Intended for
Legal and General

Date
August, 2015

Project Number
UK11-22062

UNIT A, BULLS BRIDGE INDUSTRIAL ESTATE, HAYES, UB3 4QQ ENVIRONMENTAL INFORMATION REVIEW

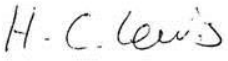
RAMBOLL ENVIRON

UNIT A, BULLS BRIDGE INDUSTRIAL ESTATE, HAYES, UB3 4QQ
ENVIRONMENTAL INFORMATION REVIEW

Project No.	**UK11-22062**
Issue No.	**01**
Date	**20/08/2015**
Made by	**Richard Hayes**
Checked by	**Hannah Lewis**
Approved by	**Hannah Lewis**

Made by:

Checked/Approved by:



Version Control Log

Revision	Date	Made by	Checked by	Approved by	Description
01	23/07/2015	RH	HL	HL	Issue to Client

Ramboll Environ
Artillery House
11-19 Artillery Row
London
SW1P 1RT
United Kingdom
T +44 207 808 1420
www.ramboll-environ.com

CONTENTS

LIST OF TABLES

APPENDICES

Appendix 1
Figures

Appendix 2
Outline Development PLans

Appendix 3
Site Inspection Photographs

Appendix 4
Historical Maps

Appendix 5
Regulatory Correspondence Letters

EXECUTIVE SUMMARY

Introduction and Background

Ramboll Environ UK Limited (Ramboll Environ) was instructed by Colliers International on behalf of Legal and General (the Client), to undertake an Environmental Information Review in support of a planning application for minor alterations proposed at Unit A, Bulls Bridge Industrial Estate, located at North Hyde Gardens, Hayes, UB3 4QQ ('the site'). The proposed alterations to the site primarily relate to the western corner and include:

- demolition of an above ground fire water tank an associated ancillary fire water pump house building;
- demolition of an electrical substation / electrical plant building; and
- resurfacing with concrete hardstand to allow an extension of the existing yard area.

In addition, other cosmetic and minor building alterations include; tarmac resurfacing, extended slot drains along the western edge of the main site building, an increase in the height of an existing roller shutter door, the addition of vehicle bollards and the construction of a raised delivery platform along the western building facade. It is understood that the site will continue in its current commercial use.

This environmental review documents the findings of a site inspection, desk based review of environmental information and a review of information relating to gas protection measures currently in place for the existing main site building.

Former site uses show a potentially contaminative past as a creosoting works, part of a landfill (according to an entry listed in proprietary environmental database) and later as a gas-fired power station. Remediation was undertaken at the site in c.1998/1999 which included source removal of shallow soils impacted with hydrocarbons. The surrounding land use also shows a long industrial past and there are a number of identified potentially contaminative activities having occurred / still present.

Current Site Configuration

Unit A forms part of the wider Bulls Bridge Industrial Estate and covers an area of approximately 11,000 m^2. The site is currently vacant and is occupied by a single industrial unit with ancillary outbuildings. The site inspection did not identified any significantly contaminative current uses. However, it was not possible to gain access to certain areas of the site including the sprinkler pump house and substation house and therefore potential for ground contamination in these areas cannot be ruled out.

Site Sensitivity

The site is located in an area of moderate to high sensitivity with respect to groundwater resources due to underlying Lynch Hill Gravels having a Principal Aquifer designation. The nearest groundwater abstraction is recorded c.50 m north of the Bulls Bridge Industrial Estate, although there are no abstractions for public potable use within 2 km. The site is not situated within a Groundwater Source Protection Zone as designated by the Environment Agency (EA).

The site is located in an area of high sensitivity with respect to surface water resources, given the presence of the Yeading Brook to the east and previous reports suggesting that there is groundwater connectivity.

Previous Remediation

Soil and groundwater hydrocarbon contamination attributed to the former use of the site as a creosoting works was identified in approximately 1998/1999 (i.e. prior to redevelopment to the current site configuration). Remediation involving soil (and encountered separate phase) was completed to the satisfaction of London Borough of Hillingdon (LBH) Council Environmental Health Department prior to the redevelopment of the site. The EA agreed in principal that there was no requirement for groundwater remediation at the time of development.

Post remediation monitoring has identified that there are localised elevated ground gas concentrations, primarily close to the previously remediated source area. Residual hydrocarbon contamination is considered to be the likely source of the ground gas.

Based on the information reviewed, it is understood that gas protection measures were factored into the design of the main site building. Although the original construction specification plans have not been seen it is understood that gas protection measures include a damp proof membrane (gauge not specified) and gravel blanket. Monitoring internal to the main building structure was carried out in 2000 in agreement with LBH Council. The results indicated no detectable methane or carbon dioxide concentrations within the building.

Conclusions and Remediation Statement

The planned development works are considered relatively minor and unlikely to result in significant ground disturbance. Replacement concrete hardstanding will serve to effectively isolate potential residual contaminant pathways for site users. A CSM has been devised to assess the potential for plausible pollutant linkages associated with the proposed development works. Risks to identified receptors are considered to be low and there is not considered to be a requirement for remediation or further investigation.

Development considerations are considered necessary and include:

- a 'watching brief' during development and preparation of an unexpected contamination protocol and method statement;
- characterisation of excavated materials (if excavation is required);
- standard brownfield development precautions to protect the health and safety of construction contractors;
- not using soakaways (if changes to drainage are required) due to the potential for residual contamination; and
- precautions should be taken to not compromise existing gas protection measures in place for the main building on site (i.e. ensuring that works that do not damage the membrane or block vents).

1. INTRODUCTION

Ramboll Environ UK Limited (Ramboll Environ) was instructed by Colliers International on behalf of Legal and General (the Client), to undertake an Environmental Information Review in support of a planning application for minor alterations proposed at Unit A, Bulls Bridge Industrial Estate, located at North Hyde Gardens, Hayes, UB3 4QQ ('the site'). The proposed alterations to the site primarily relate to the western corner and include:

- demolition of an above ground fire water tank an associated ancillary sprinkler system pump house;
- demolition of an electrical substation / electrical plant building; and
- resurfacing with concrete hardstand to allow an extension of the existing yard area.

In addition, other cosmetic and minor building alterations include: areas of tarmac resurfacing; extended slot drains along the western edge of the main site building; increasing the height of an existing roller shutter door on the western facade; the addition of vehicle bollards; and the construction of a raised delivery platform along the western building facade.

Due to the requirement for building demolition within the western corner of the site this area constitutes the 'Development Area' that will be the main focus of this report. The other planned development items are considered minor alterations. However, they will be discussed in the context of the environmental conditions as appropriate.

Ramboll Environ understands that Unit A will continue in its current commercial use.

This environmental review documents the findings of:

- a site inspection (to verify current site usage and identify potential current sources of contamination);
- a desk based review of environmental information relating to the site; and
- a review of gas protection measures at the site.

1.1 Background

Unit A (the site) forms part of the wider Bulls Bridge Industrial Estate and covers an area of approximately 11,000 m^2. The site is currently vacant and is occupied by a single industrial unit with ancillary outbuildings.

Figures providing the location of the site (Figure 1) and site boundary (Figure 2) are presented in Appendix 1. Outline development plans are included in Appendix 2.

Unit A (and the wider industrial estate) have a potentially contaminative past as a creosoting works, part of a landfill (according to an entry listed in proprietary environmental database) and later as a gas-fired power station. Remediation was undertaken at the site in approximately 1998/1999 which included removal of shallow soils impacted with creosote. Hydrocarbon concentrations have been reported to be elevated in shallow groundwater underlying the site. However, correspondence with the Environment Agency at the time of implementing the remedial strategy did not indicate a requirement to remediate groundwater. Correspondence records confirm that remediation was carried out to the satisfaction of London Borough of Hillingdon (LBH) Council Environmental Health Department.

