PHASE 1 DESK STUDY AND
PHASE 2 SITE INVESTIGATION REPORT

Site **40 TWICKENHAM ROAD, TEDDINGTON, GREATER LONDON TW11 8AW**

Client **URBAN & URBAN PROPERTIES LTD**

Consulting Engineer **THE MORTON PARTNERSHIP**

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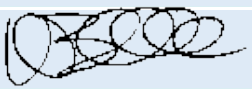
Prepared by	**K J Clark** BSc Hons Director		
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The recommendations made and opinions expressed in this Report are based on the strata conditions revealed by the fieldworks as indicated on the exploratory records, together with an assessment of the data from in situ and laboratory tests. No liability can be accepted for conditions which have not been revealed by the fieldworks, for example, between exploratory positions. While this Report may offer opinions on the possible configuration of strata, both between the excavations and below the maximum depth achieved by the investigation, these comments are for guidance only and no liability can be accepted for their accuracy. The data obtained relate to the conditions which are relevant at the time of the investigation.

The groundwater observations entered on exploratory records are those noted at the time of the investigation. The normal rate of progress does not usually permit the recording of any equilibrium water level for any one water strike. It should be noted that groundwater levels are prone to seasonal variation and to changes in local drainage conditions. The word 'none' indicates that groundwater was sealed off by the borehole casing or that no water was observed in the exploratory hole upon completion.

REPORT REF: 19/11602/KJC
CONTRACT: TWICKENHAM ROAD, TEDDINGTON

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1 INTRODUCTION

Albury SI Ltd have been commissioned to complete a geo-environmental and geotechnical investigation of the site. The initial phase of this investigation comprised a Phase One Desk Study.

1.1 Objectives

The Desk Study comprises a review of the readily available geological, historical and environmental sources for information about the site, together with a walkover survey of the area. This includes the commissioning of an Insight data report supplied by Groundsure Ltd. This report presents the findings of the Desk Study together with an outline Conceptual Site Model and preliminary risk assessment, based upon identified potential sources of contamination which may pose a significant risk to receptors or end-users of the site.

In preparing this report reference has been made to relevant guidance which includes the 'Investigation of potentially contaminated sites. Code of Practice.' (BSI, 2011) and the EA CLR 11 report 'The Model Procedures for the Management of Land Contamination' (DEFRA and EA, 2004).

1.2 Proposed Development & Scope of Phase Two Investigation

The Client proposes to construct a four storey residential block incorporating lower ground floor car park, following the demolition of the existing structures at 40 Twickenham Road, Teddington ("the site"). Consequently, a site investigation has been undertaken in order to ascertain the nature and engineering properties of the soils underlying the proposed development site and to obtain data which will assist in the formulation of a safe and economical foundation solution. In addition, a geo-environmental appraisal of the site has also been carried out. At the time of the site works, the site was unoccupied and the existing buildings were present.

The programme of this investigation initially comprised the completion of a Desk Study, which includes an Insight report by Groundsure Ltd. The scope of the subsequent intrusive investigation was provided by The Morton Partnership and included the construction of a 20m deep cable percussive borehole, three shallow depth boreholes using hand-held window sampling techniques and two manually excavated trial pits. During this work samples were recovered for further examination and laboratory testing. In addition, a number of in situ tests were also performed and a standpipe was installed within the deep borehole to facilitate groundwater level monitoring. This report describes the work undertaken, presents the information obtained and discusses the ground conditions with respect to foundation design, construction and potential contamination.

2 PHASE ONE DESK STUDY - THE SITE

2.1 Site Location

The site covers an area of 1600m^2, is roughly rectangular in shape and is located at Ordnance Survey National grid reference 516354, 171679. The site comprises an unoccupied detached bungalow. There are residential properties to the north west and south east. Twickenham Road lies to the south west and the River Thames forms the north eastern boundary with an associated pontoon and slipway from the property.

