, also targeting historic running lines.
WS08	Target the area used to store waste paint tins, contaminated plastics and waste spray booth filters.
WS09	Provide spatial coverage, targeting position of historic running lines.
WS10	Provide spatial coverage.
WS11	Target the area used to store antifreeze.
WS12	Provide spatial coverage whilst targeting fly-tipping areas.
CP01	Provide spatial coverage and target historic running lines.
CP02	Provide spatial coverage of lower yard area.
CP03	Provide spatial coverage and target historic running lines.
TP01	Provide spatial coverage.
TP02	Provide spatial coverage and target historic running lines.
TP03	Provide spatial coverage and target area of fly-tipping.
TP04	Provide spatial coverage.

The fieldworks are readily divisible into and described under the following headings.

3.2.1 Cable Percussion Boreholes

A Dando 2000 Mk2 rig was used to construct the cable percussion boreholes, following the hand excavation of a starter pit. The boreholes were drilled using 150 mm diameter tools and equipment. Standard Penetration Tests (SPTs) were undertaken at regular intervals and disturbed samples were collected for logging and laboratory testing. As the drilling progressed, details of the strata succession were recorded, together with observations concerning the incidence and behaviour of groundwater ingress and any obvious visual or olfactory evidence of soil or groundwater contamination. Temporary casings were installed as necessary to support the sides of the boreholes and it is important to note that these may affect groundwater observations during the fieldworks.

On completion of the three boreholes, groundwater/gas monitoring standpipes were installed to between 4.3 and 7.1 m depth. Details of these installations are included on the individual borehole records. In general, however, they consisted of 50 mm diameter slotted screen surrounded by non-calcareous aggregate, with a bentonite seal around a plain section of pipe extending to 1 m below the ground surface. Each installation was fitted with a gas valve and a secure steel cover.

The engineering records of the cable percussion boreholes are presented in Appendix A.

3.2.2 Lined Dynamic Sampling Boreholes

A rubber tracked Archway Competitor rig was used to form the dynamic sampling boreholes. Where hardstanding was present at the surface, it was removed with a hydraulic breaker and a hand excavated starter pit completed prior to drilling. Lined steel core barrels of 1 m length were then percussively driven into the ground, enabling the extraction of virtually continuous disturbed 'core' samples of the subsoil within polythene liners. Sub-samples were collected from the liners, sealed in polythene tubs and amber glass jars, as appropriate, and returned to the laboratory for analysis.

Boring commenced initially at approximately 105 mm diameter, reducing progressively with depth to approximately 85 mm. Standard penetration tests (SPTs) were carried out at 1 m intervals, the results of which are included on the individual borehole records.

As the drilling progressed, details of the strata succession were recorded, together with observations concerning the incidence and behaviour of groundwater ingress and any obvious visual or olfactory evidence of soil or groundwater contamination. Temporary casings were installed as necessary to support the sides of the boreholes and it is important to note that these may affect groundwater observations during the fieldworks.

On completion of six of the boreholes, groundwater/gas monitoring standpipes were installed to between 0.8 and 2.0 m depth. Details of these installations are included on the individual borehole records. In general, however, they consisted of 50 mm diameter slotted screen surrounded by non-calcareous aggregate, with a bentonite seal around a 1.0m length plain section of pipe extending just below the ground surface. Each installation was fitted with a gas valve and a secure steel cover. The remaining boreholes were backfilled with arisings and topped-up with pea gravel as necessary, and then made safe at the surface.

The engineering records of the dynamic sampling boreholes are presented in Appendix B.

3.2.3 Trial Pits

A 3-tonne, rubber tracked mini-excavator was employed for the trial pits. As the excavation progressed at each position, details of the strata succession were recorded, together with observations concerning the incidence and behaviour of any groundwater seepages, the stability of the trial pit sides, and any obvious visual or olfactory evidence of contamination.

Disturbed samples of the soils encountered were collected and sealed in polythene containers or amber glass jars, as appropriate.

The engineering records of the trial pits are presented in Appendix C.

3.2.4 In-situ Soil Infiltration Tests

Soil infiltration tests were carried out in each of the four trial pits, broadly in accordance with BRE Digest 365 (Ref. 3) methodology, insofar as this was practical within the time allowed.

The pits were filled rapidly to assumed invert levels and the water level within each pit was then monitored with time.

The results of the in-situ soil infiltration tests are presented graphically in Appendix D.

Following termination of the infiltration tests, the soakaway trial pits were backfilled with the excavated spoil, and made safe at the surface.

3.2.5 Field Monitoring

Following completion of the intrusive investigatory works, three return visits have been undertaken to date for gas and groundwater monitoring purposes. During each of these visits, concentrations of methane, carbon dioxide and oxygen, together with gas flow rates, were measured within the monitoring wells using a Geotechnical Instruments GA2000 infrared gas analyser. This instrument was also used to record the prevailing atmospheric pressure conditions.

A cable reel interface dipmeter was used to determine standing water levels within the installations.

The results of the field monitoring are presented in Appendix E.

3.3 Laboratory Testing

Geotechnical classification tests have been completed on selected soil samples, together with chemical tests appropriate for the consideration of potentially harmful effects on human health and the environment, and the aggressive effects towards buried concrete. The types of tests undertaken on the selected samples are summarised below.

3.3.1 Chemical Tests

Chemical analysis has been undertaken as follows, based on the contaminants of concern identified within Section 5.2.3 of this report:

(i) inorganics suite comprising: metals, cyanides, total and water soluble sulphate, pH and asbestos screening; and

(ii) organics suite comprising: speciated polycyclic aromatic hydrocarbons (PAHs), speciated total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs) including MTBE, polychlorinated biphenyls (PCBs), phenols and soil organic matter (SOM).

The same suite of chemical testing has also been undertaken on three groundwater samples recovered from the installed monitoring wells.

Waste acceptance criteria (WAC) testing had been completed on three combined samples to provide data for potential off-site disposal of the encountered materials.

The chemical test results are presented in Appendix F (soils), and Appendix G (waters).

3.3.2 Geotechnical Classification Tests

The following types of geotechnical classification tests have been undertaken:

(i) moisture content determinations; and

(ii) Atterburg limit determinations.

The geotechnical test results are presented in Appendix H.

4. Physical Ground & Groundwater Conditions

4.1 General

The exploratory holes have established that within the depth of investigation the site is underlain by the following general sequence of strata (from ground level down).

(i) Made Ground;
(ii) Blue Lias Formation;
(iii) Penarth Group;
(iv) Blue Anchor Formation; and
(iii) Mercia Mudstone Group.

The general characteristics of these strata, as inferred from field observations and geotechnical test data are discussed below. A typical geological cross section of the encountered ground conditions at the site is presented as Figure 2.

4.2 Strata Descriptions

4.2.1 Made Ground

Made Ground extended to between 0.45 and 2.90 m below the ground surface at the selected positions.

Depending on the position of the exploratory holes, either a tarmac surface or a sparsely vegetated surface on limestone gravel was present.

Typically, the tarmac surfacing was found to overlie a granular sub-base dominated by limestone gravel/cobbles. Where tarmac was absent, the unmade surfacing was generally sparsely vegetated and comprised similar limestone sub-base materials. This granular horizon was typically encountered to around 0.3-0.5 m depth, and is likely present as a result of an imported granular construction platform for the current usage at the site. As discussed, below, however, significantly greater thicknesses of granular material, including buried granular horizons, were encountered at some locations, which may be associated with the old railway, but could also reflect the historic quarrying activities.

Made Ground extended to maximum proven depths of up to 2.90 m, and comprised a mixture of fine- and coarse-grained materials. The coarser fraction was dominated by limestone, although materials of anthropogenic origin were often encountered such as concrete, tile, brick, ceramic pipe, bitumen, glass, metal ash and coal dust. Where fine-grained materials dominated, they included varying fractions of sand, gravel and cobbles of limestone and similar anthropogenic inclusions as mentioned above.

At a number of positions, for example within CP03 and TP02, which targeted the historic railway, gravel, cobbles and some boulders of limestone dominated. These materials were possibly used to support the running lines of the railway, but may derive from the former quarrying activities at the site. In this context materials of this type would not be unexpected within a former quarry base. It should be noted that a number of the boreholes and trial pits terminated at effective ‘refusal’ on these coarse materials.

At the positions of TP02, WS05, WS07 and CP01, hydrocarbon odours were noted, whilst a sheen of hydrocarbons was also noted where the soils were wet in WS05. The visual and olfactory evidence of

hydrocarbon contamination appeared to be due to hydrocarbon contaminated groundwater entering these exploratory holes, rather than the soils containing hydrocarbon free product.

SPT N-values recorded in these deposits ranged between 5 and greater than 50, reflecting their highly variable nature and composition.

The results of the geotechnical classification test completed on the selected sample indicate that the fine-grained fraction of the Made Ground is of high plasticity (Ref. 4 & 5) and of medium shrinkage potential (Ref. 6).

Deeper Made Ground and disturbance may be encountered between the selected positions of investigation, associated for example, with the former quarrying activities, earlier construction, and indeed should be anticipated, associated with the former underground fuel storage tanks that are known to be present to the north-west of the site.

4.2.2 Blue Lias Formation

Beneath the Made Ground, in the three exploratory holes (WS01, WS02 and WS03) that were located in the northern area of the site, along its frontage with Newbridge Road, deposits tentatively interpreted as the Blue Lias Formation were encountered. The deposits extended to the termination depth of these boreholes (i.e. 'refusal' on rock) at between around 1.0 and 1.1 m below existing ground level. It should be appreciated that although this stratum would also be expected to underlie the eastern areas of the site, this area is characterised by a historic railway cutting which would have likely been associated with the removal of these deposits, such that they were not encountered in the exploratory holes located within this feature.

At two of these positions, the Blue Lias Formation strata were initially recovered as a firm to stiff or very stiff clay, with varying fractions of silt, sand, gravel and cobbles. The coarse fraction was dominated by medium strong, light grey argillaceous limestone.

At depths of between 0.75 and 0.90 m, the Blue Lias Formation comprised medium strong, argillaceous limestone, with some clay infill. Due to the shallow depth a hydraulic breaker was used to penetrate the limestone, the boreholes being terminated after attempting to break out the materials for a duration of around 1 hour.

SPT N-values recorded in these deposits were greater than 50, reflecting the presence of the medium strong limestone in which the boreholes refused.

The results of the geotechnical classification tests completed on the selected samples indicate that the fine-grained fraction of the Blue Lias Formation encountered along the northern frontage of the site is of intermediate to high plasticity (Ref. 4 & 5) and of medium shrinkage potential (Ref. 6).

4.2.3 Penarth Group

Within all of the remaining exploratory holes (i.e. except WS01-WS03) that extended beneath the base of the Made Ground, deposits tentatively interpreted as the Penarth Group were encountered. Within two of the cable percussion boreholes (CP01 and CP02) the base of these deposits was proven at between 3.7 and 3.8 m below existing ground level. The remaining exploratory holes that encountered the deposits of the Penarth Group, all prematurely terminated upon refusal on competent limestone bands.

The deposits of the Penarth Group typically comprised dark blueish grey clay with varying fractions of silt, sand and mudstone lithorelict gravel, together with frequent bands of argillaceous limestone, which was typically recovered as gravel and cobble sized fragments. SPT N-values recorded in these

predominantly fine-grained materials ranged between 21 and 35, confirming the generally stiff and very stiff consistencies. At two locations, estimations of apparent cohesion were undertaken with a calibrated Pilcon hand vane and recorded values ranging between 94 and 106 kPa indicating stiff consistencies.

The results of the geotechnical classification tests completed on the selected samples indicate that the fine-grained fraction of the Penarth Group is of high plasticity (Ref. 4 & 5) and of medium shrinkage potential (Ref. 6).

In places, the medium strong, grey argillaceous limestone bands dominated, and were too thick for the exploratory holes to fully penetrate, such that the exploratory holes prematurely refused, even with a period of chiselling or hydraulic breaking.

SPT N-values recorded in these limestone bands were greater than 50, reflecting the relatively competent nature of the limestone.

4.2.4 Blue Anchor Formation

In two of the deeper exploratory holes (CP01 and CP02), deposits tentatively interpreted as the Blue Anchor Formation were encountered beneath the Penarth Group from depths of 3.7 and 3.8 m, to depths of 5.6 and 6.0 m.

The deposits of the Blue Anchor Formation typically comprised grey clayey silt with occasional siltstone lithorelicts. At the position of CP01, the silt graded to a weak, laminated grey siltstone, occasionally tending to a clayey silt.

SPT N-values recorded in these materials were all greater than 50, confirming the very stiff/hard or weak consistencies/strengths.

The results of the geotechnical classification tests completed on the selected samples indicate that the Blue Anchor Formation is of intermediate to very high plasticity (Ref. 4 & 5) and of medium to high shrinkage potential (Ref. 6).

4.2.5 Mercia Mudstone Group

Beneath the deposits of the Blue Anchor Formation encountered in two of the deeper boreholes (CP01 and CP02), deposits tentatively interpreted as the Mercia Mudstone Group were encountered from depths of 5.6 and 6.0 m, extending to the full depth of the investigation at 6.4 to 7.3 m.

The deposits of the Mercia Mudstone Group typically comprised reddish brown, locally light grey silty clay with occasional mudstone lithorelicts. With increasing depth, the clay graded to a very weak, reddish brown locally light grey mudstone, with the boreholes terminating in this ‘bedrock’ after a period of chiselling.

SPT N-values recorded in these materials were all greater than 50, confirming the very stiff/hard or very weak consistencies/strengths.

The results of the geotechnical classification tests completed on the selected samples indicate that the Mercia Mudstone Group is of intermediate plasticity (Ref. 4 & 5) and is of medium shrinkage potential (Ref. 6).

4.3 Groundwater

Widely ranging depths to groundwater were encountered during the intrusive works, likely reflecting the variable ground conditions and the elevation differences across the site. One of the trial pits (TP02) encountered a moderate seepage at 1.15 m depth, whilst five of the window sampler boreholes encountered groundwater strikes at depths of between 0.9 and 1.2 m. The cable percussion boreholes struck water at depths of between 2.0 and 2.3 m. It should be appreciated that groundwater was typically encountered within the granular Made Ground deposits.

Monitoring of groundwater levels within the wells installed within the boreholes, following completion of the intrusive fieldworks, indicates variable groundwater depths ranging between the wells remaining dry, to relatively shallow depths of 0.60 to 1.44 m.

A groundwater flow pattern is presented as Figure 3 and is based on groundwater level monitoring undertaken on 21st December 2015 for the three deeper cable percussion boreholes, together with the approximate monitoring well elevations at the site. The groundwater flow pattern shows that the groundwater, as would be expected based on the topography of the site and the surroundings, flows in a south-easterly direction towards the River Avon. However, given the encountered groundwater within the shallow boreholes and trial pits, and the variable nature observed during the monitoring regime, the groundwater conditions at the site are likely to be influenced by anthropogenic factors, such as the former quarrying activities, the railway cutting, variable Made Ground, buried structures and sub-structures, service and drainage channels.

Subsequent variations in groundwater and hydrological conditions could occur in response to future seasonal or climatic changes.

5. Ground and Groundwater Contamination

5.1 Introduction

The chemical test results have been considered within a risk assessment framework, whereby a conceptual model of possible pollutant linkage has been developed and updated for the site and is described in the context of the proposed development. This considers the relationship between potential contamination sources, pathways and receptors in the light of the available information concerning the site history, geology, hydrology, and environmental setting, together with details of the proposed development, as set out in the preceding sections of this report.

This section of the report considers the level of risk posed by potential contaminants to human health and controlled waters in the context of the proposed development.

5.2 Conceptual Site Model

5.2.1 Ground and Groundwater Conditions

It is possible to summarise the general ground and groundwater conditions as follows, on the basis of the information contained within the preceding sections of this report.

- The underlying geology is broadly consistent with that anticipated based on the information in the previous Desktop Study (Ref. 1), the site being underlain by Made Ground, Blue Lias Formation, Penarth Group, Blue Anchor Formation and Mercia Mudstone Group deposits.

- The revealed deposits of Made Ground extended to between 0.45 and 2.9 m depth. However, deeper pockets of Made Ground cannot be discounted due to the historic quarrying activities and current/historic development, together with the presence of underground fuel storage tanks. The Made Ground appears to comprise imported granular material at the surface, followed by reworked natural materials with inclusions of anthropogenic materials such concrete, tile, brick, ceramic pipe, bitumen, glass, metal ash and coal dust, together with some cobbles and boulders of limestone associated with the old quarry and/or beneath the former railway.

- Within TP02, WS05, WS07 and CP01, hydrocarbon odours were noted, whilst a sheen of hydrocarbons was noted where the soils were wet in WS05. The visual and olfactory evidence of hydrocarbon contamination appeared to be due to hydrocarbon contaminated groundwater entering those exploratory holes, rather than the soils containing hydrocarbon free product.

- Historic underground fuel storage tanks (USTs), although apparently decommissioned by being foam filled, are believed to be present in the north-west area of the site fronting onto Newbridge Road. Further underground structures and sub-structures, buried services and features not encountered during this investigation, associated with the historic quarrying, railway infrastructure and development, may be encountered during realisation of the proposed development.

- Groundwater was struck during the investigatory works at wide ranging depths, and was also subsequently recorded at variable depths during a monitoring regime (proven at 0.60 to 1.44 m). Although the groundwater appears to flow towards the River Avon to the south and south-east of the site (see Figure 3), it is probable that the hydrogeological conditions at the site are being affected locally by anthropogenic features.

5.2.2 Possible Sources of Contamination

It is possible to make the following comments in the light of the findings of the desk-based research, site inspection, and intrusive investigatory works referred to herein.

- The site has an established past and existing commercial use as a car sales dealership and car repair workshop, together with relatively recent past usage as a petrol filling station. Moreover, parts of the site historically comprised railway land and it has been affected by past quarrying activities. These land uses are the principal risk drivers for risks arising from potential ground contamination.

- There is a risk of contamination associated with the present and historical storage of fuel/oil at the site, associated, for example, with the underground fuel storage tanks (USTs) that are thought to still be located to the north-west of the site. There is also a risk of contamination associated, for example, with the storage of engine oil and waste oil associated with the servicing activities undertaken at the site and from oil/fuel leakage from damaged vehicles. General contamination of the ground surface could also have occurred due, for example, to spillage/leakage from vehicles, oil storage, generators, paint storage, waste skips, waste oil products etc.

- Deposits of Made Ground have been revealed at the site, containing pockets of anthropogenic materials such as concrete, tile, brick, ceramic pipe, bitumen, glass, metal ash and coal dust. Deeper deposits of unknown composition are expected, for example, in the area of the USTs.

- The deposits of Made Ground, together with degradation of organic contaminants that could be present, are potential sources of hazardous gas generation, albeit of low production potential in the absence of significant concentrations of putrescible materials.

- The former use of the lower lying parts of the site as railway land could have introduced contaminants from a variety of sources. Beneath running lines, for example, localised contamination can occur from fuel oils, lubricating oils and greases. Furthermore, contamination may have historically occurred through the dispersal of airborne contaminants from open wagons in transit, for example, coal dust or metal particulates. Moreover, historical infrastructure engineering works on railway land commonly result in the presence of deposits of Made Ground, often extending over adjacent land.

- The former use of the site as a quarry also constitutes a potentially contaminative land use in the context of the potential for infilling to have occurred from an unknown source including possible anthropogenic materials.

- The existing buildings at the site may contain asbestos-containing materials (ACM). Furthermore, earlier structures at the site, for example those indicated on historic mapping from the early 1950s may have contained asbestos, which could potentially have contaminated the site surface unless demolition was undertaken in a carefully controlled manner.

- The concrete batching plant located immediately to the west of the site, is considered an off-site source of potentially mobile contamination associated, for example, with cementitious products and fuels.

- Further surrounding land uses include a historic saw mill, brewery and other industrial works premises which could be considered sources of potentially mobile contamination in the past.

- The proposed mixed residential redevelopment of the site does not represent a potentially contaminative use.

5.2.3 Contaminants of Concern

Based on the summary presented in Section 6.2.2 above, the following broad range of potential contaminants has been considered in quantifiable terms by this assessment.

- Metals and semi-metals: arsenic, boron, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium and zinc.

- Organic compounds: speciated petroleum hydrocarbons, BTEX compounds, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), phenols and polycyclic aromatic hydrocarbons.

- Inorganic compounds: cyanides, sulphates and asbestos.

- Acids and alkalis.

- Carbon dioxide and methane.

In addition to the above, careful vigilance has been exercised throughout the intrusive investigatory works for visual or olfactory evidence of hydrocarbon contamination and/or likely asbestos containing materials.

5.2.4 Receptors and Pathways

5.2.4.1 Chronic Human Health Risks

In respect of chronic human health risks arising from the presence of contaminated soils following completion of the proposed new residential development, it should be noted that large areas of the site will be covered by the hard construction of the buildings, driveways, car parking, hard landscaping etc, which will effectively isolate any contaminated soils from the site users, such that significant chronic human health risks resulting from dermal contact with, or ingestion of, contaminated soils should not arise in these areas. Areas of soft landscaping will, however, be present following completion of the proposed development, such that the standard residential land use is considered to be most appropriate for this assessment.

5.2.4.2 Acute Human Health Risks

During construction, site workers, neighbours, and members of the public using the adjacent footpaths could potentially be exposed to contaminants present in the ground via a number of pathways, including dermal contact with contaminated soils, or ingestion of airborne particulate matter during bulk earthmoving operations. Such risks will need to be addressed in the context of the pre-construction health and safety plan prepared by the building/groundworks contractor.

In addition to the normal precautions anticipated on a site of this nature, including for example the provision of appropriate personal protective equipment and hygiene facilities, it will be essential on this site to ensure measures are taken to suppress airborne particulate matter during earthmoving activities.

5.2.4.3 Controlled Waters

The most significant controlled water receptors, for the purposes of this assessment, are considered to be the Secondary Aquifers that underlie the site, together with the River Avon to the south and south-east.

However, the site does not lie within, or in close proximity to, a source protection zone. Furthermore, there are no groundwater abstractions within a 2 km radius and the nearest licensed surface water abstraction is some 300 m distant. The nearest surface watercourse, the River Avon, encroaches within approximately 150 m of the site to the south.

Given the distance to the nearest surface water, and the fact that the immediately underlying strata comprise Secondary Aquifers, the controlled water receptors are considered to be of a relatively low sensitivity. However, in the context of this assessment, given the proximity to the site, the immediately underlying aquifers are deemed to be the critical controlled water receptor.

5.3 Assessment of Chronic Human Health Risks

5.3.1 Methodology

Chronic human health risks associated with possible land contamination at the site have been assessed using the generic quantitative risk assessment (GQRA) methods published by DEFRA and the Environment Agency in CLR 11 (Ref. 7).

At the time of writing, Generic Assessment Criteria (GAC) have been issued from several different sources for the use in generic quantitative risk assessments for contaminated land, currently including the following:

(i) Category 4 Screening Levels (C4SLs) issued by Defra in 2013 for 6 contaminants (Ref. 8);

(ii) Soil Guideline Values (SGVs) issued by the Environment Agency in 2009 for some 11 contaminants (Ref. 9); and

(iii) Suitable 4 Use Levels (S4ULs) issued by the Chartered Institute of Environmental Health (CIEH)/Land Quality Management in 2014 for some 80+ contaminants (Ref. 10).

As an initial first stage risk assessment process, due to the fact that almost all potential contaminants of concern are covered, together with the fact that the methodology is the most contemporary, the S4ULs have been used in this GQRA. However, in the case of lead (Pb), only one GAC is presently published, which is the Defra C4SL, such that this value has been used in the GQRA.

The GQRA presented herein is based on the generic residential land use as described in the Environment Agency publication SR3 (Ref. 11).

5.3.2 Sampling and Laboratory testing

The investigation has established that the site is underlain by variable, and in places appreciable thicknesses of Made Ground, including materials thought to comprise reworked natural soils, together with inclusions of anthropogenic materials such as concrete, tile, brick, ceramic pipe, bitumen, glass, metal ash and coal dust.

For the purposes of gauging chronic human health risks, attention has focussed on examining contamination levels in soil samples recovered from the Made Ground, generally, from within

approximately 0.6 m depth of the ground surface, but deeper in places, e.g. targeting visual/olfactory evidence of hydrocarbon contamination.

Twelve soil samples have been analysed for a suite of potential contaminants of concern based on those identified in Section 5.2.3.

The results of the laboratory chemical analyses conducted on the selected soil samples recovered during the investigation are presented in Appendix F, and are summarised in Table 1.

5.3.3 Risk Assessment

Our evaluation of chronic human health risks associated with the aforementioned contaminants is summarised in Table 1. Whilst for the majority of potential contaminants of concern, the detected levels are below their respective Generic Assessment Criteria (GAC) for a residential land use, there are a number of exceedances. Indeed, within seven of the twelve soils analysed, at least one contaminant is present at a level which exceeds its GAC. On this basis concentrations of potential contaminants in the near-surface soils could possibly give rise to unacceptable chronic human health risks in the context of the intended development, such that further consideration is required.

The most widespread contaminants of concern are a number of polycyclic aromatic hydrocarbons (PAH compounds), together with some metals/semi-metals. The PAHs of concern are generally the heavier, less mobile compounds including benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, and dibenzo(a,h)anthracene. Napthalene, a semi-volatile PAH compound was marginally elevated, however, in one sample. One sample, within which olfactory evidence of hydrocarbon contamination was observed, recorded elevated concentrations of aliphatic petroleum hydrocarbons in the equivalent carbon range $>nC_8$-nC_{16} (e.g. fuels such as petrol and diesel). A number of samples recorded elevated concentrations of arsenic and lead, and asbestos was detected in two of the samples. One sample also recorded an elevated concentration of zinc.

