Former BBC Site, Phase 1B, Building 9

Piling Risk Assessment

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Client Name: Select Property

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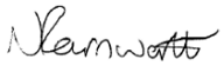
Niall Farnworth BSc (Hons) MCIWEM Geo-Environmental Engineer		30 May 2017

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For and on behalf of **Curtins**

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1.0 Introduction

The overall site of the Former BBC Site, Oxford Road, Manchester, M60 7HB is to be redeveloped for a mixed use of commercial uses and landscaped areas at ground level, with residential apartments above. Development will occur across several phases, with detailed planning applications submitted for each. A strategic phasing diagram has been included in Appendix A2.

This report details investigation works within and around proposed Building 9, which is now situated within Phase 1B development area. Development proposals for Building 9 comprise the construction of an 18-storey serviced apartment building with ancillary retail, residents hub and associated access and landscaping. Continuous Flight Auger (CFA) piled foundations are proposed for the development of Building 9.

Figure 1.1 illustrates the Phase 1B area and building 9 location within the phased area.

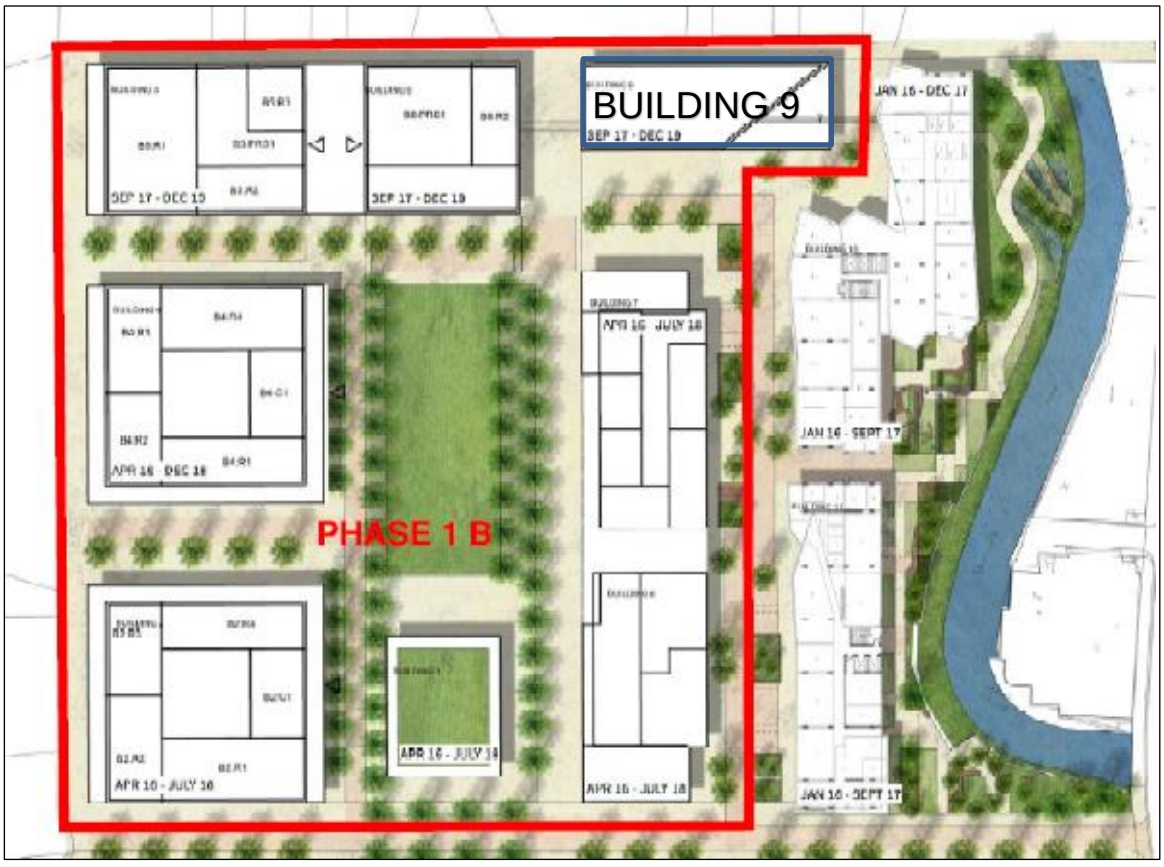

Figure 1.1 *Phase 1B Area (Plan It IE LLP, Ref PL1502-MP-SK002 issue 2 14/8/15). The redline has been added by Curtins shows the site boundary and the blueline added by Curtins shows the building boundary.*

Given the sensitivity of the groundwater underlying the site, this piling risk assessment has been produced in order to assess the risks associated with a piled foundation solution for Building 9.

