APPLiED GEOLOGY

REPORT ON
GROUND INVESTIGATION
AT
LAND TO THE WEST OF
MISWELL LANE,
TRING

REPORT STATUS SHEET

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Point Load v depth

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1.0 INTRODUCTION

1.1 Objectives and Scope of Investigation

Applied Geology Ltd was commissioned by Montpelier Estates (the Client) to undertake a desk study/Phase I Geoenvironmental Risk Assessment and Phase II ground investigation on a parcel of land to the west of Miswell Lane, Tring (the Site). The proposals for the site comprise the construction of a two to three-storey residential care home facility, with associated car parking, a new access road and communal landscape gardens.

Applied Geology was appointed by the Client to undertake a desk study/Phase I Geoenvironmental Risk Assessment and a combined geotechnical and geoenvironmental Phase II ground investigation in order to:

- assess the potential for hazardous substances or conditions to exist at the site that might warrant mitigation or remediation appropriate to the intended end use proposed by the Client,
- establish geological conditions and geotechnical parameters to assist in the safe and economic engineering design of the proposed development,
- support a future Planning Application.

The terms of reference/brief for the works were initially developed between Applied Geology and the Client and are outlined in our proposal and estimate reference AG21-7614let001, dated 1st April 2021. The findings of the desk study together with our reporting and assessment of the ground investigation (Initial/Main Investigation) were initially reported under reference AG3261-21-AM39, dated 5th of July 2021. In order to provide more robust information to inform foundation assessment and in particular the competence of Chalk within potential influencing distance of shallow spread foundations, supplementary investigation was recommended. The scope of the supplementary works was presented in an email dated 6th of July 2021 and allowed for the advancement of two rotary cored boreholes, to a provisional depth of 8m bgl, in order to confirm the ground conditions (competent structured chalk).

This current report details the findings of the desk study together with our reporting and assessment of the results from both phases of investigation.

Collectively, the scope of works undertaken by Applied Geology to date comprised the following:

- A site inspection and walkover survey.
- A review of the following desk study sources:
  - GroundSure – GeoInsight & EnviroInsight environmental databases
  - GroundSure – MapInsight historical OS maps
  - British Geological Survey (BGS) - published information & online borehole database
  - Multi-Agency Geographical Information for the Countryside (MAGIC) online database
  - Online aerial photographs

Two phases of ground investigation together with sampling, monitoring and a programme of laboratory testing.

Assessment and reporting of the results of the works.

Statutory service plans for the site were obtained by Applied Geology between the 19th and the 21st of April 2021. An updated set of underground service plans for the site was not obtained prior to the supplementary works, as no new services had been installed between Applied Geology's previous attendance on site. A topographic survey of the site by an undocumented survey company, Drawing No. JAJO-EL-DR-6201 Rev C02, was provided by the Client.

1.2 Report Layout

This report presents a brief description of the site, the desk study data and the factual results of the intrusive investigations carried out. An interpretation of the ground conditions and a discussion/assessment of the findings is presented in the later report text sections. The main text of the report has been produced in a concise format, including the use of data tables to summarise key information where possible. The report should be read in conjunction with the general procedures detailed in Appendix F and General Notes given at the end of the main text, which provide details of investigation techniques, assessment methodology and standards, health & safety and limitations and exceptions of the report. Drawings and factual data including exploratory hole records, laboratory testing results and desk study records are presented in the other Appendices.

2.0 SITE DESCRIPTION AND PROPOSALS

2.1 Site Description

The site is located to the west of Miswell Lane, Tring, Hertfordshire, c.0.8km north-west of the centre of Tring. The Ordnance Survey grid reference for the centre of the site is approximately 491442, 211636, as shown on the Site Location Plan (AG3261-21-01) in Appendix A.

The site is roughly rectangular in plan shape, measuring c.90m by c.70m at the longest and widest extents and covering an area of approximately 0.68Ha. The topographic survey, which is used as a base for the exploratory hole location plan, included in Appendix A, indicates the site to slope down gently from 156.9m AOD in the north and north-west to 155.0m AOD in the south. Elevations of 157.0m AOD to 158.0m AOD are noted in the west of the site and these are associated with a stockpiled mound, which is discussed in further detail below.

2.2 Site Walkover – Initial (Main) Investigation

A site inspection/walkover was undertaken by Applied Geology on the 19th of April 2021, as part of a pre-commencement meeting to assess the access on to site. At the time of the walkover and the subsequent intrusive works, the site was accessed off Icknield Way and via Morningside Farm and Motors to the immediate north of the site. At the time, the site comprised a grassed field with semi-mature to mature trees noted along the southern, eastern and western peripheries. Both semi-mature conifers and silver birches were sporadically located within the field itself. A relatively small, stockpiled mound of unknown material (due to grass cover) was located in the west of the site and several stockpiled mounds of debris (largely

made up of wood, vegetation, rubble and compost) were stockpiled in the central regions of the site. The north-western corner of the site was largely used to store equipment associated with the farm, including a relict tractor, bowser, trailer as well as two skips and other non-hazardous waste materials. Suspected corrugated cement-based asbestos sheeting/roof materials were stockpiled along the western boundary of the site to the adjacent west of the stockpiled mound. The rear garden of Morningside Farmhouse encroached onto the north-eastern corner of the site, where outdoor furniture and children's play equipment were located. Centrally, along the eastern boundary of the site, were the remnants of a former bonfire. Anecdotal evidence confirmed that vegetation from the site and farm was often burnt as way of disposal.

Three north to south aligning Thames Water manhole covers were noted centrally on-site, with a further two manhole covers mapped to the immediate north, on the land occupied by Morningside Farm and Motors. Upon lifting the covers a north to south trending large diameter sewage pipe was present at a depth of c.1.00m below ground level (bgl). Within all three inspection chambers and perpendicular to the main sewage pipe, a smaller east to west aligning pipe was present. None of the aforementioned sewage pipes were mapped on the statutory utility plans obtained from Thames Water, however the manhole covers are present on the topographic survey drawing.

Offsite to the north (c.60m north), several drums of Motor Oil were lined up by the exterior wall of the garage (Morningside Motors), however no evidence of leakage/staining was noted on the underlying gravel hardstanding.

The site was bound to the east and south by residential dwellings, to the west by large scale factories/ warehouse units and to the north by Morningside Farm and Motors (repair garage), with The Old Dairy Garage noted beyond.

Photographs showing the stockpiled mound of soil in the west of the site and the remnants of a bonfire in the east.

Photographs showing the stockpiled debris (wood and rubble) and the stored farm equipment in the north-western corner and central regions of the site and Morningside Motors with oil drums c.60m north/north-west of the site.

Photographs showing the stockpiled suspected corrugated cement-based asbestos sheeting/roof materials which were noted along the western boundary of the site, to the adjacent west of the stockpiled mound.

2.3 Site Walkover – Supplementary Investigation

A subsequent walkover was undertaken on the 2nd of September 2021, immediately prior to the commencement of the supplementary intrusive works. Since the initial walkover the site largely remained the same, comprising a grassed field with semi-mature to mature trees noted along the southern, eastern and western peripheries. The north-western corner of the site still housed relict farm equipment, two skips and other non-hazardous construction waste materials. The relatively small, stockpiled mound (now known to comprise granular Made Ground with cemented based sheeting) located in the west of the site and the stockpiled mounds of debris (largely wood, vegetation, rubble and compost) located in the central regions of the site all remained. The suspected corrugated cement based asbestos sheeting roof materials were no longer present along the western boundary of the site and the underlying Topsoil had been scraped in this area. Anecdotal evidence confirmed that the sheeting was removed and disposed of offsite by the existing landowner.

Photographs showing the stockpiled debris (wood and rubble) in the central regions of the site and the stockpiled mound of Made Ground in the west of the site.

Photographs showing the absence of the cement based asbestos sheeting and recent Topsoil scrape and the farming equipment, skips and construction materials in the north-western corner.

2.4 Site Proposals

The proposals for the site comprise the construction of a two to three-storey residential care home facility across much of the central region of the site, with associated car parking to the north-east and a new access road off Miswell Lane. All remaining areas are proposed for communal landscaped gardens. The proposed location and layout of the intended development is detailed as a schematic drawing on Montpelier Estates drawing referenced 19025/F01/S02 (Rev A), dated January 2021, a copy of which is presented in Appendix A.

3.0 DESK STUDY INFORMATION

The desk study findings are summarised below with the full Groundsure Report and selected Historical Ordnance Survey Maps included in Appendix B.

Site History (1877 to 2021)	**1877 to 1884** - The site and surrounding area are agricultural fields, with buildings and structures associated with a Corn Windmill and Miswell Farm located c. 50m north and 400m north-west of the site, respectively. A relatively large oval shaped pond is noted to the immediate north of Miswell Farm. An unnamed road (later known as Miswell Lane) runs parallel to the eastern boundary of the site and an east to west trending road, labelled Upper Icknield Way (later renamed to Icknield Way), is located c.60m to the north. The settlement of Tring is located from 550m south-east and 600m

	east of the site. A branch of the Grand Junction Canal (later known as the Grand Union Canal) and Wiltstone Reservoir are mapped from c.1km to 1.5km north of the site. **1897 to 1900** - There are no further significant changes on site. A residential dwelling and orchard are mapped to the adjacent south of the site. Another newly constructed residential dwelling is mapped c.100m north of the site, off Upper Icknield Way. There has been further development to the settlement of Tring, with newly constructed residential dwellings with c.300m of the southern boundary. A relatively small-scale Chalk Pit is mapped c.800m to the west. **1923 to 1924** – There are no further significant changes on site. Two relatively large residential dwellings, labelled Windmill Field and Red Lodge, are mapped to the adjacent south of the site. The Corn Windmill located c.50m north of the site is relabelled as Goldfield Mill House and is noted to be disused. Two structures, possibly residential dwellings, are mapped between c.40m and c.70m of the northern boundary, with access noted off Upper Icknield Way. A further four structures are mapped c.100m north-west of the site and a residential dwelling located c.250m north of the site is labelled Miswell House and is likely associated with Miswell Farm. There has been further significant development to the settlement of Tring, with residential housing mapped up to the southern boundary of the site and further housing under construction c.500m east of the site. **1932 to 1938** – There are no further significant changes on site. A third structure is mapped c.60m north-west of the site (accessed off Upper Icknield Way), with a further four structures, possibly residential dwellings, located between c.80m and 250m to the north-west of the site. **1950 to 1959 -** There are no further significant changes on site. A possible residential dwelling is mapped adjacent to the north-western boundary of the site and a larger 'C' shaped structure is mapped c.40m to the north/north-west. Residential dwellings are also mapped to the east of Miswell Lane and south of Upper Icknield Way, beyond Goldfield Mill House. The Grand Junction Canal located c.1km to the north of the site has been renamed as the Grand Union Canal. **1971 to 1980 –** There are no further significant changes on site. Much of the land to the east of the site (beyond Miswell Lane) and to the south/ south-west has been developed to comprise semi-detached and detached residential dwellings. The three structures to the immediate north/north-west no longer appear on mapping and have been replaced with five structures associated with the existing Garage and Morningside Farm. Upper Icknield Way to the north of the site has been renamed as Icknield Way. The residential dwellings c.100m to the north/north-west, beyond Icknield Way, are labelled as Miswell Cottages. Three relatively large factories are mapped from c.250m west of the site and buildings associated with Icknield Farm are located to the immediate north. The section of the Grand Union Canal located c.1km to the north is now labelled as disused. The A41 dual carriage way which passes the southern and western extents of Tring is under construction c. 1km to the south and west of the site. **1984 to 1995 –** There are no further significant changes on site. A fourth factory/ warehouse unit is mapped on the land to the adjacent west of the site. Areas of embankment are mapped to the north of these factories, fronting Icknield Way. **2001 to 2003 –** There are no further significant changes on site. The factories/ warehouse units to the immediate west have been labelled as 'Tring Business Centre'. Construction of the A41 dual carriageway, located c.1km to the south and west, is complete. The section of the Grand Union Canal, located c.1km to the north, is labelled but no longer mapped and so it has likely been backfilled and is now simply a walking route. **2010 to 2021 –** There are no further significant changes on site. A fifth rectangular structure is mapped on the land to the immediate north and this is likely associated with either the existing garage or Morningside Farm. The residential dwellings c. 100m to the north/north-west, which front Icknield Way, are no longer labelled as Miswell Cottages. A further two factories/Units have been developed on the site of Tring Business Centre,

