

Intended for
Lincoln MGT

Document type
Report

Date
July 2019

Job No
1620004716

STATION HILL – SOUTH SITE, READING FOUNDATION WORKS RISK ASSESSMENT

STATION HILL – SOUTH SITE, READING FOUNDATION WORKS RISK ASSESSMENT

Project name **Station Hill**
Project no. **1620004716**
Recipient **Station Hill**
Document type **Report**
Version **01**
Date **05/07/2019**
Prepared by **Siobhán McGeever**
Checked by **Kalisha Sejpar / Lucy Wright**
Approved by **Matthew Pannett**
Description **Foundation Works Risk Assessment**
Ref **SHR-RAM-SB-XX-RP-G-000017**

This report is produced by Ramboll at the request of the client for the purposes detailed herein. This report and accompanying documents are intended solely for the use and benefit of the client for this purpose only and may not be used by or disclosed to, in whole or in part, any other person without the express written consent of Ramboll. Ramboll neither owes nor accepts any duty to any third party and shall not be liable for any loss, damage or expense of whatsoever nature which is caused by their reliance on the information contained in this report.

Ramboll UK Limited
Registered in England & Wales
Company No: 03659970
Registered office:
240 Blackfriars Road
London
SE1 8NW

CONTENTS

1.	Introduction	3
1.1	Brief	3
1.2	Planning Context	3
1.3	Previous Relevant Reports	3
1.4	Proposed Development	3
1.5	Limitations	4
2.	Site Description	6
2.1	Site Constraints	6
2.2	Topography	6
2.3	Existing Buildings	7
2.4	Existing Retaining Walls	7
2.5	Proposed Construction Activities	7
3.	Ground Model	9
3.1	Ground Conditions	9
3.2	Groundwater	10
3.3	Ground Contamination Identified	10
4.	Foundation Design	12
4.1	General	12
4.2	Proposed Foundation Design	12
4.3	Pile Design	13
5.	Risk Assessment	14
6.	Conclusions	19
6.1	Roles and Responsibilities	19

1. INTRODUCTION

1.1 Brief

Ramboll UK Limited (hereafter referred to as Ramboll) has been instructed by Cast Consult Ltd (the Project Manager) on behalf of Lincoln MGT (the Client) to prepare a Foundation Works Risk Assessment (FWRA) to support the development of Station Hill, South Site, Reading, RG1 1NR.

This document outlines the risks posed by the piling methods that are considered appropriate for the site. The information outlined in this document is to be considered in the context of the structural, civil, and geotechnical schemes and designs.

This document also discusses the potential risks to the water environment that may arise from proposed piling activities at the site and should be considered by the piling contractor in determining the final proposed piling scheme method and designs. The contractor will be responsible for the final specification of the piling methods and protocols.

1.2 Planning Context

Reading Borough Council has granted Outline Planning Permission for the proposed development subject to the conditions outlined in Planning Application Number 130436.

This foundation works risk assessment (FWRA) report has been prepared in response to Planning Condition 29, which states:

"29. No development (except demolition) shall commence on any relevant Plot until a method statement for the foundation design for all buildings within the Plot has been submitted to and approved in writing by the Local Planning Authority. Such a statement shall seek to avoid piling or any other foundation designs using penetrative methods, as far as is possible/practicable. The foundation works shall therefore only be carried out in accordance with the agreed method statement, save to the extent that the Local Planning Authority approved any variation(s) to the approved statement.

Reason: the site is potentially contaminated and is located over the chalk major aquifer. Piling at the site has the potential to mobilise contaminants into the chalk aquifer which would result in pollution of controlled waters and therefore agreement will only be given for piling in those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to groundwater quality."

1.3 Previous Relevant Reports

Ramboll completed a Ground Investigation Report for the Station Hill, Reading, South Site development in March 2019 (ref: SHR-RAM-SB-XX-RP-G-000016). This report provides full details of the site description, previous reports, nature of historic land uses, geotechnical parameters and contamination identified at the site, as well as land contamination risk assessments.