As detailed below, the assessment of risk presented by a piled foundation solution has been identified as a specific condition to the overall development of the site (Planning Application no. 114863/FO/2016).

Condition 23: Piling or any other foundation designs using penetrative methods shall not be permitted other than with the express written consent of the Local Planning Authority, which may be given for those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to groundwater. The development shall be carried out in accordance with the approved details.

This report has been written to address the above planning condition.

1.1 Scope

This piling risk assessment provides an overview of the site's ground and groundwater conditions and considers the potential risks associated with the adoption of Continuous Flight Auger (CFA) piling to groundwater for Building 9. The report also identifies appropriate risk management and monitoring protocols that can be adopted to ensure any residual risk is brought within adequate and practicable limits.

1.2 References

In preparation of this report reference has been made to the following key guidance document:

- Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention National Groundwater & Contaminated Land Centre report NC/99/73 (EA Report 2001);

A separate Phase 2 report for Building 9 has not been produced, however the proposed development area (Building 9) has been characterised by various geo-environmental investigations across the wider development site (Phase 1B and Phase 1A). Reference is therefore made to the following geo-environmental reports and the pertinent information for Building 9 extracted and detailed where appropriate.

- Curtins Consulting – Phase 1 Detailed Desk Top Study report for the Former BBC Site, Oxford Road, Manchester; ref: EB1723/SH/4808 dated 02 September 2015;

- Curtins Consulting – Phase 2 Environmental Appraisal report for the Former BBC Site, Oxford Road, Manchester; ref: EB1723/LR/6004 Rev B dated 18 December 2015;

- Curtins Consulting - Phase 2 Intrusive Investigation report for the Former BBC Site, Oxford Road Manchester; ref: EB1723D/SH/6090 dated December 2015

- Curtins Consulting – Phase 2 Site Investigation for the Former BBC Site, Phase 1B Manchester; ref: B060663/RB/8256 dated March 2017.

Throughout this report, specific reference is given to exploratory borehole locations *RBH01, BH2A/1, BH2A/2, BH1A/2, BH1A/3, BH09, WS2A/1 and WS1A/6* (as shown on Curtins Exploratory Hole Plan drawing ref. B060633 L002, contained within Appendix A3) as these locations are situated on/within close proximity to the proposed Building 9 development plot

It is anticipated that readers of these reports and corresponding will have access to this reporting and hence copies are not included as part of this report.

2.0 The Site

2.1 Site Location

The proposed Building 9 plot is approximately centred on National Grid reference, 383290,397468 at the north west of the proposed Phase 1B development. It is currently bound by a car park to the east (proposed Phase 1A land), a car park to the west and south (proposed Phase 1B land) and Charles Street to the North. A site location plan can be referred to in Appendix A1.

The proposed development comprises the erection of the following:

- Building 9 – Erection of an 18-storey serviced apartment building of around 384 units with ancillary retail, residents hub and associated access and landscaping.

2.2 Site History

The earliest available historical mapping (1848) shows the Phase 1B site, and specifically Building 9, to be occupied by terraced properties. Numerous works and warehouses are later developed including a printing works.

Throughout the 1970s, the Phase 1B site is redeveloped, with Television Studios, later named New Broadcasting House, established in the north-western corner of the site. It is understood that the majority of buildings on site were demolished circa 2012, with the site remaining vacant and used as a public car park until late 2015. Following this, recent enabling works were undertaken across the site to prepare the site for development.

2.3 Hydrogeology

The 1:10,000 Bedrock Aquifer Designation Map indicates that the site, corresponding with the underlying solid geology, is underlain by a Principal Aquifer in the bedrock. The sites superficial deposits are classified as unproductive strata, however a Secondary A aquifer in the superficial deposits borders the site to the north.

Secondary A Aquifers are 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.

Principal Aquifers are 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.

There are 13 groundwater abstractions within 1,000m of the site. The nearest to the site boundary is 181m south-west of the site, at Lower Chatham Street, and used by Manchester Metropolitan University for general purposes. Water may be abstracted from a single point.

