OPUS

Proposed Lidl Store, South Ruislip

Geo-Environmental Site Investigation Report

for Lidl UK GmbH

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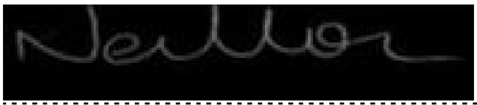
Prepared By



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1 Introduction

This report describes a geo-environmental ground investigation undertaken on behalf of Lidl UK GmbH on a site at 2 Stonefield Way, South Ruislip. The site is currently occupied by Value Windows Ltd

We understand that it is the intention of Lidl UK GmbH (The Client) to construct a supermarket on land immediately to the west of the subject site. The subject site is to be acquired to provide space for car parking, associated with the proposed supermarket.

This report has been prepared by Opus International Consultants (UK) Ltd (Opus) with all reasonable skill, care and diligence within the terms of the Contract with The Client and taking account of the information made available by The Client, as well as the manpower and resources devoted to it by agreement with The Client. Opus disclaims any responsibility to The Client and others in respect of any matters outside the scope of the above Contract.

The objectives of the investigation was to carry out a geo-environmental survey of the site. Phase 1 desk study information has already been provided (Remada Ltd Phase 1 Preliminary Geo-environmental Risk Assessment date November 2013) and this information will be reviewed by Opus, prior to undertaking a Phase 2 ground investigation of the site. The aim of the investigation was to obtain information relating to the ground conditions in order to obtain an initial assessment of potential contamination on the site, along with a preliminary appraisal of requirements for foundations and floor slabs associated with the proposed extension.

This report has been produced on behalf of The Client, Lidl UK GmbH and no responsibility is accepted to any other Third Party for all or any part. This report should not be relied upon or transferred to any other parties without the express written authorisation of Opus. If any unauthorised Third Party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill.

The findings and opinions conveyed via the desk study within this report are based on information obtained from a variety of sources, as detailed, which Opus believes are reliable. Nevertheless, Opus cannot and does not guarantee the authenticity or reliability of the information it has relied upon from these sources.

Whilst this report may express an opinion on the possible configuration of strata, contaminants or groundwater between or beyond exploratory hole positions or on the possible presence of features based on visual, verbal or published evidence, this is for guidance only and no liability can be accepted for its accuracy.

This report has been prepared on the understanding that the development is to comprise car park associated with a Lidl supermarket, which will be situated to the west of the subject site. Should the proposed site usage change significantly from the above, the contents of this report will require review and amendment as appropriate.

The comments on groundwater and ground gas conditions are based on observations made at the time of the investigation and during the monitoring period. It should be noted, however, that groundwater and ground gas levels may vary from those reported due to seasonal or other effects.

Although every effort has been made to position exploratory holes in the least sensitive areas of the site, exploratory hole positions were located approximately as part of this investigation and no guarantee can be given as to their accuracy.

The site plans enclosed in this report should not be used for scaling purposes.

2 The Site

2.1 Location & Access

The site is located in the South Ruislip area of the London Borough of Hillingdon, to the south of Victoria Road and to the west of Stonefield Way, on a light industrial estate know as Victoria Retail Park.

The site location is shown on Drawing No J-M0208.00_101_P1 and is centred at approximate National Grid Reference 512138, 185479.

At the time of the investigation, vehicular access was gained off Stonefield Way in the east of the site, via an access road which served a number of business units in the vicinity.

2.2 Proposed Development

From drawings provided by the Client, we understand that the proposed development will comprise a Lidl supermarket to the west of the site, with the subject site itself forming the car park serving the supermarket. Buildings to the north (formerly occupied by Benson Beds and Comet) will be sub-let. A new access road will be created to provide vehicle access to the parking area, via Stonefield Way.

2.3 Site Description

A brief walkover survey was undertaken on the 15th June 2015. Selected photographs are presented in Appendix A. The aim of the survey was to identify the range of potentially contaminative activities carried out on the site and in the immediate vicinity and any obvious potential sources of ground contamination. The comments provided below give a general description of the site and any features of relevance in terms of assessing historical usage, potential for contamination etc.

Access to the site was from Stonefield Way, to the east of the site.

The site is roughly rectangular in shape, and is approximately 0.06 hectares in area.

The site is generally flat and level and comprises a brick built, single storey main warehouse structure in the south, and a yard area in the north, and small ancillary buildings in the west adjoining the western site boundary.

The main warehouse structure was formed of three interconnected rooms with a multi-pitched roof constructed of suspected cement bound asbestos sheeting and glass or plexi glass sky lights. To the west of the main warehouse building, a number of temporary pre-fabricated office structures were positioned running along the western boundary. These were connected to the main structure by a pitched “lean to” style roof, formed from double glazed units.

The rooms within the pre-fabricated units were occupied by Value Windows Ltd and in use as offices and filing/equipment storage. The main warehouse rooms were in use for the storage and construction of double glazed windows. The exterior of the site, to the north of the main warehouse, was partly occupied by piles of used/dilapidated double glazed window units. A conservatory was fitted adjacent to the western site boundary and joining up with the pre-fabricated units and lean to area along this boundary. Floors within the main warehouse comprised power floated concrete. The exterior of the site was also occupied by concrete hardstanding.

There were a number of tins of spray paint situated within the main warehouse and some evidence that the operations on site included spray painting of the double glazed window units. A small cupboard in the west of the site had a poster on display titled "The Chemical (Hazardous Information and Packaging for Supply) Regulations 2002", indicating that chemicals may have been stored on site. This cupboard was locked at the time of the investigation.

There was no evidence of any above ground or below ground fuel tanks within the subject site, based on the observations made in the walkover survey.

The northern site boundary is formed by a high sided, brick and portal frame construction warehouse building, understood to have been previously occupied by Comet.

To the east there were further warehouse buildings, adjoined to the main warehouse on site. Stonefield Way was situated further to the east. To the south were further industrial units, forming the southern extent of Victoria Retail Park and accessed via Chancery Close. Similar buildings were present to the west of the site, on the area intended for construction of the Lidl supermarket.

3 Desk Study

3.1 Sources of Information

Detailed desk study searches have been carried out previously and reported as follows;

- Remada Ltd (November 2013) Phase 1 Preliminary Geoenvironmental Risk Assessment for proposed Lidl Store, Victoria Road, Ruislip, HA4 0QF.

Opus refer to the findings of the aforementioned report to provide background information relating to the site history and environmental context where appropriate. Further desk study searches have not been undertaken at this stage, hence the following text is intended as a summary of the pertinent matters relating to the current investigation and proposed use of the subject site.

3.2 Site History

Historical mapping coverage of the site is included in the aforementioned desk study report and is briefly summarised as follows in Table 3.2.

Table 3.2: Review of Historical Map Extracts

Date	Comments
1865	The site is shown to be part of a field system. There is a small pond 100m to the east.
1894	The site remains in use as agricultural fields, but field boundaries are no longer shown.
1914 to 1940	No significant changes on site or in the immediate vicinity.
1960	The site is occupied by a works / factory building
1967	The site is labelled as “engineering works”. Surrounding areas are increasingly industrialised by this time.
1986 to 1993	Subsequent mapping shows the site and surrounding areas to remain in use as an engineering works, metalizing works and a toilet requisites factory.

In summary, historical mapping suggests that the site was undeveloped until sometime after World War 2. Since then the site has been used for various light industrial purposes, although specific details are somewhat lacking.

3.3 Geology

According to regional geological mapping (Sheet 256 North London); the site is underlain by the solid geology of the London Clay Formation. Some Made Ground is anticipated at surface, associated with the former use and redevelopment of the site.

Although not recorded on the geological mapping, Alluvial Deposits may be present, associated with the former River Roxbourne which is understood to be situated in the approximate line of Victoria Road, to the north of the site (culverted watercourse).

The London Clay Formation is anticipated to comprise stiff consistency fissured clay. Alluvial Deposits can typically be organic and silty in nature.

A Phase 2 Geoenvironmental Ground Investigation was carried out by Remada in August 2014 on the adjacent site for the proposed Lidl store. The ground conditions encountered during this investigation generally comprised Made Ground to a maximum depth of 1.20m bgl in WS1 overlying Alluvial Deposits in all the exploratory hole except for WS1, consisting of soft consistency grey and brown slightly gravelly organic clay or firm consistency green grey slightly gravelly clay. The base of the Alluvium was proved at a maximum depth of 1.60m bgl in WS2.

Superficial deposits were encountered within WS1, WS5, WS6 and WS7 underlying the Alluvium and/or Made Ground strata to a maximum depth of 2.00m bgl. These are likely to be a Head Deposits. WS6 and WS7 were completed within this strata. The strata generally comprised a firm consistency grey slightly gravelly clay.

Underlying the Alluvium and/or Head Deposits within WS1 to WS5 inclusive the solid geology of the London clay Formation was encountered and proved to the base of the window sample boreholes at 6.00m bgl. The London Clay Formation comprised firm to stiff consistency brown and grey slightly silty clay with selenite crystals.

