Bellway Homes Limited (North London)

Tavistock Works, Tavistock Road, West Drayton, UB7 7RQ

Foundation Works Risk Assessment

1922035 R05 (00)

RSK GEOSCIENCES

AUGUST 2024

RSK GENERAL NOTES

Project No.: 1922035 R05 (00)

Title: Foundation Works Risk Assessment: Tavistock Works, Tavistock Road, West Drayton, UB7 7RQ

Client: Bellway Homes Limited (North London)

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1 INTRODUCTION

1.1 Commissioning

RSK Environment Limited (RSK) were engaged by Bellway Homes Limited (North London) ('the client') to carry out a Foundation Works Risk Assessment (FWRA) for the land at Tavistock Works, Tavistock Road, West Drayton, UB7 7RQ (hereafter referred to as 'the site').

The works were undertaken by means of an appointment for works and services between Bellway Homes Limited (North London) and RSK Environment Limited, dated August 2024, which forms the appointment between ourselves and the Client.

References in this report to 'we', 'us', or 'our' shall mean RSK Geosciences as a trading name of RSK Environment Limited (company no.SC115530) at registered address 65 Sussex Street, Glasgow, G41 1DX.

The site location is provided in **Figure 1** (drawing ref 11101) and the site layout boundary to which this report refers is presented in **Figure 2** (drawing ref 11201).

The report should be read and used in accordance with the limitations and constraints identified in the report text, and at **Appendix A**.

1.2 Objective

This document is intended to assess the risk posed to proposed development (future site users) and groundwater resources by the adoption of a piled foundation solution.

1.3 Standards

The assessment was designed generally to meet the requirements of the Environment Agency. Reference has been made to the Environment Agency's guidance 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention (2001) (withdrawn) and Piling in Layered Ground: risks to groundwater and archaeology – Science Report SC020074/SR.

This Piling Risk Assessment has also been prepared in accordance with current legislation. The Water Resources Act 1991 and the Groundwater Regulations 1998 (amended January 2009) refer to the protection of Controlled Waters.

1.4 Existing reports

Several phases of site investigation have been conducted by RSK and others. The reports detailing previous assessment of the site are detailed below in **Table 1**.

Table 1 Previously Completed Assessments

Report Title	Author	Date of Issue	Report Reference
Preliminary Risk Assessment: Land Quality, Padcroft Phase II	WSP	January 2018	70034440
Combined Phase I & II Site Appraisal, Former Comag Site, Tavistock Road, West Drayton	Patrick Parsons	June 2018	L17035
Geo-environmental Site Investigation: Tavistock Works, Tavistock Road, West Drayton	RSK	March 2022	1922035 R01 (00)
Remediation Method Statement: Tavistock Works, Tavistock Road, West Drayton	RSK	December 2022	1922035 R02 (00)
Plate Load Testing: Tavistock Works, Tavistock Road, West Drayton	RSK	December 2022	1922035 R03 (00)
Supplementary Geotechnical Site Investigation: Tavistock Works, Tavistock Road, West Drayton	RSK	June 2023	1922035 L02 (00)

Pertinent information from these reports has been summarised in **Section 2**.

1.5 Limitations

This report is subject to the RSK service constraints given in **Appendix A** and limitations that may be described through this document.

This report was prepared in accordance with good practice guidance at the time of issue. Consideration should be considered in the light of changes in legislation, statutory requirements, or industry practices subsequent to the date of issue.

