Maitland Park Estate

GEOTECHNICAL AND ENVIRONMENTAL DESK STUDY

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MAITLAND PARK
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1. INTRODUCTION

Ramboll has been appointed by EC Harris on behalf of Camden Council, to undertake a combined geotechnical and environmental desk study of Maitland Park, Hampstead, London, which is proposed for the construction of residential buildings and communal landscaped areas, with provision for private gardens to part of the development (Aspen Court and Grafton Terrace).

The purposes of this report are to identify potential risks which could be present with respect to ground conditions at the site. These include:

- Soil and groundwater quality with respect to human health of users and the wider environment, and implications of soil and groundwater quality for redevelopment; and
- Identifying the underlying ground conditions and highlight any potential geotechnical hazards which may impact on the design of the substructure.

A plan showing the location and extent of the study site is provided in Figure 1.

2. OBJECTIVES AND SCOPE OF WORK

This appraisal of the site provides an initial assessment of the potential risks and constraints on development with respect to geotechnical engineering and land contamination, and identifies issues that may need further study or mitigation. The report is intended for submission to the local planning authority, and for design of intrusive investigations.

On this basis the scope of the study is as follows:

i. Present factual data with regard to the historical and environmental setting of the site and its immediate surroundings;

ii. Formulate an initial conceptual site model and preliminary qualitative risk assessment; and

iii. Interpret this information in terms of implications for further work, construction and design of the project.

Limitations and standards under which this report has been completed are given in Appendix A.

This report does not cover any issues other than geotechnical engineering and contaminated land. For example, no ecological or archaeological studies are included within the scope of this report.

2.1 Information Sources

This report is based upon information derived from a variety of sources as listed below:

i. Envirocheck Report (November 2013);

ii. The Environment Agency (EA) - online environmental data ''What's in Your Backyard?') maps (accessed November 2013);

iii. Health Protection Agency - Indicative Atlas of Radon in England and Wales (November 2007);

iv. Building Research Establishment (BRE) - Radon Protection Measures for New Buildings (2007);

v. British Geological Survey (BGS) - 1:50,000 scale geological mapping, solid and drift (accessed digitally via the BGS website October 2013 and paper map Sheet 256 North London);

vi. Zetica - Unexploded Ordnance (UXO) Risk Maps for London west central area (accessed October 2013);

vii. British Geological Society (BGS) - borehole log database (accessed digitally via the BGS website October 2013);

viii. CIRIA – report C552: Contaminated Land Risk Assessment – A Guide to Good Practice (2001);

ix. Review of online aerial photography (accessed October 2013)

2.2 Consultation

Enquiries were raised with Camden Council Environmental Health department to determine whether this department has any concerns regarding ground conditions at the site. It was not considered necessary to consult with other regulatory bodies at this stage. A response was received on 3 December and stated that the council required payment for provision of information with regards to the site.

2.3 Location

The site is centred at National Grid reference TQ 27927 84913 (post code NW3 2HG) and covers an area of approximately 12,300 square metres (1.23 ha). A plan showing the site location is provided in Figure 1. The site is currently occupied by residential dwellings, a gym building, garages, car parking, roads and green, open communal areas. Surrounding land comprises residential dwellings. The current layout of the site is shown in Figure 2.

2.4 Development Proposals

It is proposed to demolish the existing gym building, Aspen House, Tenants and Residents Association (TRA) Hall and garage blocks to enable the construction of four, five and six storey residential dwellings and a new TRA Hall. Landscaping will be altered. Plans of the proposed development options are shown in Figure 3, and Figure 4 shows the areas of the site proposed for demolition and construction.

3. SITE DATA

3.1 Site History

Late 19th Century

The maps of 1871 show a road named Maitland Park Villas, running north-south through the centre of the site. To the east of this was a development of large residential properties with gardens. To the west of the road lay a large 'Orphan Working School' with playgrounds to its north and south, separate wings for boys and girls, a bath house to the rear and a chapel. Small park areas were located to the north and south of the site with St Pancras Almshouses immediately to the north of the northern park. All other development around the site consisted of housing, with larger properties to the west and mostly terraced housing to the north and east.