It should be noted that the most impacted soil samples were those recovered from the Made Ground soils that contained significant inclusions of ash and/or coal dust, which due to their formation by combustion processes, are well known to be a source of PAH and metals/semi-metal compounds.

In the context of the proposed residential development, the critical exposure pathways from the elevated contaminants of concern in the near surface soils would be the direct and indirect ingestion of contaminated soil and dust, ingestion of edible plants grown in potentially contaminated soils, dermal contact with contaminated soils and dust, and inhalation of vapours and dust. It should also be appreciated that the critical exposure pathways from asbestos in the near surface soils would be the inhalation of airborne dusts and fibres. On this basis, considering the results of the laboratory analyses in the context of the conceptual site model and source-pathway-receptor relationship set out within the preceding sections of this report, it is concluded that, for the type of residential development proposed, the near surface Made Ground in proposed garden areas and areas of soft landscaping could possibly present a significant risk of harm to the human health of future residents.

Notwithstanding the above, the physical composition of the shallow Made Ground is such that it would be considered unsuitable for retention at shallow depth within a soft landscaped garden area.

We therefore consider that suitable remedial actions will be required to mitigate possible chronic human health risks at the site. Fundamentally, such remedial actions could either involve the removal of the source/s of contamination or the removal of the critical exposure pathways stated above.

Further consideration of the most appropriate methods for remedial actions in respect of human health risks at the site is provided below.

5.3.4 Recommended Remedial Works

5.3.4.1 Metals/Semi-metals, heavy-end PAH Compounds and asbestos

Based on the findings of the risk assessment detailed above, taking into consideration the potential exposure pathways identified, the risks to human health arising from potential contaminants of concern for which the direct and indirect ingestion, and dermal contact with soils and dusts are the critical exposure pathways, together with the inhalation of asbestos fibres, could be mitigated by the use of an engineered clean cover system as described below. Such an option should be practicable to construct and would be expected to be a relatively economical strategy.

The depth of any clean cover system should be agreed with the regulatory authorities, but would be expected to be of the order of at least 600 mm for private gardens and 450 mm in communal soft landscaped areas.

Based on the laboratory test results, it is our opinion that the clean cover system could incorporate a surface layer of Topsoil of circa 250 mm thickness to support plant growth, followed by circa 350 mm depth of subsoil, constructed over a geotextile membrane and a granular capillary break layer to prevent upward migration of potential contaminants. The geotextile membrane should be designed to prevent fines from entering any capillary break layer.

All of the imported topsoil and subsoil should be derived from a suitably certified clean source and precautions should be undertaken to ensure that the imported clean soil is not intermixed with site won materials. The importation of topsoil, subsoil and other fill materials provides the opportunity for new contamination hazards to be introduced onto a site. Soils must not be contaminated with significant quantities of concrete, brick, plastics, metal, asbestos, glass, tarmac or organic matter such as wood/timber. All imported soil must comply with relevant Generic Assessment Criteria (GAC) for residential gardens, and all topsoil with the British Standard BS 3882: 2007 Specification for Topsoil.

The recommended remedial works should be undertaken by an experienced contractor and fully validated on completion.

It will be important to ensure that careful vigilance is exercised during the groundworks phase of development and associated remedial works for evidence of differing ground conditions or other evidence of contamination. Provision should be included for additional analysis and assessment if required. In this context, further analysis may also need to be undertaken to provide waste acceptance criteria for any excavated soils which are to be disposed of to landfill. It should be appreciated in this respect that due to the elevated concentrations recorded, the deposits of Made Ground may not be acceptable at an inert waste landfill, with consequent cost implications.

5.3.4.2 Volatile Organic Compounds

It should be appreciated that hydrocarbon odours were evident during the fieldworks, together with a number of elevated concentrations of VOCs such as naphthalene and aliphatic hydrocarbons in the equivalent carbon range $>nC_8$-nC_{16} (e.g. fuels such as petrol and diesel), whilst a number of other VOCs were detected in relatively low concentrations. The critical exposure pathways from such contaminants of concern would be the inhalation of indoor air. The direct and indirect ingestion of soils and dust pathway would be mitigated by the measures described above.

With regards to the inhalation of indoor air pathway, we would recommend that the gas protection measures that are required at the site for radon purposes (see Section 2.5 and 5.5) are upgraded to a vapour barrier that will afford protection to the ingress of hydrocarbon/VOC vapours.

5.3.4.3 Fuel Storage Facilities

Specific remedial actions will need to be taken to address the presence of the underground fuel storage tanks (primary source) that are thought to still be present in the north-western area of the site. Subject to consultation with the Local Authority, these fuel tanks will almost certainly need to be removed from site. Indeed, based on a consideration of potential environmental risks, described in more detail below, it is recommended that the tanks are removed.

As the tanks are being removed, any surrounding or underlying contaminated soils should also be excavated and disposed of to a suitably licensed facility. Sampling of the sides and base of the resultant excavation will need to be undertaken to validate that this exercise has been completed to an acceptable standard, and samples of the excavated soil will need to be analysed to provide waste acceptance parameters. Associated pipework such as the supply lines to any pumps should also be removed, together with any significantly hydrocarbon impacted soils in their immediate vicinity.

The above advice (i.e. primary point source removal) should also be taken if any other unknown tanks or fuel storage are encountered at the site, as well as the other known primary point sources of potential contamination such as above ground storage tanks for engine oil and waste oil.

5.3.4.4 Water Supply Services

The presence of olfactory evidence of petroleum hydrocarbons, together with detectable concentrations of some hydrocarbons and VOCs at the site suggest that precautions will need to be taken to protect water supply services, and non-permeable pipe will need to be specified. This will be a likely requirement of the water supply regulator.

5.3.4.5 General Comments

As with any site with a significant commercial heritage, and underlain by Made Ground, it is possible that areas of more significant contamination could exist between the selected positions of investigation, which could be associated with a requirement for further analysis or alternative methods of remediation. Vigilance will need to be exercised in this respect throughout the groundworks phase of construction.

Further analysis may be required in due course to provide waste acceptance criteria for use in the classification of excavation spoil for off-site disposal.

All remedial works should be undertaken by an experienced contractor in accordance with a detailed method statement, and fully validated on completion.

5.4 Assessment of Risk to Controlled Waters

5.4.1 Context

The preceding sections of this report have identified that the Secondary Aquifers that underlie the site are the critical receptors in respect of water pollution risk. This section of the report considers the risk posed to this water body in the light of the information provided by this intrusive investigation.

No attempt is made to evaluate water pollution risks that might arise as a consequence of activities that take place to facilitate and realise the redevelopment of the site. These matters should, however, be considered by the Principle Contractor who, where necessary, should ensure that appropriate actions are taken to adequately mitigate such risks.

5.4.2 Methodology

The potential for contaminants at the site to pollute sensitive controlled waters has been assessed using the methodologies described in the Environment Agency's publication entitled 'Hydrogeological Risk Assessment for Land Contamination' (Ref. 12). A Level 2 groundwater assessment has been undertaken, using the results of the analysis of groundwater samples recovered from three of the installed monitoring wells, in order to assess the risk of contaminated groundwater impacting on the identified controlled waters receptors.

The potential pollution risk to surface water receptors has been gauged by comparing the results of the groundwater analyses with water quality standard values (e.g. UK drinking water standards).

The water quality standard values used in this assessment and the source from which they have been derived are shown in Table 2, together with a summary of the laboratory test data.

The Level 2 assessment presented in this report takes no account of attenuation mechanisms such as dilution, dispersion, retardation, sorbtion and degradation. The outputs are therefore likely to provide conservative (i.e. safe) estimates of pollution risk.

5.4.3 Environmental Sampling and Laboratory Analysis

Three groundwater samples were recovered from the observation wells and have been analysed for the contaminants of concern listed in Section 5.2.3, above.

The groundwater samples were recovered on 21st December 2015 and the results of the laboratory analyses conducted on the groundwater samples are presented in Appendix G.

5.4.4 Risk Assessment

The Level 2 groundwater assessment, which involves a simple comparison of contaminant concentrations in groundwater samples with water quality standard (WQS) values, is presented in Table 2.

No volatile organic compounds (VOCs) or BTEX were detected in any of the groundwater samples.

The analytical data reveals that the groundwater recovered from the three observation well is significantly and widely affected by petroleum hydrocarbons and PAHs, and to a much lesser extent, selenium and sulphate. However, it should be appreciated that the risk driving contaminants for this site and risk assessment are the elevated petroleum hydrocarbons.

The elevated TPH concentrations are in the C_8 to C_{40} carbon band range, although are highly dominated by the C_{12} to C_{35} carbon band range. This suggests the source is likely to be fuel. It should be noted in this context that the absence of BTEX compounds suggest that the source of the fuel is either relatively historic or relatively distant from the monitoring wells. This is consistent with the former filling station having been located on the north-eastern road frontage. Given the commercial and industrial legacy at the site, however, there are numerous other potential sources for the discovered hydrocarbon contamination, together with potential off-site sources.

It is advised that further intrusive investigatory works are undertaken in due course to more accurately define the sources of primary (e.g. underground fuel tanks, supply lines etc) and secondary (e.g. pockets of soils containing hydrocarbon free-product) hydrocarbon contamination. Such works will be most practically completed following demolition of the existing premises, and could possibly include supplementary trial pits and further boreholes, to provide increased spatial coverage for soil

and groundwater sampling and analysis. Such sources, if found, should be removed from site and further laboratory chemical testing should be undertaken on the surrounding soils and groundwater.

Notwithstanding the above, the following remedial works should be undertaken.

5.4.5 Recommended Remedial Works

With respect to the pollution risk to the underlying Secondary Aquifers, the principal risk is associated with the elevated concentrations of petroleum hydrocarbons.

As discussed above, specific remedial actions will need to be taken to address the presence of the underground fuel storage tanks (primary source) that are thought to still be present in the north-western area of the site.

It is recommended that the fuel tanks are removed, together with any surrounding or underlying contaminated soils, which should be excavated and disposed of to a suitably licensed facility. Sampling of the sides and base of the resultant excavation will need to be undertaken to validate that this exercise has been completed to an acceptable standard, and samples of the excavated soil will need to be analysed to provide waste acceptance parameters. Associated pipework such as the supply lines to any pumps should also be removed, together with any significantly hydrocarbon impacted soils in their immediate vicinity.

Primary point source removal should also be undertaken if any other unknown tanks or fuel storage are encountered at the site, together with other known primary point sources of potential contamination such as above ground storage tanks for engine oil and waste oil.

All remedial works should be undertaken by an experienced contractor in accordance with a detailed method statement, and fully validated on completion.

Such measures should effectively reduce the pollution risk to controlled waters by removing the primary and secondary sources of potential hydrocarbon contamination.

Notwithstanding the above, we would recommend that further groundwater sampling and laboratory analyses is undertaken. In the first instance, further consideration of the groundwater chemistry at the site, before, during and after primary and secondary source removal could establish whether groundwater quality improves with source removal. In this regard, further data concerning the dissolved phase hydrocarbon contamination at the site could be obtained using filtered samples or by adopting low flow sampling methodology when recovering the groundwater samples to reduce and/or eliminate the very fine soil particles to which hydrocarbons can sorb.

Following the removal of the primary and secondary sources of potential hydrocarbon contamination, and depending on the results of the further groundwater sampling, analysis and assessment, a more sophisticated controlled waters risk assessment may be warranted. In line with current guidance, it may be beneficial to undertake a Level 3 groundwater risk assessment, which takes into account attenuation mechanisms within the aquifer such as dispersion, retardation and degradation, which are processes that reduce contaminant concentrations.

5.5 Gas Risk Assessment

5.5.1 Methodology

Risks arising from the possible presence of methane and carbon dioxide gas have been assessed using the methodology described in CIRIA C665 (Ref. 13).

5.5.2 Possible Gas Sources

The ground investigation has established that the site is underlain by variable thicknesses of Made Ground. Although the encountered deposits of Made Ground at the selected positions did not contain significant amounts of materials that would be expected to have a potential to generate methane or carbon dioxide gas at appreciable rates, taking into account the past use of the site as a quarry, the possibility of a significant gas source within the Made Ground cannot be wholly discounted on the basis of strata inspection alone.

It should be noted in the above context that appreciable concentrations of petroleum hydrocarbons have been found in the soils and groundwater encountered in the exploratory holes. The natural degradation of these organic contaminants could give rise to gasses such as methane, carbon dioxide and other organic soil vapours.

5.5.3 Gas Monitoring

In order to examine the soil gas regime at the site a total of 9 monitoring wells have been constructed in the boreholes. These observation wells have been monitored for gas concentrations and gas flow rates on three occasions over a period between 21st December 2015 and 7th February 2016, at atmospheric pressures ranging from 994 mB to 1012 mB. The gas monitoring data are presented in Appendix E.

Concentrations of methane were generally very low (i.e. less than 0.3 % volume) and carbon dioxide has been found at a maximum concentration of 2.0 %. No appreciable gas flows (i.e. al. were below 0.3 %) have been detected at any observation well on any monitoring occasion.

Such characteristics are consistent with soil gases originating from typical Made Ground and from decomposition of petroleum hydrocarbon compounds.

5.5.4 Gas Screening Value and Characterisation

The gas screening value (GSV) for the site has been calculated as follows.

$$GSV = (0.3 \text{ L/hr}) \times (2.0 \text{ \% vol. } CO_2) = 0.006 \text{ L/hr}$$

In the absence of any measurable gas flows, the borehole flow rate has, for the purpose of calculating a safe GSV, been taken as 0.3 L/hr which is the limit of detection for the field measuring device. The gas concentration of 2.0 % volume used to calculate the GSV relates to the maximum recorded concentration of carbon dioxide.

Based on this GSV and depending on the types of building of the proposed development, the site's gas classification is Characteristic Situation 1 (CS1) as defined in Table 8.5 of CIRIA C665.

However, as discussed previously, based on the findings of the Desktop Study (Ref. 1), a requirement for radon protection has been identified. The inclusion of the radon protection measures would also provide a degree of protection from other potentially hazardous ground gases at the site. As discussed previously, however, based on the chemistry of the soils/groundwater and current/former site use, it is recommended that the protection measures are upgraded such that they also afford protection from the ingress of hydrocarbon vapours.

The published guidance suggests, that for a high sensitivity development (i.e. residential) and a low generation potential source, ideally, six gas readings should be undertaken during a six month period. Given the above proposals in respect of gas protection, it is considered unlikely that additional

monitoring will affect our recommendations, and it is noted in this context that the guidance indicates that there is a balance to be considered between the cost of additional monitoring and the improvement in technical confidence which will result. However, as some further works have been recommended to further refine potential hydrocarbon sources, it would be prudent to combine these works with further gas monitoring to ensure contemporary data is available at the time of construction.

5.6 Aggressive Chemical Environment for Concrete

The aggressive chemical environment for concrete (ACEC) for the site has been estimated using the methodology described in BRE Special Digest 1 (see Ref. 2).

Concentrations of water soluble sulphate, total sulphate and total potential sulphate, together with pH values have been measured in a total of 22 samples distributed throughout the Made Ground and underlying natural subsoils. Comparison between the total potential sulphate and acid soluble sulphate concentrations indicates that pyrite may be present.

Based on the findings of the investigation it is necessary to assume mobile groundwater conditions.

Based on Table C2 of the published guidance, using a characteristic value based on the highest potential sulphate concentrations established, concrete conforming to ACEC Class AC-4, with a design class of DS-4 should be specified for use below ground level.

5.7 Waste Assessment Criteria

The presence of any significant amounts of asbestos within the deposits of Made Ground, together with high concentrations of PAH compounds, TPH, arsenic, lead and zinc, could potentially classify the soils as hazardous waste in respect of off-site disposal.

Notwithstanding the above, WAC testing was undertaken on three sets of combined soil samples and the results are presented in Appendix F. Combination 1 comprised general Made Ground encountered at the site, Combination 2 comprised mainly granular sub-base materials, whilst Combination 3 comprised soil samples containing visual and olfactory evidence of hydrocarbons, ash and carbonaceous material.

The results show that for Combination 1, the general Made Ground, all of the determinands are below the inert waste landfill criteria limits.

The results for Combination 2, however, indicate that the PAH result of 162 mg/kg exceeds the inert waste threshold value of 100 mg/kg (these high PAH values also impact upon the chronic human health risk assessment), whilst the inert waste threshold value for antimony is also slightly exceeded. The elevated PAH within the granular sub-base material could possibly reflect the presence of tarmac.

For Combination 3, the materials that exhibited visual and olfactory evidence of hydrocarbon contamination, the TPH result of 1290 mg/kg and the PAH result of 122 mg/kg exceed the inert waste threshold values of 500 and 100 mg/kg respectively, whilst the inert waste threshold value for antimony and TOC is also slightly exceeded.

The exceedance of inert waste thresholds may give rise to high disposal costs should this be the preferred option for the disposal of any Made Ground containing ash, coal, tarmac and/or visual or olfactory evidence of hydrocarbons.

The full results of the laboratory analyses should be presented to prospective landfill recipients of excavation spoil derived from the site, for consideration in the context of their specific license conditions.

It is recommended in the above context that any excavated materials which are to be taken to landfill, are carefully separated into individual stockpiles divided into, for example, clean natural subsoils and Made Ground. Furthermore, where soils are obviously hydrocarbon impacted it is recommended they are separated from any visually clean soils and analysed independently, in order to potentially reduce the proportion of soil which needs to be disposed of as hazardous waste.

Should evidence of more significantly contaminated materials be revealed during the subsequent groundworks, then these materials should be separated and individually stockpiled pending the completion of further tests.

6. Ground Engineering

6.1 Context

This section of the report considers the ground conditions in the context of the engineering design and construction of the proposed development. Preliminary advice is given in relation to the design of foundations, ground floor slabs, pavements and soakaways.

Particularly careful consideration will need to be afforded to the design of the foundations and other substructures for the proposed development, taking into consideration the highly variable nature of the ground conditions, including the significant thicknesses of Made Ground, coupled with the presence of buried structures and substructures (e.g. USTs), and the influence of past quarrying activities.

Further investigation will need to be undertaken in due course, most notably in respect of the concealed quarry face which is believed to run approximately parallel with Newbridge Road, beneath the footprint of the existing showroom building. It will not be practical to investigate this feature until the existing development has been demolished. It should also be appreciated that comments concerning the stability of the fly-tipped margins of the former rail cutting to the east are beyond the scope of this assessment, together with advice concerning invasive plant species such as Japanese Knotweed, which was observed during the initial walkover (Ref. 1).

6.2 Site Preparation

Prior to commencing the earthworks or ground works, all live services on, and in the vicinity of, the proposed development should be accurately located and, if necessary, diverted or protected. The ends of existing drains and sewers no longer required because of alterations to the drainage layout should be effectively sealed so as to prevent any residual or persisting seepages from adversely affecting the integrity and/or stability of the formations and/or foundations.

Any old foundations and sub-structures (e.g. former USTs) within the footprint of the proposed buildings should be cleared. Sub-structure walls should be grubbed up to a depth of at least 1.5 m below any proposed shallow foundations. Basements or service conduits, and surface voids resulting from the site preparation work, should be filled with well compacted, acceptable granular material (e.g. DoT Type 1, or similar approved).

Specific remedial actions will need to be taken to address the presence of the fuel storage tanks that are known to be present or are encountered during the site preparation. The tanks will need to be removed from site together with the supply pipes and associated features in the presence of a suitably qualified Geo-Environmental Engineer. If any surrounding or underlying contaminated soils are encountered, they should be excavated and disposed of to a suitably licensed facility. Sampling of the sides and base of the resultant excavation will need to be undertaken to validate that this exercise has been completed to an acceptable standard, and samples of the excavated soil will need to be analysed to provide waste acceptance parameters.

It is noted that a mains sewer with an associated easement crosses the southern part of the site. It will be important to ensure that appropriate precautions are put in place to afford the necessary degree of protection in this regard.

6.3 Foundations

6.3.1 Northern Area

Proposed structures that are to be located outside of the quarry, to the north of the site, in the area which fronts onto Newbridge Road, are expected to be underlain generally by relatively shallow Made Ground followed by deposits of the Blue Lias Formation. Within window sampler boreholes WS01 to WS03, Made Ground was found to depths of up to 0.9 m, followed by relatively competent limestone 'bedrock' from depths of around 0.75 to 0.90 m (likely part of interbedded sequence with clay/mudstone horizons). Subject to this stratum being present beneath the entire footprint of any proposed structures, given that Made Ground is likely to be deeper in the area of the USTs, it is possible that conventional strip, pad or trench fill foundations constructed in the relatively competent strata of the Blue Lias Formation would be suitable for use in this area. As a precautionary approach, a presumed bearing value of up to 150 kN/m^2 would be recommended, acknowledging the potential for weaker underlying clay/mudstone horizons to be present. This presumed bearing value would be considered appropriate for the preliminary design of the foundations in this area, and should ensure that total and differential settlements remain within normal acceptable limits (i.e. total settlements less than 25 mm). If ground conditions change within the footprint of the proposed structures, the foundations should be constructed in the same stratum, wherever possible, in order to reduce potential differential settlements.

Careful consideration of the foundation depth and design will be necessary in this area to ensure there is no impact on the stability of the concealed quarry face. Further investigation will be required in this regard when the development layout has been finalised, following demolition of the existing structures.

It is important to note in the above context, that foundation construction in this area could also be significantly hampered by pre-existing subsurface construction, associated for example with former USTs, which could result in a considerable depth of disturbance. It is possible that this disturbance could extend beyond the level at which it would be practical to construct conventional spread foundations, in which case consideration would need to be afforded to alternative foundation solutions involving, for example, piled foundations.

6.3.2 Southern Area

Proposed structures that are to be located within the former quarry base, at the lower elevations to the south of the site, will be underlain by significant thicknesses of Made Ground proven up to 2.9 m depth, but possibly deeper between the selected positions. In this regard, foundations would be required to be constructed beneath the Made Ground such that the influence of groundwater on excavation stability, together with the amount of arisings produced and volumes of concrete required, could make the construction of conventional foundations economically unfeasible or impracticable.

A number of foundation options may be feasible which will predominantly depend upon the economics of each type.

- Relatively deep trench fill foundations could possibly be adopted, subject to further investigation, providing the naturally deposited Penarth Group deposits are present across the whole footprint of structures. Consideration should be afforded, however, to potential instability of the trenches and the potential for groundwater inflows, together with the amount of excavated spoil that is likely to be generated. As a precautionary approach, a presumed bearing value of up to 150 kN/m^2 would be recommended, acknowledging the potential for weaker interbedded clay/mudstone horizons to be present. This presumed bearing value would be considered appropriate for the preliminary design of the foundations in this area, and

should ensure that total and differential settlements remain within normal acceptable limits (i.e. total settlements less than 25 mm). If ground conditions change within the footprint of the proposed structures, the foundations should be constructed in the same stratum, wherever possible, in order to reduce potential differential settlements.

- Vibrated stone columns (VSC) could be installed into the ground to increase the load bearing characteristics, and improve the Made Ground. The suitability and design of any specific solution based on VSC would depend on the layout and loading details of the structures together with the type of foundation and the particular ground conditions. The advice of a specialist ground treatment contractor(s) should be sought in order to confirm the suitability of the ground with respect to their particular proprietary systems and where appropriate to provide information on suitable treatment and costs. It would be essential on a site of this nature, however, to consider the potential for preferential pathways to be created through which contamination could migrate into the underlying Secondary Aquifers. Full consultation with the Environment Agency (EA) would be required in this regard and it is possible that ground improvement techniques of this type could be prohibited.

- It may prove more practicable and economically more viable to adopt a mini-piled foundation solution, extending into the underlying naturally deposited competent strata of either the Penarth Group, Blue Anchor Formation or underlying Mercia Mudstone Group deposits. The piled foundations would need to be designed by an experienced and competent specialist piling contractor who should select appropriate design parameters and guarantee safe working loads together with maximum total and differential settlements, which should be within acceptable tolerances for the proposed structures. The choice of piling technique should be agreed with the contractor. Soil parameters for the strata to be penetrated will depend on the piling technique selected and the precise method of working. Driven piles should only be considered if vibrations and environmental constraints can be maintained within acceptable limits, with regards to the proximity of nearby structures and infrastructure. It should be appreciated in this context that significant coarse-grained obstructions were encountered within the boreholes and trial pits. Moreover, as with the ground improvement techniques discussed above, full consultation with the Environment Agency (EA) would be required regarding the risk of preferential contaminant migration pathways being created.

6.4 Ground Floor Slabs

A requirement for precautionary measures to be incorporated into the design of the floor slab in respect of possible risks from radon gas and hydrocarbon vapours is highlighted in Section 5.5 of this report, which would most practically be incorporated into a suspended floor with a suitably dimensioned sub-floor void.

Notwithstanding this requirement, suspended ground floor slabs would be recommended throughout the proposed development in the light of the variable depth of Made Ground and disturbance due to previous construction revealed by the investigation, and/or envisaged.

6.5 Pavement Design

The in-situ deposits of Made Ground comprise a variable mix of materials and will consequently provide pavement formations of varying characteristics and quality. Furthermore, there is expected to be significant disturbance associated with pre-existing subsurface construction.

The existing, long established, hard surfaced construction, could possibly, subject to the proposed finished levels, be re-used and/or incorporated into the eventual roads and car parking areas of the development.

Due to the presence of granular materials and coarse particles, the CBR tests undertaken using a Mexecone Penetrometer within the trial pits were frequently obstructed. It is recommended therefore, that further in-situ CBR tests are carried out on exposed formations in due course following demolition.

For preliminary design purposes, we suggest a CBR value of 5 % could be assumed for the natural subsoils underlying the Made Ground. For deposits of Made Ground which have not been compacted to any form of engineering specification, it is recommended a CBR value of <2 % be assumed.

6.6 Soakaway Design

The results of the in-situ soil infiltration tests are presented in Appendix D and indicate very poor infiltration rates for the near-surface deposits of the Penarth Group. One of the tests (TP01) recorded an infiltration rate of 10^{-6} m/s, whilst the remaining two (TP03 and TP04) were abandoned after a period of at least 4 hours due to an imperceptible fall in groundwater level.