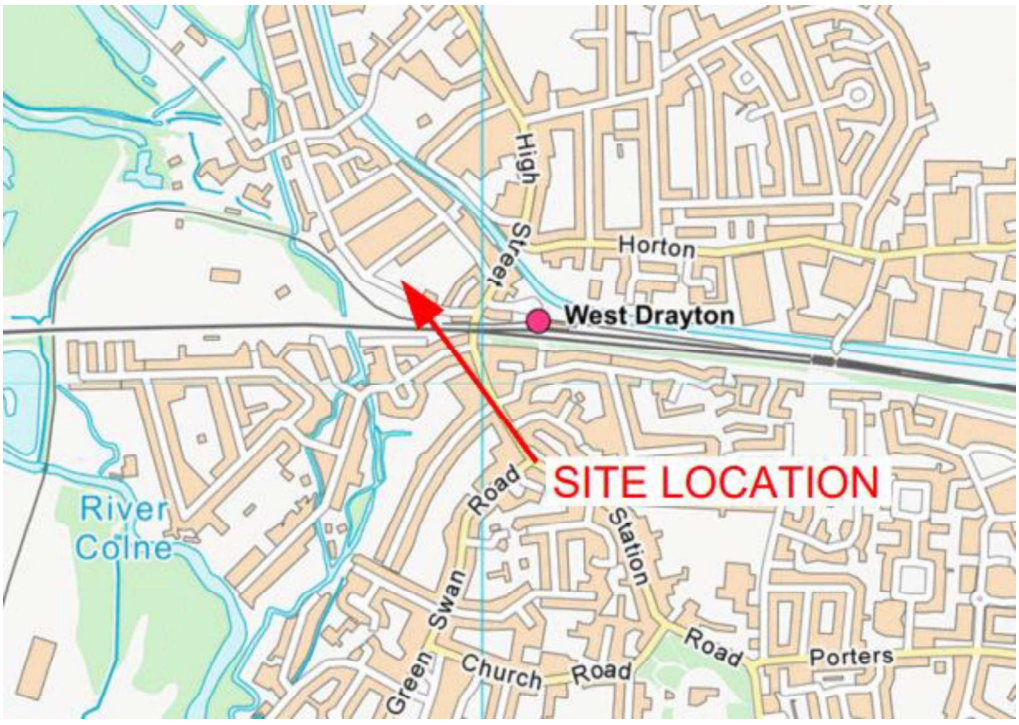
2 SITE DETAILS

2.1 Site location

Site location details are presented in **Table 2** and a site location plan is provided on **Figure 1** (drawing ref 11101).

Table 2 Site location details

Site name	Tavistock Works
Full site address and Post code	Tavistock Road, West Drayton, UB7 7RQ
National Grid reference (centre of site)	505846, 180199



2.2 Site description

The site covers an area of c. 0.33 hectares and is currently occupied by hardstanding/unmade surfacing with no building structures present. The eastern area of site is currently utilised as a general storage area. The site is essentially level with no significant slopes present on site.

The site boundary and current site layout are shown on **Figure 2** (drawing ref 11201).

2.3 Surrounding land uses

The site is located in West Drayton within a mixed residential and commercial setting. Immediate surrounding land uses are described in **Table 3**.

Table 3 Surrounding land uses

North	Residential including traditional low-rise developments and tower blocks
East	Residential including tower blocks
South	Rail track and ready-mix concrete supplier
West	Commercial land use including recycling centre with self-storage facility and skip hire operators

2.4 Development plans

The proposed development is understood to comprise a part-three and part-six storey apartment building situated along the western and southern boundary of site, with associated infrastructure and landscaping areas.

No details of the proposed ground levels have been provided therefore for the purpose of this report it has been assumed that the current levels will remain unchanged. The proposed layout of the site, at the time of preparing this report, is shown in **Appendix B**.

3 CONCEPTUAL SITE MODEL

3.1 Introduction

The following sections summarise of relevant information from previous site investigation on the ground and groundwater condition beneath the site, which have been used to build a conceptual model of the potential risks posed from piling operations.

3.2 Summary of existing information

3.2.1 Site history

The site is understood to have been occupied by a two-storey and part three-storey office building with an adjoining warehouse unit, noted to be utilised for miscellaneous storage.

Historical mapping records note the presence of warehouse style buildings prior to the development of a Mill covering the majority of the site in 1965. This building was later identified as a Joinery Works in 1968, which was demolished in 1977.

Off-site potentially contaminative land uses identified within the site vicinity comprise railway infrastructure located south of site in addition to historical industrial land uses including joinery works, coal depot and oil works. A historical landfill (Trout Lane) was noted approximately 200 m north west of site.

