HARRISON GROUP ENVIRONMENTAL LIMITED

Document: DRAFT Ground Investigation Report

Project: Stanborough Park North

Reference No.: GL22715

Date: May 2019

Prepared For: Welwyn Hatfield Borough Council

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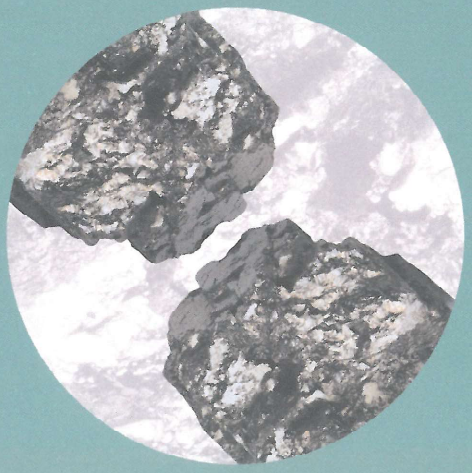
ENGINEERING



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FOREWORD

General Conditions Relating To Site Investigation

This investigation has been devised to generally comply with the relevant principles and requirements of B.S.10175:2011+A2:2017 'Investigation of potentially contaminated sites - Code of practice', science report SC050021/SR3 'Updated Technical Background to the CLEA Model' (Environment Agency, 2008), and Contaminated Land Report 11 'Model procedures for the management of contaminated land' (Department for Environment, Food and Rural Affairs and the Environment Agency, 2004) and BS EN 1997 (Eurocode 7). The recommendations made and opinions expressed in this report are based on the information obtained from the sources described using a methodology intended to provide reasonable consistency and robustness.

The opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site and of laboratory test results. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between exploratory positions, these are only for guidance and no liability can be accepted for their accuracy.

Boring and sampling procedures are undertaken in accordance with B.S.5930:2015 'Code of Practice for Ground Investigations'. Likewise in-situ and laboratory testing complies with B.S.1377:1990 'Methods of Tests for Soils for Civil Engineering Purposes' and B.S.22475:2011, unless stated otherwise in the text. Chemical Testing has been undertaken by a UKAS accredited laboratory.

The groundwater conditions entered on the boring records are those observed at the time of investigation. The normal rate of boring usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions.

Some items of the investigation have been provided by third parties and whilst Harrison Group have no reason to doubt the accuracy, the items relied on have not been verified. No responsibility can be accepted for errors within third party items presented in this report.

This report is produced in accordance with the scope of Harrison Group's appointment and is subject to the terms of appointment. Harrison Group accepts no liability for any use of this document other than by its client and only for the purposes, for which it was designed and produced. No responsibility can be accepted for any consequences of this information being passed to a third party who may act upon its contents/recommendations.

Any advice, opinions, or recommendations within this document should be read and relied upon only in the context of the document as a whole. The contents of this document are not to be construed as providing legal, business or tax advice or opinion.

EXECUTIVE SUMMARY

Introduction	This report is issued as a draft based on currently available information and thus is not complete. The full completed report will be submitted following receipt of the geoenvironmental/geotechnical laboratory analysis, ground gas/water monitoring rounds and subsequent assessment. Currently the draft report comprises of the Phase 1 Desk study undertaken for the site and details of the ground investigation intrusive works.
Location	Stanborough Park is both bisected by and accessed from the A6129. The area under investigation forms part of Stanborough Park North which is given over to recreational usage. The approximate postcode for the site is AL8 6DF.
Previous & Current Site Use	The earliest available maps detail the site as undeveloped land assumed for agricultural use. A drain was located within the site's north eastern area running parallel to its boundary. The site was first detailed as developed with a swimming pool complex by 1938 which expanded by 1960 and again by 1969 to ultimately comprise what is believed to be four pools (believed to be infilled), two sand pits, flumes, fountains, slides, a diving board and other associated structures, such as changing rooms, steps, hardstanding areas and an electrical substation (along the current site's southern boundary). Some of these structures were located immediately outside the current subject site area to the north east. The main pool which is understood to be currently infilled is located approximately within the centre of the current subject site. Currently the area to be investigated is set within and bounded by the wider confines of the Park itself. The site is relatively level, sloping to the North towards the northern perimeter of the site. It is mostly given over to grass with the exception of several small discrete structures and facilities associated with its current recreational usage.
Proposed Site Use	It is understood that the proposed development comprises the construction of a water based "splashlands" play area on the site of the former swimming pool/lido. The works will comprise the removal of the existing children's playground and reinstatement of ground as parkland, with construction of a new playground including splash pad with associated above ground water recirculation attenuation tank, changing room facility, kiosk, perimeter fencing, outdoor gym, drainage and earthworks/landscaping. The proposed earthworks involve excavation of the existing soil in higher areas and relocation on the site to form swales.
Background Information	The site is shown to be underlain by superficial Kesgrave Catchment Subgroup which is shown as overlain by Alluvial deposits in the south, south western half of the site area. Lowestoft Formation (Diamicton) is detailed some 500m to the north and south of the site which could underly the Kesgrave Catchment Subgroup. The underlying solid geology for the site area is detailed as the Lewes Nodular Chalk Formation and Seaford Chalk. No made ground is detailed in the site area but it is known that below ground structures and foundations from the historical lido and associated structures were removed crushed and subsequently backfilled The superficial deposits are detailed as having a Secondary A aquifer designation (Kesgrave Catchment Subgroup) with the Alluvium a Secondary (Undifferentiated) aquifer. The solid geology (Chalk) is designated as a Principal Aquifer. The site is located within a Source Protection 3 Zone (Total Catchment) with a Zone 2 (Outer Catchment) located some 450m to the south east. The closest groundwater abstraction is located some 1480m to the south west of the site (Status: Active) associated with general farming and domestic use. The River Lea abuts the site's south, south western boundary. Two surface water abstractions are recorded within 500m of the site, located some 270m (Status: Historical) and 375m (Status: Active) to the north west, both abstractions associated with the River Lea. The majority of the site is located within River and Coastal Flooding Zones 2 and 3 with a high confidence rating and a RoFRaS Low to High risk rating. The site is not in an area where full or basic Radon protection measures are required, nor where a geological assessment is required. There is 1 No. recorded pollution incident with 250m of the site located 218m to the north west and being a category 2 (Significant) water impact associated with diesel (2014). 4 No. Historical landfills are recorded within 1500m of the site, all located between 630m to 900m to the east. No registered landfills are recorded within 1000m of the site. 3 No. unspecified tanks are recorded between 196m north of the site in 1985 and 1993 and 256m east in 1938. 13 No. historical potentially contaminative uses are recorded within 500m of the site of which 4 No. are within 250m (comprising gravel pits and cuttings within 240m of the site). Historical electrical substations are identified onsite between 1971 and 1993. These entries appear to corelate to the existing electrical substation located onsite. 4 No. current potentially contaminative uses are recorded within 250m of the site associated with electrical features (140m west) published goods (230m south west) unspecified factory (225m south west) armed services (sea cadets corps 230m north). The site is located within a Nitrate Vulnerable Zone (NVZ) and within London Area Green Belt. Stanborough Reedmarsh is located some 745m to the south east. The historical lido onsite is identified as potentially infilled. Additionally, historical surface ground workings (potentially infilled) are identified as a boating lake (some 20m to the south west) and a pond (some 150m to the northwest). The next nearest potentially infilled feature is located >240m from the site to the north west.

Ground Conditions and Geology	The site lies within an area identified as 'rare' for sporadic underground chalk mining of restricted extent that may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered. One Non Coal Mining Cavity is recorded as 865m to the south east of the site. The extract is detailed as manmade i.e. secret tunnels, air raid shelters. The nearest identified natural cavities (sinkholes) are detailed some 400m, 500m and 660m to the north of the site. 7 No. current ground workings are identified within 1000m of the site. The closest is associated with the Twentieth Mile Gravel pit located some 550m east. Historical ground investigation reports associated with the subject site have been provided by the client and summarised within this report.
Geotechnical	To Follow
Ground Gas	To Follow
Contamination	To follow

GROUND INVESTIGATION REPORT

for

STANBOROUGH PARK NORTH

1 TERMS OF REFERENCE & INTRODUCTION

1.1 General

The work covered by this report was undertaken on behalf of Welwyn and Hatfield Borough Council in accordance with their purchase order Ref RSE2146683, Harrison Group Environmental Limited (HGE) quotation Ref GL22715 Rev 1 dated 18th March 2019 and Conisbee Site Investigation Brief Ref: 171032/T dated 13th February 2019.

As requested by the client representative, this report is issued as a draft based on currently available information and thus is not complete. The full completed report will be submitted following receipt of the geoenvironmental/geotechnical laboratory analysis, ground gas/water monitoring rounds and subsequent assessment. Currently the draft report comprises of the Phase 1 Desk study undertaken for the site and details of the ground investigation intrusive works.

Stanborough Park is both bisected by and accessed from the A6129. The area under investigation forms park of Stanborough Park North which is given over to recreational usage. The Approximate postcode for the site is AL8 6DF. A Site Location and Surveys Layout Plan Drawing No. 171116-SK_S_001 produced by Conisbee has been provided with the tender package and is presented in Appendix A. HGE Site Location Plan GE22715-DR001 is also presented in Appendix A.

Currently the area to be investigated is set within and bounded by the wider confines of the Park itself. The site is relatively level sloping to the north towards the northern perimeter of the site. It is mostly given over to grass with the exception of several small discrete structures (toilet block, electrical substation) and facilities associated with its current recreational usage (including external play area).

Historically a flat area of grass at the centre of the park was a lido which was demolished and cleared approximately 20 years ago. The lido included diving boards at the southern end of the pool, indicating a deep pool, possibly of 3m water depth.

The purpose of the works was to undertake a Phase 1 Desk Study and Phase 2 ground Investigation of the site to assist in design of the construction of a water based “Splashlands” play area on the site of the former lido as well as some landscaping works and some new structures including a shop and pavilions. The proposed earthworks involve excavation of the existing soil in higher areas and relocation on the site to forms swales.

The report was undertaken in order to assess environmental and geotechnical issues on the site prior to development involving the construction of a ‘’Splashland’’ play area and associated structures. The investigation was carried out using available published documentation in association with historical investigation data and reports supplied by the client, in-situ investigation and laboratory analysis.

The following information has currently been provided.

- Terrain Surveys Topographical Survey (Jan 2019)
- Conisbee Existing Level and Contours Drawing 17116-CON-X-XX-DR-C-2001 P1
- Conisbee Drainage Strategy Drawing 171116-CON-X-00-DR-C-1000 P4
- Conisbee Proposed Site Level and Contours Drawing 171116-con-X-XX-DR-C-2000 P6
- Conisbee Cross Sections Drawings 171116-CON-X-XX-DR-C-2100 P4
- Conisbee Flood Compensation Cross Section Drawing 171116-CON-X-XX-DR-C-2200 and 2201 P2

- Conisbee Proposed Site Level and Contours Over Existing Levels Drawing 171116-CONn-X-XX-DR-C-7010 P3
- Conisbee Strip Off Existing Ground Drawing 171116-CON-X-XX-DR-C-7001
- Conisbee Summary of Earthworks Analysis –171116-CON-X-XX-DR-C-7002 P3
- Conisbee Summary of Earthworks Analysis Cross Sections–171116-CON-X-XX-DR-C-7003 P3
- Conisbee Isopachytes Contours Plan Drawing 171116-CON-X-XX-DR-C P2
- Conisbee Summary Of Earthworks Analysis- Cross Sections Drawing 171116-CON-X-XX-DR-C-7005 P1
- Conisbee Flood Risk Assessment Ref 17116/T Gavaza Dated 24th Jan 2019
- WYG Desk Study Report May 2010 (excluding appendices)
- RPS Phase 2 Geotechnical Site Investigation June 2010
- WYG Topographical Survey A067207-5-51-C-1001 22/11/12
- WYG Flood Risk Assessment A067207-5 dated December 2012
- AMEY Geotechnical Options Report Phase 2 December 2013
- MurrayRix Plate Bearing Test Results dated May 2013
- VHE Plate Bearing Test Locations Drawing 586 004 dated June 2013
- VHE Finished Levels Drawing 586 001 dated June 2013
- VHE Duct Layout Drawing 586 002 dated June 2013
- VHE Structures Remaining Drawing 586 003 dated June 2013
- VHE Existing Services Drawing 586 005 dated July 2013

1.2 Proposed Development

It is understood that the proposed development comprises the construction of a water based “splashlands” play area on the site of the former swimming pool/lido. The works will comprise the removal of the existing children’s playground and reinstatement of ground as parkland, with construction of a new playground including splash pad with associated above ground water recirculation attenuation tank, changing room facility, kiosk, perimeter fencing, outdoor gym, drainage and earthworks/landscaping. The proposed earthworks involve excavation of the existing soil in higher areas and relocation on the site to form swales.

It is understood that the Design Concept for the proposed works is as follows.

- The design intent is to retain all existing site materials that are on site.
- The proposed landforms are proposed to accommodate excess soils from the excavations.
- The excavations are proposed to facilitate the construction of the play areas.
- Excavations are also proposed to provide flood compensation.
- The levels are being raised in the play area in order to avoid the ground water table that was anticipated to be around 62.43 to 62.60m AOD (locally only 0.5m bgl).

The proposed development is detailed by the following drawings presented in Appendix A

- Conisbee Drainage Strategy Drawing 171116-CON-X-00-DR-C-1000 P4
- Conisbee Proposed Site Level and Contours Drawing 171116-con-X-XX-DR-C-2000 P6
- Conisbee Cross Sections Drawings 171116-CON-X-XX-DR-C-2100 P4
- Conisbee Flood Compensation Cross Section Drawing 171116-CON-X-XX-DR-C-2200 and 2201 P2
- Conisbee Proposed Site Level and Contours Over Existing Levels Drawing 171116-CONn-X-XX-DR-C-7010 P3

- Conisbee Strip Off Existing Ground Drawing 171116-CON-X-XX-DR-C-7001
- Conisbee Summary of Earthworks Analysis –171116-CON-X-XX-DR-C-7002 P3
- Conisbee Summary of Earthworks Analysis Cross Sections–171116-CON-X-XX-DR-C-7003 P3
- Conisbee Isopachytes Contours Plan Drawing 171116-CON-X-XX-DR-C P2
- Conisbee Summary of Earthworks Analysis - Cross Sections Drawing 171116-CON-X-XX-DR-C-7005 P1

The existing site and buildings are detailed in the following drawings presented in Appendix A.