	the nearest is located on the land to the immediate west. **Aerial Imagery – 1999 –** The site is a single grassed field; however, the north-eastern corner is segregated from other areas and appears to be the rear garden of the Morningside Farmhouse. Relatively large trees align the eastern, western and southern boundaries. Residential properties are mapped to the east and south, several large-scale factories/warehouses are mapped to the west and a farm and two garages are mapped to the north. **Aerial Imagery – 2006** – There are no further significant changes on site. The land to the immediate north of the site has been landscaped and appears to comprise an allotment style garden, associated with Morningside Farm. **Aerial Imagery – 2015** – Several localised stockpiles of debris and stored equipment (likely associated with the farm) are mapped across the central and northern regions of the site. Several semi-mature trees are sporadically located across the site. A series of trailers, caravans and other temporary structures (sheds/greenhouses) are present to the immediate north of the site and a newly constructed 'barn/workshop' is located to the north of Morningside Farm (house). **Aerial Imagery – 2020-** The stored farm equipment is limited to the north-western corner of the site and four relatively small stockpiles of debris are present in the central regions. There are fewer trees located to the north of the site and these have likely been felled.
Anticipated Geology and Ground Conditions	The Published BGS Map indicates the site to be underlain by Solid Geology of the Cretaceous Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated). Superficial Deposits are not anticipated, however, Head Deposits comprising thin deposits of clay, silt, sand and gravel are mapped c.0.5km to the east of the site. There are no records of ground works or Made Ground within the boundaries of the site. However, due to the presence of stockpiled debris, bonfires and the presence of a mounded stockpile (of unknown material), it is anticipated that a relatively thin layer of Made Ground will be present locally. A search of available (archived) borehole records held by the BGS indicates that there are several borehole records associated with the construction of the A41 dual carriageway c.1.5km to the west. Collectively, the boreholes typically encountered a ground profile comprising cohesive Topsoil to 0.30m bgl over structured very weak to strong light grey to off white Chalk to the full depth of the investigation (15.00m bgl). Locally in one of the boreholes, granular Made Ground (with inclusions of ash, clinker, flint and chalk) was encountered from surface and proven to a depth of 2m bgl. Groundwater was generally not encountered. No known natural cavities or dissolution features are present on site or within 500m of the site. The nearest chalk cavity is recorded 795m south-east of the site. The BGS has classified the Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated) as soluble, however, the hazard rating of ground dissolution is indicated to be 'very low risk'. The site is indicated to be within a radon affected area where between 1% and 3% of properties are estimated to be affected. However, no radon protection measures are considered necessary for new properties.
Mining/Quarrying	The site is not indicated to be within an area of underground coal mining activities. There are no records of natural cavities within 500m of the site. There are no records of non-coal mining activity having been undertaken on the site or the immediate vicinity, however, due to the presence of Chalk at shallow depths the environmental database report indicates that sporadic underground mining of restricted extent may have previously occurred. There are no recorded surface ground workings within 2km of the site.
Hydrology	The nearest surface water feature is an oblong shaped pond located c.450m north of the site. The site is outside of River and Coastal Flood Zones 2 and 3. The risk of

	flooding from rivers and sea is rated 'very low', with less than 1 in 1000 chance of flooding per year. The risk from surface water flooding is considered to be negligible. There are no recorded surface water abstraction licenses within 2km of the site. There are no records of historic/operational Licensed Discharge Consents for the site. The nearest recorded license was held by Unigate Dairies Ltd c.93m north-west of the site between September 1980 and February 1991, when the license was revoked.
Hydrogeology	The Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated) is classified as a 'Principal Aquifer'. The site does not lie within a Source Protection Zone. The risk from groundwater flooding is considered to be negligible. The nearest recorded groundwater abstraction license was located c.1206m north-east of the site and was active between September 2000 and December 2002. No information relating to the abstracted volume per annum was made available. There are no potable water abstraction licenses within 2km of the site.
Other Environmental data	There are no records held for any historic/operational landfills and other waste sites within 250m of the site. There are records for eighty-two waste exemptions within 500m of the site. The nearest is held by Unit 4 off Icknield Way, c.51m south-west of the site, which permits the storage of non-agricultural waste in a secure place. There are no historic/current petrol and fuel sites within 500m of the site. Based on the walkover survey and the environmental database report, there are two operational garages (Morningside Motors and The Old Dairy Garage) located c. 40m and c.90m north/north-west of the site, respectively. There are also records of three historical garages in the location of the current Morningside Motors. There are records of five historic tanks within 500m of the site. The nearest tank dates back to 1984 and was located c.48m to the north of the site in the location of the former Corn Windmill. As such, the tank could be associated with the storage of corn, though could also have represented a fuel storage tank. There are twenty-one industrial land uses within 500m of the site. The majority are located at Tring Business Centre to the adjacent west and include a vehicle hire company, a packaging plant, a civil engineering company, and an x-ray services company. Morningside Motors (repair garage) and The Old Dairy Garage are located c.40m and c.90m north-west of the site, respectively. The nearest electricity sub-station is located c.78m north-west of the site. There are no sites determined as contaminated land within 500m of the site. There are no EA pollution incidents noted at the site, the nearest incident was associated with inert materials and waste at a site c.63m north-west of the site. The incident was assigned a Category 4 (no impact) for water and air and a Category 3 (minor) for land. There are no Sites of Special Scientific Interest (SSSI) or Special Areas of Conservation (SAC) within 1km of the site. Much of the undeveloped land surrounding the settlement of Tring are designated as being part of the London Area Greenbelt. Goldfield Mill (windmill) located c.53m north to north-east of the site, is the only (Grade II) listed building within the immediate area. Zetica Bomb Risk Maps for the area indicate a 'Low' risk from Unexploded Ordnance (UXO).
Railways/ Tunnels	There are no current or proposed railway or tunnels within 250m of the site.
Planning Application Search	Upon review of the Local Authority Planning Portal (Dacorum Borough Council) no further relevant information was available with regards to historic or current planning applications at the site.

3 1 Supplementary Environmental Searches (August 2020)

Petroleum Licence Officer

The Hertfordshire Petroleum Enforcement Authority was initially contacted via email on the 11th of May 2021 and a petroleum search for the site was requested. In response, the findings of the search did not identify any records held for the site (or a 250m buffer surrounding the site) regarding any above ground or underground petrol storage tanks. The state that other tanks such as diesel or fuel oil could have been present, though they hold not records and as it was not a requirement to inform the Local Authority.

4.0 CONCEPTUAL SITE MODEL

In developing a Conceptual Model for the site, pollutant linkages are determined by identifying likely sources of contamination from previous and current site uses, possible targets such as site users, neighbouring site users and Controlled Waters and linkages between them. These are discussed below.

4.1 Sources

Localised Made Ground soils on site associated with the stockpiled mound, stockpiled mounds of debris and areas of stored farm machinery/equipment;
Possible fuel leaks/spillages associated with the agricultural machinery stored in the north-west of the site or from machinery used to maintain the field (petroleum hydrocarbons/solvents);
Contaminants within offsite Made Ground soils (Inc. the garages to the north (Morningside Motors c.40m north/ north-west and The Old Dairy Garage c.90m north/ north-west) and the factories/warehouse units adjacent to the west of the site;
Possible leakages of petroleum hydrocarbons/solvents associated with the offsite garages to the north;
Onsite and offsite ground gases or VOC's associated with decomposition of organic material in Made Ground or hydrocarbon spillages (if encountered);
Sulphates in Made Ground (if encountered) or underlying natural strata.

Although the site has always been a single, relatively large agricultural field, the historical mapping available does not suggest that the field was ever extensively cropped and so pesticides and herbicides are not considered a potential source of significant contamination.

The electricity substation located c.78m north-west of the site has not been considered a viable source of contamination due to the fact that PCBs have low-mobility, and any form of contamination would be localised to the immediate area of the substation.

4.2 Pathways

Human dermal contact (within areas of soft landscaping);
Human ingestion (within areas of soft landscaping);
Human inhalation of dust or vapours (within areas of soft landscaping and within limited ground floor building spaces);

Direct contact with buried concrete/water supply services;
Leaching and/or migration through permeable soils (granular Made Ground if encountered and/or the Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated)).

4.3 Receptors

End users of the site (Human Health);
Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated) – Principal Aquifer (Controlled Waters);
Buried foundation/substructure concrete (Building Materials);
Water supply services (Building Materials).

4.4 Source/Pathway/Receptor Linkage and Assessed Risk

Source-pathway-receptor (SPR) linkages are tabulated below together with the qualitatively assessed risk. The risk to ground workers and construction workers is not included here due to the short-term exposure times that they will be subject to and the assumption that good hygiene practices will be adopted on site and the appropriate use of relevant PPE/RPE will be adhered to when exposed to potentially contaminated soils. Comments regarding contamination issues with respect to ground workers and construction workers are included in the health and safety section of the Standard Procedures included as Appendix F.