By 1896 two small lodges had been built in the park area to the south of the site.

Pre-World War II

Further buildings had been constructed in the park area to the south by 1915, consisting of Alexandra House and a building with two wings and a central block.

20th Century - Post World War II

By 1953 the Orphan Working School had been replaced by the Maitland Park Estate, consisting of six 'Houses', a community centre, gymnasium and some kind of store. An electrical sub-station is shown just inside the southern boundary of the site. Alder House and Hornbeam House had been constructed on the park immediately to the north of the site. A day nursery is shown just outside the south-western corner of the site. Further housing had been constructed to the south east of Alexandra House and is labelled as being part of the Maitland Park Estate. No other significant changes are shown in the area around the site.

Somewhere between 1954 and 1963 the residential properties in the eastern half of the site had been demolished and replaced with three blocks of flats (Whitebeam, Rowan and Hazel Houses) set in an open area annotated as the Maitland Park Estate. Additionally, a playground had replaced a group of houses at the very northern end of the site.

Late 20th Century – 21st Century

By 1973 the community centre and film store had been removed and replaced by Aspen House, a multi-storey block of flats. An electrical sub-station is indicated to the immediate north of Chestnut and Beech Houses. A paved area was constructed to the south of Hazel House, in the very southern tip of the site.

The 1991 map shows that by that time the playground at the northern end of the site had been replaced by a club house and that three small blocks of residences had been built to the north of Aspen House.

The 2006 map shows Alexandra House in place but this had been demolished by the date of the next map in 2013.

The locations of relevant historical features which could pose a potential risk to the proposed development are shown in Figure 4.

3.2 Geology and Geological Associated Hazards

The British Geological Survey 1:50,000 series sheet 256 (Solid & Drift edition) for North London indicates that the site is underlain by Eocene London Clay Formation (LCF). Approximately 100 metres north and north west of the site the geological map indicates the presence of Eocene Claygate Beds overlying the LCF.

Historic exploratory hole / water well records available from the British Geological Survey (BGS) website confirm the anticipated geology identified from the BGS map and are summarised in Table 1. The exploratory hole logs also indicate the presence of possible Head deposits overlying the LCF. One historic exploratory hole log identifies the deposits underlying the LCF as Woolwich and Reading Beds (Lambeth Group), Thanet Sand and Upper Chalk. The historic exploratory holes are located within the proposed site boundary.

Generally the exploratory hole logs do not extend to the base of the LCF, however a single exploratory hole was drilled into the stratum underlying the LCF. Weathered LCF is recorded at 0.6 metres below ground level (mbgl) to 1.2 mbgl and unweathered LCF is encountered at approximately 7.5 mbgl to over 9.0 mbgl. The base of the LCF is recorded at 68.0 mbgl. The LCF is typically described in the BGS logs as firm and stiff brown and blue/brown clay. The BGS describes the basal LCF as a hard dark shelly loam at the transitional zone with the Lambeth Group. No information regarding relative density of the materials or laboratory test data was undertaken or made available with the historic logs. The BGS describes the Lambeth Group as 'vertically and laterally variable sequences mainly of clay, some silty or sandy, with some sands and gravels, minor limestones and lignites and occasional sandstone and conglomerate'. The BGS describes the Thanet Sand as 'Glauconite-coated, nodular flint at base, overlain by pale yellow-brown, fine-grained sand that can be clayey and glauconitic, with rare calcareous or siliceous sandstones'.

Strata	**Historical Borehole, Year and Depth to Base of Stratum (m)**				
	BH 1946	**BH A 1956**	**BH B 1956**	**TP E 1956**	**TP F 1956**
Made Ground	n/a	1.2	0.6	0.5	0.3 (TS)
Loam (Head)	n/a	n/a	n/a	0.8	0.9
London Clay Formation	68	unproven	Unproven	unproven	unproven
Woolwich and Reading beds (Lambeth Group)	86	n/a	n/a	n/a	n/a

Strata	Historical Borehole, Year and Depth to Base of Stratum (m)				
	BH 1946	BH A 1956	BH B 1956	TP E 1956	TP F 1956
Thanet Sand Formation	94	n/a	n/a	n/a	n/a
Chalk	unproven	n/a	n/a	n/a	n/a
Water mbgl	n/a	8.2	n/a	n/a	2.8

Table 1 - Strata from Historical Exploratory Holes

3.3 Hydrogeology

The site is underlain by unproductive strata (non-aquifer) comprising the LCF. It does not lie within a groundwater Source Protection Zone. Neither is it within a designated Nitrate Vulnerable Zone. The site is not located above any groundwater bodies designated under the Water Framework Directive.