ENVIRON (now Ramboll Environ) carried out a Phase I review for the wider Bulls Bridge industrial estate in 2012. The findings are documented in the following report:

- Phase I Environmental Review, Bulls Bridge Industrial Estate, Hayes, ENVIRON, May 2012, Ref: UK11-17650.

The Phase I Environmental Review was carried out for National Westminster Bank Plc (acting in its capacity as trustee and not otherwise) of the Legal and General UK Property Trust, British Oversees Bank Nominees Ltd and WGTC Nominees Ltd. The review was required in connection with the proposed purchase of the site for investment purpose.

Where appropriate background information documented in the above referenced ENVIRON report is used to supplement this environmental review.

1.2 Objectives

The objectives of the review were to assess the potential for soil or groundwater contamination, both at and in the vicinity of the site (i.e. specifically in the area of the buildings planned for demolition and the footprint of the yard extension), and assess its significance in terms of risks to identified sensitive receptors.

A secondary objective was to carry out a review of information to determine the current status of gas protection measures understood to be in place within the main site building.

1.3 Report Limitations

The conclusions presented in this report represent Ramboll Environ's best professional judgment based upon the information available and conditions existing as of the date of this report. In performing its assignment, Ramboll Environ must rely upon publicly available information; information provided by the Client; and information provided by third parties. Accordingly, the conclusions in this report are valid only to the extent that the information provided to Ramboll Environ was accurate and complete. This review is not intended as legal advice, nor is it an exhaustive review of site conditions or facility compliance. Ramboll Environ makes no representations or warranties, expressed or implied, about the conditions of the site.

Ramboll Environ's scope of work for this assignment did not include collecting samples of any environmental media. As such, this review cannot rule out the existence of latent conditions including contamination not identified and defined by the data and information available for Ramboll Environ's review; however, this report is intended, consistent with normal standards of practice and care, to assist the Client in identifying the risks of such latent conditions.

2. SITE DESCRIPTION/INSPECTION

A site inspection was carried out by Charles Collins on 14th August 2015. The purpose of the site inspection was to identify current potentially significant sources of contamination on-site, with a particular focus on the proposed Development Area.

Photographs taken during the site inspection are presented in Appendix 3.

2.1 Site Setting

The site is situated approximately in west London, approximately 2.8 km north of Heathrow Airport and 900m north of Junction 3 of the M4, in an area primarily of industrial use. The site is situated on North Hyde Gardens at National Grid Reference 510233, 179362.

Adjacent and surrounding land uses are detailed in Table 2.1 below.

Table 2-1: Adjacent and Surrounding Land Uses

Table 2.1: Adjacent and Surrounding Land Uses		
Direction	**Occupant**	**Activities**
North	Railway Lines, beyond which is an industrial area	Industrial
East	The adjacent site in occupied by British Airways (part of Bulls Bridge Industrial Estate) and comprises a modern industrial unit used for aircraft servicing and engineering. Further industrial units are located beyond	Industrial
South	The Grand Union Canal (Paddington Branch) beyond which lies a Nestle Factory prior to residential properties. The closest residential property is situated approximately 300m from the site	Industrial with residential beyond
West	The railway corridor branches to the west of the site beyond which is further industrial / commercial facilities	Industrial /commercial

2.2 Site Layout and Activities

The site comprises a single industrial unit dating from approximately 1998/1999. The building is of a steel frame construction with blockwork and profiled steel sheet cladding. The main entrance to the building is by the access road to the south. The southern portion of the building comprises a separate wing with two storeys of office accommodation including a reception area and staff facilities. Warehouse space occupies the northern portion of the building and is entirely open with no internal partitioning and an epoxy coated concrete floor surface.

The external areas of the site comprise an access road and car parking in the south of the site with vehicle loading bays on the western facade of the main building. An electricity substation house, water tank and pump house is located in the far western corner of the site. The property was vacant at the time of inspection with no activities observed on site.

Building documentation examined on site indicates the warehouse to have been used by the previous occupants to house simulators in relation to the site's previous use as a pilot training facility. The site has undergone a degree of vandalism since it has been empty (the date of tenant exit is not known).

2.3 Storage of Chemicals and Hazardous Substances

2.3.1 Underground Storage Tanks (USTs)

No visual evidence of below ground tanks was observed by Ramboll Environ.

2.3.2 Above Ground Storage Tanks (ASTs)

A steel water storage tank appearing to relate to the sites fire sprinkler system is located in the far western corner of the site. Ramboll Environ understands that this tank is intended to be demolished.

The sprinkler pump house adjacent to the north of the water tank (also intended for demolition) was not accessible at the time of the Ramboll Environ inspection as steel anti vandal shutters had been attached. It could not be determined whether fire water pumps are diesel powered and the potential for a diesel tank to be present within this building cannot be ruled out. Historic plans provided in previous investigation reports (reviewed in Section 5) show the inferred pump house to be labelled as a 'Diesel Generator Room' suggesting that the pump system is diesel powered. There was no observed staining around areas external to the pump house building and surrounding concrete surfaces appeared to be in good condition.

Similarly, the electrical substation building (also intended for demolition) could not be accessed as steel anti vandal shutters had been attached; the potential for above ground storage tanks to be located within this building cannot be ruled out.

No visual evidence of any additional above ground tanks was observed by Ramboll Environ.

2.3.3 Polychlorinated Biphenyls (PCBs)

As mentioned above the electricity substation building present in the west of the site was not accessible at the time of the Ramboll Environ inspection. The surrounding concrete hardstanding was observed to be in good condition with no significant visual evidence of spillage or staining. Given the age of the development (approximately 1998/1999) it is considered unlikely that equipment within the substation would have used PCB containing oils.

Observations documented in the ENVIRON 2012 Phase I Environmental Review report indicate that two oil-filled transformers were present at Unit A (assumed to be within the existing substation building). It was previously reported that the transformers had been subject to damage due to vandalism and cable theft and that it appeared transformer oil had been removed. Gravel surfacing was noted to be below the transformers and it was previously reported that there was localised staining.

2.4 Ground Gas Protection Measures

Inspection of Operation and Maintenance (O&M) manuals for the site states that the foundation slab 'should be laid on a fully lapped and sealed damp proof membrane' and does not refer to any detailed specification for gas protection measures.

A number of ventilated bricks with gravel surrounds were observed to be present along the north elevation of the warehouse. These could potentially relate to sub-slab venting (although no documentation was available to confirm this).

The warehouse floor slab was observed to be in generally good condition at the time of inspection with no significant signs of scarring or extensive damage to the epoxy floor coating evident. A small area of the floor slab in the south-western corner of the warehouse appears to have been modified for installation of a high voltage supply from the substation house. The exact date that the works were completed is unknown. However, confirmation that the works were completed in a manner that did not compromise gas protections measures should be sought.

2.5 Asbestos Containing Materials (ACMs)

Given the age of the buildings on site the presence of substantial quantities of asbestos within building materials is not anticipated. No suspected or labelled ACMs were observed during the

inspection. No associated building inspection report was available for review, therefore, a building inspection would be required to further confirm the absence of asbestos prior to demolition.

2.6 Potential for Ground Contamination from Current Uses

The Ramboll Environ site inspection did not identify any significantly contaminative current activities. It was not possible to gain access to certain areas of the site including the sprinkler pump house and substation house and therefore potential for ground contamination in these areas cannot be ruled out. It is considered likely that the fire water sprinkler pump system is diesel powered. Although Ramboll Environ could not gain access to the electrical substation the previous 2012 ENVIRON Phase I indicates that oil filled transformers were previously present.