In this regard, due to the low infiltration rate it may be impractical to consider the construction of conventional soakaway type drainage. As a consequence, careful consideration should be afforded to the design of the site's surface water drainage and the advice of a specialist drainage engineer should be sought. There are a number of proprietary systems available which provide a relatively high storage volume and surface area, and can for example, be incorporated into the hard surfacing of the development.

If a solution such as permeable paving or soakaways were to be adopted however, its use would need to be agreed with the Environment Agency. The Agency normally requires that the base of the soakaway be constructed within natural ground, and located at least 1 m above the groundwater table. Moreover, it is particularly important on a site of this nature to ensure that soakaways are constructed entirely within uncontaminated ground. Given that groundwater has been recorded at relatively shallow depths, and there are some significant thicknesses of Made Ground, the design of an effective sustainable system could prove problematic in this regard.

TABLES

Newbridge Road, Bath

Table 1 - Estimation of Chronic Human Health Risks for
Standard Residential Land Use (1 % SOM)

Contaminant		Units	GAC	Pass criteria?	WS01	WS04	WS06	WS09	WS10	WS10	WS03	WS08	WS05	WS05	WS07	WS12
					0.40 - 0.50m	0.50 - 0.60m	0.50 - 0.60m	0.30 - 0.40m	0.10 - 0.20m	0.50 - 0.60m	0.30 - 0.40m	0.20 - 0.30m	0.20 - 0.30m	1.10 - 1.20m	0.40 - 0.50m	0.20 - 0.30m
pH value		-	-	-	8.2	8.1	8.0	8.3	8.1	8.0	10.2	9.6	9.0	8.3	8.1	8.3
Soil Organic Matter		%	-	-	1.0	1.6	0.8	0.7	3.4	2.6	1.4	2.7	4.0	3.4	8.1	4.9
Asbestos Fibres Screen		-	-	×	NAI	CHR/AM/ACT	NAI	NAI	NAI	NAI	NAI	NAI	CHR/AM	NAI	NAI	NAI
Metals and inorganics	Arsenic	mg/kg	**37**	×	152	36.3	23.0	33.5	18.0	345	34.4	31.0	39.9	110	40.1	10.3
	Boron	mg/kg	**290**	✓	1.0	1.0	2.0	0.8	< 0.5	0.7	0.6	0.5	1.1	2.1	3.5	0.9
	Cadmium	mg/kg	**11**	✓	< 0.5	< 0.5	< 0.5	< 0.5	0.6	< 0.5	< 0.5	0.8	2.2	5.7	1.7	0.6
	Chromium	mg/kg	**910**	✓	29.8	34.9	52.6	26.3	18.2	25.0	12.6	18.7	30.7	96.7	27.1	13.4
	Chromium (VI)	mg/kg	**6**	✓	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
	Copper	mg/kg	**2400**	✓	51.9	52.2	39.5	49.5	55.8	64.0	16.1	46.3	197	1900	243	42.1
	Lead	mg/kg	**200**[C4SL]	×	44.8	135	65.6	53.9	152	70.3	32.4	159	644	3290	746	88.8
	Inorganic Mercury	mg/kg	**40**	✓	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	2.0	< 0.5
	Nickel	mg/kg	**130**	✓	35.5	33.8	44.3	29.6	21.6	41.9	12.2	19.4	41.1	120	38.3	9.5
	Selenium	mg/kg	**250**	✓	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.3	< 1.0	< 1.0	< 1.0	< 1.0	1.2	< 1.0
	Zinc	mg/kg	**3700**	×	61.7	133	134	119	223	167	61.7	171	451	7020	664	134
	Cyanide	mg/kg	**41**[GI]	✓	< 1.0	< 1.0	33.5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Organics	Phenols	mg/kg	**280**	✓	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6
PAHs	Naphthalene	mg/kg	**2.3**	×	< 0.01	1.45	0.05	0.04	0.45	0.01	0.27	0.06	2.38	1.54	2.15	0.02
	Acenaphthylene	mg/kg	**170**	✓	0.01	1.48	0.07	0.02	0.23	< 0.01	0.16	0.08	3.01	0.41	4.01	0.03
	Acenaphthene	mg/kg	**210**	✓	0.02	2.52	0.03	0.02	0.08	< 0.01	1.77	0.01	4.79	0.49	0.56	< 0.01
	Fluorene	mg/kg	**170**	✓	0.01	4.61	0.19	0.02	0.08	< 0.01	1.21	0.02	2.29	0.46	2.58	< 0.01
	Phenanthrene	mg/kg	**95**	✓	0.16	23.8	1.13	0.16	1.03	0.04	9.92	0.30	10.8	1.08	25.8	0.08
	Anthracene	mg/kg	**2400**	✓	0.05	8.85	0.25	0.06	0.90	0.02	2.52	0.11	4.53	0.36	7.61	0.04
	Fluoranthene	mg/kg	**280**	✓	0.31	35.4	1.64	0.27	2.89	0.08	10.7	1.00	21.8	2.09	29.4	0.20
	Pyrene	mg/kg	**620**	✓	0.25	26.7	1.22	0.23	2.69	0.07	7.32	0.93	17.8	2.16	22.9	0.17
	Benzo(a)anthracene	mg/kg	**7.2**	×	0.10	13.9	0.98	0.14	1.26	0.05	3.51	0.56	13.5	0.99	13.1	0.11
	Chrysene	mg/kg	**15**	✓	0.11	13.8	1.21	0.14	1.71	0.06	3.61	0.55	14.2	1.03	13.6	0.14
	Benzo(b)fluoranthene	mg/kg	**2.6**	×	0.10	11.2	1.21	0.12	1.36	0.05	3.02	0.48	17.0	1.24	9.83	0.14
	Benzo(k)fluoranthene	mg/kg	**77**	✓	0.08	10.7	0.76	0.12	1.23	0.06	2.51	0.50	13.3	0.87	10.0	0.11
	Benzo(a)pyrene	mg/kg	**2.2**	×	0.10	13.6	0.90	0.13	1.17	0.06	3.04	0.60	18.2	1.13	12.0	0.13
	Indeno(1,2,3-c,d)pyrene	mg/kg	**27**	✓	0.06	7.63	0.49	0.07	0.70	0.03	1.77	0.34	13.4	0.71	6.48	0.09
	Dibenzo(ah)anthracene	mg/kg	**0.24**	×	0.02	2.67	0.24	0.02	0.23	0.01	0.58	0.10	4.96	0.26	2.35	0.03
	Benzo(g,h,i)perylene	mg/kg	**320**	✓	0.07	8.16	0.51	0.08	0.76	0.03	1.94	0.41	15.2	0.94	6.65	0.10
BTEX	Benzene	mg/kg	**0.087**	✓	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Toluene	mg/kg	**130**	✓	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Ethyl Benzene	mg/kg	**47**	✓	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Xylenes	mg/kg	**2600**	✓	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPHs (Aromatics)	>nC_7-nC_7	mg/kg	**370**	✓	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	>nC_7-nC_8	mg/kg	**860**	✓	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	>nC_8-nC_{10}	mg/kg	**47**	✓	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.5	< 1.0	< 1.0	< 1.0	18.8	4.3	< 1.0
	>nC_{10}-nC_{12}	mg/kg	**250**	✓	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.9	200	2.5	< 1.0
	>nC_{12}-nC_{16}	mg/kg	**1800**	✓	< 1.0	11.2	< 1.0	< 1.0	< 1.0	< 1.0	15.4	< 1.0	33.7	447	6.3	< 1.0
	>nC_{16}-nC_{21}	mg/kg	**1900**	✓	< 1.0	47.0	2.6	< 1.0	1.3	< 1.0	52.8	< 1.0	65.9	47.0	12.2	< 1.0
	>nC_{21}-nC_{35}	mg/kg	**1900**	✓	3.9	204	9.8	< 1.0	10.8	< 1.0	145	5.5	216	143	47.5	4.4
	>nC_{35}-nC_{44}	mg/kg	**1900**	✓	< 1.0	55.9	< 1.0	< 1.0	< 1.0	< 1.0	27.1	< 1.0	92.4	18.3	11.4	1.8
TPHs (Aliphatics)	>nC_5-nC_6	mg/kg	**42**	✓	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	>nC_6-nC_8	mg/kg	**100**	✓	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	>nC_8-nC_{10}	mg/kg	**27**	×	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	370	< 1.0	< 1.0
	>nC_{10}-nC_{12}	mg/kg	**130**	×	< 1.0	1.6	< 1.0	< 1.0	< 1.0	< 1.0	1.3	< 1.0	13.2	2130	< 1.0	< 1.0
	>nC_{12}-nC_{16}	mg/kg	**1100**	×	< 1.0	42.5	< 1.0	< 1.0	< 1.0	< 1.0	16.0	< 1.0	112	2760	2.1	< 1.0
	>nC_{16}-nC_{21}	mg/kg	**65000**	✓	< 1.0	72.4	< 1.0	< 1.0	< 1.0	< 1.0	36.7	< 1.0	179	99.3	6.4	< 1.0
	>nC_{21}-nC_{35}	mg/kg	**65000**	✓	< 1.0	292	< 1.0	< 1.0	4.3	< 1.0	113	9.3	425	348	20.4	7.2
VOCs	Propylbenzene	mg/kg	**34**	✓	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.0388	<0.01	<0.01
	1,2,4-Trimethylbenzene	mg/kg	**0.35**	✓	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.0114	<0.01	<0.01
	1-methylpropylbenzene	mg/kg	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.0857	<0.01	<0.01
	Butylbenzene	mg/kg	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.169	<0.01	<0.01
	Methylethylbenzene	mg/kg	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.0114	< 10.0	< 10.0
	All other VOCs	mg/kg	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Notes

GAC	Generic Assessment Criteria. All GAC are S4ULs published by CIEH/LQM in 2014, unless otherwise stated.
C4SL	Catergory 4 Screening Level published by DEFRA in 2013.
GI	GAC derived in-house by GI.
NAI	No asbestos identified
CHR/AM/ACT	Chrysotile, Amosite or Actinolite asbestos detected.
Value	Shaded cells indicate samples in which GAC is exceeded.

NEWBRIDGE ROAD,
BATH

TABLE 2 - Water Pollution Risk Assessment

Contaminant	Units	List	WQS Value	Source of WQS Value	Sample Concentrations		
					CP01	CP02	CP03
pH	Units	II	9.5	WSR	11.5	6.9	6.7
Metals and semi-metals:							
Arsenic	µg/l	II	10	WSR	8	9	<5
Cadmium	µg/l	I	5	WSR	<1	<1	<1
Chromium	µg/l	II	50	WSR	<5	<5	<5
Copper	µg/l	II	2,000	WSR	<5	<5	<5
Lead	µg/l	II	10	WSR	4	<1	<1
Mercury	µg/l	I	1	WSR	0.4	<0.1	<0.1
Nickel	µg/l	II	20	WSR	19	11	<5
Selenium	µg/l	-	10	WSR	13	<5	<5
Zinc	µg/l	II	75	WSR	<5	<5	13
Inorganic compounds:							
Sulphate	mg/l	-	250	WSR	25.4	471	109
Cyanide	ug/l	-	50	WSR	13	<5	<5
Organic compounds:							
Total Petroleum Hydrocarbons	ug/l	I	10	PWSR	13,900	640	1,530
Benzene	ug/l	I	1	WSR	<1	<1	<1
Toluene	ug/l	I	700	WHO	<1	<1	<1
Ethyl Benzene	ug/l	-	300	WHO	<1	<1	<1
Xylenes	ug/l	I	500	WHO	<1	<1	<1
PAHs	µg/l	I	0.1	WSR	30.97	62.5	4.22
Benzo(a)pyrene	µg/l	I	0.01	WSR	10.7	20.1	1.34
Naphthalene	µg/l	I	290	SRC	7.51	0.97	0.28
Phenols	µg/l	II	0.5	WSR	<1	<1	<1
PCBs (all in suite)	µg/l	-	-	-	<0.1	<0.1	<0.1
VOCs	µg/l	-	-	-	<1	<1	<1

Notes

(1) WQS = Water Quality Standard.
(2) WSR = Water Supply Regulations, 2001.
(3) PWSR = Private Water Supply Regulations, 1991.
(4) WHO = WHO drinking water standards.
(5) SRC = Serious Risk Concentration
(6) The WSR value for PAHs applies to the sum of the concentrations of the following four compounds: benzo(b)flouranthene, benzo(k)flouranthene, benzo(ghi)perylene, and indeno(1,2,3-cd)pyrene.
(7) Black shading indicates samples in which contaminant concentrations exceed water quality standard values.

FIGURES

AREA OF MACADAM SURFACING

GENERATOR AND GAS BOTTLES (SOME SURFACE STAINING)

OIL INLET PIPES AND SURFACE STAINING

WS1

WS2

WS3

CAR SHOW ROOM AT GROUND LEVEL
VEHICLE SERVICING AND REPAIRSAT LEVEL -1
VEHICLE VALET SERVICES AT LEVEL -2

WS6

CP2

CONCRETE BATCHING PLANT

JAPANESE KNOTWEED

ETE TANKS

SKIP

WS5

WS4

DENSELY VEGETATED AREA

WS12

TP2

CP3

WS9

TP3

CP1

WS7

WS11

CAR BODY REPAIR WORKSHOP

TP1

WS10

WS8

TP4

FLY-TIPPING AND SURFACE WATER PONDING

WASTE ANTI-FREEZE STORED

METAL AND CARDBOARD RECYCLING SKIPS

CONTAINERS FOR PAINT TINS, CONTAMINATED PLASTICS AND SPRAY BOOTH FILTERS

GENERATOR, WASTE OI
TANK AND OTHER DRU

GROUND INVESTIGATION
geotechnical & geo-environmental consultants

Unit 3 Custom House Court,
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Tel: 01275 876903 **Fax:** 01275 879662
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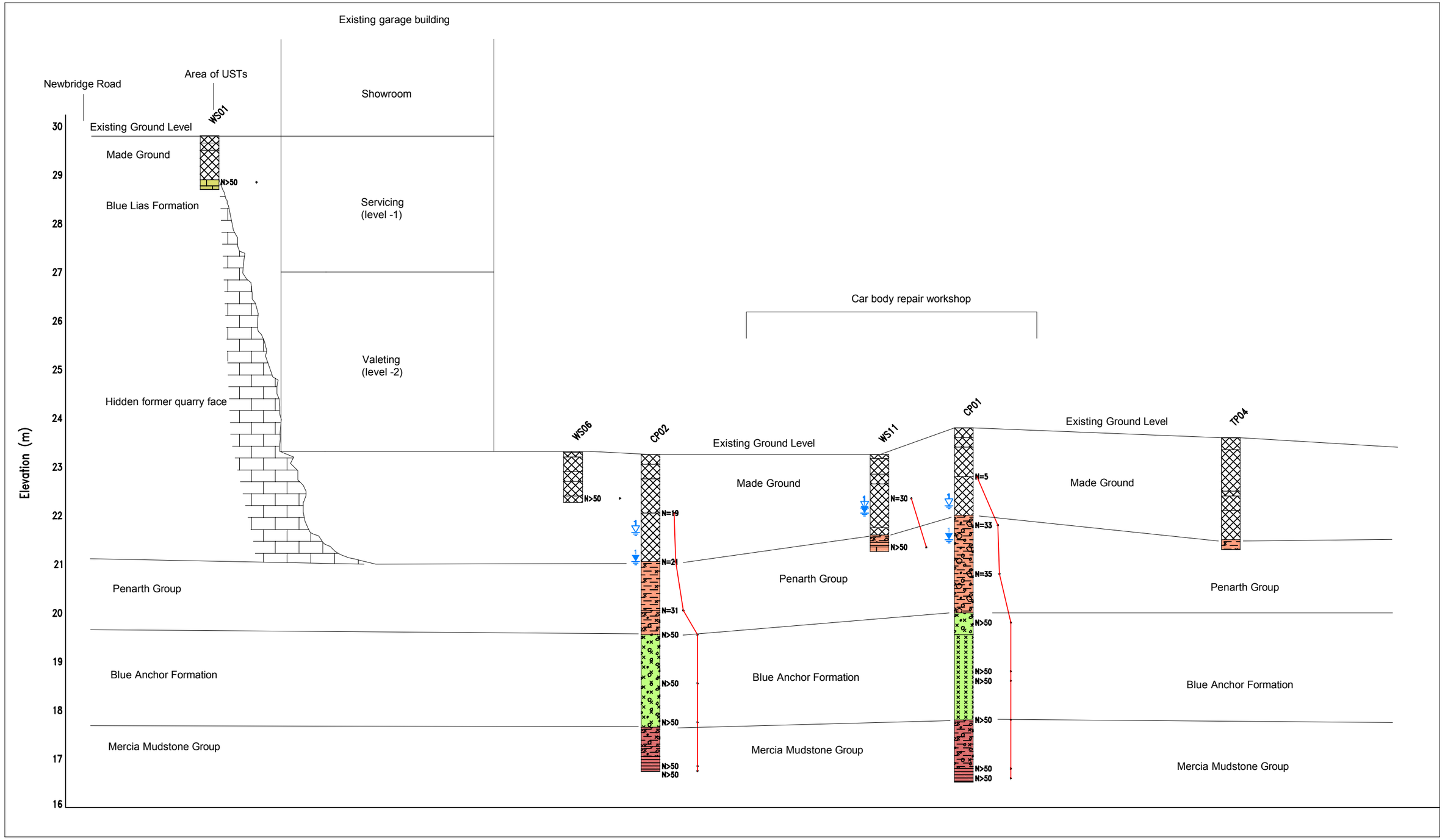
SITE: Newbridge Road, Bath

CLIENT: Oakhill Group Limited

PROJECT ID: sw-766 | **SCALE:** Not to scale

FILENAME: p-sw-766.Fig1

FIGURE 1
EXPLORATORY HOLE LOCATION PLAN



GEOLOGY LEGEND

1 MADE GROUND
2 BLUE LIAS FORMATION
3 PENARTH GROUP
4 BLUE ANCHOR FORMATION
5 MERCIA MUDSTONE GROUP

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Site:
Newbridge Road, Bath

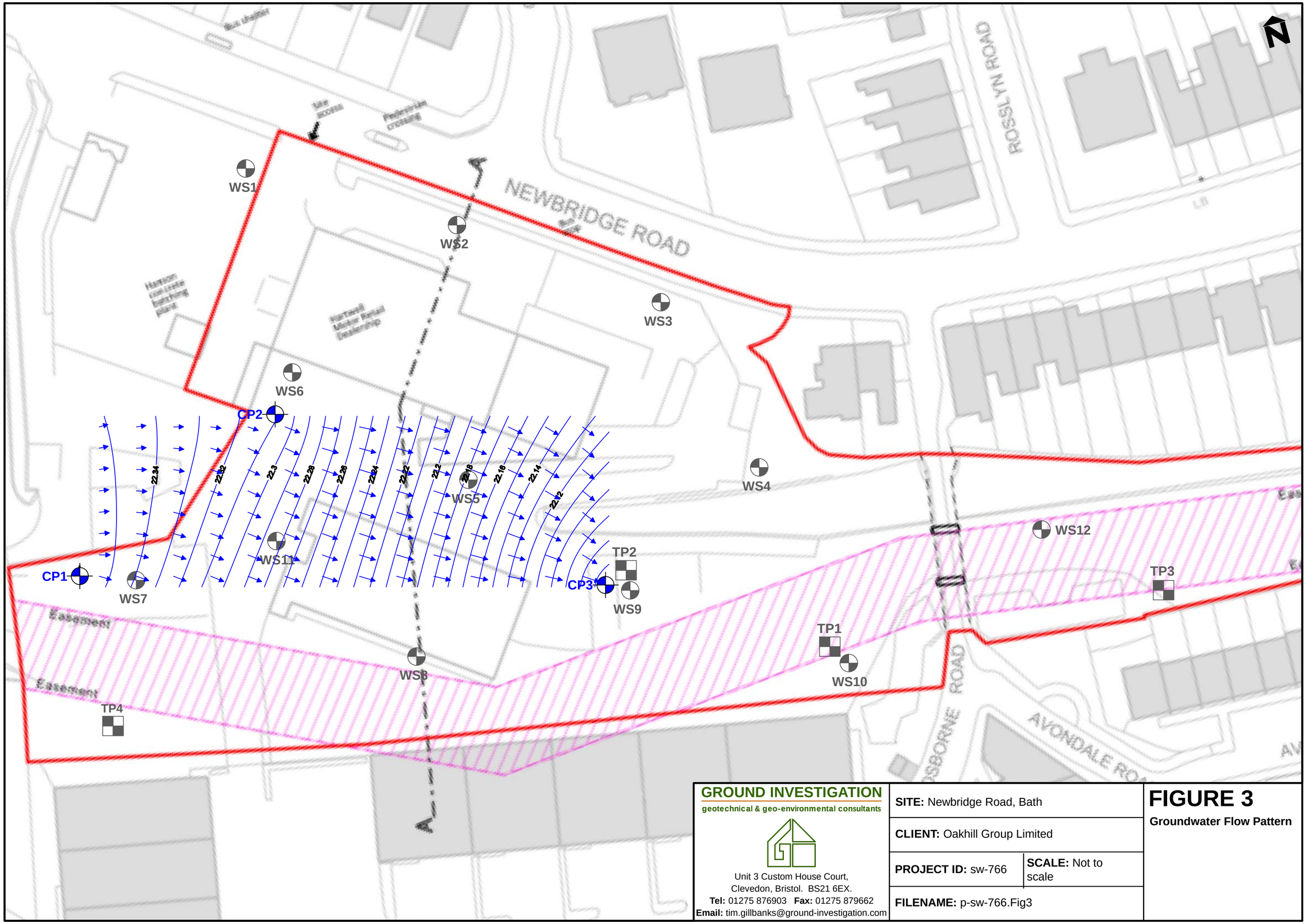
Client:
Oakhill Group Limited

Project No:
p-sw.766-01

Scale:
NTS

Filename:
p-sw.766-01.FIG2.DWG

FIGURE 2
Geological Cross Section



GROUND INVESTIGATION
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Tel: 01275 876903 **Fax:** 01275 879662
Email: tim.gillbanks@ground-investigation.com

SITE: Newbridge Road, Bath

CLIENT: Oakhill Group Limited

PROJECT ID: sw-766 | **SCALE:** Not to scale

FILENAME: p-sw-766.Fig3

FIGURE 3
Groundwater Flow Pattern

APPENDIX A

Engineering Records of Cable Percussion Boreholes

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Ground Investigation

Cable Percussion Borehole Record

Hole ID
CP01
Sheet 1 of 1 (0.00m-10.00m)
All dimensions in metres
Scale 1:50

Site: Newbridge Road, Bath	**Method/Plant Used:** Dando 2000 Mk2		
Client: Oakhill Group Limited	**Start date:** 15/12/15	**End Date:** 16/12/15	**Logged By:**
Job No: p-sw-766	**Easting:**	**Northing:**	**Elevation:** 23.800

SAMPLES & IN-SITU TESTS				Water	STRATA			Well / Backfill
Depth	Type / No		Result / Remark		Legend	Depth (R.L.)	Description	
						0.20 (23.60)	[Medium dense] GRAVEL of light grey limestone (0.10m), over [loose] black very gravelly SAND sized particles of predominantly carbonaceous material, coal dust, ash and clinker. **MADE GROUND**	
						0.40 (23.40)	[Dense] GRAVEL of light grey limestone. **MADE GROUND**	
						(0.60)	[Soft to firm] dark grey to greenish grey slightly sandy silty gravelly CLAY with frequent cobbles. Gravel and cobbles are predominantly grey limestone.	
1.00	SPTLS-1					1.00 (22.80)	**MADE GROUND**	
1.00-2.00	B-2						[Soft] grey slightly sandy silty gravelly CLAY. Gravel is fine to medium occasionally coarse of grey limestone.	
1.00-1.45	S		N=5 (2,2:1,0,2,2)			(0.80)	**MADE GROUND**	
				1			1.00-1.50m: Slight hydrocarbon odour.	
						1.80 (22.00)	1.70m: Probable band of limestone, recovered as cobble sized fragment.	
2.00	SPTLS-3						Stiff to very stiff locally laminated dark bluish grey silty CLAY with occasional gravel sized mudstone lithorelicts locally tending to a weak laminated mudstone. Frequent bands of grey argillaceous limestone, recovered as gravel and cobble sized fragments.	
2.00-3.00	B-4						**PENARTH GROUP**	
2.00-2.45	S		N=33 (9,5:7,11,8,7)	1				
						(2.00)		
3.00	SPTLS-5							
3.00-4.00	B-6							
3.00-3.45	S		N=35 (10,11:12,12,6,5)					
						3.80 (20.00)	Very stiff grey clayey SILT with occasional very weak sub-angular angular gravel sized siltstone lithorelicts.	
4.00	SPTLS-7					(0.45)	**BLUE ANCHOR FORMATION**	
4.00-5.00	B-8					4.25 (19.55)	Weak laminated grey SILTSTONE occasionally tending to very stiff clayey silt.	
4.00-4.38	S		N>50 (7,12:14,15,21/75mm)				**BLUE ANCHOR FORMATION**	
5.00	SPTLS-9							
5.00-5.20	B-10					(1.75)		
5.00-5.06	S		N>50 (25/27mm50/35mm)					
5.20	SPTLS-11							
5.20-6.00	B-12							
5.20-5.23	S		N>50 (25/15mm50/16mm)			6.00 (17.80)	Very stiff reddish brown locally light grey silty CLAY with occasional gravel sized mudstone lithorelicts, locally tending to very weak mudstone.	
6.00	SPTLS-13						**MERCIA MUDSTONE GROUP**	
6.00-7.00	B-14					(1.00)		
6.00-6.12	S		N>50 (17,8:50/24mm)			7.00 (16.80)	Very weak reddish brown locally light grey MUDSTONE.	
7.00	SPTLS-15					7.28 (16.52)	**MERCIA MUDSTONE GROUP**	
7.00-7.16	S		N>50 (12,13:50/5mm)					
7.20	SPTLS-16							
7.20-7.28	S		N>50 (25/75mm50/5mm)					

Boring Progress and Water Observations					Water Strikes					Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	From	To	Time (hh:mm)	Depth	Diameter (mm)	Depth	Diameter (mm)
15/12/15	16:30	5.20	5.20	4.10	2.30		1.60	20	4.50	5.00	5.40	1:30	7.28	150	7.00	150
16/12/15	12:00	7.28	7.00	6.50						7.00	7.28	1:00				

General Remarks

1) Hand pit excavated to 1.00mbGL.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials are likely fragmented by sample barrels.
4) Groundwater seepages may be obstructed through use of borehole casing.
5) Borehole terminated at 7.28m due to consistent effective refusal, and following a total of 2.5 hours chiselling.
6) Borehole installed with 50mm diameter HDPE installation.