The window sample logs and exploratory hole location plan are presented within Appendix B to the rear of this report.

3.4 Hydrogeology

It is understood that the geology underlying the site is classified as non-productive strata, although near surface Taplow Gravel strata may be water bearing. The site does not lie within a Source Protection Zone (SPZ) and there are no groundwater abstraction wells within close proximity.

3.5 Hydrology

It is understood that the River Roxbourne is a culverted watercourse and follows the approximate line of Victoria Road, to the north of the site.

It is understood that the site may lie within Flood Zone 2, associated with the culverted River Roxbourne to the north. A flood risk specialist should be consulted at the earliest opportunity with regard to flooding issues. It should be noted that this report does not constitute a detailed flood risk assessment.

3.6 Environmental Considerations

Specific details relating to the environmental setting of the site are presented within the environmental database report included in the aforementioned desk study report. The salient issues which relate to the site are summarised as follows:

- There are no landfill sites within influencing distance of the site
- The site is not within an area affected by naturally occurring radon
- There are no environmental permits, pollution incidents or registered processes relating to the site or its immediate surroundings
- The site is not situated on areas recorded as being "artificial ground"
- The site is not within or near to any designated environmentally sensitive site such as Sites of Special Scientific Interest (SSSI) or Nature Reserves
- The site is not within an area known to be at risk from mining subsidence
- The nearest recorded discharge consent is situated approximately 128m north-east of the site and relates to a temporary consent associated with sewer storm overflows discharging to Yealding Brook
- There are no petrol or fuel filling stations recorded within 250m of the site

- Contemporary Trade Directories indicate that industrial activities on or near to site include the following;

  - Kwik Fit (vehicle repair testing and servicing)
  - Delfield Precision Engineering (engineering services)
  - Sheild Foods Ltd (fish meat and poultry products)
  - Davis and Dann Ltd (medical equipment, supplies and pharmaceuticals)

3.7 Unexploded Ordnance

Prior to commencing the site work, desk study searches in connection with risks from Unexploded Ordnance (UXO) were carried out by others and detailed in a report as follows;

- BACTEC/FIND Preliminary Unexploded Ordnance Risk Assessment reference 500456 (undated)

Following on from the above, Opus commissioned a detailed UXO desk study report prior to commencing the current ground investigation. This was undertaken by Dynasafe BACTEC Ltd and reported as follows;

- Dynasafe BACTEC Ltd Explosive Ordnance Threat Assessment in respect of Victoria Way/Stonefield Way, London – reference 6048TA dated 1st June 2015.

The outcome of the UXO risk assessment is provided within Appendix B of this report. In summary, the site is classified as Low to Medium risk from buried UXO and this implies that risk mitigation measures are required for drilling and other activities that disturb the ground. To mitigate risks, Opus appointed BACTEC to provide UXO risk mitigation on site during the ground investigation, comprising the attendance on site of an Explosives Ordnance Disposal (EOD) Engineer providing down hole magnetic scanning at each borehole location during progression of the exploratory holes.

You should be aware that further more detailed risk assessment and/or mitigation measures may be required at a later date prior to any construction work on site, especially if piled foundations are utilised for any new buildings or extension. Further advice is provided within the BACTEC report, included in Appendix B of this report.

4 Preliminary Conceptual Site Model

4.1 Introduction

A Conceptual Site Model (CSM) is a simplified written and/or visual or schematic description of the environmental conditions on the site and the surrounding area. It is developed from the individual components of the investigation at each stage to provide a depiction of likely contaminants, pathways and receptors and highlights the key areas of uncertainty. Fundamental to the CSM is the principle of pollutant linkages.

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, i.e. a substance that is capable of causing pollution or harm;
- a pathway, i.e. a route by which contaminants can reach the receptor;
- a receptor, i.e. something which could be adversely affected by the contaminant.

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

This form of risk assessment is referred to as a 'Source-Pathway-Receptor' risk assessment and forms the basis for the production of a conceptual model of the site to assist the qualitative assessment of potential risks identified as part of this desk study, as detailed in the following section.

Based on the findings of the desk study and site walkover investigation detailed in the preceding sections, a preliminary conceptual model has been established for the site and is summarised below.

4.2 Potential Sources of Contamination

With reference to the findings detailed above, the following potential on site sources of ground contamination have been identified.

4.2.1 General Site Usage

- Potential for Made Ground associated with historical site use as light industrial units (post World War 2 construction) to have originated from an uncontrolled source with the potential for contamination by metals, metalloids and PAH's;
- Asbestos Containing Materials (ACM) may have become incorporated into shallow soils (also noting that some existing structures are built from materials with the potential for containing asbestos)
- Possible for chemical contaminants (such as TPH from fuel/lubricants used on site or possibly VOC's from aerosol spray paints used by the existing site occupiers)

4.2.2 Off Site Sources

- Ground gases emanating from alluvium deposits located near to the northern site boundary, and possibly encroaching onto the site margins.

4.3 Receptors of Contamination and Migration Pathways

Receptors are defined as human or non-human organisms that have the potential to experience adverse effects from direct or indirect exposure to contaminated material.

Migration pathways are defined as the courses chemicals take from a source to an exposed organism or receptor. The exposure pathway can be direct (i.e. stays within the same exposure media) or indirect transport from one medium to another can take place.

The following potential human health and environmental receptors have been identified (for the proposed Lidl supermarket car park):

- Workers and visitors associated with the proposed site usage who may come in contact with the soils during any ground works associated with the development (excavation of foundations for example) and during occupation of the site;
- Building structures and services placed in or on the ground (buried concrete and other construction materials within the ground including water supply pipes etc.);
- Site construction and maintenance workers during construction works;

Based on the proposed end use of the site and the ground conditions, the following potential contaminant pathways are potentially present and considered within the CSM as follows:

4.3.1 Human Health

- Inhalation
  - » Breathing in dust from contaminated soil in outdoor air.
  - » Breathing in contaminated fugitive dust from contaminated soil in indoor air.
  - » Vapours from volatile contaminants in underlying soils.
  - » Ground gases.
- Ingestion
  - » Eating and swallowing of contaminated soil either by deliberate consumption, indirectly by eating or smoking with dirty hands or by ingestion of fugitive dust.
- Dermal Contact
  - » Direct contact with contaminated soil causing skin conditions such as dermatitis etc. Certain contaminants can be absorbed into the body through the skin or enter directly through open cuts or abrasions.

4.3.2 Building Materials/Services

- Aggressive Attack
  - » Building materials can be damaged by direct contact with aggressive/contaminated ground, especially if mobile groundwater is present; for example sulphate attack on concrete.

4.4 Preliminary CSM Relationships

Based on the assumptions above, a preliminary CSM of pollutant linkages on the site has been developed and is summarised in Table 4.4 below bearing in mind the development proposals.

Table 4.4: Preliminary Conceptual Model

Source	Pathway	Receptor	Preliminary Assessment of Magnitude of Risks
Contaminated soil potentially including metals, PAHs and Asbestos, possibly also TPH and VOC's	Ingestion Dermal contact Inhalation (outdoor air)	Construction workers Future employees and site users	Low
	Inhalation (indoor air)	Future employees and site users	Low
	Leaching	Groundwater	Low
	Aggressive attack	Building materials	Low to Moderate
Potentially Contaminated groundwater	Ingestion Dermal contact Inhalation (outdoor air)	Construction workers Future employees	Low
	Inhalation (indoor air)	Future employees	Low
	Lateral and vertical migration	River Roxbourne	Low
	Aggressive attack	Building Materials	Low to Moderate
Ground Gases from Alluvial Soils	Inhalation (indoor air)	Future employees and site users	Low to Moderate

To summarise, the preliminary conceptual model has identified some potential for ground contamination on the site, along with possible pathways for contamination to migrate and potentially impact sensitive receptors within the proposed development and the environment.

The findings of the conceptual model detailed above have been considered when implementing an intrusive investigation of the site.

5 Investigation Methodology

5.1 Objectives

Given the findings of the desk study the objectives of the intrusive investigation are as follows:

- To characterise the ground conditions across the proposed development area.
- To confirm potential pollutant linkages identified within the Preliminary Conceptual Site Model.
- To undertake a qualitative assessment of risks posed by any identified contaminants to the recognised receptors.
- To provide a preliminary geotechnical assessment of the proposed development area in the context of the proposed development.

The techniques adopted for the investigation were specified with reference to known site constraints. In particular, access was restricted to internal parts of the site and the form of investigation took into account the space available to work within for construction of the exploratory holes.

Given the nature of the proposed development, the investigation was designed to provide shallow boreholes for the provision of geotechnical design parameters, which were targeted at the proposed building footprints (where appropriate) and also at potential sources of contamination where possible.

The site work was carried out on the 15th June 2015 and comprised seven window sampling boreholes with concrete coring at surface (WS101 to WS107) under the supervision of Opus.

An Exploratory Hole Location plan is presented as drawing number J-M0208.00_102_P1.

5.2 Clearance of Underground Services and UXO

Information regarding the nature and location of buried services was provided by the Client.

