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CONSTRUCTION SKILLS CENTRE & SITE ACCOMMODATION AT FORMER MARIA FIDELIS SCHOOL SITE CONTAMINATION REPORT

1CP01-MDS_ARP-EV-REP-SS08_SL23-990006 – C01

Revision Key:
P = Preliminary Documents/Drawings – P01, P02, P02
C = Contractual Documents/Drawings – C01, C02, C03
X = As Built Mark-Up Drawings – X01, X02, X03
Z = As Built Record Drawings – Z01, Z02, Z03

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1 Executive Summary

This report has been produced by Mace Dragados Joint Venture (MDjv) on behalf of High Speed 2 Ltd (HS2 Ltd), to support a full planning application for a Construction Skills Centre and Site Accommodation at the former Maria Fidelis school site (the 'Proposed Development').

The main objective of this report is to present a contamination risk assessment and remediation strategy to support the planning application for the Proposed Development to demonstrate that safe development can be achieved in accordance with the National Planning Policy Framework.

This report is intended to satisfy pre-commencement requirements relating to ground contamination, and to avoid associated pre-commencement conditions being placed on the Proposed Development. This report presents the findings of ground investigation that has already been completed at the site and uses data obtained to inform the contamination risk assessment.

A review of the available environmental data including the site history, setting and sensitivity of the site identified potential onsite and offsite sources of contamination including burial grounds, tanks, garages and printing works. The offsite sources identified have been removed as part of the construction of Euston Station for HS2 Ltd. The only onsite sources identified are Made Ground and historical electrical substations. The environmental sensitivity of the site is considered to be low. The Lynch Hill Gravel recorded as underlying the site is classified as a Secondary A aquifer, but this stratum has not been encountered during previous onsite ground investigation and may no longer be present. The Proposed Development will not penetrate into the sensitive Principal Aquifer (Chalk) located at depth as all construction will terminate in the overlying London Clay. No other environmental receptors have been identified.

The results from the ground investigation undertaken do not indicate the presence of significant widespread contamination at the site. All results are below Generic Assessment Criteria (GAC) derived for a commercial end use, except for two individual concentrations of Polyaromatic Hydrocarbons (PAH) in Made Ground. Asbestos in the form of cement and fibres was also identified in Made Ground soils, which is not uncommon. The Proposed Development is low sensitivity considering its proposed construction has limited in ground works (piling and base slab construction) and the (temporary) end use.

Ground gas monitoring indicates the site falls within a Characteristic Situation 1 (very low risk), and therefore no ground gas protection measures are required.

During excavation works just to the north of the site at the St James's Garden burial ground, potentially contaminated soils were encountered. Although the available

ground investigation information does not indicate that this contamination significantly extends onto the site, a watching brief should be undertaken during excavation works for potential contamination.

Plausible contaminant linkages have been identified between potential onsite contamination and human health receptors during construction and operation of the Proposed Development and building services and materials. Risk assessment has determined that risks to human health are moderate to low during construction and very low during operation. In general, good construction practices (e.g. health and safety, environmental controls) will mitigate the risks identified. Risks to building materials and services can be mitigated through robust design taking account of ground conditions and consultation with relevant utility providers regarding material selection.

No further ground investigation is considered to be required to further refine the risk assessment and recommendations included in this report as there is considered to be sufficient existing data available in the context of the proposed construction (and associated controls) and end-use, site setting and potential for contamination. There are established HS2 controls in place including enhanced health and safety measures for the construction and any contamination that may be present onsite can be manged by the implementation of a watching brief.

No specific remediation (e.g. source removal) is warranted. The 'remediation strategy' consists of standard brownfield development measures including:

- the implementation of the enhanced health and safety measures including those within the HS2 Code of Construction Practice;
- the implementation of a watching brief during below ground works for the presence of contamination, including hydrocarbons and asbestos; and,
- additional enhanced health and safety measures relating to asbestos.

A verification report should be prepared to document the works undertaken to address the specific control and mitigation measures outlined in this report and include pertinent 'land quality' information to document the works as part of the health and safety file and/or contractual close out document.

2 Introduction

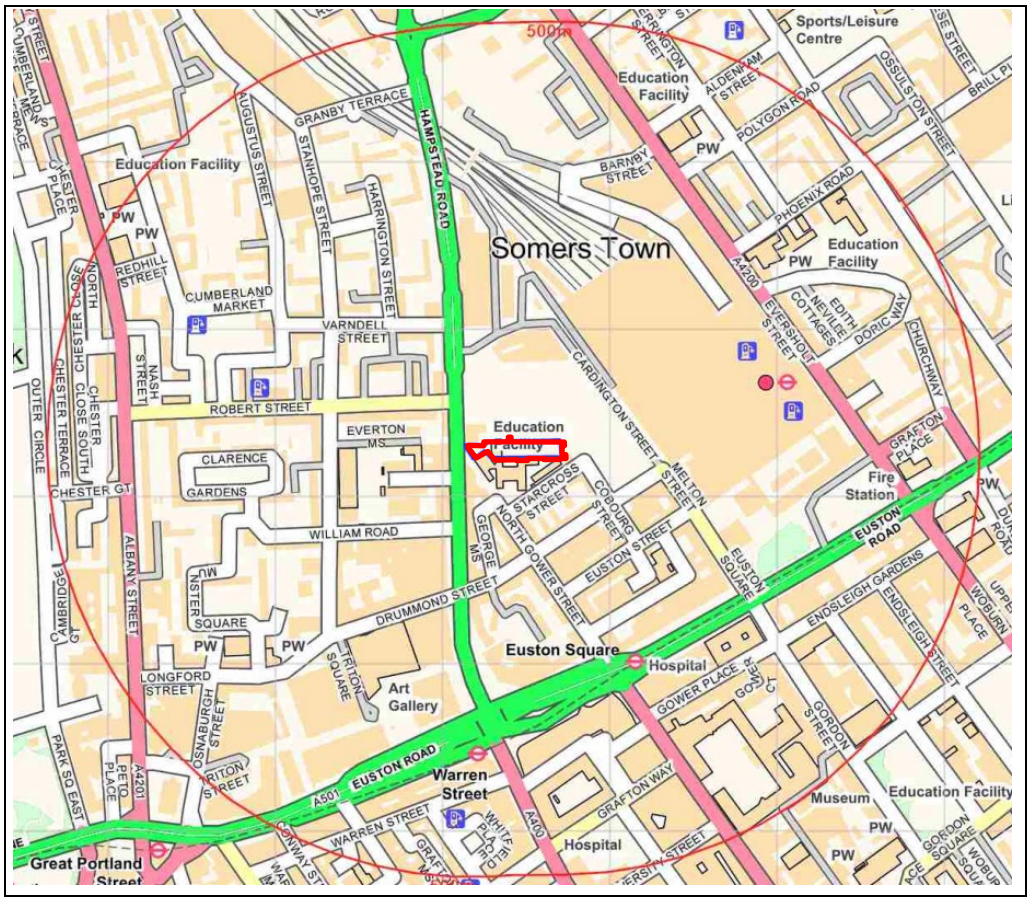
2.1.1 The site is located in the northern part of the former Maria Fidelis Catholic School in the London Borough of Camden as shown in Table 1. The site is currently vacant but had most recently been used as outdoor play space associated with the school and a two-storey ancillary school building, constructed in the 1990s, remains on-site.

2.1.2 The land immediately to the south of the site is occupied by the five-storey former school building, which was constructed in the interwar period. Planning consent was granted (subject to completion of s.106 agreement) in October 2020 for the mixed-use redevelopment of the former school building.

2.1.3 The surrounding area is a mix of residential and commercial uses, with Euston Station located to the north east. To the north of the site is the HS2 Euston Station construction site, which was formerly St. James' Gardens.

2.1.4 The site is accessed via North Gower Street to the west and via Cobourg Street to the east. Starcross Street is located to the south of the wider Maria Fidelis site and connects North Gower Street and Cobourg Street. Hampstead Road is located beyond North Gower Street to the west of the site. There are no Listed buildings on-site and the application site is not within a Conservation Area. The buildings on the eastern (no's 190-204) and western (no's 211-229) North Gower Street, located approximately 100 metres to the south of the site, are Grade II Listed. 108 Hampstead Road, located 20 metres to the north east of the application site is Locally Listed.

Table 1 Site Location



2.1.5 The Proposed Development would provide:

- a Construction Skills Centre (CSC) on behalf of London Borough of Camden (LBC), for which a similar scheme was previously granted planning permission under LBC application reference 2019/3091/P; and,
- a Site Accommodation facility to accommodate approximately 2,500 site operatives and management staff, including office space, ancillary rooms, WCs, showers and changing rooms, and on-site catering. This is required as part of the High Speed Two (HS2) railway project and will facilitate the construction of HS2 Euston Station.

2.1.6 The Proposed Development is required for a temporary period of 10 years from occupation and will be removed following the construction of HS2 Euston.

2.1.7 A summary of the application and how this report fits into the suite of documents can be found in the Planning Statement.

2.1.8 The previous planning application 2019/3091/P for an alternative scheme of development, which covered a wider area, was submitted to the LBC and included the demolition of three existing buildings, the refurbishment of the main school building into managed workspace, the provision of a new multi-use community hall

(through the change of use of an existing building), and the construction of a new Construction Skills Centre.