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Ground Investigation

Cable Percussion Borehole Record

Hole ID
CP02
Sheet 1 of 1 (0.00m-10.00m)
All dimensions in metres
Scale 1:50

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Dando 2000 Mk2
Start date: 16/12/15 **End Date:** 17/12/15 **Logged By:**
Easting: **Northing:** **Elevation:** 23.250

SAMPLES & IN-SITU TESTS				STRATA			
Depth	Type / No	Result / Remark	Water	Legend	Depth (R.L.)	Description	Well / Backfill
0.50-1.20	B-1				0.20 (23.05)	Tarmac surfacing. **MADE GROUND**	
					0.50 (22.75)	[Medium dense] slightly sandy GRAVEL of light grey limestone. **MADE GROUND**	
					(0.70)	[Firm] grey sandy clayey/silty GRAVEL of mixed lithologies including grey limestone and sandstone and yellowish brown oolitic limestone. Occasional gravel sized concrete/mortar fragments. **MADE GROUND**	
1.20	SPTLS-2				1.20 (22.05)	[Stiff] light and dark grey sandy gravelly silty CLAY. Gravel is predominantly grey limestone. Occasional gravel sized fragments of brick, concrete/mortar, as well as metal sheeting. **MADE GROUND**	
1.20-2.20	B-3						
1.20-1.65	S	N=19 (3,2:3,4,6,6)	1		(1.00)		
			1		2.20 (21.05)	Stiff locally laminated dark bluish grey silty CLAY. Occasional bands of grey argillaceous limestone, recovered as gravel and cobble sized fragments. **PENARTH GROUP**	
2.20	SPTLS-4						
2.20-3.20	B-5						
2.20-2.65	S	N=21 (4,3:4,4,6,7)			(1.00)		
3.20	SPTLS-6				3.20 (20.05)	Stiff to very stiff locally laminated dark bluish grey silty CLAY with occasional gravel sized mudstone lithorelicts. Frequent bands of grey argillaceous limestone, recovered as gravel and cobble sized fragments.	
3.20-3.70	B-7				(0.50)		
3.20-3.65	S	N=31 (4,4:5,6,10,10)			3.70 (19.55)	**PENARTH GROUP**	
3.70	SPTLS-8					Very stiff grey clayey SILT with occasional very weak sub-angular angular gravel sized siltstone lithorelicts. **BLUE ANCHOR FORMATION**	
3.70-4.70	B-9						
3.70-4.08		N>50 (7,14:16,15,19/75mm)			(1.90)		
4.70	SPTLS-10						
4.70-5.50	B-11						
4.70-5.08		N>50 (9,12:16,15,15,4/5mm)			5.60 (17.65)	Very stiff reddish brown locally light grey silty CLAY with occasional gravel sized mudstone lithorelicts.	
5.50	SPTLS-12				(0.40)		
5.50-6.40	B-13				6.00 (17.25)	**MERCIA MUDSTONE GROUP**	
5.50-5.60		N>50 (15,10:50/15mm)			6.20 (17.05)	Very stiff reddish brown locally light grey silty CLAY with occasional gravel sized mudstone lithorelicts, locally tending to very weak mudstone. **MERCIA MUDSTONE GROUP**	
6.40	SPTLS-14				6.51 (16.74)	Very weak reddish brown locally light grey MUDSTONE. **MERCIA MUDSTONE GROUP**	
6.40-6.49		N>50 (19,6:50/10mm)					
6.50	SPTLS-15						
6.50-6.51		N>50 (25/5mm50/5mm)					

Boring Progress and Water Observations					Water Strikes					Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	From	To	Time (hh:mm)	Depth	Diameter (mm)	Depth	Diameter (mm)
17/12/15	16:30	3.20	3.20	-	2.20		1.60	20	3.00	6.40	6.51	1:30	6.51	150	6.40	150
18/12/15	12:00	6.51	6.40	-												

General Remarks
1) Hand pit excavated to 1.00mbGL.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials are likely fragmented by sample barrels.
4) Groundwater seepages may be obstructed through use of borehole casing.
5) Borehole terminated at 6.51m due to consistent effective refusal, and following 1.5 hours chiselling.
6) Borehole installed with 50mm diameter HDPE installation.

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Ground Investigation

Cable Percussion Borehole Record

Hole ID
CP03
Sheet 1 of 1 (0.00m-10.00m)
All dimensions in metres
Scale 1:50

Site: Newbridge Road, Bath	**Method/Plant Used:** Dando 2000 Mk2		
Client: Oakhill Group Limited	**Start date:** 16/12/15	**End Date:** 17/12/15	**Logged By:**
Job No: p-sw-766	**Easting:**	**Northing:**	**Elevation:** 23.150

SAMPLES & IN-SITU TESTS				Water	STRATA			Well / Backfill
Depth	Type / No		Result / Remark		Legend	Depth (R.L.)	Description	
0.40-1.00	B-1			1		0.20 (22.95)	[Loose] sandy GRAVEL of light grey limestone. **MADE GROUND**	
						0.40 (22.75)	[Medium dense] slightly clayey/silty slightly sandy GRAVEL of grey limestone. **MADE GROUND**	
						(0.60)	[Soft] grey slightly sandy gravelly silty CLAY with frequent cobbles. Gravel and cobbles are grey limestone. **MADE GROUND**	
1.00	SPTLS-2					1.00 (22.15)		
1.00-1.50	B-3						[Very dense] black sandy GRAVEL of grey limestone with frequent silt and sand sized particles of predominantly carbonaceous material, coal dust, ash and clinker.	
1.00-1.23	S		N>50 (4,6:6,50/5mm)			(0.50)	**MADE GROUND**	
1.50	SPTLS-4					1.50 (21.65)		
1.50-3.00	B-5						[Very dense] slightly clayey/silty slightly sandy GRAVEL, COBBLES and probable boulders of grey limestone. Occasional gravel sized brick fragments.	
1.50-1.51	C		N>50 (25/5mm50/5mm)	1			**MADE GROUND**	
2.00	SPTLS-6							
2.00-2.01	C		N>50 (25/5mm50/5mm)			(1.40)		
2.50	B-7							
2.50-2.51	C		N>50 (25/5mm50/5mm)			2.90 (20.25)		
3.00	SPTLS-8						Medium strong to strong argillaceous LIMESTONE, recovered by chiselling, as angular to sub-angular gravel and occasional cobble sized fragments. **PENARTH GROUP**	
3.00-3.01	C		N>50 (25/5mm50/5mm)					
3.50	SPTLS-9							
3.50-4.30	B-10					(1.41)		
3.50-3.51	C		N>50 (25/5mm50/5mm)					
4.20	SPTLS-11					4.31 (18.84)		
4.20-4.21	C		N>50 (25/5mm50/5mm)					
4.30	B-12							
4.30-4.31	C		N>50 (25/5mm50/5mm)					

Boring Progress and Water Observations					Water Strikes					Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	From	To	Time (hh:mm)	Depth	Diameter (mm)	Depth	Diameter (mm)
16/12/15	17:00	3.00	3.00	1.50	2.00		0.80	20	-	1.50	1.80	1:00	4.31	150	3.00	150
17/12/15	14:00	4.31	3.00	1.50						2.00	2.40	1:00				
										2.60	2.90	1:00				
										3.00	4.31	6:00				

General Remarks
1) Hand pit excavated to 1.00mbGL.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials are likely fragmented by sample barrels.
4) Groundwater seepages may be obstructed through use of borehole casing.
5) Borehole terminated at 4.31m due to consistent effective refusal, and following a total of nine hours chiselling.
6) Borehole installed with 50mm diameter HDPE installation.

APPENDIX B

Engineering Records of Continuous Percussion Boreholes

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS01
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 10/12/15 **End Date:** 10/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 29.800

SAMPLES & IN-SITU TESTS				Water	STRATA			Backfill & Inst
Depth	Type / No		Result / Remark		Legend	Depth (thick.)	Description	
						(0.15) 0.15	TARMAC surfacing of moderate condition comprising grey limestone gravel in a bituminous matrix. **MADE GROUND**	
						(0.15) 0.30	[Medium dense] GRAVEL of grey limestone in a greyish pink sandy silty clay matrix. **MADE GROUND**	
0.40-0.50	ES/1					(0.60) 0.90	[Soft to firm] yellowish brown locally orangish brown silty gravelly sandy CLAY with occasional cobbles. Gravel and cobbles are predominantly light grey limestone. **MADE GROUND**	
0.95-1.03		↓	N>50 (25/50mm50/30mm)			(0.20) 1.10	Medium strong light grey locally stained light yellowish brown argillaceous LIMESTONE with some clay infill. Recovered with hydraulic breaker as slightly clayey/silty angular gravel and cobble sized fragments. **BLUE LIAS FORMATION** 0.95-1.10m: Limestone broken out with difficulty using hydraulic breaker.	

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)

General Remarks:

1) Hardstanding removed with hydraulic breaker, and shallow pit excavated to 0.95m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 1.10m due to effective refusal within band of rock, and following approximately one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS02
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 10/12/15 **End Date:** 10/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 29.800

SAMPLES & IN-SITU TESTS				Water	STRATA			Backfill & Inst
Depth	Type / No		Result / Remark		Legend	Depth (thick.)	Description	
						0.08	TARMAC surfacing of moderate condition comprising grey limestone gravel in a bituminous matrix. **MADE GROUND**	
						0.15	[Medium dense] slightly sandy GRAVEL of grey limestone, stained greyish pink. **MADE GROUND**	
						(0.15) 0.30	[Very dense] light brown sandy GRAVEL of grey limestone with frequent gravel and cobble sized fragments of concrete and occasional brick. **MADE GROUND**	
0.30-0.40	ES/1					(0.15) 0.45	[Dense] brown slightly clayey/silty sandy GRAVEL of grey limestone. **MADE GROUND**	
						(0.35) 0.80	Very stiff light grey stained yellowish brown gravelly silty CLAY with frequent cobbles. Gravel and cobbles are light grey argillaceous limestone. **BLUE LIAS FORMATION**	
0.70-0.80	D/2							
0.80-1.12			N>50 (20,5:7,10,33/30mm)			(0.32) 1.12	Medium strong light grey locally stained light yellow argillaceous LIMESTONE with much clay infill. Recovered with hydraulic breaker as clayey/silty angular gravel and cobble sized fragments. **BLUE LIAS FORMATION** 0.80-1.12m: Limestone broken out with difficulty using hydraulic breaker.	

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)

General Remarks:
1) Hardstanding removed with hydraulic breaker, and shallow pit excavated to 0.80m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 1.12m due to effective refusal within band of rock, and following approximately one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS03
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 09/12/15 **End Date:** 09/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 29.900

SAMPLES & IN-SITU TESTS				Water	STRATA			Backfill & Inst
Depth	Type / No		Result / Remark		Legend	Depth (thick.)	Description	
						0.11	TARMAC surfacing of moderate condition comprising grey limestone gravel in a bituminous matrix (0.03m), over black bitumen coated slightly sandy grey limestone gravel. **MADE GROUND**	
						0.20	[Medium dense] GRAVEL of grey limestone in a greyish pink slightly sandy silty clay matrix. **MADE GROUND**	
0.30-0.40	ES/1					(0.20) 0.40	[Medium dense] GRAVEL of grey limestone in a grey silty clay matrix. **MADE GROUND**	
						(0.20) 0.60	[Firm to stiff] grey slightly sandy gravelly silty CLAY with frequent cobbles. Gravel and cobbles are grey limestone. **MADE GROUND**	
0.60-0.70	D/2					(0.15) 0.75	Firm to stiff grey slightly gravelly silty CLAY with occasional cobbles. Gravel and cobbles are medium strong light grey argillaceous limestone. **BLUE LIAS FORMATION**	
0.75-0.80	D/3						Medium strong light grey locally stained light yellow argillaceous LIMESTONE with much clay infill. Recovered with hydraulic breaker as clayey/silty angular gravel and cobble sized fragments. **BLUE LIAS FORMATION**	
0.80-0.93		↓	N>50 (19,6:50/50mm)			(0.25) 1.00	0.80-1.00m: Limestone broken out with difficulty using hydraulic breaker.	

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)

General Remarks:
1) Hardstanding removed with hydraulic breaker, and shallow pit excavated to 0.80m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 1.00m due to effective refusal within band of rock, and following approximately one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS04
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 10/12/15 **End Date:** 10/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 28.250

SAMPLES & IN-SITU TESTS				STRATA			
Depth	Type / No		Result / Remark	Water	Legend	Depth (thick.)	Description	Backfill & Inst
						0.10	Vegetation over [loose] brown slightly sandy very clayey/silty GRAVEL with much organic matter. Gravel is fine to medium occasionally coarse of grey limestone. **MADE GROUND**	
						(0.15) 0.25	[Medium dense] GRAVEL of grey limestone. **MADE GROUND**	
						(0.15) 0.40	[Medium dense] sandy GRAVEL of grey limestone in a greyish pink sandy silty clay matrix. **MADE GROUND**	
0.50-0.60	ES/1					(1.50)	[Soft to firm] greenish grey and yellowish brown slightly sandy silty gravelly CLAY. Gravel is grey limestone and occasional yellowish brown oolitic limestone. Occasional gravel sized fragments of brick and tile. **MADE GROUND**	
1.00-1.45			N=9 (2,1:2,2,2,3)					
1.40-1.50	ES/2					1.90		
						(0.25) 2.15	[Very stiff] grey and yellowish brown silty gravelly CLAY. Gravel is grey limestone. Occasional gravel sized brick fragments. **MADE GROUND**	
2.00-2.15			N>50 (17,8:50/60mm)				2.15m: Refusal on probable limestone cobbles/boulders.	

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)

General Remarks:
1) Shallow pit excavated to 1.00m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 2.15m due to effective refusal within probable band of rock, and following one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS05
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 09/12/15 **End Date:** 09/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 23.000

SAMPLES & IN-SITU TESTS				STRATA				
Depth	Type / No		Result / Remark	Water	Legend	Depth (thick.)	Description	Backfill & Inst
						0.09	TARMAC surfacing of moderate condition comprising grey limestone gravel in a bituminous matrix (0.03m), over black bitumen coated slightly sandy grey limestone gravel. **MADE GROUND**	
0.20-0.30	ES/1					(1.26)	[Loose to medium dense] dark grey to black locally slightly clayey/silty sandy GRAVEL of predominantly grey limestone. Frequent gravel sized fragments of concrete, bitumen, glass and metal, as well as probable ash and/or coal dust throughout. **MADE GROUND**	
0.50-0.60	ES/2							
				1			... Slight ingress at ~1.00m, remaining at 1.10m following completion.	
1.00-1.45			N=6 (2,2:2,1,2,1)				1.00-1.35m: Materials wet, with hydrocarbon odour and sheen.	
1.10-1.20	ES/3			1		1.35		
1.40-1.50	D/4					(0.25)	Stiff light grey clayey SILT. **BLUE ANCHOR FORMATION**	
						1.60		
						(0.20)	Stiff light grey clayey SILT with occasional very weak sub-angular gravel sized siltstone lithorelicts. **BLUE ANCHOR FORMATION**	
						1.80		
1.80-1.90	D/5					(0.35)	Very weak light grey locally laminated SILTSTONE. **BLUE ANCHOR FORMATION**	
1.90-2.15			N>50 (9,14:31,19/25mm)			2.15		

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)
					1.00		1.10	20					

General Remarks:
1) Hardstanding removed with hydraulic breaker, and shallow pit excavated to 1.00m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
4) Borehole terminated at 2.15m due to effective refusal within probable band of rock, and following one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS06
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 09/12/15 **End Date:** 09/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 23.300

SAMPLES & IN-SITU TESTS				Water	STRATA			Backfill & Inst
Depth	Type / No		Result / Remark		Legend	Depth (thick.)	Description	
						0.10	TARMAC surfacing of moderate condition comprising grey limestone gravel in a bituminous matrix (0.05m), over black bitumen coated sandy grey limestone gravel. **MADE GROUND**	
						(0.30) 0.40	[Medium dense] GRAVEL of grey limestone in a greyish pink sandy silty clay matrix. **MADE GROUND**	
0.50-0.60	ES/1					(0.20) 0.60	[Firm] dark grey to black sandy silty gravelly CLAY. Gravel is grey limestone and sandstone, and occasional yellowish brown oolitic limestone. Occasional gravel sized concrete fragments. **MADE GROUND**	
						(0.30) 0.90	[Firm] yellowish brown slightly sandy silty gravelly CLAY. Gravel is grey limestone and yellowish brown oolitic limestone. Occasional gravel sized fragments of concrete, glass and ceramic pipe. **MADE GROUND**	
0.90-1.00	ES/2							
0.95-1.03		↓	N>50 (25/40mm50/40mm)			(0.13) 1.03	[Firm] dark grey sandy silty gravelly CLAY with occasional cobbles. Gravel and cobbles are grey limestone and yellowish brown oolitic limestone. Occasional gravel sized fragments of concrete, glass and ceramic tile and plastic. **MADE GROUND** 1.03m: Refusal on probable limestone cobbles.	

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)

General Remarks:
1) Hardstanding removed with hydraulic breaker, and shallow pit excavated to 0.95m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 1.03m due to effective refusal within probable band of rock, and following one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS07
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 10/12/15 **End Date:** 10/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 23.600

SAMPLES & IN-SITU TESTS				STRATA			
Depth	Type / No	Result / Remark	Water	Legend	Depth (thick.)	Description	Backfill & Inst
					(0.20) 0.20	[Medium dense] GRAVEL of light grey limestone in a light greyish pink sandy matrix. **MADE GROUND**	
					0.30	[Medium dense] GRAVEL of light grey limestone in a light brown sandy clayey/silty matrix. **MADE GROUND**	
0.40-0.50	ES/1				(1.00)	[Medium dense] dark grey to black locally slightly clayey/silty sandy GRAVEL of predominantly grey limestone and occasional yellowish brown oolitic limestone. Frequent gravel sized fragments of concrete, tile and brick, as well as probable ash and/or coal dust throughout. **MADE GROUND**	
			1			... Slight ingress at ~1.00m, remaining at 1.20m following completion.	
1.00-1.45		N=13 (2,2:2,3,4,4)					
			1		1.30		
1.30-1.40	ES/2				1.40	[Firm] greyish brown mottled orange slightly gravelly silty CLAY. Gravel is grey limestone. **MADE GROUND**	
					(0.30) 1.70	1.30-1.40m: Hydrocarbon odour. [Dense] probable boulder of CONCRETE, recovered as gravel sized fragments. **MADE GROUND**	
1.70-1.80	D/3				(0.22) 1.92	Medium strong light grey locally stained light yellowish brown argillaceous LIMESTONE. Recovered as angular gravel sized fragments. **PENARTH GROUP**	
1.80-1.92		N>50 (16,9:50/35mm)					

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)
					1.00		1.20	20					

General Remarks:
1) Shallow pit excavated to 1.00m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
4) Borehole terminated at 1.92m due to effective refusal within probable band of rock, and following one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS08
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 09/12/15 **End Date:** 09/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 23.300

SAMPLES & IN-SITU TESTS				STRATA			
Depth	Type / No	Result / Remark	Water	Legend	Depth (thick.)	Description	Backfill & Inst
					0.10	Vegetation over [loose] brown slightly sandy very clayey/silty GRAVEL with much organic matter. Gravel is grey limestone. **MADE GROUND**	
0.20-0.30	ES/1				(0.40)	[Medium dense] GRAVEL of grey limestone in a slightly sandy silty clay matrix. **MADE GROUND**	
					0.50		
			1		(0.70)	[Firm to stiff] grey slightly sandy slightly gravelly silty CLAY with frequent cobbles. Gravel and cobbles are grey limestone. **MADE GROUND**	
0.90-1.00 0.90-1.35	ES/2	N=24 (9,6:6,6,5,7)	1			... Slight ingress at ~0.90m, remaining at 0.80m following completion.	
					1.20		
					(0.20)	[Soft] dark grey slightly sandy silty/clayey GRAVEL of mixed litholigies, predominantly grey limestone. Occasional gravel sized fragments of brick and concrete. **MADE GROUND**	
					1.40		
					(0.20)	[Firm to stiff] grey mottled yellowish brown slightly sandy slightly gravelly silty CLAY. Gravel is grey limestone. Occasional gravel sized brick fragments. **MADE GROUND**	
					1.60		
1.70-1.80	D/3				(0.20)	Stiff grey stained orange silty CLAY with occasional very weak sub-angular gravel sized mudstone lithorelicts. **PENARTH GROUP**	
					1.80		
1.80-1.92		N>50 (25/50mm50/70mm)			(0.12)	Medium strong light grey locally stained light yellowish brown argillaceous LIMESTONE. Recovered as angular gravel sized fragments. **PENARTH GROUP**	
					1.92		

Boring Progress and Water Observations

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed
0.90		0.80	20	

Hole Diameter

Depth	Diameter (mm)

Casing Diameter

Depth	Diameter (mm)

General Remarks:

1) Shallow pit excavated to 0.90m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 1.92m due to effective refusal within probable band of rock, and following one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS09
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 09/12/15 **End Date:** 09/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 23.150

SAMPLES & IN-SITU TESTS				Water	STRATA			Backfill & Inst
Depth	Type / No		Result / Remark		Legend	Depth (thick.)	Description	
						(0.30)	[Loose] sandy GRAVEL of light grey limestone. **MADE GROUND**	
0.30-0.40	ES/1					0.30	[Soft] grey slightly sandy gravelly silty CLAY with occasional cobbles. Gravel and cobbles are grey limestone. **MADE GROUND**	
						(0.76)	0.75-0.85m: Limestone boulder recovered.	
0.90-1.00	ES/2			1			... Slight ingress at ~0.90m, pooling within base of pit.	
0.95-1.06			N>50 (25/50mm50/60mm)			1.06	1.06m: Refusal on probable limestone cobbles.	

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)
					0.90		1.10	20					

General Remarks:
1) Shallow pit excavated to 0.95m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 1.06m due to effective refusal within probable band of rock, and following one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS10
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 09/12/15 **End Date:** 09/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 22.400

SAMPLES & IN-SITU TESTS				Water	STRATA			Backfill & Inst
Depth	Type / No		Result / Remark		Legend	Depth (thick.)	Description	
0.10-0.20	ES/1					(0.25) 0.25	Sparse vegetation over [loose] brown sandy clayey/silty GRAVEL with much organic matter. Gravel is grey limestone. **MADE GROUND**	
						(0.15) 0.40	[Soft to firm] dark greyish brown sandy gravelly silty CLAY. Gravel is grey limestone. Occasional gravel sized brick fragments. **MADE GROUND**	
0.50-0.60	ES/2					(0.20) 0.60	[Firm] yellowish brown slightly sandy silty gravelly to very gravelly CLAY with occasional cobbles. Gravel and cobbles are grey limestone. Occasional gravel sized brick fragments. **MADE GROUND**	
0.65-0.75 0.70-0.75	D/3	↓	N>50 (25/25mm50/20mm)			(0.15) 0.75	Medium strong light grey locally stained light yellowish brown argillaceous LIMESTONE with some clay infill. Recovered with hydraulic breaker as slightly clayey/silty angular gravel and cobble sized fragments. **PENARTH GROUP**	

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)

General Remarks:
1) Shallow pit excavated to 0.70m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 0.75m due to effective refusal within probable band of rock, and following one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS11
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 09/12/15 **End Date:** 09/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 23.250

SAMPLES & IN-SITU TESTS				STRATA			
Depth	Type / No	Result / Remark	Water	Legend	Depth (thick.)	Description	Backfill & Inst
					0.08	TARMAC surfacing of moderate condition comprising grey limestone gravel in a bituminous matrix. **MADE GROUND**	
					(0.32) 0.40	[Medium dense] GRAVEL of grey limestone. **MADE GROUND**	
0.50-0.60	ES/1				(0.20) 0.60	[Firm] yellowish brown silty sandy clayey GRAVEL and COBBLES of yellowish brown oolitic limestone. **MADE GROUND**	
0.90-1.00 0.90-1.35	ES/2	N=30 (6,6:8,7,7,8)	1 1		(0.90) 1.50	[Medium dense to dense] dark grey to black slightly sandy clayey/silty GRAVEL of predominantly grey limestone and occasional yellowish brown oolitic limestone. Frequent gravel sized fragments of concrete, brick and ceramic pipe, as well as probable ash and/or coal dust throughout. **MADE GROUND** ... Slight ingress at ~1.20m, remaining at 1.10m following completion.	
					(0.15) 1.65	[Firm] dark bluish grey slightly gravelly silty CLAY with occasional cobbles. Gravel and cobbles are yellowish brown oolitic limestone gravel. **MADE GROUND**	
1.70-1.80	D/3				(0.15) 1.80	Stiff dark bluish grey locally stained orange silty CLAY with occasional very weak sub-angular gravel sized mudstone lithorelicts. **PENARTH GROUP**	
					1.90	Very stiff laminated dark bluish grey silty CLAY, tending to very weak mudstone. **PENARTH GROUP**	
1.90-1.95 1.90-1.99	D/4	N>50 (25/50mm50/40mm)			1.99	Medium strong light grey argillaceous LIMESTONE. **PENARTH GROUP**	

Boring Progress and Water Observations

Date	Time	Hole Depth	Casing Depth	Water Depth

Water Strikes

Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed
1.20		1.10	20	

Hole Diameter

Depth	Diameter (mm)

Casing Diameter

Depth	Diameter (mm)

General Remarks:

1) Hardstanding removed with hydraulic breaker, and shallow pit excavated to 0.90m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 1.99m due to effective refusal within probable band of rock, and following one hour breaking out.