- Terrain Surveys Topographical Survey Drawing TS19-029D1 and D2 (Jan 2019).
- Conisbee Existing Level and Contours Drawing 17116-CON-X-XX-DR-C-2001 P1

A utility search for the site has been commissioned which includes the subject site area and is presented in Appendix A:

2 BACKGROUND INFORMATION

The environmental setting background information (geology, hydrology, hydrogeology, database information) and site history information have been researched as part of this report, a summary of which is given in the following sections.

2.1 Environmental Setting

Table 2.1, below, gives background information from mapping, online and literature sources.

	Data Source	Data Summary
Topography	Terrain Survey Drawing TS19-029D1 dated 2 January 2019.	The drawing is presented in Appendix A. Currently the area to be investigated is set within and bound by the wider confines of the Park itself. The site is relatively level sloping to the north east towards the north eastern perimeter of the site. The site's south, south western boundary which abuts the River Lea is at around 63 to 63.5maOD slightly dipping in the central area to around 63maOD then gently rising to the site's north, north eastern boundary to around 65 to 65.5maOD
Geology	GroundSure GeoInsight Report Reference GS-5876483. Online resource, British Geological Survey, Geology of Britain, accessed April 2019.	The site is shown to be underlain by superficial Kesgrave Catchment Subgroup which is shown as overlain by Alluvial deposits in the south, south western half of the site area. Lowestoft Formation (Diamicton) is detailed some 500m to the north and south of the site which could underly the Kesgrave Catchment Subgroup. The underlying solid geology for the site area is detailed as the Lewes Nodular Chalk Formation and Seaford Chalk. No made ground is detailed in the site area but it is known that below ground structures and foundations from the historical lido and associated structures were removed crushed and subsequently backfilled.
Hydrogeology	GroundSure EnviroInsight Report Reference GS-5876482.	The superficial deposits are detailed as having a Secondary A aquifer designation (Kesgrave Catchment Subgroup) with the Alluvium a Secondary aquifer (Undifferentiated). The solid geology (Chalk) is designated as a Principal Aquifer. The superficial deposits are detailed as intergranular with a very low to very high permeability. The solid geology is detailed as fracture with a very high permeability. The soils are classified as 'High' leaching potential with a Soil Vulnerability Category of 'H1'.
Hydrology	GroundSure EnviroInsight Report Reference GS-.5876482	The site is located within a Source Protection 3 Zone (Total Catchment) with a Zone 2 (Outer Catchment) located some 450m to the south east. The closest groundwater abstraction is located some 1480m to the south west of the site (Status: Active) associated with general farming and domestic use. All other recorded abstraction licences within 2000m of the site had a recorded historical status.

	Data Source	Data Summary
		The River Lea, 'Inland river not influenced by normal tidal action', abuts the site's south, south western boundary. There are Biological Quality records detailed in the site area for the River Lea, both located some 320m to the south of the site. The most recent Grades were recorded as B and A in 2009. Two surface water abstractions are recorded within 500m of the site, located some 270m (Status: Historical) and 375m (Status: Active) to the north west, both abstractions associated with the River Lea.
		The majority of the site is located within River and Coastal Flooding Zones 2 and 3 with a high confidence rating and a RoFRaS Low to High risk rating.
Radon Potential	GroundSure GeoInsight Report Reference GS-5876483.	The site is not in an area where full or basic protection measures are required, nor where a geological assessment is required. No radon protection measures required at this location.
Pollution and Landfill	GroundSure EnviroInsight Report Reference GS-5876483.	There are no recorded environmental permits or licences recorded within 250m of the site. There are no records of Licensed Discharge Consents within 250m of the site. There is 1 No. recorded pollution incident with 250m of the site located 218m to the north west and being a category 2 (Significant) water impact associated with diesel (2014). No sites have been determined as Contaminated Land under Part 2A with 500m of the site. 4 No. Historical landfills are recorded within 1500m of the site, all located between 630m to 900m to the east. No registered landfills are recorded within 1000m of the site. 7 No. licensed waste sites are recorded within 1500m of the site, all recorded between 870m to 1010m east. 3 No. unspecified tanks are recorded between 196m north of the site in 1985 and 1993 and 256m east in 1938. 13 No. historical potentially contaminative uses are recorded within 500m of the site of which 4 No. are within 250m (comprising gravel pits and cuttings within 240m of the site). The remaining 9 No. are associated with 'a pumping station, gravel pits, refuse heap, sand pits, unspecified workings and gravel and brickworks'. 4 No. current potentially contaminative uses are recorded within 250m of the site associated with electrical features (140m west) published goods (230m south west) unspecified factory (225m south west) armed services (sea cadets corps 230m north). Historical Electrical substations are identified onsite between 1971 and 1993. These entries appear to corelate to the existing electrical substation located onsite. No historical petrol fuel stations are identified within 500m of the site, although a historical garage is identified 276m to the south west in 1960. A current fuel site is recorded 270m to the south of the site. The historical lido onsite is identified as potentially infilled. Additionally, historical surface ground workings (potentially infilled) are identified as a boating lake (some 20m to the south west) and a pond (some 150m to the northwest). The next nearest potentially infilled featured is located >240m from the site to the north west.
Environmental Sensitivity	GroundSure EnviroInsight Report Reference GS-5876483	The site is located within a Nitrate Vulnerable Zone (NVZ) and within the London Area Green Belt. Stanborough Reedmarsh is located some 745m to the south east. No other environmental sensitive areas are identified with 100m of the site.
Geotechnical Hazards	GroundSure GeoInsight Report Reference GS-5876483.	The following Hazard ratings have been identified Shrink-Swell Clay - Negligible to very low Landslides – Very low Ground Dissolution of Soluble Rocks – Very low to low Compressible Deposits – Negligible to moderate (south, south western area) Collapsible Deposits – Negligible to very low Running Sand - – Negligible to very low
Non-Coal Mining, Ground	GroundSure GeoInsight Report Reference GS-5876483.	The site is not in an area likely to be affected by coal mining. The site lies within an area identified as 'rare' for sporadic underground chalk mining of restricted extent that may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered.

	Data Source	Data Summary
		One Non Coal Mining Cavity was recorded as 865m to the south east of the site. The extract is detailed as Manmade i.e. secret tunnels, air raid shelters. The nearest identified natural cavities (sinkholes) are detailed some 400m, 500m and 660m to the north of the site. 7 No. current ground workings are identified within 1000m of the site. The closest is associated with the Twentieth Mile Gravel pit located some 550m east. The remaining records are associated with the Twentieth Mile Gravel Pit or Lemsfordmills Chalk Pit located between 690 and 915m from the site. Historical ground workings are identified onsite associated with the infilled Lido in the centre of the site. Additionally, identified surface working include a boating lake located some 19m to the south west and gravel pits and cuttings some 245m to the north west.
UXO Assessment	Brimstone Stage 1 Preliminary Assessment (PRA-19-1094) and Stage 2 Detailed UXO Risk Assessment (DRA-19-1082)	The Stage 1 report identified a Moderate risk from German UXO and recommended a Stage 2 Detailed risk Assessment should be undertaken which was commissioned. The Stage 2 report concluded that UXO poses a Low risk, though risk from UXO cannot be completely ruled out and therefore UXO Safety Awareness Briefings were recommended for all personnel carrying out ground works on site, as a minimum measure.
Utilities Search	Cornerstone Underground Utilities Search Report Ref33242-CS	The report is presented in Appendix B.
Regulator Correspondence	EA Ref: NE/2019/129826/01-L01 EA email date 5th March 2019 to Conisbee Conisbee Meeting Notes 26th March 2019 Planning Consultation Memo Ref: 6/2019/0814/FULL	Environmental Agency comments from a meeting held with Conisbee on the 22nd February 2019 are presented in Appendix B. EA preliminary review of the available historical ground investigations for the site presented in Appendix B. Subsequent meeting with the Environment Agency following their initial comments from the meeting on the 22nd February 2019. Conisbee meeting notes presented in Appendix B. On the 14th May the client representative provided a planning consent memo for the proposed works dated 09/05/19. The Memo is presented in Appendix B.

Table 2.1: Background Information

2.2 Site History

The history of the site has been researched from historical mapping sources. Copies of the Ordnance Survey maps examined have been presented in the appendices and a summary of the pertinent features is provided in table 2.2. Please note the subject site area detailed on the historical mapping is larger than the area of the currently proposed works (to be submitted for planning). The area on the maps is overly large to the south west, by c. 50m, with the current subject site boundary being defined by the existing car parking area which is c. 270m too large to the north west. The subject site area is defined by the Conisbee drawings presented in Appendix A.

Date of Mapping	Scale of Mapping	Detail
1878 -1898 1896-1898	1:2,500 1:10,560	**On site:** The site appears to have been agricultural land with a drain located in its eastern section running parallel to the site's eastern boundary. The drain enters the River Lea to the south of the site. The River Lea abuts the site's western boundary and shows a north to south flow direction. A footpath cuts across the site's south eastern corner. A circular area of trees is detailed in the sites south western area. **Off site:** The surrounding area is predominantly given over to agricultural usage. Stanborough Farm is located some 350m to the south. A spring and two pumps are annotated in the farm area. Chalk Pits are annotated some 750m north of the site with a gravel pit beyond. A road is detailed some 150m to the west. A railway line is located some 750m to the south east. Various other springs, wells and small tracks are located in the surrounding area. A brickworks is annotated some 600m to the east, north east.

Date of Mapping	Scale of Mapping	Detail
1923 1922	1:2,500 1:10,560	**On site:** No significant change but site area annotated 'Liable to Flood' and rough ground/pasture. A footbridge is located annotated across the drain. **Off site:** No significant change has occurred in the surrounding area. A cutting associated with a road is located some 200m to the south east. The chalk pits to the north are annotated as allotments. Tanks are annotated some 900m north of the site.
1938 1938 & 1939	1:2,500 1:10,560	**On site:** Lee Valley Swimming Pool is annotated in the site's north eastern area cutting the drain. Structures presumed to be changing benches are also present along the north eastern area of the development. **Off site:** Significant residential development has occurred to the west and north. The Great North Road was located 50m to the west. Welwyn Garden City and associated development is detailed to the north and the former tanks are no longer shown. A school is detailed some 200m and 500m to the north east.
1946-1949	1:10,560	**On site:** No significant change **Off site:** The gravel works to the east now annotated Twentieth Mile Gravel and Brick Works and have extended to within 500m of the site. A gravel pit is annotated some 350m to the north. Continual development of Welwyn Garden City has occurred.
1960 -1961 1960 - 1966	1:1,250 1:10,560	**On site:** The swimming pool complex has expanded including the area immediately off site to the north east comprising what is believed to be four rectangular water filled structures, a stream between two smaller pools and two fountains. Additional structures, possible changing facilities, are also detailed with two potential step structures to the pool. **Off site:** Area immediately to the north west is shown as wooded/vegetated. Continued development to the north now expanding to some 200m of the site and annotated 'Drill Hall' and Drill Hall Cottages'. Twentieth Mile Gravel Pit now annotated 'old' and shown to encroach to 200m east of the site. An embankment is shown along the south face of the drain located immediately to the south of the site. A spring is located to the south east of the site. Area to the east annotated playing field.
1969-1971 1976	1:1,250 1:10,000	**On site:** Additional rectangular structures are present along the north western boundary in the area of the former four rectangular structures (potential changing rooms) and an additional structure is located immediate off site to the north east. A cutting is shown along the site's north eastern boundary. The drain along the western boundary is no longer shown. Trees are detailed in the western south western area of the site. An 'electrical' substation is annotated within the southern area of the site in the south eastern corner of the swimming pool complex. The substation is approximately in the same location it currently is in 2019 with the area beyond annotated 'car park' as it currently is in 2019. A footbridge is shown crossing the River Lea into the site area. **Off site:** The Boating Lake with islands and a landing stage is shown and annotated immediately to the west of the River Lea with a yachting lake further south east beyond Stanborough Road. Stanborough Park is annotated in the immediate surrounding area. The A1 had been constructed to the west with associated cuttings. By 1976 Police Headquarters and associated sports/football grounds and playing field are shown 250m to the south east with associated cuttings. Watercress beds are annotated along the River Lea some 250m north west from the site. .
1985-1988 1988	1:1,250 1:10,000	**On site:** A path is detailed to the south of the swimming pool leading to a small rectangular area to the north west of the fountain. **Off site:** A footbridge is shown crossing the boating lake. A range assumed associated with shooting for the police headquarters is annotated some 625m to the south east. An Air Cadet Centre is annotated some 150m to the north with workshops beyond.
1993 2002	1:1,250 1:10,000	**On site:** No significant change. **Off site:** No significant change. Lemsford Springs Nature Reserve is annotated some 500m to the north west.
2010	1:10,000	**On site:** The swimming pool complex is no longer detailed with the exception of two buildings located along the southern boundary of the 2019 subject site. One of the structures is in the approximate location of the current 2019 substation and toilet block onsite. **Off site:** Limited detail but appears to be no significant change.
2014	1:10,000	**On site:** No significant change. **Off site:** Limited detail but appears to be no significant change.