The site is not situated within a Source Protection Zone (SPZ), however there is a Total Catchment Zone 3 located 86m south-west of site.

2.4 Hydrology

The nearest surface water feature is the River Medlock, located 47m east of the site boundary, flowing in a westerly direction. It should be noted that the Medlock is culverted in places and characterised by high retaining walls, limiting pathway to the receptor.

There is a canal abstraction point, 279m north-west of the site from Rochdale Canal, Dickinson Street, for cooling purposes.

The site lies in a Flood Zone 2 - extreme flooding from river or sea without defences.
Adjacent to the northern site boundary, the area lies in a Flood Zone 3 - flooding from river or sea without defences.

2.5 Ground Model

2.5.1 Ground Conditions

The sequence of the strata encountered during investigation works in and around the proposed Building 9 footprint generally confirms the anticipated geology as interpreted from the geological map.

The sequence is summarised as Made Ground overlying superficial deposits (sands and gravels), overlying sandstone bedrock (Chester Pebble Beds Formation). This summary references borehole records RBH01, BH2A/1, BH2A/2, BH1A/2, BH1A/3, BH09, WS2A/1 and WS1A/6 as recorded on Curtins Exploratory Hole Plan drawing ref. B060633 L002 contained within Appendix A3

Made Ground was encountered at all locations to various depths between 1.50m bgl (WS2A/1) and 4.90m bgl (BH2A/2). Made Ground generally comprised of gravelly clay brick, limestone, concrete and occasional ash and clinker.

Superficial deposits comprising Glacial Till were encountered directly beneath Made Ground at all locations in the vicinity of proposed Building 9 and consisted of interbedded granular and cohesive soils. Glacial Till varied in thickness across the exploratory holes, the base of these deposits was identified at a minimum depth of 5.9m (BH1A/2) and a maximum depth of 12.50m (RBH01), overlying bedrock deposits.

The granular superficial soils were generally described as brown yellow, silty, clayey sand and gravel and were recorded as medium dense to dense. The cohesive soils were generally described as brown, slightly sandy, gravelly clay. Consistencies were generally recorded as firm to very stiff.

Sandstone bedrock was encountered within RBH01, BH2A/1, BH2A/2, BH1A/2 and BH1A/3 recorded as extremely weak reddish brown thinly bedded to thickly bedded medium grained sandstone.

The depths at which groundwater was encountered during the site investigation and return monitoring visits are recorded in Table 2.5.1.

Table 2.5.1: *Groundwater Levels*

Exploratory Hole Location Ref.	Monitored Water Levels			
	Strike Depth (mbgl)	Strata	Installation Strata	Monitored Levels (mbgl)
RBH01	10.70m after 20mins, rose to 7.70m	Sand and gravel	Sand and gravel	6.50
BH2A/1	-	-	Sand, clay and sandstone.	5.2
BH2A/2	-	-	-	-
BH1A/2	-	-	Clay and sandstone	3.8 - 4.3
BH1A/3	Strike at 7.00 after 20 mins rose to 6.10m.	Sandstone	-	-
BH09	-	-	Made Ground	-
WS2A/1	-	-	-	-
WS1A/6	-	-	Made Ground	-

Within the shallow window sample boreholes, groundwater was not encountered. Groundwater encountered in rotary boreholes RBH01 and BH1A/3 corresponds to the interface at the base of the superficial and the top of the bedrock deposits within the Principal aquifer.

2.5.2 Contamination Sources

The site has been previously occupied by a terraced properties and numerous works. The site was converted to Television Studios, later named New Broadcasting House, by 1975. It is understood that the majority of buildings on site were demolished circa 2012, with the site remaining vacant and used as a public car park until late 2015.

The main likely onsite contamination sources, considered at Phase 1 stage, are outlined below:

- Made Ground from unknown sources associated with development and demolition of site buildings;
- Uncontrolled deposition of Made Ground from historical site use; works (including printers) and film making;
- A 1000 gallon underground fuel storage tank;
- Localised spillages and leakages from vehicles in car park.