2.2 Site Topography

The recent small scale Ordnance Survey maps c1973 and 1991 indicate that the 5m contour traverses the site. In addition, a spot height of 7.6mAOD is shown in Twickenham Road adjacent to the site on a large scale map c1991. A block plan, no 1520.02.c supplied by the Consulting Engineers, indicates that the site levels reduce from a maximum of 51.9m in the south east corner to 47.97m in the north east corner. A slipway is present in the north east corner, which provides boat access to the River Thames. A standing water level of 46.28m is shown.

3 SITE HISTORY

3.1 Historical Mapping

The historical Ordnance Survey mapping contained within the Groundsure report has been reviewed. The maps reviewed are included in Appendix 1.

Table 1 - Historical Mapping Summary

Date	Source Scale	Relevant Information	
		On Site	Off Site
1840	1:2500*	No specific coverage. High water mark of ordinary tides noted on north east boundary. Trigonometry point on north west boundary.	River Thames forms the north east boundary. Teddington Lock present 250m to south east, indicating that the river is still tidal with the river flow to north west.
1864 1865	1:2500 1:10560	Site forms part of a larger open area.	The now Twickenham Road forms the south west boundary. A large residential house called Teddington Grove is present to the south west.

1894 1896	1:10560 1:2500	Site appears to from half of a square plot of land. A small structure may be present in the north west corner.	Houses now present to the north west. Engineering works now present 100m to the south east. Boat houses are recorded 230m north and south east. A wharf is also noted to the south east. Inlet to river partially infilled 170m to south east.
1898	1:2500	No change.	No change.
1913	1:2500		Teddington Lock expanded with extended man-made island in river and additional lock (Skiff Lock).
1915	1:2500	A number of structures are now present on site including a slip in the northern corner and rectangular structure in southern corner.	Houses now present to south east. Engineering works now motor works. A timber yard is present beyond. A boat house is now present 35m north of the site with an associated slip way.
1934	1:2500	Structure now present as per layout today. Slip extended.	Timber yard no longer shown. Large building now shown 100m south east. Motor repairs works now further to the south east. Teddington Grove now redeveloped by housing. Large boat house present 95m south east.
1948	1:10560	No discernible change.	No discernible change.
1959 1960	1:1250 1:2500	House now numbered 40.	A further house is now present to the south east. Small glasshouses identified attached to existing bungalow. Warehouse identified to south east.
1973	1:1250	No discernible change.	No discernible change.
1982	1:1250	No significant change.	No significant change. One glasshouse no longer present. Works to south east identified as boat building yard.
1991	1:1250	No significant change.	No significant change.
2002	1:10000	No significant change.	No significant change.
2010	1:10000	No significant change.	No significant change.
2014	1:10000	No significant change.	No significant change.

*indicates partial mapping coverage

At the time of the earliest mapping the site formed part of open land and was developed in the 1930's by the property present today.

3.2 Aerial Imagery

Consideration of the modern aerial imagery contained within Google Earth and Streetview indicates that no significant change has occurred within the last 15years. Google Earth records the presence of a pontoon in the River Thames not previously recorded on the OS Maps.

3.3 Bomb Damage Maps & Unexploded Ordnance Risk

The following is considered to be a non-specialist assessment in accordance with CIRIA C681. A review of the Bombsight website indicates that a number of strikes were recorded during the period 7th October 1940, to 6th June 1941 in the general vicinity of the site. A high explosive bomb strike is recorded in Twickenham Road. Other strikes are also noted at Teddington Lock together with two strikes in Grove Gardens to the south. It is unlikely that any unexploded ordnance or bomb craters would have gone unnoticed and the risk of UXO is considered to be low.

4 GEOLOGY

4.1 Published Geology

An examination of the digital 1:50,000 British Geological Society mapping and the Geo Insight report has been completed. This indicates that the site is underlain by Alluvium of Recent age. The Kempton Park Gravel Member of similar age underlies the Alluvium. The London Clay Formation of Eocene age is present at depth.

4.2 Historical Borehole Records

The records of the BGS have been reviewed and a borehole record has been found 134m south west of the site in Grove Gardens. Based upon the anticipated geology and the above record the likely ground conditions beneath the site are summarised in tabular form below.