A preliminary UXO risk assessment (Zetica, 2017) noted that the site is likely to have a low UXO hazard level.

3.2.2 Ground conditions

The current site layout and exploratory hole locations completed by RSK are shown on **Figure 3** (drawing ref. 22201).

The previous investigations by RSK encountered made ground underlying superficial deposits of the Langley Silt Member and Lynch Hill Gravel Member. The deeper geological succession beneath the site consists of the bedrock geology of the London Clay Formation at depth. A summary of the ground conditions is provided in **Table 4** below and the following subsections.

Table 4 General succession of strata encountered

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl	Proven thickness (m)
Made Ground (Granular)	All locations	Ground level	0.40 to 1.30
Made Ground (Cohesive)	WS01 to WS03 TP01 to TP05 PLT04, PLT05, PLT06	0.55 to 1.10	0.10 to 1.20

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl	Proven thickness (m)
Langley Silt Member	BH101 WS01 to WS03 TP03 PLT03, PLT04, PLT05	0.65 to 1.80	0.10 to 0.60
Lynch Hill Gravel Member	BH101 to BH104 WS01 to WS03 TP01 to TP05 PLT01, PLT02, PLT06	0.60 to 1.20	0.15 to 3.50
London Clay Formation	BH101 to BH104 WS01 to WS03	3.00 to 4.80	Maximum proven thickness of 2.70 m (BH102)

3.2.2.1 Made ground

The made ground encountered on site generally comprised a surface layer of compacted granular material, underlain by a cohesive material at depth, recorded up to a maximum depth of 1.80 m at location PLT04.

Granular fill-type made ground material comprised brown to grey flint gravels with frequent brick and concrete in addition to occasional clinker, asphalt, plastic and glass fragments.

Recorded beneath the granular fill-type material, cohesive made ground soils comprised dark grey sandy gravelly clays with flint gravel and anthropogenic material including brick, concrete and timber fragments.

3.2.2.2 Langley Silt Member

Materials understood to represent the Langley Silt Member were locally encountered underlying the Made Ground, extending down to a depth of between 1.00 m and 1.50 m. Based on the site descriptions, the soils generally comprised a soft to firm slightly gravelly sandy clay. The sand fraction was recorded as medium to coarse, whilst the gravels were noted to comprise angular to subrounded, medium to coarse flint.

3.2.2.3 Lynch Hill Gravel Member

Granular soils of the Lynch Hill Gravel Member were confirmed extending either directly beneath the Made Ground soils or, locally where encountered, beneath the Langley Silt Member. The strata top was recorded to range between 0.60 m and 1.20 m, with the granular materials extending within the ground profile to depths ranging 3.00 m to 4.00 m. Based on site observation, the materials were described as brown sandy gravels, with the sand grainsize noted to be medium to coarse, and gravels of angular to rounded fine to coarse flint recorded.

3.2.2.4 *London Clay Formation*

The upper surface of the London Clay Formation was found to be slightly dipping across the targeted area of investigation in the vicinity to the southern site boundary, ranging between 3.00 m in BH103, located furthest towards the south east, whilst BH104, positioned towards the south western corner of the site, recorded the London Clay Formation interface at 4.00 m. The soils were encountered as firm to stiff grey silty clay.

It is noted that a previous phase of investigation completed by Partrick Parsons (June 2018) included deep boreholes, which recorded the presence of the London Clay Formation to a maximum investigation depth of 35.00 m.

3.2.2.5 *Visual/olfactory evidence of soil contamination*

Within the made ground, various anthropogenic constituents were observed within the soils. These were generally found to comprise brick and concrete with local observations of occasional clinker, asphalt, plastic and glass fragments

During the RSK investigation evidence of potential soil contamination was limited to organic type odours within reworked natural soils of the Langley Silt Member, noted to comprise a black to grey colouring.