2.1.9 The Proposed Development covered by the new planning application is smaller in scale and extent and does not include any demolition or refurbishment of the main school building.

2.2 Objectives

2.2.1 The main objective of this report is to present a contamination risk assessment and remediation strategy to support the planning application for the revised scheme to demonstrate that safe development can be achieved in accordance with the National Planning Policy Framework (NPPF).

2.2.2 This report is intended to satisfy pre-commencement requirements relating to ground contamination, and to avoid (if possible) associated pre-commencement conditions being placed on the development. This report presents the findings of ground investigation that has already been completed at the site and uses data obtained to inform the contamination risk assessment.

2.2.3 The objectives of this report are therefore to:

- present a detailed assessment of the available ground investigation information to inform the potential risk of harm to human health and pollution of environmental receptors by contamination at the site and Proposed Development;
- inform the mitigation and control measures to be implemented during the construction phase; and,
- detail the verification requirements of the works to demonstrate the works have been undertaken to the required standard.

2.2.4 MDjv on behalf of HS2 have provided this report to the LBC Contaminated Land Officer (CLO) for review and comment as part of early (pre-application engagement). MDjv on behalf of HS2 received as a response via email on 13th May 2021 from the LBC CLO, which stated that they had no comments on the report. A copy of the email correspondence is provided in Appendix A

2.3 Structure

2.3.1 This report has the following structure:

- Section 1 introduces the project and scope of works;
- Section 2 outlines the site layout, the Proposed Development, the environmental site setting and site history;
- Section 3 summarises the ground investigation undertaken at the site;
- Section 4 quantitatively assesses the data obtained from ground investigation;

- Section 5 presents the identified contamination sources, pathways and receptors to inform the conceptual site model and potential contaminant linkages; and,
- Section 6 presents the conclusions and recommendations for the construction phase to mitigate the identified risks.

2.4 Information Sources

2.4.1 The following information sources have been used within this report:

- Groundsure report, provided as Appendix B. This report provides comprehensive public domain information including information on Environment Agency permits, consents, pollution notification and mapping, potentially contaminative land uses, sensitive land uses and ground conditions;
- Ground Engineering (2018), Site Investigation Report Maria Fidelis, December 2018. Report ref No.C14593 [Reference 1] also provided as Appendix C1;
- High Speed 2 (2017) Code of Construction Practice, High Speed Rail (London-West Midlands) [Reference 2]; and,
- Euston Station HS2 Enabling Works (2018), Ground Investigations Factual Report (HES). Doc No. 138076-BRI-REP-EGE-0000001 [Reference 3].

2.5 Limitations

2.5.1 This report has been produced by MDjv on behalf of HS2 for the proposed construction works for the Maria Fidelis development. It considers the particular instructions and requirements of MDjv on behalf of HS2. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

2.5.2 MDjv on behalf of HS2 has prepared this report based on current legislation, statutory requirements and industry good practice prevalent at the time of writing. Any subsequent changes or new guidance may require the findings, conclusions and recommendations made in this report to be reassessed considering the circumstances. Should the approved layout or use of the site change, the assessments and conclusions presented in this report may need to be revised.

2.5.3 MDjv on behalf of HS2 has based the report on the sources of information detailed within the report text and believes them to be reliable but cannot and does not guarantee the authenticity or reliability of third-party information. Notwithstanding the efforts made by the professional team in undertaking this assessment, it is possible that ground and contamination conditions other than those potentially indicated by this report may exist at the site.

2.5.4 The results of the ground investigations have been interpreted considering the groundwater table, ground type, drilling method, transport, handling and specimen

preparation. Where any data have been interpreted the assumptions made in the interpretation are stated:

- data required for design are collected, recorded and interpreted by appropriately qualified personnel;
- adequate continuity and communication exist between the personnel involved in data-collection, design and construction;
- the investigation and analysis were carried out according to the relevant standards and specifications by personnel having the appropriate skill and experience;
- construction materials and products are used as specified in this standard or in the relevant material or product specifications; and,
- the structure and site will be used for the purpose defined for the design, should the proposed layout or use of the site change, the assessments and conclusions presented in this report may need to be revised.

2.5.5 This report does not present a survey or assessment of the location, condition or liabilities associated with hazardous materials in building fabric such as (but not limited to) asbestos containing material (ACM), radiological or bacterial substances, or lead.

2.5.6 Site reconnaissance has not been undertaken due to COVID-19 restrictions. Observations recorded by Ground Engineering 2018 during their ground investigation have been used in this report as there have been no significant onsite changes in the intervening period.

2.5.7 The report does not consider the risk of UXO to the development. An unexploded ordnance desk study and risk assessment for the Act Limits of the Phase One route of HS2 was written in 2016 (Unexploded Ordnance Desk Study 0615-ZET-GT-REP-000-000001 P03). The report (drafted in accordance with CIRIA C681 Unexploded Ordnance (UXO), a Guide for the Construction Industry) provides an assessment of the risks posed to the Site by UXO and outlines recommended mitigation methods to address the UXO risk prior to and during ground investigation or any other intrusive works commencing.

3 The Site

3.1.1 This section is based on information from the Groundsure Report [Reference 1] (included as Appendix B) unless otherwise stated. Figure 1 shows the site location and extent.

3.2 Site Description and Setting

3.2.1 The site is located in the northern part of the former Maria Fidelis Catholic School in the London Borough of Camden. The site is currently vacant but had most recently been used as outdoor play space associated with the school and a two-storey ancillary school building, constructed in the 1990s, remains onsite.

3.2.2 The land immediately to the south of the site is occupied by the five-storey former school building, which was constructed in the interwar period.

3.2.3 The surrounding area is a mix of residential and commercial uses, with Euston Station located to the north east. To the north of the site is the HS2 Euston Station construction site, which was formerly St. James' Gardens.

3.2.4 The site is accessed via North Gower Street to the west and via Cobourg Street to the east. Starcross Street is located to the south of the wider Maria Fidelis site and connects North Gower Street and Cobourg Street. Hampstead Road is located beyond North Gower Street to the west of the site. There are no Listed buildings onsite and the application site is not within a Conservation Area. The buildings on the eastern (no's 190-204) and western (no's 211-229) North Gower Street, located approximately 100 metres to the south of the site, are Grade II Listed. 108 Hampstead Road, located 20 metres to the north east of the application site, is Locally Listed.

3.3 Proposed Development

3.3.1 This section details the design and construction of the Proposed Development.

3.3.2 The draft description of development is as follows:

- Erection of a six-storey combined Construction Skills Centre (Class F1(a) - Education) and Site Accommodation (Class E(g)(i) – Offices) to facilitate the construction of HS2 Euston station, as meanwhile uses for a period of up to 10 years from occupation.
- The Proposed Development would provide 1,378sqm of CSC floorspace and 5,747sqm of Site Accommodation floorspace. The overall site area is 0.24ha. The maximum height of the building would be 22.4m and the building would be 77m wide and 18m deep.
- The building would utilise modular construction, using modern methods of construction and assembly on-site to the form described above.

- Vehicular access to the Site Accommodation would be delivered via a combination of the existing HS2 worksite to the north and Cobourg Street. Vehicular access arrangements for the Site Accommodation would change throughout the construction and operational period to accommodate wider HS2 works to the north of the site. Vehicular access for the Construction Skills Centre would remain as previously approved with infrequent servicing use of North Gower Street (consented under extant permission 2019/3091/P).
- Pedestrian access to the Construction Skills Centre would be via the open space to the south of the building. Pedestrian access to the Site Accommodation would only be from Hampstead Road and through the existing HS2 worksite to the north.

3.3.3 No basement is included in the Proposed Development. The ground floor will be used as a teaching space and welfare facilities.

3.3.4 The Proposed Development is conceptually low risk as the entire site will be hardcover with a small corner in the west being retained soft landscaping. There are therefore no direct pathways (including dermal/ingestion or rainwater infiltration) for potential exposure to contamination during operation. The Proposed Development will only be occupied by adults (i.e. no children), there are minimal excavations into the ground during the construction phase.

3.3.5 Following the temporary use for the Proposed Development, the site will be handed back to the existing landowners (Camden Council / London & Continental Railways). The site is earmarked for redevelopment as part of the Euston Area Plan[1] but the future use is not known at this time. The landowner will be responsible for undertaking any further assessments associated with future use of the site. This report only assesses the temporary use.

3.4 Environmental Setting

3.4.1 The environmental setting of the site is based on information provided by the Groundsure Report unless otherwise stated.

Geology

3.4.2 There are no BGS borehole records located onsite as identified by the BGS online viewer [Reference 4]. Based on the published BGS geological mapping in the vicinity of the site and information presented in the Groundsure report, the expected geological sequence in the area is Made (or Worked) Ground, Lynch Hill Gravel (River Terrace Deposits (RTD)), London Clay, Lambeth Group, Thanet Formation and Chalk.

3.4.3 Ground investigation has been undertaken onsite and the findings, including the sequence of strata, is described in Section 4.