The pump infrastructure, transformers and associated buildings will be removed as part of the proposed development. Given that the recent site inspection could not determine the condition of ground surfacing in these areas it is suggested that a watching brief be carried out during the redevelopment to assess for the potential for diesel or transformer oil to have been released to ground.

3. HISTORICAL & REGULATORY INFORMATION

3.1 Map History

Ramboll Environ has undertaken a review of historical mapping and aerial imagery (where available) obtained from a proprietary environmental database which is summarised below. Selected historical maps are presented in Appendix 4.

3.1.1 The Site

A map edition dated 1894 showed the site to be undeveloped. A railway line (currently still present) was shown to have been present along the north site boundary and the Grand Union Canal was shown to have been present to the south. A 'Creosoting Works' building and features labelled 'tanks' were depicted on a map dated 1934. The works building and tanks extended onto the eastern half of the site, along the northern boundary (running parallel with the railway line). Numerous railway sidings associated with the creosoting works were shown to have extended west across the site (within the footprint of the Development Area) and to link up with the main (off-site) railway line.

A historical aerial image dated 1946 showed the outline of numerous storage containers or sheds situated across the footprint of the site. The exact nature of these features is unclear but considered likely to have been related to equipment or product storage associated with the creosoting works. Further expansion of the creosoting works was shown to have occurred on a map dated 1964-1967 with the appearance of a number of square outbuildings (potentially tanks) in the eastern half of the site. By 1970 the creosoting works was no longer shown and the site was cleared. By 1979 a power station (understood to be gas-fired) was shown to extend onto the eastern half of the site. The power station remained in place until approximately 1995. A map dated 2006 shows the current site building to have been constructed.

3.1.2 The Surrounding Area

Maps dated 1868 to 1960s show the surrounding land use to have historically included a number of potentially contaminative industrial facilities and activities including:

- Excavation and likely infilling of pits (approximately 40m north of the site);
- Brick fields (approximately 300m south-west) and a clay mill (approximately 40m north);
- A gas works (approximately 650m north-east);
- Creosoting works (footprint having extended onto the site between c.1934 to c.1970);
- A rubastic works, approximately 200m east (manufacturer of rubber balls used for sport);
- Food manufacturing facilities (including jam, potato crisps, cheese and cocoa) within 500m of the site; and
- An electrical substation and distribution infrastructure (approximately 70m south-east).

Between the 1970s and current day surrounding land use has remained largely industrial / commercial in use with various warehouse / factory buildings and residential properties beyond.

3.1.3 Potential for Historical Contamination

Historically the western corner of the site (Development Area footprint) has been occupied (1930s-1970s) by railway sidings associated with the adjacent creosoting works. An aerial photograph dated 1946 showed equipment / storage containers (unknown contents) to be situated throughout the area. This historical site use is considered to be potentially contaminative.

The former power station and creosoting works covered a proportion of the east of the site (between the late 1970s and approximately 1995). However, the main Development Area footprint appeared to remain clear during power station operations up until development to the sites current configuration (i.e. addition of hardstanding and construction of the water tank and substation building) in c.1998/1999.

The surrounding land use has been subject to a long industrial past and there are a number of identified potentially contaminative activities having occurred / still present.

3.2 Environmental Database Records

A review of a proprietary environmental database (Landmark) was carried out as part of the ENVIRON 2012 Phase I Environmental Site Assessment. A summary of key environmental database information is presented for the site in Table 3.1.

Table 3-1: Summary of Key Environmental Database Information

Table 3.1: Summary of Key Environmental Database Information					
Data Type	**On site**	**Within 250m**	**Within 500m**	**Within 1km**	**Details of nearest relevant record within 250m of the site**
Contaminated Land Register entries	**0**	0	0	0	None
Prosecutions or enforcement actions	**0**	1	0	0	Prosecution in August 1999 for polluting the Grand Union Canal with heavy fuel oil and diesel. No details on defendant.
Pollution incidents	**0**	28	17	29	A number of pollution incidents have been reported within 250m of the site. Three of which relate to units within the wider Bulls Bridge Industrial Estate and the spillage of oils. The first was in July 1989, the second in January 1993, both were considered to be classified as Category 2 – Significant Incidents. In July 1996 there was a third pollution incident that was classified as Category 3 – Minor Incident. No further information was provided.
Former landfill sites	**1**	2	1	3	Records indicate that the site forms part of the Bulls Bridge Landfill. The last input date was 1936. Deposited wastes reported to include inert, industrial, commercial, household and special wastes. No further details were provided by the database.
Current landfill sites	**0**	0	0	0	None.
Registered Waste Sites	0	1	0	0	Personal Hygiene Services Ltd, located approx. 220m north, is categorised as a Clinical Waste

Table 3.1: Summary of Key Environmental Database Information					
					Transfer Station. The licence was last modified in April 2002.
Part A(1) Environmental Permits	**0**	1	0	2	Nestle UK Ltd, located 80m south / south-west. The Permit has been effective as of 27th February 2007, and allows the combustion of any fuel greater or equal to 50mW.
Part A(2) Environmental Permits	**0**	0	0	0	None.
Part B Environmental Permits	**0**	4	4	3	Ivo Textiles Ltd, located approx. 400m east of the site. The Permit allows textile and fabric coating of finishing processes, as of 16th March 1993.
Control of Major Accident Hazards Sites (COMAH)	**0**	0	0	0	None.
Fuel Stations	**0**	1	1	2	Tesco Extra. Located approx. 500m south-east of the site.
Contemporary trade directory entries	**0**	67	169	149	Kezvale Ltd (electronic equipment manufacturers). Located approx. 49m to the north of the site.
Registered Radioactive Substances	**0**	0	0	0	*Information on certain radioactive substance authorisations is not publicly accessible.*
EA discharge consents	**0**	2	0	1	Domestic discharges to land approx. 400m to the east.
Radon affected area	**N**	N	N	N	N/A.
Designated ecological sites	**0**	0	0	0	None.

The LinesearchbeforeUdig database lists pipelines distributing crude oil and refined hydrocarbon products owned and/or operated by a number of UK pipeline operators, including BPA, BP, ConocoPhillips, Esso, Government Pipelines and Storage System, Sabic, Shell and Total. According to the database, there are no records of underground oil or refined hydrocarbon products pipelines on the site or within 250m.

3.3 Regulatory Authority Enquiries

3.3.1 Local Authority Environmental Health Department

In 2012, ENVIRON made an enquiry to the Environmental Health Department of LBH Council in relation to the Bulls Bridge Industrial Estate and surrounds. The Local Authority confirmed that:

- the site was not identified as a priority site for inspection under Part 2A of the Environmental Protection Act 1990;

- they are aware of ground investigations and remedial works undertaken at the time of development in the late 1990s; and
- no on-going scrutiny of the site was reported by the Environmental Health Department.

A number of correspondence letters relating to the site around the time of the remediation / development in approximately 1998/1999 were also provided by LBH Council. These records have been reviewed in Section 5.

3.3.2 Local Authority Planning Department

The Ramboll Environ 2012 Phase I ESA included a summary of planning history for the site based on records provided by LBH Council. A summary of applications relevant to the site is provided in Table 3.2 below. It is noted that the site has remained vacant with the same building configuration since ENVIRON carried out the 2012 review.