3.3 Hydrogeology and Hydrology

3.3.1 Hydrogeology

The aquifer designation map published on the Defra Magic Map Application (www. magic.defra.gov.uk) indicates that the geological units beneath the site are classified as,

- Langley Silt Member – Unproductive stratum
- Lynch Hill Gravel Member – Principal aquifer
- London Clay Formation – Unproductive stratum

The site does not lie within a currently designated groundwater Source Protection Zone (SPZ) for an abstraction well.

A total of 3No return monitoring visits were completed by RSK to record resting groundwater levels within the Lunch Hill Gravel Member response zone, within monitoring well installations at WS01 to WS03 across the site.

The rest groundwater levels recorded during the monitoring programmed are summarised in **Table 5** below. Reference should be made to the full report for further information.

Table 5 Groundwater summary

Monitoring well	Response zone stratum	TOC elevation (m AOD)	Depth to water (mb TOC)	Product thickness (m)	Groundwater elevation (m AOD) – min.	Groundwater elevation (m AOD) – max.
WS01	Lynch Hill Gravel Member	26.44	2.18 to 2.34	N/A	24.10	24.26
WS02		26.49	3.55 to 4.69	N/A	21.80	22.49
WS03		27.04	2.75 to 2.92	N/A	24.12	24.29

The findings reflect the presence of a groundwater table at an elevation of 21.80 m to 24.29 m AOD within the principal aquifer of the Lynch Hill Gravel Member.

3.3.2 Hydrology

The closest surface watercourse is identified as the Frays River, located 50m west of the site. The Grand Junction Canal is recorded 150 m north east but is not considered to be in hydraulic continuity with groundwater present in the Lynch Hill Gravel Member, as the canal is anticipated to be lined with impermeable material.

No surface water abstractions are present within 250 m of the site.

3.4 Contamination Status

3.4.1 Human health (future site users)

Soil samples were tested for a range of potential contaminants associated with the historical uses of the site. The results were compared against human health generic risk assessment criteria (GAC) for a 'residential without plant uptake' end use scenario.

Within the RSK dataset, all contaminants were below the adopted GAC.

Confirmed exceedances identified within the Patrick Parsons dataset for a 'residential without plant uptake' end use scenario are detailed below in **Table 6**.

Table 6 Contamination data summary table (Patrick Parsons, January 2018)

Determinand	No. of samples tested	GAC (mg/kg)	No of exceedances	Maximum concentration (mg/kg)	
				Value	Location / depth (m bgl)
Aliphatic C10-C12	6	330*	1	560	WS04 (0.30m)
Notes: *Patrick Parsons GAC for a 'residential without plant uptake' end use scenario adopted a Soil Organic Matter (SOM) percentage of 2.50%.					

The laboratory screening for asbestos identified detectable asbestos in the form of chrysotile bitumen within a single sample of made ground from location TP02 (0.50 m depth). This sample was further analysed for asbestos content at <0.1% by weight present.

No detectable asbestos was reported within the samples analysed from the Patrick Parsons dataset.

3.4.2 Ground Gas Assessment

The ground gas risk assessment completed to date has included 4No return monitoring visits.

The characteristic gas situation, based on the initial calculated gas screening value for the entire site, was classified as Characteristic Situation 1 (CS1), whereby no formal gas protection measures are considered necessary.

3.4.3 Controlled Waters

As the primary controlled waters receptors was identified as the principal aquifer (Lynch Hill Gravel Member response zone), groundwater samples were assessed against Drinking Water Standards (DWS) protective of groundwater quality.

The assessment confirmed that all concentrations were below the relevant GAC, suggesting that a contaminant linkage to the wider aquifer associated with contaminants in the dissolved phase are incomplete.

3.5 Conceptual Site Model

3.5.1 Sources of contamination

- The results of the ground investigation identified that the made ground is impacted locally with elevated concentrations of TPH.
- A viable source of ground gas has not been identified.

3.5.2 Pathways

- In theory piled foundations may create a preferential pathway for the vertical migration of contamination into the underlying aquifer.
- Direct contact with contaminated soils during piling operations.