1.4 Proposed Development

The proposed development consists of the demolition of the current buildings on the Station Hill South Site, and the construction of two apartment buildings; a 6-12-storey building and a 11-12-

storey building with a split single/double-storey basement and a podium to bridge the two buildings.

The proposed buildings (Plot E and Plot F) house primarily residential accommodation, with a combination of residential, retail, amenity spaces and bicycle parking at podium level. Below podium level there is a split-level car park of 1-2 storeys, which also houses plant rooms, cycle parking, water tanks and storage.

Both the substructure and superstructure of the buildings are proposed to be formed of reinforced concrete, with varying slab thicknesses throughout the different areas of the buildings. The stability of the buildings against horizontal forces is achieved through a number of in-situ reinforced concrete core structures with 250mm thick core walls, coupled with a number of shear walls.

The roof is split across the several levels and houses plant, amenity space and green roof areas. A proposed aerial view of the south site is shown below in Figure 1.



Figure 1: Proposed Aerial View of the South Site taken from above Friar Street (Source: cRTKL Architects)

1.5 Limitations

This document has been prepared for use by Lincoln MGT. 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 proposed 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 environmental risks identified.

This report has been prepared by Ramboll exclusively for the intended use by the client in accordance with the agreement between Ramboll and the client defining, among others, the purpose, the scope and the terms and conditions for the services. No other warranty, expressed or implied, is made as to the professional advice included in this report or in respect of any

matters outside the agreed scope of the services or the purpose for which the report and the associated agreed scope were intended, or any other services provided by Ramboll.

In preparation of the report and performance of any other services, Ramboll has relied 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 was accurate, complete and available to Ramboll within the reporting schedule.

Ramboll's services are not intended as legal advice, nor an exhaustive review of site conditions and/or compliance. This report and accompanying documents are initial and intended solely for the use and benefit of the client for this purpose only and may not be used by or disclosed to, in whole or in part, any other person without the express written consent of Ramboll. Ramboll neither owes nor accepts any duty to any third party, unless formally agreed by Ramboll through that party entering into, at Ramboll's sole discretion, a written reliance agreement.

2. SITE DESCRIPTION

Full details of the site setting are provided within the Ramboll Ground Investigation Report, dated April 2019, for the South Site and are summarised in Table 2.1 below. Reference should be made to the this report for additional information.

In summary, the site is located in central Reading, adjacent to Reading train station. The site is bound by Garrard Street to the north, Merchants Place to the east, Friars Street to the south, and Greyfriars Road to the west.

Table 2.1 Site Setting

Element	Discussion
Topography	The topography of the site slopes down to the north and varies between approximately 39 m above ordnance datum (AOD) at Garrard Street in the north and 45.7 m AOD at Friars Street in the south. Further detail on the topography of the south site is provided in Section 2.2 below.
Geology	The site is underlain by concrete, overlying up to 1.85 m of Made Ground across the site. This is underlain by superficial deposits of occasional Alluvium and gravels, overlying the solid geology of the Upper Chalk Formation.
Hydrology	The nearest surface water feature is a drainage network 320 m northwest of the site, associated with the railway line. The easterly flowing River Thames, at its closest point, lies 420 m northeast of the site. The River Kennet is located approximately 500 m southeast of the Site and also flows in an easterly direction. Overall the site is considered to be of low environmental vulnerability in terms of surface water receptors.
Hydrogeology	The Made Ground is classed as unproductive strata. The Alluvium and Taplow Gravel Formation are Secondary A Aquifers. The Chalk is a Principal Aquifer.

2.1 Site Constraints

The key site constraints for the South Site are:

- foundation obstructions due to the existing buildings;
- boundary/party wall issues on both the West and East; and
- busy, public roads on Friar Street and Garrard Street in the North and South.

2.2 Topography

The ground level varies by over 6 m across the site, from +39.0m AOD along Garrard Street, to +45.7m along Friar Street. This has resulted in a podium structure across the site at +45.7m which effectively forms the ground floor level of the buildings. Beneath the podium there is a

split-level car park of 1-2 levels, the lowest level of which is at Garrard Street level, which is the location of the entrance to the car park.