[1] https://www.eustonareaplan.info/planning-in-euston/

Hydrogeology and hydrology

3.4.4 Localised pockets of perched groundwater may be present in the Made Ground. The distribution of these localised pockets will be dependent on numerous factors including surfacing, rainfall, and the local drainage conditions.

3.4.5 The Groundsure report indicates that the Lynch Hill Gravels (shallow superficial deposits) are designated as a Secondary A aquifer. The London Clay is designated as unproductive strata and the Chalk a principal aquifer. The Thanet Formation and granular layers at the base of the Lambeth Group are classed as Secondary aquifers. The Thanet Formation, the lower sandy layers in the Lambeth Group and Chalk are hydraulically linked and are commonly referred to as the Chalk Basal Sands aquifer.

3.4.6 The Langley Silt has not been recorded onsite but has been recorded in historical boreholes immediately to the west of the site and is designated as an unproductive aquifer.

3.4.7 There are no active groundwater abstractions within 500m of the site. The nearest active groundwater abstraction is located approximately 700m east and is used for heat pump water for the University College London (UCL) building on Mabledon Place.

3.4.8 The nearest active surface water abstraction is located over 1km northeast of the site and is from the River Thames for non-evaporative cooling.

3.4.9 The nearest active potable groundwater abstraction is located over 1km south of the site.

3.4.10 There are no surface water features within 250m of the site. The nearest surface water feature is the Grand Union Canal, located over 1km to the north of the site. The site is not located within a source protection zone (SPZ).

Sensitive Land Uses

3.4.11 A Local Nature Reserve (Camley Street Nature Park) is located approximately 1km northeast of the site.

3.4.12 There are no other national designated environmentally sensitive receptors on or within 2km of the site including Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), RAMSAR sites, Ancient Woodland, World Heritage sites, Environmental Sensitive Areas, Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Nitrate Sensitive Areas, Nitrate Vulnerable Zones or the London Green Belt.

Radon

3.4.13 The Groundsure report states that site is not within a radon affected area as less than 1% of properties are above the action level and that no radon protection measures are necessary.

Environmental Permits, Incidents and Registers

3.4.14 There is a recorded incident regarding the release of diesel located approximately 200m east of the site. The incident did not have an impact to either water, land or air (category 4).

3.4.15 There are seven records of Part A(2) and Part B activities and enforcements located within 250m of the site, none of which are located onsite. The nearest site is located 127m north west and is for the unloading of petrol into storage at the BP Euston service station. The permit has been revoked as the station is no longer in use. The records indicate that there have been no enforcements notified relating to contamination at Part 2A and 2B sites.

3.4.16 There are 11 records of category 3 and 4 radioactive substances authorisations within 250m of the site, of which eight are located onsite at the University College Hospital (31m north). They relate to the keeping, use and disposal of radioactive materials. Four of the permits have been revoked or superseded.

3.4.17 It is unlikely that these incidents will have caused any significant contamination to the ground and are therefore not a risk to the Proposed Development.

Landfill and Waste Activities

3.4.18 No landfill or other waste sites are located within 500m of the site.

3.4.19 There are 19 records of Environment Agency permitted waste sites within 1.5km of the site. The nearest facility is located approximately 850m northeast and is listed as a metal recycling facility.

3.4.20 None of the waste sites identified are considered to have the potential to impact the contaminative status of the site given their distance from site.

Current Land Use

3.4.21 An electricity substation is located onsite. There are no other current industrial land uses. The substation has been identified as a potentially contaminative activity and has been carried through to the risk assessment.

3.4.22 Within 100m of the site there are two recorded industrial land uses relating to:

- Construction and tool hire (Drayton Scaffolding, 53m south east).
- Electricity substations (nearest is 88m south west).

3.4.23 Within 250m of the site there are 20 recorded industrial land uses relating to:

- Photographic and optical equipment (Calumet Photographic, 112m south east).
- Rubber, silicones, and plastics (Green Tech, 120m south west).
- Radar and telecommunications (Getincased Ltd, 121m south west).
- Railway station (Euston Station, 126m east).
- Vehicle hire (Enterprise Rent-A-Car, 135m north east and Europcar, 142m north east).
- Medical equipment (Haverstock Health Care, 141, south west).
- Electronic equipment (A M Security Services Ltd, 160m north).
- Published goods (Samuel French Ltd, 167m south east).
- Depot located 178m north east.
- Recording studio (Bun the Grid, 218m west).
- Clothing (Jon Adams, 226m south west).
- Airline services (Finnair, 227m east).
- London Underground (Euston Square, 227m south east).
- Vehicle parts and accessories (Halfords, 249m south).

3.4.24 These offsite land uses are not considered to be of significance to the Proposed Development and have not been taken forward to the risk assessment. They comprise mostly registered offices or commercial uses. The unspecified depot is located within Euston Station and is therefore inferred to be the Royal Mail depot located on the upper deck of Euston Station. In addition, given the distance from site and the anticipated geology, the potential for contamination that may have arisen at these sites to migrate to the Maria Fidelis site is negligible.

Historical Land Use

3.4.25 There are four records an historic electricity substation located onsite dated between 1969 and 1991. There are an additional two historical substations within 100m of the site, both shown as present in 1952.

3.4.26 There are no other historic potentially contaminative onsite land uses identified.

3.4.27 Within 250m of the site there are 33 entries of historic industrial land use. They relate to:

- Hospital (26m north).
- Railway Station (77m north east); and,
- Railway sidings (134m north).

3.4.28 There are also:

- Five records of historic tanks within 250m of the site, located 155m south and 180m north.
- 17 records of historical garage and motor vehicle repair within 250m of the site, located 27m north east, 76m south east, 151m north (carriage shed), 164m south east and 200m south west; and,

- There are two unspecified heaps located 261m and 318m east of the site. These are only shown on the 1894 map extract and are not significant for the site.

3.4.29 The historical garage and vehicle repair shops located within 100m of the site have been taken through to the risk assessment. The others are not considered a risk due to the distance from the site.

Archaeological works

3.4.30 The St James's Gardens burial ground excavation is adjacent to the site in the north. The CSJV (2019) Health and Safety File – Euston North (doc no. 1EW02-CSJ-HS-HSF-SS06-000006) describes the excavation works.

3.4.31 The works have included the removal of 5.5m of soil including 1.5m of surface material, archaeological hand excavation of 3m and a further 1m to ensure the site had been cleared of all burial remains.

3.4.32 The details of the St James's excavation are summarised below:

- The site was generally flat at a level of approximately +24mOD levels. Following works the levels in the excavation area now range between +18.6 to +20mOD, which is approximately 6m below ground level (bgl) across the site.
- The excavated material has consisted of 1.5m of imported overburden material containing clinker, animal bone, organic waste, pottery etc. underlain by London Clay; and,
- The site was handed over at a reduced level with a validated formation level in the London Clay.

3.4.33 The excavation works have removed most of the Made Ground to the north of the site extending to Euston Station. The Early Works Contractor (EWC) health and safety files detail coal tar deposits and broken asbestos tiles were identified within the 1-3 Cobourg area at the southern extent of the St James's Gardens excavation.

3.4.34 Japanese Knotweed was also prevalent throughout St James's Gardens. The majority has been removed but isolated pockets remain along the southern boundary of St James's Gardens.

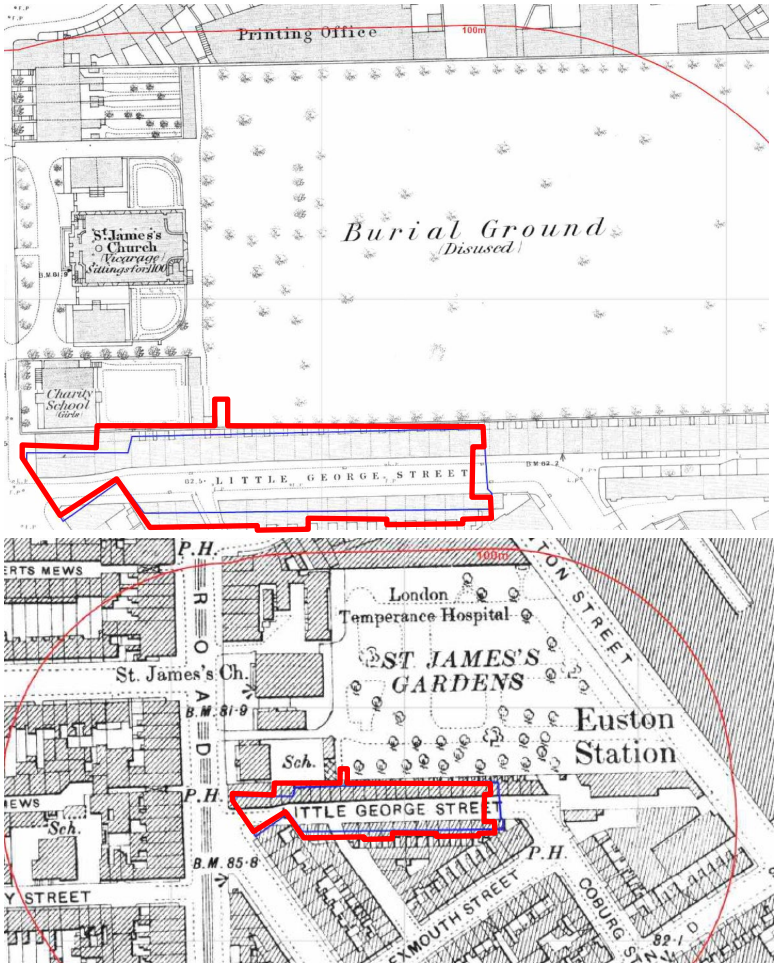
3.4.35 The previously identified contamination and Japanese Knotweed along the southern boundary of the site may present a risk to the Proposed Development.