Source	Pathway	Receptor	Risk*
Potential contaminants in any localised Made Ground on site – historic/current site use (stockpiled mound, stockpiled debris, bonfire, area of stored farm machinery/equipment).	Inhalation, ingestion, dermal contact	End Users	Low
	Leaching/ migration	Principal Aquifer (Controlled Waters)	Low
	Direct contact	Water supply pipes	Low
Potential hydrocarbon leaks/ spillages associated with agricultural machinery stored in the north-west of the site or from machinery used to maintain the field (petroleum hydrocarbons)	Inhalation, ingestion, dermal contact	End Users	Low
	Leaching/ migration	Principal Aquifer (Controlled Waters)	Low
	Direct contact	Water supply pipes	Low to Medium
Potential contaminants within Made Ground associated with offsite industrial site usage (hydrocarbons and volatile organic compounds)	Vertical and lateral migration and leaching	Principal Aquifer (Controlled Waters)	Low
Potential hydrocarbon leaks/ spillages associated with the offsite garages to the north of the site	Vertical and lateral migration and leaching	Principal Aquifer (Controlled Waters)	Low

Source	Pathway	Receptor	Risk*
Ground gas from Made Ground soils on and off-site sources (methane, carbon dioxide, VOC's).	Migration into building, service ducts, etc (inhalation/ explosion)	End Users	Negligible to Low
Elevated sulphates in Made Ground/natural soils (on site)	Direct contact	Buried concrete	Negligible to Low

*** Definition of Risk Categories**
Negligible - Contaminants that might have unacceptable impact on key receptors, are unlikely to be present, or, no pathway is envisaged.
Low Risk: Contaminants may be present but are unlikely to be at levels to have unacceptable impact on key receptors, or pathways are likely to be minimal.
Medium Risk: Contaminants are probably present and might have an unacceptable impact on key receptors. Pathways may also be present therefore remedial measures may be necessary to reduce the risks.
High Risk – Contaminants probably or certainly present and pathways are probably also present. Therefore, contaminants are likely to have an unacceptable impact on key receptors and remedial measures are likely to be necessary to reduce the risks to acceptable levels.

5.0 GROUND INVESTIGATION WORKS

5.1 Initial (Main) Fieldwork

The following scope of fieldwork was undertaken by Applied Geology between the 4th and 13th of May 2021:

2 No 150mm diameter Cable Percussion boreholes (ref. BH1 and BH2) to depths of 2.39m and 4.55m bgl;
5 No Driven Continuous Sampling boreholes (ref DCS1 to DCS5) to depths of between 1.69m and 2.41m bgl with follow on dynamic probing to depths of between 1.94m and 6.83m bgl;
7 No Machine Excavated Trial Pits (ref. TP1 to TP7) to depths of between 0.60m and 2.20m bgl;
Soakaway infiltration tests within TP2 and TP5.

Fieldwork was generally carried out, where relevant, in accordance with BS5930 (2015) "Code of Practice for Site Investigations" and was supervised by an experienced Geoenvironmental Engineer.

The borehole and trial pit records are included in Appendix C, together with an SPT summary and calibration certificate. The soakaway records are included in Appendix D.

The locations of the exploratory holes were selected by Applied Geology and set out on site and cleared for the presence of underground services by specialist contractor Midland Survey Limited. The Cable Percussion and Driven Continuous Sampling boreholes were positioned roughly within the footprint of the proposed structures for geotechnical purposes. The Trial Pit excavations were located in areas of proposed car parking/ hardstanding and soft landscaping. Some of the trial pits also coincide with areas of potential concern as identified from the walkover and the desk study, in order to obtain samples for subsequent contamination analysis. This is summarised further in the table below;

Area of concern	Investigation Location	Rationale
Stored disused/relict farm equipment/machinery	TP1	TP1 was located in the north-western corner of the site in the area of the disused/relict farm equipment/machinery in order to confirm the absence/presence of hydrocarbon leakages/spillages.
Bonfire area	TP3	TP3 was located within the area utilised for bonfires, in order to confirm the absence/ presence of hydrocarbons/PAHs in the site soils.
Stockpiled mound of unknown material	TP7	TP7 was located on the southern extent of the mound in order to confirm the composition of the stockpiled materials and the presence/absence of any significant contamination.

5.2 Supplementary Fieldwork

The following scope of fieldwork was undertaken by Applied Geology on the 2nd and 3rd of September 2021:

2 No Rotary Cored boreholes (ref. RC01 and RC02) to depths of 9.28m and 9.69m bgl.

The borehole records are included in Appendix C, together with an SPT summary and calibration certificate.

The rotary cored boreholes were advanced within the footprint of the proposed structure to confirm or otherwise the presence of competent chalk within the full influencing depth of the anticipated foundations. The boreholes were drilled using a track mounted Commachio 205 drilling rig and were advanced using equipment to drill 121mm diameter boreholes with water flush. Following completion, Standard Penetration Tests (SPTs) were undertaken at the base of each borehole. Core of approximately 92mm diameter was recovered within core liners from the base of the hand dug pits (1.20m bgl) to base depths of 9.20m and 9.60m bgl. Samples of core were obtained in either 1.0m or 1.5m length runs and were subsequently stored in core boxes. The core was photographed, logged and sub-sampled by an Applied Geology engineer at the time of the intrusive investigation.

The positions of the exploratory holes were surveyed to National Grid and levelled to Ordnance Datum by Midland Survey Ltd. The locations of the exploratory holes are presented on the Exploratory Hole Location Plan (AG3261-21-02 Rev 1) included in Appendix A and the co-ordinates and levels are included on the exploratory hole records in Appendix C.

5.3 Instrumentation and Monitoring

On completion of boring, 50mm diameter standpipes were installed in selected Driven Continuous Sampling boreholes as follows, with further details included in the relevant borehole logs in Appendix C:

Location	Standpipe installation response zone	Stratum
DCS1	Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated)	0.50 to 1.50
DCS2	Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated)	0.50 to 1.50
DCS3	Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated)	1.00 to 2.00

Washed silica gravel (2-6mm) was used as the filter medium. Each standpipe was fitted with a push-in bung and single gas tap and was finished with a flush metal cover concreted in place.

Based on the findings of the desk study it is considered unlikely that a potential source material generating ground gases exists at the site. As such, three confirmatory ground gas monitoring visits were undertaken to coincide with the groundwater monitoring visits undertaken between the 11th and the 24th of May 2021. Each monitoring well was monitored for concentrations of carbon dioxide, methane, oxygen VOCs, flow rates and differential pressures and water level. The monitoring results are included in Appendix D.

5.4 Laboratory Testing

Geotechnical laboratory testing was initially undertaken by specialist laboratory Terra Tek Ltd (UKAS lab no. 0126) as part of the Initial (Main) investigation works. The supplementary rock testing was undertaken by Professional Soils Laboratory (UKAS lab no. 4043). Collectively, the geotechnical testing comprised the following:

10 No BRE SD1 natural ground suite tests;
6 No Chalk moisture content, porosity and density tests;
10 No Franklin Point Load tests (axial and diametral).

Chemical testing was undertaken by specialist laboratory Chemtest (UKAS lab no. 2183). The scope of testing was based on the desk study, walkover and site observations during the fieldwork.

Made Ground

One sample of the stockpiled Made Ground (TP7) was analysed for the following suite of contaminants:

Selected metals suite [arsenic, cadmium, chromium (total, trivalent and hexavalent), copper, mercury, nickel, lead, zinc, selenium, Boron, Beryllium and Vanadium];
Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
Phenols (total);
pH;
Water soluble sulphate;
Asbestos Containing Materials (ACM) Screen;
Soil organic matter;

Total Petroleum Hydrocarbons (TPH) by the Criteria Working Group (CWG) method;
Benzene, toluene, ethylbenzene and xylene (BTEX); and
Methyl tertiary butyl ether (MTBE).

Natural Strata

Five samples of Topsoil and two samples of the underlying Chalk strata were analysed for the following suite of contaminants:

Selected metals suite [arsenic, cadmium, chromium (total), copper, mercury, nickel, lead, zinc, selenium, boron, beryllium, vanadium];
Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
pH;
Water soluble sulphate;
Asbestos Containing Materials (ACM) Screen;
Soil organic matter;
TPH CWG; and
BTEX and MTBE.

One Inert WAC test was also undertaken on a sample of the Chalk strata, as requested by the Client.

Leachate

Leachate analysis was carried out on two samples of Topsoil for the following suite of contaminants:

Selected metals suite [arsenic, cadmium, chromium (total, trivalent and hexavalent), copper, mercury, nickel, lead, zinc, selenium, vanadium];
Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
pH;
Water soluble sulphate.

Copies of the laboratory test results are included in Appendix E.

6.0 GROUND CONDITIONS

6.1 Strata Encountered

The ground investigations have typically identified a nominal covering of Topsoil directly underlain by Solid Geology of the Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated). Made Ground was only encountered within the relatively small, stockpiled mound located in the west of the site.

Full details of the strata encountered are given on the borehole records presented in Appendix C. A generalised ground profile is presented below to summarise the information. An SPT ‘N’ value versus depth plot is presented in Appendix A.

Stratum	Depth to Top of Strata (m bgl)	Depth to Base of Strata (m bgl)	Comments
Made Ground	Above GL mound	Above GL mound	Only encountered in TP7 which was undertaken on the small, stockpiled mound in the west of the site.
Topsoil	GL	0.25 to 0.60	Encountered in all exploratory holes across the site excluding TP7.
Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated)	0.25 to 0.60	Proven to the full depth of the investigation (4.55m bgl)	Encountered in all exploratory holes across the site excluding TP7, which terminated shallow in the stockpiled Made Ground soils.

6.2 Made Ground

Made Ground was encountered in TP7 only, which comprised the small, stockpiled mound in the west of the site. The material comprised dark brown slightly clayey, slightly gravelly sand with occasional roots and rootlets and gravels of chalk, flint, brick and concrete. The trial pit was terminated at a depth of 0.60m due to the presence of cement-based sheeting (likely asbestos), therefore, it was not possible to determine whether the Made Ground extended beneath the existing ground level.

Some form of Made Ground, such as a uniform gravel (pea gravel), will likely be present around the north to south and east to west orientated sewage pipes present on site. It is considered likely that such utilities will require re-routing as part of the proposed development.

6.3 Topsoil

Topsoil was encountered from surface across the majority of the site (excluding TP7) and was proven to depths of between 0.25m (TP1 and TP5) and 0.60m bgl (BH1 and BH2). The Topsoil typically comprised brown slightly clayey sand with occasional fine to coarse subangular to subrounded flint and chalk gravels.

6.4 Chalk

Strata considered to represent the Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated) were recorded in all exploratory holes with the exception of TP7, which terminated shallow in the stockpiled Made Ground. The stratum was encountered directly beneath the Topsoil from depths of between 0.25m (TP1 and TP5) and 0.60m bgl (BH1 and BH2) and was proven to the full depth of the investigation (9.69m bgl).

As part of the Cable Percussion and Driven Continuous Sampling drilling, the methods of sampling severely disturb any structure present in Chalk strata, leading to the recovery of highly disturbed samples. As such, full engineering descriptions and the assignment of Chalk grades was only possible for the chalk viewed en masse within the trial pit excavations and the retrieved rock core.

Structureless Grade Dc (clast dominated) Chalk was encountered directly beneath the Topsoil in TP5 only and was proven to a depth of 1.10m bgl. The strata

comprised structureless greyish white to white very silty medium to high density Chalk with occasional cobbles of Chalk.