Table 2 - Anticipated Ground Conditions

Strata	Thickness m	Depth to Base m
Made Ground	TBC by SI	TBC by SI
Alluvium	TBC by SI	TBC by SI
Kempton Park Gravel Member	4m	4.4m
London Clay Formation	Not known	Not known

4.3 Hydrogeology

The site is underlain by a superficial Secondary (A) aquifer associated with the underlying Alluvium. The Kempton Park Gravel Member is a Principal aquifer of high leaching potential. The London Clay Formation is an unproductive stratum. However, the site is not underlain by a drinking water Source Protection Zone [SPZ].

No potable water abstractions are noted. However, groundwater abstraction points are recorded 534m and 762m south east of the site, which are related to the Lensbury Club for spray irrigation.

4.4 Radon

The Geo Insight report indicates that the site is not in a radon affected area as less than 1% of properties are above the action level. Moreover, no protective measures as described in BRE report BR211 are necessary in the construction of new properties or extensions.

5 ENVIRONMENTAL SETTING

5.1 Hydrology & Flood Risk

The River Thames is present immediately to the north east of the site and forms the site boundary. The site lies downstream of Teddington Lock and the river adjoining the site is tidal. The site is located within a zone 3 floodplain and at high risk of flooding from the River Thames.

5.2 Landfill Data

There are no active or inactive registered landfill sites listed in the Enviro Insight report within 1km of the site. Historic surface ground workings are recorded. The vast majority are located north, north east, and east of the site beyond the River Thames and they are deemed to represent no risk to the proposed redevelopment.

5.3 Recent & Current Land Use

It is evident from the OS mapping that the site has been in residential usage c1934. It is likely that it was in this usage prior to this date. The site is still residential in nature, although the current bungalow has been vacant for some time. The Enviro Insight report notes potentially contaminative sites in the form of boat houses/slipways and landing stages.

5.4 Ecologically Sensitive Receptors

There are no sensitive environmental or ecological receptors within 1250m of the site.

6 SITE RECONNAISSANCE

A visit to site was made on 11th July 2019 using the procedures outlined in CLR 2. At the time of the survey the conditions were dry with hazy sunshine.

The existing bungalow sat to the rear of the site and a garage block was present on the Twickenham Road boundary. The site was overgrown with shrubs, bushes and nettles and a number of mature trees were also noted within the site boundary. A slip way was present in the north east corner and a landing stage extended out over the River Thames. Some itinerant use of the site was recorded, including discarded wood, a wheelbarrow and a boat trailer. No obvious evidence of potential sources of contamination were observed, although the site was very overgrown.

During the visit a number of photographs were taken, which include close ups of areas of concern, which are presented as Figure 3 attached to this report. Also included are drawings showing the existing site layout, presented as Figure 1.

7 PRELIMINARY RISK ASSESSMENT

7.1 Conceptual Site Model

In accordance with the report CLR 11 a Conceptual Model has been prepared for this site. The model prepared for the site in tabular format below lists potential sources of contamination, identified receptors on and within the immediate vicinity of the site, together with the pathways between them. A pathway must exist for an identified source to pose a risk to a receptor, thereby forming an active pollutant linkage.

The primary receptors are considered to be future residents (human health), surrounding ecology (plants and animals), controlled waters and proposed buildings.

A qualitative assessment of the risk of each potential pollutant linkage is given based upon the CIRIA guidance document ‘Contaminated Land Risk Assessment: A Guide to Good Practice’ (Rudland, Lancefield and Mayell, 2001). The risk is a combination of the probability or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

Table 3 - Preliminary Conceptual Site Model			
Source(s)	**Potential Pathway(s)**	**Receptor(s)**	**Risk Level**
Alluvium (on site) - *ground gases: carbon dioxide and methane* Boat maintenance (on site) - *VOC vapours*	Migration, ingress and accumulation	Proposed and existing buildings (asphyxiation or explosion)	Very low
		Neighbouring buildings (off site) residential and commercial (asphyxiation or explosion)	Very low
Boat maintenance (on site) - heavy metals (lead & copper)/hydrocarbons	Inhalation, ingestion and migration	Site workers and end users	Very low

7.2 Groundwater

The anticipated regional groundwater flow within the superficial aquifer is likely to be towards the River Thames to the north east. There is likely to be some hydraulic continuity between the superficial aquifer and this surface water feature.

