Kings Cross Central Building R5

Ground Contamination Interpretative Report

for

Kings Cross Central General Partner Limited

SEPTEMBER 2010

Project No.: 7665

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KINGS CROSS CENTRAL
BUILDING R5

Client:

KINGS CROSS CENTRAL GENERAL PARTNER LIMITED

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PURPOSE OF THE REPORT

Ramboll UK was instructed by Kings Cross Central General Partner Limited to undertake an interpretation of available ground investigation data for the R5 site located in the eastern section of the wider Kings Cross Central (KXC) development in London.

This Ground Contamination Interpretative Report is required to satisfy the requirements of the planning process and also to identify potential ground based environmental risks which could affect the re-development of the site.

The report also provides a strategy for addressing and managing the identified ground contamination risks through design and the site redevelopment process.

SITE INFORMATION

APPROX. GRID REFERENCE	530226, 183750	**APPROX. AREA (ha)**	0.328ha

CURRENT SITE DESCRIPTION

The R5 site forms part of the Kings Cross Central (KXC)development, which will provide significant regeneration of over 16 hectares of land to the north of Kings Cross Station, London.

The R5 site is currently vacant. Existing site levels vary from 25.55m AOD to +25.73m AOD from west to east.

SITE HISTORY

Between 1746 and 1834, the site comprised large open fields. The first development on the site in the form of railway lines associated with the development of the wider KXC site appeared on the 1862 maps. The site remained relatively unchanged untill around 1968 when all the railway lines and associated sidings on the site were cleared. Between 1968 to present, the site has remained as open land.

Site surroundings in the immediate vicinity of the R5 site have historically included a mixture of railway tracks, sidings and ancillary buildings as well as residential developments.

PROPOSED DEVELOPMENT

The proposed development is to comprise a residential student accommodation consisting of three blocks varying in height up to 16 storeys. The blocks will be linked together by a single storey building. The development will be constructed in two phases, namely - phase I (north and western block) and phase II (southern block). A basement car park is proposed below the southern block. However, plans for this have not yet been finalised. The ground floor consists of a mixture of retail, plant and storage space. From the first floor upwards the building contains residential units. A basement water tank is proposed below the northern block. The development will also include entrance into a public courtyard to the west, a new road (East Street) and a new junction (Randall's Junction between East Street and the existing York Way) to the south.

Proposed site levels will range from +25.90m AOD in the west to +27.40m AOD in the east of the site. The proposed finished floor levels (FFL) for the main retail areas are set at +26.00m AOD in the west and +27.35m AOD in the west. The atrium in the centre of the building is set at +26.80m AOD. The

court yard levels are set at +26.00m AOD. The lift pits are set at +25.40m AOD and the proposed plant room in the northern block is set at +23.02m AOD.

ENVIRONMENTAL SETTING AND FINDINGS OF THE MARCH TO MAY 2010 R5 SITE INVESTIGATION

SCOPE OF THE INVESTIGATION

A geo-environmental ground investigation was undertaken on the R5 site between the 17th March 2010 and the 26th May 2010. The scope of works completed was specified by WSP and undertaken by Bam Ritchies. The scope of works completed relevant to the ground contamination assessments presented in this report included 3No cable percussive boreholes to a maximum depth of 50.0mbgl with dual gas and groundwater monitoring installations and 6No window sample holes to a maximum depth of 6.0mbgl. Following completion of the site works, 5No ground gas and groundwater monitoring visits were undertaken at the site. A total of 4No soil samples (2No in Made Ground and 2No in London Clay) were tested for a range of potential contaminants. Additionally, a total of 4No samples (2No in Made Ground and 2No in London Clay) were analysed for Waste Acceptance Criteria (WAC) to determine suitability for off site disposal.

The results and interpretation of the site investigation data to determine the geotechnical suitability of existing materials for reuse on site are not discussed in this report.

GEOLOGY

The geological stratigraphy underlying the site consists of Made Ground (up to 2.9m in thickness) over London Clay (up to 36.2), Lambeth Group Clay (over 16m in thickness as the base of the stratum was not established). The underlying Thanet Sands and Upper Chalk were not identified during recent site investigations completed between March and May 2010.