Due to the significant ground level variation, attention has been given to understand the impact of the proposed lower ground slab levels on the proposed structure. Where the proposed ground level is lower than the existing, upstands will be required, and temporary retaining measures made.

2.3 Existing Buildings

The south site is currently occupied by 2 No. existing buildings, Telecoms House, to the western edge of the site, and most of the remainder of the site is occupied by Friars Walk Shopping Centre. Demolition of these buildings commenced in March 2019 and is currently being undertaken by McGee.

The buildings have varying lower structural slab levels and foundations. The proposed buildings lie both beneath and above the level of the existing foundations, which vary across the site. From the opening up works conducted, evidence has concluded that most of the site was previously founded on pads; no piles have been found to date.

Work has been done to understand the constraints on construction due to the existing building foundations both within and along the site boundaries, with the aim of: minimising excavation; retain, where possible, existing structure; and avoid undermining of neighbouring building foundations. Due to the extensive nature of existing foundations on the site, it is anticipated that a significant number of these will need to be removed to enable the proposed building foundations to be installed as designed.

2.4 Existing Retaining Walls

There are existing retaining walls around the site, that form the perimeter of the existing buildings below ground level. These are generally proposed to be retained, with them being propped and used as temporary works during construction. Due to the differing levels of the new and proposed structural slab levels and the very limited knowledge regarding the structural details of the walls, these walls are not to be used in the permanent construction, but new reinforced concrete (RC) retaining walls will be cast against these, using them as a back shutter, to provide soil retention. Where the proposed basement is deeper than the existing, sheet pile walls will be required inside the existing walls, to enable the additional excavation to formation level. The extent of the basement is constrained by the space provided by these existing walls.

The new retaining walls support a maximum retained soil height of 6.7 m and are currently sized as 250 mm to 300 mm thick.

2.5 Proposed Construction Activities

The construction activities to be undertaken as part of the proposed development are as follows:

- demolition of current buildings;
- reduction of Made Ground and levels for basement construction;
- new RC retaining walls cast against existing retaining walls bordering the site;
- sheet pile walls for the proposed basement and basement excavation;
- placement of piling mat;

- installation of building piles;
- excavation of soils/pile mat and cutting backing back of piles and basement down to slab formation level;
- construction of pile caps and pile beams;
- construction of suspended reinforced concrete slab; and,
- construction of proposed superstructure and infrastructure connections.

3. GROUND MODEL

3.1 Ground Conditions

A summary of the geology encountered during the ground investigation undertaken between 12th November and 3rd December 2018 by Geotechnical Engineering Limited (GEL) on behalf of Ramboll, is provided in Table 3.1 below.

Further detail on the ground conditions can be found in the following reports:

- Ramboll (April 2019), *Ground Investigation Report, Station Hill Reading*, Ref: 1620004761-SHR-RAM-SB-XX-RP-G-000016); and,
- Geotechnical Engineering Limited, (February 2019), *Factual Report on Ground Investigation, Station Hill Reading*, Ref: 34769.

Table 3.1 Sequence of Strata Encountered on Site

Stratum	Level at Top of Stratum (m AOD)	Thickness Range (m)	Typical Description
Made Ground	+39.2 - +45.7	0.40 – 1.9	The Made Ground is variable but is generally described as dark bluish grey angular medium and coarse sandy crystalline gravel and light brown slightly silty sandy subangular to rounded fine and medium brick, concrete, flint, and chalk gravel. There are also clay units which have brick, chalk and flint gravels.
Alluvium	+37.2 - +38.8	0.3 – 0.8	The Alluvium and Taplow Gravels are discontinuous across the site with the Alluvium only being encountered in 4no. exploratory holes with an average thickness of 0.5m.
Taplow Gravels	+37.6 - +45.2	0.3 – 2.5	The Taplow Gravels are encountered in 6no. window samples, each borehole also has a layer of silty gravelly chalk which due to the destructive nature of using shell and auger drilling techniques at this depth, could have included a layer of gravel which has been subsumed by the chalk.
Upper Chalk (Structureless)	+35.4 - +44.9	4.4 – 6.8	The structureless chalk has a CIRIA grade of Dm or Dc. With a typical description consisting of; structureless chalk composed of white slightly gravelly Silt. Gravel is subangular and subrounded fine to coarse very weak medium density white with frequent black specks chalk, rarely angular fine to coarse flint.
Upper Chalk (Structured)	+30.9 - +31.2	>16.6 (Unproven)	The structured chalk was only encountered in the boreholes. With a top of stratum level ranging between 30.9m AOD and 31.2m AOD. The thickness was unproven. The CIRIA grade of the chalk included B5, B4, B3, A5, A4, A3. Two fracture sets are present with one predominantly sub horizontal to 30°, and the second set between predominantly 45° and 70°. Thin layers (5mm) of cobbled sized black nodular flint were encountered. The typical description consists of very weak medium density white CHALK with frequent black specks and yellowish orange staining.