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Ground Investigation

Continuous Percussion Borehole Record

Hole ID
WS12
Sheet 1 of 1 (0.00m-3.00m)
All dimensions in metres
Scale 1:15

Site: Newbridge Road, Bath
Client: Oakhill Group Limited
Job No: p-sw-766
Method/Plant Used: Archway Competitor Rig
Start date: 09/12/15 **End Date:** 09/12/15 **Logged By:** DH
Easting: **Northing:** **Elevation:** 22.050

SAMPLES & IN-SITU TESTS				STRATA			
Depth	Type / No		Result / Remark	Water	Legend	Depth (thick.)	Description	Backfill & Inst
						(0.20) 0.20	Grass over [loose] brown sandy clayey/silty GRAVEL with much organic matter. Gravel is grey limestone. **MADE GROUND**	
0.20-0.30	ES/1					(0.20) 0.40	[Medium dense] GRAVEL of grey limestone. **MADE GROUND**	
						(0.15) 0.55	[Medium dense] light pinkish brown SAND. **MADE GROUND**	
						0.65	[Soft] brown sandy gravelly silty CLAY. Gravel is grey limestone and occasional red mudstone. Occasional gravel sized brick fragments. **MADE GROUND**	
0.70-0.80	D/2					(0.30) 0.95	Stiff laminated dark bluish grey locally stained orange silty CLAY, tending to very weak mudstone. **PENARTH GROUP**	
0.80-0.98		↓	N>50 (8,9:50/30mm)			0.98	Medium strong light grey argillaceous LIMESTONE. **PENARTH GROUP**	

Boring Progress and Water Observations					Water Strikes					Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Strike Depth	Flow Rate	Post Strike Depth	Elapsed Minutes	Depth Sealed	Depth	Diameter (mm)	Depth	Diameter (mm)

General Remarks:
1) Shallow pit excavated to 0.80m prior to commencing drilling.
2) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
3) No obvious visual or olfactory evidence of mobile contaminants.
4) Recovered particle size controlled by diameter of sampling barrels within coarser grained materials or bands of rock. These materials may be fragmented by sample barrels.
5) Borehole terminated at 0.98m due to effective refusal within probable band of rock, and following one hour breaking out.

APPENDIX C

Engineering Records of Trial Pits

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Ground Investigation

Trial Pit Record

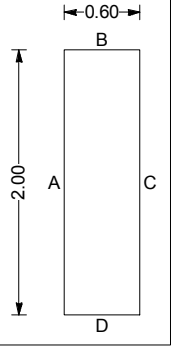
Hole ID
TP01
Sheet 1 of 1 (0.00m-2.50m)
All dimensions in metres
Scale 1:13

Site: Newbridge Road, Bath	**Method/Plant Used:** 3 Tonne Tracked Excavator		
Client: Oakhill Group Limited	**Start date:** 22/12/15	**End Date:** 22/12/15	**Logged By:** DH
Job No: p-sw-766	**Easting:**	**Northing:**	**Elevation:** 22.500

SAMPLES & IN-SITU TESTS			Water	STRATA		
Depth	Type / No	Results / Remarks		Legend	Depth (R.L.)	Description
					(0.10) 0.10	Grass over [loose] brown sandy clayey/silty GRAVEL with much organic matter. Gravel is grey limestone. **MADE GROUND**
					(22.40)	[Medium dense] slightly sandy GRAVEL and occasional cobbles of grey limestone, stained greyish pink. **MADE GROUND**
					(0.25) 0.35	
					(22.15) 0.40	[Medium dense] dark grey to black locally slightly clayey/silty sandy GRAVEL of predominantly grey limestone, and occasional yellowish brown oolitic limestone. Frequent gravel sized fragments of concrete, tile and brick, as well as probable ash and/or coal dust throughout. **MADE GROUND**
0.40-0.50	D-1				(22.10)	
0.50		CBR @ 0.50m: >15%			(0.20) 0.60	[Medium dense] slightly sandy GRAVEL and COBBLES of predominantly yellowish brown oolitic limestone. **MADE GROUND**
0.60-0.70	D-2				(21.90)	
					(0.10) 0.70	Weak to medium strong light grey locally stained light yellowish brown argillaceous LIMESTONE. Recovered as angular gravel and cobble sized fragments. **PENARTH GROUP**
0.75		HSV @ 0.75m: 94-106kPa			(21.80)	
0.75		CBR @ 0.75m: >15%			(0.10) 0.80	Stiff to very stiff laminated dark bluish grey silty CLAY, tending to very weak mudstone. **PENARTH GROUP**
					(21.70)	0.80m: Refusal on grey argillaceous limestone band, partially recovered with excavator as gravel sized fragments.

Groundwater Observations	
Strike Depth	Flow Rate Remarks

Shoring/Support: none
Side Stability: stable



General Remarks
1) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
2) Infiltration test undertaken upon reaching full depth.
3) Excavation terminated at 0.80m due to effective refusal, and infiltration test undertaken.
4) Excavation backfilled following completion.

T 01275 876903 | E southwest@ground-investigation.com | www.ground-investigation.com

Ground Investigation

Trial Pit Record

Hole ID
TP02
Sheet 1 of 1 (0.00m-2.50m)
All dimensions in metres
Scale 1:13

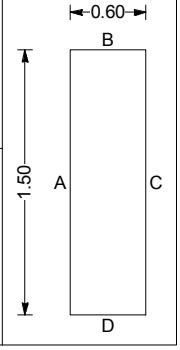
Site: Newbridge Road, Bath	**Method/Plant Used:** 3 Tonne Tracked Excavator		
Client: Oakhill Group Limited	**Start date:** 22/12/15	**End Date:** 22/12/15	**Logged By:** DH
Job No: p-sw-766	**Easting:**	**Northing:**	**Elevation:** 23.150

SAMPLES & IN-SITU TESTS			Water	STRATA		
Depth	Type / No	Results / Remarks		Legend	Depth (R.L.)	Description
					(0.15)	[Medium dense] slightly sandy GRAVEL and occasional cobbles of grey limestone, stained greyish pink. **MADE GROUND**
					0.15	
					(23.00)	[Soft] grey slightly sandy gravelly silty CLAY with frequent cobbles. Gravel and cobbles are grey limestone. **MADE GROUND** 0.15-0.50m Gravel filled trench at western end of pit, crossing to southern side, possibly associated with nearby buried services.
0.40-0.50	D-1					
0.50		CBR @ 0.50m: 2 - >15% (obstructed)				
					(0.90)	
1.00		CBR @ 1.0m: >15%				
					1.05	
					(22.10)	[Medium dense] slightly sandy GRAVEL and COBBLES of predominantly yellowish brown oolitic limestone. **MADE GROUND**
					(0.10)	
					1.15	
					(22.00)	[Medium dense] GRAVEL and occasional cobbles of grey limestone. **MADE GROUND** 1.15m: Moderate groundwater ingress, remaining at 1.20m after approximately 2hrs. Hydrocarbon odour detected.
					(0.15)	
					1.30	
					(21.85)	[Compacted] gravelly COBBLES and BOULDERS (<600mm) of predominantly grey limestone. **MADE GROUND**
					(0.25)	
					1.55	
					(21.60)	1.55m: Refusal on probable limestone cobbles and boulders (obscured by water).

Groundwater Observations

Strike Depth	Flow Rate Remarks
1.15	Moderate

Shoring/Support: none
Side Stability: stable



General Remarks
1) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
2) Infiltration test undertaken upon reaching full depth.
3) Excavation terminated at 1.55m due to effective refusal.
4) Excavation backfilled following completion.

T 01275 876903 | E southwest@ground-investigation.com | www.ground-investigation.com

Ground Investigation

Trial Pit Record

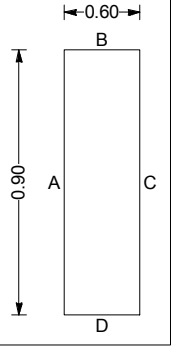
Hole ID
TP03
Sheet 1 of 1 (0.00m-2.50m)
All dimensions in metres
Scale 1:13

Site: Newbridge Road, Bath	**Method/Plant Used:** 3 Tonne Tracked Excavator		
Client: Oakhill Group Limited	**Start date:** 22/12/15	**End Date:** 22/12/15	**Logged By:** DH
Job No: p-sw-766	**Easting:**	**Northing:**	**Elevation:** 22.100

SAMPLES & IN-SITU TESTS			Water	STRATA		
Depth	Type / No	Results / Remarks		Legend	Depth (R.L.)	Description
					(0.30)	Grass over [loose] sandy grey GRAVEL with much organic matter. Gravel is grey limestone. **MADE GROUND**
					0.30	
					(21.80)	[Medium dense] dark grey to black locally slightly clayey/silty very sandy GRAVEL of predominantly grey limestone. Probable ash and/or coal dust throughout.
					(0.10)	
0.40-0.50	D-1				0.40	
					(21.70)	**MADE GROUND**
0.50		CBR @ 0.50m: 2 - 5%				[Firm] grey and orangish brown silty gravelly CLAY. Occasional brick and ceramic pipe. **MADE GROUND**
					(0.55)	
					0.95	
					(21.15)	Stiff to very stiff laminated dark bluish grey silty CLAY, tending to very weak mudstone. **PENARTH GROUP**
1.00		CBR @ 1.00m: 5-7%				
1.00-1.10	D-2					
1.00		HSV @ 1.00m: 98-100kPa				
					(0.85)	
					1.80	
					(20.30)	1.80m: Refusal on grey argillaceous limestone band, partially recovered with excavator as gravel sized fragments.

Groundwater Observations	
Strike Depth	Flow Rate Remarks

Shoring/Support: none
Side Stability: stable



General Remarks
1) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
2) Infiltration test undertaken upon reaching full depth.
3) Excavation terminated at 1.80m due to effective refusal, and infiltration test undertaken.
4) Excavation backfilled following completion.

T 01275 876903 | E southwest@ground-investigation.com | www.ground-investigation.com

Ground Investigation

Trial Pit Record

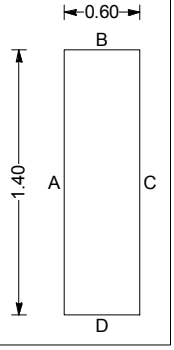
Hole ID
TP04
Sheet 1 of 1 (0.00m-2.50m)
All dimensions in metres
Scale 1:13

Site: Newbridge Road, Bath	**Method/Plant Used:** 3 Tonne Tracked Excavator		
Client: Oakhill Group Limited	**Start date:** 22/12/15	**End Date:** 22/12/15	**Logged By:** DH
Job No: p-sw-766	**Easting:**	**Northing:**	**Elevation:** 23.600

SAMPLES & IN-SITU TESTS			Water	STRATA		
Depth	Type / No	Results / Remarks		Legend	Depth (R.L.)	Description
					(0.25)	Grass over [loose] brown sandy clayey/silty GRAVEL with some organic matter. Gravel is grey limestone. **MADE GROUND**
					0.25	
0.30-0.40	D-1				(23.35)	[Firm to stiff] greenish grey to yellowish brown slightly sandy silty CLAY with frequent cobbles and occasional boulders (<400mm). Gravel, cobbles and boulders are angular of predominantly grey limestone. Occasional slate. **MADE GROUND**
0.50		CBR @ 0.50m: 2 - >15% (obstructed)				
					(0.85)	
1.00		CBR @ 1.0m: >15%				
					1.10	
					(22.50)	[Medium dense] dark orangish brown sandy GRAVEL of predominantly grey limestone and sandstone.
					(0.10)	**MADE GROUND**
					1.20	
					(22.40)	[Medium dense] dark grey to black locally slightly clayey/silty sandy GRAVEL of predominantly grey limestone. Frequent gravel sized fragments of concrete, tile and brick, as well as predominantly sand sized probable ash and/or coal dust throughout.
					(0.30)	**MADE GROUND**
1.40-1.50	D-2					
					1.50	
					(22.10)	[Firm to stiff] greenish grey to yellowish brown gravelly silty CLAY with occasional cobbles. Gravel and cobbles are angular of grey limestone. **MADE GROUND**
					(0.60)	
					2.10	
					(21.50)	Very stiff laminated dark bluish grey silty CLAY, tending to very weak mudstone. **PENARTH GROUP**
2.20-2.30	D-3				(0.20)	
					2.30	
					(21.30)	2.30m: Refusal on grey argillaceous limestone band, partially recovered with excavator as gravel sized fragments.

Groundwater Observations	
Strike Depth	Flow Rate Remarks

Shoring/Support: none
Side Stability: stable



General Remarks
1) All recorded strengths and densities based on visual observations, where field tests have not been undertaken. Square brackets indicate approximation within Made Ground.
2) Infiltration test undertaken upon reaching full depth.
3) Excavation terminated at 2.30m due to effective refusal, and infiltration test undertaken.
4) Excavation backfilled following completion.

APPENDIX D

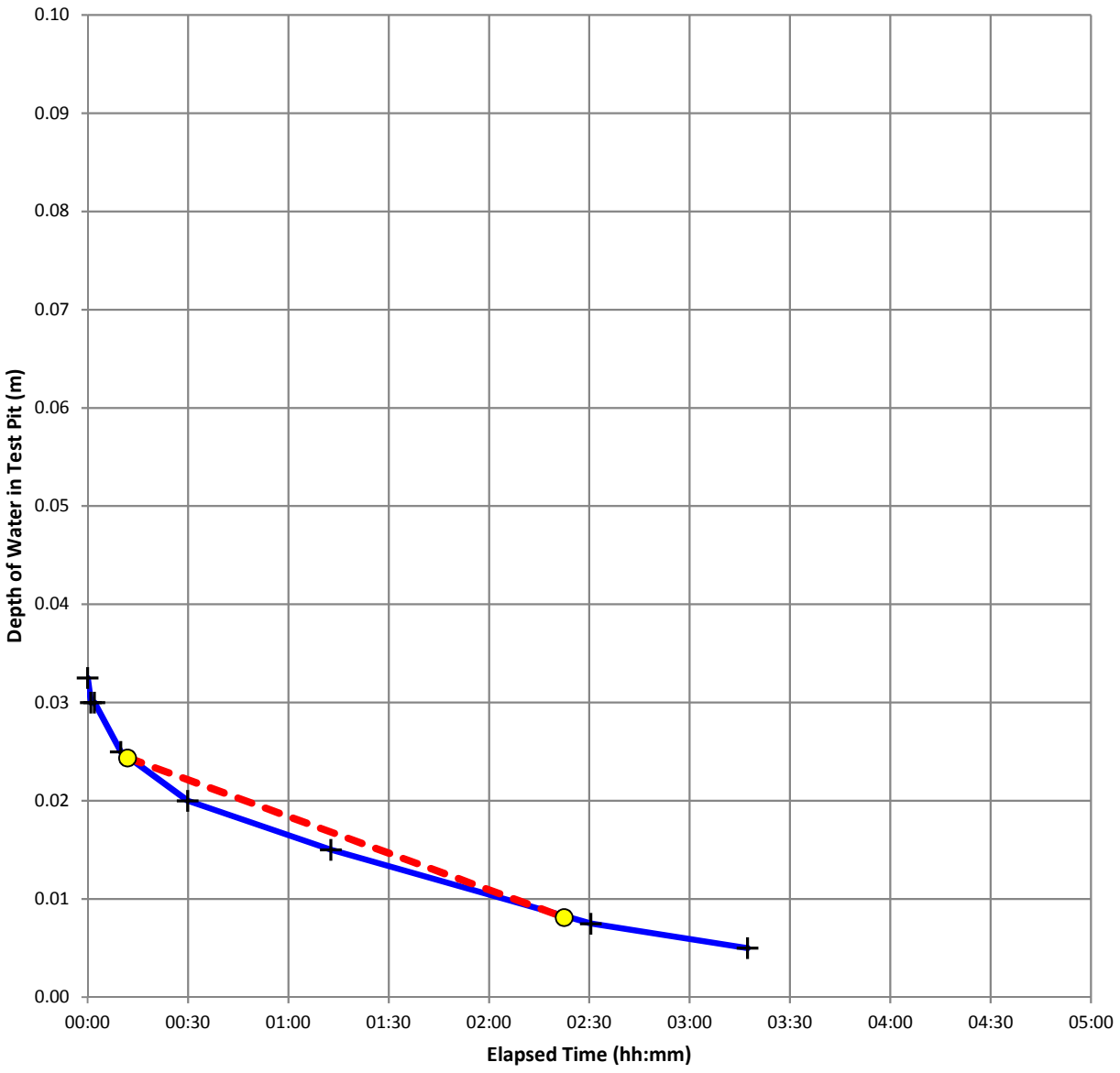
Soil Infiltration Test Results

Ground Investigation
Unit 3, Custom House Court, Clevedon, BS21 6EX
Tel: 01275 876903
Fax: 01275 879662
Email: southwest@ground-investigation.com

Soil infiltration Test Results

SITE NAME: Newbridge Road, Bath
PROJECT No: 766 **WORK CODE:** 1 **FIELD OPERATIVE:** DH
TEST PIT ID: TP01 **TEST No:** 1 **TEST DATE:** 22/12/2015
PIT LENGTH (m): 2 **PIT WIDTH (m):** 0.6 **PIT DEPTH (m):** 0.8

	t (hh:mm:ss)	*Z* (m)	% FULL	*V* (m^3)	*A* (m^2)
t_1	00:12:00	0.024	75.00	0.029	1.327
t_2	02:23:00	0.008	25.00	0.010	1.242



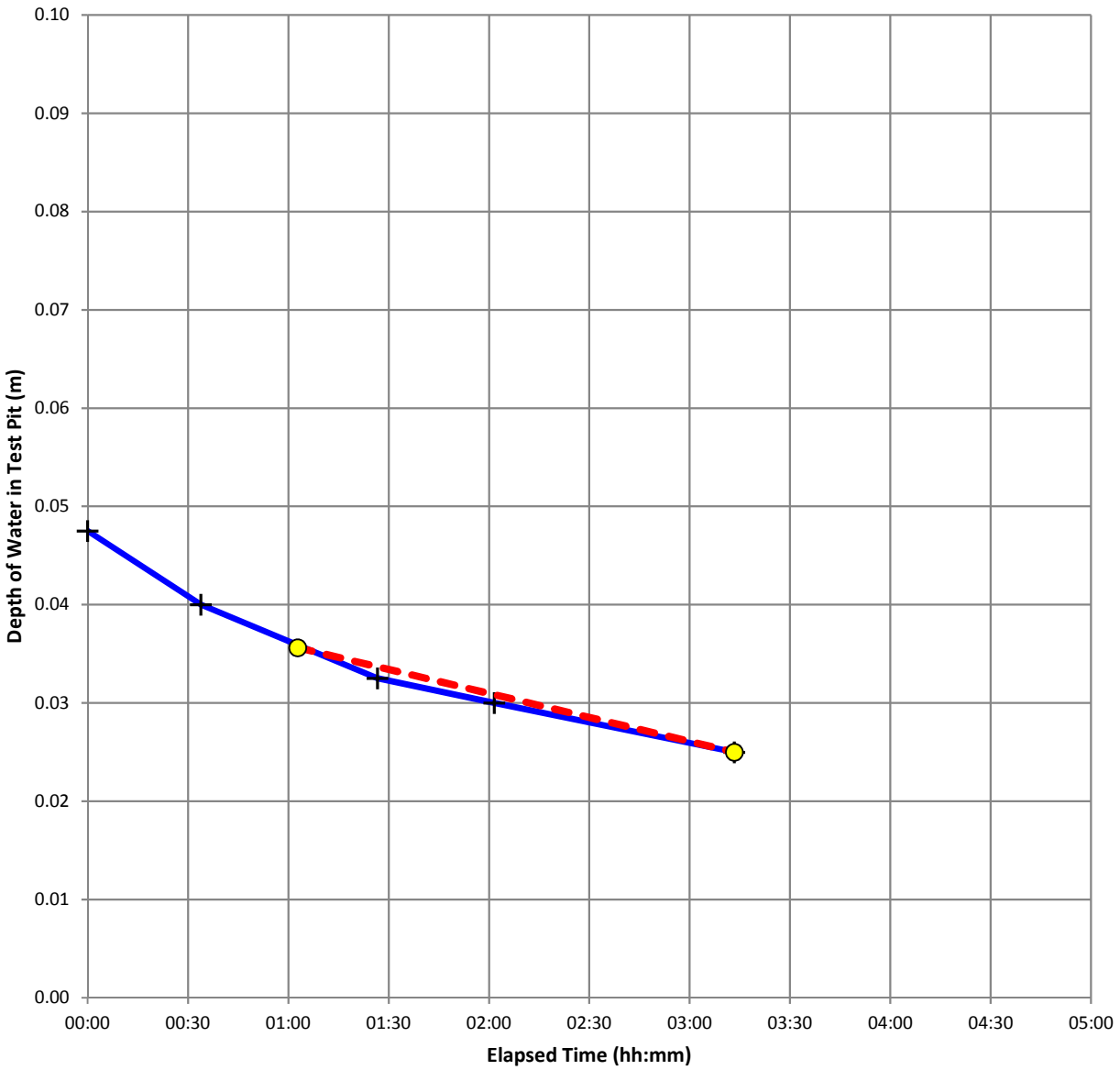
Elapsed time, t_2-t_1 (hh:mm:ss):	02:11:00
Elapsed time, t_2-t_1 (seconds):	7,860
Volume of infiltrating water during period t_1-t_2 (m^3):	0.020
Average area of infiltration surfaces during period t_1-t_2 (m^2):	1.285
Infiltration rate (m/s)	**1.93E-06**

Ground Investigation
Unit 3, Custom House Court, Clevedon, BS21 6EX
Tel: 01275 876903
Fax: 01275 879662
Email: southwest@ground-investigation.com

Soil infiltration Test Results

SITE NAME: Newbridge Road, Bath
PROJECT No: 766 **WORK CODE:** 1 **FIELD OPERATIVE:** DH
TEST PIT ID: TP01 **TEST No:** 2 **TEST DATE:** 22/12/2015
PIT LENGTH (m): 2 **PIT WIDTH (m):** 0.6 **PIT DEPTH (m):** 0.8

	t (hh:mm:ss)	*Z* (m)	% FULL	*V* (m^3)	*A* (m^2)
t_1	01:03:00	0.036	75.00	0.043	1.385
t_2	03:14:00	0.025	52.63	0.030	1.330



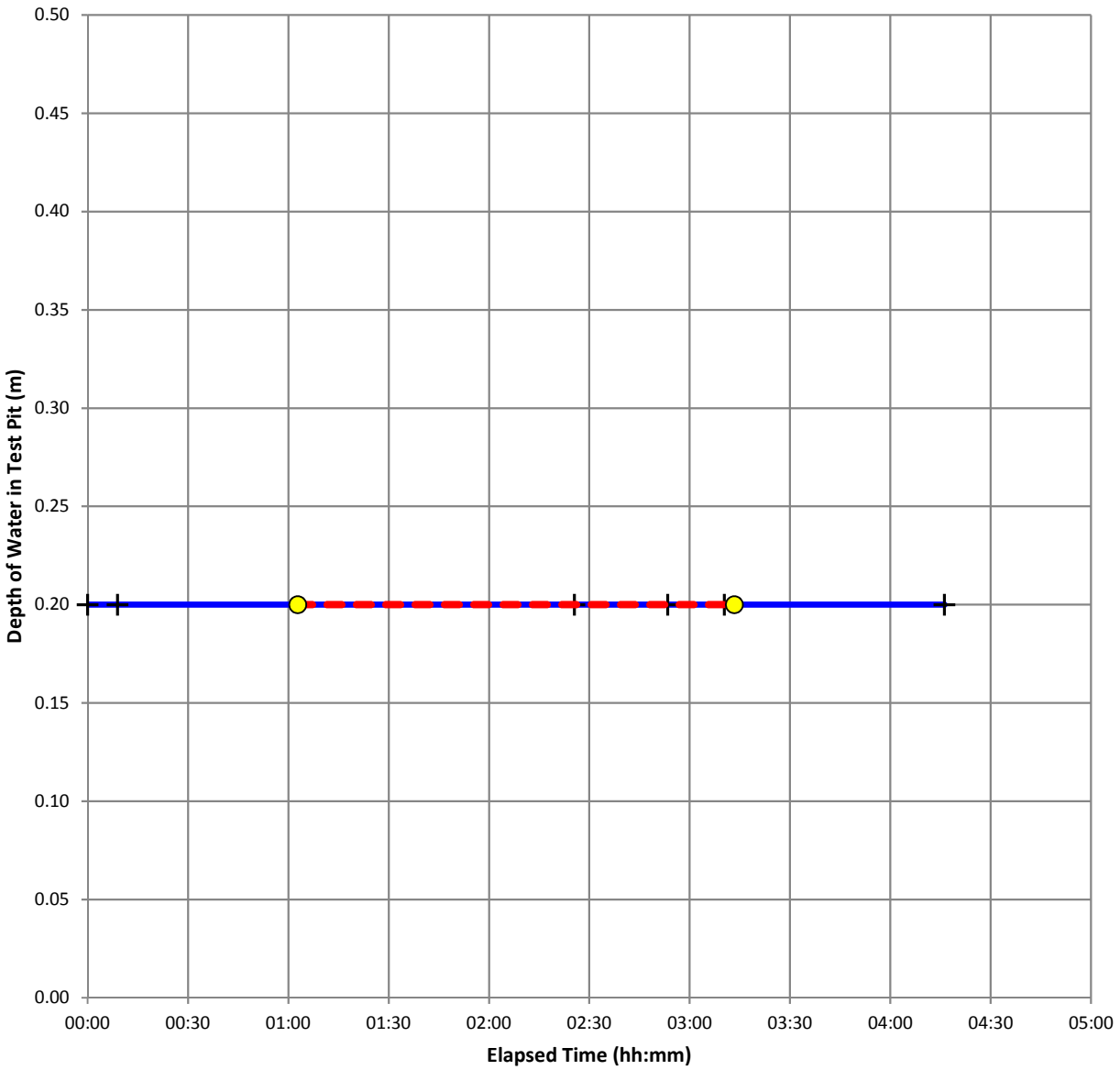
Elapsed time, t_2-t_1 (hh:mm:ss):	02:11:00
Elapsed time, t_2-t_1 (seconds):	7,860
Volume of infiltrating water during period t_1-t_2 (m^3):	0.013
Average area of infiltration surfaces during period t_1-t_2 (m^2):	1.358
Infiltration rate (m/s)	**1.19E-06**