HYDROLOGY

There are no surface water features located on the site. The nearest surface water feature is the Regents Canal which is approximately 400m to the south west of the site.

HYDROGEOLOGY

Though not considered to be shallow perched groundwater, some perched was identified in the Made Ground at depths of +23.38 to +23.87m AOD.

The site is underlain by over 47.2m of relatively impermeable London Clay and Lambeth Group Clay. Pore water in the London Clay stratum ranged in depths between +4.78 to +5.63m AOD.

Limited pore water was recorded in the Lambeth Group at depth of -19.03 to -19.08m AOD.

The depths to groundwater in the underlying Thanet Sands and Upper Chalk (Principal Aquifer) stratum were not established during the site investigation completed at the site between March and May 2010. The aquifers are separated from the Made Ground by a significant depth of relatively impermeable London Clay and Lambeth Group Clays.

GROUND CONTAMINATION RISK ASSESSMENTS

HUMAN HEALTH

The majority of the determinands identified in the Made Ground and underlying strata were below their respective Generic Assessment Criteria (GAC) screening values. Marginally elevated levels of benzo (a) pyrene and some volatile PAHs were recorded in the Made Ground and could pose a risks to human health.

	Due to the nature of the proposed development comprising predominantly hard standing with areas of soft landscaping in the form of raised planted beds of imported top soil, the risks to future site users was assessed as LOW. The risks to construction workers were assessed as LOW/MODERATE. However, the risks can be mitigated to LOW through the implementation of best practice measures during site works by the contractors. The Contractor will be responsible for site health and safety and will manage the risk through control of suitable Health and Safety measures including provision of PPE, education of the workforce and inductions for all site staff and visitors.
CONTROLLED WATERS	Due to the presence of significant depths of London Clay (36m) and Lambeth Group Clays (>16m in thickness), the groundwater in the Thanet Sands and Upper Chalk are not considered as sensitive receptors, relative to the R5 site. Additionally, the piling solutions for the new build will terminate into the London Clay stratum. As such there is no pathway for contaminant migration into the underlying aquifers. The surface water of the Regent's Canal is over 400m south of the site and is not considered to be a sensitive receptor to the site. Risks to Controlled Waters (groundwater and surface waters) have been assessed as LOW.
GROUND GASES	Based on best practice guidance including CIRIA C665, the proposed KXC Plot R5 site has been classified as a Characteristic Situation 1 site. The risk from ground gases has been assessed as LOW. Specific ground gas protection measures are not required as part of the new development on the R5 site.
CONCLUSIONS AND RECOMMENDATIONS	
CONCLUSIONS	A site investigation has been undertaken and ground contamination risk assessment has been undertaken at the R5 site and the majority of the risks from ground contamination have been assessed as LOW. However, due to the presence of underground obstructions on the site, there is an uncertainty that ground contamination associated with the obstructions could be identified during site works and could pose a risk to Construction Wokers. Residual risks to Construction workers can be minimised by the implementation of best practice measures during the site works by the contractor.
RECOMMENDATIONS	A number of risk management measures are proposed, including the following: • Implementation of an Environmental Management Plan (EMP) and a Site Waste Management Plan (SWMP) throughout the site enabling and construction phase of the development; • Based on the site characterisation presented in this report, it is not anticipated that significant unforeseen contamination will be encountered on the site. However, in the unlikely event that previously unidentified contamination is encountered at the site during construction works, any remedial works undertaken will be in accordance with the agreed site wide strategy as detailed in paragraph 16.6.9 of the KXC Environmental Statement.

1 INTRODUCTION

1.1 Brief

Ramboll has been instructed by Kings Cross Central General Partner Limited to act as Structural, Civil, Geotechnical Engineers, Land Quality Consultants for the proposed Building R5 development located in the eastern corner of the wider Kings Cross Central (KXC) area.

As part of its duties, Ramboll are:

- providing assistance to Kings Cross Central General Partner Limited in order to satisfy its planning and environmental obligations with respect to managing potential ground based environmental risks associated with the redevelopment of the R5 site; and

- providing assistance to Kings Cross Central General Partner Limited in managing ground contamination risks through design.