7.3 Geotechnical Hazards

There are no specific geotechnical hazards recorded for the site.

7.4 Further Investigation

It would be prudent to carry out a limited intrusive investigation to prove the underlying natural strata and confirm that the near surface soils are suitable for their intended use. The CSM has noted the possible generation and migration of ground gas/vapours. However, the risks are considered to be very low as the proposed redevelopment will incorporate a lower ground floor car park level with the residential accommodation above.

8 PHASE TWO SITE INVESTIGATION - FIELDWORKS

The Phase 2 intrusive investigation has been undertaken in order to ascertain the nature and engineering properties of the soils underlying the proposed development site and to obtain data which will assist in the formulation of a safe and economical foundation solution. In addition, a geo-environmental appraisal of the site has also been carried out. At the time of the site works, the site was unoccupied and the existing buildings were still present.

In accordance with the Consulting Engineer's requirements the programme of this investigation comprised the construction of a single deep cable percussive borehole (BH1), three shallow depth boreholes using window sampling techniques (WS1, WS2 and WS3) and two hand excavated trial pits (TP1 and TP2). During this work samples were recovered for further examination and laboratory testing. In addition, a number of in situ tests were also performed and a standpipe was installed in borehole BH1 in order to complete groundwater level monitoring.

8.1 Site Works

The boreholes and trial pits were constructed on 11th and 12th July 2019 at locations as shown on the site plan, which is presented as Figure 1. The exploratory positions were located as instructed by the Consulting Engineers.

The depths and descriptions of the strata encountered in the boreholes and trial pits are given on the exploratory records, which comprise Appendix 2 to this report. These records note the depths at which samples were taken, the results of in situ tests and the groundwater observations noted at the time of the fieldworks.

8.2 Installations

Upon completion of the deep borehole a standpipe or monitoring well was installed in order to carry out long-term groundwater level monitoring. This comprised of 1m plain pipe extended to 4m with geowrapped slotted pipe.

9 GROUND CONDITIONS

9.1 Stratigraphy

Consideration of the exploratory records indicates that made ground generally comprising dark brown sand with brick fragments, roots and gravel was noted at the investigatory locations and was shown to extend to depths of between 0.4m and 1.4m. Trial pit TP1 was concluded within the made ground at 1.1m.

Brown becoming orange brown silty clay was exposed beneath the made ground and was proved to depths of 1.8m and 2m. At the location of borehole WS1, a horizon of dark brown peat becoming grey organic clayey sand was observed upon penetration of the brown clay. This organic soil extended to 2.5m. The soils described above are collectively thought to represent the Alluvium.

Granular soils grading from brown sand and gravel to sand with gravel were encountered beneath the Alluvium. These soils are indicative of the Kempton Park Gravel Member. Boreholes WS2 and WS3 and trial pit TP2 were all terminated within this stratum at 2m and 4.1m. The Kempton Park Gravel Member was noted to 4m in borehole BH1 and to 3.4m in borehole WS1.

Blue-grey silty clay, representative of the unweathered zone of the London Clay Formation, was revealed beneath the Kempton Park Gravel Member, within which boreholes WS1 and BH1 were concluded at 4.1m and 20m.

9.2 In Situ Testing

During the construction of borehole BH1 a series of in situ Standard Penetration Tests [SPT] were performed. The test results are presented in terms of the number of blows to achieve a seating drive for 150mm of penetration, recorded as two 75mm increments and the test drive over 300mm recorded as four 75mm increments. The test drive is used to derive the penetration resistance for that soil layer and is recorded as the uncorrected SPT *N* value. Penetration resistances or *N* values of 15 blows/300m were recorded in the made ground and of 20 blows/300mm to 24 blows/300mm in the Kempton Park Gravel Member, which represents a medium dense condition for a granular soil. The remaining tests were completed within the London Clay Formation and *N* values ranging from 18 blows/300mm to 36 blows/300mm were recorded, which, using established correlations, infers a stiff to very stiff condition in situ for a cohesive soil.