Table 2.2: Historical setting from maps

2.2.1 Summary of Site History & Details of The Former Splash Lands Pool Development

The earliest available maps (1878) detail the site as undeveloped land assumed for agricultural use. A drain is located within the site's north eastern area running parallel to its boundary which branches off and re-joins the River Lea offsite. The River Lea defines the site's south western boundary. The site is first detailed as developed with the swimming pool complex by 1938 which expanded by 1960 and again by 1969 to ultimately comprise what is believed to be four pools, two sand pits, flumes, fountains, slides, a diving board and other associated structures, such as changing rooms, steps, hardstanding areas and an electrical substation (along the current site's southern boundary), although some of these structures were located immediately outside the current subject site area to the north east (in the area of the current high ropes facility).

By 1969 the Boating Lake with islands and a landing stage is shown and annotated immediately to the west of the River Lea with a yachting lake further south east beyond Stanborough Road. Stanborough Park is annotated in the immediate surrounding area. The A1 had been constructed to the west with associated cuttings and the River Lea channel appears wider and potentially altered.

By 2010 the swimming pool complex is no longer detailed (potentially infilled) except for two small structures along the current site's southern boundary with car parking beyond. The most south western structure is known to comprise an electrical substation and toilet and current toilet block.

A local newspaper article (link below) from 1999 about the closure of the swimming pool suggests that the pool closed due to ''*safety concerns and costs associated with repairing swallow holes*''. ''*Extensive geological surveys reveal the pool could be sitting on loose subsoil and there may be holes where the chalk layer below the earth is dissolving. But the voids cannot simply be filled all the concrete surrounding the pool would have to be removed and structures supported before up to 5m of slushy subsoil is replaced with compacted gravel. And before reopening much other work is needed, including replacement of the boiler and chlorinating plants*''. The article was found from the following internet links, the latter also provides some historical photos of the development, stated in 1937 and 1974.

http://welwynhatfield.co.uk/wgc_society/wp-content/uploads/2019/04/WHT-article-from-July-21-1999.pdf
http://welwynhatfield.co.uk/wewantasplashpark/history-of-splashlands/

Pictures of the former Splashlands Swimming Pool development (obtained from the internet) before its closure are detailed below (unknow dates).

Figure 1

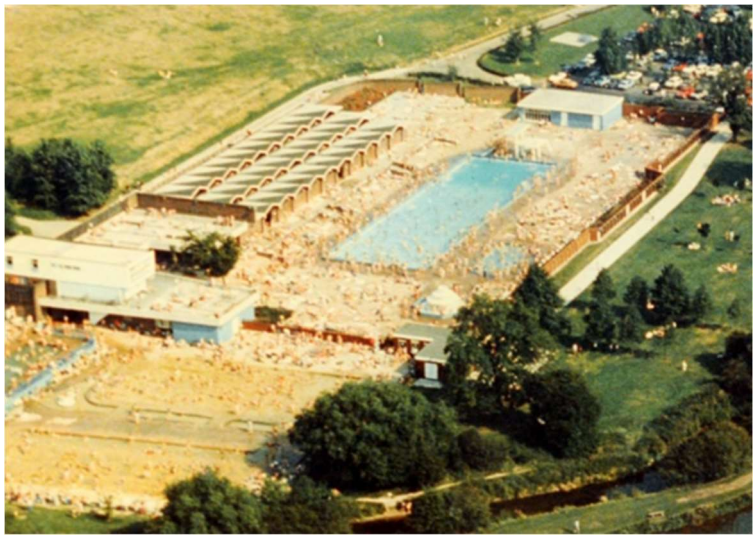

Figure 2

A video presenting numerous historical photos of the former Splash Lands development can be viewed on https://www.youtube.com/watch?v=ZnI4etLm6-g

The location of the former boiler room/s and chlorinating plant associated with the historical Splash Lands Development are currently not known.

2.3 Site Walkover

A site walkover was undertaken prior to fieldwork. A description of the reconnaissance is presented in table 2.3 below.

Further details and photo locations are detailed on HGE drawing GE22715-DRD003 Annotated Site Plan in Appendix A. Site walkover photos are presented in Appendix B.

Subject Site Area	The area under investigation forms park of Stanborough Park North which is given over to recreational usage. The approximate postcode for the site is AL8 6DF. The approximate site area is detailed below detailed accurately by the Conisbee drawings detailed in section 1.2. 
Current Use	The subject site is set within and bounded by the wider confines of the Park itself. The site is relatively level sloping slightly rising towards the north east perimeter of the site. It is mostly given over to grass except for a toilet block and electrical substation along its south, south east boundary and a play area located in its south, south west area. A picnic area with mature trees is located in the south, south eastern corner of the site. The site is currently utilised for recreational usage associated with Stanborough Park.
Former Use	Refer to section 2.2.1.
Access	Stanborough Park North is accessed by vehicles from the A6129 into the North Car Park. A vehicle height restriction barrier is located just off the road access junction. The site area is accessed from the North Car Park into the site area along the site's south, south eastern boundary. A concrete access road is located along the site's north, north east boundary. A second access is located midway along the south, south east boundary. Pedestrians can also access the area off the car park into the site via a path which is located just to the south of the toilet block.

Topography	The site is relatively level sloping to the north east towards the north eastern perimeter of the site. The site's south, south west boundary which abuts the River Lea is around 63m to 63.5maOD slightly dipping in the central area to around 63maOD then gently rising to the site's northeastern boundary to around 65 to 65.5maOD. Immediately to the north of the site's northern boundary, beyond the concrete access road, a marked change of slope/cutting is present, rising by circa 1.5m to the north (Photo 1, 3 and 4). Mature trees are present along the slope/cutting and flowing surface water/potential spring was noted just north of the sites north western corner.
Vegetation	Onsite mature trees are located within the picnic area in the site's south eastern area. The topographical survey details these up to 16m in height. Two 8m high trees are also located within the play area located to the north of the picnic area and along the northern side of the pedestrian path (located to the north east of the play area and forms the sites southern boundary in the north west corner). Matures trees up to 10m high are also located along the boundary of the site's north eastern comer. Mature trees are also located immediately off site along the slope/cutting running parallel to the site's northeastern boundary.
Site surface	The site surface was predominantly grass, associated with recreational open space. Hardstanding is present associated with the concrete access path and the play area.
Structures	A toilet black is located along the site's south, south east boundary with an electrical substation. At the time of the intrusive works, the toilet block was closed to the public, potentially being refurbished. Structures associate with a child's playground are located in the site's south western corner.
Above/below ground tanks	No above or below ground tanks were noted on site.
Services	A raised manhole cover was noted within the site's south western corner which is also detailed on the topographical drawing. Additional surface manholes were noted in close proximity to the toilet block (also detailed on the topographical survey). A large metal cover was also noted along the site's south western boundary. The topographical survey details this as a soakaway. Other services were recorded within the site area by the services clearance team during setting out of the HGE exploratory locations.
Potential below ground obstruction	Sporadic concrete, potential historical foundations, were noted to the north west of the play area but were considered to be located immediately outside of the proposed site area. Concrete in a X shape was also located in the sites south west corner potentially indicating the location of a former structure.
Surrounding area	Immediately to the south is Stanborough Park North Car Park (hardstanding) which the site is accessed from. To the south, south west is The River Lea which abuts the south western corner of the site with a boating lake beyond. Immediately to the north, north west is a high ropes activity area.
Surface water	The River Lea abuts the site's south western corner with a boating lake beyond. Pooling surface water was noted in the central area of the site approximately in the area of the historical swimming pool. Slow flowing surface water (potential spring) was noted immediately off site to the north of the site's north eastern corner.

Table 2.3: Details of the site walkover

2.4 Historical Reports

Details of information currently provided to HGE by Conisbee is presented in section 1.1 of this report. An overview of the provided historical ground investigation reports and assessments is presented below. For full details of historical information reference should be made to the original documents which are presented in Appendix B.

2.4.1 WYG Desk Study Report a063692 Dated May 2010

The appendices of the above WYG report were not provided to HGE.

The report details the site setting, site history, environmental setting, and geotechnical issues for the site in 2010. The subject site at the time appears larger than the current subject site including the high rope area (north west of the current site), car park (south east of the current site) and parkland to the north and east of the historical pool development (north and east of the current subject site).

The report references and briefly discusses a historical report undertaken by Herts & Essex Site Investigations undertaken in May 2008. It states 10 No. boreholes were undertaken to 3m below ground level (bgl). This report has not been provided to HGE.

At the time of the report the former swimming pool area was reported as relatively level but terracing associated with the former changing huts and sun deck appears to remain beneath overgrown vegetation

and concrete steps remain. The area included piles of debris (concrete, metal, possible sound insulation panels, sand and building materials). The toilet block and electrical substation were present as was the playground adjacent to the River Lea.

The report stated that the former swimming pool had been kept full of water through the years, as when empty, there was not enough weight to prevent the floor of the pool from cracking. Subsidence cracking and escalating maintenance costs resulted in the closure of the site. It was considered that the reported heave of the pool base suggested significant hydrostatic pressures due to shallow groundwater.

The report stated that the 2008 investigation identified minimum groundwater depths of 0.40mbgl. Historical plans indicating the presence of springs along with local place names such as Long Spring Grove indicate prevalence in the area. Additionally, there was anecdotal evidence of transient springs emerging on the eastern slope of the site. The presence of chalk overlain by Boulder Clay and sand and gravels is typical of geology in which springs are common. It was considered possible that shallow groundwater, seasonally fluctuating groundwater tables and the granular nature of the overlying sand and gravel material resulting in rapid transmission of groundwater which could result in localised groundwater flooding within the site.

The report concludes that historical site use including agriculture and the swimming pool development was considered unlikely to have resulted in significant contamination of site soils. However, risk of contamination may rise as a result of infilling the former swimming pools with what is believed to be site won material including rubble produced during the demolition of the buildings. It was considered that the rubble may contain asbestos. It noted that a number of natural and man made cavities were recorded in the surrounding area.

Geotechnical issues were identified as, presence of made ground, remnant foundations and structures, potential for mining induced cavities and fissures/swallow holes.

The report recommended intrusive investigations to determine information on potential soil contamination, made ground, groundwater behaviour and to inform foundation design.

2.4.2 RPS Phase 2 Geotechnical Site Investigation June 2010

The RPS investigation was undertaken across the current subject site and also included the current high rope area to the north east. The investigation comprised of the following to investigate for a proposed children's play area and slash pool development.

- Twelve window sample boreholes (WS) to a maximum depth of 4mbgl
- Five hand excavated trial pits (TP) to a maximum depth of 1.0 mbgl;
- Installation of three shallow groundwater/gas monitoring wells;
- Geotechnical analysis of soils (2 No. concrete classifications, 2 No. particle size distributions, 3 No. Atterberg limits and 5 No. moisture contents)
- 3 No. groundwater sample analysis (chemical suite including, heavy metals, PAHs, BTEX, TPH CWG, Phenols, cyanide, SO4 and Sulphate).
- 1 No. groundwater and ground gas monitoring round.

Boreholes were positioned to provide coverage of the site from a geotechnical perspective.

RPS were unaware of any previous site investigations having been carried out at the site.

It was reported the site was found to be underlain by Made Ground or topsoil to a maximum proven depth of 1.0m bgl. Beneath the Made Ground, Alluvium was encountered to a depth of 1.9m bgl in the centre of the site (WS12). Across the remainder of the site, Glacial Gravel, typically comprising a cohesive layer underlain by medium dense sandy gravel, was encountered beneath the Made Ground. The Upper Chalk was encountered beneath the Glacial Gravels in WS1,2,4,5 and 12 at depths between 2.4mbgl and 3.9mbgl.

The report stated that no visual or olfactory evidence of soil or groundwater contamination was identified during the investigation or monitoring. However, HGE have noted the following from the exploratory logs:

WS3 ashy clay Made Ground with slight TPH odour to 0.6m. Borehole terminated at 0.68m on concrete obstruction.

Groundwater was recorded as standing between 0.54 and 1.69m during the single monitoring round on 3 No. installations.

The base of the swimming pool was encountered in HP4 at 0.2mbgl. WS6,7,8,9 and 10 all terminated at 0.2mbgl due to likely concrete obstruction. WS11 terminated at 1.00mbgl in made ground.

For the proposed buildings, shallow strip foundations bearing within the granular Glacial Gravel were considered likely to be appropriate. Additional trial pitting was recommended to investigate the depth of the Made Ground in the vicinity of WS11 which terminated in Made Ground at 1.00mbgl (located immediately north of the existing toilet block and electrical substation), and the presence of underground structures beneath the former building. During the trial pitting, it was considered that an assessment of the requirement for groundwater control measures could be made. It was considered that significant groundwater control measures would not be required during foundation construction. No specific gas protection measures were recommended. Maximum methane and carbon dioxide concentrations were recorded at 0.1 and 1.1% respectively.

2.4.3 AMEY Geotechnical Options Report Phase 2 December 2013

The above AMEY report was to provide geotechnical options for Phase 2 which comprises construction of a proposed children's wet play facility, café/education facility, play areas and high ropes adventure play. The objectives were to review all available existing geotechnical and historical information that may be relevant to the scheme, provide geotechnical options recommendations for construction and general advice on buildability/geotechnical risk to the development.

HGE have not been provided the following investigations undertaken at the site which have been detailed within the above AMEY report.

- WYG Environment. Ground Investigation and Groundwater Monitoring at Stanborough Park, Interim Report, August 2010; -

  The investigation appears to comprise 10 No. boreholes 5 No. groundwater installations which were installed and monitored over a period of 6 months, June to December 2010. It stated WYG WS4 & 5 are located within the proposed splash lands play area and WYG WS2 is located within the area of the proposed cafe. HGE have not received any logs or information regarding this investigation.

- WYG Environment. Groundwater Monitoring at Stanborough Park, Interpretative Report, March 2011;
- VHE Construction PLC Phase 1 Enabling works as built drawings, June 2013.

The AMEY report details the development of the site was to be undertaken in two phases as detailed below.