There are no water abstraction licenses held on, or within 250 metres of the site. There are no water discharge consents within 500 metres of the site.

The site is underlain by unproductive strata (non-aquifer) comprising of the LCF. Groundwater movement would be anticipated to be slow through the low permeability deposits of the LCF. An outer groundwater source protection zone is located approximately 500 metres to the south west of the site.

3.4 Hydrology

The site is located in Flood Risk Zone 1 i.e. where there is less than a 0.1% (1 in 1000) chance of flooding occurring each year[1]. The risks to the site for flooding from surface water, groundwater and drainage are not known. There are no flood defences within 250 metres of the site. The British Geological Survey indicates a negligible susceptibility to groundwater flooding based on the underlying geology. The site is not at risk of flooding from reservoir failure.

There are no surface water features on the site. The River Fleet flows underground and is a tributary to the River Thames; it now forms part of what is the London sewer system and is believed to be located approximately 150 metres to the north-east corner of the site.

3.5 Ground Gases (including Radon)

The Health Protection Agency (HPA) Indicative Atlas of Radon in England and Wales (2007) indicates that the site lies in an area where 0-1% of homes are above the UK Action Level for radon. The Building Research Establishment guidance document 'Radon Protection Measures for New Buildings (2007)' states that radon protection is not required for residential developments in such areas.

3.6 Waste

The EA website and the Envirocheck report do not record any authorised or historical landfill sites or waste transfer sites within one kilometre of the site.

3.7 Sensitive Land Use

There is one site designated for its sensitive use (e.g. nature designations) within one kilometre of the site. This is Belsize Wood, located approximately 400 metres north west of the site.

3.8 Unexploded Ordnance

Bomb risk maps searched online (Zetica Ltd) identify the site to be of medium to high risk. The 'Bombsight' website[2] provides access to National Archive records of bombs that fell on London during the Blitz and indicates that a high explosive bomb fell on Maitland Park Villas in 1940 or 1941. Further bombs were recorded within several hundred metres of the site.

[1] Environment Agency 'What's in Your Backyard?' website, accessed November 2013

[2] http://www.bombsight.org/#14/51.4760/-0.1541

3.9 Environmental Permits and Authorisations

There are three sites within 250 metres of the site that are subject to local authority pollution and prevention controls. These are all dry cleaners that lie approximately 100 metres to the south, 120 metres to the north and 230 metres to the east of the site.

3.10 Trade Activities

There are a number of small-scale trades in the general area of the site in addition to the dry cleaners detailed above. These include a laundry, MOT testing station, scaffold suppliers, pharmacy, hardware store, car dealers and ice cream manufacturers. None of these are located within the immediate vicinity of the proposed areas of development.

3.11 Existing Ground Investigation Data

No site-specific ground investigation data with respect to ground contamination is available for review. The Envirocheck report provides data from the BGS, sourced from their national soil mapping project. This indicates the potential for soil at the site in excess of standards appropriate for residential use (with no home-grown vegetables) with respect to arsenic and lead.

4. DISCUSSION OF GEOLOGICAL STRATA AND GEOTECHNICAL RISKS

4.1 Strata

Made Ground

A review of the existing historic borehole data indicates that deposits of made ground will likely be present across the whole site. The borehole logs describe the made ground as fill, hardcore, bricks, rubble and ashes.

Head (Brickearth)

There are no descriptions of Head deposits other than 'Loam'. Loam is described by the BGS as 'Organic-rich sand, silt and clay. A class of soil texture composed of sand, silt and clay, which produces a physical property intermediate between the extremes of the three components. ' – which is likely to be Head/Brickearth.