Chalk interpreted as structured in-situ was generally encountered directly beneath the Topsoil and beneath the Grade Dc Chalk in TP5 and extended to the full depth of the investigation (9.69m bgl). Whilst the materials excavated as part of the trial pitting were recovered as structureless, the sidewalls of the trial pits generally comprised greyish white to white medium strong to strong (strength inferred) Chalk (Grade B3). The retrieved rock core generally comprised weak to moderately weak medium to high density off-white to white Chalk (Grade B3 to B4) with closely to very closely spaced clean open (rarely infilled) fractures/discontinuities.

Twenty in-situ SPT tests were carried out within the Undifferentiated Chalk strata, recording 'N' values of between N=13 and N=>100 (extrapolated) at 1.2m bgl, and 'N' values of N=16 and N=>100 (extrapolated) at 2.0m bgl. The SPT vs depth plot shows a slight increase in strength with depth.

Following SPT 'refusals' in the Driven Continuous Sampling boreholes, follow-on dynamic probing was undertaken. The dynamic probing in DCS1, DCS2, DCS3 and DCS5 generally recorded N100 values of between 20 and 38 at the base of the DCS boreholes (c.1.60m to 2.30m bgl), which likely represent the disturbed ground at the base of the sampling. From depths of between 1.90 and 2.20m bgl, relatively consistent N100 values of >50 were recorded down to depths of 2.00 to 2.80m bgl, which likely represents the undisturbed intact Undifferentiated Chalk strata. Dynamic probing at the base of DCS4 (in the south of the site) recorded lower N100 values of between 6 and 12 at depths of between 2.50 and 6.60m bgl, upon which N100 values of 28 to >50 were recorded to the base at 6.80m bgl.

Six saturation Moisture Content (SMC) tests were undertaken on bulk samples of Chalk and recorded dry density values of between 1.63Mg/m^3 and 1.79Mg/m^3 (mean 1.71Mg/m^3), indicating medium to high density Chalk. The tests also recorded moisture contents of between 18% and 23% (mean 20%), SMCs of between 19% to 24% (mean 22%) and porosity values of between 34% and 40% (mean 37%). These results suggest the chalk is generally at or close to full saturation.

A summary of the rock core detail is given in the table below, which demonstrates the variabilities in core recovery within the two boreholes.

Borehole	Range of TCR (%)	Range of SCR (%)	Range of RQD (%)	Range of average If (mm)	Comments
RC01	83 to 100	27 to 91	0 to 30	0 to 90	No recovery from …. 1.52m to 1.72m bgl 2.05 to 2.10m bgl 6.60m to 6.87m bgl 7.92m to 8.10m bgl 8.25m to 8.42m bgl 8.57m and 8.68m bgl
RC02	93 to 100	57 to 97	0 to 59	0 to 170	No recovery from…. 1.20m to 1.44m bgl 1.95m to 2.10m bgl 3.55m to 3.60m bgl 3.92m to 4.07m bgl 4.94m to 5.61m bgl 5.86m to 5.90m bgl 6.04m to 6.12m bgl 6.47m to 6.60m bgl 6.60m to 6.78m bgl 7.91m to 8.27m bgl 9.19m to 9.40m bgl

Key
TCR – Total Core Recovery
SCR – Solid Core Recovery
RQD – Rock Quality Designation
IF- Fracture Spacing

Laboratory testing of samples of rock core was undertaken using point load testing and the $I_{S(50)}$ results have been plotted against depth and shows a generally consistent trend with depth (See Appendix A).

6.5 Groundwater and Soakaway Tests

Groundwater was not encountered in any of the boreholes or trial pits during formation or during the subsequent monitoring of standpipes. Based on archival BGS borehole logs, groundwater is anticipated to be at depths greater than 15m bgl.

Preliminary soakaway tests were carried out within two open trial pits located in the north (TP2) and south (TP5) of the site. The trial pits were terminated shallow at depths of 1.53m (TP2) and 1.50m bgl (TP5) within the rock strength Chalk. The soakaway tests were carried out in general accordance with BRE Digest DG365 methodology and three test fills were undertaken over the course of the day. The results of the tests are included in Appendix D, including the calculations in accordance with BS 5930 (BSI, 1999) and summarised in the table below:

Test ID	Stratum	Test results (m/s)
TP2 (Fill 1)	Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated)	$2.63x10^{-4}$
TP2 (Fill 2)		$2.48x10^{-4}$
TP2 (Fill 3)		$2.03x10^{-4}$
TP5 (Fill 1)	Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated)	$1.27x10^{-4}$
TP5 (Fill 2)		$1.18x10^{-4}$
TP5 (Fill 3)		$1.21x10^{-4}$

As is normal and expected the infiltration rates generally reduced with successive fills of the test pits and it is recommended in BRE DG 365 that the results from the third fill is taken as being the most representative for long term design purposes.

6.6 Contamination

Generally, no significant visual or olfactory evidence of gross contamination was recorded across the site. Several fragments of cement-based sheeting were encountered within the granular Made Ground in the stockpiled mound in the north-west of the site. Chemical analysis was undertaken on a sample of this material and no asbestos was detected (further discussed in Section 7).

No visual or olfactory evidence of contamination was recorded within the natural soils across the site.

All Environmental Samples of Made Ground, Topsoil, and Undifferentiated Chalk were screened on-site using a Photo Ionisation Detector (PID) to determine the presence of VOCs within the soils. The screening returned values consistently below the level of detection (<0.1ppm), which are considered negligible and of limited significance.

6.7 Soil Gas

The results of the ground gas monitoring undertaken indicated methane concentrations below the limit of detection (<0.1%) together with carbon dioxide concentrations of between 0.8% and 1.9%. Oxygen concentrations were recorded between 16.9% and 19.2% and average flow rates were recorded at below the limit of detection (<0.1l/hr).

Based on the highest recorded steady carbon dioxide and methane concentrations and the highest average flow rate from the three visits, gas screening values have been calculated in accordance with CIRIA C665 of 0.0019l/hr (carbon dioxide) and 0.0001l/hr (methane).

All VOC, Carbon Monoxide and Hydrogen Sulphide concentrations were noted to be of low order and often below the limit of detection (<0.1ppm) and therefore are of no significant concern.

7.0 GEOENVIRONMENTAL ASSESSMENT

7.1 Human Health Risk Assessment

The results of the chemical testing on soils have been assessed as described in Appendix F, with specific details as follows:

> Proposed end-use – residential care home facility;
> Screening criteria – residential without plant uptake, assuming 2.5% SOM and 6% SOM. Assuming two datasets based on the strata encountered: dataset (1) Stockpiled Made Ground (2) In-situ Natural Strata;

There are no published generic screening criteria for a care home facility end use. It could be argued that the critical receptor is an adult worker present on site from the age of 16 to 65. Therefore, a commercial end use criterion could be considered

appropriate. However, to reflect the end use as predominantly residential with respect to the care home facility, a more conservative Residential without plant uptake criterion has been used to give an initial screen for the entire site. Should greater landscaping or allotment style gardens be incorporated into final plans, the conclusions below would need to be reviewed and potentially compared to more onerous screening criteria such as Residential with plant uptake screening values.

The spreadsheets summarising the laboratory results and relevant screening values for each dataset are presented in Appendix E. A review of the chemical testing undertaken on the soil samples analysed has identified the majority of the results to be below the screening criteria for a 'residential without plant uptake' end use. However, the following three exceedances were recorded within the sample of stockpiled Made Ground obtained from TP7.

Lead exceedance in TP7 at 0.30m bgl (390mg/kg against a screening value of 310mg/kg);
Benzo[b]fluoranthene exceedance in TP7 at 0.30m bgl (8.3mg/kg against a screening value of 4mg/kg);
Benzo[a]pyrene exceedance in TP7 at 0.30m bgl (6.5mg/kg against a screening value of 3.2mg/kg);

A localised marginal exceedance of Dibenzo[a,h]anthracene (0.37mg/kg against a screening value of 0.32mg/kg); was recorded in the in-situ Topsoil in DCS2, which is located centrally on site within the footprint of the proposed development.

Collectively, of the eight samples submitted for hydrocarbon analysis, five recorded total concentrations at less than the laboratory detection limit (10mg/kg). The remaining three tests low concentrations of hydrocarbons of between 14mg/kg and 71mg/kg in the Topsoil and 240mg/kg in the stockpile, which remained below the relevant screening criteria.

All samples from both datasets recorded BTEX, MTBE, and Phenol concentrations below the laboratory limits of detection.

Laboratory screening for asbestos did not detect the presence of Asbestos Containing Materials (ACM) within any of the samples tested, including the sample from the stockpiled Made Ground (TP7 at 0.30m bgl) where cement-based sheeting was noted.

The documented exceedances were predominantly encountered within the stockpiled Made Ground in the west of the site. The localised exceedance of Dibenzo[a,h]anthracene in the in-situ Topsoil is considered marginal and therefore of no concern. Given the stockpiled materials are likely to be removed from site during the development, the risks to human health are considered to be low. Further detail will be provided in the conclusion section of this report.

7.2 Controlled Waters Risk Assessment

The Principal Aquifer beneath the site (Undifferentiated Chalk) is considered to be the Key Controlled Water receptor. In the absence of groundwater within the investigated strata, the potential for complete pollutant linkages associated with leaching and vertical migration from impacted soils has been semi-quantitatively assessed using the results of the soil leachate analysis, as detailed below.

As the Made Ground at the site was encountered stockpiled above ground level, two samples of Topsoil (TP1 at 0.10m bgl and TP3 at 0.20m bgl) were analysed to examine their metal and PAH leaching potential. The results were compared directly to the Controlled Waters screening values based on the UK Drinking Water Standards 2010 (UK DWS). In the absence of a relevant standard, the laboratory limit of detection has been used as an initial screen. The results are tabulated and are presented in Appendix E.

Following the initial screening, the two samples tested identified the following exceedances;

Chromium (Total) exceedance in TP1 at 0.10m bgl (330mg/l against a screening value of 50µg/l);
Chromium (Total) exceedance in TP3 at 0.20m bgl (110mg/l against a screening value of 50µg/l);
Nickel exceedance in TP1 at 0.10m bgl (190mg/l against a screening value of 20mg/l);
Nickel exceedance in TP3 at 0.20m bgl (77mg/l against a screening value of 20mg/l);
Vanadium exceedance in TP1 at 0.10m bgl (2.7ug/l against a screening value of 1ug/l): and
Vanadium exceedance in TP3 at 0.20m bgl (1.7ug/l against a screening value of 1ug/l).

Chromium (Total), Nickel and Vanadium are all considered to be non-hazardous and so do not warrant any further consideration. Both samples recorded PAH concentrations to be below the laboratory limit of detection.

No evidence of significant contamination has been identified on site within the Topsoil and underlying natural strata. Furthermore, groundwater was not encountered during formation/excavation of the exploratory holes or during the returned monitoring programme.

Based on the available information, including site history, visual and olfactory observations and results of chemical analysis, there is considered to be a negligible to low risk to Controlled Waters.

7.3 Disposal of Soil Arisings

General comments regarding the procedures for the assessment of waste soil for off-site disposal purposes is included in Appendix F. Under the Waste Framework Directive, naturally occurring soils are not considered waste if reused on the site of origin for the purposes of development. The comments below only apply if surplus soil is sent off-site for disposal.