Phase 1 constructed in Spring 2013 comprising the development of a high ropes area within the site's existing woodland located to the north. The former Lido site was cleared, reclaimed and redeveloped as public open space. It is assumed that the VHE Construction PLC Phase 1 Enabling works as built drawings, June 2013 is associated with these works which HGE have not received.

It is stated VHE removed the structures and historic foundations associated with the former Lido structures to a depth of approximately 1.0-1.5m. Figure 2.1 within the AMEY report details the extent of the excavations. All excavated materials (comprising crushed concrete graded to 6F2, sands and gravels, sub soils) were re-laid in layers to an engineered specification in thin layers using a vibrating sheepsfoot roller. The works were undertaken in a very dry period and no rainfall was recorded. All obstructions were removed, with the exception of the base to the main swimming pool located at 1.3mbgl to 2.5mbgl.

During the excavation of the main swimming pool and learner pools for the removal of foundations/obstructions, groundwater inundated the excavation overnight, with the groundwater measured at 0.55m below final ground level. These excavations were terminated early as a result of the groundwater, with the swimming pool bases remaining in place. These were documented on VHE Construction PLC drawing VHE 586 003.

On completion of the Phase 1 enabling works it was noted that there was localised ponding of surface water. This could represent a surface topography issue whereby water is collecting at a low spot with near surface deposits being slow draining/low permeability.

On completion the backfill was tested using three 600mm diameter plate load tests. These confirmed a CBR varying between 1.5% and 6.7%, and a modulus of subgrade reaction of 22MPa/m to 53MPa/m. Post Phase 1 site levels are recorded on VHE Construction PLC Drawing VHE 586 001, and are noted to have changed from the 2010 ground investigation levels.

Phase 2 proposed the further construction of a new play park facility, including wet and dry play areas, upon the former Lido site with the provision of a new building to supply catering, learning resources, toilets and changing facilities.

The AMEY report concluded the following associated with the proposed Phase 2 works:-

The site has been investigated by RPS and WYG Environment in 2010, which indicates the site to be underlain by Alluvium - Sands and Gravels, onto weathered Chalk. There are localised spots of soft Clays, and the groundwater level is generally encountered between +62.43maOD and +62.60maOD in the Alluvium - Sands and Gravels.

The site is located in a Flood Plain, and the Flood Risk Assessment completed by WYG Engineering reports that the minimum building finished floor level must be at least 300mm above the 1 in 100 year plus climate change flood level, resulting in a minimum building finished floor of +63.91maOD.

Based on estimated structural loads and raising site levels, it was estimated that differential settlement due to localised soft Clay deposits should be less than 35mm; these could be reduced by modifying the extent to which site levels are raised.

Accounting for flooding, foundations formed to a depth of 0.45m below ground level in the Alluvium – Sands and Gravels should provide a safe bearing capacity based on assumed structural loadings.

Engineering discussions provided in the report highlight two main geotechnical risks; differential settlement and groundwater.

If the proposed structures are formed on a raft, with the base of the foundation constructed above the standing groundwater level (+62.43mOD to +62.60mOD) by raising site levels using a free draining granular material placed to an engineering specification then the geotechnical risk is reduced.

3 INITIAL HAZARD IDENTIFICATION AND ASSESSMENT

Contamination hazard identification has been undertaken based on the information available and this has been developed to include source-pathway-receptor principles. Geotechnical hazards are also identified and commented upon.

3.1 Initial Geotechnical Hazard Identification

Table 3.1 below contains an initial assessment of the likely geotechnical hazards that could be present at the site.

Hazard	Requires further consideration?	Comment
Sulphate bearing soils.	**Yes.**	Considered to be a low to medium risk from encountering soils high in sulphate, chemical testing of soils and groundwater is recommended.
Uncontrolled backfill.	**Yes.**	The site profiles have been altered historically with historical structures removed and subsequently backfilled. Potential for asbestos in crushed concrete materials. Also potential for areas of the site to have been altered with material from the adjacent boat pond construction.
Low permeability soil.	**Yes.**	Although permeable soils are likely to underlie the majority of the site, it has been reported that soft cohesive Alluvial deposits are locally encountered. Additionally it has been reported that surface water pooling occurs within the area of the infilled swimming pool. Material excavated and utilised for the proposed earthworks could contain cohesive materials.

Hazard	Requires further consideration?	Comment
Shrink/ swell potential.	**Yes.**	The site may include cohesive (potentially shrinkable) soils within the superficial deposits and backfilled materials. Material excavated and utilised for the proposed earthworks could contain cohesive materials.
Slope stability.	**Yes.**	Currently Insufficient slope to suffer instability on site. May need to be considered regarding the proposed earthworks swaths and any produced slopes.
Underground obstructions and structures.	**Yes.**	The base of the swimming pool is known to remain in-situ. Other potential obstructions from former structure could still remain onsite. Concrete remnants noted at ground level to the north west of the existing paly area (assumed located just offsite).
High groundwater level/flooding.	**Yes.**	Based on the current information average standing groundwater is at a level of +62.56maOD. Site ground levels circa 63 to 65.5maOD. The River Lea abuts the sites south western boundary. The majority of the site is located within River and Coastal Flooding Zones 2 and 3 with a high confidence rating and a RoFRaS Low to High risk rating. Springs are detailed within the surrounding area on historical maps.
Dissolution Features.	**Yes.**	Site is underlain by soluble Upper Chalk deposits with overlaying granular deposits. The site lies within an area identified as 'rare' for sporadic underground chalk mining of restricted extent that may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered. The nearest identified natural cavity's (sinkholes) are detailed some 400m, 500m and 660m to the north of the site. Historically local paper article has mentioned that that dissolution features could be located within the site area.
Potential variable deposits.	**Yes.**	Variable made ground and superficial deposits likely across the site. Localised soft clay has historically been recorded.

Table 3.1: Initial geotechnical hazard identification

This table has been based on available historical information, geology and topography. However, it should be revised at any time if additional relevant data was identified.

3.2 Initial Environmental Hazard Identification

In this part of the report, environmental hazard identification is undertaken, leading to the development of a conceptual ground model for the site. Contamination sources are specified based on the information previously presented in this report as well as our experience and identified receptors, in association with a list of potential contaminants. As an initial step, the viability of the potential sources are considered in table 3.2a below.

Potential Source	Distance (m)	Location / Direction	Initial assessment	Requires Further consideration?
Made Ground.	On Site.	Identified across site area. Potentially deeper in areas of infilled structures/excavations.	Made Ground identified across the site area. No known geoenvironmental analysis has been undertaken on soils across the site to date. Undertake geoenvironmental analysis of soils. Potential source of ground gas..	Yes.
Infilled swimming pool and structures.	On Site and Immediately Off Site.	Main historical pool in central area of the site. Other structures across the site area plus off site to the NW.	In the 2010 Phase 1 enabling works undertaken by VHE, the historical pool was excavated. The building material which the structures were initially backfilled with was crushed and re-used as backfill for the excavations. There is the potential for this to be contaminated especially with asbestos. No known geoenvironmental analysis has been undertaken on soils across the site to date. Potential source of ground gas.	Yes.

Potential Source	Distance (m)	Location / Direction	Initial assessment	Requires Further consideration?
Asbestos In shallow soils from crushing of building waste (2010 Phase 1 enabling works).	Onsite.	Across site but mainly around the Phase 1 enabling work areas (former structures).	Undertake asbestos screen in soil suite to include shallow soils.	Yes.
Historical boiler houses/ chlorinating plant associated with the historical swimming pool development.	On Site.	Location within the site unknown.	Potential source of hydrocarbons, chlorine or chlorine compounds. Target historical structures and undertake geoenvironmental analysis on soils and groundwater.	Yes.
Electricity infrastructure.	On Site.	Located along southern site boundary adjacent existing toilet block.	Contaminants (PCBs) associated with this source are generally relatively immobile and considered unlikely to impact the site but should be considered and soils in the area analysed especially given the proposed earthworks	Yes.
Potential asbestos in existing toilet bock and electrical substation.	On Site.	Located along southern site boundary.	Existing building structures potential source for asbestos fibres which could be spread further across site areas during any refurbishment/demolition.	Yes.
2010 identified TPH odour.	On site.	Area of WS3 along sites southern boundary.	Not considered significant and also located within an area which is likely to have been removed during the VHE Phase 1 works. Area to be targeted and soils analysed for hydrocarbons	Yes.
Offsite: Historical and current contaminative uses.	4 No. Historical <250m 4 No. current <250m .		3 No. unspecified tanks were recorded between 196m north of the site in 1985 and 1993 and 256m east in 1938. Historical potentially contaminative uses all associated with gravel pits and cuttings within 240m of the site. Current potentially contaminative uses associated with electrical features (140m west) published goods (230m south west) unspecified factory (225m south west) armed services (sea cadets corps 230m north).	Not considered significant at this stage.
Offsite: Infill/Made Ground.	Various.		The historical pool immediately offsite was identified as potentially infilled. Additionally, historical surface ground workings (potentially infilled) were identified as a boating lake (some 20m to the south west) and a pond (some 150m to the northwest). The next nearest potentially infilled featured was located >240m from the site.	Yes.

Table 3.2a: Initial assessment of potential sources of contamination

Of these potential sources, made ground, historical infilled swimming pool and associated backfilled structures tanks, historical boiler room and chlorinating plant (location unknown), electric substation, and asbestos in buildings/soil are believed to be the most significant sources of potential contamination and will be considered further in the assessment process. To a lesser extent the former hydrocarbon odours identified in RPS WS03 and offsite potential contaminative activities should also be given consideration.

The hazard identification is based on the assumptions presented below:

- The proposal is to construct a Splashlands development with associated earthworks as detailed in section 1.2.

- The site has had past use as an agricultural field before the historical swimming pool development was constructed, expanded and subsequently demolish with backfilling of the site areas with demolished (crushed) materials and sub soils.
- The site will be assessed based on its former and proposed use from information provided in CLR11 'Model procedures and the management of land contamination' (DEFRA, 2004) and science report SC050021/SR3 'Updated technical background to the CLEA model' (Environment Agency, 2008).
- Drinking water will be from mains supply.

The identified contamination hazards/sources and sensitive receptors are summarised in Tables 3.2b and 3.2c below.

Contamination Hazards/Sources			
On Site		**Off Site**	
Source	**Implication**	**Source**	**Implication**
Potential for contaminated Made Ground (and/or from backfilled swimming pool and former swimming pool development structures).	Possible total and leachable contaminants.	Areas of infilled Made Ground immediately north northeast offsite associated with the former swimming pool development and potentially infilled surface workings to the South west.	Possible total and leachable contaminants.
	Possible ground gases source.		Possible ground gases source.
Electrical substation.	PCBs total and leachable contaminants.	Local potentially contaminative activities (historical and current).	Possible total and leachable contaminants.
Historical boiler room and Chlorinating Plant (location unknown),	Possible total and leachable source of hydrocarbons, vapours, chlorine or chlorine compounds.		Possible ground gases source.
Identified TPH odours.	Possible total and leachable TPH contamination and vapours in the area of 2010 RPS WS3.		
Possible asbestos containing soils and materials in existing buildings.	Inhalation of fibres in existing near surface soils and if disturbed and /or reused during earthworks. Also demolition, refurbishment or development of the existing structures.		

Table 3.2b: Potential contamination sources and implications

Sensitive Receptors
Humans currently using the site, during development (groundworkers) and post development.
Local flora & fauna.
Controlled Waters/Surface Waters-Groundwater
Proposed buildings and services

Table 3.2c: Potential sensitive receptors

3.3 Key Contaminants

It is normal to consider the contamination implications of a specific land use to formulate a list of key contaminants. It is considered that current and historical potentially contaminative uses at the subject site. We have therefore suggested a list of contaminants below, which include a common contaminates associated with Made Ground soils but also specific contaminates considering the potential sources detailed above.

A key contaminant list has been derived for an initial screen considering the discussion in section 3.2 and comprises the following: Asbestos Screen (with undertaking quantification to 0.001% if asbestos identified), As, Cd, Cr, Cr VI, Cu, Ni, Zn, Pb, Hg, Se, B, pH, TOC, TPH CWG, BTEX, PAH USEPA16. Additionally, Chloride, Chlorine, Sulphate, Sulphide, Sulphur. PCB analysis should be undertaken in close vicinity to the existing electrical substation (south western boundary).

Potential asbestos containing materials (ACMs) although not identified could be found within the ground especially associated with the backfill material in the area of the former swimming pool structures and at shallow depth in surrounding areas. An asbestos fibre screen should be included as part of the recommended suite to assess its presence within the near surface soils where physical contact is anticipated in its current state and after the earthworks associated with the proposed development. The existing buildings should also be surveyed for the possible presence of asbestos where redevelopment works include alterations to existing structures

If visually contaminated or malodourous material is encountered during the investigation or development, or other observations suggest the potential presence of other contaminants, additional analysis may be advised. These are not suggested as part of initial testing, but in some cases, may form part of follow-up analysis, particularly where initial test results indicate greater potential for other contaminants.

3.4 Schematic Section

In order to identify potential pollutant linkages, a schematic section has been included below as figure 3.4a, with figure 3.4b showing the trend line of the section.