The ground may compress if loaded by overlying structures, or due to changes in groundwater level, potentially causing a depression of the ground and disturbance of foundations. If the ground is extremely compressible the building may settle significantly such that it becomes unserviceable or detrimentally affects surrounding services or facilities.

London Clay Formation

The only description of the LCF from existing historical exploratory hole logs is firm/stiff brown clay.

Very limited information is currently available regarding the underlying LCF at the site. The strength of the upper part of the LCF will be dependent upon its weathering state. In weathered zones the LCF is typically described as firm becoming firm to stiff in strength. Below the weathered zones it then typically comprises a stiff to very stiff with undrained shear strengths in the order of 75 kPa increasing with depth. For pile design the strength of the LCF in the unweathered zones are typically limited to upper bound shear strength of between 150 kPa to 200 kPa.

From the brief descriptions contained in the BGS historic records this deposit is also described as having a sandy secondary constituent and therefore the stratum may also be water bearing. Whilst no geotechnical laboratory test data is currently available for the site it should be noted that the LCF is typically of a high to very high plasticity and therefore potentially will exhibit a high volume change potential.

Chemically the cohesive material can exhibit substantial sulphate concentrations leading to a potentially aggressive chemical environment. Substructure concrete in particular (shallow foundations) will need to be designed in accordance with BRE Special Digest 1:2005 'Concrete in Aggressive Ground' 3rd Edition.

4.2 Groundwater and Use of Soakaways

Records of groundwater level are available from historical exploratory holes carried out in 1956 and summarised in the Table 2.

Exploratory Hole	Date	Groundwater Level (mbgl)
BHA	1956	8.2
TPF		2.8

Table 2 Groundwater levels from historical exploratory holes

From ground investigation records it is likely that groundwater is present in the LCF at a depth between 3 mbgl and 8 mbgl.

Due to the anticipated cohesive nature of the underlying ground conditions it is envisaged that the site will not be suitable for the use of soakaways.

To fully determine the groundwater level it would be necessary to install monitoring standpipes within the exploratory holes as part of a detailed ground investigation. The standpipes will give an indication as to whether groundwater will be present at shallow depths.

4.3 Foundations

The foundation solution of the proposed housing development will be dependent upon confirmation of the ground and groundwater conditions present at the site and the structural form of the building.

It is therefore recommended that a detailed geotechnical ground investigation is undertaken to determine the underlying ground and groundwater conditions. Information obtained from the investigation will allow identification of the key soil parameters which, along with the exploratory hole records, will assist with the foundation design.

Should shallow spread foundations be adopted then these would need to be founded in the underlying LCF. Should stiff LCF be encountered at near surface then for a founding depth of 1.2 metres the allowable bearing capacity would typically be in the order of 125 kN/m^2 to 175 kN/m^2 for square pads foundations up to 3.0 metres in width and strip foundations up to 1.0 metre width. Shallow foundations may be able to be founded within the head deposits, however, the suitability of this strata will need to be determined following a ground investigation.

Shallow foundation depths within the LCF should be subject to the NHBC guidance for building near trees (Part 4 of the NHBC Standards 2007).

Should the allowable bearing pressure of the shallow spread foundations prove inadequate to support the proposed loads, or the settlement criterion dictate, then a piled foundation solution for the proposed structure would be required. It is likely that continuous flight auger (CFA) piles are recommended due to the proximity to residential properties and noise/vibrations caused by other piling methods. The piles would be embedded into the LCF where the strength of the material (derived from ground investigation works) would be adequate to support the required loads. Pile design should be undertaken in accordance with BS EN1997-1:2004 'Geotechnical Design', with further guidance from the London District Surveyors Association 'Guidance Notes for the Design of Straight Shafted Bored Piles in London Clay'.

4.4 Trees

Currently the south western perimeter of the site is bounded by trees and several single trees are located throughout the site. Historic exploratory hole logs indicate the site being underlain by cohesive material and therefore it is recommended that geotechnical laboratory testing is carried out to determine the plasticity and moisture content of the clays to assess the potential volume change.

The underlying soils impose a risk for potential shrinkage and heave, and any existing or proposed trees located within the vicinity of the proposed development should be considered with regards to foundation design in regard to moisture content and especially if clays have high plasticity.