Table 3-2: Summary of Relevant Planning Applications at the Site

Table 3.2: Summary of Relevant Planning Applications at the Site		
Application Ref.	**Details of Application**	**Status**
13226/G/96/0250	Redevelopment for the erection of buildings for use within Classes B1, B2 and B8 (involving demolition of disused power station) (outline application). Condition 22: Site survey to assess contamination levels with a scheme for addressing contaminants to be approved by the Local Planning Authority. Any imported material shall be tested	Approval on 03-09-1997
13226/J/97/1460	Erection of a building for use as a civil flight training centre or for purposes within Class B2/B8 with ancillary offices and associated car parking and landscaping. Condition 9: Required a scheme to deal with contamination including investigation and measures to avoid risk to the water environment to be approved by the Local Planning Authority	Approval on 12-02-1998.
13226AD/98/2346	Erection of services plant compound and relocation of fourteen car parking spaces	Approval on 02 February 1999
13226/AG/99/0457	Former power plant: remedial treatment of on-site contamination involving installation of funnels, soakaway chambers and monitoring wells including temporary diversion of Yeading Brook and restoration with associated landscaping	Approval on 07-06-1999

4. ENVIRONMENTAL SETTING

Desk-based research of the local geology, hydrogeology and hydrology was carried out in order to provide information on the sites environmental setting, assess the potential for migration of contamination (if present), and assess the sensitivity of the surrounding localised area.

Information was obtained from a number of sources, including:

- Examination of published geological maps produced by the British Geological Survey (BGS) and associated sheet memoirs (where available);
- a proprietary environmental database that was procured by ENVIRON as part of the 2012 Phase I review;
- Regulatory Authority websites including the Environment Agency (EA); and
- Review of previous site investigation reports.

4.1 Geology and Hydrogeology

A summary of the published geology according to BGS is provided in Table 4.1. Observations relating the generalised geological profile encountered during previous investigations have been summarised below in Table 4.1.

Table 4-1: Summary of Geology and Hydrogeology

Table 4 1: Summary of Geology and Hydrogeology			
Formation	**Description**	**EA Aquifer Designation**	**Hydrogeological Significance**
Langley Silt	Clay and silt	Unproductive Strata	Described as rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
Lynch Hill Gravel	Sand and gravel	Principal Aquifer	Described as layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, Principal Aquifers are aquifers previously designated as Major Aquifer
Alluvium	Gravels, sand silt and clay	Secondary A Aquifer	Described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers
London Clay Formation	Clay	Unproductive Strata	Described as rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow

Previous investigations (ENSR 1998 and ERM 1999, see Section 5) have encountered the following general sub-surface profile:

- Made Ground (surface level up to 5.6 metres below ground level (mbgl)): the average thickness of Made Ground observed in the far west (Development Area) of the site was approximately 3.5mbgl. A greater thickness of Made Ground was reported to be present in the centre of the site (centre of the existing yard area, approximately 10m to the east of the Development Area). Made Ground was observed to primarily comprise silty sand and gravel with observed fragments of clinker and concrete. However, within the thicker Made Ground deposits present in the centre of the site there was observed to be inclusions of wood chippings and straw. It was reported that the deeper areas of filling likely relate to waste materials originating from the former creosoting works;
- Sandy, silty clay (alluvium) at approximately 3.0mbgl to 5.0mbgl: described to include occasional organic layers;
- Sand and gravel (Lynch Hill Gravels) at approximately 4.0mbgl to 6.5mbgl; underlain by
- Stiff clay (depth and lateral extent unproven).

Groundwater levels have historically been recorded to be in the region of 3.0mbgl to 5.2mbgl within granular sand and gravel deposits. Interpretation of groundwater elevation data in Third Party reports indicates that groundwater flow is towards the west beneath the western half of the site and towards the east / south east (towards Yeading Brook) in the eastern half of the site. Previous investigations for the wider Bulls Bridge Industrial Estate have identified that shallow superficial gravel deposits are likely to be in hydraulic continuity with Yeading Brook.

According to the Landmark environmental database obtained by ENVIRON in 2012 for the wider Bulls Bridge Industrial Estate there are six licensed groundwater abstractions abstracting from six points within a 2km radius of the estate, as detailed in Table 4.2 below:

Table 4-2: Groundwater Abstractions

Table 4 2: Groundwater Abstractions			
Operator	**Distance**	**Source**	**Purpose**
Nestle UK Limited	50m N	Unconfirmed	Evaporative Cooling
USC Europe UK Ltd	160m E	Unconfirmed	Non-Evaporative Cooling
Chancerygate Group Limited	310m E	Unconfirmed	Non-Evaporative Cooling
Thorn EMI Electronics Ltd	840m W	Chalk (Undifferentiated)	Manufacture (Boiler)

The site is not situated within a Groundwater Source Protection Zone as designated by the EA.

4.2 Hydrology

The nearest identified surface water course is Yeading Brook which runs through the Bulls Bridge Industrial Estate at a distance of approximately 260m to the east of the site. The Grand Union Canal runs along the southern site boundary and there are understood to be a number of surface drains within the localised area that are linked to the canal or brook.

The EA currently classify Yeading Brook as 'poor potential' with regards to ecological quality and 'good' chemical quality under the Water Framework Directive classification scheme. The Grand Union Canal is currently listed by the EA as 'good' ecological quality and chemical quality is listed as 'not requiring assessment'.

According to the Landmark environmental database obtained by ENVIRON for the wider Bulls Bridge Industrial Estate in 2012, there is 1 licensed surface water abstraction within a 2km radius of the site, as detailed in Table 4.3 below.

Table 4-3: Surface Water Abstractions

Table 4 3: Surface Water Abstractions			
Operator	**Distance**	**Source**	**Purpose**
British Waterways Board	Approx. 1km NW	Unconfirmed	Non-Evaporative Cooling

According to the EA the site is in a Flood Risk Zone 1 (Low Probability). This zone comprises land assessed as having a less than 1 in 1000 annual probability of river flooding in any year (<0.1%).

4.3 Ecology

According to an independent third party environmental database there are no potentially significant ecological designations located within 2km of the site. A number of surrounding areas have been classified as Areas of Adopted Greenbelt.

4.4 Significance of Geology, Hydrogeology and Hydrology

The site is located in an area of moderate to high sensitivity with respect to groundwater resources due to the underlying Lynch Hill Gravel and the associated Principal Aquifer designation. The nearest groundwater abstraction is recorded approximately 50 m north of the Bulls Bridge Industrial Estate, although there are no abstractions for public potable use within 2 km. The site is not situated within a Groundwater Source Protection Zone as designated by the EA.

The site is located in an area of high sensitivity with respect to surface water resources, given the presence of the Yeading Brook to the east and previous reports suggesting that there is groundwater connectivity. It is considered unlikely that the Grand Union Canal is in connectivity with groundwater given that canal structures are commonly clay lined. The Yeading Brook has been classified as 'poor potential' with regards to ecological quality and 'good' chemical quality.

According to the EA the site is located outside of a designated flood plain, otherwise known as Flood Zone 1 (Low Probability).

5. OVERVIEW OF REMEDIATION AND PREVIOUS INVESTIGATION FINDINGS

There is an extensive amount of previous investigation and verification information relating to the site. This Section of the report provides a summary of previous works. Section 5.1 presents a high level overview of the previous reports and sequence of works; Section 5.2 provides further detail about each of the reports reviewed; and Section 5.3 presents Ramboll Environ's discussion of their significance in terms of the proposed development works.

5.1 Overview

The site has historically been subject to shallow soil and groundwater contamination with the source being attributed to the former creosoting works. The earliest investigation report available for review is a Phase II Environmental Site Assessment (ESA) carried out by ENSR International Ltd (ENSR) in 1998. This Phase II ESA covered the footprint of a wider development area that forms the footprint of the current Bulls Bridge Industrial Estate.

Within the ENSR 1998 Phase II report there is reference to five previous stages of investigation that occurred between 1986 and 1997 (understood to relate to decommissioning of the former power station). These reports are not available for review. However, the ENSR 1998 Phase II investigation was carried out as there was a need for further soil and groundwater characterisation prior to site redevelopment.