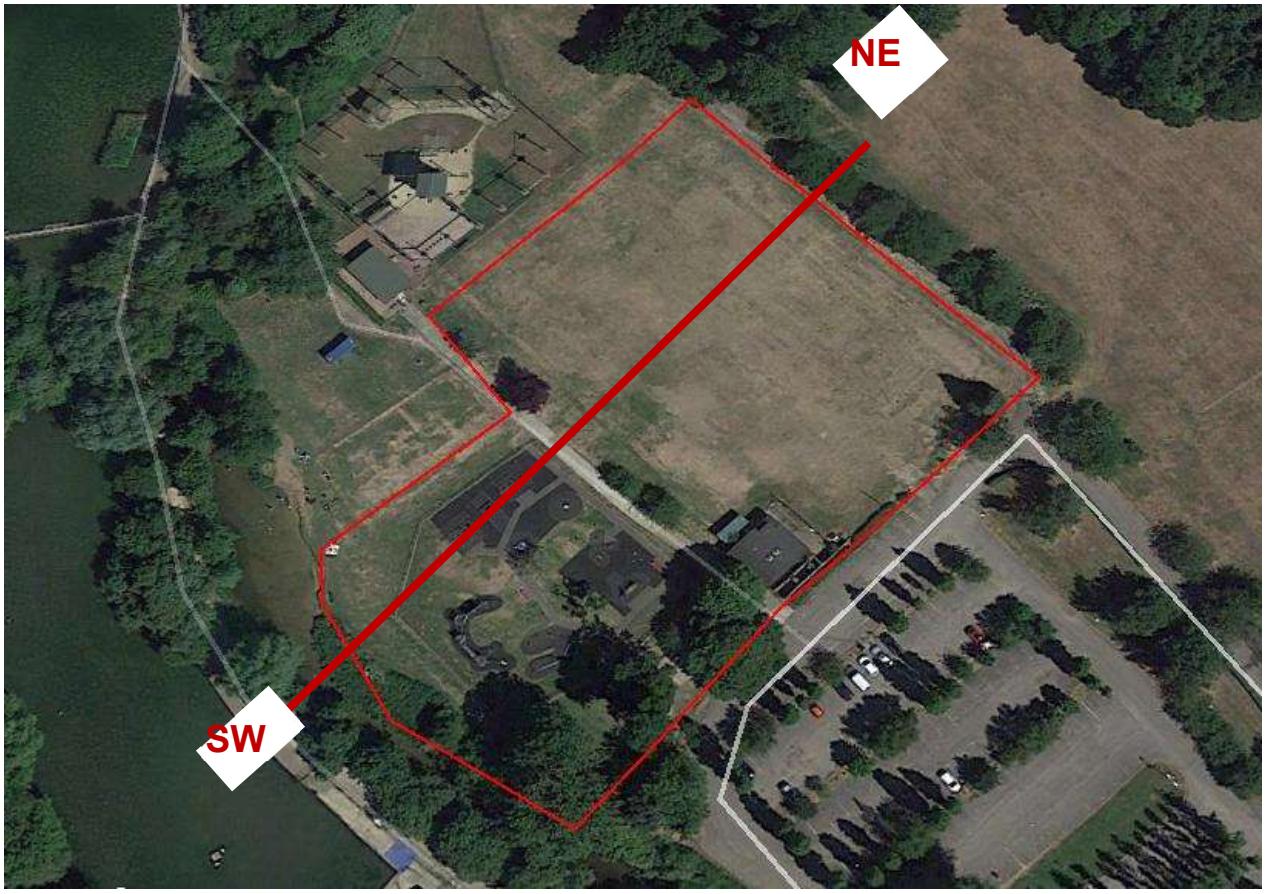

Figure 3.4a: Trend line of the schematic section across the site

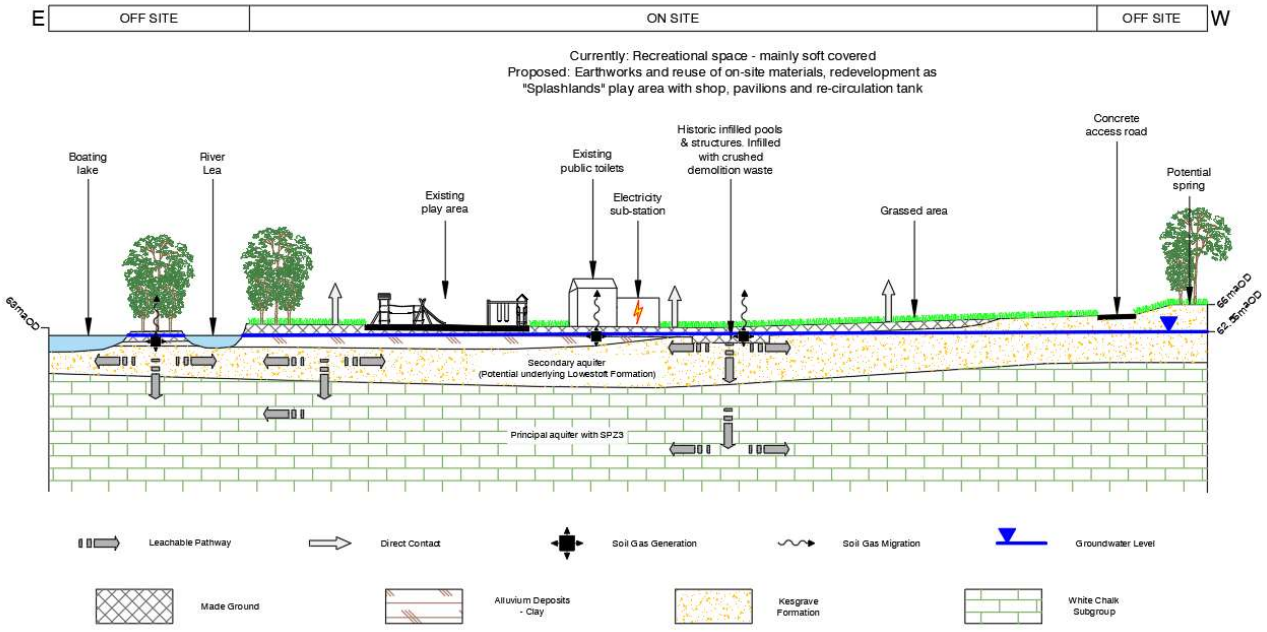

Figure 3.4b: Schematic cross-section

3.5 Initial Hazard Assessment

An initial assessment of the risks posed by each pollutant linkage was carried out. This is included as below and identifies a low to medium hazard with recommended subsequent activity having the potential to include:

- Action required (AR) in the short term to break existing source-pathway-receptor link;
- Site investigation (SI) with risk estimation, or;
- No action (NA) at this stage.

Hazard Identification				Hazard Assessment			
Link No.	**Source/ Hazard**	**Pathway**	**Receptor**	**Probability**	**Consequence**	**Hazard Ranking**	**Hazard Assessment:** - **Action required (AR)** - **Site Investigation (SI)** - **No Action (NA)**
1	Ground gas/vapour from on & off-site Made Ground and natural soils and groundwater	Ingress into excavations, structures and confined spaces, and subsequent inhalation.	People on the site during development construction.	Low Likelihood	Severe	Moderate Risk	**SI** - Ground gas monitoring/assessment with ground worker risk assessment required. TOC analysis to be undertaken is soils to assess potential for organic rich material.
2		Ingress into structures and confined spaces, and subsequent inhalation.	People using the site post development construction.	Low Likelihood	Severe	Moderate Risk	
3	Contaminated soil from previous and present contamination sources both on and off site	Ingestion of soil through direct contact, eating with dirty hands and dust inhalation.	People currently utilising the site and during development construction.	Low Likelihood.	Medium	Moderate/ Low Risk	**SI** - Possibility of soil contamination requires quantification through investigation and chemical testing followed by risk assessment and ground worker risk assessment.
4			People using the site post development construction.	Low Likelihood.	Medium	Moderate/ Low Risk	**SI** - Possibility of soil contamination requires quantification, through investigation and chemical testing followed by risk assessment.
5		Via service pipes.	People using site after development completion.	Low Likelihood.	Medium	Moderate/ Low Risk	**SI** - Possibility of soil contamination requires quantification, through investigation and chemical testing followed by risk assessment to assess whether barrier pipe will be required for new water mains.
6		Plant uptake.	Local flora and fauna.	Low Likelihood.	Mild	Low Risk	NA - Chemical testing and assessment of risk required only if significantly deleterious conditions encountered during invasive investigation works.
7		Leaching.	Groundwater & Surface Water (Secondary & Principal Aquifer). River Lea defines site south western boundary	Low Likelihood.	Medium	Moderate/ Low Risk	**SI** - Groundwater and soil leachate chemical analysis should be undertaken as part of intrusive investigation.
8	Contaminated Groundwater	Off and on site migration through permeable soils		Low Likelihood.	Medium	Moderate/ Low Risk	
9	Potential asbestos containing fibres/materials within existing soils especially backfilled crushed demolition waste and existing structure	Inhalation of dust.	Humans currently utilising site and during and post re development (inc. demolition refurbishment of existing structures).	Low Likelihood.	Severe	Moderate Risk	**SI -** Possibility of asbestos in shallow soils, made ground and existing building fabric investigation analysis and a survey followed by risk assessment.

Table 3.5: Initial Hazard Identification and Hazard Assessment (Table of Pollutant Links)

4 INTRUSIVE INVESTIGATION

4.1 Introduction

The intrusive investigation was designed by Conisbee and HGE to provide a good coverage of the ground conditions across the site areas considering the proposed earthworks, proposed facilities and the known historical structures onsite. As requested this was undertaken by dynamic continuous sampling (window sampler) boreholes, machine excavated trail pits, hand dug trail pits, dynamic cone penetrometer tests and ground gas/water monitoring of borehole installations.

At this stage a shallow investigation was requested to be undertaken which will not be deep enough to assist with any potential deep pile design requirements or to investigate any potential cavities (man made or natural) within the underlying chalk deposits.

The majority of the intrusive site works were undertaken between the 8th and 12th April 2019 but were hindered by the requirement to keep the reinstatement as tidy as possible, high groundwater table and the expected busy nature of the site during the school holidays. Therefore, the intrusive works were completed on the 23rd April 2019.

4.2 Fieldwork, Monitoring and In-situ Testing Program

Details of the ground investigation methods employed have been presented on the appended data sheet and a brief summary of the fieldwork has been presented below.

The exploratory locations are detailed on drawing GE22715-DR002 presented in Appendix B. The drawing also details the extent of the proposed earthworks and the approximate location of historical structures identified from the OS maps.

The sampling strategy was undertaken in general accordance with the engineers scope and took into account local constraints, including reference to the topography of the site, potential pollutant sources, the geology encountered and the development proposals. Environmental and geotechnical samples were generally collected in each change of strata with additional environmental samples taken within any zone of suspected or identified contamination.

During and immediately following completion of the fieldwork geotechnical samples were transported to Harrison Group's Laboratory in Norwich via in house transportation and/or couriers where, upon arrival, they were logged into sample management system.

Environmental samples were dispatched to the nominated chemical test laboratory using cool boxes and refrigerant blocks. Chain of Custody (CoC) Sheets were prepared, copies of which accompanied the samples.

4.2.1 Service Clearance/Surveying

Pre-intrusive works were undertaken by an independent specialist who cleared proposed exploratory locations utilising a range of techniques including Ground Penetration Radar (GPR).

The service cleared locations were also surveyed in to establish the coordinates of all exploratory positions, the details of which are shown on the appropriate records presented in Appendix C.

4.2.2 Dynamic Sampling (Windowless Sampler) Boreholes

12 No. dynamic sampler boreholes (WS101 to WS112) were drilled between the 10th and 12th April 2019. The works were undertaken using a dual-purpose tracked rig to depths between 1.31 and 4.45mbgl in order to identify, sample and test the underlying sub-soils.

Upon completion, 9 No. boreholes were installed with groundwater/gas monitoring wells, the details of which are summarised in Table 4.2.3 below. The remaining boreholes were backfilled with arisings.

WS105 and WS106 were located within the historical swimming pool footprint and terminated due to obstructions at 1.38 and 1.31mbgl respectively. It is considered that the obstructions are likely associated with the historical pool base.

A detailed description of all the strata encountered, in-situ testing undertaken, position and types of samples taken along, with any groundwater observations made at the time of drilling are included on the dynamic sampling borehole records presented in Appendix C.

4.2.3 Monitoring Wells

9 No. boreholes were installed with standpipes for monitoring groundwater/gas levels within the soils encountered. Table 4.2.3 summarises these installations.

Monitoring Point I.D	Diameter of Installation (mm)	Base Depth of Installation (m)	Response Zone (m depth)		Target Strata
			Top	Base	
WS101	50	1.50	0.50	1.50	Made Ground (Granular)
WS102	50	4.00	1.00	4.00	Fluvial Deposits (Granular), Chalk
WS103	50	3.40	1.00	3.40	Fluvial Deposits (Cohesive), Fluvial Deposits (Granular), Chalk
WS104	50	4.00	1.00	4.00	Fluvial Deposits (Granular), Chalk
WS105	50	1.00	0.50	1.00	Made Ground (Granular)
WS107	50	4.00	1.00	4.00	Fluvial Deposits (Granular)
WS108	50	1.20	0.50	1.20	Made Ground (Granular), Fluvial Deposits (Granular),
WS109	50	3.00	1.00	3.00	Made Ground (Cohesive), Fluvial Deposits (Granular),
WS111	50	1.20	0.20	1.20	Made Ground (Granular), Fluvial Deposits (Granular),

Table 4.2.3: Summary of monitoring installations.

Detailed descriptions of the installations and their corresponding backfill materials are included on the relevant exploratory hole logs presented in Appendix C.

4.2.4 Machine and Hand Excavated Trial Pits

10 No. machine dug trial pits (TP101 – TP110) were excavated between the 8th and 23rd April 2019 to depths between 1.20 and 3.00mbgl in order to sample, test and log the underlying soils. This was undertaken using a wheeled JCB 3CX excavator.

The pits were hindered locally by high groundwater, instability, buried structures and the potential of asbestos fibres in demolition waste backfill. All arisings from the pits were placed on plastic and the excavations were terminated if groundwater was encountered. This ensured that no potential contamination was left at surface and allowed for the materials to be compacted with the excavator bucket on completion.

Trial Pit TP105 encountered what is believed to be the historical swimming pool wall at 0.8m bgl. The pit was continued on the north eastern side of the concrete structure (assumed wall) in TP105b, and to the south western side in TP105a. A fast groundwater strike was encountered in TP105a and the pit was terminated before the depth of the concrete base was identified.