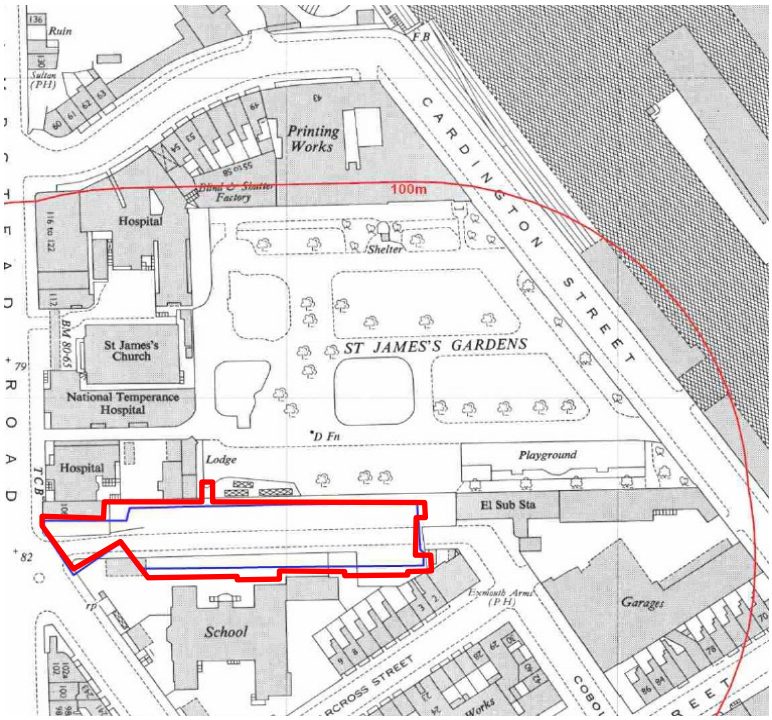
3.5 Site History

3.5.1 Historical Ordnance Survey (OS) maps included in the Groundsure report (Appendix B), Ground Engineering report (Appendix C1) and other sources (identified in Table 2) have been reviewed to document the history of the site, which is summarised in Table 2. Unless otherwise stated, offsite features have been identified within 250m of

the site. The blue line depicts the development boundary from the previous planning application. The boundary for the this planning application is shown in red.

Table 2 Historical Map Review

Year	Description	Map Extract
1747 John Roque's Map	The earliest available map extract shows the site to be open fields with the 'Road to Highgate' located adjacent to the west.	
1802 J.Fairburn's Map	The site is still shown to be open fields. There is some limited, small scale residential development in the surrounding area. St James's Garden burial ground is shown directly north of the site.	
1827 Greenwood Map	The site is first shown as being developed and is likely occupied by residential dwellings. The area around the site to the west, south and east has been developed. The burial ground remains directly north of the site. A farm is shown beyond this to the north.	
1873 to 1916	The earliest available OS map shows that the site is occupied residential dwellings with gardens. The area to the west, south and south-east of the site is also predominantly residential dwellings Euston Station is now located approximately 100m to the east of the site. The burial grounds are shown as disused. The London temperance Hospital is shown on the 1916 map extract in the north of the St James's Garden and a printing office located beyond to the north.	
1939 to 45 London County Council	No bomb damage is recorded onsite. The surrounding area has been subject to bomb damage. The bomb damage maps list the site as being marked for clearance. The maps include a building of the same size and shape as what will later become the Maria Fidelis Convent school.	

Year	Description	Map Extract
Bomb Damage Map		
1952	The area of the Proposed Development is vacant. It is assumed that the residential buildings that occupied the site were cleared following World War II. A building labelled as a school which will later become the Maria Fidelis Convent School. Residential properties are still present in the east of the site. Offsite, a printing works, blind and shutter factory, substation and garages are shown.	
1952 to 2003	There is little change onsite. The Maria Fidelis building has not changed significantly, and no other development has taken place within the site boundary. The surrounding area is occupied by residential dwellings and commercial property.	

Year	Description	Map Extract
2019 to present	The site remains unoccupied. The site is adjacent to the HS2 construction and enabling works which includes the excavation of St James's Gardens burial ground, located directly north of the site as shown by the white structure in the extract opposite. The area around these works have also been cleared as part of the Euston Station construction including the area of the garage, printing works and hospitals shown n previous map extracts.	

4 Previous Ground Investigation

4.1 Introduction

4.1.1 This section describes the previous ground investigation which has been undertaken at the site. Ground Investigation locations are shown on Figure 2.

4.2 High Speed 2 2017

4.2.1 The HS2 2017 HES Package [Reference 2] of ground investigation undertaken on the neighbouring Euston Station HS2 investigation included one exploratory location (ML000-RO001) located within the Proposed Development site boundary. This was a rotary core borehole advanced to 30m bgl. Soil samples were obtained and submitted for laboratory analysis. This location and the laboratory data obtained is considered in the assessment.

Observations during investigation

4.2.2 There were no recorded visual and olfactory observations of potential contamination, such as staining, brightly coloured soils and hydrocarbon odours at onsite exploratory locations as summarised in Table 3. Anthropogenic materials including brick, limestone and glass were recorded in the Made Ground.

Table 3 Summary of HS2 exploratory locations

Hole	Type	Location	Depth (m)	Observations of contamination
ML000-RO001	Rotary core	Onsite	30	Frequent fragments of coal (0.1m bgl)

Analytical and testing strategy

4.2.3 Two soil samples were scheduled for the analysis outlined in Table 4 and described in the Euston Station HS2 Enabling Works – Ground Investigation [Reference 2].

Table 4 Summary of chemical analysis on soils

Determinands
Metals and inorganics (two samples)
Arsenic, boron, cadmium, chromium (total), copper, lead, mercury, nickel, zinc, pH, water soluble sulphate as SO4, total petroleum hydrocarbons, speciated Poly Aromatic Hydrocarbons (PAHs), phenols, cyanide (total), organic matter (SOM).
Hydrocarbons (2 samples)
Polyaromatic hydrocarbons (PAH), Gasoline Range Organics (GRO), Extractable Petroleum Hydrocarbons (EPH)
Asbestos (1 sample)
Identification and quantification

Deviating Samples

4.2.4 Deviating samples can occur from sampling, transportation and storage issues including, incorrect sample containers, holding time for the analysis exceeded. Table 5 provides details of the two samples that were recorded by the laboratory as deviating as part of the HES package.

Table 5 Summary of deviating samples

Sample (m bgl)	Type	Determinand	Reason
ML000-RO001 (0.15m bgl)	Solid	GRO	Solid Samples were received at a temperature above 9°C
ML000-RO001 (1.00m bgl)			
ML000-RO001 (0.15m bgl)		Cyanide, GRO, EPH and PAH	Sample holding time exceeded

4.2.5 As there is further solid data from the Ground Engineering investigation, the assessment in this report does not rely on these deviating results. Cyanide is not a contaminant of concern and there were no significant organic or volatile contamination observed.

4.3 Ground Engineering 2018

4.3.1 A ground investigation was undertaken by Ground Engineering in December 2018 for LBC [Reference 1]. The ground investigation report is provided as Appendix B.

4.3.2 Table 6 summarises the scope of the Ground Engineering investigation, including locations within the immediate vicinity of the site which are also representative of potential ground conditions at the site.

Observations during investigation

4.3.3 Asbestos containing material (ACM) was identified in Made Ground of BH1. Laboratory analysis confirms the presence of chrysotile cement at a concentration of 0.27% w/w.

4.3.4 Frequent anthropogenic materials including ash, concrete, brick, flint, mortar and coal fragments were recorded in the Made Ground.

Table 6 Summary of Ground Engineering Exploratory Locations (2018)

Hole	Type	Location	Depth (m)	Observations of contamination
BH1	Cable percussive borehole	Onsite	15	Cement fragment containing asbestos (0.1m bgl)
WS1	Window sample	Onsite	5.45	None
WS2		Onsite		Coal and ash fragments (1.4m bgl)

Hole	Type	Location	Depth (m)	Observations of contamination
WS3		7m south		Iron staining on gravel (1.5m bgl)
TP1	Foundation inspection pit	32m south	1.7	None
TP2A		30m south	0.2	None
TP2B		23m south	2.3	Ash fragments (1m bgl)
TP3		25m south	3.2	Ash fragments (1.5m bgl)
TP4		Onsite	1.5	Ash fragments (0.5m bgl)
TP5		4m south	1.8	Ash fragments (0.3m bgl)
TP6		1m south	1.7	Ash fragments (0.45m bgl)
TP7		33m south	1.6	None

4.3.5 Locations BH1, WS1, WS2 and TP4 are within the current development boundary. Based on the site history the offsite locations are potentially representative of onsite conditions and therefore data from these locations has been used in the assessment in this report.