Hand shear vane tests were conducted within the Alluvium using the Geonor Shear Vane test equipment. Shear strengths increasing from 40kPa to 180kPa have been recorded, which infer a soft to very stiff in situ condition for a cohesive soil. One test was completed within the London Clay Formation at 3.5m within borehole WS1 where a result of 120kPa was established confirming the stiff nature of this soil.

9.3 Groundwater

During the construction of the exploratory positions groundwater strikes were recorded in boreholes WS1, WS2 and WS3 at 2.5m. Short-term standing water levels upon completion of these boreholes were recorded at 2.3m, 2.4m and 2.45m. The trial pits remained dry throughout.

Water added to assist boring through the granular soils in borehole BH1 is likely to have masked groundwater inflows. On completion of this borehole a standpipe was installed to enable groundwater monitoring, which is discussed below.

9.4 Monitoring

A return visit was made on 25th July 2019 to monitor the standpipe installed as part of the intrusive investigation. A depth to water of 2.7m was recorded at 9am. The nearby River Thames was noted to be at high tide. This is confirmed by examination of the tide times at Richmond Lock available on the internet.

9.5 Existing Foundations

The existing foundations of the bungalow exposed in the trial pits are depicted in the sectional drawing nos. 19/11602/5 and 19/11602/6, presented in Figure 4 to this report. The excavations revealed that the existing foundations comprise corbelled brickwork, which extended to 0.23m and 0.3m. At this depth concrete was exposed to 0.4m.

10 LABORATORY TESTING

A programme of laboratory testing has been undertaken and the results are presented as Appendix 3 to this report. The geotechnical soil testing was undertaken by Albury S.I. Ltd, whilst representative samples were submitted for geochemical testing at the UKAS accredited laboratories operated by i2 Analytical Ltd. Each type of test is summarised below and the results obtained have been used to assist in the formulation of the discussion.

10.1 Water Content

The water contents of samples of the soils encountered at this site have been determined. Water contents within the range 25.4% to 40.7% have been recorded.

10.2 Index Properties

The liquid and plastic limits of samples of the Alluvium have been determined. The results of this work indicate that the samples tested can generally be described as inorganic clays of intermediate to high plasticity and of medium shrinkage potential.

10.3 Particle Size Distribution

Samples of the granular soils encountered at this site have been subjected to sieve analysis in order to determine the soils' particle size distribution. The results of this work are presented in the form of grading curves.

10.4 Triaxial Compression

The undrained shear strength characteristics of samples of the London Clay Formation have been determined by testing specimens in the triaxial compression apparatus. Under the conditions of this work cohesions of between 95kPa and 320kPa were obtained, which are indicative of a high to very high strength condition for a cohesive soil.

10.5 Oedometer Consolidation

The one dimensional consolidation/swelling characteristics of a sample of the London Clay Formation underlying the site have been determined by testing specimens in the Terzaghi Oedometer or Consolidation apparatus. The results of this work are presented in the form of coefficients of volume decrease/increase and of consolidation/swelling, which relate to the magnitude and rate of settlement/heave, respectively. The results obtained suggest that moderate magnitudes of heave may be expected, these movements occurring over a long period of time.

10.6 Chemical Testing – Organic Matter, Soluble Sulphates & pH

Samples of the soils and groundwater encountered at this site have been subjected to chemical analyses in order to determine their soluble sulphate contents and pH values. Under the conditions of this work low concentrations of soluble sulphate have been recorded in association with near neutral pH values. The organic matter content of a sample of the peat from borehole WS1 at 2m has been assessed. A result of 44% of the dry weight of the soil has been attained.

10.7 Geochemical Testing

Selected samples of the made ground have been submitted to the UKAS accredited laboratories operated by i2 Analytical Ltd. The testing comprises a suite of typical inorganic and organic priority contaminants including metals, PAH, TPH CWG and an asbestos screen.