This report presents the assessment and interpretation of the ground contamination data and also proposes a risk management strategy for managing the identified ground based risks during the development of the site. The report does not address geotechnical risks.

1.2 Proposed development and site levels

The proposed development will comprise a mixture of commercial and residential land uses. Figure 1.3, extracted from the Architects plans (MLA plan M MLA-219/SK/100804/04) shows the general arrangement of the ground floor of proposed building on the R5 site.

The proposed development is to comprise a residential student accommodation consisting of three blocks varying in height up to 16 storeys. The blocks will be linked together by a single storey building. The development will be constructed in two phases, namely - phase I (north and western block) and phase II (southern block). A basement car park is proposed below the southern block. However, plans for this have not yet been finalised. The ground floor consists of a mixture of retail, plant and storage space. From the first floor upwards the building contains residential units. A basement water tank is proposed below the northern block. The development will also include entrance into a public courtyard to the west, a new road (East Street) and a new junction (Randall's Junction between East Street and the existing York Way) to the south.

Proposed site levels will range from +25.90m AOD in the west to +27.40m AOD in the east of the site. The proposed finished floor levels (FFL) for the main retail areas are set at +26.00m AOD in the west and +27.35m AOD in the west. The atrium in the centre of the building is set at +26.80m AOD. The court yard levels are set at +26.00m AOD. The lift pits are set at +25.40m AOD and the proposed plant room in the northern block is set at +23.02m AOD.

The proposed site levels are shown on the MLA Drawing MLA/219/SK/100806/01.

1.3 Aims and Objectives

The aim of this report is to assess existing information, from the site investigation completed at the site between March and May 2010 and to evaluate ground based contamination risks at the site, and where appropriate, to outline a strategy for the management of these risks to facilitate safe development of the site.

The objectives of this report are:

- Prepare a Preliminary Conceptual Site Model (CSM) for the site and undertake a ground contamination risk assessment using the available site investigation data; and
- To propose a strategy for the management of the ground based risks in order to facilitate the safe development of the site.

1.4 Data Sources

This report should be read in conjunction with the following reports, listed in Table 1.1, pertaining to the site and its surroundings.

Table 1.1: List of available information reviewed

Report Title	Author	Date
Contract 3 for Borehole Investigations at Kings Cross.	Soil Mechanics	1993
Contract "L" Phase 3 Ground Investigation Geotechnical Factual Report on Site Investigation.	Foundation and Exploration Services	1995
Contract 2 for Phase 4 Ground Investigations in Project Area 100.	Soil Mechanics	1997
King's Cross Central Environmental Statement (ES) Volume 4: Part 16 Soils and Contamination Specialist Report.	Arup	May 2004
King's Cross Central ES Volume 2: Part 9 Cultural Heritage and Townscape Specialist Report. Appendix 9B.	International Heritage Conservation and Management (IHCM), RPS and Arup	May 2004
King's Cross Central ES Volume 5: Supplement.	Arup	September 2005
Ground Investigation Factual Report for Building R4 and R5	Bam Ritchies	June 2010
Kings Cross T6 Ground Contamination Interpretative Report. Ref. 6955.E.GCIR.1C	Ramboll UK	August 2010

1.5 Constraints and Limitations

This report has been prepared for the exclusive use of Kings Cross Central General Partner Limited for the purpose of assisting its site evaluation in the context of the proposed development. This report may not be used in whole or in part by any third parties without the express permission of Ramboll UK Ltd in writing.

The proposed environmental risk management strategies and recommendations summarised in this report relate to details of the proposed development at the time

of writing the report. Any substantial changes to the proposed design may require a reassessment of the implications of the environmental risks identified.

Ramboll has endeavoured to assess all information provided during this appraisal. This report summarises information provided from a number of external sources and cannot offer any guarantees or warranties for the completeness or accuracy of information relied upon.

The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

2 SITE SETTING

2.1 Site Location

The R5 site is located in the east of the wider KXC development site. It is situated at approximate National Grid Reference 530226, 183750

The location of the site is shown in Figure 1.1. The location of the R5 site in the context of the wider KXC development is shown in Figure 1.2.

2.2 Description of the Site and its Surroundings

The site is currently vacant and has been cleared of any structures. An aerial view of the site and its surroundings is shown in Figure 1.1.