Ground Investigation
Unit 3, Custom House Court, Clevedon, BS21 6EX
Tel: 01275 876903
Fax: 01275 879662
Email: southwest@ground-investigation.com

Soil infiltration Test Results

SITE NAME: Newbridge Road, Bath
PROJECT No: 766 **WORK CODE:** 1 **FIELD OPERATIVE:** DH
TEST PIT ID: TP03 **TEST No:** 1 **TEST DATE:** 22/12/2015
PIT LENGTH (m): 0.9 **PIT WIDTH (m):** 0.6 **PIT DEPTH (m):** 1.8

	t (hh:mm:ss)	*Z* (m)	% FULL	*V* (m^3)	*A* (m^2)
t_1	01:03:00	0.200	100.00	0.108	1.140
t_2	03:14:00	0.200	100.00	0.108	1.140



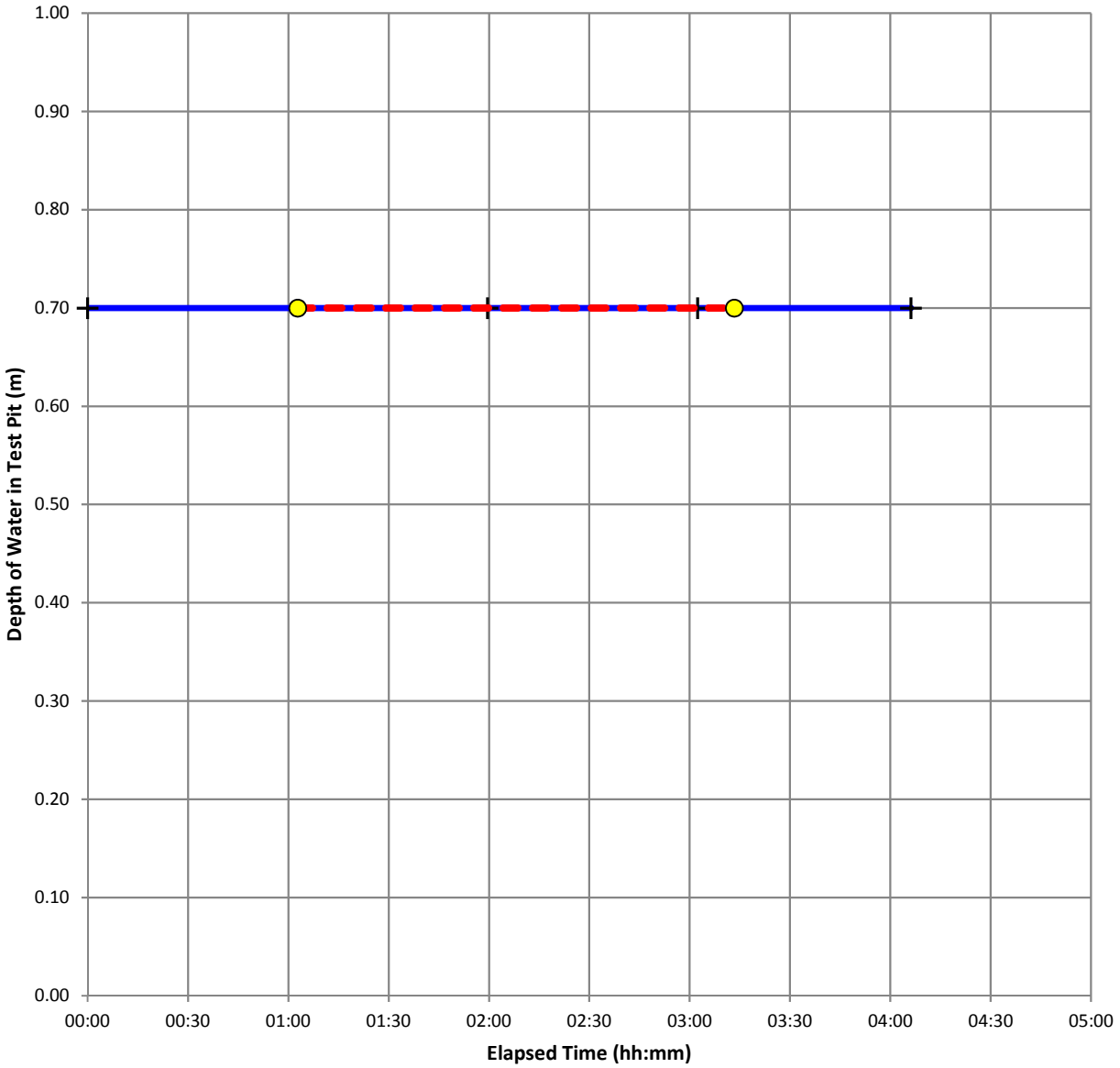
Elapsed time, t_2-t_1 (hh:mm:ss):	02:11:00
Elapsed time, t_2-t_1 (seconds):	7,860
Volume of infiltrating water during period t_1-t_2 (m^3):	
Average area of infiltration surfaces during period t_1-t_2 (m^2):	1.140
Infiltration rate (m/s)	

Ground Investigation
Unit 3, Custom House Court, Clevedon, BS21 6EX
Tel: 01275 876903
Fax: 01275 879662
Email: southwest@ground-investigation.com

Soil infiltration Test Results

SITE NAME: Newbridge Road, Bath
PROJECT No: 766 **WORK CODE:** 1 **FIELD OPERATIVE:** DH
TEST PIT ID: TP04 **TEST No:** 1 **TEST DATE:** 22/12/2015
PIT LENGTH (m): 1.4 **PIT WIDTH (m):** 0.6 **PIT DEPTH (m):** 2.3

	t (hh:mm:ss)	*Z* (m)	% FULL	*V* (m^3)	*A* (m^2)
t_1	01:03:00	0.700	100.00	0.588	3.640
t_2	03:14:00	0.700	100.00	0.588	3.640



Elapsed time, t_2-t_1 (hh:mm:ss):	02:11:00
Elapsed time, t_2-t_1 (seconds):	7,860
Volume of infiltrating water during period t_1-t_2 (m^3):	
Average area of infiltration surfaces during period t_1-t_2 (m^2):	3.640
Infiltration rate (m/s)	

APPENDIX E

Records of Field Monitoring

Ground Investigation

Unit 3 Custom House Court, Kenn Road, Clevedon, Bristol, BS21 6EX
Email: southwest@ground-investigation.com
Tel: 01275 876903

Field Gas Monitoring Records

Site Name:	Newbridge Road, Bath				
Job No:	p-sw-766	**Monitoring Date:**	21/12/15	**Field Personnel:**	TG
Weather Conditions:	Overcast with showers.				
Atmospheric Pressure Trend:	Moderate and falling.				
Instrument Type:	Geotechnical Instruments GA2000 infra-red field gas analyser with integral flow pod.				
Instrument Serial No:	G10475/07	**Instrument Calibration Date:**	07 February 2015		

Well ID	Barometric Pressure (mBar)	Water Depth (m)	Flow Rate (l/hr)	CH_4 peak (% vol)	CH_4 steady (% vol)	CO_2 steady (% vol)	O_2 steady (% vol)
CP01	1008	1.44	<0.1	0.3	0.3	0.1	12.9
CP02	1008	0.94	<0.1	<0.1	<0.1	0.5	19.5
CP03	1008	1.09	<0.1	<0.1	<0.1	0.2	16.7
WS01	1008	Dry	<0.1	<0.1	<0.1	<0.1	20.9
WS04	1008	Dry	<0.1	<0.1	<0.1	1.0	20.3
WS05	1008	1.02	<0.1	<0.1	<0.1	0.8	20.1
WS07	1008	1.34	0.2	<0.1	<0.1	2.0	14.6
WS08	1008	0.61	<0.1	<0.1	<0.1	0.2	20.6
WS11	1008	1.04	<0.1	<0.1	<0.1	0.1	12.6

Ground Investigation

Unit 3 Custom House Court, Kenn Road, Clevedon, Bristol, BS21 6EX
Email: southwest@ground-investigation.com
Tel: 01275 876903

Field Gas Monitoring Records

Site Name:	Newbridge Road, Bath				
Job No:	p-sw-766	**Monitoring Date:**	08/01/16	**Field Personnel:**	DH
Weather Conditions:	Overcast.				
Atmospheric Pressure Trend:	Low and falling.				
Instrument Type:	Geotechnical Instruments GA2000 infra-red field gas analyser with integral flow pod.				
Instrument Serial No:	G10475/07	**Instrument Calibration Date:**	07 February 2015		

Well ID	Barometric Pressure (mBar)	Water Depth (m)	Flow Rate (l/hr)	CH_4 peak (% vol)	CH_4 steady (% vol)	CO_2 steady (% vol)	O_2 steady (% vol)
CP01	994	1.44	<0.1	0.1	0.1	<0.1	14.0
CP02	994	0.87	<0.1	<0.1	<0.1	0.4	20.3
CP03	994	1.26	<0.1	<0.1	<0.1	0.2	20.6
WS01	994	Dry	<0.1	<0.1	<0.1	0.1	21.4
WS04	994	Dry	<0.1	<0.1	<0.1	1.2	20.1
WS05	994	1.05	<0.1	<0.1	<0.1	0.6	20.8
WS07	994	1.38	0.1	<0.1	<0.1	1.8	15.5
WS08	994	0.60	<0.1	<0.1	<0.1	0.3	20.6
WS11	994	0.98	<0.1	<0.1	<0.1	0.2	17.3

Ground Investigation

Unit 3 Custom House Court, Kenn Road, Clevedon, Bristol, BS21 6EX
Email: southwest@ground-investigation.com
Tel: 01275 876903

Field Gas Monitoring Records

Site Name:	Newbridge Road, Bath				
Job No:	p-sw-766	**Monitoring Date:**	19/01/16	**Field Personnel:**	TG
Weather Conditions:	Sunny.				
Atmospheric Pressure Trend:	Moderate, steady.				
Instrument Type:	Geotechnical Instruments GA2000 infra-red field gas analyser with integral flow pod.				
Instrument Serial No:	G10475/07	**Instrument Calibration Date:**	07 February 2015		

Well ID	Barometric Pressure (mBar)	Water Depth (m)	Flow Rate (l/hr)	CH_4 peak (% vol)	CH_4 steady (% vol)	CO_2 steady (% vol)	O_2 steady (% vol)
CP01	1012	1.40	<0.1	<0.1	<0.1	0.1	9.6
CP02	1012	0.94	<0.1	<0.1	<0.1	0.3	20.3
CP03	1012	1.07	<0.1	<0.1	<0.1	0.6	20.9
WS01	1012	Dry	<0.1	<0.1	<0.1	0.1	21.0
WS04	1012	Dry	<0.1	<0.1	<0.1	0.9	20.5
WS05	1012	0.96	<0.1	<0.1	<0.1	0.5	20.8
WS07	1012	1.33	<0.1	<0.1	<0.1	1.4	18.1
WS08	1012	0.61	<0.1	<0.1	<0.1	0.2	20.8
WS11	1012	1.02	<0.1	<0.1	<0.1	0.2	16.0

APPENDIX F

Results of Chemical Laboratory Tests - Soils

Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY
Telephone: (01424) 718618
Facsimile: (01424) 729911
info@elab-uk.co.uk

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number:	15-04970
Issue:	1
Date of Issue:	18/12/2015
Contact:	David Hornibrook
Customer Details:	Ground Investigation (South West) Ltd Unit 3 Custom House Court Clevedon BristolBS21 6EX
Quotation No:	Q14-00071
Order No:	Not Supplied
Customer Reference:	p-sw-766
Date Received:	14/12/2015
Date Approved:	18/12/2015
Details:	Newbridge Road, Bath
Approved by:	

John Wilson, Operations Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683

Sample Summary

Report No.: 15-04970

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
47889	WS01 0.40 - 0.50	09/12/2015	14/12/2015	Silty clayey loam	
47890	WS04 0.50 - 0.60	09/12/2015	14/12/2015	Silty clayey loam	
47891	WS04 1.40 - 1.50	09/12/2015	14/12/2015		
47892	WS06 0.50 - 0.60	09/12/2015	14/12/2015	Silty clayey loam	
47893	WS06 0.90 - 1.00	09/12/2015	14/12/2015		
47894	WS08 0.90 - 1.00	09/12/2015	14/12/2015		
47895	WS09 0.30 - 0.40	09/12/2015	14/12/2015	Silty clayey loam	
47896	WS09 0.90 - 1.00	09/12/2015	14/12/2015		
47897	WS10 0.10 - 0.20	09/12/2015	14/12/2015	Sandy silty loam	
47898	WS10 0.50 - 0.60	09/12/2015	14/12/2015	Silty loam	
47899	WS11 0.50 - 0.60	09/12/2015	14/12/2015		
47900	WS03 0.30 - 0.40	09/12/2015	14/12/2015	Sandy silty loam	
47901	WS08 0.20 - 0.30	09/12/2015	14/12/2015	Silty clayey loam	
47902	WS11 0.90 - 1.00	09/12/2015	14/12/2015		
47903	WS05 0.20 - 0.30	09/12/2015	14/12/2015	Silty loam	
47904	WS05 1.10 - 1.20	09/12/2015	14/12/2015	Sandy silty loam	
47905	WS07 0.40 - 0.50	09/12/2015	14/12/2015	Sandy silty loam	
47906	WS07 1.30 - 1.40	09/12/2015	14/12/2015		
47907	WS12 0.20 - 0.30	09/12/2015	14/12/2015	Silty loam	
47908	MBO 1 WS01 - WS11 0.20 -	09/12/2015	14/12/2015	Silty clayey loam	
47909	2 WS03, WS08 + WS11 0.2	09/12/2015	14/12/2015	Sandy silty loam	
47910	MBO 3 WS05 + WS07 0.20 -	09/12/2015	14/12/2015	Sandy silty loam	

Results Summary

Report No.: 15-04970

	ELAB Reference	47889	47890	47892	47895	47897	47898
	Customer Reference						
	Sample ID						
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sample Location	WS01	WS04	WS06	WS09	WS10	WS10
	Sample Depth (m)	0.40 - 0.50	0.50 - 0.60	0.50 - 0.60	0.30 - 0.40	0.10 - 0.20	0.50 - 0.60
	Sampling Date	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015
Determinand	**Codes**	**Units**	**LOD**						
Metals									
Arsenic	M	mg/kg	1	152	36.3	23.0	33.5	18.0	345
Cadmium	M	mg/kg	0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	< 0.5
Chromium	M	mg/kg	5	29.8	34.9	52.6	26.3	18.2	25.0
Copper	M	mg/kg	5	51.9	52.2	39.5	49.5	55.8	64.0
Lead	M	mg/kg	5	44.8	135	65.6	53.9	152	70.3
Mercury	M	mg/kg	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Nickel	M	mg/kg	5	35.5	33.8	44.3	29.6	21.6	41.9
Selenium	M	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.3
Zinc	M	mg/kg	5	61.7	133	134	119	223	167
Anions									
Water Soluble Sulphate	M	g/l	0.02	0.04	0.20	0.03	0.05	0.03	0.07
Inorganics									
Hexavalent Chromium	N	mg/kg	0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Total Cyanide	M	mg/kg	1	< 1.0	< 1.0	33.5	< 1.0	< 1.0	< 1.0
Total Sulphur	N	%	0.01	0.16	0.21	0.04	0.09	0.05	0.44
Total Potential Sulphate	N	%	0.01	0.48	0.64	0.11	0.28	0.16	1.32
Acid Soluble Sulphate (SO4)	U	%SO4	0.02	0.18	0.13	0.04	0.08	0.03	0.33
Water Soluble Boron	N	mg/kg	0.5	1.0	1.0	2.0	0.8	< 0.5	0.7
Miscellaneous									
Acid Neutralisation Capacity	N	mol/kg	0.1	n/t	n/t	n/t	n/t	n/t	n/t
Loss On Ignition (450°C)	M	%	0.01	n/t	n/t	n/t	n/t	n/t	n/t
pH	M	pH units	0.1	8.2	8.1	8.0	8.3	8.1	8.0
Soil Organic Matter	U	%	0.1	1.0	1.6	0.8	0.7	3.4	2.6
Total Organic Carbon	N	%	0.01	n/t	n/t	n/t	n/t	n/t	n/t
Phenols									
Total Phenols	N	mg/kg	6	< 6	< 6	< 6	< 6	< 6	< 6
Polyaromatic hydrocarbons									
Total PAH (Including Coronene)	N	mg/kg	2	n/t	n/t	n/t	n/t	n/t	n/t
Naphthalene GCMS	N	mg/kg	0.01	< 0.01	1.45	0.05	0.04	0.45	0.01
Acenaphthylene GCMS	N	mg/kg	0.01	0.01	1.48	0.07	0.02	0.23	< 0.01
Acenaphthene GCMS	N	mg/kg	0.01	0.02	2.52	0.03	0.02	0.08	< 0.01
Fluorene GCMS	N	mg/kg	0.01	0.01	4.61	0.19	0.02	0.08	< 0.01
Phenanthrene GCMS	N	mg/kg	0.01	0.16	23.8	1.13	0.16	1.03	0.04
Anthracene GCMS	N	mg/kg	0.01	0.05	8.85	0.25	0.06	0.90	0.02
Fluoranthene GCMS	N	mg/kg	0.01	0.31	35.4	1.64	0.27	2.89	0.08
Pyrene GCMS	N	mg/kg	0.01	0.25	26.7	1.22	0.23	2.69	0.07
Benzo(a)anthracene GCMS	N	mg/kg	0.01	0.10	13.9	0.98	0.14	1.26	0.05
Chrysene GCMS	N	mg/kg	0.01	0.11	13.8	1.21	0.14	1.71	0.06
Benzo (b) fluoranthene GCMS	N	mg/kg	0.01	0.10	11.2	1.21	0.12	1.36	0.05
Benzo(k)fluoranthene GCMS	N	mg/kg	0.01	0.08	10.7	0.76	0.12	1.23	0.06
Benzo (a) pyrene GCMS	N	mg/kg	0.01	0.10	13.6	0.90	0.13	1.17	0.06
Indeno (1,2,3-cd) pyrene GCMS	N	mg/kg	0.01	0.06	7.63	0.49	0.07	0.70	0.03
Dibenzo(a,h)anthracene GCMS	N	mg/kg	0.01	0.02	2.67	0.24	0.02	0.23	0.01
Benzo(g,h,i)perylene GCMS	N	mg/kg	0.01	0.07	8.16	0.51	0.08	0.76	0.03
Total PAH(16) GCMS	N	mg/kg	0.04	1.47	187	10.9	1.63	16.8	0.61

Tests marked N are not UKAS accredited.

Results Summary

Report No.: 15-04970

			ELAB Reference	47889	47890	47892	47895	47897	47898
			Customer Reference						
			Sample ID						
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sample Location	WS01	WS04	WS06	WS09	WS10	WS10
			Sample Depth (m)	0.40 - 0.50	0.50 - 0.60	0.50 - 0.60	0.30 - 0.40	0.10 - 0.20	0.50 - 0.60
			Sampling Date	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015
Determinand	**Codes**	**Units**	**LOD**						
BTEX									
Benzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Toluene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Ethylbenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Xylenes	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
MTBE	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Total BTEX	M	mg/kg	0.01	n/t	n/t	n/t	n/t	n/t	n/t
TPH CWG									
>C5-C6 Aliphatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C6-C8 Aliphatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C8-C10 Aliphatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C10-C12 Aliphatic	N	mg/kg	1	< 1.0	1.6	< 1.0	< 1.0	< 1.0	< 1.0
>C12-C16 Aliphatic	N	mg/kg	1	< 1.0	42.5	< 1.0	< 1.0	< 1.0	< 1.0
>C16-C21 Aliphatic	N	mg/kg	1	< 1.0	72.4	< 1.0	< 1.0	< 1.0	< 1.0
>C21-C35 Aliphatic	N	mg/kg	1	< 1.0	292	< 1.0	< 1.0	4.3	< 1.0
>C35-C40 Aliphatic	N	mg/kg	1	< 1.0	62.8	< 1.0	< 1.0	< 1.0	< 1.0
>C5-C7 Aromatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C7-C8 Aromatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C8-C10 Aromatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.5
>C10-C12 Aromatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C12-C16 Aromatic	N	mg/kg	1	< 1.0	11.2	< 1.0	< 1.0	< 1.0	< 1.0
>C16-C21 Aromatic	N	mg/kg	1	< 1.0	47.0	2.6	< 1.0	1.3	< 1.0
>C21-C35 Aromatic	N	mg/kg	1	3.9	204	9.8	< 1.0	10.8	< 1.0
>C35-C40 Aromatic	N	mg/kg	1	< 1.0	55.9	< 1.0	< 1.0	< 1.0	< 1.0
Total (>C5-C40) Ali/Aro	N	mg/kg	1	3.9	789	12.4	< 1.0	16.4	1.5
Total Petroleum Hydrocarbons									
Mineral Oil	U	mg/kg	5	n/t	n/t	n/t	n/t	n/t	n/t
PCB (ICES 7 congeners)									
PCB (Total of 7 Congeners)	M	mg/kg	0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

Results Summary

Report No.: 15-04970

	ELAB Reference	47900	47901	47903	47904	47905	47907
	Customer Reference						
	Sample ID						
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sample Location	WS03	WS08	WS05	WS05	WS07	WS12
	Sample Depth (m)	0.30 - 0.40	0.20 - 0.30	0.20 - 0.30	1.10 - 1.20	0.40 - 0.50	0.20 - 0.30
	Sampling Date	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015
Determinand	**Codes** / **Units** / **LOD**						
Metals							
Arsenic	M / mg/kg / 1	34.4	31.0	39.9	110	40.1	10.3
Cadmium	M / mg/kg / 0.5	< 0.5	0.8	2.2	5.7	1.7	0.6
Chromium	M / mg/kg / 5	12.6	18.7	30.7	96.7	27.1	13.4
Copper	M / mg/kg / 5	16.1	46.3	197	1900	243	42.1
Lead	M / mg/kg / 5	32.4	159	644	3290	746	88.8
Mercury	M / mg/kg / 0.5	< 0.5	< 0.5	< 0.5	< 0.5	2.0	< 0.5
Nickel	M / mg/kg / 5	12.2	19.4	41.1	120	38.3	9.5
Selenium	M / mg/kg / 1	< 1.0	< 1.0	< 1.0	< 1.0	1.2	< 1.0
Zinc	M / mg/kg / 5	61.7	171	451	7020	664	134
Anions							
Water Soluble Sulphate	M / g/l / 0.02	0.56	0.13	0.11	0.06	0.05	0.03
Inorganics							
Hexavalent Chromium	N / mg/kg / 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Total Cyanide	M / mg/kg / 1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphur	N / % / 0.01	0.18	0.08	0.17	0.43	0.26	0.01
Total Potential Sulphate	N / % / 0.01	0.55	0.23	0.51	1.30	0.77	0.04
Acid Soluble Sulphate (SO4)	U / %SO4 / 0.02	0.26	0.09	0.11	0.22	0.09	0.05
Water Soluble Boron	N / mg/kg / 0.5	0.6	0.5	1.1	2.1	3.5	0.9
Miscellaneous							
Acid Neutralisation Capacity	N / mol/kg / 0.1	n/t	n/t	n/t	n/t	n/t	n/t
Loss On Ignition (450°C)	M / % / 0.01	n/t	n/t	n/t	n/t	n/t	n/t
pH	M / pH units / 0.1	10.2	9.6	9.0	8.3	8.1	8.3
Soil Organic Matter	U / % / 0.1	1.4	2.7	4.0	3.4	8.1	4.9
Total Organic Carbon	N / % / 0.01	n/t	n/t	n/t	n/t	n/t	n/t
Phenols							
Total Phenols	N / mg/kg / 6	< 6	< 6	< 6	< 6	< 6	< 6
Polyaromatic hydrocarbons							
Total PAH (Including Coronene)	N / mg/kg / 2	n/t	n/t	n/t	n/t	n/t	n/t
Naphthalene GCMS	N / mg/kg / 0.01	0.27	0.06	2.38	1.54	2.15	0.02
Acenaphthylene GCMS	N / mg/kg / 0.01	0.16	0.08	3.01	0.41	4.01	0.03
Acenaphthene GCMS	N / mg/kg / 0.01	1.77	0.01	4.79	0.49	0.56	< 0.01
Fluorene GCMS	N / mg/kg / 0.01	1.21	0.02	2.29	0.46	2.58	< 0.01
Phenanthrene GCMS	N / mg/kg / 0.01	9.92	0.30	10.8	1.08	25.8	0.08
Anthracene GCMS	N / mg/kg / 0.01	2.52	0.11	4.53	0.36	7.61	0.04
Fluoranthene GCMS	N / mg/kg / 0.01	10.7	1.00	21.8	2.09	29.4	0.20
Pyrene GCMS	N / mg/kg / 0.01	7.32	0.93	17.8	2.16	22.9	0.17
Benzo(a)anthracene GCMS	N / mg/kg / 0.01	3.51	0.56	13.5	0.99	13.1	0.11
Chrysene GCMS	N / mg/kg / 0.01	3.61	0.55	14.2	1.03	13.6	0.14
Benzo (b) fluoranthene GCMS	N / mg/kg / 0.01	3.02	0.48	17.0	1.24	9.83	0.14
Benzo(k)fluoranthene GCMS	N / mg/kg / 0.01	2.51	0.50	13.3	0.87	10.0	0.11
Benzo (a) pyrene GCMS	N / mg/kg / 0.01	3.04	0.60	18.2	1.13	12.0	0.13
Indeno (1,2,3-cd) pyrene GCMS	N / mg/kg / 0.01	1.77	0.34	13.4	0.71	6.48	0.09
Dibenzo(a,h)anthracene GCMS	N / mg/kg / 0.01	0.58	0.10	4.96	0.26	2.35	0.03
Benzo(g,h,i)perylene GCMS	N / mg/kg / 0.01	1.94	0.41	15.2	0.94	6.65	0.10
Total PAH(16) GCMS	N / mg/kg / 0.04	53.9	6.05	177	15.7	169	1.39