Shallow foundation depths within the LCF should be subject to the NHBC guidance for building near trees (Part 4 of the NHBC Standards 2007).

5. DISCUSSION OF CONTAMINATED LAND RISKS

The UK framework for assessment of contaminated land is outlined in Appendix A. The basis of this framework is that for significant contamination to be present there must be a Source – Pathway – Receptor linkage in place. Further details of this are presented in the appendix.

Review of available documentary sources indicates that there is the potential for contamination to occur on the site from the historic existence of two electrical sub stations. Their locations are shown on Figure 4. They are not located where demolition or construction is due to take place. The location of part of the proposed development is where buildings have been demolished in the past. There is therefore the potential in these locations for foundations or demolition rubble to be encountered. Due to the age of the buildings that existed, there is also the potential for asbestos to occur within that material.

No current uses have been identified, either on site or in the vicinity that would indicate the presence of a significant risk. Several garages are to be demolished in order to allow construction of part of the development; however, given that these are for residential usage they are unlikely to present any significant risk, although there may be some residual material (such as hydrocarbons) contained in drains adjacent to them.

The potential for elevated concentrations of lead and arsenic has been identified. Surface infiltration of atmospheric waters into the soil beneath the site could wash or dissolve potential contaminants, and cause lateral migration through made ground and superficial deposits; such migration would be limited in the LCF due to the low expected permeability of this unit.

A preliminary risk assessment and conceptual site model is given in Table 3 below. This assessment is based on residential development at the site, with private gardens where food might be grown.

Table 3 - Preliminary Conceptual Site Model and Risk Assessment (without mitigation)

Potential Source/ Location	Potential Contaminant(s)	Pathway	Potential Receptor	Probability of Risk Being Realised*	Consequence of Risk Being Realised*	Risk Classification*
Electrical Sub stations	Poly- chlorinated biphenyls, hydrocarbons	Contact pathways, inhalation of soil and soil derived dust	End users	Unlikely	Mild	Very low
			Ground-workers	High likelihood	Minor	Moderate/low
		Leaching to groundwater	Groundwater	Unlikely	Minor	Very low
		Ingestion of vegetables	End users	Unlikely	Medium	Low risk
Former buildings on site – potential demolition material within made ground	Asbestos	Inhalation of fibres	Ground-workers End users	Low	Severe	Moderate
Background concentrations of substances in soils	Lead and arsenic	Contact pathways, inhalation of soil and soil derived dust	End users	Likely	Mild	Moderate
		Ingestion of vegetables	End users	Low likelihood	Mild	Low risk

* see Appendix A

6. CONCLUSIONS

6.1 Summary of Key Findings

The site is currently a housing estate and historically was developed for housing, parkland and an orphans' school. The area immediately surrounding the site has had a mostly residential use. Commercial land uses have included normal urban activities such as dry cleaners and car sales but there has been nothing identified as potentially presenting a significant risk to the proposed development.

Chemically the Made Ground and LCF can exhibit substantial sulphate concentrations leading to a potentially aggressive chemical environment.

The underlying cohesive soils impose a risk for potential shrinkage and heave, and any existing or proposed trees located within the vicinity of the proposed development should be considered with regards to foundation design in regard to moisture content and especially if clays have high plasticity.

6.2 Implications for Design and Construction

Design

Should new areas of soft landscaping be proposed, the soil conditions would need to be verified as being suitable for this use. Allowance should be made for approximately 300 mm of clean topsoil cover to landscaped areas.

Should services be required at the site, the soil conditions may be such that the types of services materials (such as water supply pipes) would need to be chosen such that unacceptable risks would not be posed to end users or ground workers.

Findings of any site investigation works could be used to provide an indication regarding the potential for aggressive ground conditions from which an assessment could be made with regards to concrete classifications.

Should any fill material or topsoil be imported to the site, this should be sampled and tested to verify that it is suitably clean for the proposed use

Construction

Initial assessment of the potential risks indicates that these might be mitigated through provision of standard personal protective equipment (PPE) during the construction period.