3.2 Groundwater

The Environment Agency (EA) classifies the Made Ground as an Unproductive Strata, the Alluvium and Taplow Gravel as a Secondary A aquifer, and the Upper Chalk Formation as a Principal Aquifer.

During the drilling investigation works groundwater strikes were identified in the Chalk at depths of between 33.95 m AOD and 35.95m AOD rising to between 34.57m AOD and 36.4m AOD after 20 minutes. No shallower groundwater strikes in the Taplow Gravels or Alluvium was reported and, in some cases, even in the deep chalk, groundwater strikes were not observed. Drilling techniques did however utilise water flush methods so in some cases a water strike would not be apparent.

Groundwater monitoring of all installed boreholes was undertaken as part of the ground investigation in January 2019. All of the window sample installations were dry at the time of monitoring and as such have not been referenced further. The groundwater elevations were all in the region of 36m AOD. The highest water level measured was +36.7 m AOD and the lowest water level measured was +36.05 m AOD. The groundwater strike elevations and resting groundwater levels suggest that in some cases groundwater may be semi-confined however the strikes and resting groundwater levels are not substantially different suggesting for the most part, groundwater continuity throughout the ground profile.

Combining the water strike and installations data an average water level of +36.15 m AOD has been observed. A design water level of +36.5 m AOD has been recommended in the Ground Investigation Report.

3.3 Ground Contamination Identified

Following the ground investigation, a number of potentially significant pollutant linkages were identified. The linkages relevant to piling and are summarised below in Table 3.2.

Table 3.2 Hazards and Pollutants Identified as Requiring Remedial Action as Relevant to Piling

	Hazard / Pollutant	Additional Actions Required
1	Asbestos Seventeen samples taken from the Made Ground were submitted for asbestos screening. One sample (BH303 at 0.2m) detected chrysotile loose fibres in the sample. There were no observations of possible asbestos containing material (ACM) observed in soil during the site investigation. An asbestos quantification test was then scheduled on the sample BH303 at 0.2m and the result was <0.001%. Significant asbestos was therefore not detected during the ground investigation.	The risk assessment in Section 5 assesses the potential impact to human health from arisings. This will either be removed as part of basement excavations prior to piling or cased off during piling. Waste assessment of pile arisings (if relevant) for appropriate disposal.
2	PAH - BaP (and contaminants that use the BaP GAC as a surrogate) were detected in one location at 0.2m bgl at a maximum concentration of 32 mg/kg. This exceeds the residential without plant uptake C4SL of 5.3mg/kg, however does not exceed the C4SL for commercial use, which is 76mg/kg.	The risk assessment in Section 5 assesses the potential impact to human health from arisings. The material containing exceedances was predominantly in shallow Made Ground and the majority of this material may be removed as part of the basement excavations prior to piling or cased off during piling.

		Waste assessment of pile arisings (if relevant) for appropriate disposal.
3	TPHs - Heavy end Aromatic TPH C16-21 and C21-C35 exceed the GAC for residential without plant uptake in WS301 at 0.2 m bgl and BH301 at 0.2m bgl. The maximum concentration of 2,600mg/kg was detected in WS301 at 0.2m bgl. This exceeds the GAC for residential use without plant uptake used, 1,900mg/kg. No TPH results exceed the GAC for commercial use at 29,000mg/kg.	The risk assessment in Section 5 assesses the determine potential impact to human health from arisings. The material containing exceedances was predominantly in shallow Made Ground and the majority of this material may be removed as part of the basement excavations prior to piling or cased off during piling. Waste assessment of pile arisings (if relevant) for appropriate disposal.
4	Groundwater Chemical analysis of three groundwater samples collected during the ground investigation revealed all contaminant concentrations to fall below the relevant GAC for assessment of controlled waters	Appropriate selection of piling methodologies to prevent migration of hydrocarbons into the deeper aquifer.