Remedial strategies were derived for a number of the Bulls Bridge Industrial Estate development parcels based on the findings of the ENSR 1998 Phase II. For the subject site, a hydrocarbon impacted source area was identified within the eastern half of the site. The remediation strategy comprised excavation of impacted soil and removal of 'separate phase' contamination encountered during excavation works. The strategy was provided to LBH Council and the EA for review and comment prior to implementation.

For background purpose it should be noted that the remedial strategy implemented for an undeveloped parcel of land located 300m to the east of the site included the installation of a funnel and gate groundwater treatment system. The system was installed along the eastern bank of Yeading Brook and comprised sheet piling keyed into deeper clay deposits. Groundwater was channelled through three lower permeability treatment cells (gates) filled with granular activated carbon to remove dissolved phase hydrocarbons. The treatment system was installed as it was deemed impractical to remove all soils impacted with PAH from the north-east area of the industrial estate. The treatment system does not intercept groundwater migrating from Unit A as it is situated along the opposite edge of the brook.

Remediation was carried out at the site in approximately 1998 and subsequent post-remediation monitoring (groundwater and ground gas) was completed by ENSR over a two year period. Post remediation monitoring included four monitoring points situated within the footprint of Unit A. The post remediation monitoring results showed localised elevated ground gas readings in areas close to the remediated source area. Shallow groundwater was also reported to be impacted with residual hydrocarbon contamination (it is noted that, in agreement with the EA, no active groundwater remediation was deemed necessary). Correspondence provided by LBH Council indicates that remediation works were properly implemented and that it subsequently considered that the site appeared suitable for use as a light industrial development.

ERM was commissioned in 1999 by a previous site owner to carry out additional intrusive investigation works to assess site conditions post development to the current building configuration. The key findings relate to an identified area of residual impacted soil ('hotspot') to the west of the main site building and in the centre of the current yard area. ERM also reported

elevated ground gas concentrations within the main building on site. The ERM investigation report was provided to LBH Council by ENSR. A response from an LBH Council Scientific Officer informed ENSR that the identified hotspot is unlikely to present any direct public health implications due to the presence of hardstanding. However, it was considered necessary that further ground gas monitoring be carried out. This was subsequently completed by ENSR and the results showed no elevated ground gas concentrations within the building structure. Subsequent communication from the Scientific Officer acknowledged that no detectable gas concentrations were found in the building itself or airbricks located along the building perimeter.

No further intrusive investigations or monitoring reports have bene made available for the site since between 2000 and present day. Phase I desk based investigations have been carried out for the purpose of site divestment and property transactions. The Phase I reports did not identify a significant risk of contamination associated with current site use. However, the presence of residual soil and groundwater hydrocarbon contamination was acknowledged within the Phase 1 reports.

5.2 Summary of Previous Investigations and Key Findings

A list of the previous reports and correspondence letters relating to the site is provided in this section together with a summary of the main findings. The reports provided include:

ENSR Remediation and Investigation Reports (1998 to 2000):

- Environmental Site Assessment, Bulls Bridge Power Station, ENSR International Ltd (ENSR), May 1998 Ref: 20161-2.
- Land Quality Statement, Orbit Site (Unit A), Bulls Bridge Development, ENSR International Ltd July 1998 Ref: 20161-4; and
- Post Remediation Monitoring Report, Bulls Bridge Development, ENSR International, July 2000 Ref: 20161 -6.

ERM Baseline Investigation (1999):

- Baseline Environmental Investigation: Hayes Orbital Simulation Centre, Environmental Resources Management (ERM), December 1999 Ref: 5610.

Correspondence Letters associated with Unit A (2000 to 2002):

- Letter from LBH Council to ENSR regarding the findings of the ERM (2000) Baseline Investigation, 03 February 2000 (Ref: MB/EPU/Orbit);
- Letter from ENSR to Geoff McCarthy of Salmon Harvester Properties Ltd. regarding Orbit gas monitoring, 7th February 2000 (Ref: 201611379/npb);
- Letter from LBH Council to ENSR regarding Orbit gas monitoring, 8th February 2000 (Ref: EPU/MB/Orbit); and
- Letter from LBH Council to Arup regarding gas monitoring at the site, 29 July 2002 (Ref: EPU/MB).

Phase I Environmental Review for the Bulls Bridge Industrial Estate, associated with site divestment:

- Phase I Environmental Assessment, Bulls Bridge Centre, WSP Environmental Limited (WSP), October 2011 Ref: 25904.

A summary of the report findings relating specifically to the site is provided in the following sub-sections. A number of regulatory correspondence letters referring to the site are included in Appendix 5.

5.2.1 ENSR Remediation and Investigation Reports (1998 to 2000)

The ENSR 1998 Environmental Site Assessment included a review of five phases of environmental investigation carried out between 1986 and 1998. On the basis of the review, ENSR carried out additional grid based and targeted assessment of the quality of soil, ground gas and groundwater for the current footprint of Bulls Bridge Industrial Estate.

For Unit A (referred to as the 'Orbit site' by ENSR) the ENSR 1998 investigation reported elevated concentrations of nickel (81mg/kg), copper (337mg/kg), zinc (3,401mg/kg), sulphate (3,200mg/kg) sulphide (436mg/kg), total PAH (>5,902mg/kg) and TPH (940mg/kg) in soil. Results were compared to the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) values and Dutch Guideline which were appropriate for the time at which the investigation was carried out. The groundwater results showed hydrocarbon impact. The source of contamination was understood to relate to former site activities, in particular the historic creosoting works. Elevated concentrations of methane and carbon dioxide were reported within the boundaries of the site, however, the exact locations are unclear.

The ENSR 1998 Land Quality Statement for Unit A (July 1998, Ref: 20161-4) documents subsequent remedial actions carried out in agreement with the LBH Council and comprising mass excavation and disposal of hydrocarbon impacted soils (and encountered separate phase). The source area removed extended from the eastern site boundary westwards beneath approximately 30% of the existing Unit A building footprint. The EA were also notified of the proposed remedial strategy. Communication records between ENSR and the EA document that there was no specific requirement for groundwater treatment. The EA agreed in principle that hot spot impacted soil removal and risk based natural attenuation was an appropriate remedial strategy.

Full compliance with pre-agreed site specific target levels (1,000 mg/kg for PAH which approximately corresponds to 1,200 mg/kg for TPH) was reportedly achieved for verification soil samples collected and the excavation was backfilled with imported clean spoil which consisted of crushed brick below the water table and crushed concrete above. Following source removal the EA requested that the quality of groundwater be monitored for a minimum of two years post construction.

Post remediation monitoring completed by ENSR (reported in report Ref: 20161-6) included groundwater and ground gas monitoring before and during development for commercial use. The monitoring programme was agreed with the EA. Bi-weekly monitoring was carried out for monitoring wells located across a number of development parcels (that make up the current industrial estate) during completion of remediation works. Four monitoring wells (MW6-1 to MW6-4) are situated within the footprint of Unit A.

The bi-weekly monitoring was followed by monthly monitoring post remediation for a period of a year and quarterly monitoring for the consecutive year. ENSR reported that elevated hydrocarbon contamination was present within groundwater samples collected post remediation, however, it was inferred that there had been an apparent reduction in dissolved phase contaminant mass and that there was no risk to identified surface water receptors. Elevated ground gas concentrations were reported for Unit A. Appendix D of the ENSR report includes result tables for monthly ground gas data collected between July 1998 and August 2000. A summary of the results is provided in Table 5-1.