4.3.6 A groundwater and ground gas monitoring standpipe were installed at BH1 with a response zone of 1 to 7m within the Made Ground and London Clay.

Analytical and testing strategy

4.3.7 Samples were scheduled for analysis as outlined in Table 7 and described in the Ground Engineering factual report and was devised by Ground Engineering Limited.

Table 7 Summary of chemical analysis on soils

Determinands
General (6 samples)
Total concentrations of arsenic, cadmium, chromium, lead, mercury, selenium, nickel and benzo[a]pyrene, boron, copper, zinc, phenols, total and free cyanide, hexavalent chromium, sulphate, sulphide, and pH
Speciated polyaromatic hydrocarbons (PAH) (6 samples)
PAH - USEPA 16
Asbestos identification (1 sample)
Asbestos containing material (ACM).
Leachability (1 sample)
Waste Acceptance Criteria (WAC) CEN Leachate Suite at 10:1 ratio.

Deviating samples

4.3.8 Table 8 provides details of the sample that was recorded by the laboratory as deviating as part of the Ground Engineering works.

Table 8 Summary of deviating samples

Sample (m bgl)	Type	Determinand	Reason
BH1 (0.3m bgl)	Solid	Leachate results	Sample not received in appropriate containers (plastic tub)

4.3.9 As this is the only sample scheduled for leachability analysis and due to the form of container supplied, this does impact the main conclusions of the assessment.

Geology

4.3.10 The geology encountered during the ground investigations confirms the expected general geological profile discussed in Section 2.4.

4.3.11 Table 9 summarises the ground conditions encountered at the site.

Table 9 Geology

Stratum	Depth to top of layer (m bgl)	Approximate Top Level (mOD)	Thickness (m)
Asphalt	0	25.7 to 24.6	0.1 to 0.15
Made Ground	0.1 to 0.15	25.6 to 24.5	1.3 to 3.1
River Terrace Deposits (RTD)*	1.4 to 1.6	23.8 to 23.6	0.2 to 0.7
Weathered London Clay	1.4 to 2.2	24.05 to 22.4	0.2 to 3.9
London Clay	4.8 to 5.4	20.5 to 19.35	0.65 to 9.6

*Not identified in all exploratory locations

4.3.12 The Made Ground encountered was typically hardstanding over sandy gravelly clay with inclusions of anthropogenic materials. The Made Ground encountered ranged in depth but was predominantly recorded at depths of up to 3m bgl.

4.3.13 RTD were identified at three of the 11 exploratory locations at WS1, WS3 and TP5. These holes are located within to the south of the area assessed in this report. No superficial deposits were encountered at the locations within the site extent assessed in this report.

Groundwater

4.3.14 Only one location onsite had a monitoring installation at BH1. Three rounds of groundwater monitoring were undertaken. The response zone was between 1 to 2.5m bgl within the Made Ground and London Clay. BH1 was recorded as dry during all three monitoring visits.

4.3.15 No groundwater strikes were recorded on exploratory hole logs. Perched water was encountered in TP6 at 1.4m bgl towards the base of the Made Ground. No sample was collected.

Ground Gas

4.3.16 Ground gas monitoring was undertaken from gas standpipe at BH1 located onsite, with a response zone in the Made Ground and London Clay. The standpipe was monitored on three occasions. Considering the low generation potential of Made Ground and low development sensitivity, three rounds is considered sufficient to inform this assessment.

4.3.17 The location of the ground gas standpipes is shown on Figure 2 and the ground gas monitoring results are presented in Appendix C.

4.3.18 The results are assessed in Section 4.4.

5 Data Evaluation

5.1 Assessment methodology

5.1.1 The assessment of ground contamination considers the risk to human health and environmental receptors during the proposed ground works. The evaluation of ground investigation data has been carried out in accordance with the risk assessment methodology outlined in Appendix D, which describes the background and context of the assessment and defines the criteria used to assess soils, groundwater and ground gas.

Human health

5.1.2 Commercial generic assessment criteria (GAC) has been adopted for an initial assessment of the results. This is appropriately conservative of the active potential PCLs for the enabling works. A SOM of 2.5% has been considered in the derivation of GAC used in this assessment based on results of ground investigation. The generic commercial end use is based on assessing the risks to a female office worker, spending her entire working life (full time) on site.

5.1.3 SDSC has derived GAC using CLEA 1.07 software. Input data for the toxicological effects, physical characteristics and contaminant fate and transport parameters for the determinands have been taken from sources published by the Environment Agency and other sources (including LQM/CIEH [Reference 5] and CL:AIRE [Reference 6]. Concentrations above the GAC do not necessarily indicate unacceptable contamination, rather the results should be taken forward for further assessment.

5.1.4 There are no published GAC for asbestos in soils in the UK. The results have been assessed using multiple lines of evidence as to the potential significance during and after construction based on the latest guidance in CAR-SOIL™ [Reference 7] and CIRIA C733 [Reference 8].

Controlled waters

5.1.5 The assessment criteria for controlled waters is set out in Appendix D3. A hierarchy of water quality standards (WQS) has been used in the assessment of groundwater and leachability chemical data. Environment Quality Standards (EQS) set out in the Water Framework Directive (2000) have been used where available. Where these values are not available other relevant UK EQS for surface water and drinking have been used. Results above the WQS do not necessarily indicate significant contamination but may require further assessment.

Ground gas assessment

5.1.6 The methodology for the assessment of ground gas data is summarised in Appendix D4. The following published guidance on the assessment of ground gas has been used in the assessment:

- CIRIA (2007) Report C665 Assessing risks posed by hazardous ground gases to buildings [Reference 9];
- BS 8485 (2015) Code of practice for the design of protective measures for methane and carbon dioxide gases for new buildings [Reference 10]; and
- Card, Wilson and Haines (2009) Ground gas handbook [Reference 11].

5.2 Human health

Soil

5.2.1 Overall, the results do not indicate the presence of significant contamination with all results below GAC derived for a commercial end use. A summary of the results obtained from the seven soil samples scheduled for analysis during the Ground Engineering and HS2 investigation is presented below:

- Asbestos was identified in two Made Ground samples from BH1 at concentrations of 0.27% w/w (chrysotile cement) and 0.001% w/w (chrysotile fibres);
- Concentrations of metals were low, and all measured concentrations were below the GAC derived for a commercial end use;
- PAH were measured above the MDL in all samples with total concentrations ranging from 1.1mg/kg to 530mg/kg. All concentrations of individual PAH compounds were below the GAC for a commercial end-use, except for locations TP4 and WS1, which recorded concentrations of dibenzo(a,h)anthracene of 5.0mg/kg and 5.9mg/kg, marginally above the commercial screening criteria of 3.5mg/kg;
- Phenols were detected below the method of detection limit (MDL) in four of the six samples. The maximum recorded concentration was 0.4mg/kg at WS1, which is low.
- Two Made Ground samples from RO001 was scheduled for extractable petroleum hydrocarbon (EPH) analysis. EPH was measured above the MDL in one of the two samples at a measured concentration of 3,406mg/kg. There are no GAC derived for EPH. The result was predominantly comprised of heavy end ($>C_{21}$ to C_{40}) hydrocarbons. There were no recorded observations of potential hydrocarbon contamination recorded on the borehole log; and,
- Cyanide was not detected above the MDL in any of the samples.

5.2.2 A screening spreadsheet comparing results to GAC is presented in Appendix E.

5.3 Controlled Waters

5.3.1 There are no significant controlled waters receptors that could be impacted by potential contamination at the site and the Proposed Development.

5.3.2 One sample from BH1 was scheduled for leachability analysis, with concentrations low and below the most protective WQS. However, this samples was recorded as deviating by the laboratory so the results cannot be fully relied upon considering the low solid concentrations and lack of significant contamination recorded, the site does not present an unacceptable risk to controlled waters.

5.4 Ground Gas

5.4.1 A summary of the results of ground gas monitoring undertaken at the site is provided below:

- concentrations of methane were typically recorded below the limit of detection of the gas analyser <0.1% v/v;
- concentrations of carbon dioxide were low with a maximum concentration of 1.4%; and,
- maximum ground gas flow rate was 0.1 L/hr.

5.4.2 The Ground gas handbook [Reference 11] describes a process of deriving gas screening values (GSV) for hazardous ground gases. The method uses both gas concentrations and borehole flow rates to define a range of characteristic situations (CS1 to CS6) based on limiting borehole gas volume flow for methane and carbon dioxide. The GSV is calculated by multiplying the borehole flow rate (litres per hour) by the gas concentration.

5.4.3 The GSV based on the maximum carbon dioxide concentration of 1.4% and the maximum flow rate of 0.1L/hr is 0.0014, is indicative of a Characteristic Situation (CS) 1 (very low risk) and no ground gas protection measures are required.

6 Conceptual Site Model and Risk Assessment

6.1 Introduction

6.1.1 Land contamination is regulated under several regimes, including environmental protection, pollution prevention and control, waste management, planning and development control and health and safety.