TP106 also encountered a concrete slab at 1.30mbgl. TP106 was located within the footprint of the historical swimming pool so the slab is assumed to be the pool base. WS105 and 106 were also located within the historical swimming pool footprint and terminated due to obstructions at 1.38 and 1.31mbgl respectively. It is considered that the obstructions are likely associated with the historical pool base.

2 No. hand dug pits were undertaken on the 23rd April 2019 to obtain samples of the shallow underlying deposits for subsequent laboratory analysis. The locations were in an area of mature trees with associated tree protection zones (south western corner of the site). The ground levels in this area are proposed to remain as existing.

A detailed description of all the strata encountered, position and types of samples taken, tests performed; along with any groundwater observations made at the time of excavation are included on the trial pit logs presented in Appendix C.

4.2.5 Dynamic Cone Penetrometer Tests

8 No. Dynamic Cone Penetrometer (DCP) tests were undertaken across the site area, which can be identified as TRL1 to TRL8, using a TRL probe to obtain in situ CBR estimates of the soil. The TRLs were undertaken to depths between 0.30 to 0.90 mbgl adjacent previously undertake exploratory locations as detailed on the logs. Refer to the relevant exploratory log for corresponding ground conditions.

Details of the test results are included on the relevant record sheets presented in Appendix C.

4.2.6 Gas/Groundwater Monitoring

Currently 4 No. rounds of monitoring have been undertaken as part of this investigation on the following dates.

- Round 1 – 17/04/2019
- Round 2 – 24 & 25/04/2019 (Ground water samples taken from installations exc. WS104)
- Round 3 – 29/04/2019 (Groundwater sample taken from WS104)
- Round 4 – 09/05/2019

Conditions permitting the gas monitoring were planned to be undertaken in a range of atmospheric conditions, including high pressure (more than 1000 mbar), low pressure (less than 1000 mbar), rising pressure, and falling pressure conditions. Met Office definitions for falling pressure are – 'falling' change of 1.6 to 3.5 hPa in 3 hr, 'falling quickly' 3.6 to 6.0 hPa in 3 hr 'falling very rapidly' >6.0 hPa in 3 hr. The atmospheric conditions 3hr prior to monitoring are presented in the 'other remarks' box at the bottom of the monitoring results sheets. These atmospheric conditions were obtained from the www.weather.org website.

The monitoring utilised a GA5000 infrared gas analyser to record concentrations of gases including methane, carbon dioxide, oxygen and also related pressure and flow. Volatile Organic Compounds (VOCs) were monitored utilising a PID meter on environmental samples (ES). The results are presented on the Gas Monitoring Result sheets contained in Appendix C and summarised in table 4.3.4.

Groundwater levels and any free phase NPAL (DNAPL and LNAPL) were also monitored on the above dates utilising a dual phase interface meter.

The results of the water strikes encountered during the intrusive works are detailed on the relevant records presented in Appendix C. The standing water levels from the subsequent monitoring rounds are summarised in the monitoring tables presented in Appendix C.

4.3 Fieldwork Observations

4.3.1 Ground Conditions

The following section is presented as a draft outline and could be amended within the final report following receipt of the laboratory analysis, further monitoring data and subsequent assessment.

A summary of the geology encountered during the site investigations is presented in Table 4.3.1 below.

Geology	Depth Below Ground Level (m) Encountered		Thickness (Min / Max) (m)	Thickness (Average) (m)	Site Level Range (maOD) Encountered	
	Upper Boundary	Lower Boundary			Upper Boundary	Lower Boundary
Made Ground - Granular	Ground Level	0.10 - 2.30	0.10 - 2.30	0.83	63.15 - 65.37	61.45 - 65.07
Made Ground - Cohesive	0.25 - 0.90	0.70 - 1.50	0.45 - 1.15	0.73	62.44 - 63.91	61.84 - 62.76
Fluvial Deposits - Granular	0.10 - 2.30	1.30 - 4.45	0.40 - 4.35	1.55	61.45 - 64.88	58.91 - 63.93
Fluvial Deposits - Cohesive	0.20 - 1.50	1.00 - 2.00	0.05 - 1.46	0.86	61.84 - 65.07	61.79 - 64.17
Fluvial Deposits - Silt	1.60 - 2.40	1.80 - 3.00	0.20 - 0.60	0.40	62.56 - 62.97	62.36 - 62.37

White Chalk Subgroup	1.30 - 3.30	3.00 - 4.45	0.30 - 3.15	1.28	61.09 - 63.93	60.01 – 60.79

Table 4.3.1: Depth/level range of the differing strata encountered during drilling/excavation.

Made Ground and Underground Obstructions

Across the majority of the site grass overlay a varying thickness of made ground. The made ground was predominantly granular with anthropogenic material such as brick and concrete also asphalt, possible clinker, roof tile, wood fragments and metal (generally rebar). The locations where anthropogenic material is considered to represent potential contamination is detailed in section 4.3.2.

The following exploratory locations terminated within made ground.

- WS105 at 1.38m – Concrete obstruction (likely historical swimming pool slab)
- WS106 at 1.31m – Concrete obstruction (likely historical swimming pool slab)
- TP104 at 1.20m – Terminated due to water ingress
- TP105a at 1.30m – Terminated due to water ingress
- TP106 at 1.30m – Concrete obstruction (likely historical swimming pool slab)

Trial Pit TP105 encountered what is believed to be the historical swimming pool wall at 0.8m bgl. The pit was continued on the north eastern side of the concrete structure (assumed wall) in TP105b, and to the south western side in TP105a. A fast groundwater strike was encountered in TP105a and the pit was terminated before the depth of the concrete base was identified.

TP106 also encountered a concrete slab at 1.30mbgl. TP106 was located within the footprint of the historical swimming pool so the slab is assumed to be the pool base. WS105 and 106 were also located within the historical swimming pool footprint and terminated due to obstructions at 1.38 and 1.31mbgl respectively. It is considered that the obstructions are likely associated with the historical pool base.

Superficial Fluvial Deposits

The geological maps detail the site to be underlain by superficial Kesgrave Catchment Subgroup overlain by Alluvial deposits in the south, south western half of the site area. Lowestoft Formation (Diamicton) is detailed some 500m to the north and south of the site.

Underlying the made ground, the exploratory locations generally encountered yellowish or brown/orangish brown locally clayey sandy GRAVEL locally with low cobble content. The gravel and cobbles were of flint.

A cohesive unit was encountered above the gravels in the north eastern area of the site in WS103,104,110, and TP101,102,103,109. The exception was WS102 located within the north eastern area which did not encounter the cohesive unit. The cohesive unit was generally encountered as a soft to firm or stiff brown, greyish brown or orangish brown slightly gravelly or gravelly CLAY. The gravel was flint.

It is difficult to determine with certainty if any of the above deposits have been reworked for instance the cohesive deposits identified within the north eastern area of the site where historically above ground structures (presumed changing rooms) were located.

Solid Geology – White Chalk Subgroup

Chalk was encountered in WS102, 103, 104, 110 between depths of 1.30 and 3.30mbgl and was prove to a maximum depth of 4.45mbgl. The chalk was recovered generally as a cream to white gravelly SILT.

4.3.2 Contamination Observations

The following olfactory and visual evidence of potential contamination was identified during the site works. It is limited to asphalt and possible clinker fragment with locally wood fragments and metal (rebar) with the made ground strata.

- WS101 Asphalt fragments in Made Ground between 0.0 and 1.50m reducing in content between 1.00 and 1.50m
- WS103 Asphalt fragments in Made Ground between 0.0 and 0.24m
- WS104 Possible clinker fragments in Made Ground between 0.0 and 0.30m
- WS105 Occasional asphalt fragments in Made Ground between 0.0 and 1.38m.
- WS109 Possible clinker and asphalt fragments in Made Ground between 0.25 and 1.40m
- WS110 Possible clinker and asphalt fragments in Made Ground between 0.0 and 0.90m

- WS111 Asphalt fragments and possible clinker in Made Ground between 0.25 and 1.00m. Band of asphalt at 0.50m
- TP101 Asphalt fragments and possible clinker in Made Ground between 0.30 and 0.60m
- TP104 Possible clinker and metal fragments in Made Ground between 0.25 and 1.20m
- TP105a Occasional wood fragments, asphalt and possible clinker in Made Ground between 0.02 and 1.30m. Metal rebar around the concrete structure
- TP106 Occasional wood fragments and metals in Made Ground between 0.22 and 1.30m
- TP108 Occasional metal and possible clinker in Made Ground between 0.15 and 0.30m
- TP109 Occasional possible clinker and metal in Made Ground between 0.0 and 0.30m

Additionally the highest PID readings undertaken on the environmental soil samples during the fieldworks were recorded as 3.4ppm within the made ground.

Elevated PID readings we also recorded within the fluvial granular deposits recorded as 11.1ppm at 1.5m and 38.2ppm at 2.5m within WS108 and WS109 respectively. Both of the PID readings were recorded below the water table and both boreholes were installed with monitoring wells for subsequent groundwater analysis and monitoring.

4.3.3 Groundwater

The following section is presented as a draft outline and could be amended within the final report following receipt of additional monitoring data and subsequent assessment

Groundwater details encountered during the intrusive works and subsequently during the currently 4 No. rounds of monitoring of the wells installed are summarised in Table 4.3.3. The monitoring records are presented in Appendix C.

Exploratory Hole Location	Approximate Water Strike		Standing Groundwater Depth Encountered During Monitoring	
	mbgl	maOD	mbgl	maOD
HDTP101	N/E	-	-	-
HDTP102	N/E	-	-	-
TP101	2.00	62.35	-	-
TP102	N/E	-	-	-
TP103	2.00	62.51	-	-
TP104	1.00	62.29	-	-
TP105a	0.70	62.64	-	-
TP105b	N/E	-	-	-
TP106	1.10	62.26	-	-
TP107	1.30	62.18	-	-
TP108	1.20	62.14	-	-
TP109	N/E	-	-	-
TP110	1.60	62.11	-	-
WS101	1.50	61.65	0.58 - 0.76	62.39 - 62.57
WS102	2.00	63.23	2.58 - 2.66	62.57 - 62.65
WS103	2.50	61.96	2.00 - 2.06	62.40 - 62.46
WS104	2.00	61.65	1.20 - 1.30	62.35 - 62.45
WS105	N/E	-	0.82 - 0.95	62.40 - 62.53
WS106	N/E	-	-	-

Exploratory Hole Location	Approximate Water Strike		Standing Groundwater Depth Encountered During Monitoring	
	mbgl	maOD	mbgl	maOD
WS107	1.00	62.36	0.82 - 0.85	62.51 - 62.54
WS108	1.00	62.47	0.95 - 1.10	62.37 - 62.52
WS109	2.00	62.16	1.67 - 2.20	61.96 - 62.49
WS110	2.00	61.79	-	-
WS111	0.70	62.71	-	-
WS112	2.30	61.45	0.85 - 0.90	62.51 - 62.56

Table 4.3.3: Summary of Groundwater levels during drilling/excavation & monitoring

4.3.4 Ground Gas

The following section is presented as a draft outline and could be amended within the final report following receipt of additional monitoring data and subsequent assessment

The gas monitoring regime currently comprises of 4 No. rounds carried out over a one month period following completion of the fieldwork, the results of which are presented in the Appendix C and summarised in Table 4.3.4 below.

Point ID	Barometric Pressure (mB)	Gas Concentration Ranges					Max Flow Rate (l/hr)	Peak PID (ppm)	Stable PID (ppm)
		CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)			
WS101	989 - 1018	0.0 - 0.2	0.1 - 6.0	15.1 - 21.2	0.0 - 6.0	0.0	0.1	0.3 - 3.3	1.0 - 3.3
WS102	986 - 1018	0.0 - 0.1	2.3 - 7.0	14.1 - 18.3	0.0 - 5.0	0.0	0.1	0.1 - 7.0	0.1 - 5.4
WS103	986 - 1018	0.0 - 0.2	0.1 - 9.9	11.1 - 20.5	0.0 - 5.0	0.0	0.0	0.1 - 2.8	0.7 - 2.6
WS104	986 - 1018	0.0 - 0.2	0.3 - 5.5	14.9 - 20.7	0.0 - 4.0	0.0	0.1	0.1 - 3.9	0.4
WS105	989 - 1018	0.0 - 0.2	0.0 - 0.2	18.0 - 20.2	0.0 - 3.0	0.0	0.0	0.4 - 14.0	
WS107	986 - 1018	0.0 - 0.2	0.3 - 1.9	18.5 - 20.4	0.0 - 10.0	0.0	0.1	0.0 - 3.5	0.2 - 3.5
WS108	986 - 1018	0.0 - 0.2	0.2 - 2.4	18.1 - 20.2	0.0 - 1.0	0.0	0.1	0.0 - 1.2	0.2 - 0.7
WS109	986 - 1018	0.0 - 0.2	2.2 - 4.5	18.1 - 20.0	0.0 - 2.0	0.0	0.0	0.0 - 6.1	0.0 - 1.2
WS111	989 - 1018	0.0 - 0.2	0.1 - 3.0	17.4 - 19.0	0.0 - 3.0	0.0	0.0	0.1 - 3.3	2.3

Table 4.3.4: Summary of Gas Concentrations and Flow Rates

4.4 In-Situ Testing

To Follow

4.5 Geotechnical Laboratory Testing

To Follow

4.6 Chemical Laboratory Testing

Selected soil samples and groundwater samples were submitted to a UKAS/MCERTS accredited laboratory for the analyses as detailed in table 4.6 below.

est Type	Number of tests
Soil	
Soil Primary Suite HSS6 Includes: As, Cd, Cr, Cr, VI, Cu, Ni, Zn, Pb, Hg, Se, B, pH, TOC, TPH CWG, PAH USEPA16, Asbestos Screen/ID plus quants 0.001% if detected	26
Chloride, Sulphate, Sulphide, Sulphur	18
Asbestos Screen/ID plus quants 0.001% if detected	3
PCB (WHO)	2
Leachate Suite HGWS2 Includes: As, Cd, Cr, Ni, Pb, Hg, Se, Cu, Zn, Bo, PAHs USEPA 16 EPA speciated, TPH 5 band, BTEX, Sulphate, pH, Hardness	5
Leachate Primary Suite (2:1) Includes: As, B, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn, Ammonical Nitrogen, Chloride, Sulphate (SO4), TOC, Total Cyanide, Free Cyanide, Complex Cyanide and Total Hardness (CaCO3).	4
Full WAC.	6
Waters	
HGW2: As, Cd, Cr, Cu, Ni, Zn, Pb, Hg, B, Se, sulphate, pH, hardness, PAH (speciated), TPH (6-10, 10-12, 20-30, 30-40)	7
Sulphide, sulphur, chloride, NH4 as N, DOC, Calcium	7

Table 4.6: Summary of Chemical Laboratory Testing

It was noted that Chlorine which has been identified as a contaminate of concern was not analysed as part of the groundwater suite currently undertaken. Therefore, a full set of groundwater samples from across the site was obtained on the 15th May 2019 and scheduled for chlorine analysis on a fast turnaround so as not to delay the assessment. Additionally, River Lea water samples were obtained up stream and drown stream of the subject site area.