With respect of the chemical testing and Human Health risk, the Topsoil is generally considered suitable for retention and re-use on site. Determination of other suitability Criteria for Topsoil re-use is outside the scope of this investigation.

With regards to potential waste disposal of the Made Ground, the samples tested indicate contaminants at concentrations that would likely be classified as non-hazardous waste. Currently no non-hazardous WAC is in place.

Whilst the laboratory screening for asbestos did not detect the presence of ACM within any of the samples tested, visual suspected ACM was encountered within TP7, which was undertaken on the stockpiled mound of Made Ground in the west of the site. Similar corrugated cement-based (possible asbestos) sheeting/roof materials were stockpiled to the adjacent west of the mound, as documented in Section 2.1 above. As the stockpiled Made Ground will likely be disposed of as part of the development, it is recommended that further subsampling and testing is undertaken by an appropriately qualified person. In order to mitigate disposal costs, it is recommended that the stockpile be turned over with the aid of an excavator and where any visible ACM is encountered (as per TP7), the ACM should, where feasible, be separated from the soils by hand by a qualified contractor and then be disposed of at an appropriate landfill.

Inert WAC testing was undertaken on one sample of the Undifferentiated Chalk strata obtained from within the footprint of the proposed residential care home facility (DCS2 at 0.40m bgl). The results demonstrate general compliance with the WAC limits for inert landfills.

7.4 Conclusions and Recommendations

Based on the above assessment, it is considered that the site generally presents a low risk to human health and a negligible to low risk to Controlled Water receptors and, therefore, no remediation is considered necessary prior to construction. However, should any suspected contamination be identified during the development, a specialist should be consulted to enable additional investigation and testing.

Careful segregation of soils should be undertaken if proposing to dispose of surplus soils off-site to landfill.

Issues with respect to ground gas and potential effects of contaminants on buried concrete and water supply pipework are included in Section 8.0.

8.0 GEOTECHNICAL ASSESSMENT

8.1 General

The proposals for the site comprise the construction of a two to three-storey residential care home facility across much of the central region of the site, with associated car parking to the north-east and a new access road off Miswell Lane. All remaining areas are proposed for communal landscaped gardens. No loading information was available at the time of writing.

The ground investigation has identified a covering of Topsoil (0.25 to 0.60m bgl) directly underlain by Solid Geology of the Holywell Nodular Chalk Formation and

New Pit Chalk Formation (Undifferentiated), which was proven to the full depth of the investigation (9.69m bgl). Groundwater was not encountered in any of the boreholes or trial pits during drilling/excavation or during the subsequent monitoring of installations.

8.2 Foundation Design

It is considered that the structured in-situ Chalk will form suitable founding strata to support conventional strip/trench fill or pad foundations. Foundations must be placed below any Made Ground (if encountered locally) or disturbed ground and also beneath any soft or loose natural materials (if encountered) and embedded into the underlying competent Chalk.

The ground conditions include soils of low shrinkage potential, hence a minimum foundation depth of 0.75m bgl with apply to the site to cater for seasonal variations.

Strip/trench fill (up to 1m wide) and pad foundations (up to 2m x 2m) competently designed to the above requirements may adopt safe net design bearing pressures of up to 200kN/m^2. This is based on the lower bound values within BS8004:1986 Table 2 and CIRIA C574 for a structured chalk and using engineering judgement, whilst taking into account observations of the strata and both in-situ and laboratory test results. At such bearing pressures settlements are considered to be within typical tolerance (up to 25mm).

It is recommended that any chalk that becomes ‘puttied’ by mechanical excavation be removed, by hand trimming if necessary and the exposed formation be blinded immediately after excavation.

If conditions, significantly at variance to those described herein are encountered, specialist geotechnical advice should be sought to make appropriate assessment and recommendations.

8.3 Floor Slab and Gas Protection

It is considered that lightly loaded ground bearing floor slabs bearing upon the in-situ chalk strata will be feasible at the site. However, should construction take place during periods of sub-zero temperatures the floor slabs should be insulated in line with the recommendations in CIRIA C574 to prevent damage from potential frost-heave. The formation should be proof rolled and any soft spots removed and replaced with suitable granular fill.

Based on the conceptual model, the ground conditions encountered, and confirmatory ground gas monitoring undertaken, the site may be characterised as Characteristic Situation 1 (CIRIA C665) for which no special precautions against ground gas are required. Radon protection measures are also not considered necessary.

8.4 Excavations

All seven trial pits advanced as part of this investigation remained stable during excavation, although minor sidewall collapse was noted during the first soakaway fill in both TP2 and TP5.

Cut faces in chalk rock are likely to be stable at relatively steep angles in the very short term, though stability cannot be guaranteed. If required, trench support or the angle of batter should be designed by an appropriately qualified engineer or competent person to suit the required depth and the ground and groundwater conditions. Groundwater was not encountered during the intrusive works or the subsequent monitoring and so significant groundwater ingress is not expected in excavations. However, it is recommended that some provision for sump pumping equipment is made available to control seepages or run-off in wet weather conditions.

8.5 Pavement Design

Topsoil and any organic subsoil should be removed from below any proposed roads, car parking and hardstanding.

Based on a review of soil type, construction conditions and reference to IAN 73/06, an equilibrium CBR value of 4% is recommended for the Undifferentiated Chalk strata.

It should be noted that chalk is susceptible to frost heave in winter months and so it is recommended that these soils are not present within the top 450mm of road pavement construction (hardstanding).

8.6 Soakaways

Based upon the results of the soakaway tests described in Section 6, the Chalk is considered suitable for the discharge of surface run-off water into conventional soakaways.

The EA should be contacted at the design stage in order to obtain a 'consent to discharge' and planning approval will also be required for their use.

The guidance in CIRIA C574 ‘Engineering in Chalk’ recommends that soakaways in Chalk should be located well away from foundations for structures and roads and quotes a minimum 10m for low density chalk and minimum 5m for medium density chalk or better. Collectively, the laboratory results suggest the chalk is of medium to high density and therefore a standoff of 5m is considered appropriate.

8.7 Buried Concrete and Services

As defined by BRE Special Digest 1, Concrete Aggressive Ground, 2005 the Design Sulphate Class and the Aggressive Chemical Environment for Concrete (ACEC) has been assessed for the Undifferentiated Chalk strata. Following the results of the chemical and geotechnical testing, the characteristic values have been determined and are detailed below;

Chalk (12 samples)

Water soluble sulphate: <0.1g/l (rounded to the nearest 0.1g/l)
pH: 8.5

In accordance with the guidance in BRE SD1 the characteristic value for the Undifferentiated Chalk has been determined based on the mean average of the highest 20% of results (where 10 samples or more).

The Design Sulphate Class for the Undifferentiated Chalk is DS-1 and AC-1s, as defined by the BRE Special Digest 1, Concrete Aggressive Ground, 2005 for a static groundwater regime. Further reference should be made to BRE Special Digest 1 for requirements in respect of types of cement and aggregate to be used and variations in type of concrete construction.

The results of the laboratory testing undertaken have indicated concentrations of TPH at less than the threshold for Polyurethane pipes. Barrier supply pipes, therefore, may not be necessary on this site. It should be noted that the full suite of testing required by the UKWIR guidance has not been undertaken as part of this investigation and such testing may be required by the Water Authority once pipeline routes are known. Further guidance on this subject is included in Appendix F.

8.8 Conclusions and Recommendations

Traditional strip/trench fill or pad foundations bearing within the structured in-situ Chalk designed in accordance with the recommendations specified in Section 8.2, may adopt a safe net design bearing capacity of up to 200kN/m^2.

It is recommended that a watching brief is undertaken for signs of dissolution features or other natural cavities or Chalk mining (although not anticipated at this site) during any groundworks and construction of foundations undertaken at the site.

A ground bearing floor slab bearing upon the in-situ Chalk is considered feasible.

No gas protection measures, or water supply pipe materials are considered necessary.

Conventional soakaways are likely to be suitable at this site subject to the EA and planning approval and provided design is undertaken with in accordance with recommendations provided in CIRIA C574 ‘Engineering in Chalk’.

Sulphate resistant concrete is not required.

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GENERAL NOTES

A) The assessment made in this report is based on the site terrain and ground conditions revealed by the various field investigations undertaken and also any other relevant data for the site including previous site investigation reports (if available) and desk study data. There may be special conditions appertaining to the site, however, which have not been revealed by the investigation and which have not, therefore, been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available. It must be recognised that many of the Environmental Searches obtained during the course of the desk study are often lengthy. Applied Geology have, where appropriate and in the interests of simplicity, only reproduced the summary of the searches within the report. A full copy of all the search data is held at the Applied Geology office and is available for inspection if required.

B) The services provided are defined within our proposal and are carried out in line with the terms of appointment between Applied Geology and the Client.

C) Where any data supplied by the Client or other external source, including that from previous site investigations, has been used it has been assumed that the information is correct. No responsibility can be accepted by Applied Geology for inaccuracies within this data.

D) Whilst the report may express an opinion on possible configurations of strata between or beyond the exploratory locations, or on the possible presence of features based on either visual, verbal or published evidence this is for guidance only and no liability can be accepted for the accuracy.

E) Comments on groundwater (and landfill gas) conditions are based on observations made during the course of the present and past investigations or with reference to published data unless otherwise stated. It should be noted, however, that groundwater (and landfill gas) levels vary due to seasonal (or atmospheric conditions) or other effects.

F) The copyright of this report and other plans (and documents prepared by Applied Geology) is owned by Applied Geology and no such report, plan or document may be reproduced, published or adapted without the written consent of Applied Geology. Complete copies of the report may, however, be made and distributed by the Client as an expedient in dealing with matters related to its submission.

G) This report is prepared and written in the context of the proposals stated in the introduction to the report and should not be used in a differing context. Furthermore, new information, improved practices and legislation may necessitate an alteration to the report in whole or in part after its submission. Therefore with any change in circumstances or after the expiry of one year from the date of the report, the report should be referred to Applied Geology for re-assessment and if necessary, re-appraisal.

H) The survey was conducted and this report was prepared for the sole internal use and reliance of the Client. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Applied Geology. If an unauthorised third party comes into possession of this report they rely on it at their peril and Applied Geology owes them no duty of care and skill.

I) Ground conditions should be monitored during the construction of the works and the recommendations of the report re-evaluated in the light of this data by the supervising geotechnical or geo-environmental engineers.

J) Unless specifically stated, the investigation has not taken into account the possible effects of mineral extraction.

K) The works performed are not a comprehensive site characterisation and should not be construed as being such.

L) The findings of the geo-environmental risk assessment are based on information obtained from a variety of sources which Applied Geology believe to be correct. Applied Geology cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

M) The report represents the findings and opinions of experienced geo-environmental consultants. Applied Geology does not provide legal advice and the advice of lawyers may be required.

N) Conditions at the site are subject to change from the time of the site inspection.

O) It is possible that researches carried out by Applied Geology, whilst fully appropriate for a phase 1 desk study, failed to indicate the existence of important information sources. Assuming such indicators actually exist, their information could not have been considered in the formulation of Applied Geology findings and opinions.