Soils proposed for re-use on site may need to be tested and verified as being suitable for use prior to being reused. Soils which are to be removed from the site will require testing to determine their character for waste disposal purposes.

6.3 Recommendations for Further Work/Ground Investigation

To enable detailed design of the proposed residential dwellings, it is recommended that a combined geotechnical and contaminated land ground investigation is designed and undertaken in accordance with BS EN 1997-2:2007 'Ground Investigation and Testing'. The intrusive investigation should be designed to ascertain the following.

Environmental:

- Soil character, particularly in terms of potential contaminants which may pose a significant risk, but also a wide enough suite to undertake initial waste characterisation, should the need for soil disposal be identified; and
- Sampling and analysis of groundwater should it be encountered.

Geotechnical:

- Strength and stiffness of the soils,

- Classification testing of the various soil types, in particular moisture contents and Atterberg Limits.
- Information with respect to the existing groundwater levels ,
- Chemical properties of the soil (in particular any Made Ground deposits and of the LCF) and groundwater for determining the classification of buried concrete.

Proposed Ground Investigation

Based on the current proposed layout of the dwellings (see Figure 3) a preliminary ground investigation should comprise a combination of the following techniques:

- Cable percussive boreholes – to enable in-situ testing and collection of soil samples for both geotechnical and contamination laboratory analysis, engineering descriptions of the London Clay Formation and installation of combined gas and groundwater monitoring installations. It is recommended that the boreholes are drilled to a maximum depth of approximately 30 mbgl.
- Monitoring of water levels in installations once a week for four weeks following completion of site investigation works.

An allowance of around 10 – 12 weeks should be made from the commencement of intrusive works to interpretation of the findings of the investigation.

6.4 Unexploded Ordnance

Records indicate that bombs fell in the vicinity of the site during World War II. As such the risk of encountering UXO during any intrusive works cannot be discounted and actions to mitigate the risk should be considered. Prior to intrusive works, it is recommended that the client carries out a risk assessment in accordance with the guidelines set out in CIRIA C681, Unexploded Ordnance: 'A Guide for the Construction Industry' (2009).

6.5 Consultation

It is recommended that this report be submitted to the Local Authority Contaminated Land Officer (CLO) for comment prior to undertaking any further investigation. Best practice would be to agree the scope of the further ground investigation with the CLO prior to commencing the work.

APPENDIX A

LIMITATIONS AND STANDARDS

This report is intended for the stated client for the purpose of assisting them in evaluating the site in the context of the potential development. This report should not be used in whole or in part by any third parties without the express permission of Ramboll in writing.

Ramboll has endeavoured to assess all information provided to them. The report includes summaries of information from external sources and cannot offer any guarantees or warranties for the completeness or accuracy of information relied upon. The proposed geotechnical design options and recommendations summarised in this report relate to the feasibility of developing on the site are based on information gained at the time of writing the report. Any substantial changes to the use of the site may require a reassessment of the implications of the risks identified and a review of the geotechnical design options.

No site walkover has been carried out.

It should be noted that some of the aspects considered in this study are subject to change with time. If the development is postponed or delayed for a significant period, this report should be reviewed to confirm whether changes have taken place, either at the site or within relevant legislation. Similarly, this report (and the risk assessment contained within) is based on the end use specified. If this end use is changed, the risk assessment must be reviewed and amended as appropriate.

Any observations or comments made within this report with respect to asbestos are intended to assist the client and do not constitute an asbestos survey. Ramboll are not asbestos specialists and we recommend that you appoint an asbestos consultant to advise you.

No intrusive ground investigation works were undertaken as part of this study.

Environmental risks are assessed in accordance with Contaminated Land (England) (Amendment) Regulations 2012, Part IIA of the Environmental Protection Act 1990, and Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, DEFRA 2012. Part IIA provides a statutory definition of contaminated land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that:

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

(b) Significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.