To the east of the site is York Way. The immediate site surroundings are occupied by open areas of land which form part of the wider KXC development area.

2.3 Existing Site Topography

The site is relatively flat with site levels ranging from +25.55m AOD in the west to +27.73m AOD in the east. The site is approximately 0.67m higher than York Way to the east of the site.

Site surroundings consisting of further KXC development plots are of similar levels.

2.4 Site History

Between 1746 and 1834, the site comprised large open fields. The first development on the site in the form of railway lines associated with the development of the wider KXC site appeared on the 1862 maps. The site remained relatively unchanged till around 1968 when all the railway lines and associated sidings on the site were cleared. Between 1968 to present, the site has remained as open land.

Site surroundings in the immediate vicinity of the R5 site have historically included a mixture of railway tracks, sidings and ancillary buildings as well as residential developments.

A detailed site history of the site and its immediate surroundings is presented in Table 2.1

Table 2.1: KXC R5 Site History

Source	Scale	Site	Surroundings
Roque's Map 1746	1: 75	The site is undeveloped and comprises large open fields.	Site surroundings are largely open undeveloped fields. A small settlement is shown approximately 500m west of the site and is labelled Pancras Wells.
Tomson's Map 1801	1: 75	No significant changes on the site.	No significant changes to the immediate vicinity of the site. Extensive developments have taken place at distances of >500m to the west of the site.

Source	Scale	Site	Surroundings
Greenwood's Map 1827	1: 37.5	No significant changes on the site.	Extensive developments have taken place to the west, south east and north west of the site. A **gas works** is shown at approximately 600m to the west of the site and is named **Imperial Light Coke Works.**
Bartlett's Map 1834	1: 75	No significant changes on the site.	Extensive developments have taken place to the west, south east and north west of the site. The development shown on the previous map appears to be have expanded further west, north and south west of the site
Standford's Map 1862	1: 75	The site now comprises of **railway land** with **rail tracks** leading into a building **(goods shed)** further west.	The majority of the site surroundings have been developed to **railway land** and associated **rail tracks** and **ancillary buildings.**
County Series 1869 - 1873	1: 10, 560	No significant changes on the site.	A **goods depot** is shown to the west of the site. Site surroundings are predominantly **railway land** and ancillary buildings including **a coal depot** to the north and **goods depot** to the west. .
County Series 1894	1: 10, 560	No significant changes on the site.	No significant changes to the site surroundings.
County Series 1894	1: 10, 560	No significant changes on the site.	No significant changes to the site surroundings.
County Series 1911 - 1913	1: 10, 560	No significant changes within the site.	No significant changes to the site surroundings.
County Series 1914	1: 10, 560	No significant changes within the site.	No significant changes to the site surroundings.
County Series 1916	1:1,250	No significant changes within the site.	No significant changes to the site surroundings. To the west of the site is an **engine shed** and further to the south west is a **goods depot.**
National Grid 1952	1:2,500	No significant changes within the site.	The site surroundings remain largely unchanged comprising of railway land. However, the **goods depot** to the south west of the site is no longer present.
National Grid 1968-1971	1:1,250	The site has been completely cleared of any **railway lines** and is now open land.	Most of the area to the west and east of the site has been cleared and is now open land. A **freight terminal** is shown at ~150m south west of the site.
National Grid 1982-1986	1;1,250	No significant changes within the site.	No significant changes to the site surroundings.
National Grid 1992-1993	1:1,250	No significant changes within the site.	No significant changes to the site surroundings.
Master Map 2009	1: 2, 500	No significant changes within the site.	The majority of the site surroundings has been cleared of railway land and ancillary buildings.

2.5 Anticipated Ground Conditions

The anticipated ground conditions at the site has been reviewed by assessing the historic and available information in the vicinity of the site as detailed in Table 1.1. Additionally, the published geology on the British Geological Survey Map 1: 50 000 Map England and Wales Sheet 256 North London (BGS, 1994) was also reviewed.

Based on this information the anticipated ground conditions at the site are presented in Table 2.2.