P) The economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, depends on very many factors in addition to geotechnical considerations and hence its evaluation is outside the scope of this report.

Q) Applied Geology operates as a Consultancy and does not operate it's own laboratory for soil testing, this work being sub contracted to known and respected, generally UKAS accredited, laboratories. Applied Geology can therefore not be held responsible for the testing carried out.

LIST OF REFERENCES COMMONLY USED BY APPLIED GEOLOGY IN REPORTS

SECTION/TITLE	AUTHOR/PUBLICATION
LABORATORY TESTING	
BS 1377-1:2016 Method of Test for Soils for Civil Engineering Purposes	BSI
SITE WORK	
Guidelines for Combined Geoenvironmental and Geotechnical Investigations. Issue 2. March 2006.	AGS
BS 5930:2015. Code of Practice for Ground Investigations	BSI
BS 10175:2011 & A1:2013 Code of Practice for the Investigation of Potentially Contaminated Sites	BSI
FOUNDATION DESIGN	
BS EN 1997-1 Eurocode 7 – Geotechnical Design, Part 1. 2004.	BSI
BS EN 1997-2 Eurocode 7 – Geotechnical Design, Part 2. 2007.	BSI
Paper by M. A. Stroud 'The Standard Penetration Test – its Application and Interpretation' within Thomas Telford/ICE book 'Penetration Testing in the UK'. 1989.	Stroud
BRE Special Digest 1: 2005 Third Edition. Concrete in Aggressive Ground	BRE
NHBC Standards, Chapter 4.2: Building Near Trees. 2017.	National House Building Council
Engineering in Chalk (C574). 2002.	CIRIA
Engineering in Mercia Mudstone (C570). 2001.	CIRIA
Engineering in Glacial Till (C504). 1999.	CIRIA
GROUND GAS	
BRE 211 Protecting New Buildings from Radon. 2015.	BRE
BS 8485:2015 Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings.	BSI
Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present. 4th Ed, 2007	NHBC & RSK Group
Assessing Risks Posed by Hazardous Ground Gases to Buildings. C665. 2007.	CIRIA
Research Bulletin 17. 2012.	CLAIRE
BS 8576:2015 Guidance on Investigations for Ground Gas. Permanent Gases and Volatile Organic Compounds (VOCs)	BSI
Guidance on the Use of Plastic Membranes as VOC Vapour Barriers. C748. 2014.	CIRIA
Remediating and Mitigating Risks from Volatile Organic Compound (VOC) Vapours from Land Affected by Contamination. C716. 2012.	CIRIA
GROUNDWATER	
BRE DG 365: Soakaway Design. 2016.	BRE
BS EN ISO 22282-2:2012 Geotechnical Investigation and Testing – Geohydraulic Testing, Part 2. 2012.	BSI
CONTAMINATION ASPECTS (Soil & Groundwater)	
Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance. 2012.	DEFRA
Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination - SP1010. 2014.	DEFRA
HPA Contaminated Land Information Sheet – Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons. Version 3. 2010.	HPA
Cover Systems for Land Regeneration. Thickness of Cover Systems for Contaminated Land. 2004. BR465.	AGS/BRE
Development of Generic Assessment Criteria for Assessing Vapour Risk to Human Health from Volatile Contaminants in Groundwater. Version 1.0. February 2017.	SOBRA
BS 3882:2015 Specification for Topsoil	BSI
The LQM/CIEH S4ULs for Human Health Risk Assessment, 2015. S4UL3159.	Chartered Institute of Environmental Health. Land Quality Management.
Generic Assessment Criteria for Human Health Risk Assessment. 2009.	Chartered Institute of Environmental Health. Land Quality Management.
Model Procedures for the Management of Contaminated Land. Contaminated Land Report. 11 September 2004.	DEFRA / Environment Agency
The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils. February 2005.	Environment Agency
The Environment Agency's Approach to Groundwater Protection, V1. 2017.	Environment Agency
Remedial Targets Methodology. Hydrogeological Risk Assessment for Land Contamination. 2006.	Environment Agency
Guidance for the Safe Development of Housing on Land Affected by Contamination	NHBC
Sampling Strategies for Contaminated Land. Contaminated Land Research Report no.4. 1994.	DoE
NHBC Standards, Chapter 4.1: Land Quality – Managing Ground Conditions. 2017.	National House Building Council
ATRISK^{soil} Soil Screening Values. 2017.	Atkins
CLEA Software (Version 1.071). 2015.	Environment Agency

The Water Supply (Water Quality) Regulations. 2016.	DWI
Prioritisation & Categorisation Procedure for Sites Which May Be Contaminated (CLR Report No6)	Department of the Environment, Contaminated Land Research Report
Code of Practice for the Investigation & Mitigation of Possible Petroleum-Based Land Contamination. 1993.	The Institute of Petroleum
Piling & Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. 2001.	Environment Agency
DISPOSAL OF SOIL	
Guidance on the Classification and Assessment of Waste. Technical Guidance WM3. 1st Ed. 2015.	SEPA, NIEA, Natural Resources Wales & Environment Agency
Waste Sampling and Testing for Disposal to Landfill. 2013.	Environment Agency
BURIED SERVICES	
Guidance for the Selection of Water Supply Pipes to be Used in Brownfield Sites. (10/WM/03/21). 2011.	UK Water Industries Research
PAVEMENT DESIGN	
Interim Advice Note 73/06 Rev 1, 2009. Design Guidance for Road Pavement Foundations (Draft HD25)	Highways Agency
PLANNING	
DCLG:2012 National Planning Policy Framework and Practice Guidance	Department for Communities and Local Government
HEALTH & SAFETY ASPECTS	
A Guide for Safe Working on Contaminated Sites (Report 132)	CIRIA
Protection of Workers and the General Public During the Development of Contaminated Land (HSG66)	Health & Safety Executive
Construction (Design & Management) Regulations 2015 (CDM)	Health & Safety Executive
Control of Substances Hazardous to Health Regulations 2002	Health & Safety Executive
Workplace Exposure Limits. EH40/2005	Health & Safety Executive
Trenching Practice. Guidance on Groundwater Control (Report 97)	CIRIA
Control of Groundwater for Temporary Works (Report 113)	CIRIA
Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks. C733. 2014.	CIRIA

APPENDIX A

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APPLiED GEOLOGY

Unit 23
Abbey Park
Stareton
Kenilworth
CV8 2LY

Tel: 02476 511822
email: admin@appliedgeology.co.uk

Client: MONTPELIER ESTATES

Project: LAND TO THE WEST OF MISWELL LANE, TRING

Drawn By:	Checked By:	Paper Size:
JS	MS	A4

Scale:	Date:	NGR:
NTS	30.04.2021	491442 211636

Drawing No: AG3261-21-01

Revision: 0

Title: SITE LOCATION PLAN

KEY:

TP1 — Trial Pit

BH1 — Cable Percussion Borehole

DCS1 — Driven Continuous Sampling Borehole

Drawing based on drawing supplied by client, drawing No: JAJO-EL-DR-6202 REV C02 dated 31st March 2019.

APPLiED GEOLOGY

Unit 23
Abbey Park
Stareton
Kenilworth
CV8 2LY

Tel: 02476 511822
email: admin@appliedgeology.co.uk

Client: MONTPELIER ESTATES

Project: LAND TO THE WEST OF MISWELL LANE, TRING

Title: EXPLORATORY HOLE LOCATION PLAN

Drawn By:	Checked By:	Paper Size:
JS	MS	A3

Scale:	Date:
1:500	30.04.2021

Drawing No:	Revision:
AG3261-21-02	0

Scale 1:500

0 5 10 15 20 25 (metres) 50

Rev.	Date	Description
A	25/6/20	Layout amended, Tree Survey incorporated

MISWELL LANE

Miswell Orchard

Proposed Care Home

Goldfield Mill House

Crossways

Barn Co

Windmill (disused)

Morningside Farm

Garage

ICKNIELD WAY

ESS

Tring Business Centre

WEAVERS R

MORNINGSIDE FARM, ICKNIELD WAY TRING

PROPOSED SITE PLAN

1:500 @ A2

Montpelier estates

31/01/2020 19025/F01/S02/RevA

IN SITU SOAKAWAY TEST RESULT

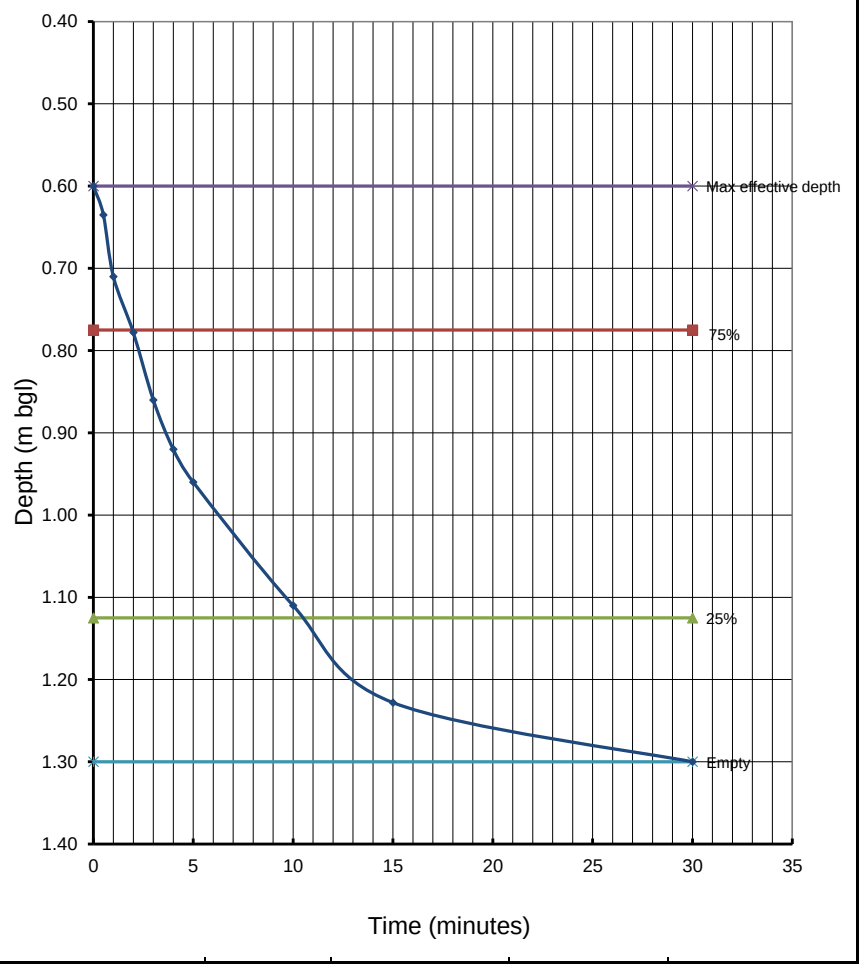
Trial Pit No.	TP2

Filling	1 of 3

Date	05.05.2021
Operator	MS
Test Strata	Chalk
Stability of pit	Stable - initially
Backfill used	None