The 2017 Curtins Consulting Site Investigation of the Former BBC Site Phase 1B identified Made Ground across the site to a maximum depth of 4.00m in WS101. Visual or olfactory evidence of contamination was generally not noted within Made Ground deposits. Referencing *'commercial'* and '*open space'* soil guidance values only slight soil exceedances for benzo(a)pyrene in 3 samples (4.1mg/kg to 14mg/kg compared to an SSV of 3.7mg/kg) were identified. However, these concentrations do not exceed C4SL thresholds (21mg/kg for open spaces and 77mg/kg for commercial development).

The 2015 Curtins Consulting Site Investigation of the Former BBC Site Phase 1B & 2 identified elevated concentrations of Lead, Poly Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPHs), Sulphate, Sulphur and Sulphide against '*Residential without the Consumption of Produce*' thresholds within the Made Ground samples. This included exceedances for Poly Aromatic

Hydrocarbons (PAHs), Sulphate, Sulphur in BH2A/2, located in close proximity to proposed Building 9.

Similar general assessment criteria exceedances for metals, PAHs and TPHs were observed in the Made Ground soils during the NX Consulting 2014 site investigation, referenced within Curtins Consulting Phase 2 Environmental Appraisal report.

During the 2017 Curtins Consulting Site Investigation, four groundwater samples were collected from RBH01, RBH02, RBH03 and RBH04, with the results compared against the water framework directive (WFD) EQS due to the proximity of the River Medlock. Screening was also undertaken against UK Drinking Water Standards (DWS), due to site to the presence of the Principal Aquifer in the underlying bedrock and Groundwater Source Protection Zone 3, 86m to southwest, this is deemed conservative. The results recorded exceedances of metals and Poly Aromatic Hydrocarbons (PAHs) within all the boreholes.

Specific exceedances of (WFD) EQS standards in samples obtained from RBH01 (located in close proximity to proposed Building 9) were identified for copper (1.8 µg/l) and zinc (17 µg/l). Specific exceedances of UK DWS in samples obtained from RBH01 were identified for sulphate (280 µg/l).

The 2015 Curtins Consulting Site Investigation of the Former BBC Site Phase 1B & 2 identified elevated levels of metals, Poly Aromatic Hydrocarbons (PAHs) and Total Petroleum Hydrocarbons (TPHs) of EWS, DWS and World Health Organisation (WHO) thresholds from samples obtained from the Principal aquifer. During the collection of the Curtins groundwater samples, a hydrocarbon odour was observed in BH1B/3.

Specific exceedances of assessment criteria in samples obtained from BH2A/1 and BH1A/2 (located in close proximity to proposed Building 9) were identified for copper, various PAH species (anthracene, naphthalene, fluoranthene, benzo(a)pyrene), TPHs (C21-C35) Ali, total PAHs.

The previous NX Consulting report recorded some EQS, DWS and WHO exceedances in the groundwater samples collected during the 2014 site investigation. These samples were collected from the superficial deposits.

Appropriate risk assessments have been undertaken and the following conclusions are made:

- On-site contamination sources (soil and water) identified as part of the site investigation works are considered to present a low risk to the underlying Principal aquifer and surface waters.
- Relatively low levels of contamination have been observed in site soils with limited potential pathways to the deep Principal aquifer (Superficial soils generally including a significant thickness of cohesive soils).
- The site is not considered to be significantly contributing to the slightly reduced groundwater quality encountered in some boreholes.
- Risks to site end users, adjacent residents and construction workers (with appropriate PPE) from direct contact, ingestion and inhalation of Made Ground soils is also determined to be low.

The action of piling can however alter source pathways receptor linkages and therefore potential risks to receptors. Risks associated with piling are therefore assessed below in Section 3.0.

3.0 Piling Risk Assessment

At the current design stage, the adoption of CFA piles is considered to be the preferred pile solution for Building 9. This method has been selected with consideration of minimal ground vibration, as well as groundwater protection aspects.

CFA piles essentially involve driving a large auger into the ground, soils within the radius of the auger are brought to surface and replaced with concrete on withdrawal of the auger. The displacement of the surrounding ground is governed by the speed of rotation of the auger relative to the speed of vertical penetration. Theoretically, it is possible to adjust the speeds so that the volume of soils displaced laterally and removed as arisings is equal to the volume of concrete placed.