Table 2.2: Anticipated Ground Conditions at the R5 site

Geological Strata	Hydrogeological Classification
Made Ground	Perched Water -Not Classified
London Clay	Unproductive Stratum
Lambeth Group	Unproductive Stratum
Thanet Sands	Secondary Aquifer
Upper Chalk	Principal Aquifer

2.6 Environmental Settings

A summary of the environmental setting of the site has been obtained from the GroundSure EnviroInsight and GeoInsight Reports dated August 2010 which were obtained for the T5 site located approximately 107m to the north west of the R5 site.

A summary of the site setting is presented in Table 2.3.

Table 2.3: Summary of Environmental Setting Data

Parameters	Description
Surface Water	There are no surface water features located on the site. The nearest surface water feature is the Regents Canal, which is part of the Grand Union Canal system. The Regents Canal is located approximately 400m south west of the site which flows to the east. There is a river quality record for the River GUC (Regent's Canal) 298m south west of the site at the reach of Camden Road-Hertford Union, The Chemical Grade is B and the Biological Grade is O.
Source Protection Zones	An Outer Catchment of a Source Protection Zone is located at over 500m to the north east of the site. The outer zone covers pollution that takes up to 400 days to travel to the borehole or 25% of the total catchment area, whichever is the biggest. This travel time is the minimum amount of time that the pollutant needs to be diluted, reduced in strength or delayed by the time they reach the borehole.
Groundwater and Surface Water Abstraction Licences	There are no groundwater abstraction licenses located on the site. There is one groundwater abstraction license recorded within 500m of the site. This is located at a distance of ~350m to the north west of the site (point at Kings Cross Concrete Plant) and groundwater abstraction is for general use. There are no portable groundwater abstraction points within 1000m of the site.

2.7 Preliminary Conceptual Site Model

Risk from contamination is assessed by consideration of possible linkages between contaminant sources and potential receptors which could be harmed or polluted. The key aspect of the UK contaminated land framework is the development of a Conceptual Site Model which illustrates the spatial interaction between the potential sources and receptors on site. Sources, receptors and pathways are defined as:

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

Further details of environmental receptors included in the current UK contaminated land framework for contamination assessment are provided in Appendix B.

A preliminary conceptual site model for the R5 site is presented on Drawing 7665/YE/001.

2.7.1 Potential Sources

Potential sources in the vicinity of the proposed development site include:

- Made Ground across the site; and
- The historic railway land and activities (including railway lines, goods sheeds and ancillary services).

2.7.2 Potential Receptors

The site specific receptors that could potentially be affected by ground contaminative hazards are summarised in Table 4.2.

A detailed description of the receptors and the definitions of the categories of significant harm to the receptors is presented in Appendix B.

Table 2.4: Potential Receptors Identified

Category	Receptor	Properties
Humans	Future site users	Potential exposure and contact with contamination to future site workers within landscaped areas. Toxic and explosive ground gases may build up in confined areas during site operations as a result of construction design.
	Construction workers	Potential exposure and contact with contamination to construction workers during construction activities such as reworking of made ground, excavations, etc. Toxic and explosive ground gases may build up in confined spaces during construction activities.
Property	Materials and site structures	Foundations and services beneath the ground may be damaged by potentially aggressive compounds present in soils and groundwater. Toxic and explosive ground gas may build up in confined areas and cause damage to property.
Controlled Waters	Surface Water	The Regent's Canal is approximately 400m to the south west of the site. Relative to the context of the R5 site, the Regents Canal is not considered to be a sensitive receptor. It is not discussed further in this report.

Category	Receptor	Properties
	Groundwater in the Thanet Sands and Upper Chalk	The groundwater in the Thanet Sands and Upper Chalk are classed as a Principal Aquifer. Within the KXC development site, the Thanet Sands and Upper Chalk are typically protected from any potential contaminants in the Made Ground by over 40m of London Clay and Lambeth Group Clay formations. In the context of the R5 site, these aquifers are not considered to be sensitive receptors. As such they are not discussed further in this report.

2.7.3 Potential Pathways

In order for contaminants to reach potential receptors, there has to be a viable route for the contaminant. Potential pathways that may affect the migration of contaminants within KXC R5 site are listed in Table 2.5.