Prior to commencing the ground investigation, a walkover survey was carried out to identify the presence of underground services. Where underground services were suspected, exploratory positions were relocated away from the suspected areas in the interests of health and safety.

In addition to the above, the positions were scanned with a cable avoidance tool (CAT) as a further precautionary measure.

With regard to unexploded ordnance (UXO) a specialist Engineer attended site and scanned each borehole location to assess risk from UXO. Scanning for UXO comprised down hole magnetometry, allowing the Engineer to scan 2m ahead of the drilling tools and clear each position at regular depths, before allowing the drillers to proceed.

5.3 Site Works

All soils and rocks were logged by Opus Geo-environmental Engineers in general accordance with BS EN ISO 14688 ‘Geotechnical investigation and testing – Identification and Classification of Soil – Part 1: Identification and description’, 2002 and BS EN ISO 14689 ‘Geotechnical investigation and testing – Identification and Classification of Rock – Part 1: Identification and description’, 2003.

In situ standard penetration testing (SPT) was carried out in all of the window sample boreholes to derive 'N' values, which can be used to assess the relative strength and density of encountered strata.

It should be noted that SPT 'N' values quoted within the borehole logs presented in Appendix C and referenced within this report, are presented as un-corrected values. Further correction of the 'N' values generally in accordance with BS EN 22476 Part 3, to account for the rig efficiency, borehole depth, overburden factors etc. has been carried out and reported in Section 6 below. Raw field data is archived within the Opus project file and can be provided on request.

Seven window sample holes (WS101 to WS107) were advanced using a tracked percussive Window Sampling rig to depths of between 3.00m and 6.00m below ground level (bgl) to provide ground investigation data relevant the area of the development.

A concrete coring attachment was used to penetrate hardstanding and concrete surface layers at all borehole locations and the concrete cores were logged and photographed for future reference.

The installation of gas monitoring wells were installed in boreholes WS103 and WS104. The installations generally comprised a 40mm diameter standpipe installed with bentonite seals from ground level to 1m below ground level (bgl) and a response zones extending from 1m to the base of the borehole. Details of the installations are presented on the relevant borehole log presented in Appendix C. All the remaining boreholes were backfilled with arisings on completion.

Soil samples were placed in containers appropriate for the type of laboratory analysis to be undertaken. All samples were labelled following standard protocols to ensure the site location, borehole location, sample depth, sample type, date and job reference were all clearly identifiable.

Collected soil samples were stored in cool boxes chilled with ice packs to preserve sample integrity as far as reasonably practicable. Subsequently the samples were transported to the laboratory for testing.

Copies of the window sample borehole logs are presented in Appendix C.

5.4 Chemical Laboratory Testing

The programme of chemical tests was undertaken on samples obtained from the intrusive investigation to assess the levels of contamination within the strata encountered on the site with regard to identified receptors, as detailed within the Conceptual Site Model. This analysis was carried out at the MCERTS accredited laboratory of QTS Environmental Ltd, for suites of determinands chosen bearing in mind the Conceptual Model.

Samples of near surface soil consisting of Made Ground and natural soils were selected in order to identify potential contaminants that may pose a risk to human health.

In summary, the following soil analyses were carried out:

- General Screening suite (including metals, pH, Sulphate, Phenols, PAH's)
  (4 samples – Made Ground to give general site coverage)

- Metals (As, WSB, Cd, Cr, Cu, Pb, Hg, Ni, Se & Zn)
  (4 samples – some Made Ground and some Natural Soils)

- Asbestos screen
  (4 samples – Targeted within Made Ground)

- TPH CWG including BTEX compounds

(Single sample of Alluvial Soils, located near to suspected chemical storage area in the west of the site)

- Volatile Organic Compounds (VOC's)
  (2 samples targeted at suspected chemical storage area and area of the warehouse possibly in use for spray painting of window frames)

Results of the chemical testing are presented in Appendix D along with a statistical assessment of the results in line with current guidelines.

5.5 Geotechnical Laboratory Testing

Representative samples were submitted to an approved and accredited laboratory and the following tests scheduled to determine soil properties as related to foundation design and construction.

- Aggressive ground suite – pH , water soluble sulphates, total sulphur and total sulphates
  (8 samples)

- Plasticity Index Determinations – Cohesive samples
  (4 samples)

- Moisture Content Determinations – Cohesive samples
  (4 samples)

Results of the geotechnical testing are presented within Appendix E.

5.6 Gas and Groundwater Monitoring

Gas monitoring has been carried out using a GFM 430 gas monitor which is fully calibrated and maintained in accordance with Opus Quality Assurance Protocols, to facilitate the measurement of Methane, Carbon Dioxide, Hydrogen Sulphide and Oxygen concentrations as well as flow rates.

Gas monitoring was carried out during three return visits to site on the 7th July, and the 5th and 12th August 2015 following completion of the site work.

Gas monitoring was undertaken in a sequence in accordance with established best practice, and as suggested within section 5.1 of the CIRIA guidance:

- Flow rate between the borehole and atmosphere;
- Soil gas concentrations at 'peak' and 'steady state' levels;
- Time taken for the soil gas to reach 'steady state';
- Standing water levels within the borehole;
- Atmospheric pressure at the beginning and end of the monitoring visit.

In addition the groundwater levels within the wells was measured and recorded.

Gas and groundwater level monitoring data is provided in Appendix F.

6 Results of the Site Investigation

6.1 Ground Conditions

A table summarising the ground conditions encountered, together with recommended soil parameters for foundation design are presented in Table 6.1 below.

Hardstanding

Concrete hardstanding was encountered at all exploratory hole locations to depths varying from 0.11m and 0.23m bgl.

Concrete was penetrated using a concrete coring attachment to the Window Sample rig and cores were logged as follows;

Table 6.1: Concrete Core Records

Exploratory Hole Location	Core Log
WS101	0.00m to 0.18m: Intact high strength concrete (no reinforcement). No aggregate visible within sample.
WS102	0.00m to 0.20m: Intact high strength concrete (no reinforcement). Concrete comprises much coarse aggregate
WS103	0.00m to 0.23m: Intact high strength concrete (no reinforcement). Concrete comprises some to much medium to coarse aggregate
WS104	0.00m to 0.23m: Intact high strength concrete (no reinforcement). Concrete comprises some to much medium to coarse aggregate - concrete is weak and friable from 0.20m to 0.23m
WS105	0.00m to 0.11m: Intact high strength concrete (no reinforcement). Concrete comprises some to much medium to coarse aggregate
WS106	0.00m to 0.22m: Intact high strength concrete (no reinforcement). Concrete comprises some to much medium to coarse aggregate - concrete is poor condition and weak from 0.17m to 0.22m
WS107	0.00m to 0.17m: Intact medium to high strength concrete (no reinforcement). Concrete comprises some to much medium to coarse aggregate - concrete is poor condition and weak from 0.09m to 0.17m

Made Ground

Made Ground was encountered immediately below the concrete hardstanding in all boreholes at depths varying from 0.11 and 0.23m below ground level (bgl) and extending to a maximum depth of 0.65m bgl (WS104).

Made Ground typically comprised clayey or sandy coarse stone, brick, crushed concrete etc. with black ash/clinker inclusion encountered in WS101, WS104 and WS105

A discrete layer of black ash/clinker was encountered in WS104 at a depth of 0.4m to 0.5m bgl.

There was no recorded visual or olfactory evidence of significant contamination within the Made Ground strata during site work.

Alluvial Deposits

Strata interpreted as being Alluvial Deposits were encountered at all exploratory positions beneath the Made Ground strata at depths varying from 0.35m and 0.60m bgl and extending to a maximum depth of 1.3m bgl.

Alluvial Deposits typically comprised grey or black, soft to firm consistency slightly sandy organic clay with inclusions of fine to medium gravel.

SPT testing within the Alluvial Deposits proved uncorrected 'N' values of N=15 (WS103 at 1m bgl) and N=18 (WS107 at 1m bgl) although it should be noted that these tests extended into the underlying strata so may not give an accurate assessment of strength for these strata.

Taplow Gravel Formation

Strata interpreted as being the Taplow Gravel Formation were encountered beneath the Alluvial Deposits at depths varying from 0.8m to 1.3m bgl and extended to a maximum proven depth of 4.5m (WS103), though more typically these strata extended to depths of around 2m bgl. It is noted that the deeper Taplow Gravel strata are encountered in WS103 (4.5m bgl) and WS104 (4.0m bgl) in the western area of the site, with this being potentially being due to this part of the site being nearer to the former river channel of the culverted River Roxbourne.

The Taplow Gravel Formation typically comprised firm to stiff consistency reddish or yellowish brown sandy clay with sub rounded gravel of mixed geology. In WS105 these strata graded to a clayey sand and gravel at 1.6m, extending to 2m bgl. In WS103 there was no sample recovery from 3m to 4m bgl with this possibly being due to sand and gravel being encountered at this location, and not recoverable by the drilling equipment due to a lack of cohesion.

SPT testing within the Taplow Gravel Formation proved uncorrected 'N' values in the range N=11 to N=18 with a mean average of 14.7 indicating a medium dense granular strata.