Within the EA Report (2001) the six Source-Pathway-Receptor scenarios are identified as:

1. *Creation of preferential pathways, through a low permeability layer (an aquitard), to allow potential contamination of an underlying aquifer;*

2. *Creation of preferential pathways, through a low permeability surface layer, to allow upward migration of landfill gas, soil gas or contaminant vapours to the surface;*

3. *Direct contact of site workers and others with contaminated soil arising which have been brought to the surface;*

4. *Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of pile materials (where the secondary effects are to increase the potential for contaminant migration);*

5. *The driving of solid contaminants down into an aquifer during pile driving; and*

6. *Contamination of groundwater and, subsequently, surface waters by concrete, cement paste or grout.*

This piling risk assessment tabulated overleaf address aspects 1, 5 and 6 above only, in keeping with the objectives of this report. The risk assessment methodology follows that presented in Appendix B.

TABULATED RISK ASSESSSMENT: CFA Piles

Aspect	Potential Consequence	Potential Probability	Potential Risk	Risk Management Options Available	Resultant Risk
1. Creation of preferential pathways, through a low permeability layer (an aquitard), to allow potential contamination of an underlying aquifer.	**Medium** Pollution of sensitive water resources in groundwater; although not abstracted in the immediate vicinity and primary pathways likely to be to the adjacent river.	**Unlikely** • Relatively limited ground and groundwater contamination identified; • CFA piling method essentially self-sealed with concrete and therefore no resultant pathway; • Preferential pathways for shallow contamination from the site likely to be to the adjacent river and not to deep groundwater.	**Low**	Not applicable	**Low**
5. The driving of solid contaminants down into an aquifer during pile driving.		**Low Likelihood** Above considerations, plus: • Arisings brought to surface in CFA method, but speed of auger rotation needs to be matched with downward force to avoid driving soils down.	**Moderate / Low**	Speed of auger rotation needs to be matched with downward force to avoid driving soils down.	**Low**
6. Contamination of groundwater and, subsequently, surface waters by concrete, cement paste or grout.		**Low Likelihood** Above considerations.	**Moderate / Low**	Cement content of the concrete will need to be closely monitored so that this in itself does not 'bleed' into groundwater.	**Low**

4.0 Summary and Recommendations

The risk assessment presented herein has concluded that there is a low risk to contamination of groundwater beneath the site from the use of CFA piling for Building 9, providing that the following risk management measures are put in place:

- Speed of auger rotation needs to be matched with downward force to avoid driving soils down; and
- Cement content of the concrete will need to be closely monitored so that this in itself does not 'bleed' into groundwater.

The following considerations should also be taken into account:

- The piling contractor should prepare and submit relevant method statements for approval prior to piling works commencing;
- Where arisings are generated, they should be classified, handled and disposed of in compliance with relevant best practice and regulatory requirements;
- The piling contractor should make allowance for the provision of appropriate PPE; and
- In the event of uncovering any areas of unexpected contamination during the piling works, including odorous or stained soils, the advice of the appointed environmental consultant should be sought immediately.

This document should be forwarded to the Planning Authority for discharge of the relevant planning condition before piling works commence.

Appendix A

A1 Site Location Plan, dated July 2015.

A2 Planit Intelligent Environments LLP, Former BBC Site - Diagrammatic Phasing, PL1502-ID-014-01, dated 27 August 2015.

A3 Curtins Exploratory Hole Location Plan B060633 L002 dated 29 March 2016.