6.1.2 The NPPF [Reference 12] places responsibility on the developer of the land for ensuring that the development is safe and suitable for use for its intended purpose, which will include dealing with historic contamination of the ground to the satisfaction of the local authority and Environment Agency. The NPPF defines site investigation information as including a risk assessment of land potentially affected by contamination. It states that all investigations of land potentially affected by contamination should be carried out in accordance with established procedures.

6.1.3 The UK framework for the assessment of contaminated land endorses the principle of risk assessment and a 'suitable for use' approach to contaminated land. Remedial action is only required if there are unacceptable risks to human health or the environment, considering the use of the land and its environmental setting. The assessment of the impacts arising from potentially contaminated land is based upon considerations of potential contaminant linkages between contaminated sources and sensitive receptors. The methodology of risk assessment is set out within a source-pathway-receptor model of the site. All three of these elements must be present for a site, or area of a site, to be determined as contaminated.

6.1.4 The most relevant documentation to support the assessment and management of contaminated land is the Land Contamination Risk Management (LCRM) framework [Reference 13], based on the CLR11 Model Procedures for the Management of Contaminated Land (now withdrawn), which sets out the procedures to be undertaken at various stages of a project on land affected by contamination. A key activity is the development of an initial conceptual model identifying plausible contaminant linkages between potential sources and receptors.

6.1.5 A contamination risk assessment using the framework based on the following information has been completed to identify sources, receptors, and pathways:

- Historical and current potential contaminative sources both onsite and offsite;
- Sensitivity of the site in the context of the wider environmental setting and ground conditions; and,
- Sensitivity of the future development and potential receptors.

6.2 Code of Construction Practice

6.2.1 The Proposed Development is within HS2 Act Limits but won't be consented under the HS2 Act Regime. However, it will be constructed by those constructing HS2 and therefore HS2 standards will apply to the works. Therefore, the measures outlined in the Code of Construction Practice (CoCP) [Reference 2] will be followed for the Proposed Development.

6.2.2 The CoCP states that the nominated undertaker will require that its contractors adopt appropriate measures to assess potentially contaminated land and, where necessary, undertake remediation

6.2.3 The CoCP contains control measures and standards to be implemented throughout Phase One of HS2. With respect to land quality and the assessment of contamination (Section 11 of the CoCP), there is the requirement to:

- implement control measures as appropriate including; watching briefs to identify all areas within Phase One of HS2 where land contamination is unexpectedly encountered, sealing of existing pathways through services or service trenches (e.g. land drains) affected during construction, lining of drainage trenches and buried services with bedding media to inhibit the mobilisation of contaminated groundwater or lateral migration through granular backfill and monitoring of groundwater/ground gases prior to, during and after construction.

6.2.4 The requirements of the CoCP have been taken into consideration within the risk assessment in this report.

6.3 Potential Sources

6.3.1 Several potential sources of contamination have been identified. These are summarised in Table 10. The sources have been identified both on and offsite from a review of the site history.

Table 10 Summary of Potential Sources of Contamination

Potential Sources	Description	Source reference
Onsite		
Made Ground	Asbestos has been identified within the Made Ground at one location onsite in the form of chrysotile cement and fibres. PAH were measured at concentrations marginally above the commercial screening criteria in two samples. EPH was measured in one Made Ground sample at an elevated concentration, likely a result of coal inclusions identified on the borehole log. Overall, no significant widespread contamination identified. The EWC health and safety files identified coal tar deposits and broken asbestos tiles were at the southern extent of the St James's Gardens excavation, which may extend onto the Proposed Development, although this has not been indicated in the available ground investigation information. Ground investigation has identified asbestos, which is not uncommon in made Ground soils. No evidence of coal tar or significant hydrocarbon contamination has been identified, however coal fragments were noted in one borehole.	S1
Electricity substation	There are records of an historic electricity substation located onsite dated between 1969 and 1991. Contaminants of concern associated with electricity substations include fuels, petroleum hydrocarbons, and polychlorinated biphenyls (PCBs). Substations tend to have small volumes of oils (which may have contained PCBs) and leaks are generally captured or contained. Ground investigation undertaken to date has not included PCB testing, however no evidence of oil contamination has been identified. In addition, substations tend to have small volumes of oils containing PCB with leaks captured/contained. Substations are not normally a major source of contamination. Not considered further.	n/r
Offsite		
St James's Burial Ground	The EWC scope of works has removed the entirety of the burial ground and the area has been excavated to a level within the London Clay. Not considered further.	n/r
Historic garage and motor vehicle repair	The areas occupied by both of these historical land uses has been excavated as part of the HS2 works for Euston Station. Any contaminated soils have therefore been removed. Any contamination that may have migrated historically is covered by S1. Not considered further.	n/r

n/r: not relevant; source not considered to be active and therefore not taken forward to the initial conceptual model

6.4 Potential Pathways

6.4.1 The potential contaminant pathways associated with the site are summarised in Table 11.

Table 11 Summary of Potential Pathways

Potential pathway	Efficiency of pathway	Pathway ref
Through direct contact with soil and dust, ingestion of soil and dust, or inhalation of dust	During construction: Potential for exposure of construction workers and neighbours during construction works.	P1
	During operation: The site will be covered entirely by hardstanding either in the form of the building or hard surfacing. Maintenance workers may be exposed to residual contamination if present if ground break is required, which is considered unlikely.	P2
Inhalation of soil gas or vapour	Made Ground will be present beneath the building. Data from ground investigation indicates a very low gas risk (CS1) and no protection measures are required. Not considered further.	n/r
Lateral migration of mobile contamination (dissolved and free phase)	Shallow superficial deposits (RTD), could act as a pathway for migration of dissolved phase contamination. Ground investigation did not identify any RTD in onsite locations. Not considered further	n/r
Rainwater infiltration and leaching of contamination	The site will be covered entirely by hardstanding either in the form of the building or hard surfacing. No soft landscaping is shown on current site plans. Not considered further.	n/r
Direct contact of concrete and services (e.g. foundations and water supply pipes)	Any structures or services in direct contact with underlying and surrounding soils could be subject to chemical attack by residual contamination. All concrete and building materials will need to be appropriately specified and service runs designed to reflect the ground conditions.	P3
Root uptake (vegetation and trees)	No soft landscaping included in current design. Not considered further.	n/r

n/r: not relevant; pathway not considered to be active and therefore not taken forward to the initial conceptual model

6.5 Potential Receptors

6.5.1 The potential receptors associated with the have been identified for during construction and the operational phase of the development are summarised in Table 12.

Table 12 Summary of Potential Receptors

Potential receptors	Potential sensitivity	Receptor ref
Construction workers (particularly ground workers) and site visitors and neighbours during construction.	Moderate: Construction workers will come into direct contact with soils during construction. It is assumed construction workers will be wearing PPE, with good hygiene facilities and site practice, reducing sensitivity. There is the potential for generation of dust as part of the construction works, albeit minimal considering the limited below ground works.	R1
Site users during operation and maintenance workers;	Very low: The site will be covered entirely by hardstanding either in the form of the building or hard surfacing. No soft landscaping is shown on current site plans. Maintenance workers may be exposed to residual contamination, if present, should future groundbreak be required. This is, however, considered unlikely given the form of development and temporary use.	R2
Shallow groundwater (secondary aquifer)	Low to moderate: Shallow superficial deposits are designated as a Secondary aquifer but none have been encountered onsite. Not considered further.	n/r
Chalk principal aquifer	High: Located at depth and overlain by a significant thickness of low permeability deposits. The site is not located within a SPZ and there are no potable water supply abstractions within 1km of the site. Not considered further.	n/r
Buildings/underground structures and services	Low: materials and services will need to be appropriately designed / specified to reflect the ground conditions.	R3
Vegetation (e.g. shrubs and trees), and soft landscape areas.	Negligible: Small area of low-quality soft landscaping present in the west of the site, not considered to be significant and not considered further.	n/r
n/r: not relevant; receptor not considered to be relevant and therefore not taken forward to the initial conceptual model		

6.5.2 Ecological receptors have not been identified in the area surrounding the site and are not considered further.

6.6 Potential contaminant linkages

6.6.1 Based on the identified potential sources, pathways and receptors, an initial conceptual site model (CSM) for the site has been produced as shown in Table 13, which includes an assessment of the potential contaminant linkages (PCLs).

6.6.2 The approach to risk estimation adopted in the CSM is based on the methodology presented in Appendix D6. This sets out a risk classification and estimation methodology, considering the severity of the consequence of the exposure and the likelihood the exposure would occur.