London Clay Formation

Strata interpreted as comprising the London Clay Formation were encountered underlying the Taplow Gravel Formation at depths varying from 2.0m bgl to 4.5m bgl and to the full depth of investigation at all exploratory locations.

The London Clay Formation typically comprised stiff consistency grey laminated clay.

SPT testing within the London Clay Formation proved uncorrected 'N' values in the range N=12 to N=27 with a mean average of 18.6.

Table 6.1.: Summary of Ground Conditions

Soil Type	Depth Encountered m bgl (Unit Thickness (m))						
	WS101	**WS102**	**WS103**	**WS104**	**WS105**	**WS106**	**WS107**
CONCRETE HARDSTANDING	GL to 0.18	GL to 0.20	GL to 0.23	GL to 0.23	GL to 0.11	GL to 0.22	GL to 0.17
MADE GROUND	0.18 to 0.45	0.20 to 0.35	0.23 to 0.50	0.23 to 0.65	0.11 to 0.50	0.22 to 0.60	0.17 to 0.60
ALLUVIAL DEPOSITS	0.45 to 0.90	0.35 to 0.80	0.23 to 1.30	0.65 to 0.90	0.50 to 0.90	0.60 to 0.90	0.60 to 1.30
TAPLOW GRAVEL FORMATION	0.90 to 2.00	0.80 to 2.10	1.30 to 4.50	0.90 to 4.00	0.90 to 2.00	0.90 to 2.00	1.30 to 2.20
LONDON CLAY FORMATION	2.00 to 5.00	2.10 to 4.00	4.50 to 6.00	4.00 to 6.00	2.00 to 4.00	2.00 to 3.00	2.20 to 3.00
GROUNDWATER	NONE	NONE	3.3m	NONE	NONE	NONE	NONE

6.2 Groundwater Observations

Groundwater was encountered at 3.3m bgl in WS103 with all other exploratory holes being dry at the time of the site work.

It is likely that the groundwater encountered within WS103 represents a pocket of perched groundwater within a layer of sand and gravel strata.

It should be noted that groundwater levels may fluctuate due to seasonal variations or other effects.

Gas/groundwater monitoring wells were installed in boreholes WS103 and WS104. Groundwater level measurements were taken during the three return visits to site. Groundwater levels were recorded at depths of between 1.11m and 1.95m bgl. During the third monitoring visit the well installed within WS3 by Remada was dipped, the water level was recorded at 1.11m bgl.

The results of the groundwater levels are present on the logs (Appendix D) and the groundwater levels recorded during the return monitoring visits are presented on the gas monitoring data sheets in Appendix G.

6.3 Gas Monitoring

Three return monitoring visits have been carried out on the 7th July, and the 5th and 12th August 2015, on the third visit an attempt to monitor the Remada installations was made however access was limited due to squatters. An additional visit was carried out to locate one of the Remada gas monitoring installations on the 21st August 2015. The results of all four visits, and the data collated during the Remada investigation are summarised below;

» Methane <0.1 to 18.5%
» Carbon Dioxide 1.7 to 12.7%
» Oxygen <0.1 to 20.2%
» Flow Rates <0.1 to 1.0l/h

The results indicate elevated levels of methane and carbon dioxide and depleted levels of oxygen.

The gas and groundwater monitoring results obtained during this investigation and the Remada investigation are presented within Appendix 'G'.

6.4 Chemical Testing

Background Information and Assessment Criteria

We have reviewed the results of the chemical testing on soil samples in accordance with the legislative framework and criteria set out in Appendix E. The Contaminated Land Exposure Assessment (CLEA) methodology has derived four 'generic' land use scenarios, for the assessment of potential contamination, namely residential (with home-grown produce), residential (without home grown produce), allotment and commercial.

We consider the proposed end use of the site, which is a supermarket, to comply with a 'commercial' end use at this stage for the preliminary assessment of any significant contamination.

In March 2014, Defra published final Category 4 Screening Levels (C4SLs) within their document entitled 'SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document' to assist with the implementation of the April 2012 revision of the Part 2A Statutory Guidance. The C4SLs differ from the existing Soil Guideline Values (SGVs) and Opus Tier 1 soil screening values (SSVs) in that they are considered by Defra to be more pragmatic (albeit still strongly precautionary) and indicate the concentration of a contaminant in soil that would potentially pose a 'low risk', yet still acceptable risk, to human health.

Defra envisage that, where derived, the new C4SLs will replace the current SGVs, which are considered indicative of 'minimal risk' and were derived using version 1.06 of the Contaminated Land Exposure Assessment (CLEA) model. The C4SLs include values derived for residential with consumption of home grown produce end land use. The C4SLs have, however, only been derived for a number of contaminants, including lead and benzo(a)pyrene, and have presently only been published for a sand soil type at 6% soil organic matter (SOM) content. In view of this Opus have used the CLEA model to derive adjusted C4SLs for benzo(a)pyrene at 0.25%, 1% and 3% SOM.

Where Soil Guideline Values (SGV's) or Opus In House Screening Values (IHSV's) are not published for certain compounds, reference is initially made to any results exceeding the laboratory detection limit to flag up these results for subsequent discussion and assessment.

Should the nature of the proposed development change significantly (for example residential use instead of commercial) it may be necessary to re-evaluate the contamination results and recommendations presented within this report.

Metals and PAH results have been combined into a Made Ground data set for statistical assessment purposes, split as follows:

- PAH compounds in Made Ground – 4 samples
- Metals/metalloids in Made Ground Strata – 6 samples

In addition to the above, 2 samples of Alluvial Deposits were tested for metals/metalloids. Insufficient data is available to statistically analyse this data set, therefore these results are compared directly to the relevant Opus IHSV's rather than looking at the data in terms of the mean value and maximum value test.

Statistical results are presented within Appendix E.

Results for TPH and VOC's have not been analysed statistically since these tests are typically targeted at potential hotspots or discrete sources of contamination. Results are compared directly to the relevant Opus IHSV's and any results found to exceed the guideline values are flagged up at this stage for further consideration.

With regard to VOC's, where Opus do not have IHSV's to compare results against, we identify any results exceeding the laboratory detection limit for further consideration in the first instance.

Total Organic Content within Made Ground soils have proved values in the range 1.2% to 2.5% with a mean average of 2%. Using Van Blemmelen's Factor this derives a mean Soil Organic Matter (SOM) value of 1.16%. To provide a conservative assessment of contamination data, the 0.25% SOM CLEA scenario has been utilised in the first instance.

Interpretation of Results

Based on the above methodology, chemical testing of the soil samples indicates the following;

- The results of the laboratory testing for PAHs undertaken on the four samples of Made Ground indicate an absence of significant contamination by these parameters

- The results of the laboratory testing for metals and metalloids undertaken on the six samples of Made Ground indicate an absence of significant contamination by these parameters

- Results for asbestos presence/absence indicated a positive result for two of the four Made Ground samples tested (WS101 at 0.3m bgl and WS104 at 0.4m bgl)

- Results for Phenols were all found to lie below the laboratory detection limit

- Results for speciated TPH CWG analysis on 5 samples of Made Ground are all noted to be well below the relevant SGV's or IHSV's

- Results for Benzene, Ethylbenzene, Xylene and Toluene (BTEX) were all below the laboratory detection limit, indicating an absence of contamination from these parameters

- All results for VOC compounds were found to lie below the laboratory detection limit, with the exception of Trichloroethene in WS107 at 0.4m bgl, with a proven concentration of 68ug/kg.

In summary, the results generally indicate an absence of significant contamination with the possible exception of Asbestos and Trichloroethene. Further discussion regarding these 'contaminants of concern' and recommendations relating to the chemical results detailed above are provided within Section 7 of this report.

6.5 Geotechnical Testing

The results of geotechnical testing for pH and sulphates carried out during this investigation are included alongside the chemical testing data in Appendix D. The plasticity indices and moisture content test results are included within Appendix E.

The sulphate, sulphur and pH values determined for selected samples taken from across the site have proved values in the following ranges;

• Total Sulphate as SO4	349 to 4381mg/kg
• Water Soluble Sulphate (SO4)	0.08 to 0.48g/l
• Total Sulphur	<0.02 to 0.45%
• pH	7.9 to 10.5 pH units

With regard to the above, the site is considered to be "brownfield" location and the London Clay is potentially pyritic. The site is assumed to have a "mobile water table" to provide an assessment of aggressive ground in accordance with BRE Special Digest No 1 (2005).

For a data set with N>5 but less than 10, the mean of the two highest figures for sulphate and sulphur can be taken as indicative of aggressive ground conditions. On this basis, due to the pyritic ground conditions, the site is classed as DS3 and AC-3, with regard to the aforementioned guidance.

In addition to the above, the results of the Plasticity Index testing and moisture content determinations have been proved in the following ranges;

- Plasticity Index 18 to 24%
- Moisture Content 25 to 33%

When adjusted to account for the percentage of particles passing a 425µm sieve, the Modified Plasticity Index (MPI) values remain unchanged at between 25 and 33% indicating that the natural strata underlying the site are classified as being of 'low to medium shrinkage potential' with regard to standard industry guidelines.