Trial Pit Length (m)	2.42
Trial Pit Width (m)	0.53
Trial Pit Depth (m)	1.30
Amount of Backfill placed (m)	0
Assumed Backfill Void Ratio	N/A

Time (Minutes)	Water level (m.bgl)
0	0.60
0.5	0.64
1	0.71
2	0.78
3	0.86
4	0.92
5	0.96
10	1.11
15	1.23
30	1.30



Initial Water Level (m)	0.60	Total internal surface area of pit (m^2)	8.95
Final Water Level (m)	1.30	Internal surface area of trial pit within effective depth range (m^2)	3.35
Change in Water Level (m)	0.70	Volume outflowing between 75% and 25% effective depth (m^3)	0.45
Effective Depth at 25% (tp25) (m)	1.13	Time at 25% (tp25) (minutes)	10.5
Effective Depth at 75% (tp75) (m)	0.78	Time at 75% (tp75) (minutes)	2

Soil Infiltration Rate (m/s)	2.63E-04

Notes: 1. Undertaken in general accordance with BRE DG 365 method
2. Based on extrapolated data NO

Client:	Montpelier Estates
Project:	Land to the West of Miswell Lane, Tring
Project No.	AG3261-21

APPLiED GEOLOGY

IN SITU SOAKAWAY TEST RESULT

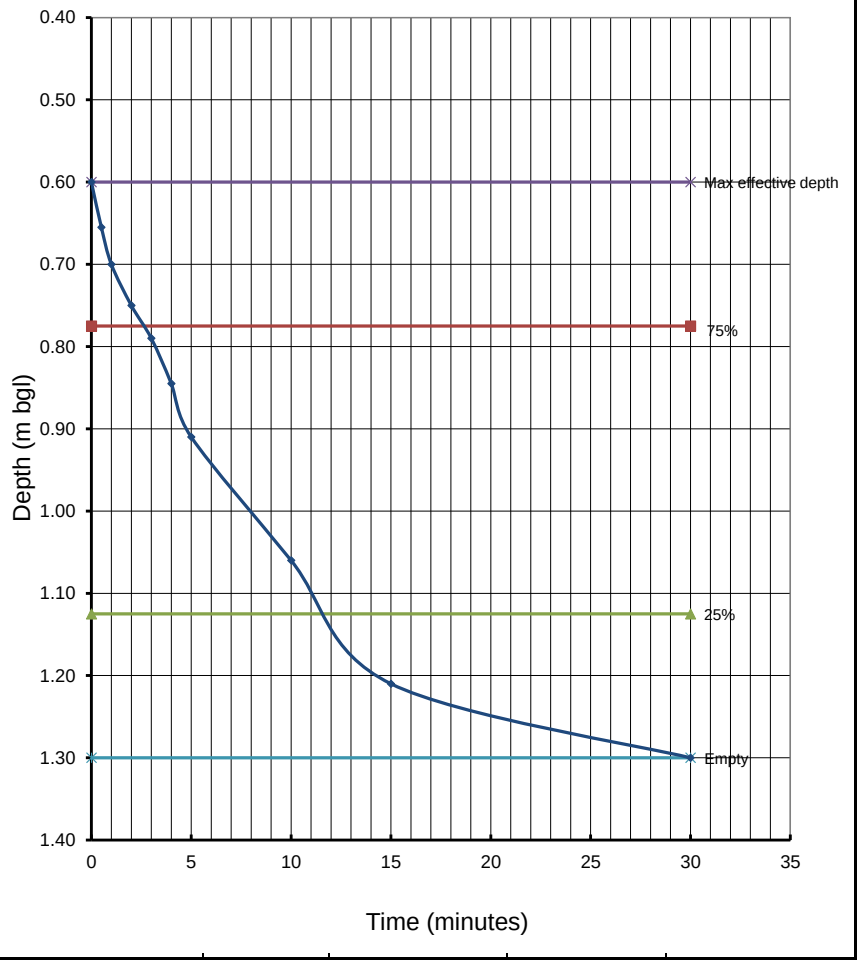
Trial Pit No.	TP2

Filling	2 of 3

Date	05.05.2021
Operator	MS
Test Strata	Chalk
Stability of pit	Stable - initially
Backfill used	None

Trial Pit Length (m)	2.42
Trial Pit Width (m)	0.53
Trial Pit Depth (m)	1.30
Amount of Backfill placed (m)	0
Assumed Backfill Void Ratio	N/A

Time (Minutes)	Water level (m.bgl)
0	0.60
0.5	0.66
1	0.70
2	0.75
3	0.79
4	0.85
5	0.91
10	1.06
15	1.21
30	1.30



Initial Water Level (m)	0.60	Total internal surface area of pit (m^2)	8.95
Final Water Level (m)	1.30	Internal surface area of trial pit within effective depth range (m^2)	3.35
Change in Water Level (m)	0.70	Volume outflowing between 75% and 25% effective depth (m^3)	0.45
Effective Depth at 25% (tp25) (m)	1.13	Time at 25% (tp25) (minutes)	11.5
Effective Depth at 75% (tp75) (m)	0.78	Time at 75% (tp75) (minutes)	2.5

Soil Infiltration Rate (m/s)	2.48E-04

Notes: 1. Undertaken in general accordance with BRE DG 365 method
2. Based on extrapolated data NO

Client:	Montpelier Estates
Project:	Land to the West of Miswell Lane, Tring
Project No.	AG3261-21

APPLiED GEOLOGY

IN SITU SOAKAWAY TEST RESULT

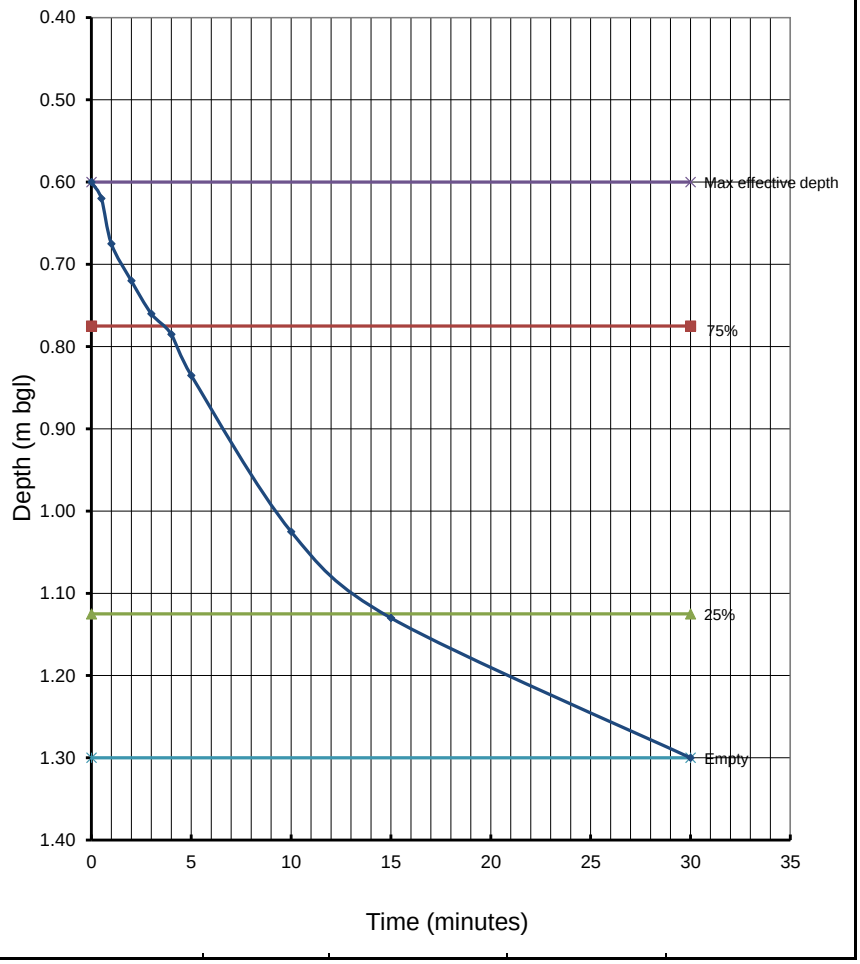
Trial Pit No.	TP2

Filling	3 of 3

Date	05.05.2021
Operator	MS
Test Strata	Chalk
Stability of pit	Stable - initially
Backfill used	None

Trial Pit Length (m)	2.42
Trial Pit Width (m)	0.53
Trial Pit Depth (m)	1.30
Amount of Backfill placed (m)	0
Assumed Backfill Void Ratio	N/A

Time (Minutes)	Water level (m.bgl)
0	0.60
0.5	0.62
1	0.68
2	0.72
3	0.76
4	0.79
5	0.84
10	1.03
15	1.13
30	1.30



Initial Water Level (m)	0.60	Total internal surface area of pit (m^2)	8.95
Final Water Level (m)	1.30	Internal surface area of trial pit within effective depth range (m^2)	3.35
Change in Water Level (m)	0.70	Volume outflowing between 75% and 25% effective depth (m^3)	0.45
Effective Depth at 25% (tp25) (m)	1.13	Time at 25% (tp25) (minutes)	14.5
Effective Depth at 75% (tp75) (m)	0.78	Time at 75% (tp75) (minutes)	3.5

Soil Infiltration Rate (m/s)	2.03E-04

Notes: 1. Undertaken in general accordance with BRE DG 365 method
2. Based on extrapolated data NO

Client:	Montpelier Estates
Project:	Land to the West of Miswell Lane, Tring
Project No.	AG3261-21