Table 13 Potential Contaminant Linkages

Potential contaminant linkage			Classification and risk estimation			Further assessment or mitigation required
Source	Pathway	Receptor	Probability	Consequence	Risk	
Onsite Made Ground (S1),	Direct contact and ingestion or inhalation of dust (P1).	Construction workers, site visitors and neighbours during construction (R1).	Low	Medium	Moderate /low	**Yes (PCL1)** Workers are likely to come into direct contact with soil during the below ground work, however this is minimal. The potential for significant contamination at the site is relatively low based on the results of ground investigation, which have not identified significant or widespread contamination. Risks can be mitigated through the implementation of enhanced safety controls and implementation of the CoCP and other legislative regimes (e.g. CDM). Additional measures are required to mitigate risks from asbestos, these are provided in Section 6 of this report.
	Direct contact and ingestion or inhalation of dust (P2).	Site users and maintenance workers during operation (R2).	Unlikely	Minor	Very low	**No**. No potential direct contact with underlying soils during operation. The site is only intended for temporary use (10 to 15 years).
	Direct contact with soils (P3).	Buildings/ underground structures and services (R3)	Unlikely	Minor	Very low	**Yes (PCL3)** The results of ground investigation do not indicate the presence of significant widespread contamination. Materials will be appropriately specified for the ground

Potential contaminant linkage			Classification and risk estimation			Further assessment or mitigation required
Source	Pathway	Receptor	Probability	Consequence	Risk	
						conditions and relevant utility providers are assumed to be consulted regarding material selection.

7 Conclusion and Recommendations

7.1 Conclusions

7.1.1 The results from the ground investigation undertaken do not indicate the presence of significant widespread contamination at the site. All results are below GAC derived for a commercial end use, except for two individual concentrations of PAH in Made Ground. Asbestos in the form of cement and fibres was also identified in Made Ground soils, which is not uncommon. The Proposed Development is low sensitivity considering its proposed construction with limited in ground works (piling and base slab construction) and (temporary) end use with hardcover.

7.1.2 Potential contamination has been identified at the northern site boundary by the EWC following their works to excavate the St James's Garden burial ground. Although not identified by the available ground investigation information, it is possible that this contamination could locally extend onto site. If encountered, it will not present an unacceptable risk to be Proposed Development and any short-term risks during groundworks can be appropriately manged during the construction phase.

7.1.3 No shallow superficial deposits were encountered at the site and all construction terminates in the London Clay. No risks to groundwater have been identified.

7.1.4 Ground gas monitoring indicates the site falls within a Characteristic Situation 1 (very low risk). No ground gas protection is therefore required.

7.1.5 Plausible contaminant linkages have been identified between potential onsite contamination and human health receptors during construction and operation of the Proposed Development and building services and materials. Risk assessment has determined that risks to human health are moderate to low during construction and very low during operation. In general, good construction practices (e.g. health and safety, environmental controls) will mitigate the risks identified. Risks to building materials and services can be mitigated through robust design taking account of ground conditions and consultation with relevant utility providers regarding material selection.

7.1.6 No further ground investigation is considered to be required to further refine the risk assessment and recommendations included in this report as there is considered to be sufficient existing data available in the context of the proposed construction, site setting and potential for contamination.

7.1.7 No specific remediation (e.g. source removal) is warranted. The 'remediation strategy' consists of standard brownfield development measures.

7.1.8 There are already enhanced health and safety measures in place for the construction as part of the HS2 CoCP and any contamination that may be present onsite can be manged by the implementation of a watching brief.

7.1.9 A remediation strategy and verification plan are provided in the following sections.

7.2 Remediation strategy

7.2.1 The results of ground investigation do not indicate the presence of significant contamination and no significant risks have been identified. No specific 'remediation' (e.g. source removal) is warranted based on the results of ground investigation undertaken at the site. The 'remediation strategy' consists of standard brownfield development measures as detailed in the following sections.

Site safety and control

7.2.2 Based on the findings of the ground investigation and risk assessment, mitigation measures including those outlined should be implemented as a minimum during the works:

- the works will be undertaken in a fashion to prevent or limit the creation of dust and hence also prevent dust emissions from the works. Dust prevention measures will be in place before work commences.
- sufficient hygiene control and personal protective equipment (PPE) will be provided for the works. Suitably competent personnel will advise on and supervise the works and all staff will be briefed on the working methods. Working methods that control human exposure to soils will be adopted and access to the site will be controlled during the works with the Made Ground.
- the contractor(s) will undertake an appropriate level of awareness training, inductions and toolbox talks. Inductions, risk assessments, method statements and toolbox talks will emphasise the specific ground conditions such as hydrocarbons and asbestos potentially indicated as being present onsite from ground investigation information.
- the relevant risk assessments, method statements, health and safety plans and toolbox talks will be subject to review if different conditions are encountered.

Watching brief and unexpected contamination

7.2.3 A watching brief should be maintained during the works for the presence of contamination, in particular for works along the northern boundary of the site where hydrocarbon contamination and asbestos have been recorded. Low levels of asbestos in soils and Made Ground may not be visible but still present a risk of harm to human health.

7.2.4 The method for implementing the watching brief should be described in the construction phase risk assessment method statement (RAMS). The watching brief should be documented and reported on during progress meetings. This may not

include specialist staff for the general operations. However, if contamination is suspected then a specialist should be consulted.

7.2.5 The key actions are:

- A detailed brief should be provided to all staff involved in excavation and/or ground break works prior to works commencing onsite (likely as part of the site induction and at key stages via toolbox talks) so they are aware of the visual and olfactory observations that can indicate the presence of contamination. It is a legal requirement that if asbestos may be present then the minimum training is at least asbestos awareness training.
- If potential contamination is identified, works are to be suspended in the area and a qualified and experienced specialist (appropriate to the type of contamination) should be consulted.
- Where required, an assessment (by the appropriately qualified and experienced specialist) undertaken to assess the requirement for additional control and/or mitigation measures or modifications to the working method. An assessment of potential effects on and changes to the design (such as concrete, polymers etc.) because of contamination will also be considered.
- Where it is necessary to sample and test soils for waste classification purposes or for dealing with unexpected contamination, this will be undertaken in an appropriate manner by appropriately experienced and qualified staff. Soil testing should be to MCERTS and UKAS standards. All such activities should be recorded and reported on.
- Determination for the requirement to consult the Local Authority.

Asbestos

7.2.6 Asbestos was identified during ground investigation in the form of chrysotile fibres and cement. There is a potential for encountering asbestos in Made Ground soils. Additional precautions are recommended during construction. Risks to construction workers and neighbours can be managed with enhanced safety procedures. The following actions are required as a minimum:

- All site staff should have at least asbestos awareness level training.
- An occupational risk assessment should be undertaken by a competent assessor (asbestos specialist) in accordance with the Control of Asbestos Regulations (CAR) 2012 [Reference 17] and the associated code of practice to determine the likely exposure resulting from the works and the level of protection and management required by CAR 2012.
- The CAR 2012 assessment will identify the levels of precautions necessary. Measures will include proactive dust control, materials management, and additional site controls.
- The CL:AIRE Joint Industry Working Group (JIWG) CAR-SOILTM (2016) Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials guidance [Reference 7] should be used to ensure the works comply with the requirements of CAR 2012.

Materials and waste management

7.2.7 Limited excavation will be undertaken during the development and there will be no potential for re-use of soil as part of the Proposed Development.

7.2.8 If disposal to landfill is required, the available chemical data indicates that the results are below the hazardous waste threshold, except for one sample due to the EPH concentration of 3,406mg/kg.

7.2.9 In addition, one result was recorded above the hazardous waste threshold for asbestos of 0.1% (maximum recorded concentration of 0.27% w/w of chrysotile cement). One sample also recorded chrysotile fibres at a concentration of <0.001% w/w, which is below the hazardous threshold.

7.2.10 The Environment Agency indicates that if waste contains less than 0.1% w/w as 'free fibres' it is not hazardous waste. However, if fragments of asbestos containing material (ACM) can be seen by the 'naked eye' by a 'competent person' (such as that identified in BH1) then the content of asbestos in ACM would exceed 0.1% w/w and the material (soil and ACM) would be classed as a mixed waste. If the ACM cannot be segregated from the soil, then the material would be classified as hazardous. As visible ACM was identified, soils would be classified as hazardous if this cannot be segregated. There are no waste acceptance criteria for asbestos, although it would typically be assumed that inert waste was free from asbestos fibres.

7.2.11 Excavated material and stockpiles of soils arising from construction should be appropriately managed to prevent the spread of material, dust generation and potential cross contamination.

7.3 Verification plan

7.3.1 A verification report should be prepared to document the works undertaken to address the specific control and mitigation measures outlined in this report. The information about the ground conditions should be passed on such that it can be taken account of during the operational phase. This will also be required for any areas of land being handed over to other landowners.

7.3.2 The verification report should include:

- Details of any contamination identified during the works and how these were addressed;
- Details of the type, form, amount, and distribution of asbestos encountered during excavation and construction works; and,
- Asbestos health and safety control measures, including CAR occupational risk assessment and resulting specific/additional control measures, air monitoring results.

7.3.3 The verification report should also include the pertinent 'land quality' information to document the works as part of the health and safety file and/or contractual close out document. This may include, but not necessarily restricted to:

- Waste disposal records;
- Health and safety and environmental control measures employed;
- Encountered ground conditions and results of any additional laboratory testing; and,
- Communication and correspondence with the Local Authority.

8 References

Reference 1 Ground Engineering (2018), Site Investigation Report Maria Fidelis, December 2018. Report ref No.C14593.