Geotechnical recommendations relating to the above results are included within Section 8 of this report.

7 Environmental Assessment

7.1 Introduction

This report has been prepared to provide preliminary information specific to the ground conditions at the site. We understand that the proposed development is to comprise a car park to serve a new Lidl supermarket. The new supermarket will be situated to the west of the subject site.

Given the nature of the proposed development, this investigation has been carried out on the assumption that the final development of the site will conform to the 'commercial' land use scenario in accordance with the Contaminated Land Exposure Assessment (CLEA) methodology.

Should the proposed site usage change significantly from the above, the contents of this report will require review and amendment as appropriate.

7.2 Soil Contamination Summary

Background and Context

The findings of this investigation have been assessed in relation to a combination of specific site characteristics as identified within the Preliminary Conceptual Model and with reference to the proposed future site end-use.

The geology underlying the site has been classified by the Environment Agency as non-productive strata and the site is not situated within a Source Protection Zone.

The intrusive ground investigation and chemical analysis of the retrieved soil samples has been specifically tailored to the identification of potential 'contaminants of concern', based on a review of desk study searches and the findings of a walkover survey of the site.

The results of the soil contamination testing when compared directly to the published SGVs, or Opus IHSV's to indicate that the concentrations detected were all below their respective assessment criteria for a commercial end use, with the exception of the following;

- Results for asbestos presence/absence indicated a positive result for 2 of the 4 Made Ground samples tested (WS101 at 0.3m bgl and WS104 at 0.4m bgl)

- Results for Trichloroethene in WS107 at 0.4m bgl, with a proven concentration of 68ug/kg.

Trichloroethene

With regard to Trichloroethene, Opus have derived IHSV's utilising the CLEA model (CLEA 1.06) and calculate an acceptable concentration within the commercial land use scenario at 0.25 SOM to be 12mg/kg. The single result exceeding the laboratory detection limit on this site is 68ug/kg, which is clearly well below the Opus ISHV.

Further reference to the Opus IHSV for Trichloroethene within a residential scenario at 0.25% SOM indicates an allowable concentration of 0.048mg/kg (i.e. 48ug/kg) indicating that the proven concentration would be unacceptable for retention within a residential development with gardens etc., although it is noted that the result only marginally exceeds the IHSV in this scenario.

Overall, with regard to Trichloroethene, Opus do not consider that this poses a significant risk to human health within the proposed development, although it should be noted that if development plans change and then this assessment would require re-appraisal. Given the absence of significant groundwater bodies beneath the site in near surface soils, and also the absence of recognised aquifers in the general vicinity, then the proven concentration of Trichloroethene is not considered to pose a risk to controlled waters.

In summary, no further action is considered to be necessary with regard to Trichloroethene on the subject site.

Asbestos

The asbestos results both indicate "loose fibres of chrysotile". Chrysotile is the most commonly encountered type of asbestos and poses lower risks to human health than some of the more hazardous forms, although risks obviously cannot be disregarded. The fact that the asbestos is present as "free fibres" increases risks to human health, since this material is more likely to become airborne during construction activities.

The asbestos was encountered in Made Ground at WS104 (south-west corner of site) and WS101 (north-east corner of site) therefore it is not possible, based on the available data, to define a hotspot within which the asbestos is contained.

The origin of the asbestos is unknown, but given the presence of hardstanding across the whole site currently, the asbestos is likely to be derived from imported materials during previous redevelopment of the site, or possibly former industrial uses of the site may be a cause of the contamination.

Risks from asbestos during construction would be most significant, both to members of the public (especially during dry/dusty conditions) and also to construction workers during site redevelopment.

Summary

Therefore in conclusion, based on the available data and findings to date, we consider that some remedial measures may be necessary with regards to human health risks to ensure the safety of end users of the site, to address the potential risk from asbestos.

7.3 Recommended Remedial Strategy

Based on the findings of this investigation, the following measures are considered necessary to be protective of the identified receptors:-

7.3.1 Asbestos Products in Building Construction

The age of the existing structures is such that asbestos containing materials may be present as part of the construction. Visual inspection of the roof line of the main warehouse building indicates that this is likely to be constructed in part from Cement Bound Asbestos sheeting.

In accordance with the 'Control of Asbestos Regulations 2012', we recommend that an asbestos survey in conjunction with an inspection of the asbestos register for the building is carried out prior to any construction work. Any Asbestos Containing Materials should be removed from site in a controlled manner by appropriately qualified and experienced contractors, prior to proceeding with demolition and site clearance.

7.3.2 Asbestos in Soils

The testing carried on four samples of Made Ground has proved the presence of Chrysotile Asbestos as free fibres in two of the samples, taken from opposite ends of the site.

Asbestos poses a risk to construction workers and members of the public during construction work on site, however once the site is redeveloped then there will be no further risks to human health since the site will be capped with hardstanding associated with the car park, thus preventing the asbestos from coming into contact with humans.

At this stage it is considered that there are two options for dealing with the risk from asbestos on this site;

1) Further testing to confirm the distribution of asbestos within Made Ground and quantify asbestos to a higher degree of certainty, followed (where results are favourable) by selective excavation and removal of asbestos contaminated soils prior to commencement of construction work.

2) Wholesale excavation and removal off site of all Made Ground materials, in a controlled manner, to prevent the airborne distribution of potentially asbestos contaminated dust.

Given the small size of the site, and the relatively thin layer of Made Ground encountered during the investigation, at this stage it is considered that Option 2 (wholesale excavation and removal of all Made Ground) would be the most convenient and practical form of remediation on this site.

It is estimated that, once concrete hardstanding has been removed and crushed for re-use on site, the remainder of Made Ground on site is likely to comprise a layer of around 350mm thickness. Given the area of the site (approx. $600m^2$), wholesale removal of all Made Ground would generate around $200m^3$ of waste soils, equating to approximately 450 tonnes.

If this approach is adopted then the excavation of Made Ground should be carried out in a carefully planned and controlled manner to prevent airborne distribution of dust which may contain asbestos. The waste soils should be disposed of at an appropriately licensed waste management facility. For budgeting purposes the soils should be assumed to be hazardous for waste disposal purposes.

7.3.3 Protection of Human Health & Controlled Waters

Should any unexpected significant contamination be encountered as development works progress, then the Client should contact a suitably qualified Geo-Environmental Engineer to inspect the site, and then form an appropriate remediation strategy.

In addition to the above, site workers should adopt suitable health and safety measures to be protective of health for the duration of construction works, especially where operatives are likely to be coming into contact with soils.

7.3.4 Summary

The identified receptors are not considered to be at significant risk from shallow soils within the study area, provided that the above recommendations are adhered to during the development of the site.

7.4 Gas Risk Assessment

Previous investigations by Remada on the area of land to be occupied by the Lidl Supermarket have characterised the ground gas regime as “Characteristic Situation 2” in accordance with CIRIAC665.

The results of the gas monitoring have been assessed in accordance with the guidance provided in CIRIA C665, ‘’Assessing risks posed by hazardous ground gases to buildings’’.

The Gas Screening Value (GSV, defined as litres of gas per hour emission) is calculated by multiplying the borehole flow rate (litres per hour) and gas concentration (per cent by volume). The GSV is calculated for both methane and carbon dioxide and the worst case value adopted. Based on the typical maximum gas concentrations and the GSVs, the appropriate Characteristic Situation ranging from 1 – Very Low Risk to 6 – Very High Risk is determined from Table 8.5 of the CIRIA C665 document.

Based on the gas monitoring carried out to date, and including the Remada data, maximum methane and carbon dioxide concentrations of 18.5% and 12.7% respectively have been proven with a maximum flow rate of 1.0l/h. The calculated GSV for methane is 0.185l/h and for carbon dioxide is 0.127l/h.

Based on investigations to date, the made ground and alluvial deposits encountered beneath the site are putrescible (organic) material which are a potential source of gas generation. Therefore it is considered likely that the gases detected on site are probably originating from these layers.

It is recommended that three further gas monitoring visits should be undertaken to fully comply with CIRIA C665 guidance. The outcome of this further assessment may influence geotechnical recommendations, especially with regard to the options for foundations.

Reference to the Building Research Establishment (BRE) publication BR211 “Radon: guidance on protective measures for new dwellings” (2007 edition) indicates that the site is within an area where radon protective measures are not required in the construction of new dwellings.

7.5 Health & Safety

During the construction of the development, a high standard of health and safety awareness should be maintained in order to protect construction workers from exposure to potentially contaminated soil. We therefore recommended that the appropriate precautions given in Health and Safety Executive Report HS (G) 66 ‘Protection of workers and the general public during the redevelopment of contaminated land’ are adopted.

It is our judgement that The Construction Design and Management (CDM) Regulations 2015 (regulation 3) will apply to this project. As a designer we have a responsibility to inform you of your duties to which you are subject by virtue of the Regulations as specified in regulation 11 (1).