APPLiED GEOLOGY

IN SITU SOAKAWAY TEST RESULT

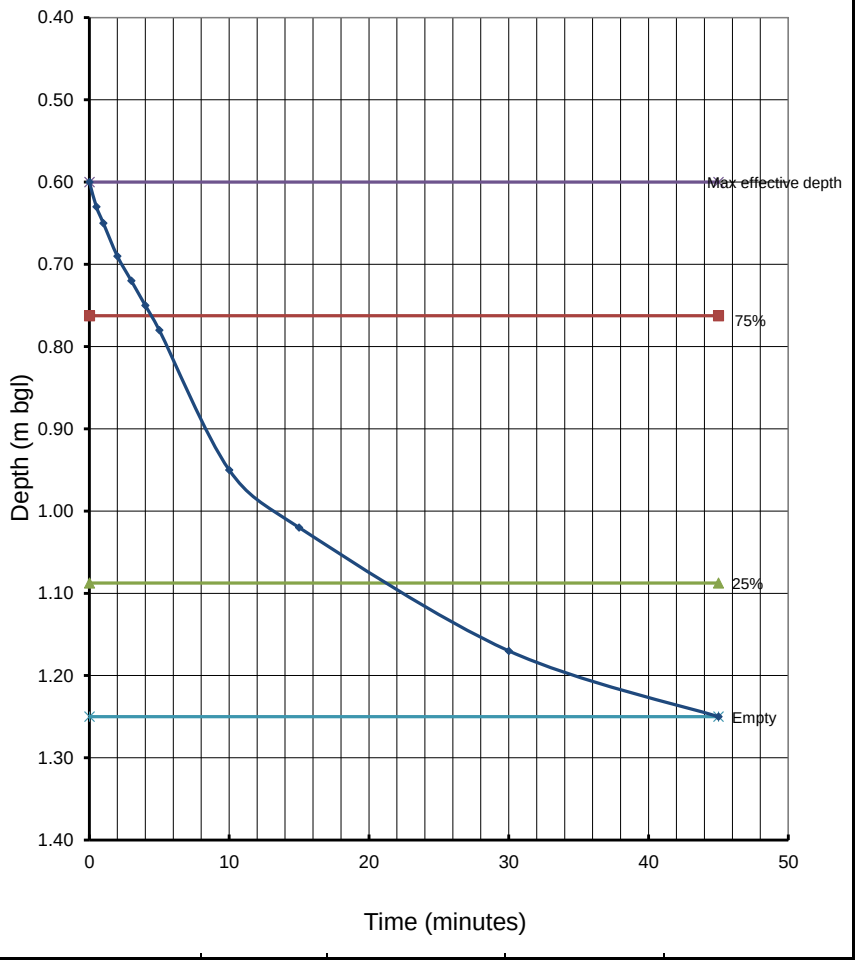
Trial Pit No.	TP5

Filling	1 of 3

Date	05.05.2021
Operator	MS
Test Strata	Chalk
Stability of pit	Stable - initially
Backfill used	None

Trial Pit Length (m)	2.60
Trial Pit Width (m)	0.50
Trial Pit Depth (m)	1.25
Amount of Backfill placed (m)	0
Assumed Backfill Void Ratio	N/A

Time (Minutes)	Water level (m.bgl)
0	0.60
0.5	0.63
1	0.65
2	0.69
3	0.72
4	0.75
5	0.78
10	0.95
15	1.02
30	1.17
45	1.25



Initial Water Level (m)	0.60	Total internal surface area of pit (m^2)	9.05
Final Water Level (m)	1.25	Internal surface area of trial pit within effective depth range (m^2)	3.32
Change in Water Level (m)	0.65	Volume outflowing between 75% and 25% effective depth (m^3)	0.42
Effective Depth at 25% (tp25) (m)	1.09	Time at 25% (tp25) (minutes)	21
Effective Depth at 75% (tp75) (m)	0.76	Time at 75% (tp75) (minutes)	4.25

Soil Infiltration Rate (m/s)	1.27E-04

Notes: 1. Undertaken in general accordance with BRE DG 365 method
2. Based on extrapolated data NO

Client:	Montpelier Estates
Project:	Land to the West of Miswell Lane, Tring
Project No.	AG3261-21

APPLiED GEOLOGY

IN SITU SOAKAWAY TEST RESULT

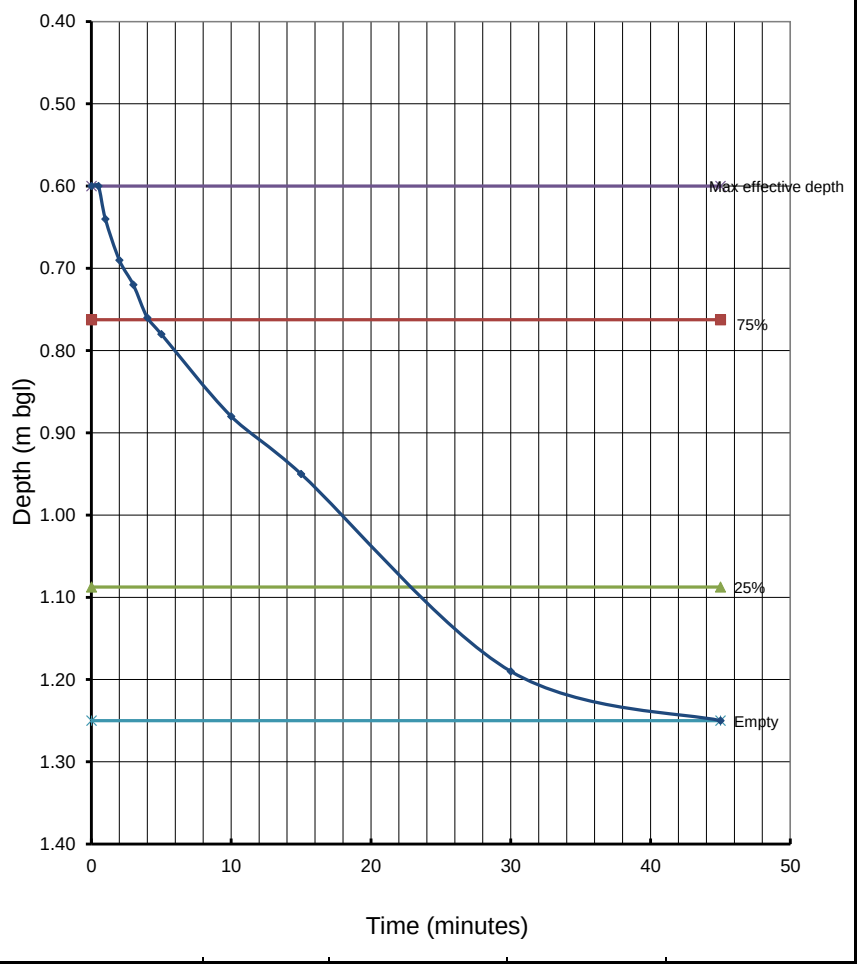
Trial Pit No.	TP5

Filling	2 of 3

Date	05.05.2021
Operator	MS
Test Strata	Chalk
Stability of pit	Stable - initially
Backfill used	None

Trial Pit Length (m)	2.60
Trial Pit Width (m)	0.50
Trial Pit Depth (m)	1.25
Amount of Backfill placed (m)	0
Assumed Backfill Void Ratio	N/A

Time (Minutes)	Water level (m.bgl)
0	0.60
0.5	0.60
1	0.64
2	0.69
3	0.72
4	0.76
5	0.78
10	0.88
15	0.95
30	1.19
45	1.25



Initial Water Level (m)	0.60	Total internal surface area of pit (m^2)	9.05
Final Water Level (m)	1.25	Internal surface area of trial pit within effective depth range (m^2)	3.32
Change in Water Level (m)	0.65	Volume outflowing between 75% and 25% effective depth (m^3)	0.42
Effective Depth at 25% (tp25) (m)	1.09	Time at 25% (tp25) (minutes)	23
Effective Depth at 75% (tp75) (m)	0.76	Time at 75% (tp75) (minutes)	4

Soil Infiltration Rate (m/s)	1.12E-04

Notes: 1. Undertaken in general accordance with BRE DG 365 method
2. Based on extrapolated data NO

Client:	Montpelier Estates
Project:	Land to the West of Miswell Lane, Tring
Project No.	AG3261-21

APPLiED GEOLOGY

IN SITU SOAKAWAY TEST RESULT

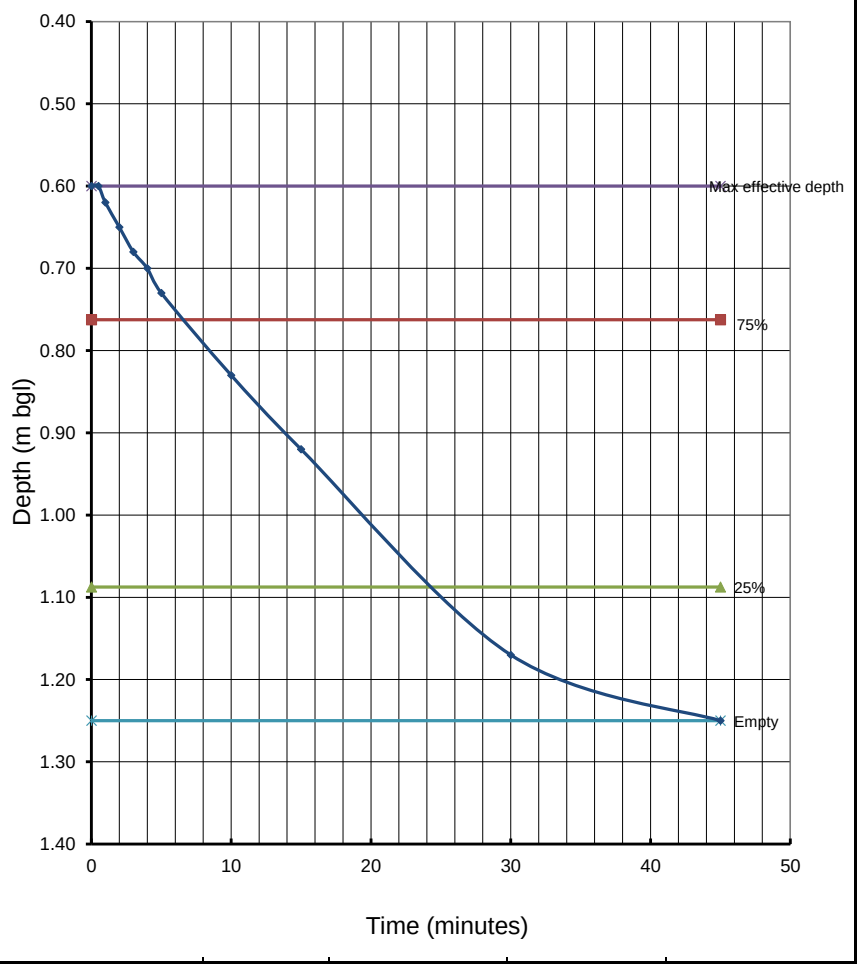
Trial Pit No.	TP5

Filling	3 of 3

Date	05.05.2021
Operator	MS
Test Strata	Chalk
Stability of pit	Stable - initially
Backfill used	None

Trial Pit Length (m)	2.60
Trial Pit Width (m)	0.50
Trial Pit Depth (m)	1.25
Amount of Backfill placed (m)	0
Assumed Backfill Void Ratio	N/A

Time (Minutes)	Water level (m.bgl)
0	0.60
0.5	0.60
1	0.62
2	0.65
3	0.68
4	0.70
5	0.73
10	0.83
15	0.92
30	1.17
45	1.25



Initial Water Level (m)	0.60	Total internal surface area of pit (m^2)	9.05
Final Water Level (m)	1.25	Internal surface area of trial pit within effective depth range (m^2)	3.32
Change in Water Level (m)	0.65	Volume outflowing between 75% and 25% effective depth (m^3)	0.42
Effective Depth at 25% (tp25) (m)	1.09	Time at 25% (tp25) (minutes)	24
Effective Depth at 75% (tp75) (m)	0.76	Time at 75% (tp75) (minutes)	6.5

Soil Infiltration Rate (m/s)	1.21E-04

Notes: 1. Undertaken in general accordance with BRE DG 365 method
2. Based on extrapolated data NO

Client:	Montpelier Estates
Project:	Land to the West of Miswell Lane, Tring
Project No.	AG3261-21

APPLiED GEOLOGY