4. FOUNDATION DESIGN

4.1 General

Although the EA recommends that piling on contaminated sites underlain by aquifers should be avoided where possible, it was considered by the design team that other foundation solutions were impractical for this particular development and would result in the need to excavate large quantities of material which could potentially mobilise contaminants and represent a greater potential for risk to sensitive receptors.

4.2 Proposed Foundation Design

The entire site is to be founded on piles, due to the variable extent and thickness of the superficial deposits that are considered unsuitable for shallow foundations. Piles are spaced at a minimum of three times the pile diameter to fully attain the base resistance of the structured upper chalk. The current proposal is to use Continuous Flight Auger (CFA) piles as these are financially more effective than bored piles, produce the least amount of vibration and noise and limit the potential spread of contamination from the shallow strata to the chalk aquifer (as per the discussion in Table 4.1). The CFA method will use casing at shallow depth where soils are less cohesive and there is potential for collapse such as in any residual made ground and the shallow drift deposits of the alluvium and Taplow Gravels.

In addition to the building piles, new RC retaining walls will be cast against existing retaining walls bordering the site and sheet pile walls for the proposed basement.

Further details of the proposed foundation solution are presented in Table 4.1.

Table 4.1 Foundation / Piling Technique

Piling Technique	Description	Potential Hazards
CFA	This non-displacement piling method involves the drilling of an auger with a hollow stem (temporarily plugged) into the ground. Once the design depth is reached, concrete is pumped through the hollow stem of the auger while the auger is extracted at a controlled rate, keeping the end of the auger embedded into the concrete, maintaining a positive pressure throughout the process. Once the full length of the pile is concreted a reinforcement steel cage is pushed into the fluid concrete to provide additional strength.	The introduction of non-displacement piles has the potential to bring contaminated soil arisings to the surface. Soil arisings will require disposal off-site or re-use as agreed in a Materials Management Plan. The soil contamination identified is limited to the shallow material and the material beneath is likely to be classified as non-hazardous or inert. Limited material may be classified as hazardous or potentially hazardous and therefore a protocol will need to be set in place for them to be managed as part of a Materials Management Plan. Segregation of this material from the vicinity of each pile location during piling will minimise the potential for cross contamination of arisings and the creation of additional waste that will need controlled disposal.

	The progression of CFA piles relies on the retention of soil on the auger flights to support the surrounding soil and prevent collapse or migration outwards of soil. The potential for creation of a temporary pathway around the pile is limited with this method, and should one occur it would likely be short lived (in the region of minutes). The retention of soil in the auger as the pile commences will reduce the void space for migration of shallow contamination and subsequent concreting of the pile would close the pathway.
--	---

4.3 Pile Design

The pile capacity assessment has been conducted according to UK NA, EC 7 based on current loading assumptions and the current ground model. As the ground stratigraphy has not been proven beneath Plot F, the conceptual ground model used for the foundation of Plot F is still based on the preliminary information. The pile design will be refined after the Ground Conditions Report for the north has been completed to fully assess the depth of the Structured Chalk.

Parameters for the Made Ground and Alluvium layers were not considered as the pile design has been based only on the strength of the Upper Chalk (Structureless), and Upper Chalk (Structured) layers as any contribution from the overlaying material is negligible.

Most columns require two-pile caps and need to be tied together with ground beams. A few three-pile and four-pile caps are required under heavily loaded columns. These typical pile caps are 1m deep under the columns.

Pile caps underneath shear walls and lift and stair cores need to be deeper than typical pile caps and range between 1.6 m to 2 m depths.