We therefore draw your attention to the CDM Regulations 2015 and the Approved Codes of Practice contained therein.

7.6 Waste Disposal and Environmental Permitting Issues

Any soils removed from the site must be disposed of at an appropriately permitted landfill or exempt facility. As producer of the waste, the landowner or employer has a Duty of Care to ensure that their waste is disposed of appropriately.

Where it is proposed to remove soils from site, it is recommended that the classification of the waste as Inert, Non-hazardous or Hazardous is confirmed by discussion with the receiving waste management facility prior to disposal.

There is a legal requirement to treat contaminated soil (including non-hazardous waste) prior to disposal to landfill. Originating from the Landfill Directive, this legislation seeks to increase recycling and reduce pollution from landfills. Typically on Brownfield sites there are two main options for treatment of contaminated soil, namely separation or bulk treatment. To qualify as 'treatment' a 'three point test' must be satisfied, this is summarised below:

- It must be a physical, thermal, chemical or biological process including sorting;
- It must change the characteristics of the waste;
- It must do so in order to:
  - reduce its volume, or
  - reduce its hazardous nature, or
  - facilitate its handling, or
  - enhance its recovery.

The Environment Agency recommends that a written declaration is provided to waste management contractors confirming how the waste contaminated soils have been treated. Further guidance is provided by the Environment Agency in 'Your Waste-Your Responsibility Factsheet on Contaminated Soils'.

Should it be proposed to re-use site derived excavated soils (including natural materials) at the site or import naturally occurring unpolluted soils directly from another site, such activities may potentially fall under the Environmental Permitting (England and Wales) Regulations 2010. In March 2011, Contaminated Land: Applications in Real Environments (CL:AIRE) published Version 2 of the Definition of Waste: Development Industry Code of Practice. The Code of Practice is supported by an Environment Agency Position Statement, which indicates:

"If materials are dealt with in accordance with the Code of Practice we consider that those materials are unlikely to be waste at the point when they are to be used for the purpose of land development."

Under the Code of Practice, such soils should not be a waste if they are retained on the site provided the re-use is "certain", the soils "are suitable for use without any treatment" and "only the quantity necessary for the specified works" as noted at the planning stage of the project is re-used. Rather than apply for a formal environmental permit or waste exemption, such works can now be undertaken under self-regulation so long as the protocols in the Code of Practice are followed. The Code of Practice requires the preparation of a Materials Management Plan, which needs to be signed off by a Qualified Person and the subsequent preparation of a Verification Plan and Verification Report. Opus is able to assist in the preparation of the above documents and provide an appropriate Qualified Person to sign off the Materials Management Plan.

Should it be proposed to import waste materials (as defined by the EU Waste Framework Directive) to site from an off-site source for use in construction, then either a waste exemption will need to be registered with the Environment Agency or a Standard Rules Permit obtained, depending on the quantities of waste to be imported. Such wastes may include clean topsoil and subsoil generated from other constructions sites, although by adopting the Code of Practice for the importation of these materials, this should omit the requirement for a waste exemption or Standard Rules Permit.

Should it be proposed to import recycled aggregate to site, then so long as this has been processed in accordance with the WRAP protocols this is unlikely to be considered to be a waste and no waste exemption or Standard Rules Permit is required. If the recycled aggregate has not been processed in accordance with the WRAP protocols then this may be considered a waste and an exemption or Standard Rules Permit will be required.

7.7 Protection of Plastic Materials and Service Pipes

Certain hydrocarbons (particularly aromatic compounds) can permeate plastic water pipes and taint drinking water supplies. Other hydrocarbons can cause aggressive attack to plastic building materials.

Given the history of the site and the absence of any significant contamination, the use of standard plastic supply pipes (such as HDPE) is likely to be appropriate. We recommended that the water supply utility company is contacted to determine whether the water supply pipes to be adopted meet with their approval prior to any irrevocable actions at the site.

We further recommended that plastic building materials such as pipes are laid above the groundwater level within a trench of clean granular material.

7.8 Regulatory Liaison

We recommend that the above recommendations are agreed with the Local Authority (Environmental Health and Planning) and the Environment Agency (where appropriate) prior to commencing work on site, especially where planning conditions relating to environmental assessment are outstanding for the proposed development.

8 Geotechnical Assessment

8.1 Foundation Design

Background and Previous Investigation Findings

Opus is not aware as to the precise details or form of construction that may be utilised for the proposed development and thus the precise loadings that may need to be carried by the foundations. Subject to review, as and when these details become available, a range of foundation options may therefore be appropriate. The following discussion of foundation options should therefore be regarded as preliminary and subject to review as and when the detail of the intended development and the associated foundation loadings are known.

We understand that the proposed development will comprise a car park to serve a new supermarket which will be situated to the west of the subject site. The proposed Lidl Supermarket building will come very close, possibly slightly encroaching into, the western fringes of the subject site.

Lidl have provided a copy of a Ground Investigation carried out on land to the west of the subject site, references as follows;

- Remada Ltd (August 2015) Phase 2 Preliminary Geoenvironmental Ground Investigation for proposed Lidl Store, Victoria Road, Ruislip, HA4 0QF.

A brief review of this report, with regard to foundation design recommendations, confirms that ground conditions are broadly similar to those encountered on the current subject site. The report provides the following advice with regard to foundations;

- Made Ground and Alluvial Deposits are unsuitable for the support of strip or pad foundations.

- Foundations should therefore be extended to a depth of at least 1.5m, fully penetrating Made Ground and Alluvial Deposits to sit on the Firm to Stiff sandy gravelly clay of the Taplow Gravel Formation.

- On this basis, foundations can be designed using an allowable of $50kN/m^2$

It is noted that the route of the former River Roxbourne (now culverted) runs close to the western/northern site boundary and may the source of problematic ground conditions such as very soft organic alluvium or shallow groundwater. Whilst it is considered unlikely that difficult ground conditions associated with this former watercourse will be encountered within the subject site, since the exact line of the former watercourse is unknown, the possibility of difficult ground conditions being encountered on site cannot be totally discounted.

Current Investigation Findings

The Made Ground and Alluvial Deposits proven during the investigation are considered to be unsuitable for the support of foundations. Foundations should therefore be designed to fully penetrate these strata where encountered, to be supported by the Firm to Stiff sandy clay of the Taplow Gravel Formation, at a minimum depth of 0.9m bgl due to the medium volume change potential of the clayey strata.

Based on the investigation findings to date, it is anticipated that foundation depths will vary between 0.9m and 1.3m bgl within the subject site. It would be prudent to assume 1.5m deep foundations to be consistent with the recommendations provided by Remada in the aforementioned report.

It should be noted that foundations may need to be deepend, to account for the presence of trees or proposed plantings, given the medium volume change potential of the clayey strata encountered on site. Foundations should also be designed with regard to the potential for heave within clay soils.

Given the depth of the Made Ground and Alluvial Deposits encountered across the site, we consider that traditional pad, strip or raft foundations to be a suitable foundation option for the proposed extension, depending on the anticipated loads of the structures.

Assuming the foundations are supported on medium strength clayey strata, either firm to stiff consistency clay of the Taplow Gravel Formation or the stiff consistency London Clay Formation, then we estimate an allowable bearing pressure for foundations of at least 1.5m deep would at least 50kN/m^{2}.

Please note that bearing pressures quoted within this report are **allowable** values using a global factor of safety of 3.0.

All bearing capacities given are on the assumption that all loads are vertical, positioned at the centre of the footing and no moments acting on the footing.

The relative uniformity of the strata underlying the site should mean that the risk of differential settlement occurring would be low. Care will need to be taken to ensure that the positioning of new foundations does not place additional loads on existing foundations (adjacent structures).

Where foundations span from cohesive to granular soils, it may be necessary to utilise mesh reinforcement to mitigate the risk of differential settlements on the structure.

Final designs for the foundations should be carried out by a suitably qualified Engineer based on the findings of this investigation and with reference to the anticipated loadings and serviceability requirements for the structure.

We recommend that excavations for new foundations are inspected by a suitably qualified person prior to the pouring of new foundations to ensure that the exposed founding layer is consistent with those assumed for this report.

8.2 Floor Slab Design and Pavements

Due to the extent of Made Ground and Alluvium across the site, we recommend that a suspended floor slab is used for the proposed buildings. However, if there is a requirement to remove the Made Ground to lower site levels (or to remove risks from asbestos contamination) or if the Made Ground is excavated and re-engineered, depending on final proposed levels and the influence frost and of any proposed trees, shrubs or plantings in relation to the building, then a ground bearing floor slab may be suitable. Recommendations from the engineer specifying the design of the earthworks should be sought to confirm floor slab requirements.

Final designs for the floor slabs should be carried out by a suitably qualified Engineer based on the findings of this investigation and with reference to the anticipated loadings and serviceability requirements for the structure.

With regard to the car parking area, it is assumed that concrete hardstanding will be broken up and crushed to a specification to be re-used within the final development construction.

Any soft pockets (especially within the Alluvial Deposits) should be excavated and replaced with engineered granular fill, compacted to a specification before formation of the new pavement construction.