Table 5-1: Summary of ENSR (July 2000) Post Remediation Gas Monitoring Results

Table 5 1: Summary of ENSR (July 2000) Post Remediation Gas Monitoring Results						
Well ID	**No. Readings**	**Flame Ionisation Detector (FID) Range (ppm)**	**CH_4 Range (%v/v)**	**CO_2 Range (%v/v)**	**O_2 Range (%v/v)**	**Gas Flow Range (l/hr)**
MW6-1	4	<2 to 900	<0.1	<0.1 to 11.5	3.7 to 20.0	0.0 to 0.3
MW6-2	8	<2 to 70	<0.1 to 6.5	<0.1 to 15.7	0.1 to 20.2	-3.2 to 0.3
MW6-3	11	<2 to >10,000	<0.1 to 1.2	0.2 to 4.8	10 to 20.4	0.0 to 0.4
MW6-4	6	130 to >10,000	<0.1 to 22.9	<0.1 to 6.7	0.7 to 20.0	0.0 to 0.2

ENSR concluded that the recorded gas flow rates indicate land to the west of Yeading Brook is not producing significant quantities of gas. However, it was acknowledged that 'to the West of Yeading Brook localised concentrations of methane are seen in the area of source removal'. This refers in part to the methane levels recorded for MW6-2 and MW6-4, located within the footprint of Unit A. The maximum CO_2 concentration reported for sample locations to the west of Yeading Brook was 15.7 %v/v which was the value detected at MW6-2.

ENSR acknowledge that elevated FID readings have been recorded for select wells and that O_2 concentrations have been shown to be depleted.

It is stated in the ENSR post remediation monitoring report that monitoring is to continue on a quarterly basis until November 2000. Ramboll Environ has not seen the results of subsequent monitoring (if carried out).

5.2.2 ERM Baseline Environmental Investigation (2000)

In December 1999, ERM carried out a baseline environmental investigation for the site as part of a joint venture agreement between GE Capital Corporation (GE) and Thompson. At the time of the investigation, the site was owned by Salmon Harvester Properties Ltd who were supervising the construction of a flight simulator building for Orbit. The investigation was carried out after the site had been developed to include the buildings that make up the current site configuration. It was reported that 'intrusive investigation within the building was not undertaken given the presence of a gas protective membrane beneath the building'.

The ERM report refers to a Phase I Environmental Due Diligence Assessment also undertaken by ERM in July 1999 (not provided for review). The July 1999 Due Diligence report concluded that the effectiveness of remedial works undertaken at the site may be in question and as such, a Phase II investigation was considered necessary. ERM subsequently installed seven groundwater and ground gas monitoring wells which included two wells (MW1 and MW2) within the footprint of the proposed Development Area.

Soil and groundwater samples collected at MW1 and MW2 were submitted for a suite of analysis consistent with the wider investigation area which included volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), metals, semi-volatile organic compounds, polychlorinated bi-phenyls, pH, sulphate, sulphide and cyanide. An area of soil impacted with creosote was

identified in the central portion (MW7) of the site (approximately 10m to the east of the substation building) where Made Ground deposits were noted to extend to up to 5.6mbgl. Groundwater analysis included the collection of samples from each of the seven newly installed wells and the following two existing ENSR wells:

- MW6-3: located to the south-west of the main warehouse building present at the site (outside of the Development Area footprint); and
- MW6-4: located to the south-east of the main warehouse building present at the site (outside of the Development Area footprint).

During gauging it was reported that dense non-aqueous phase liquids (DNAPL) were present within MW6-4 at a thickness of 1.17m.

ERM reported that soil sample analysis results showed one elevated (> Dutch Ministry of Public Housing guidance value of 1,000 mg/kg) concentration of TPH in a sample collected at MW7. A result of 8,038mg/kg TPH was reported for a sample collected from a depth of 3.0-3.2mbgl which was confirmed to be consistent with creosote and corresponded with visual observations of contamination. Elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) in soil *(maximum not specified)* were detected across the site at various depths. The distribution of PAH impact is not clear as there are no analytical certificates included within the report version reviewed. There is, however, reference to the maximum concentration relating to MW7, consistent with the observations of creosote impact.

ERM reported that 'trace detections' of VOCs were present and select metals (copper, lead and zinc) were elevated when compared to IRCRL guidance values but in line with concentrations commonly encountered in UK soils / fill materials.

ERM included a summary table for the TPH (C_{10}-C_{35}) results reported for the groundwater samples collected. This is provided below:

Table 5-2: Summary of ERM (2000) Groundwater TPH Results

Table 5 2: Summary of ERM (2000) Groundwater TPH Results	
Location	**TPH Concentration (µg/L)**
ERM Installed Wells	
MW1	21
MW2	13
MW3	51
MW4	5,606
MW5	1,929
MW6	1,774
MW7	6,014
Existing ENSR Wells	
ENSR MW6-3	1647
ENSR MW6-4	49,100

The most elevated concentration (49,100 µg/L) corresponds with the observed presence of DNAPL. It is noted that the TPH concentrations reported for the two monitoring wells located beneath the footprint of the proposed Development Area (MW1 and MW2) are a number of orders of magnitude lower than sample locations in the eastern half of the site.

With the exception of MW2, elevated (above the adopted Dutch criteria) dissolved phase PAH concentrations were reportedly present in groundwater. Detectable 'trace' levels of select VOCs were reported and detectable concentrations of zinc and cadmium were noted.

ERM reported that land gas concentrations were generally found to be below the guidance detailed in the Department of the Environment (DoE) and Building Research Establishment (BRE) guidance. The maximum concentrations detected were methane 0.5% and carbon dioxide 10.1%. Flow rates were not presented.

A gas screening survey was also undertaken within confined spaces in the newly constructed building on site. ERM reported that one methane reading detected in an electrical ducting box located on the ground floor was recorded in excess of the DoE guideline of 1% (although the actual concentration recorded is not specified). ERM interpreted the presence of elevated methane internal to the building as indicative of the possible ingress of landfill gas which could accumulate in time and increase in volume. Further gas monitoring and investigative works were deemed appropriate by ERM.

5.2.3 Correspondence Letters Relating to Unit A (2000 to 2002)

Letter from London Borough of Hillingdon Council to ENSR in Relation to the ERM 2000 Baseline Investigation (dated 03 February 2000):

A letter from the Scientific Officer at LBH Council to ENSR refers to the findings of the ERM 2000 Baseline Investigation report. Within the letter it is acknowledged that the ERM investigations show an area of residual hydrocarbon impact (referred to as a 'hotspot' in the letter) to be present beneath the centre of the yard area to the west of the main site building (based on the results reported for MW7). It was suggested that further delineation of the extent of the identified residual impact, and the completion of an associated risk assessment, would be warranted and that the ERM wells could be included in any planned post remediation monitoring requirements agreed with the EA.

Based on the historical investigation reports and correspondence letters reviewed by Ramboll Environ it is not clear whether further delineation of the residual hotspot has been carried out.

It was indicated in the letter that LBH considered that the identified hotspot was unlikely to present direct public health implications due to the presence of hardstanding. The possibility of 'hydrocarbon liquids or vapours' migrating into the main building on site was noted to be an 'apparent concern'. However, the Scientific Officer noted that there was understood to be protection against gas incorporated into the building construction. The letter from LBH included a requirement for additional monitoring ('as a matter of urgency') to further investigate the elevated ground gas readings reported by ERM. As summarised below, ENSR subsequently carried out additional ground gas monitoring.

Gas Monitoring Letter from ENSR to Geoff McCarthy of Salmon Harvester Properties (dated 07 February 2000):

In response to the request for additional ground gas monitoring by LBH Council ENSR attended the site on Wednesday 02 February 2000. The letter presents a headline summary of the monitoring results to Salmon Harvester Properties. Gas monitoring was carried out within the main building at the same sample points previously investigated by ERM. In addition the monitoring included measurement for airbricks around the building perimeter and existing accessible ERM / ENSR monitored wells.