Risk from contamination is assessed by consideration of possible linkages between contaminant sources and potential receptors which could be harmed or polluted and the potential pathways between them. For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- A source - a substance that is capable of causing pollution or harm;
- A receptor - something which could be adversely affected by the contaminant; and
- A pathway - a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

The Environment Agency Contaminated Land Report CLR 11 Model Procedures for the Management of Land Contamination provides the technical framework for structured decision making about land contamination. CLR 11 advocates a phased approach to risk assessment comprising:

- Preliminary Risk Assessment (PRA) – desk study and qualitative assessment

- Generic Quantitative Risk Assessment (GQRA) − assessment of contaminant concentrations against generic assessment criteria.
- Detailed Quantitative Risk Assessment (DQRA) − detailed site specific risk assessment and development of site-specific assessment criteria.

Each of these phases follows the same basic steps buts adds site specific details and further certainty into the assessment as the stages progress.

RISK ESTIMATION

An assessment of environmental risks is made for each potential pollutant linkage identified.

Risk estimation has been completed in accordance with the guidance provided in:

NHBC and Environment Agency 2008. *Guidance for the Safe Development of Housing on Land Affected by Contamination*. R&D Publication 66: 2008.

The following is taken directly from NHBC/EA 2008. The key to the classification is that the designation of risk is based upon the consideration of both:

a) the magnitude of the potential consequence (i.e. severity). [takes into account both the potential severity of the hazard and the sensitivity of the receptor]

b) the magnitude of probability (i.e. likelihood). [takes into account both the presence of the hazard and receptor and the integrity of the pathway]

Category	Definition
Severe	Highly elevated concentrations **likely** to result in "significant harm" to human health as defined by the EPA 1990, Part 2A, if exposure occurs. Equivalent to EA **Category 1** pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population. Catastrophic damage to crops, buildings or property.
Medium	Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A if exposure occurs. Equivalent to **EA Category 2** pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. Significant damage to crops, buildings or property.
Mild	Exposure to human health **unlikely** to lead to "significant harm". Equivalent to **EA Category 3** pollution incident including minimal or short lived effect on water quality; marginal effect on amenity value, agriculture or commerce. Minor or short lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population. Minor damage to crops, buildings or property.
Minor	No measurable effect on humans. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects of damage to buildings, structures and services.

* For these purposes, disease is to be taken to mean an unhealthy condition of the body or a part of it and can include, for example, cancer, liver dysfunction or extensive skin ailments. Mental dysfunction is included only insofar as it is attributable to the effects of a pollutant on the body of the person concerned.

Table 1 Classification of Consequence (after NHBC/EA 2008)

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given below.

Category	Definition
High Likelihood	There is pollutant linkage and an event would appear 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 pollutant linkage and all the elements are present and in the right place which means that it is probable 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 pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place, and is less likely in the shorter term.
Unlikely	There is pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 2 Classification of Probability (after NHBC/EA 2008)

The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard.

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

Table 3 The Classification of Risk (after NHBC/EA 2008)

Very high risk

There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to be site owner/or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.

High risk

Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action. Realisation of the risk is likely to present a substantial liability to the site owner/or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely 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, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner/occupier. Some remediation works may be required in the longer term.

Low risk

It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the site owner/or

occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.