The results of the current analysis are presented in Appendix D.

5 GEOTECHNICAL ASSESSMENT

To Follow

6 CONTAMINATION ASSESSMENT

To Follow

REFERENCES

BS1377:1990, 'Methods of Test for Soils for Civil Engineering Purposes'.

BS5930:2015, ‘Code of Practice for Ground Investigations’.

BS8485:2015, ‘Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings’.

BS10175:2011+A1:2013, ‘Investigation of Potentially Contaminated Sites’

BS EN 1997-1:2004 +A1:2013, ‘Eurocode 7: Geotechncial Design - Part 1: General rules”.

BS EN 1997-2:2007, “Eurocode 7: Geotechnical Design - Part 2: Ground Investigation and Testing”.

BS EN ISO 14688-2:2004 Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification.

BS EN ISO 22475-1:2006 & 22475-2/3:2011 Geotechnical investigation and testing. Sampling methods and groundwater measurements.

BS EN ISO 22476:2005+A1:2011 Geotechnical investigation and testing. Various.

BS EN ISO 17892-1:2014, ‘Geotechnical investigation and testing - Laboratory testing of soil - Part 1: Determination of water content’.

Building Research Establishment, 2005. Special Digest 1:2005, ‘Concrete in Aggressive Ground’.

Building Research Establishment, 2016. Digest DG 365:2016, ‘Soakaway design’

CIRIA Report C665: 2007, ‘Assessing risks posed by hazardous ground gases to buildings’.

CL:AIRE, 2016. ‘CAR-SOIL™ – Control of Asbestos Regulations 2012, Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry Guidance.’

Environment Agency science report: SC050021/SR3 ‘Updated technical background to the CLEA model’.

Environment Agency Technical Guidance WM3: 2015 ‘Waste Classification - Guidance on the classification and assessment of waste (1st edition 2015)

Land Quality Management Ltd, (2014). The LQM/CIEH Suitable 4 Use Levels (S4ULs) for Human Health Risk Assessment.

National House Building Council (NHBC) Standards, Part 4.2.

The Waste (England and Wales) Regulations 2011 – as amended.

The Landfill (England and Wales) Regulations 2002 – as amended.

LIST OF APPENDICES

Datasheet: Site Investigation Methods

Datasheet: General Risk Assessment Methodology

Appendix A - Drawings

Site Location Plan	GE22715-DR001
2019 Fieldwork Location Plan	GE22715-DR002
Annotated Site Plan	GE22715-DR003

The proposed development is detailed by the following drawings

- Conisbee Drainage Strategy Drawing 171116-CON-X-00-DR-C-1000 P4
- Conisbee Proposed Site Level and Contours Drawing 171116-con-X-XX-DR-C-2000 P6
- Conisbee Cross Sections Drawings 171116-CON-X-XX-DR-C-2100 P4
- Conisbee Flood Compensation Cross Section Drawing 171116-CON-X-XX-DR-C-2200 and 2201 P2
- Conisbee Proposed Site Level and Contours Over Existing Levels Drawing 171116-CONn-X-XX-DR-C-7010 P3
- Conisbee Strip Off Existing Ground Drawing 171116-CON-X-XX-DR-C-7001
- Conisbee Summary of Earthworks Analysis –171116-CON-X-XX-DR-C-7002 P3
- Conisbee Summary of Earthworks Analysis Cross Sections–171116-CON-X-XX-DR-C-7003 P3
- Conisbee Isopachytes Contours Plan Drawing 171116-CON-X-XX-DR-C P2
- Consibee Summary Of Earthworks Analysis- Cross Sections Drawing 171116-CON-X-XX-DR-C-7005 P1

The existing site and buildings is detailed in the following drawings.

- Terrain Surveys Topographical Survey (Jan 2019).
- Conisbee Existing Level and Contours Drawing 17116-CON-X-XX-DR-C-2001 P1

Appendix B - Background Information

Site Walkover/ Recognisance Photos	Photo 1 to 11
Groundsure Enviro Insight	GS-5876483
Groundsure Geo Insight	GS-5876482
Historical Maps	
Brimstone Stage 1 Preliminary UXO Risk Assessment	PRA-19-1094
Brimstone Stage 2 Detailed UXO Risk Assessment	DRA-19-1082
Utilities Search Plans	
Conisbee Flood Risk Assessment	Ref 17116/T Gavaza Dated 24th Jan 2019
<u>Regulator Correspondence</u>	
EA Ref: NE/2019/129826/01-L01	
EA email	5th March 2019 to Conisbee
Conisbee Meeting Notes	26th March 2019
Planning Consultation Memo	Ref: 6/2019/0814/FULL

<u>Historical Reports</u>

WYG Desk Study Report May 2010,

RPS Phase 2 Geotechnical Site Investigation June 2010,

WYG Topographical Survey A067207-5-51-C-1001 22/11/12,

WYG Flood Risk Assessment A067207-5 dated December 2012,

AMEY Geotechnical Options Report Phase 2 December 2013,

Murray Rix Plate Bearing Test Results dated May 2013,

VHE Plate Bearing Test Locations Drawing 586 004 dated June 2013,

VHE Finished Levels Drawing 586 001 dated June 2013,

VHE Duct Layout Drawing 586 002 dated June 2013,

VHE Structures Remaining Drawing 586 003 dated June 2013

VHE Existing Services Drawing 586 005 dated July 2013,

Appendix C - Fieldwork Records/Data

Dynamic Continuous Sample Borehole Records	WS101-110
Dynamic Continuous Sampler SPT Calibration Certificate	
Machine and Hand Dug excavated Trial Pit Records	TP101 to 110 & HDTP101-102
Photo Plates of Trial Pit Locations	TP101 to 110 & HDTP101-102
Dynamic Cone Penetrometer	TRL1 to 8
Gas and Groundwater monitoring Results	Round 1 – 17/04/2019
	Round 2 – 24 & 25/04/2019
	Round 3 – 29/04/2019
	Round 4 – 09/05/2019

Appendix D - Laboratory Test Data

Geotechnical Laboratory Test Results	To Follow
Chemical Laboratory Analysis Results	i2 Reports
	19-37047-2
	19-37050-1
	19-37740-1
	19-37741-1
	19-38993-2
	19-39000-1
	19-39487-1
	19-39709-1

DATASHEET: SITE INVESTIGATION METHODS

This datasheet provides basic details of the methods employed during the undertaking of site investigations. Detailed method statements may be provided if requested or further information may be obtained from the relevant British Standards or other quoted publications. Investigations are generally carried out in accordance with BS 5930:2015, "Code of practice for ground investigations", BS 10175:2011+A1:2013, "Investigation of potentially contaminated sites – Code of Practice, and BS EN ISO 1997-2:2007, "Eurocode 7 – Geotechnical design – Part 2: Ground investigation and testing".

Prior to any excavation being undertaken, service plans are obtained and/or a service tracing team may be employed to locate and mark up service locations. A surface sweep using a cable avoidance tool (CAT) is undertaken, in order to avoid services and service inspection pits are generally hand excavated prior to commencing work with any mechanical plant.

CABLE PERCUSSIVE BOREHOLES

The cable percussive borehole drilling rig may be towed by a 4x4 pick up or similar vehicle, and is capable of forming cased boreholes to depths of up to 50m. The hole may be formed at diameters from 300mm down to the more typical 150mm, with disturbed samples obtained direct from the drilling tools. The equipment requires a minimum 2m access width, and the rig itself is 6m long (11m including tow). A rough 3m x 5m base area is required for drilling, but each site should be considered on specifics.

The technique can penetrate dense made ground, rubble and concrete or weathered rock/thin bands of rock using a chisel. However, in some cases these materials can form obstructions.

Sampling is generally carried out in accordance with BS EN ISO 22475-1:2006, "Geotechnical investigation and testing – Sampling methods and groundwater measurements - Part 1 – Technical principles for execution". A variety of disturbed samples can be obtained for both geotechnical and environmental purposes and undisturbed samples including U100 (thick walled OS-TK/W), UT100 (thin walled OS-T/W) and piston samples (PS-T/W) may be obtained. Standard in-situ testing may include Standard or Cone Penetration Tests (SPT/CPT) to BS EN ISO 22476-3:2005+A1:2011, "Geotechnical investigation and testing – Field testing – Part 3 – Standard penetration test"; vane testing in accordance with BS 1377-9:1990, "Methods of test for soils for civil engineering purposes" and permeability testing in accordance with BS EN ISO 22282-1-6:2012, Geotechnical investigation and testing – Geohydraulic testing – Parts 1 to 6.

Instrumentation/standpipes/monitoring wells can be installed, otherwise the borehole would be backfilled with spoil, or where instructed bentonite, concrete or sand may be used. Excess spoil is either removed from site or left in a tidy heap nearby.

In wet drilling conditions (beneath groundwater level) or where water needs to be added to facilitate drilling, the spoil can spread over a wide area through splashing and flow of the spoil from the tools, unless precautions are taken to prevent this. Conversely, the system can be very clean for instance when drilling through dry clay soil.

DYNAMIC CONTINUOUS SAMPLING (WINDOW SAMPLER) BOREHOLES

The window sampler system comprises a series of varying diameter (100mm down to 36mm) steel tubes of either 1m length, and in the case of window (rather than windowless) having a slot or window cut along the side. The tubes are driven into the ground using a light percussive hammer attached to solid rods, and withdrawn by use of a jack. The hammer may be machine mounted (wheeled or tracked) or for restricted access work, hand held. The soil sample is forced up into the tube during the driving, samples being obtained directly through the slot or window, or in the case of windowless, in plastic liners in the steel tube. The sampler generally achieves depths of around 5m in favourable soils. Use of a super heavy tracked rig allows samples to be retrieved in liners to depths of up to 10m in suitable ground conditions.

Sampling can be carried out from the boreholes in accordance with BS EN ISO 22475-1:2006 and SPT testing can be undertaken in accordance with BS EN ISO 22476-3:2005+A1:2011. In addition small diameter standpipes/monitoring wells can be installed to facilitate the sampling and monitoring of gas and groundwater.

CONE PENETRATION TESTING

A 20.5 tonne or larger truck-mounted rig is normally used, with or without tracks, to undertake cone penetration tests (CPT). The CPT unit is equipped with a hydraulic ram to drive an electric piezocone of a type conforming to the requirements of clause 3.1 of BS1377: 1990: Part 9 or BS EN ISO 22476-1.

Cone measurements can include cone tip resistance, friction sleeve resistance and dynamic pore water pressure (piezometer) sampled at a 10mm resolution. Cone maintenance, checks and calibrations are carried out in accordance with recommendations of the International Reference Procedure for CPTU (ISSMGE, 1999).

ROTARY BOREHOLES

Rotary drilling is used in hard rock areas where cable percussive or auger methods are not suitable. Drilling fluid is generally used, which are passed from the surface through hollow drill rods to the face of the drill bit to cool and lubricate the bit and transport drill cuttings to the ground surface as well as stabilising the hole in certain circumstances. Drilling fluids used include water, mist, air and in some cases mud, polymers or foam.

There are two basic types of rotary drilling; open hole drilling, where the drill bit cuts all the material within the diameter of the borehole; and core drilling, where an annular bit, fixed to the bottom of the outer rotating tube of a core barrel, cuts a core, which is recovered within the innermost tube of the core barrel assembly and bought to the surface.

Open hole drilling is often used with casing to stabilise the drill hole and is generally used to form a rapid hole in soils or weak rock. The returns and the rate of penetration are the only means of recording information so the accuracy of rock descriptions and identification of the changes of strata are limited using this method. Rotary coring is used to recover good quality core samples of the materials being drilled with various methods and diameters available, depending upon anticipated strata and requirements.

Numerous rig types are available from small track mounted units able to work in limited access situations to large lorry mounted units requiring large operating areas.

DYNAMIC PROBING

Dynamic probing (also known as 'dynamic penetration testing') is undertaken in accordance with BS EN ISO 22476-2:2005+A1:2011. A sacrificial cone is percussively driven into the ground using rods, with the number of blows taken to achieve a 10cm penetration (N_{10}) recorded. Torque is measured at 1.0m intervals when additional rods are added and depths of up to 20m are achievable in suitable ground conditions. The rods are removed using a jack, and the results presented graphically as N_{10} values against depth.