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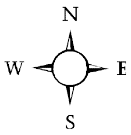
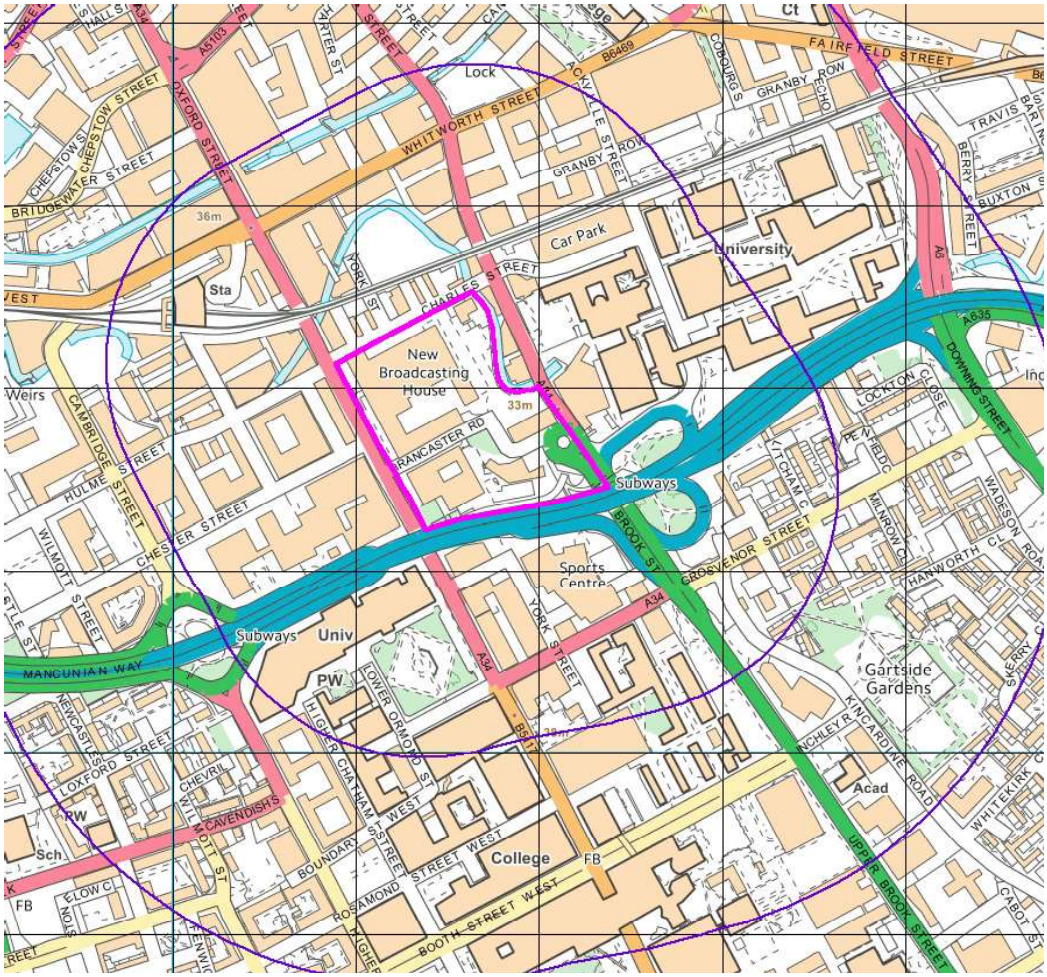
Site Location Plan





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Key

Approximate site boundary

Project	Job Reference	Author
Former BBC Site, Oxford Road, Manchester	EB1723	RB
Drawing Title	**Date**	**Checked**
Site Location Plan	08.07.2015	SH