In the current design, all piles under Block F are to be 750 mm diameter, under Block E due to the improvement in ground conditions from the SI the piles are generally 600 mm diameter with monopiles, 750 mm diameter under podium areas.

5. RISK ASSESSMENT

The assessment of piling risks utilises the EA documents:

- Piling into Contaminated Sites¹;
- Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention NC/99/73²; and,
- Piling in Layered Ground: Risks to Groundwater and Archaeology³.

In particular this risk assessment makes reference to six pollution scenarios detailed within NC/99/73 which are summarised in Table 5.1.

Table 5.1 Generic Pollution Scenarios

Scenario	Detail
1	Creation of preferential pathways through a low permeability layer (an aquitard) to allow potential contamination of an aquifer and/or surface water feature
2	Creation of preferential pathways, through a low permeability surface layer, to allow migration of landfill gas, soil gas or vapours to surface
3	Direct contact between site workers and others, with contaminated soil arisings that have been brought to the surface
4	Direct contact between the piles or engineered structures, with contaminated soil or leachate causing degradation of pile materials
5	The driving of solid contaminants down into an aquifer during pile driving
6	Contamination of groundwater, and subsequently, surface waters by wet concrete, cement paste or grout

Consideration is given to whether the Scenarios 1-6 are significant in the context of the proposed piling regime at the site in Table 5.2. Each of the risks of concern for the site-specific piling methods are then assessed in terms of the likelihood of the risk being realised, and the severity of the consequence if the risk was realised, using the following criteria:

Table 5.2 Severity and Likelihood Criteria for Piling Risk Assessment

Severity	Criteria
High	Significant pollutant linkage which would cause deterioration of water quality or significant risks to human health in the long term.
Medium	Pollutant linkage which could result in deterioration of water quality or risks to human health in the long term, or cause a short-term pollutant linkage restricted to the duration of piling.
Low	Any pollutant linkage caused would not significantly affect water quality or risks to health.

¹ Environment Agency (2002) Piling into Contaminated Sites

² Environment Agency (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination Guidance on Pollution Prevention NC/99/73

³ Environment Agency (2014) Piling in Layered Ground: Risks to Groundwater and Archaeology SC020074

Severity	Criteria
Likelihood	Criteria
High	Would cause a pathway to be created.
Medium	May cause a pathway to be created, but if it was realised, would not be likely to represent a significant risk.
Low	Would be unlikely to cause a pollutant linkage, but if it was realised, would not be likely to represent a significant risk.

The severity and likelihood classifications are then used to provide an overall risk, as detailed in Table 5.3 below.

Table 5.3 Piling Risk Assessment Method

		Severity		
		High	Medium	Low
Likelihood	High	Very High	High	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Very Low

An assessment of the risks associated with foundation works at the site is provided in Table 5.4 below. The assessment is based on site-specific conditions and contamination as detailed in Table 3.1 and Table 3.2.

Table 5.4 Foundation Works Risk Assessment

Site-Specific Pollution Scenario	Activity	Source (S) Pathway (P) Receptor (R)	Severity	Likelihood	Risk Assessment*	Comments/Mitigation Measures
1: Creation of preferential pathways through an aquitard to allow potential contamination of an aquifer.	CFA piles / retaining walls / sheet pile walls	S Contaminated soils / shallow groundwater P Pathway created by piles R Underlying aquifer	Medium	Low	Low	The principal source of contamination, the Made Ground, will either be removed as part of basement excavations prior to piling commencing or cased off and isolated during the piling process. The use of CFA piles minimises the risk of vertical pathway creation and is a method generally accepted by the EA for contaminated sites where important aquifers lie beneath.
2: Creation of preferential pathways through a low permeability surface layer, allowing migration of landfill gas, soil gas or contaminant vapours to the surface.	CFA piles / retaining walls / sheet pile walls	S Underlying geology P Pathway created by piles R Human health and buildings	Medium	Low	Low	The site has been classified as having a Gas Characteristic Situation of 1 (very low risk) and no ground gas protection measures are required for the proposed development. Negligible thickness of made ground is present (maximum 2m depth); was not observed to contain putrescible or notable organic material; and will be excavated for basement construction. The alluvial materials were observed with little or no visible organic content and the natural bedrock geology (Chalk) does not have a high gas generation potential. During construction, the enabling, piling and main works contractors are required to have appropriate safe working practices and health and safety measures in place during works e.g. personal protective equipment (PPE), (respiratory protective equipment) RPE and confined spaces entry systems etc.