With reference to in-situ SPT testing and description of strength and consistency values within the underlying strata, it is suggested that CBR values of around 3 to 5% should be assumed for the design of any access roads/car parking pavements. This assumes that any below ground obstructions will be grubbed up and any voids or soft spots will be backfilled and compacted with suitable crushed aggregate to achieve an appropriate standard of compaction.

Final CBR values should be confirmed by in-situ testing following demolition, and removal of hardstanding from site.

8.3 Demolition and Construction

Where any significant obstructions (old foundations, drain runs etc.) are encountered then these should be chased out and the position, extent and depth of any resultant voids should be recorded for future reference as this could influence foundation designs for the proposed development.

Where deep voids are to be in-filled the advice of an Engineer should be sought to ensure that a suitable earthworks specification is achieved so as to minimise impacts of designs for foundations / floor slabs etc.

Based on observations during the site works, excavations through the Made Ground and clayey Alluvial strata and Taplow Gravel Formation strata are likely to remain stable in the short term. Deep trenches may need to be shored off or battered back where sand and gravel strata are encountered, or where perched water is present.

It is generally anticipated that excavations within the near surface strata should be readily achieved using conventional plant (JCB 3CX or similar). However, obstructions (old foundations, drain runs etc.) may be encountered, associated with previous phases of development and may require a higher specification of plant and /or breaking out.

The results of the pH, sulphate, sulphur and sulphide analysis have been assessed for potential aggression to buried concrete in accordance with the Building Research Establishment: Special Digest 1: 2005 – Concrete in Aggressive Ground. With reference to the desk study review findings, we consider that the site can be classified as a 'Brownfield site'.

For the majority of the site, in accordance with Part C of BRE Special Digest 1:2005, based on the testing carried out, we consider that the made ground and natural materials underlying the site are assigned a Design Sulphate Class DS-3 and an ACEC (Aggressive Chemical Environment for Concrete) Class AC-3.

The specific concrete mixes for the Design Concrete Class (DCC) to be used on site will be determined by the site specific concrete requirements in terms of the required durability and structural performance. These are assessed in terms of the Structural Performance Level (SPL) and any need for Additional Protective Measures (APM), detailed in Part 2 with further guidance in Parts 3 and 4 of BRE Special Digest 1.

8.4 Soakaways/Drainage

The site is underlain by predominantly cohesive strata with the London Clay being present at depth. These strata are likely to be relatively impermeable due to their cohesive nature. Therefore shallow soakaways are not likely to be appropriate for use on this site. If soakaways are proposed we recommend that infiltration testing is carried out in accordance with the BRE 365 specification.

8.5 Design Recommendations

Any design recommendations made within this report are considered the most appropriate considering a number of factors including investigation findings, financial and safety implications. All design recommendations are considered to be achievable within a safe system of work. During construction due consideration should be taken in relation to the safety implications inherent in the chosen construction method.

Any design recommendations suggested within this report should be carried out in line with current best practice and regulatory requirements. We consider that the contractor carrying out any recommendations contained within this report will be aware of the standard construction processes involved and have detailed knowledge of the relevant health and safety measures.

9 Further Recommendations

The following further works have been recommended prior to the development of the site:

1. Consultation with a flood risk specialist with regard to the potential need for a flood risk assessment.

2. Asbestos survey of the existing structure and removal of any asbestos containing materials prior to demolition

3. Confirmation with the local authority with regard to remediation options.

4. Carry out 3No. additional monitoring visits to confirm the gas regime for the site.

5. UXO mitigation measures during construction.

6. Finalisation of geotechnical designs for the proposed development with reference to a finalised planning layout, dead and imposed structural loadings. Foundation designs should be finalised based on a medium shrinkage potential within the clayey strata.

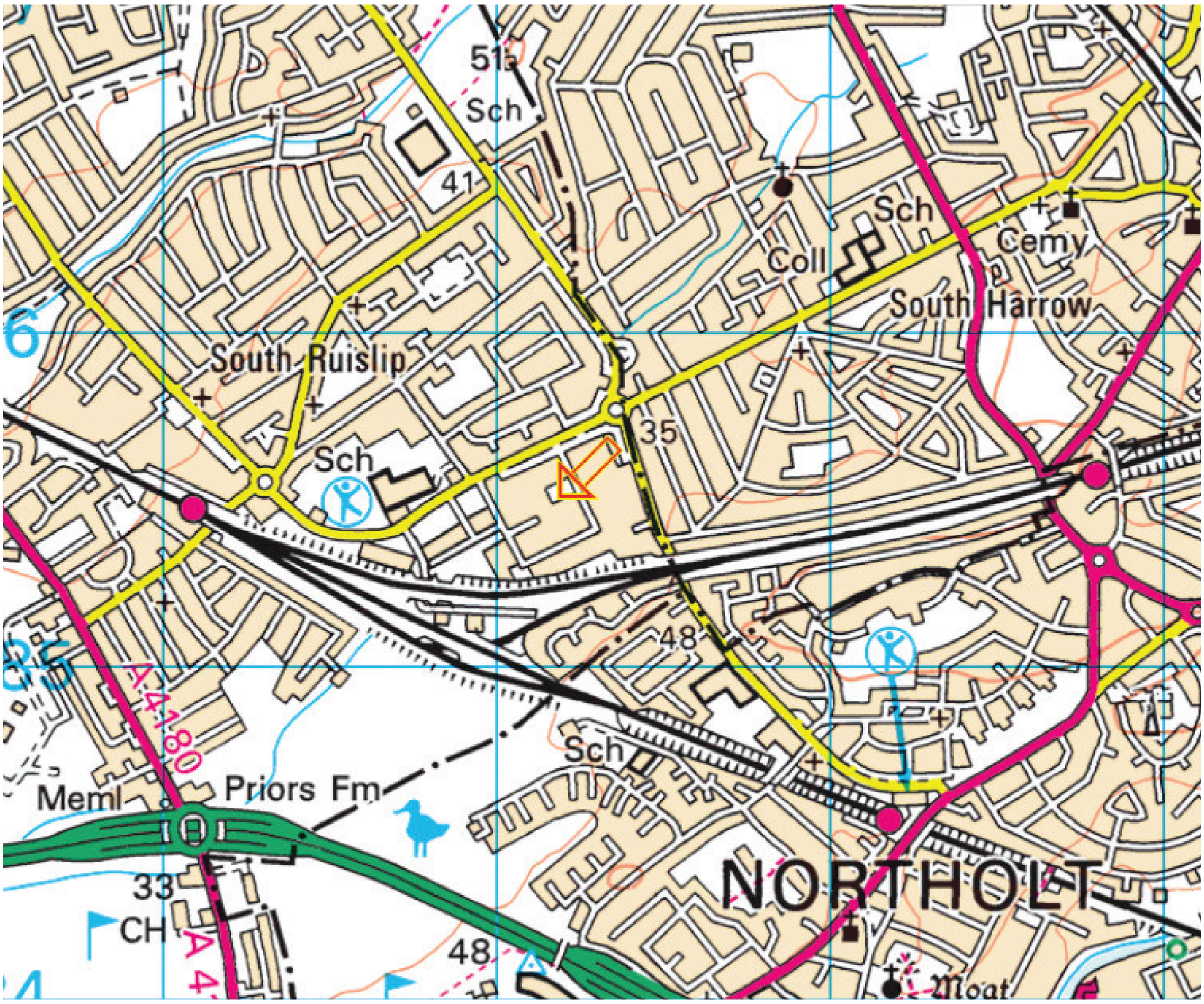
7. Soakaway testing in accordance with BRE: 365 if soakaways are required on site.

8. Confirmation of the water supply pipe specification with the appropriate authorities prior to construction.

DRAWINGS

Drawing No MK J-M0208.00_100_P1	Site Location Plan
Drawing No 3096-406D	Proposed Development Plan
Drawing No MK J-M0208.00_102_P1	Exploratory Hole Location Plan