11 GEOTECHNICAL DISCUSSION

11.1 Foundations

The Client proposes to construct a four storey residential block, incorporating a lower ground floor level that will comprise car parking and storage areas. The proposed layout and floor plans are shown in Figure 2. At the time of the preparation of this report no precise information had been provided with respect to the anticipated structural loads.

It cannot be recommended that major structural foundations be located within the made ground or Alluvium revealed by this investigation. These soils have been shown to be present in a weak and variable condition such that unacceptable settlement could occur even under the action of light loading intensities. Moreover, they have been shown to extend to depths of up to 2.5m. Therefore, it will be necessary to continue foundation excavations through these undesirable materials where they are of less than 1m in thickness to this minimum depth in order to avoid that zone of soil which is subject to normal seasonal moisture variation or frost action. The above precautions need not necessarily be applied to light ancillary structures, which will be formed structurally discrete from the main development and in which a greater degree of settlement can be tolerated.

Interpretation of the data derived from this investigation indicates that it may be feasible to construct strip or spread foundations within the Kempton Park Gravel Member revealed at depths of the order of 1.8m to 2.5m. It should be noted that this granular layer is relatively thin at the location of borehole WS1. Therefore, it is recommended that the maximum increase in load applied to these soils is restricted to 125kPa. At this loading intensity a factor of safety of 3 against general shear failure will be operative. Moreover, control over settlements will be provided and the risk of overstress of the underlying London Clay Formation should be avoided.

Alternatively, consideration could be given to piles. The design of piles lies outside the scope of this report as it is dependent upon the type of pile employed, its size and bearing capacity. When the loadings are known it will be sensible to seek the advice of suitably experienced specialist piling contractors in order to provide a satisfactory solution to the problem. The information given in Appendices 2 and 3 may be used in pile design.

11.2 Retaining Wall Parameters

The walls to the lower ground floor structure should be designed to resist any earth pressures generated by the surrounding ground and surcharge loads, for example adjacent foundations. The earth pressures can be calculated using the following soil parameters which are quoted in terms of effective stress and, therefore, reflect the long-term conditions.

Table 4 - Retaining Wall Design

Soil Parameter	Effective Cohesion c' kPa	Effective Angle of Friction Ø'	Soil Density kg/cum
Made ground & Alluvium	0	15	1800
Kempton Park Gravel Member	0	30	1850
London Clay Formation	5	20	1900

11.3 Heave

The proposed lower ground floor lies completely within the footprint of the main structure. It is possible that some release in overburden may result from the construction and excavation of the lower ground floor. The results of the oedometer/heave testing indicate that relatively moderate magnitudes of heave are likely to be anticipated within the London Clay Formation at this site. Consequently, this phenomenon should be considered in the design of the lower ground floor slab which will be dependent upon the proposed loadings and depth of overburden removed.

11.4 Stability of Excavations

It is likely that support will have to be given to the surrounding ground for the construction of the proposed lower ground floor structure. This support may be provided by some form of strutted cofferdam, which will be constructed in order to give clearer access to the construction works. The decision as to whether temporary works in the form of sheet piles or permanent installation, comprising contiguous or secant bored cast in situ piled walls, lies outside the scope of this report. This decision will be dependent upon economic considerations as well as the type of piling method adopted and the design philosophy of the contractor.

Excavations of less than 1m depth should not require temporary support to their sides. However, as foundation excavations are likely to be extended below this level, adequate temporary support or shoring should be provided in order to comply with current statutory safety regulations and to maintain the stability of the excavation sides.

11.5 Groundwater

The groundwater observations noted at the time of the fieldworks suggest that this phenomenon should not represent an engineering problem with respect to shallow depth excavations. Where excavations extend to the Kempton Park Gravel Member is it possible that groundwater will be encountered and dewatering facilities will be required.

11.6 Drainage

The near surface drainage characteristics of the underlying soils have not been specifically considered as part of this investigation. However, the Alluvium is unlikely to provide a suitable drainage medium. The underlying Kempton Park Gravel Formation is relatively thin and is also water bearing, which would preclude it suitability for disposal of surface water run-off.