No detectable methane or carbon dioxide concentrations were recorded within the building or airbricks. FID readings reported for all readings internal to the main building on site were 0.0 ppm. Oxygen levels were recorded to be between 20.1%v/v to 20.5%v/v.

The land gas concentrations monitored in existing boreholes were reportedly consistent with previous readings. The maximum concentrations detected were 1.5%v/v methane and 7.1%v/v carbon dioxide. Oxygen concentrations ranged from 0.8%v/v to 18.7%v/v and recorded flow rates ranged from 0.0 l/hr to -2.3 l/hr.

Gas Monitoring Letter from London Borough of Hillingdon Council to ENSR (dated 08 February 2000):

ENSR provided the results of additional gas monitoring (summarised above) to LBH Council. The Scientific Officer acknowledged that no detectable gas concentrations were found in the building itself or external airbricks and that the concentrations in the monitoring wells were consistent with previous results. It was suggested that confirmation of the specification of the gas protection measures installed as part of the development should be obtained.

Gas Monitoring Letter from London Borough of Hillingdon Council to Arup (dated 29 July 2002):

In response to an information request to LBH Council by ENVIRON in 2012 (as part of its Phase I 2012 assessment) the above referenced correspondence letter was provided. The letter relates to a request from Arup to LBH Council for a summary of the background relating to previously reported elevated ground gas concentrations. LBH acknowledges within the letter that: extensive remediation works has been carried out at the site. LBH states that 'the remedial works were properly implemented' and that the site subsequently appeared suitable for use as a light industrial development. The results of ENSR post remediation monitoring are referred to in the letter together with the ERM (2000) Baseline Investigation. The LBH Scientific Officer further refers to the subsequent repeat gas monitoring carried out by ENSR in response to the findings in the ERM 2000 Baseline Investigation. The Scientific Officer notes that the results of the ENSR repeat monitoring did not give any cause for concern.

The letter states that details or plans are not held on the Environmental Protection Units (EPU) records for remedial measures associated with gas protection on the building. LBH however states that, that through correspondence with ENSR it appears that remedial works were undertaken and a 'DPM and granular blanket' were incorporated into the design.

The LBH Scientific Officer noted that LBH EPU had not been provided with any further investigation information relating to the site since early 2000 and that they are not aware of any concerns.

5.2.4 WSP Site Divestment Phase I Environmental Assessment (2011)

WSP was instructed by Legal and General to undertake a Phase I Environmental Assessment of the wider Bulls Bridge Industrial Estate in association with the proposed divestment of the freehold interest in the site (reportedly subject to leasehold interests). A desk-based assessment, with site walkover was carried out for the wider Bulls Bridge Industrial Estate. However, access to Unit A was not possible and the site was not inspected.

WSP summarised the findings of consultations with a Contaminated Land Officer of LBH Council. It was reported that LBH Council considered current site use at Bulls Bridge Industrial Estate to be 'lower risk' and that a review of the industrial estate has not been completed under Part IIA. WSP report that ongoing remediation and monitoring is being carried out (however Ramboll Environ understands this to relate to the funnel and gate system installed off-site). WSP reports that it is understood that developments at the Bulls Bridge Industrial Estate were provided with final sign off from LBH Councils Building Control Department. However, no certificates were included with the WSP report.

Based on the information available, WSP carried out a risk assessment considering an outline conceptual model using the 'source-pathway-receptor pollutant linkage' concept. A summary of

the CSM presented by WSP (acknowledging that the CSM is for the wider Bulls Bridge Industrial Estate) is provided below:

- Potential sources: predominantly historical, i.e. former creosoting works and power station. It was reported that source reduction in the form of remediation was completed prior to the development, however, subsequent intrusive investigation indicates residual hydrocarbon impact in soil and groundwater (primarily PAHs);
- Receptors and sensitivity: WSP considered the site setting to be of moderate to high sensitivity due to residential properties in the area and the sensitive underlying Principal Aquifer. In addition to groundwater the Yeading Brook and Grand Union Canal were considered to be potential controlled water receptors. Human health receptors considered were site workers (including maintenance workers) and Third Party neighbours;
- Pathways and pollutant linkages: vapour migration due to residual contamination was considered to be a potential human exposure pathway. However, it was noted that the presence of hardstanding reduces the potential for a pollutant linkage. It was reported that there are indications that gas protections measures have been incorporated into building design. A response provided by a LBH Council Building Control Officer was reported to verbally confirm that units associated with the Bulls Bridge Industrial Estate were issued with a 'practical completion certificate'. It was acknowledged that groundwater impact due to the presence of hydrocarbons has historically been reported. However, the active funnel and gate groundwater treatment system is in place to reduce the risk posed to Yeading Brook (acknowledging that this is present along the eastern edge of the brook).

WSP concluded that the site represents a low/medium risk with respect to contaminated land liability issues considering a continued light industrial use.

5.3 Significance of Previous Report Findings

In the context of the proposed development works the findings of the previous investigation reports have indicated the following key points:

- The ERM 1999 investigation identified residual soil impact in the centre of the car park to the west of the main site building, as well as DNAPL in one of the previous boreholes (MW6-4). Based on communication between ENSR and LBH Council, it is understood that LBH that the residual contamination encountered on the site was unlikely to affect site users providing concrete hardstanding is present. The proposed Development Area is to the west of the identified residual soil impact. The planned development is considered relatively minor and unlikely to result in significant ground disturbance. Replacement concrete hardstanding will be added to isolate potential contaminant pathways for site users.
- Elevated ground gas concentrations have historically been reported at monitoring wells surrounding the main site building. The ERM 1999 investigation also identified isolated elevated ground gas concentrations within the main site building. Subsequent monitoring carried out by ENSR reported no detectable concentrations of methane, VOCs or carbon dioxide within the building structure. It is understood that the planned development works will not result in disturbance to the building floor slab and DPM. It is also understood that minor alterations to the western building facade can be carried out in a manner that does not compromise existing gas protection measures.
- Both the EA and LBH Council were kept informed of the planned remediation works, validation sampling and post remediation monitoring results. Correspondence records from LBH Council Environmental Health Department infer that the remediation works were properly implemented considering use as a light industrial development. The planned development works will not significantly alter the site.

- In general levels of residual contamination within soil and groundwater to the west of the substation building (i.e. within the proposed Development Area) appear orders of magnitude lower than investigatory locations in the eastern half of the site.
- Given the site history and previous investigation findings there is potential contamination to still be present beneath the site. Therefore, appropriate development management considerations (such as those detailed in Section 7 will need to be taken into account.

6. QUALITATIVE RISK ASSESSMENT

The regime for contaminated land was set out in Part 2A of the Environmental Protection Act 1990 (EPA). Under Part 2A, contaminated land is defined as land which appears to be in such a condition, by reason of substances in, on or under the land, 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"[1].

Revised statutory guidance ('the Guidance') entered into force in England on 11th April 2012. "Significant harm" is defined in the Guidance based upon risk-based criteria and must be the result of one or more relevant 'contaminant linkages' relating to the land. The presence of a contaminant linkage relies on the Contaminant-Pathway-Receptor concept, where all three factors must be present and potentially or actually linked for a potential risk to exist.

A "contaminant linkage" requires the following:

i) a "contaminant" is a substance which is in, on or under the land and which has the potential to cause significant harm to a relevant receptor, or to cause significant pollution of controlled waters;

ii) a "receptor" is something that could be adversely affected by a contaminant, for example, a person, an organism, an ecosystem, property, or controlled waters;

iii) a "pathway" is a route by which a receptor is or might be affected by a contaminant.