Results Summary

Report No.: 15-04970

			ELAB Reference	47900	47901	47903	47904	47905	47907
			Customer Reference						
			Sample ID						
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sample Location	WS03	WS08	WS05	WS05	WS07	WS12
			Sample Depth (m)	0.30 - 0.40	0.20 - 0.30	0.20 - 0.30	1.10 - 1.20	0.40 - 0.50	0.20 - 0.30
			Sampling Date	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015
Determinand	**Codes**	**Units**	**LOD**						
BTEX									
Benzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Toluene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Ethylbenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Xylenes	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
MTBE	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Total BTEX	M	mg/kg	0.01	n/t	n/t	n/t	n/t	n/t	n/t
TPH CWG									
>C5-C6 Aliphatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C6-C8 Aliphatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C8-C10 Aliphatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	370	< 1.0	< 1.0
>C10-C12 Aliphatic	N	mg/kg	1	1.3	< 1.0	13.2	2130	< 1.0	< 1.0
>C12-C16 Aliphatic	N	mg/kg	1	16.0	< 1.0	112	2760	2.1	< 1.0
>C16-C21 Aliphatic	N	mg/kg	1	36.7	< 1.0	179	99.3	6.4	< 1.0
>C21-C35 Aliphatic	N	mg/kg	1	113	9.3	425	348	20.4	7.2
>C35-C40 Aliphatic	N	mg/kg	1	34.9	< 1.0	218	35.7	2.9	1.9
>C5-C7 Aromatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C7-C8 Aromatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C8-C10 Aromatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	18.8	4.3	< 1.0
>C10-C12 Aromatic	N	mg/kg	1	< 1.0	< 1.0	3.9	200	2.5	< 1.0
>C12-C16 Aromatic	N	mg/kg	1	15.4	< 1.0	33.7	447	6.3	< 1.0
>C16-C21 Aromatic	N	mg/kg	1	52.8	< 1.0	65.9	47.0	12.2	< 1.0
>C21-C35 Aromatic	N	mg/kg	1	145	5.5	216	143	47.5	4.4
>C35-C40 Aromatic	N	mg/kg	1	27.1	< 1.0	92.4	18.3	11.4	1.8
Total (>C5-C40) Ali/Aro	N	mg/kg	1	443	14.8	1360	6620	116	15.3
Total Petroleum Hydrocarbons									
Mineral Oil	U	mg/kg	5	n/t	n/t	n/t	n/t	n/t	n/t
PCB (ICES 7 congeners)									
PCB (Total of 7 Congeners)	M	mg/kg	0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

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Results Summary

Report No.: 15-04970

			ELAB Reference	47908	47909	47910
			Customer Reference	WS01 - WS11	WS03, WS08 + WS11	WS05 + WS07
			Sample ID			
			Sample Type	SOIL	SOIL	SOIL
			Sample Location	COMBO 1	COMBO 2	COMBO 3
			Sample Depth (m)	0.20 - 0.30	0.20 - 0.30	0.20 - 0.30
			Sampling Date	09/12/2015	09/12/2015	09/12/2015
Determinand	**Codes**	**Units**	**LOD**			
Metals						
Arsenic	M	mg/kg	1	n/t	n/t	n/t
Cadmium	M	mg/kg	0.5	n/t	n/t	n/t
Chromium	M	mg/kg	5	n/t	n/t	n/t
Copper	M	mg/kg	5	n/t	n/t	n/t
Lead	M	mg/kg	5	n/t	n/t	n/t
Mercury	M	mg/kg	0.5	n/t	n/t	n/t
Nickel	M	mg/kg	5	n/t	n/t	n/t
Selenium	M	mg/kg	1	n/t	n/t	n/t
Zinc	M	mg/kg	5	n/t	n/t	n/t
Anions						
Water Soluble Sulphate	M	g/l	0.02	n/t	n/t	n/t
Inorganics						
Hexavalent Chromium	N	mg/kg	0.8	n/t	n/t	n/t
Total Cyanide	M	mg/kg	1	n/t	n/t	n/t
Total Sulphur	N	%	0.01	n/t	n/t	n/t
Total Potential Sulphate	N	%	0.01	n/t	n/t	n/t
Acid Soluble Sulphate (SO4)	U	%SO4	0.02	n/t	n/t	n/t
Water Soluble Boron	N	mg/kg	0.5	n/t	n/t	n/t
Miscellaneous						
Acid Neutralisation Capacity	N	mol/kg	0.1	< 0.1	0.1	< 0.1
Loss On Ignition (450°C)	M	%	0.01	2.81	1.97	4.43
pH	M	pH units	0.1	8.6	9.6	8.2
Soil Organic Matter	U	%	0.1	n/t	n/t	n/t
Total Organic Carbon	N	%	0.01	1.8	1.6	4.4
Phenols						
Total Phenols	N	mg/kg	6	n/t	n/t	n/t
Polyaromatic hydrocarbons						
Total PAH (Including Coronene)	N	mg/kg	2	5	162	122
Naphthalene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Acenaphthylene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Acenaphthene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Fluorene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Phenanthrene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Anthracene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Fluoranthene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Pyrene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Benzo(a)anthracene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Chrysene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Benzo (b) fluoranthene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Benzo(k)fluoranthene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Benzo (a) pyrene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Indeno (1,2,3-cd) pyrene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Dibenzo(a,h)anthracene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Benzo(g,h,i)perylene GCMS	N	mg/kg	0.01	n/t	n/t	n/t
Total PAH(16) GCMS	N	mg/kg	0.04	n/t	n/t	n/t

Results Summary

Report No.: 15-04970

			ELAB Reference	47908	47909	47910
			Customer Reference	WS01 - WS11	WS03, WS08 + WS11	WS05 + WS07
			Sample ID			
			Sample Type	SOIL	SOIL	SOIL
			Sample Location	COMBO 1	COMBO 2	COMBO 3
			Sample Depth (m)	0.20 - 0.30	0.20 - 0.30	0.20 - 0.30
			Sampling Date	09/12/2015	09/12/2015	09/12/2015
Determinand	**Codes**	**Units**	**LOD**			
BTEX						
Benzene	M	ug/kg	10	n/t	n/t	n/t
Toluene	M	ug/kg	10	n/t	n/t	n/t
Ethylbenzene	M	ug/kg	10	n/t	n/t	n/t
Xylenes	M	ug/kg	10	n/t	n/t	n/t
MTBE	N	ug/kg	10	n/t	n/t	n/t
Total BTEX	M	mg/kg	0.01	< 0.01	< 0.01	< 0.01
TPH CWG						
>C5-C6 Aliphatic	N	mg/kg	0.01	n/t	n/t	n/t
>C6-C8 Aliphatic	N	mg/kg	0.01	n/t	n/t	n/t
>C8-C10 Aliphatic	N	mg/kg	1	n/t	n/t	n/t
>C10-C12 Aliphatic	N	mg/kg	1	n/t	n/t	n/t
>C12-C16 Aliphatic	N	mg/kg	1	n/t	n/t	n/t
>C16-C21 Aliphatic	N	mg/kg	1	n/t	n/t	n/t
>C21-C35 Aliphatic	N	mg/kg	1	n/t	n/t	n/t
>C35-C40 Aliphatic	N	mg/kg	1	n/t	n/t	n/t
>C5-C7 Aromatic	N	mg/kg	0.01	n/t	n/t	n/t
>C7-C8 Aromatic	N	mg/kg	0.01	n/t	n/t	n/t
>C8-C10 Aromatic	N	mg/kg	1	n/t	n/t	n/t
>C10-C12 Aromatic	N	mg/kg	1	n/t	n/t	n/t
>C12-C16 Aromatic	N	mg/kg	1	n/t	n/t	n/t
>C16-C21 Aromatic	N	mg/kg	1	n/t	n/t	n/t
>C21-C35 Aromatic	N	mg/kg	1	n/t	n/t	n/t
>C35-C40 Aromatic	N	mg/kg	1	n/t	n/t	n/t
Total (>C5-C40) Ali/Aro	N	mg/kg	1	n/t	n/t	n/t
Total Petroleum Hydrocarbons						
Mineral Oil	U	mg/kg	5	< 5	186	1290
PCB (ICES 7 congeners)						
PCB (Total of 7 Congeners)	M	mg/kg	0.03	< 0.03	< 0.03	< 0.03

Results Summary

Report No.: 15-04970

	ELAB Reference	47889	47890	47892	47895	47897	47898	47900	47901
	Customer Reference								
	Sample ID								
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sample Location	WS01	WS04	WS06	WS09	WS10	WS10	WS03	WS08
	Sample Depth (m)	0.40 - 0.50	0.50 - 0.60	0.50 - 0.60	0.30 - 0.40	0.10 - 0.20	0.50 - 0.60	0.30 - 0.40	0.20 - 0.30
	Sampling Date	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015	09/12/2015
Determinand	**Codes**	**Units**	**LOD**							
VOC										
Heptane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Octane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Nonane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Benzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Toluene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Ethylbenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
m+p-xylene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
o-xylene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
cis-1,2-dichloroethene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,1-Dichloroethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Chloroform	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Tetrachloromethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,1,1-Trichloroethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Trichloroethylene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Tetrachloroethylene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,1,1,2-Tetrachloroethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,1,2,2-Tetrachloroetha	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Chlorobenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Bromobenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Bromodichloromethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Methylethylbenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,1-Dichloro-1-propene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Trans - 1-2 -dichloroethylene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
2,2-Dichloropropane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Bromochloromethane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dichloroethane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Dibromomethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dichloropropane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
cis-1,3-Dichloro-1-propene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
trans-1,3-Dichloro-1-propene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,1,2-Trichloroethane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Dibromochloromethane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,3-Dichloropropane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,2-dibromoethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Styrene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Propylbenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
2-Chlorotoluene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,2,4-Trimethylbenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
4-Chlorotoluene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
t-butylbenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,3,5-Trimethylbenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1-methylpropylbenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
o-cymene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,3-Dichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Butylbenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dibromo-3-chloropropane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Hexachlorobutadiene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,2,3-Trichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Naphthalene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	42.4	< 10.0
1,2,4-Trichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,4-Dichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Bromoform	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
VOC TIC										
Vinyl chloride	N	ug/kg	100	None Detected	None Detected	None Detected	None Detected	None Detected	None Detected	None Detected	None Detected

Tests marked N are not UKAS accredited.
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Results Summary

Report No.: 15-04970

			ELAB Reference	47903	47904	47905	47907
			Customer Reference				
			Sample ID				
			Sample Type	SOIL	SOIL	SOIL	SOIL
			Sample Location	WS05	WS05	WS07	WS12
			Sample Depth (m)	0.20 - 0.30	1.10 - 1.20	0.40 - 0.50	0.20 - 0.30
			Sampling Date	09/12/2015	09/12/2015	09/12/2015	09/12/2015
Determinand	**Codes**	**Units**	**LOD**				
VOC							
Heptane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Octane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Nonane	N	ug/kg	10	< 10.0	15.1	< 10.0	< 10.0
Benzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Toluene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Ethylbenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
m+p-xylene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
o-xylene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
cis-1,2-dichloroethene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,1-Dichloroethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Chloroform	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Tetrachloromethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,1,1-Trichloroethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Trichloroethylene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Tetrachloroethylene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,1,1,2-Tetrachloroethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,1,2,2-Tetrachloroetha	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Chlorobenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Bromobenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Bromodichloromethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Methylethylbenzene	M	ug/kg	10	< 10.0	11.4	< 10.0	< 10.0
1,1-Dichloro-1-propene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Trans - 1-2 -dichloroethylene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
2,2-Dichloropropane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Bromochloromethane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dichloroethane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Dibromomethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dichloropropane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
cis-1,3-Dichloro-1-propene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
trans-1,3-Dichloro-1-propene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,1,2-Trichloroethane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Dibromochloromethane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,3-Dichloropropane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,2-dibromoethane	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Styrene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Propylbenzene	N	ug/kg	10	< 10.0	38.8	< 10.0	< 10.0
2-Chlorotoluene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,2,4-Trimethylbenzene	N	ug/kg	10	< 10.0	11.4	< 10.0	< 10.0
4-Chlorotoluene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
t-butylbenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,3,5-Trimethylbenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1-methylpropylbenzene	N	ug/kg	10	< 10.0	85.7	< 10.0	< 10.0
o-cymene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,3-Dichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Butylbenzene	N	ug/kg	10	< 10.0	169	< 10.0	< 10.0
1,2-Dibromo-3-chloropropane	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Hexachlorobutadiene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,2,3-Trichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Naphthalene	N	ug/kg	10	54.1	10.2	22.2	< 10.0
1,2,4-Trichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,4-Dichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
1,2-Dichlorobenzene	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
Bromoform	N	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0
VOC TIC							
Vinyl chloride	N	ug/kg	100	None Detected	None Detected	None Detected	None Detected

Results Summary

Report No.: 15-04970

WAC Analysis								
Elab Ref:	47910					**Landfill Waste Acceptance Criteria Limits**		
Sample Date:	09/12/2015					**Inert Waste Landfill**	**Stable Non-reactive Hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:	COMBO 3 WS0							
Depth:								
Site:	Newbridge Road, Bath							
Determinand		**Code**	**Units**					
Total Organic Carbon		N	%		4.40	3	5	6
Loss on Ignition		M	%		4.4	--	--	10
Total BTEX		M	mg/kg		< 0.01	6	--	--
Total PCBs (7 congeners)		M	mg/kg		< 0.03	1	--	--
TPH Total WAC		M	mg/kg		1290	500	--	--
Total (of 17) PAHs		N	mg/kg		122.0	100	--	--
pH		M			8.2	--	>6	--
Acid Neutralisation Capacity		N	mol/kg		< 0.1	--	To evaluate	To evaluate
Eluate Analysis			**2:1**	**8:1**	**10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
			mg/l	**mg/l**	**mg/kg**			
Arsenic		N	0.014	0.007	0.07	0.5	2	25
Barium		N	0.222	0.173	1.78	20	100	300
Cadmium		N	< 0.001	< 0.001	< 0.01	0.04	1	5
Chromium		N	< 0.005	< 0.005	< 0.05	0.5	10	70
Copper		N	< 0.005	< 0.005	< 0.05	2	50	100
Mercury		N	< 0.005	< 0.005	< 0.01	0.01	0.2	2
Molybdenum		N	0.086	0.016	0.23	0.5	10	30
Nickel		N	0.003	0.002	< 0.05	0.4	10	40
Lead		N	0.003	< 0.001	< 0.05	0.5	10	50
Antimony		N	0.054	0.023	0.26	0.06	0.7	5
Selenium		N	< 0.005	< 0.005	< 0.05	0.1	0.5	7
Zinc		N	0.006	0.012	0.12	4	50	200
Chloride		N	7.000	< 5	< 50	800	15000	25000
Fluoride		N	< 1	< 1	< 10	10	150	500
Sulphate		N	41.000	29.000	303.00	1000	20000	50000
Total Dissolved Solids		N	300.000	250.000	2550.00	4000	60000	100000
Phenol Index		N	< 0.01	< 0.01	< 0.10	1	-	-
Dissolved Organic Carbon		N	29.900	9.320	113.00	500	800	1000
Leach Test Information								
Eluent Volume (ml)		N	173	1390				
pH		N	8.5	8				
Conductivity (uS/cm)		N	457	353				
Temperature (°C)		N	18	18				
Solid Information								
Dry mass of test portion (g)			176					
Moisture (%)			29.7					

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ELAB cannot be held responsible for any discrepencies with current legislation

Results Summary

Report No.: 15-04970

WAC Analysis								
Elab Ref:	47909					**Landfill Waste Acceptance Criteria Limits**		
Sample Date:	09/12/2015					**Inert Waste Landfill**	**Stable Non-reactive Hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:	COMBO 2 WS0							
Depth:								
Site:	Newbridge Road, Bath							
Determinand		**Code**	**Units**					
Total Organic Carbon		N	%		1.60	3	5	6
Loss on Ignition		M	%		2.0	--	--	10
Total BTEX		M	mg/kg		< 0.01	6	--	--
Total PCBs (7 congeners)		M	mg/kg		< 0.03	1	--	--
TPH Total WAC		M	mg/kg		186	500	--	--
Total (of 17) PAHs		N	mg/kg		162.0	**100**	--	--
pH		M			9.6	--	>6	--
Acid Neutralisation Capacity		N	mol/kg		0.1	--	To evaluate	To evaluate
Eluate Analysis			**2:1**	**8:1**	**10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
			mg/l	**mg/l**	**mg/kg**			
Arsenic		N	0.007	0.013	0.13	0.5	2	25
Barium		N	0.048	0.051	0.51	20	100	300
Cadmium		N	< 0.001	< 0.001	< 0.01	0.04	1	5
Chromium		N	0.007	< 0.005	< 0.05	0.5	10	70
Copper		N	0.045	0.011	0.15	2	50	100
Mercury		N	< 0.005	< 0.005	< 0.01	0.01	0.2	2
Molybdenum		N	0.034	0.006	0.10	0.5	10	30
Nickel		N	0.003	0.001	< 0.05	0.4	10	40
Lead		N	< 0.001	< 0.001	< 0.05	0.5	10	50
Antimony		N	0.030	0.013	0.15	**0.06**	0.7	5
Selenium		N	< 0.005	< 0.005	< 0.05	0.1	0.5	7
Zinc		N	< 0.005	< 0.005	< 0.05	4	50	200
Chloride		N	9.000	< 5	< 50	800	15000	25000
Fluoride		N	< 1	< 1	< 10	10	150	500
Sulphate		N	232.000	55.000	784.00	1000	20000	50000
Total Dissolved Solids		N	320.000	150.000	1720.00	4000	60000	100000
Phenol Index		N	< 0.01	< 0.01	< 0.10	1	-	-
Dissolved Organic Carbon		N	25.300	11.000	129.00	500	800	1000
Leach Test Information								
Eluent Volume (ml)		N	230	1400				
pH		N	8.7	8.7				
Conductivity (uS/cm)		N	584	311				
Temperature (°C)		N	18	18				
Solid Information								
Dry mass of test portion (g)			177					
Moisture (%)			13.4					

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ELAB cannot be held responsible for any discrepencies with current legislation

Results Summary

Report No.: 15-04970

WAC Analysis								
Elab Ref:	47908					**Landfill Waste Acceptance Criteria Limits**		
Sample Date:	09/12/2015					**Inert Waste Landfill**	**Stable Non-reactive Hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:	COMBO 1 WS0							
Depth:								
Site:	Newbridge Road, Bath							
Determinand		**Code**	**Units**					
Total Organic Carbon		N	%		1.80	3	5	6
Loss on Ignition		M	%		2.8	--	--	10
Total BTEX		M	mg/kg		< 0.01	6	--	--
Total PCBs (7 congeners)		M	mg/kg		< 0.03	1	--	--
TPH Total WAC		M	mg/kg		< 5	500	--	--
Total (of 17) PAHs		N	mg/kg		5.0	100	--	--
pH		M			8.6	--	>6	--
Acid Neutralisation Capacity		N	mol/kg		< 0.1	--	To evaluate	To evaluate
Eluate Analysis			**2:1**	**8:1**	**10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
			mg/l	**mg/l**	**mg/kg**			
Arsenic		N	< 0.005	< 0.005	< 0.05	0.5	2	25
Barium		N	0.181	0.069	0.82	20	100	300
Cadmium		N	< 0.001	< 0.001	< 0.01	0.04	1	5
Chromium		N	< 0.005	< 0.005	< 0.05	0.5	10	70
Copper		N	0.006	< 0.005	< 0.05	2	50	100
Mercury		N	< 0.005	< 0.005	< 0.01	0.01	0.2	2
Molybdenum		N	0.046	0.008	0.12	0.5	10	30
Nickel		N	0.003	0.002	< 0.05	0.4	10	40
Lead		N	< 0.001	< 0.001	< 0.05	0.5	10	50
Antimony		N	0.005	< 0.005	< 0.05	0.06	0.7	5
Selenium		N	< 0.005	< 0.005	< 0.05	0.1	0.5	7
Zinc		N	< 0.005	< 0.005	< 0.05	4	50	200
Chloride		N	8.000	< 5	< 50	800	15000	25000
Fluoride		N	< 1	< 1	< 10	10	150	500
Sulphate		N	459.000	52.000	990.00	1000	20000	50000
Total Dissolved Solids		N	810.000	240.000	3050.00	4000	60000	100000
Phenol Index		N	< 0.01	< 0.01	< 0.10	1	-	-
Dissolved Organic Carbon		N	26.500	9.290	113.00	500	800	1000
Leach Test Information								
Eluent Volume (ml)		N	203	1400				
pH		N	8.2	8.2				
Conductivity (uS/cm)		N	1030	405				
Temperature (°C)		N	18	18				
Solid Information								
Dry mass of test portion (g)			177					
Moisture (%)			21.1					

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ELAB cannot be held responsible for any discrepencies with current legislation

Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonards on Sea, East Sussex, TN38 9BY
Tel: +44 (0)1424 718618, Email: info@elab-uk.co.uk, Web: www.elab-uk.co.uk

Results Summary

Report No.: 15-04970

Asbestos Qualitative Results

Analytical result only applies to the sample as submitted by the client. Any comments, opinions or interpretations (marked #) in this report are outside UKAS accreditation (Accreditation No2683). They are subjective comments only which must be verified by the client.