Table 2.5: Potential pathways

Pathway	Medium	Properties
Direct contact	Dust, solid and liquid phase	There may be direct contact with potentially contaminated Made Ground across the site. There is a possibility of dust fumes being produced during earth works in the construction phase. Dermal contact/ingestion of potentially contaminated soils during construction or operational phase of site.
Migration of ground gas	Gaseous flow	Made Ground is known to be heterogeneous in composition. Migration through granular material in Made Ground and alongside buried utility pipes/cables or along preferential flow paths.

2.7.4 Potential Pollutant Linkages

Based on the potential sources, pathways and sensitive receptors identified above relative to the R5 site, a number of potential pollutant linkages (Table 2.6) associated with the Made Ground source could impact on human health during the site works and site redevelopment.

Table 2.6: Possible pollutant linkages at the R5 site

Hazard/ Pollutant	Pathways	Receptor	Potential Severity	Probability of Risk	Level of Risk
Made Ground (organic and inorganic contaminants	Soil ingestion, inhalation of soil/dust, inhalation of volatised compounds, dermal absorption	Site operatives and construction workers[a]	Medium	Low Likelihood	Low/Moderate
		Future Site Users	Medium	Low Likelihood	Low/Moderate
	Direct Contact	Property	Mild	Low Likelihood	Low
Ground Gases (CO_2 and CH_4) in Made Ground	Migration through preferential flow paths	Site operatives and construction workers[a]	Medium	Low Likelihood	Low/Moderate
		Future Site Users	Medium	Low Likelihood	Low/Moderate

[a] The risk to construction workers and site operatives assumes that the contractor will deal with all risk to construction workers, based on the hazards identified within this report and revised according to ground conditions encountered during any on-site activities. The Contractor will be responsible for site health and safety and will manage the risk through control of suitable Health and Safety measures including provision of PPE, education of the workforce and inductions for all site staff and visitors

The next sections of this report will summarise the site investigation works completed at the site in order to generate data to refine the pollutant linkages identified at the R5 site.

3 SITE INVESTIGATION

3.1 Introduction

A site investigation was completed at the R5 site between the 17th March 2010 and 26th May 2010 and was in accordance with BS 5930:1999, Code of Practice for Site Investigations.

The site investigation was design and specified by WSP (WSP, 2010). The site works were undertaken by Bam Richties as Contractor with WSP acting as the Project Manager (Engineer) on behalf of the Client, Carillion.

The site investigation was undertaken for both the R5 site and the R4 site which is situated south of the R5 site. This report only relates to the data obtained for the R5 site.

Extracts of the Bam Richies Factual Geotechnical Report on Ground Investigation relevant to the R5 site, including exploratory hole plan, exploratory hole logs, ground gas data, groundwater monitoring data, chemical test data undertaken by Chem Test, a UKAS and MCerts accredited laboratory are included in Appendix A.

3.2 Scope of works completed

As part of the site investigations, the following scope of works specific to the R5 site was completed:

- 3No boreholes (BH1003, BH1004 and BH1005) to a maximum depth of 44.50mbgl; and
- 6No window samples (WS1013 - 1018) to a maximum depth of 6.00mbgl.

One of the boreholes BH1003 was relocated 3No times due to ground obstructions in the form of a concrete slab.

A site plan showing the exploratory hole locations is shown in Drawing 7665/CG/002.

As part of the site works, ground gas and groundwater monitoring installations were put in place in the cable percussive boreholes as detailed in Table 3.1. The installations consisted of 50mm standpipes in the Made Ground to monitor shallow perched water and ground gas and 19mm piezometer in the London Clay and Lambeth Group to measure pore water pressures.

Table 3.1: Summary of groundwater and ground gas installations within the R5 site

Exploratory hole location	Drilling method	Exploratory hole depth (mbgl)	Installation Details (50mm diameter) (mblg)	Response Zone (mbgl)	Screen Stratum[1]
BH1003D[1]	Cable percussive	40	0 - 2.5	1.0 - 2.5	Made Ground
BH1003D	Cable percussive	40	0 - 35	33 - 35	London Clay
BH1004	Cable percussive	44.5	0 - 2.1	1.0 - 2.1	Made Ground
BH1004	Cable percussive	44.5	0 - 45	43 - 45	Lambeth Ground (sand lense)