Site Location Plan



	BY	CHECKED	DATE
DESIGN	ES	NM	AUG15
DRAWN	ES	NM	AUG15

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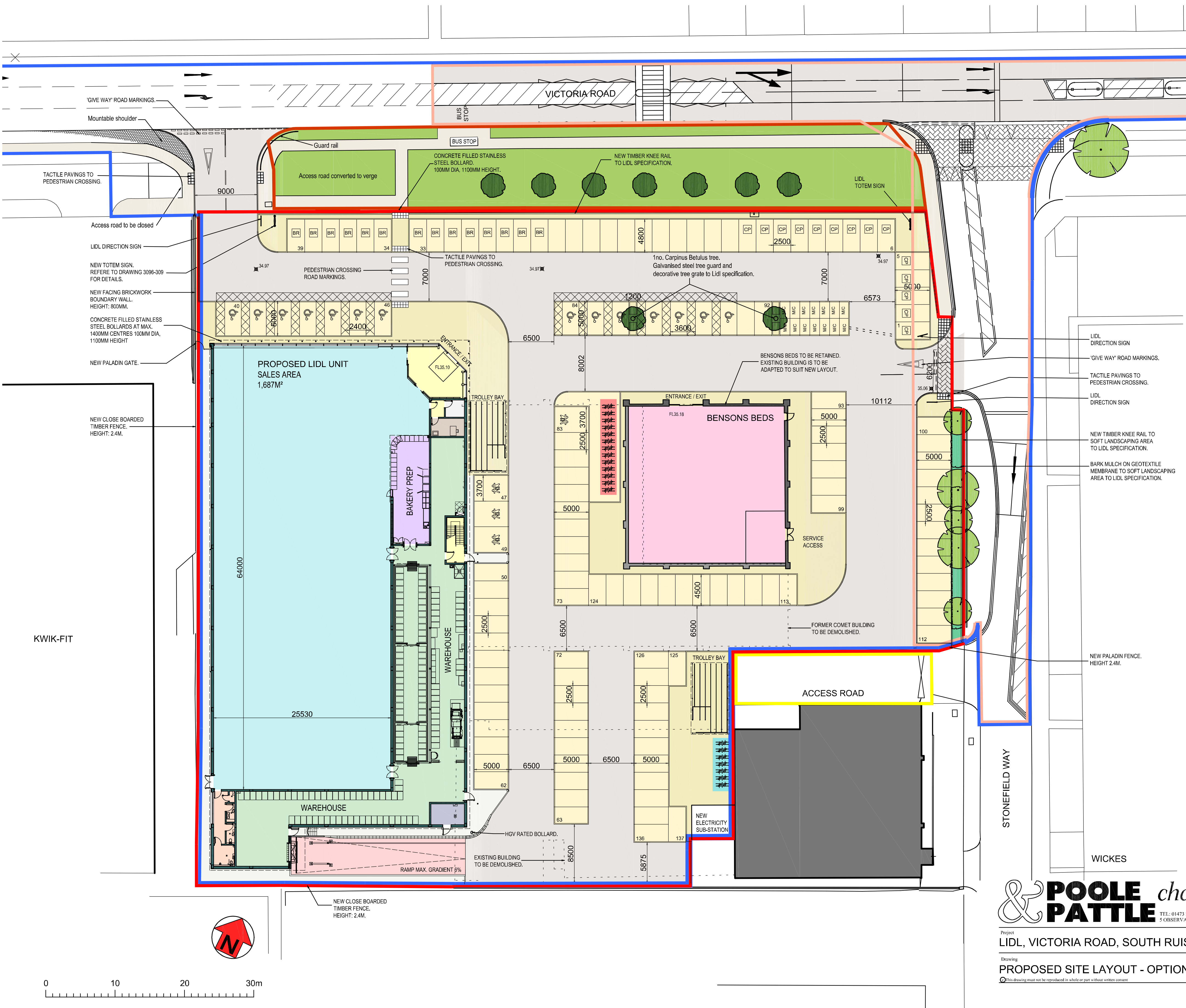
Status: For Information | **File:** J-M0218.00

Scale: Not to scale | **Date:** **21st August 2015**

Drawing Number: MK J-M0208_100_R0



SCHEDULE OF ACCOMMODATION

- LIDL OWNERSHIP
- APPLICATION SITE
- LAND RELATING TO EXTANT PLANNING PERMISSION REF 41266/APP/2012/2939 DATED 18 APRIL 2013
- COUNCIL OWNED LAND (LANDSCAPE WORKS TO BE CARRIED OUT UNDER LICENCE AGREEMENT)
- RIGHT OF WAY

GEA	2,639 sq m
GIA Ground	2,554
GIA First	201
GIA Total	2,755

SALES	1,687
WAREHOUSE	450.5
WELFARE	605.8
OFFICE	12.4
UTILITIES	14.4
BAKERY	83.5
STORAGE	6.8

PARKING

Standard		91	
Disabled		14	
Brown Badge	BR	14	
EVCP Active	CP	7	
AVCP Passive	CP	7	
Parent & child		4	
TOTAL		137	spaces
Motor cycles	M/C	14	
Bicycles		24	short stay
Bicycles		14	long stay (covered)

POOLE & PATTLE chartered architects
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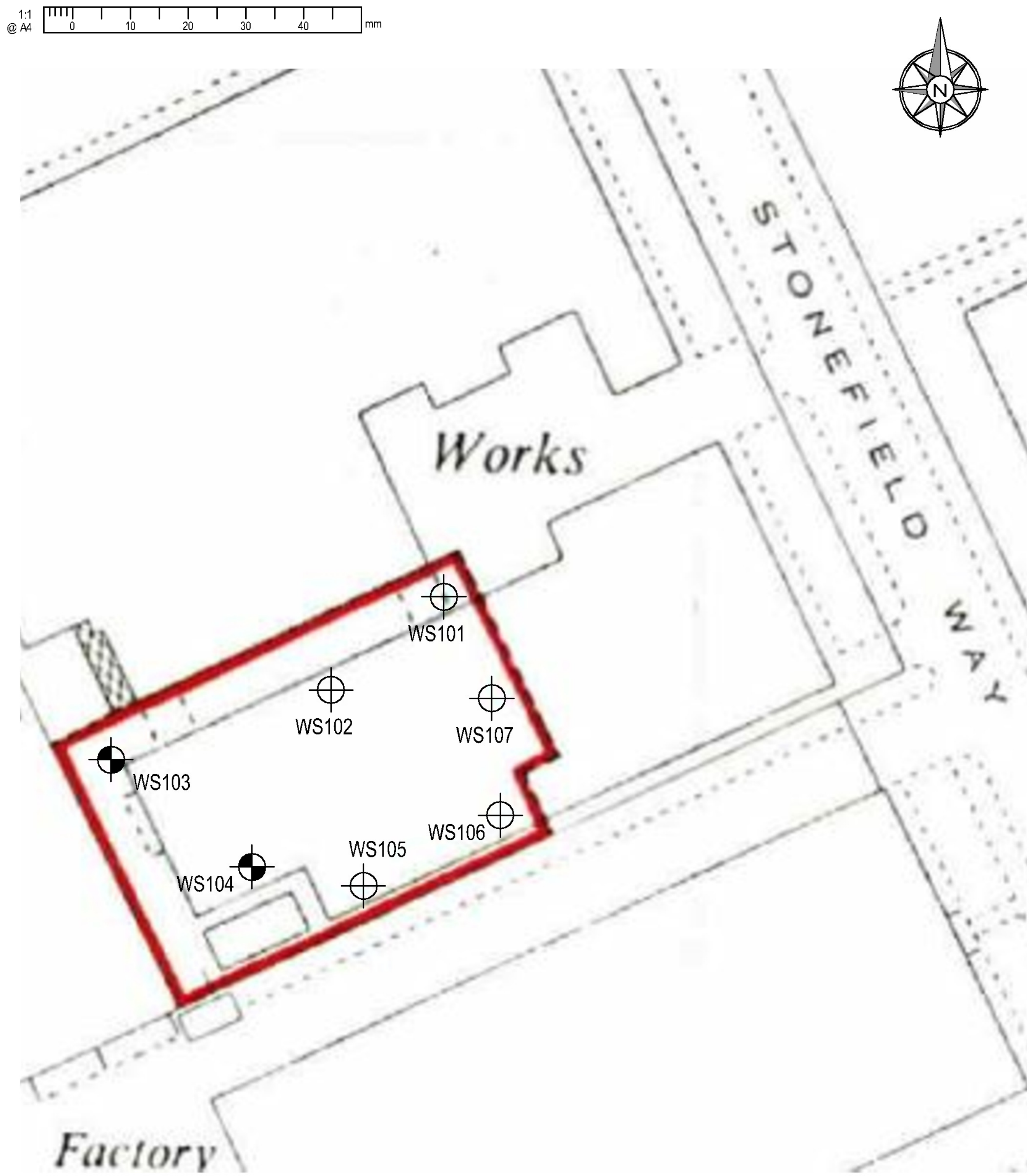
5 OBSERVATION COURT 84 PRINCES STREET IPSWICH SUFFOLK IP1 1RY

Project	Date	Scale	
LIDL, VICTORIA ROAD, SOUTH RUISLIP	JAN 2015	1:500 @ A3	
Drawing			
PROPOSED SITE LAYOUT - OPTION E	3096	406	L



NOTES

1. DO NOT SCALE.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS.
3. ALL BOUNDARIES ARE APPROXIMATE.

KEY

WS101 APPROXIMATE LOCATION OF OPUS WINDOW SAMPLE BOREHOLE

WS103 APPROXIMATE LOCATION OF OPUS WINDOW SAMPLE BOREHOLE WITH GAS MONITORING INSTALLATION

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Project: PROPOSED LIDL STORE, SOUTH RUISLIP

Sheet: EXPLORATORY HOLE LOCATION PLAN

Revision	Amendment	Approved	Date

Designed	Approved	Approved Date
NM	NM	JULY '15

Drawn	Scales	Project No.	Sheet. No.	Revision
NF	NOT TO SCALE	MK J-M0208.00	02	-

Original Sheet Size A4 [210x297]