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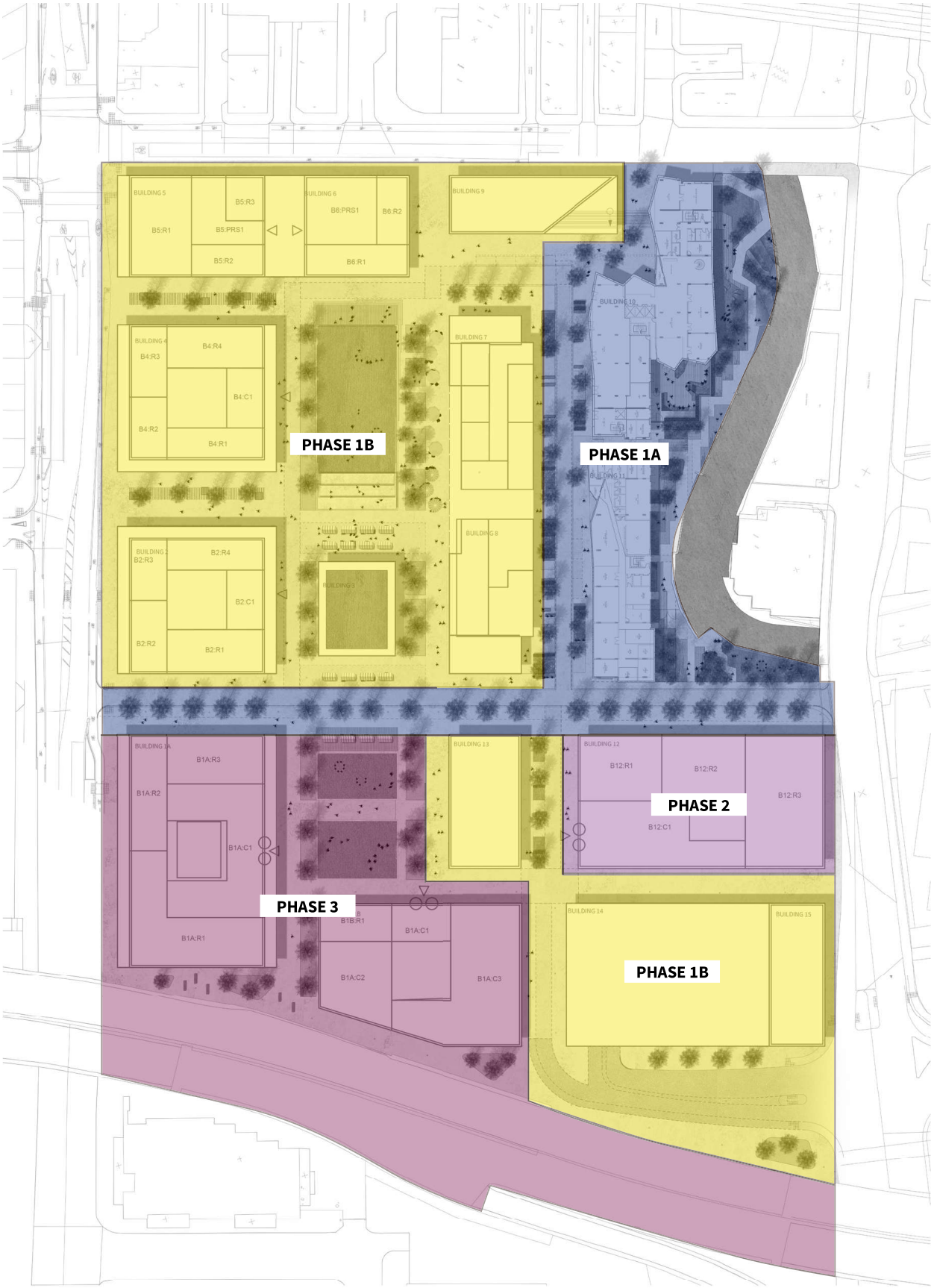
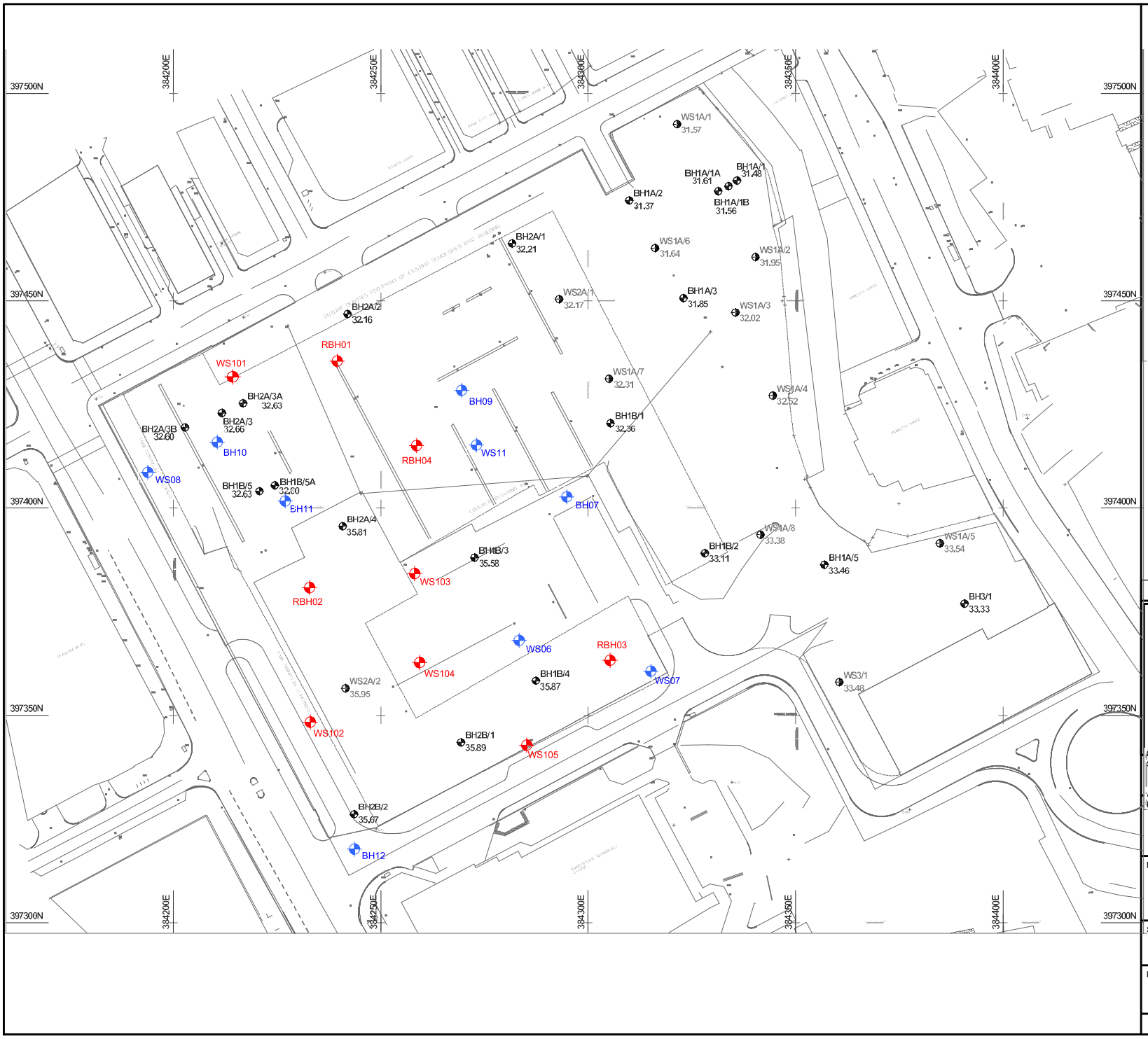
SIMPLIFIED STRATEGIC PHASING DIAGRAM