Various dynamic probe rigs with differing specifications are available with DPH (heavy) and DPSH (super heavy) generally being used. Rigs may be wheeled or tracked and are generally able to access areas at a minimum width of 1.0m and operate in a headroom of as little as 3.0m. Specifications for the type of probing usually undertaken are provided below:

DPH Penetrometer Specification

Mass of weight	*50Kg*	Drop	*500mm*
Cone	*90 degree*	Rods	*32mm diameter*

DSPH-B Penetrometer Specification

Mass of weight	*63.5Kg*	Drop	*750mm*
Cone	*90 degree*	Rods	*35mm diameter*

The results provide an assessment of the relative density of the near surface soils and are quoted as raw N_{10} values. Various correlations have been established with the results and a number of geotechnical parameters, which are provided in Annex G of BS EN 1997-2:2007 or site specific correlations with parameters such as SPT 'N' value may be derived where sufficient data is available. Raw N_{10} values should be adjusted for torque and the specific energy ratio (E_r) of the equipment used which is provided on the calibration certificate for the specific equipment.

MONITORING WELL INSTALLATIONS

All types of boreholes can be fitted with monitoring wells to enable subsequent sampling and monitoring of groundwater and ground gas levels. Monitoring wells are usually of upvc or hdpe material, although steel may also be used in certain circumstances. Various diameters are available from 19mm upwards, depending upon the size of the borehole. 38mm or 50mm diameter wells are the most commonly used. Wells generally have slotted lower sections which may have a geomesh filter and then are surrounded with a filter medium such as single sized gravel. The upper sections are generally solid casing which is usually grouted to produce a seal with the surrounding ground. The top of the well is generally fitted with a removable cap that may include a gas valve to enable future gas monitoring. The installation is usually protected by a lockable cover set in a concrete base. Details of monitoring well installations and associated backfill are given on the relevant borehole records.

BOREHOLE INSTRUMENTATION

Various types of instrumentation may be installed in boreholes to enable subsequent monitoring of groundwater levels and pressures and ground movements. Instruments that may be installed include piezometers (standpipe, vibrating wire or pneumatic), inclinometers, extensometers, settlement and strain gauges.

GROUNDWATER MONITORING

Groundwater monitoring is undertaken using an electronic dip meter, which records the depth to water in a standpipe or monitoring well. Alternatively, down-hole pressure transducers cab be utilised which can record variations over an extended period, which is particularly useful in monitoring variations due to tidal influences or when undertaking permeability tests or draw down tests or when undertaking soakaway testing. Where a non-aqueous phase liquid (e.g. floating hydrocarbon layer) is present, an interface meter is utilised to measure the thickness.

GROUND GAS MONITORING

Ground gas composition and flow monitoring may be undertaken where monitoring wells have been installed. Both flow (litres per hour) and composition (%) are measured using a portable infra-red multi-gas meter, calibrated for methane, carbon dioxide, carbon monoxide, hydrogen sulphide and oxygen. Records are also taken of atmospheric pressure, and relative pressure. The results are presented in the appendix of the report on the relevant records.

Ground gas monitoring can also be undertaken on a continuous basis using in-situ GasClam instrumentation where specific projects warrant accurate identification and quantification of the ground gas regime.

MACHINE EXCAVATED TRIAL PITS

Machine excavated trial pits are undertaken using a wheeled back-hoe or tracked 360 excavator. The hole is progressed, with the supervising Geotechnical Engineer taking samples and/ or carrying out in-situ testing as appropriate. No access may be made in to unstable/ contaminated pits, or into pits greater than 1.20m deep. Where man access is required, shoring can be provided and installed to maintain stability of the excavation. The trial pits are backfilled in compacted layers, with spoil heaped up in order to allow for future settlement. Pits may be taken to a maximum of 4.50m depth in favourable conditions.

Machine excavated trial pits require relatively large clear working areas in which to be carried out and can cause considerable disturbance to the ground surface.

HAND EXCAVATED TRIAL PITS

Hand excavated pits may be undertaken for a variety of reasons, which include service observation pits, obtaining near surface samples, and examining foundations of existing buildings. Pits are excavated using a shovel, postholers and other suitable equipment. Shoring is necessary where pits are to be extended greater than 1.2mbgl and deep excavations may take a considerable time to undertake. Detailed records of hand excavated pits are only normally recorded where foundation depths and detailed information is required.

TRIAL PIT SOAKAWAY TESTING

Soakaway tests are undertaken in machine excavated trial pits to determine the infiltration rate of the soils on a site in accordance with BRE Digest 365, "Soakaway design". The trial pit is excavated using a mechanical excavator and vertical sides are trimmed square and accurate measurements of the pit dimensions are made. In granular soils the pit is backfilled with coarse single size gravel to the top of the natural soils to prevent collapse of pit sides upon filling with water. Where granular fill is used a temporary perforated monitoring well is installed over the depth of the trial pit prior to backfilling. This allows monitoring of the water level by an electronic dip-meter or pressure transducer. In cohesive soils, granular fill may not be required and a monitoring installation is replaced by a fixed datum bar placed across one end of the pit. The water level is monitored using a tape or dip-meter. The pit is rapidly filled with water from a bowser / tanker to fill the pit to its maximum effective depth in a short time. Care is taken to prevent the collapse of pit walls. The pit is filled and allowed to drain three times to 25% full where ground conditions and time constraints allow. The water level is recorded at intervals sufficiently

close to define water level versus time. The three fillings should be on the same or consecutive days. The soil infiltration rate (f) is calculated from the time taken for the water level to fall from 75% to 25% effective storage depth in the pit, using the lowest f value the three tests for design.

IN-SITU CBR TESTS

The California Bearing Ratio (CBR) test was originally conceived as a laboratory test to measure the strength of subgrade materials for pavement design purposes. The in-situ variation of the test is now widely used for assessment of the subgrade and is carried out in accordance with BS 1377: Part 9: 1990. The test set up consists of a manually operated gearbox mounted onto a stable platform (usually a 4x4 vehicle or backhoe excavator). A load ring is attached beneath the gearbox, along with a strain gauge and various extension rods with a solid plunger on the end. The gearbox is manually operated to force the plunger into the ground at a constant rate, the resultant stress is recorded by the load ring and the movement of the plunger is measured by the strain gauge acting upon a datum bar placed across the test area. The results are presented in the appendix of the report on the relevant record.

PLATE BEARING TESTS

The plate bearing test is carried out in accordance with BS 1377: Part 9: 1990. This method covers the determination of the vertical deformation and strength characteristics of soil in-situ by assessing the force and amount of penetration with time when a rigid plate is made to penetrate the soil. The test is used to evaluate the load deformation characteristics of the soil beneath the plate without entailing the effects of sample disturbance. The method may be carried out at the ground surface, in pits, trenches or adits and at the bottom of a borehole. Kentledge is usually a tracked excavator or loaded dumper.

Results may be used to directly assess settlements in equivalent foundations although size and depth differences may preclude such use. Results may also be used to assess plate modulus of elasticity (E_{PLT}) and the coefficient of sub-grade reaction (K_s), both in accordance with BS EN 1997-2:2007.

TRL DYNAMIC CONE PENETROMETER TEST (TRL DCP)

The TRL (Transport Research Laboratory) Dynamic Cone Penetrometer is an instrument designed for the rapid in-situ measurement of the structural properties of existing road pavements constructed with unbound materials. Continuous measurements are made down to a depth of 850mm, or when extension rods are use, the subgrade strata beneath can be penetrated to a depth of 2 metres. These measurements are converted to CBR values and Layer Stiffness Modulus. Where pavement layers have different strengths the boundaries can be identified and the thickness of the layers determined, similarly with the strata beneath.

The TRL DCP uses an 8kg hammer dropping through a height of 575mm and a 60^0 cone having a maximum diameter of 20mm. (this punches a clearance hole to ensure there is no friction on the rods.) The instrument is held vertically and the hammer raised to the top of the instrument and allowed to fall freely. The resulting penetration of the rod is measured and the number of blows recorded for a penetration of about 10mm (the number of blows carried out per reading of penetration can be varied to suit the strength of the layer). After the DCP is carefully withdrawn by hand cones shall be checked by measurement regularly to check the wear and replaced when necessary. From the DTP Interim Advice Note 73/06 – Design Guidance for Road Pavement Foundations, a calculation is then applied to the mm//blow to calculate the CBR value, using the following relationship with was developed by the Transport Research Laboratory

$$\mathbf{Log_{10}(CBR) = 2.48 - 1.057 \times Log_{10}(mm/blow)}$$

The following equation has been used (after Powell et al. 1984) to give an estimated value of Stiffness Modulus E, acknowledging a degree of uncertainty :

$$\mathbf{E = 17.6(CBR)^{0.65} MPa}$$

DATASHEET: GENERAL RISK ASSESSMENT METHODOLOGY

The pollutant links and initial conceptual ground model provide a potential 'source-pathway-receptor' analysis for the site based on the information presented in the report. Qualitative risk assessment allows for a consideration of the relative risk or hazard due to each potential linkage. Risk assessment is an iterative process, and as such must start at a general level, gradually becoming more specific as more cycles are performed based on better information.

An initial estimation of risk can be undertaken using the methodology set out in CIRIA 552 (2001), "Contaminated land risk assessment. A guide to good practice". This involves classification of the magnitude of the potential consequence (severity) of risk occurring (table D1) and magnitude of the probability (likelihood) of the risk occurring (table D2). These are then used to produce a risk category (table D3).

Classification	Definition	Examples
Severe	Short-terms (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/property. A short-terms risk to a particular ecosystem or organism forming part of such ecosystem (note: the definitions of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health ("significant harm" as defined in DETR, 2000). Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem (note: the definitions of ecological systems within Draft Circular on Contaminated Land, DETR, 2000).	Concentrations of a contaminant from site exceed the generic or site-specific assessment criteria. Leaching of contaminants from a site to a principal or secondary aquifer. Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as defined in the *Draft Circular on Contaminated Land*, DETR, 2000). Damage to sensitive buildings/structures/ services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

Table D1: Classification of consequence

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

Table D2: Classification of probability

DATASHEET: GENERAL RISK ASSESSMENT METHODOLOGY (CONT.)

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low Likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Table D3: Definition of Risk (Comparison of consequence against probability)

Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term, and are likely to be necessary over the longer term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Table D4: Description of the classified risks and likely action required

The process described above represents the general qualitative risk assessment methodology used by Harrison Group Environmental in the context of the report in which it was represented, and may not necessarily be transferable to all situations.

Appendix A - Drawings

Site Location Plan	GE22715-DR001
2019 Fieldwork Location Plan	GE22715-DR002
Annotated Site Plan	GE22715-DR003

The proposed development is detailed by the following drawings

- Conisbee Drainage Strategy Drawing 171116-CON-X-00-DR-C-1000 P4
- Conisbee Proposed Site Level and Contours Drawing 171116-con-X-XX-DR-C-2000 P6
- Conisbee Cross Sections Drawings 171116-CON-X-XX-DR-C-2100 P4
- Conisbee Flood Compensation Cross Section Drawing 171116-CON-X-XX-DR-C-2200 and 2201 P2
- Conisbee Proposed Site Level and Contours Over Existing Levels Drawing 171116-CONn-X-XX-DR-C-7010 P3
- Conisbee Strip Off Existing Ground Drawing 171116-CON-X-XX-DR-C-7001
- Conisbee Summary of Earthworks Analysis –171116-CON-X-XX-DR-C-7002 P3
- Conisbee Summary of Earthworks Analysis Cross Sections–171116-CON-X-XX-DR-C-7003 P3
- Conisbee Isopachytes Contours Plan Drawing 171116-CON-X-XX-DR-C P2
- Consibee Summary Of Earthworks Analysis- Cross Sections Drawing 171116-CON-X-XX-DR-C-7005 P1

The existing site and buildings is detailed in the following drawings.

- Terrain Surveys Topographical Survey (Jan 2019).
- Conisbee Existing Level and Contours Drawing 17116-CON-X-XX-DR-C-2001 P1

Appendix B - Background Information

Site Walkover/ Recognisance Photos	Photo 1 to 11
Groundsure Enviro Insight	GS-5876483
Groundsure Geo Insight	GS-5876482
Historical Maps	
Brimstone Stage 1 Preliminary UXO Risk Assessment	PRA-19-1094
Brimstone Stage 2 Detailed UXO Risk Assessment	DRA-19-1082
Utilities Search Plans	
Conisbee Flood Risk Assessment	Ref 17116/T Gavaza Dated 24th Jan 2019

Regulator Correspondence

EA Ref: NE/2019/129826/01-L01	
EA email	5th March 2019 to Conisbee
Conisbee Meeting Notes	26th March 2019
Planning Consultation Memo	Ref: 6/2019/0814/FULL

Historical Reports

WYG Desk Study Report May 2010,

RPS Phase 2 Geotechnical Site Investigation June 2010,

WYG Topographical Survey A067207-5-51-C-1001 22/11/12,

WYG Flood Risk Assessment A067207-5 dated December 2012,

AMEY Geotechnical Options Report Phase 2 December 2013,

Murray Rix Plate Bearing Test Results dated May 2013,

VHE Plate Bearing Test Locations Drawing 586 004 dated June 2013,

VHE Finished Levels Drawing 586 001 dated June 2013,

VHE Duct Layout Drawing 586 002 dated June 2013,

VHE Structures Remaining Drawing 586 003 dated June 2013

VHE Existing Services Drawing 586 005 dated July 2013,

Appendix C - Fieldwork Records/Data

Dynamic Continuous Sample Borehole Records	WS101-110
Dynamic Continuous Sampler SPT Calibration Certificate	
Machine and Hand Dug excavated Trial Pit Records	TP101 to 110 & HDTP101-102
Photo Plates of Trial Pit Locations	TP101 to 110 & HDTP101-102
Dynamic Cone Penetrometer	TRL1 to 8
Gas and Groundwater monitoring Results	Round 1 – 17/04/2019
	Round 2 – 24 & 25/04/2019
	Round 3 – 29/04/2019
	Round 4 – 09/05/2019

Appendix D - Laboratory Test Data

Geotechnical Laboratory Test Results	To Follow
Chemical Laboratory Analysis Results	i2 Reports
	19-37047-2
	19-37050-1
	19-37740-1
	19-37741-1
	19-38993-2
	19-39000-1
	19-39487-1
	19-39709-1