11.7 Ground Floor Slabs

The thickness of made ground revealed by this investigation, commonly in excess of 0.6m, infers that a system of fully suspended floor slabs should be incorporated within the proposed structure in accordance with NHBC criteria. The comments regarding heave should be considered in the design of basement floor slabs.

11.8 Buried Concrete

The information obtained from this investigation has been compared with the criteria proposed in BRE Special Digest 1, 2005 Edition, Concrete in Aggressive Ground. Using the information in Table C1 (natural ground) of this publication the Aggressive Chemical Environment for Concrete Classification is AC-1, which coincides with a Design Sulphate Class DS-1. This Design Sulphate Class can be used to establish the design mix for buried concrete in accordance with Part D of the Digest.

12 GROUND CONTAMINATION

A Conceptual Site Model (CSM) was formulated for this site as part of the Phase 1 Desk Study, which informed the current Phase 2 intrusive investigation. The CSM produced as part of the Desk Study has been reviewed and updated and is presented in tabular form below.

Table 5 - Conceptual Site Model

Source(s)	Potential Pathway(s)	Receptor(s)	Risk Level
Alluvium (on site) - *ground gases: carbon dioxide and methane*	Migration, ingress and accumulation	Proposed and existing buildings (asphyxiation or explosion)	Very low
Boat maintenance (on site) - *VOC vapours*		Neighbouring buildings (off site) residential and commercial (asphyxiation or explosion)	Very low
Boat maintenance (on site) - heavy metals (lead & copper)/hydrocarbons	Inhalation, ingestion and migration	Site workers and end users	Very low

12.1 Human Health

A generic assessment of the chronic or long-term risk to human health from soil contamination has been made using the available generic screening criteria. The screening values include the Category 4 Screening Levels [C4SLs] (DEFRA, 2014) and Suitable for Use Levels [S4ULs] (LQM/CIEH, 2014) derived using the CLEA software. It should be appreciated that these do not consider the short-term or acute risks, such as to construction workers or SI personnel.

The results have been compared against the GAC for a Residential (without home grown produce) end-use and appropriate SOM. A study of the data shows that no significant levels of contamination have been recorded and remedial measures will not need to be implemented.

12.2 Vegetation

The metals boron, copper, nickel and zinc are phytotoxic at certain levels, with their availability being dependent upon soil pH. These levels may not pose a significant long-term health risk to humans, but could be detrimental to plant growth or function. The results obtained suggest that problems with respect to the growth of plants are not anticipated.

12.3 Preliminary Waste Assessment

Where it is not possible to reuse or retain excavated soils on site, then these surplus materials will require off-site disposal. It may be possible to divert the unwanted material to a soil treatment hub where it can be recycled. Where material cannot be re-used or recycled then disposal at a licensed landfill site can be considered. It will then be necessary to classify the spoil as inert, non-hazardous or hazardous. A discussion of the current regime for the classification and treatment of waste soils is included in Appendix 4.

An initial assessment of the geochemical results obtained from this investigation has been carried out to provide a preliminary classification of the surplus materials. The Atkins CAT-WASTE tool determines whether waste soil should be classified as being non-hazardous or hazardous. The output from the CAT-WASTE assessment is located in Appendix 4. Asbestos was not detected in any of the samples screened. Based on the output waste soil arisings from this site have been tentatively identified as being non-hazardous waste. The underling natural granular soils are considered to be inert for disposal purposes. It should be appreciated, however, that layers of organic peat may be encountered within the basement excavation. These soils should be segregated for separate treatment as they are unlikely to be accepted at landfill sites.

This assessment is preliminary and based upon the information obtained from the investigation. Where made ground is excavated then these materials should be stockpiled and segregated. Further sampling, testing and characterisation to accurately classify waste soil arisings may be required. It should be appreciated that it is the responsibility of the waste producer to sufficiently characterise their waste. Moreover, the agreement of the waste acceptor should be sought.

If material is to be disposed at an inert licensed waste landfill site then supplementary waste acceptance criteria [WAC] testing may also be required. Confirmation should be sought from the relevant licensed waste handler or landfill operator.