3: Direct contact of site workers and others with contaminated soil arising that have been brought to the surface.	CFA piles / retaining walls / sheet pile walls	S Contaminated soils / shallow groundwater P Soils brought to the surface	Low	High	Medium	Site workers will require standard construction PPE; this will reduce risk to low. Site activities are to be managed and controlled. Material is likely to be a combination of inert, non-hazardous and hazardous and require management, segregation and disposal accordingly. If required, increased health, safety and environmental procedures will be required to be used by the Contractor should asbestos containing materials be encountered. Much of the made ground will have been excavated (and disposed of off-site) for the purpose of the basement excavation and deeper materials can be expected to be of low potential for contamination, such that exposure risks are considered to be low.
4: Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of materials.	CFA piles / retaining walls / sheet pile walls	S Natural soil conditions such as elevated sulphates P Contact R Construction Materials	Low	Medium	Low	An assessment of the ground and groundwater aggressivity suggests a Design Sulphate Class of DS-1 for all the strata present. The Aggressive Chemical Environment for Concrete (ACEC) Classification is AC-1 for all the strata present. The appropriate design of concrete specification will mitigate the risk.
5: The driving of solid contaminants down into an aquifer during pile driving	CFA piles / retaining walls / sheet pile walls	S Contaminated soils / shallow groundwater P Pathway created by piles	Medium to High	Low	Low to Medium	The anticipated volume of material dragged down would be small owing to the nature of the method used. Use of a convex/conical drilling shoe could limit driving material down. Furthermore, the shallow made ground (in which higher contaminant concentrations would be expected) is to be largely excavated for the basement construction, prior to piling. Groundwater is considered to be, for the most part, in continuity throughout the ground profile into the chalk. Some localised areas of semi-confined aquifer may be present, but the groundwater monitoring results have not identified contaminant concentrations in excess of GACs for

						controlled waters. As such the risk from mixing between shallower and deeper groundwater is considered to be low.	
6: Contamination of groundwater and, subsequently, surface waters by wet concrete, cement paste, grout or polymer	CFA piles / retaining walls / sheet pile walls	S	Construction Materials			Low	Whilst the risk of contamination cannot be discounted the impact is assessed as low as both concrete and grout have low mobility potential.
		P	Pathway created by piles	Medium	Low		
		R	Underlying aquifer				

6. CONCLUSIONS

This document discusses the potential risks to the water environment that may arise from the proposed piling activities at the site.

Prior to piling commencing, a reduction of levels and the excavation of Made Ground for the construction of the basement will remove the majority of the principal source of contamination. New RC retaining walls cast against existing retaining walls bordering the site and sheet pile walls for the proposed basement will then take place, followed by the installation of CFA piles. Any remaining made ground material would then be cased off and isolated during the piling process. With the method proposed and the ground conditions encountered through site investigation to date, the potential for the creation of pollutant linkages is considered to be limited and CFA piles are considered suitably appropriate and protective of the controlled waters environment at the site.

The adoption of CFA piling techniques will result in arisings being brought to the surface. The majority of these arisings are likely to be a combination of inert and non-hazardous in terms of waste classification. The site investigation was limited due to the buildings still requiring demolition and therefore previously unidentified contamination cannot be discounted and if contaminated material is encountered then this may be classified as hazardous. Arisings should therefore be managed and disposed of in accordance with a Materials Management Plan.

6.1 Roles and Responsibilities

This document discusses the potential risks to the water environment that may arise from proposed piling activities at the site. These will be considered by the Piling Contractor in determining the final proposed piling scheme method and designs.

During the course of works the piling Contractor shall ensure that appropriate Quality Assurance/Quality Control (QA/QC) methods are incorporated to demonstrate that high levels of workmanship have been used.

On completion of the piling works, the Piling Contractor shall validate that the works were carried out in accordance with the agreed piling method.