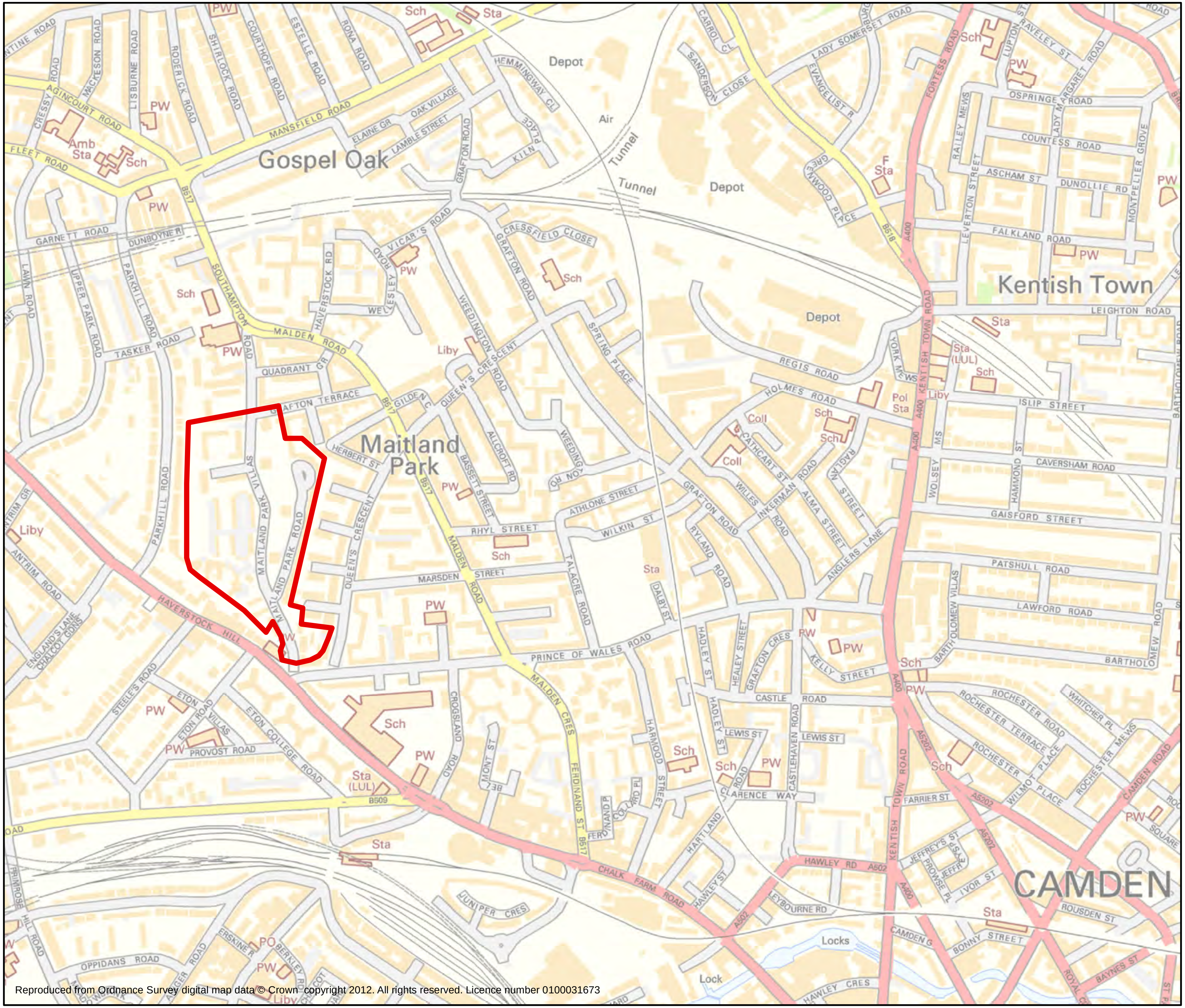
Very low risk

It is a low possibility that harm could arise to a designated receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.

No potential risk

There is no potential risk if no pollution linkage has been established.

FIGURES



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Key

Site Boundary

Scale at A4 - 1:6000

N

Client
Camden Council

Project Title
Maitland Park, Camden

Project Number
61031879

Figure Title
Site Location Plan

RAMBOLL

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Fax: 023 8081 7600 www.ramboll.co.uk

Date	Prepared By
27/11/13	WF
Figure No.	**Revision**
1	-

Key

Site Boundary

Not to scale

N

Client

Camden Council

Project Title

Maitland Park, Camden

Project Number

61031879

Figure Title

Current Site Layout

RAMBOLL

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Date	Prepared By
19/12/13	WF
Figure No. 2	Revision A

Key

Site Boundary

Note to scale

N

Client

Camden Council

Project Title

Maitland Park, Camden

Project Number

61031879

Figure Title

Development Proposals

RAMBOLL

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Date	Prepared By
219/12/13	WF
Figure No.	**Revision**
3	A

Key

- Demolition
- Construction
- Allotments
- Potential Contamination Source

Not to scale

N

Client

Camden Council

Project Title

Maitland Park, Camden

Project Number

61031879

Figure Title

Development Proposals with Potential Contamination Sources

RAMBOLL

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Date	Prepared By
10/07/14	WF
Figure No.	**Revision**
4	B