Elab No	Depth (m)	Clients Reference	Description of Sample Matrix #	Result
47889	0.40 - 0.50	WS01	Silty clayey loam	No asbestos detected
47890	0.50 - 0.60	WS04	Silty clayey loam	Chrysotile Amosite Actinolite (broken down lagging)
47892	0.50 - 0.60	WS06	Silty clayey loam	No asbestos detected
47895	0.30 - 0.40	WS09	Silty clayey loam	No asbestos detected
47897	0.10 - 0.20	WS10	Sandy silty loam	No asbestos detected
47898	0.50 - 0.60	WS10	Silty loam	No asbestos detected
47900	0.30 - 0.40	WS03	Sandy silty loam	No asbestos detected
47901	0.20 - 0.30	WS08	Silty clayey loam	No asbestos detected
47903	0.20 - 0.30	WS05	Silty loam	Chrysotile Amosite
47904	1.10 - 1.20	WS05	Sandy silty loam	No asbestos detected
47905	0.40 - 0.50	WS07	Sandy silty loam	No asbestos detected
47907	0.20 - 0.30	WS12	Silty loam	No asbestos detected

Method Summary

Report No.: 15-04970

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
PAH (GC-MS)	M	As submitted sample	15/12/2015		GC-MS
VOC in solids	M	As submitted sample	15/12/2015		GC-MS
Hexavalent chromium	N	As submitted sample	15/12/2015	110	Colorimetry
Acid Soluble Sulphate	U	Air dried sample	17/12/2015	115	Ion Chromatography
Aqua regia extractable metals	M	Air dried sample	15/12/2015	118	ICPMS
Phenols in solids	M	As submitted sample	15/12/2015	121	HPLC
Water soluble anions	M	Air dried sample	16/12/2015	172	Ion Chromatography
VOC in solids	M	As submitted sample	15/12/2015	181	GC-MS
Water soluble boron	N	Air dried sample	16/12/2015	202	Colorimetry
Total cyanide	M	As submitted sample	16/12/2015	204	Colorimetry
Aliphatic hydrocarbons in soil	N	As submitted sample	15/12/2015	214	GC-FID
Aliphatic/Aromatic hydrocarbons in soil	N	As submitted sample	17/12/2015	214	GC-FID
Aromatic hydrocarbons in soil	N	As submitted sample	15/12/2015	214	GC-FID
Low range Aliphatic hydrocarbons soil	N	As submitted sample	16/12/2015	214	GC-MS
Low range Aromatic hydrocarbons soil	N	As submitted sample	16/12/2015	214	GC-MS
Soil organic matter	U	Air dried sample	16/12/2015	BS1377:P3	Titrimetry
Asbestos identification	U	As submitted sample	16/12/2015	PMAN	Microscopy
Leachate					
Arsenic*	N		18/12/2015	101	ICPMS
Cadmium*	N		18/12/2015	101	ICPMS
Chromium*	N		18/12/2015	101	ICPMS
Lead*	N		18/12/2015	101	ICPMS
Nickel*	N		18/12/2015	101	ICPMS
Copper*	N		18/12/2015	101	ICPMS
Zinc*	N		18/12/2015	101	ICPMS
Mercury*	N		18/12/2015	101	ICPMS
Selenium*	N		18/12/2015	101	ICPMS
Antimony	N		18/12/2015	101	ICPMS
Barium*	N		18/12/2015	101	ICPMS
Molybdenum*	N		18/12/2015	101	ICPMS
pH Value*	N		18/12/2015	113	Electrometric
Electrical Conductivity*	N		18/12/2015	136	Probe
Dissolved Organic Carbon	N		18/12/2015	102	TOC analyser
Chloride*	N		18/12/2015	131	Ion Chromatography
Fluoride*	N		18/12/2015	131	Ion Chromatography
Sulphate*	N		18/12/2015	131	Ion Chromatography
Total Dissolved Solids	N		18/12/2015	144	Gravimetric
Phenol index	N		18/12/2015	121	HPLC
WAC Solids analysis	N				
pH Value**	M	Air dried sample	16/12/2015	113	Electrometric
Total Organic Carbon	N	Air dried sample	17/12/2015	210	IR
Loss on Ignition**	M	Air dried sample	16/12/2015	129	Gravimetric
Acid Neutralization Capacity to pH 7	N	Air dried sample	16/12/2015	NEN 737	Electrometric
Total BTEX**	M	As submitted sample	16/12/2015	181	GCMS
Mineral Oil**	U	As submitted sample	15/12/2015	117	GCFID
Total PCBs (7 congeners)	M	Air dried sample	16/12/2015	120	GCMS
Total PAH (17)**	N	As submitted sample	17/12/2015	133	GCFID

Tests marked N are not UKAS accredited

Report Information

Report No.: 15-04970

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis
Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
PCB congener results may include any coeluting PCBs
Uncertainty of measurement for the determinands tested are available upon request

Deviation Codes

a	No date of sampling supplied
b	No time of sampling supplied (Waters Only)
c	Sample not received in appropriate containers
d	Sample not received in cooled condition
e	The container has been incorrectly filled
f	Sample age exceeds stability time (sampling to receipt)
g	Sample age exceeds stability time (sampling to analysis)

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month
All water samples will be retained for 7 days following the date of the test report
Charges may apply to extended sample storage

APPENDIX G

Results of Chemical Laboratory Tests - Waters

Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY
Telephone: (01424) 718618
Facsimile: (01424) 729911
info@elab-uk.co.uk

UKAS TESTING 2683

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number:	15-05088
Issue:	2a
Date of Issue:	15/01/2016
Contact:	David Hornibrook
Customer Details:	Ground Investigation (South West) Ltd Unit 3 Custom House Court Clevedon BristolBS21 6EX
Quotation No:	Q14-00071
Order No:	p-sw-766
Customer Reference:	p-sw-766
Date Received:	22/12/2015
Date Approved:	15/01/2016
Details:	Newbridge Road, Bath
Approved by:	

John Wilson, Operations Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683

Sample Summary

Report No.: 15-05088

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
49005	CP01	21/12/2015	14/01/2016		
49006	CP02	21/12/2015	14/01/2016		
49007	CP03	21/12/2015	14/01/2016		

Results Summary

2683

Report No.: 15-05088

ELAB Reference			49005	49006	49007
Customer Reference					
Sample ID					
Sample Type			WATER	WATER	WATER
Sample Location			CP01	CP02	CP03
Sample Depth (m)					
Sampling Date			21/12/2015	21/12/2015	21/12/2015
Determinand	**Codes**	**Units**	**LOD**		
Dissolved Metals					
Arsenic	U	ug/l	5	8	9	< 5
Boron	N	ug/l	5	83	312	130
Cadmium	U	ug/l	1	< 1	< 1	< 1
Chromium	U	ug/l	5	< 5	< 5	< 5
Copper	U	ug/l	5	< 5	< 5	< 5
Mercury	U	ug/l	0.1	0.4	< 0.1	< 0.1
Nickel	U	ug/l	5	19	11	< 5
Lead	U	ug/l	1	4	< 1	< 1
Selenium	U	ug/l	5	13	< 5	< 5
Zinc	U	ug/l	5	< 5	< 5	13
Anions					
Sulphate	U	mg/l	0.5	25.4	471	109
Inorganics					
Hexavalent Chromium	U	ug/l	100	< 100	< 100	< 100
Total Cyanide	U	ug/l	5	13	< 5	< 5
Miscellaneous					
pH	U	pH units	0.1	11.5	6.9	6.7
Phenols					
Phenol	N	ug/l	1	< 1	< 1	< 1
M,P-Cresol	N	ug/l	1	< 1	< 1	< 1
O-Cresol	N	ug/l	1	< 1	< 1	< 1
3,4-Dimethylphenol	N	ug/l	1	< 1	< 1	< 1
2,3-Dimethylphenol	N	ug/l	1	< 1	< 1	< 1
2,3,5-trimethylphenol	N	ug/l	1	< 1	< 1	< 1
Total Monohydric Phenols	N	ug/l	1	< 1	< 1	< 1
Polyaromatic hydrocarbons					
Naphthalene GCMS	N	ug/l	0.01	7.51	0.97	0.28
Acenaphthylene GCMS	N	ug/l	0.01	3.29	5.32	0.63
Acenaphthene GCMS	N	ug/l	0.01	1.26	0.69	0.12
Fluorene GCMS	N	ug/l	0.01	3.49	2.95	0.20
Phenanthrene GCMS	N	ug/l	0.01	15.3	19.1	1.05
Anthracene GCMS	N	ug/l	0.01	7.11	9.48	0.87
Fluoranthene GCMS	N	ug/l	0.01	17.6	39.3	2.00
Pyrene GCMS	N	ug/l	0.01	14.6	28.7	1.76
Benzo (a) anthracene GCMS	N	ug/l	0.01	10.1	20.1	1.18
Chrysene GCMS	N	ug/l	0.01	9.07	17.5	1.01
Benzo (b) fluoranthene GCMS	N	ug/l	0.01	8.57	18.3	1.26
Benzo (k) fluoranthene GCMS	N	ug/l	0.01	8.08	15.1	0.90
Benzo (a) pyrene GCMS	N	ug/l	0.01	10.7	20.1	1.34
Indeno (1,2,3-cd) pyrene GCMS	N	ug/l	0.01	7.27	14.9	1.09
Dibenzo(a,h)anthracene GCMS	N	ug/l	0.01	2.91	6.64	0.38
Benzo(ghi)perylene GCMS	N	ug/l	0.01	7.05	14.2	0.97
Total PAH(16) GCMS	N	ug/l	0.01	134	233	15.0
BTEX					
Benzene	U	ug/l	1	< 1.00	< 1.00	< 1.00
Toluene	U	ug/l	1	< 1.00	< 1.00	< 1.00
Ethylbenzene	U	ug/l	1	< 1.00	< 1.00	< 1.00
Xylenes	U	ug/l	1	< 1.00	< 1.00	< 1.00
MTBE	U	ug/l	1	< 1.00	< 1.00	< 1.00

Tests marked N are not UKAS accredited.

Results Summary

2683

Report No.: 15-05088

			ELAB Reference	49005	49006	49007
			Customer Reference			
			Sample ID			
			Sample Type	WATER	WATER	WATER
			Sample Location	CP01	CP02	CP03
			Sample Depth (m)			
			Sampling Date	21/12/2015	21/12/2015	21/12/2015
Determinand	**Codes**	**Units**	**LOD**			
TPH CWG						
>C5-C6 Aliphatic	N	ug/l	1	< 1.0	< 1.0	< 1.0
>C6-C8 Aliphatic	N	ug/l	1	< 1.0	< 1.0	< 1.0
>C8-C10 Aliphatic	N	ug/l	5	21.6	< 5.0	< 5.0
>C10-C12 Aliphatic	N	ug/l	5	301	< 5.0	< 5.0
>C12-C16 Aliphatic	N	ug/l	5	1180	< 5.0	46.2
>C16-C21 Aliphatic	N	ug/l	5	1480	27.5	95.1
>C21-C35 Aliphatic	N	ug/l	5	4360	153	475
>C35-C40 Aliphatic	N	ug/l	5	285	24.9	46.7
Total (>C5-C40) Aliphatic	N	ug/l	5	7630	206	663
>C5-C7 Aromatic	N	ug/l	1	< 1.0	< 1.0	< 1.0
>C7-C8 Aromatic	N	ug/l	1	< 1.0	< 1.0	< 1.0
>C8-C10 Aromatic	N	ug/l	5	11.9	< 5.0	< 5.0
>C10-C12 Aromatic	N	ug/l	5	212	< 5.0	< 5.0
>C12-C16 Aromatic	N	ug/l	5	1010	< 5.0	62.1
>C16-C21 Aromatic	N	ug/l	5	1390	61.4	144
>C21-C35 Aromatic	N	ug/l	5	3410	331	591
>C35-C40 Aromatic	N	ug/l	5	244	41.9	73.3
Total (>C5-C40) Aromatic	N	ug/l	5	6280	435	870
Total (>C5-C40) Ali/Aro	N	ug/l	5	13900	640	1530
PCB (ICES 7 congeners)						
PCB 28	N	ug/l	0.1	< 0.1	< 0.1	< 0.1
PCB 52	N	ug/l	0.1	< 0.1	< 0.1	< 0.1
PCB 101	N	ug/l	0.1	< 0.1	< 0.1	< 0.1
PCB118	N	ug/l	0.1	< 0.1	< 0.1	< 0.1
PCB 153	N	ug/l	0.1	< 0.1	< 0.1	< 0.1
PCB 138	N	ug/l	0.1	< 0.1	< 0.1	< 0.1
PCB 180	N	ug/l	0.1	< 0.1	< 0.1	< 0.1
PCB (7 Congeners)	N	ug/l	0.1	< 0.1	< 0.1	< 0.1

Results Summary

2683

Report No.: 15-05088

			ELAB Reference	49005	49006	49007
			Customer Reference			
			Sample ID			
			Sample Type	WATER	WATER	WATER
			Sample Location	CP01	CP02	CP03
			Sample Depth (m)			
			Sampling Date	21/12/2015	21/12/2015	21/12/2015
Determinand	**Codes**	**Units**	**LOD**			
VOC						
MTBE	U	ug/l	1	< 1	< 1	< 1
Heptane	N	ug/l	1	< 1	< 1	< 1
Octane	N	ug/l	1	< 1	< 1	< 1
Nonane	N	ug/l	1	< 1	< 1	< 1
Benzene	U	ug/l	1	< 1	< 1	< 1
Toluene	U	ug/l	1	< 1	< 1	< 1
Ethylbenzene	U	ug/l	1	< 1	< 1	< 1
m+p-xylene	U	ug/l	1	< 1	< 1	< 1
o-xylene	U	ug/l	1	< 1	< 1	< 1
cis-1,2-dichloroethene	U	ug/l	1	< 1	< 1	< 1
1,1-Dichloroethane	U	ug/l	1	< 1	< 1	< 1
Chloroform	U	ug/l	1	< 1	< 1	< 1
Tetrachloromethane	U	ug/l	1	< 1	< 1	< 1
1,1,1-Trichloroethane	U	ug/l	1	< 1	< 1	< 1
Trichloroethylene	N	ug/l	1	< 1	< 1	< 1
Tetrachloroethylene	U	ug/l	1	< 1	< 1	< 1
1,1,1,2-Tetrachloroethane	U	ug/l	1	< 1	< 1	< 1
1,1,2,2-Tetrachloroetha	N	ug/l	1	< 1	< 1	< 1
Chlorobenzene	U	ug/l	1	< 1	< 1	< 1
Bromobenzene	U	ug/l	1	< 1	< 1	< 1
Bromodichloromethane	U	ug/l	1	< 1	< 1	< 1
Methylethylbenzene	U	ug/l	1	< 1	< 1	< 1
1,1-Dichloro-1-propene	U	ug/l	1	< 1	< 1	< 1
Trans - 1-2 -dichloroethylene	U	ug/l	1	< 1	< 1	< 1
2,2-Dichloropropane	N	ug/l	1	< 1	< 1	< 1
Bromochloromethane	N	ug/l	1	< 1	< 1	< 1
1,2-Dichloroethane	U	ug/l	1	< 1	< 1	< 1
Dibromomethane	U	ug/l	1	< 1	< 1	< 1
1,2-Dichloropropane	U	ug/l	1	< 1	< 1	< 1
cis-1,3-Dichloro-1-propene	U	ug/l	1	< 1	< 1	< 1
trans-1,3-Dichloro-1-propene	U	ug/l	1	< 1	< 1	< 1
1,1,2-Trichloroethane	U	ug/l	1	< 1	< 1	< 1
Dibromochloromethane	U	ug/l	1	< 1	< 1	< 1
1,3-Dichloropropane	U	ug/l	1	< 1	< 1	< 1
Dibromoethane	U	ug/l	1	< 1	< 1	< 1
Styrene	U	ug/l	1	< 1	< 1	< 1
Propylbenzene	U	ug/l	1	< 1	< 1	< 1
2-Chlorotoluene	U	ug/l	1	< 1	< 1	< 1
1,2,4-Trimethylbenzene	U	ug/l	1	< 1	< 1	< 1
4-Chlorotoluene	U	ug/l	1	< 1	< 1	< 1
t-butylbenzene	U	ug/l	1	< 1	< 1	< 1
1,3,5-Trimethylbenzene	U	ug/l	1	< 1	< 1	< 1
1-methylpropylbenzene	U	ug/l	1	< 1	< 1	< 1
o-cymene	U	ug/l	1	< 1	< 1	< 1
1,3-Dichlorobenzene	U	ug/l	1	< 1	< 1	< 1
Butylbenzene	U	ug/l	1	< 1	< 1	< 1
1,2-Dibromo-3-chloropropane	U	ug/l	1	< 1	< 1	< 1
Hexachlorobutadiene	U	ug/l	1	< 1	< 1	< 1
1,2,3-Trichlorobenzene	U	ug/l	1	< 1	< 1	< 1
Naphthalene	U	ug/l	1	9	1	< 1
1,2,4-Trichlorobenzene	U	ug/l	1	< 1	< 1	< 1
1,4-Dichlorobenzene	U	ug/l	1	< 1	< 1	< 1
1,2-Dichlorobenzene	U	ug/l	1	< 1	< 1	< 1
Bromoform	U	ug/l	1	< 1	< 1	< 1

Results Summary

2683

Report No.: 15-05088

			ELAB Reference	49005	49006	49007
			Customer Reference			
			Sample ID			
			Sample Type	WATER	WATER	WATER
			Sample Location	CP01	CP02	CP03
			Sample Depth (m)			
			Sampling Date	21/12/2015	21/12/2015	21/12/2015
Determinand	**Codes**	**Units**	**LOD**			
VOC						
VOC TIC						
Vinyl chloride	N	ug/l	10	None Detected	None Detected	None Detected

Tests marked N are not UKAS accredited.
The Environmental Laboratory Ltd. Reg. No. 3882193

Method Summary

Report No.: 15-05088

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Water					
Aliphatic/Aromatic hydrocarbons in water	N		24/12/2015		GC-FID
Aromatic hydrocarbons in water	N		24/12/2015		GC-FID
Phenols in waters	N		14/01/2016		HPLC
VOC in waters	U		22/12/2015		GC-MS
Dissolved metals by ICP in waters	U		23/12/2015	101	ICPMS
pH of waters	U		23/12/2015	113	Electromeric
Chromium Hexavalent in waters	U		23/12/2015	123	Colorimetry
Anions	U		23/12/2015	131	Ion Chromatography
PAHs and/or PCBs in waters	N		24/12/2015	135	GC-MS
VOC in waters	U		22/12/2015	200	GC-MS
BTEX in waters	U		23/12/2015	200A	GC-MS
Cyanide in waters	U		23/12/2015	205	Colorimetry
Aliphatic hydrocarbons in water	N		23/12/2015	215	GC-FID
Aromatic hydrocarbons in water	N		23/12/2015	215	GC-FID
Low range Aliphatic hydrocarbons water	N		23/12/2015	215	GC-MS
Low range Aromatic hydrocarbons water	N		23/12/2015	215	GC-MS

Tests marked N are not UKAS accredited

2683

Report Information

Report No.: 15-05088

Key

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N	do not currently hold UKAS accreditation
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SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
I/S	Insufficient Sample
U/S	Unsuitable sample
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Deviation Codes

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Sample Retention and Disposal

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All water samples will be retained for 7 days following the date of the test report
Charges may apply to extended sample storage

APPENDIX H

Results of Geotechnical Laboratory Tests

Laboratory Report

2788

GEO Site & Testing Services Ltd

Contract Number: 29487

Client's Reference: **p-sw-766**

Report Date: **20-01-2016**

Client **Ground Investigation (South West) Limited**
Unit 3, Custom House Court
Kenn Road
Clevedon
Bristol
BS21 6EX

Contract Title: **Hartwell Bath**

For the attention of: **Tim Gillbanks**

Date Received: **05-01-2016**

Date Commenced: **05-01-2016**

Date Completed: **20-01-2016**

Test Description	Qty
Moisture Content 1377 : 1990 Part 2 : 3.2 - * UKAS	12
4 Point Liquid & Plastic Limit (LL/PL) 1377 : 1990 Part 2 : 4.3 & 5.3 - * UKAS	12
(GI) BRE SD1 Reduced Suite pH, Acid Soluble Sulphate, Water Soluble Sulphate and Total Sulphur 1377 : 1990 Part 3 & BRE CP2/79 - @ Non Accredited Test	10
Disposal of Samples on Project	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:
Alex Wynn (Associate Director) - Benjamin Sharp (Contracts Manager) - Emma Sharp (Office Manager)
Paul Evans (Quality/Technical Manager) - Vaughan Edwards (Managing Director)

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Client ref: p-sw-766

Location: Hartwell, Bath

Contract Number: 29487-050116

Hole Number	Sample Number	Type	Depth (m)	Description of Sample*
CP1	5	SPT	3.00	Grey fine to medium gravelly silty CLAY.
CP1	7	SPT	4.00	Grey fine gravelly sandy silty CLAY.
CP1	13	SPT	6.00	Brown fine gravelly sandy silty CLAY.
CP2	3	B	1.20	Brown fine to coarse gravelly sandy silty CLAY.
CP2	5	B	2.20	Brown fine to medium gravelly sandy silty CLAY.
CP2	9	B	3.70	Grey fine sandy silty CLAY.
CP2	13	B	5.50	Brown fine gravelly sandy silty CLAY.
TP3	2	D	1.00	Grey fine sandy silty CLAY.
WS2	2	D	0.70	Brown fine to coarse gravelly sandy silty CLAY. Gravel of limestone nature
WS3	2	D	0.60	Brown fine to medium gravelly sandy silty CLAY.
WS5	4	D	1.40	Brown fine sandy silty CLAY.
WS8	3	D	1.70	Brown fine sandy silty CLAY.

Note: Results on this table are in summary format and may not meet the requirements of the relevant standards, additional information is held by the laboratory

GSTL
GEO SITE & TESTING SERVICES LTD

For and behalf of GEO Site & Testing Services Ltd

Authorised By:

Paul Evans (Quality/Technical Manager)

Date: 20.1.16

UKAS TESTING 2788

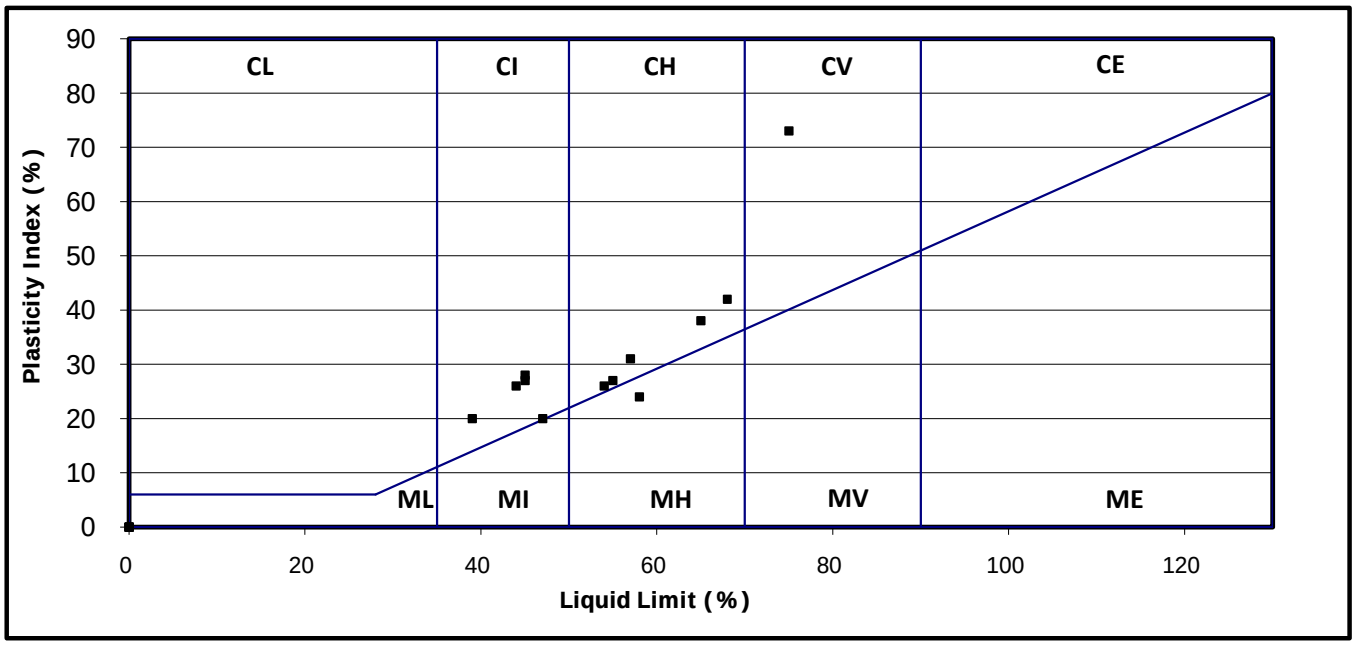
Test Report: **Method of the Determination of the plastic limit and plasticity index**
BS 1377 : Part 2 : 1990 Method 5

Client ref: p-sw-766
Location: Hartwell, Bath
Contract Number: 29487-050116

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
CP1/5	SPT	3.00	43	58	34	24	67	MH High Plasticity
CP1/7	SPT	4.00	35	47	27	20	88	CI Intermediate Plasticity
CP1/13	SPT	6.00	21	45	18	27	90	CI Intermediate Plasticity
CP2/3	B	1.20	23	54	28	26	64	CH High Plasticity
CP2/5	B	2.20	29	55	28	27	83	CH High Plasticity
CP2/9	B	3.70	16	44	18	26	100	CI Intermediate Plasticity
CP2/13	B	5.50	22	45	17	28	91	CI Intermediate Plasticity
TP3/2	D	1.00	26	68	26	42	95	CH High Plasticity
WS2/2	D	0.70	12	39	19	20	50	CI Intermediate Plasticity
WS3/2	D	0.60	21	57	26	31	74	CH High Plasticity
WS5/4	D	1.40	26	75	2.0	73	100	CV Very High Plasticity
WS8/3	D	1.70	23	65	27	38	100	CH High Plasticity

Symbols: **NP : Non Plastic** **# : Liquid Limit and Plastic Limit Wet Sieved**

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.
BS 5930:1999+A2:2010



For and behalf of GEO Site & Testing Services Ltd

Authorised By:
Paul Evans (Quality/Technical Manager)
Date: 20.1.16

UKAS TESTING 2788

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Certificate of Analysis

Date:	18/01/2016
Client:	Ground Investigation
Our Reference:	29487-050116
Client Reference:	p-sw-766
Contract Title:	Hartwell, Bath
Description: (Total Samples)	10
Date Received:	05/01/2016
Date Started:	14/01/2016
Date Completed:	18/01/2016
Test Procedures:	(B.S. 1377 : PART 3 : 1990 AND BRE CP2/79)
Notes:	

Solid samples will be disposed 1 month and liquids 2 weeks after the date of issue of this test certificate

Approved By:

Authorised Signatories:

Emma Williams	Ben Sharp	Paul Evans
Laboratory Office Manager	Contracts Manager	Quality Manager

Contract No: 29487-050116
Client Ref: p-sw-766
Location: Hartwell, Bath
Date: 18/01/2016

Summary of Chemical Analysis

(B.S. 1377 : PART 3 : 1990 AND BRE CP2/79)

Hole Number	Sample Number	Depth m	Sulphate Content SO3 (as SO_4)			Chloride Content		pH Value @ 25°C	Total Sulphur %	Magnesium g/l	Nitrate mg/l	Organic %
			Acid Soluble Sulphate as % SO_4 Clause 5.5.	Aqueous Extract Sulphate as g/l SO_4 Clause 5.5.	Ground-water g/l Clause 5.4.	Soluble Chloride as % equiv. NaCl Clause 7.3	Ground-water g/l Clause 7.2	Clause 9.				
CP1		3.00	0.55 (0.66)	0.04 (0.04)				6.56	0.24			
CP1		4.00	0.34 (0.41)	0.02 (0.03)				6.89	0.18			
CP1		6.00	0.15 (0.19)	0.02 (0.02)				7.79	0.11			
CP2		2.20	2.98 (3.58)	0.11 (0.13)				7.31	1.11			
CP2		3.70	0.31 (0.37)	0.02 (0.02)				7.42	0.14			
CP2		5.50	0.34 (0.41)	0.01 (0.01)				7.68	0.15			
WS2		0.70	0.21 (0.25)	0.02 (0.02)				7.27	0.12			
WS3		0.60	0.19 (0.23)	0.02 (0.02)				7.49	0.09			
WS5		1.40	0.17 (0.21)	0.02 (0.02)				7.75	0.11			
WS8		1.70	0.15 (0.19)	0.02 (0.03)				7.39	0.09			

NCP - No Chloride present

APPENDIX I

References

REFERENCES

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13. **CIRIA**. *Assessing Risks posed by hazardous ground gasses to buildings*. C665, 2007.