3.5.3 Receptors

- Groundworkers
- Controlled waters (Principal Aquifer in Lynch Hill Gravel, though not located in an SPZ)
- Surface waters (Frays River 50 m west)

3.5.4 Potential pollutant linkages

- Risk to controlled water by creating preferential pathways for contamination via piled foundations.
- Risk to groundwater from direct contact with impacted soils.

3.5.5 Incomplete linkages

- Risk to future site users from the migration of gas via piled foundations.

4 PILING RISK ASSESSMENT

4.1 Foundation Solution

Given the ground conditions encountered, the use of shallow foundations is not considered a suitable design approach for the proposed apartment blocks. Consequently, it is understood that the use of both bored and continuous flight auger (CFA) piles to support the required building loadings are technically feasible.

At the current time, based on information provided by the client, it is proposed to use up to 600 mm diameter CFA piles down to depths of approximately 25m bgl. A pile layout plan is included within **Appendix C**.

Non-displacement piles (also known as 'bored' piles, e.g. CFA) extract soil from the ground and replace it with the pile, which is typically formed by casting concrete in situ. Displacement of the surrounding soil is minimised.

A geological cross section showing the proposed maximum depth of the piles in relation to geology and groundwater is presented as **Figure 4** (drawing ref. 43101).

4.2 Introduction

The purpose of the piling risk assessment is to assess whether the proposed piling methods will have an adverse impact by creating new pathways for the migration of identified contamination, primarily in relation to the protection of Controlled Waters.

The Environment Agency's approach can be summarised as follows:

"Where sites are underlain by aquifers, piling should be avoided wherever possible, particularly if it would involve penetration of a clay layer previously providing protection to an underlying aquifer. Piling using the vibro-compaction/replacement method should always be avoided where contaminants are to remain on site, as the granular columns formed will produce an easy route of pollutants into the underlying formation.

Where there is an option, concrete raft foundations are the preferred means of foundation on contaminated sites. Where these are not possible and there is no alternative to piling, continuous flight augered (CFA) piles probably pose the least risk of groundwater pollution, although even these will not be acceptable at some sites without further precautions such as removal of contaminated material from individual pile sites or the use of temporary casing to seal out contaminated water".

4.3 Hazard Identification and Assessment

The six pollution scenarios outlined in the Environment Agency guidance, their applicability to the site and the proposed use of piles and subsequent hazard assessment are presented in the following sections.

4.4 Continuous flight auger (CFA) bored cast in situ piles

4.4.1 Creation of preferential pathways through made ground to allow potential contamination of an aquifer

Considered possibly applicable at this site.

The findings of the site investigations to date have identified a potential source of contamination that may pose a potential risk to the underlying aquifer.

The presence of the Langley Silt Member has been identified at variable locations across the site. Due to the absence of this stratum at some exploratory holes, a full continuous layer of this potential aquitard is considered unlikely to be present, based on the information obtained to date. As such the ground profile within some areas of site comprises made ground soils directly underlain by the Lynch Hill Gravel Member.

Groundwater analysis of the Lynch Hill Gravel Member response zone has not identified exceedances with respect to a Drinking Water Standards GAC (Section 3.4.3). In addition, the remediation method statement (RSK, December 2022) notes a requirement to remove the hydrocarbon impacted material identified around historical borehole WS04, further removing the potential source of contamination that may pose a potential risk.

The proposed development plans (see **Appendix B**) show that the majority of the site will remain covered by hard standing reducing the leaching potential of any contamination. Furthermore, as stated within Science Report SC020074/SR the CFA piles would not result in deformation of the surrounding soils. Concrete will be cast directly against the soil which seal against the surrounding soil and would not act as a conduit for vertical migration of contamination.

Hazard assessment: Low

4.4.2 Creation of preferential pathways through a low permeability surface layer allowing migration of gas to the surface

Considered possibly applicable at this site.

A ground gas risk assessment of the site found the characteristic gas situation to be classified as Characteristic Situation 1 (CS1) across the whole site. Formal gas protection measures are therefore not considered necessary for the development.