Under the Guidance, a 'significant contaminant linkage' is one which gives rise to a level of risk sufficient to justify a piece of land being determined as contaminated land.

The Guidance provides a four category test to help decide when land is and is not defined as 'contaminated' under Part 2A. Land in Category 1 and Category 2 would be capable of being determined as contaminated land under Part 2A on the grounds of significant possibility of significant harm to human health, or a significant possibility of significant pollution of controlled waters. Land in Category 3 and Category 4 comprises cases where there is not considered to be a significant possibility of significant harm, or the level of risk posed is low.

Based on the above factors, an initial assessment of the presence of a potential contaminant linkage can be made qualitatively. A conceptual model is an essential element of any site-specific environmental risk assessment, providing a simple representation of the hypothesised relationships between contaminants, pathways and receptors. For the purpose of this report, a basic conceptual site model has been developed based on the presentation and interpretation of information regarding the site gathered during this Environmental Information Review. This conceptual site model allows the identification of potential contaminant linkages and, therefore, an interpretation of the potential for significant harm and/or significant pollution of controlled waters in relation to a site. Based on this interpretation, the suitability of the site for the proposed development (demolition of disused site features, extension of the yard area and minor cosmetic alterations) can be evaluated.

The area of the site, that is subject of this assessment, comprises the Development Area, however, reference to the planned alterations for the western building facade is also made as appropriate. Table 6.1 presents the conceptual site model (CSM) specifically for the Development Area and potential significance of identified contaminant linkages.

[1] As Amended by the Water Act 2003 (commencement No. 11) Order 2012

Table 6-1: Conceptual Site Model

Table 6.1: Conceptual Site Model			
Source	**Pathway[2]**	**Receptor[3]**	**Potential for Contaminant Linkage and Proposed Mitigation**
Land gas associated with the presence of Made Ground and residual contamination	Migration to indoor air/enclosed spaces	Site users	*Current configuration*: Low. Above ground structures currently present within the Development Area footprint comprise water and electricity supply equipment / storage. The buildings are not permanently inhabited by site workers. The yard area is covered with concrete hardstanding which reduces the potential for ground gas migration. It is understood that the main building on site has gas protection measures (DPM and gravel blanket) in place and gas monitoring internal to the building (undertaken by third parties) has previously shown no detections VOCs (using a handheld FID), methane or carbon dioxide. *Upon redevelopment*: Low. The planned development works are considered relatively minor. Replacement hardstanding will restrict ground gas migration. Minor alterations to the western building facade are unlikely to require excavation works. If disturbance to the building floor slab is required, it will need to be carried out in a manner that does not compromise existing gas protections measures. Given the potential for residual contamination to be present it is not recommended that soakaways are used if changes to the current surface water drainage system are required as a part of the development works.
Residual contamination in soils and groundwater associated with historic site use, in particular the creosoting works. Primary contaminants of concern include: TPH and PAH	Inhalation, direct contact and ingestion	Development workers	*Upon redevelopment:* Low to moderate. Health and Safety risk assessments will need to accommodate the presence of shallow soils potentially impacted with hydrocarbons at shallow depth. It is not anticipated that the proposed development works will result in deep excavations. In the event that impacted shallow soil materials require excavation (such as along the route of utility lines) materials requiring off-site disposal should be appropriately classified. Standard brownfield development precautions will need to be adopted by construction contractors.

[2] Pathway: mechanism or route by which a contaminant comes into contact with, or otherwise effects, a receptor.
[3] Receptor: persons, living organisms, ecological systems and controlled waters that could be adversely affected by the contaminants.

Table 6.1: Conceptual Site Model			
Source	**Pathway[2]**	**Receptor[3]**	**Potential for Contaminant Linkage and Proposed Mitigation**
	Leaching and lateral migration through shallow deposits	Groundwater in the natural strata	*Upon redevelopment:* Low. The addition of concrete hardstanding will inhibit vertical migration of surface water through soils potentially impacted with residual hydrocarbon contamination. It is considered unlikely that the planned development works will alter the hydrogeological conditions at the site or create preferential contaminant migration pathways. As mentioned above, the use of soakaways is not recommended.
	Leaching to groundwater, lateral migration towards surface water	Surface water as Controlled Water	*Upon redevelopment:* Low. Water infiltration will be restricted through the addition of concrete hardstand. This will serve to prevent leaching of residual contamination sorbed to soil particles in the vadose zone. Therefore, a mechanism for increased mobilisation of contamination in groundwater towards surface water receptors is not being introduced.

7. REMEDIATION STATEMENT AND DEVELOPMENT MANAGEMENT CONSIDERATIONS

Owing to the relatively minor nature of the proposed development works it is not considered that specific remediation is necessary. However, we recommend the following development management considerations:

- a 'watching brief' is carried out to assess the ground condition beneath the substation building and sprinkler system pump house building footprints. This will allow for assessment of potential visual or olfactory indications of contamination in shallow soil materials, owing to the possible release of diesel or transformer soils (considered unlikely to have resulted in significant contamination, however, visual inspection was not possible at the time of the site inspection). An appropriately qualified Environmental Consultant should be appointed to undertake the watching brief;
- an unexpected contamination protocol and method statement should be produced by the development contractor in consultation with a qualified Environmental Consultant;
- appropriate characterisation of excavated materials (if excavation is required) should be carried out to assess the most appropriate re-use and/or disposal options;
- standard brownfield development precautions will need to be adopted by construction contractors;
- given the potential for residual contamination to be present it is not recommended that soakaways are used if changes to the current surface water drainage system are required as a part of the development works; and
- alterations to the main building are minor. However, precautions should be taken to not compromise existing gas protection measures.

8. CONCLUSIONS

The site and surrounding areas have a potentially contaminative history. Soil and groundwater hydrocarbon contamination attributed to the former use of the site as a creosoting works was identified prior to the development of the current site in approximately 1998/1999. Remediation involving soil removal was completed to the satisfaction of LBH Council Environmental Health Department prior to the development of the site. The EA agreed in principal that there was no requirement for groundwater remediation at the time of development.

Post remediation monitoring did identify that there were localised elevated ground gas concentrations, primarily at close to the previously remediated hotspot area. Residual hydrocarbon contamination is considered to be the likely source of the ground gas. Monitoring internal to the main building structure was carried out by ENSR in 2000 in agreement with LBH Council. The results indicated no detectable methane or carbon dioxide concentrations within the building.

Based on the information reviewed it is understood that gas protection measures have been factored into the design of the main site building. The original construction specification plans have not been seen, however, it is understood that gas protection measures include a DPM and gravel blanket.

A previous intrusive investigation carried out in 1999 identified residual impacted soil in the centre of the yard area to the west of the main site building. Subsequent correspondence with LBH Council indicates that the residual contamination is unlikely to affect site users due to the presence of concrete hardstand. The proposed Development Area is located to the west of the part of the site where residual impacted soils were reported by ERM.

The planned development is considered relatively minor and unlikely to result in significant ground disturbance. Replacement concrete hardstanding will serve to effectively isolate potential contaminant pathways for site users. A CSM has been devised to assess the potential for plausible pollutant linkages associated with the proposed development works. Risks to identified receptors are considered to be low and there is not considered to be a requirement for remediation or further investigation.

Development considerations that are considered necessary include:

- a 'watching brief' during development, following demolition of the unused ancillary buildings, and preparation of an unexpected contamination protocol and method statement;
- characterisation of excavated shallow soil materials to inform disposal / reuse options (if excavation is required);
- standard brownfield development precautions to protect the health and safety of construction contractors;
- not using soakaways (if changes to drainage are required) due to the potential for residual contamination; and
- precautions should be taken to not compromise existing gas protection measures.