FORMER BBC SITE
OXFORD ROAD
MANCHESTER

DIAGRAMMATIC PHASING
PL1502-ID-014-01
27TH AUGUST 2015



CURTINS 2016 PROPOSED BOREHOLE LOCATIONS

NX 2014 BOREHOLE LOCATIONS

CURTINS 2015 CABLE PERCUSSIVE BOREHOLE LOCATIONS

CURTINS 2015 WINDOW SAMPLE BOREHOLE LOCATIONS

Rev:	Description:	Date:	By:	Chkd:

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Status: INFORMATION

Project: BBC SITE INVESTIGATION

Drg Title: PROPOSED EXPLORATORY HOLE LOCATION

Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	29.03.16	RB	SH

Drg No: B060663 / L002

Rev: -

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Appendix B – Risk Assessment Rationale

The qualitative risk assessment of environmental harm is designed to establish connecting links between a hazardous source to a potential receptor via an exposure pathway.

The qualitative risk assessment corresponds with the proposed piling operations on site.

Risk assessment is the process of collating known information on a hazard or set of hazards in order to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem or future construction materials. Receptors can be connected to the hazardous source by one or several exposure pathways such as direct contact for example. Risks are generally managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway and receptor there can be no risk. Therefore the presence of hazard on a site does not necessarily mean there is a risk.

By considering where a viable pathway exists which connects a source with a receptor the risk assessment in Section 3.0 and Table A4.1 identifies where pollutant linkage exists. If there is no pollutant linkage there is no risk and only where a pollutant linkage is established does the risk assessment consider the level of risk.

The risk assessment considers the likelihood of a particular event taking place (accounting for the presence of the hazard and receptor and the integrity of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment the consequence of the hazard has been classified as severe or medium or mild or minor and the probability (likelihood) of the circumstances actually occurring classified as high likelihood or likely or low likelihood or unlikely.

The consequences and probabilities are subsequently cross-correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability (Likelihood)	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Very Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Very Low Risk
	Low Likelihood	High/Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

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In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in a particular ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

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In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
Very High Risk	There is a *high probability* that *severe harm* could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	*Harm* is *likely to arise* to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	*It is possible* that without appropriate further action *harm could arise* to a designated receptor. It is relatively *unlikely* that any such harm would be *severe*, and if any harm were to occur it is *more likely* that such harm would be *relatively mild.*
Low Risk	*It is possible* that *harm could arise* to a designated receptor from an identified hazard. It is *likely* that, at worst, if any harm was realised any effects would be *mild.*
Negligible Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term ‘risk’ in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation or risk management operations.

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