Hazard assessment: Low

4.4.3 Direct contact by site workers with soil arisings brought to the surface

Considered applicable at this site.

Pile arisings will be created with this piling method and brought to the surface during operation. Contamination in the form of asbestos and hydrocarbon impact have been recorded within the made ground and therefore risks to workers should be considered as part of the site's health and safety plan.

However, these should be mitigated through techniques such as dampening down soils during dry weather (to minimise dust generated), and use of Personal Protective Equipment (wear gloves etc).

Hazard assessment: Low to moderate

4.4.4 Direct contact of the piles with contaminated soil or leachate causing degradation of materials

Considered possibly applicable at this site.

No elevated concentrations of strong acidic or alkali contaminants have been identified that are likely to cause long term deterioration in the piles. A suitable concrete mix design will be required for the identified ground conditions.

Hazard assessment: Low

4.4.5 Pushing of solid contaminants down into an aquifer during pile driving

Not applicable.

No soil would be pushed downwards as part of the CFA method.

Hazard assessment: Not applicable

4.4.6 Contamination of groundwater and/or surface water by wet concrete, cement paste or grout

Considered possibly applicable to this site.

Wet concrete or grout would be introduced as part of this method. However, grout/concrete only remains mobile until hardened. Suitable working methods should be implemented to minimise any environmental damage. The Frays River is the nearest surface water body adjacent to the site but following correct working methods should minimise this risk.

Hazard assessment: Low

4.4.7 Summary for Continuous Flight Auger Bored Cast In Situ Piles

The following in **Table 7** may be summarised from the assessment above:

Table 7 Summary of Potential Pollution Scenarios

Pollution Scenario	Applicability	Hazard Assessment
Pathways through contaminated soil	Applicable	Low
Pathways allowing gas to the surface	Applicable	Low
Direct contact by site workers	Applicable	Low to moderate
Degradation of piles by contamination	Applicable	Low
Pushing solid contaminants down into an aquifer	Not applicable	Not applicable

Pollution Scenario	Applicability	Hazard Assessment
Contamination of groundwater or surface water by wet concrete or grout	Applicable	Low
OVERALL HAZARD ASSESSMENT		**LOW**

5 CONCLUSIONS AND RECOMMENDATIONS

This document is intended to assess the risk posed to groundwater resources and the proposed development (future site users / groundworkers) by the introduction of new pollutant linkages from the construction of piled foundations.

It is proposed that the site will be redeveloped with a residential end use with mid-rise apartment blocks along the southern and western boundary of site. It is proposed that a piled (CFA) solution shall be adopted due to the underlying ground conditions. The piles shall extend to a maximum ~25 m depth.

The ground conditions beneath the site comprise,

- Made ground - up to 1.80 m in thickness.
- Langley Silt Member - up to 0.60 m in thickness.
- Lynch Hill Gravel member – up to 3.50 m in thickness.
- London Clay Formation – in excess of 15.00 m in thickness.

With respect to groundwater sensitivity, the site is underlain by a Principal Aquifer consisting of the Lynch Hill Gravel Member. Based on a return groundwater monitoring programme, resting groundwater levels were recorded between 21.80 m to 24.29 m AOD.

The results of the ground investigation found limited exceedances of contamination within the made ground. However, further assessment of groundwater beneath the site found that any exceeded concentrations are unlikely to pose an unacceptable risk to the underlying aquifer.

Furthermore, the use of CFA piles would not introduce new pathways for any contamination to migrate along. The risk from piling operations is therefore considered to be **low**, and no further action is currently required.

The presence of contamination within the made ground should be communicated and any risk to groundworkers from direct contact with the made ground should be mitigated through the use of personal protective equipment, which should be assessed by the groundworker.

REFERENCES

Standards and guidance

Piling in layered ground: Risks to groundwater and archaeology, Environment Agency Science Report SC20074/SR, dated 2006.

Piling and penetrative ground improvement methodologies on land affected by contamination, published by the Environment Agency, dated 2001.

The Lost River of London, Nicholas Barton, published 1996.