Reference 2 High Speed 2 Ltd (2017) Code of Construction Practice (Annex 1 of the High Speed Rail (London-West Midlands) Environmental Minimum Requirements)

Reference 3 Euston Station HS2 Enabling Works (2018), Ground Investigations Factual Report (HES). Doc No. 138076-BRI-REP-EGE-0000001

Reference 4 British Geological Survey (2021), GoeIndex Map Viewer. Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html?_ga=2.259657354.1661486783.1612518478-693331568.1611662669

Reference 5 The LQM/CIEH (2015) S4ULs for Human Health Risk Assessment, (Copyright Land Quality Management Limited (Publication Number S4UL3227))

Reference 6 CL:AIRE (2010), Soil Generic Assessment Criteria for Human Health Risk Assessment

Reference 7 The CL:AIRE Joint Industry Working Group (JIWG) CAR-SOILTM (2016) Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials

Reference 8 CIRIA C733 (2014), Asbestos in Soil and Made Ground: A guide to understanding and managing risks

Reference 9 CIRIA (2007), Report C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings.

Reference 10 BS 8485 (2015) Code of practice for the design of protective measures for methane and carbon dioxide gases for new buildings

Reference 11 Wilson, Card & Haines (2009), Ground Gas Handbook, Whittles Publishing, Caithness, Scotland

Reference 12 The National Planning Policy Framework (NPPF), February 2019, ISBN 978-1-5286-1033-9

Reference 13 Land Contamination Risk Management (LCRM) framework, October 2020. Available at: https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

Reference 14 Defra and Environment Agency (2004) CLR 11: Model Procedures for the management of land contamination.

Reference 15 CIRIA (2001), C552 Contaminated land assessment – A guide to good practice.

Reference 16 Environment Agency (March 2012), Good practice for decommissioning redundant boreholes and wells

Reference 17 CL:AIRE (2016), Control of Asbestos Regulations 2012, Interpretation for managing and working with asbestos in soil and construction and demolition materials, Industry guidance

Figures

Figure 1 Site location plan

Figure 2 Previous ground investigation location plan

Appendix A: Correspondence with London Borough of Camden

Contaminated Land Officer

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Appendix B: Groundsure (2021) report

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Appendix C1: Ground Engineering ground investigation report

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Appendix C2: HS2 ground investigation information

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Appendix D: Risk Assessment Methodology

D1 Background

A generic quantitative assessment of the results of the contemporary phase of ground investigation is provided in the report in accordance with the current UK guidance on the assessment of contaminated land and in particular the Contaminated Land Exposure Assessment (CLEA) framework.

D2 Human health

D2.1 Chemical contamination

D2.1.1 Generic assessment criteria

The UK statutory guidance suggests that generic soil quality guideline values may be used for an initial screening of soil contamination results in relation to human health risk assessment. Generic assessment criteria (GAC) provide an indication of concentrations in soil below which the long-term human health risks for various generic land-use scenarios are considered to be minimal. Concentrations above GAC do not necessarily indicate that significant contamination is present, but rather that further assessment or risk management measures may be warranted.

A generic commercial end use has been considered in the assessment to provide an initial appraisal of the results. The generic commercial end use is based on assessing risks to a female office worker, spending her entire working life (full time) onsite. She frequently uses soft landscaping and is directly exposed to soils being assessed via ingestion, dermal contact, and inhalation of dust and vapour both outside and inside the building. Future users of the Site will not come into direct contact with potential contamination in soils or dust on the Site because the site comprises the footprint of the 1 Triton Square building.

Category 4 Screening Levels (C4SLs), released by Defra for some determinands including lead, have been used in the first instance within this assessment. C4SLs are only available for six contaminants and consequently SDSC has derived GAC using CLEA 1.07 which use C4SL exposure parameters but maintain the traditional minimal risk toxicological benchmarks. Input data for the toxicological effects, physical characteristics and contaminant fate and transport parameters for the determinands have been taken from sources published by the Environment Agency and other industry sources (including LQM/CIEH and the European Food Safety Authority (EFSA). Further details of the derivation of the GACs including changes made to the default user chemical database and exposure assumptions are available on request.

D2.1.2C4SLs

Defra has released a set of Category 4 Screening Levels (C4SLs) which, according to associated guidance may be applicable under the planning regime in some circumstances.

The Contaminated Land Statutory Guidance (2012) defines four 'categories' of land when considering human health and the water environment to assist in determining whether a site might be "Contaminated Land" under Part 2A. Category 1 and 2 would indicate that the site would be determined; whereas in the case of both Category 3 and 4 it would not. Land that has been developed which is assessed to be within category 4 should be acceptable under planning. Defra recently confirmed in writing that C4SL (criteria developed to define the boundary between category 3 and category 4) could be used under the planning regime. It states that C4SL provide a simple test for deciding if land is "suitable for use" and definitely not contaminated. A developer may decide that in the cases where they are providing high quality new development that a higher level of protection may be preferred on a voluntary basis, for instance by using generic assessment criteria based on negligible levels of risk.

The conditions assumed in the C4SL calculations include sandy loam soil and 6% SOM. The detailed description of the Made Ground suggest that the soils could reasonable classified within the sandy loam to sandy clay range; the %SOM is low, typically <1%.

d2.1.3 Asbestos in soil

Work with asbestos in the UK is controlled by the Health and Safety Executive (HSE) and the Control of Asbestos Regulations (CAR) 2012. Certain activities, such as working with asbestos insulation, coatings, and insulting board require licensing and notification to the appropriate authority before work commences. All work with asbestos materials must be initially assessed by a competent person and various requirements arise from that assessment.

The HSE has published a Code of Practice for CAR 2012 which does not include specific guidance regulating asbestos in soils. In March 2014 CIRIA published C733 Asbestos in Soil and Made Ground: A guide to understanding and managing risks.

In order for asbestos found within soil to pose a risk to health, it has to be present in a form that can release fibres to air for inhalation (or may do after it has been disturbed). The potential for fibre release is likely to be relatively lower when asbestos is present in soil in the form of cements or other 'bonded' materials and higher when friable forms or unconsolidated forms such as 'free fibres' are present. However, even cemented and bonded ACM may eventually degrade and release fibres and can be disturbed and broken during construction for instance.

The release of fibres from the soil into the air can occur via wind-blown disturbance or physical disturbance either during site development (e.g. construction, remediation

or earthworks) or during site use after development. The concentration of airborne fibres released is influenced by many factors including asbestos type, ACM type and condition/state, depth, distribution and concentration in soil, soil type, and soil moisture content. There is limited data on the release of airborne fibres from soils in real world environments, but soil moisture content has a particularly significant impact. In laboratory studies, the addition of 5% moisture to a dry soil reduced airborne fibre release by 80-95% and no airborne fibre were detected when the soil moisture content was greater than 15%.

There are currently no generic assessment criteria for asbestos in soils and C733 makes it clear that such criteria are unlikely in the near future due to uncertainties on the mechanisms for fibre release, calculating the likely exposure and the risk of harm at low levels of exposure. Instead the report recommends site specific assessment based on multiple lines of evidence.

In 2016 a guide was published by CL:AIRE referred to as 'Interpretation for managing and working with asbestos in soils CAR-SOILTM', which is currently the most authoritative guide on the topic and should be followed. CAR-SOILTM confirms that all work with asbestos in soil should be carried out under a 'plan of work' and defines the contents of that plan.

Analysis has been performed to the lowest possible accredited detection limit routinely reported by laboratories (0.001%) and a robust strategy to sever plausible pollutant linkages will be adopted in the remediation strategy, to reduce exposure as low as reasonably practicable during development and prevent exposure after development.

D3 Controlled waters

The framework within which the Environment Agency can work with others to manage and protect groundwater is set out within 'Groundwater protection: Principal and practice (GP3), 2013. Groundwater and leachability results have been screened against Water Quality Standards (WQS), initially by comparison with the environmental quality standards (EQS) for inland surface water, or where unavailable freshwater EQS. Where EQS screening criteria are not available, the following guidelines and standards have been referred to in this hierarchy:

- UK Drinking Water Standards (DWS);
- Surface Water Abstraction Directive (SWAD); and
- The World Health Organisation (WHO) Guidelines for Drinking Water.

No criteria are available at all for certain other PAH and for TPH. In the absence of criteria for TPH the withdrawn DWS of 0.01mg/kg has been considered as an initial assessment.

D4 Ground gas

The following published guidance on the assessment of ground gas has been used in the assessment:

- CIRIA 2007 Report C665 Assessing risks posed by hazardous ground gases to buildings;
- BS 8485 (2015) Code of practice for the characterisation and remediation from ground gas in affected developments; and
- Card, Wilson and Haines (2009) Ground gas handbook.

The Ground gas handbook describes a process of deriving gas screening values (GSV) for hazardous ground gases (it summarises the guidance presented in reference 14 and 15 above). The method uses both gas concentrations and borehole flow rates to define a range of characteristic situations (CS1 to CS6) based on limiting borehole gas volume flow for methane and carbon dioxide. The GSV is calculated by multiplying the borehole flow rate (litres per hour) by the gas concentration

D5 Waste assessment methodology

Framework

There are three types of permitted landfill (inert, non-hazardous and hazardous) and four principal types of waste, as outlined below:

- Inert; generally uncontaminated natural soils and certain clean construction materials such as crushed concrete. The material may be disposed of to an inert landfill without testing. If the natural soils are suspected as contaminated then it may be classed as inert if it satisfies the inert waste acceptance criteria (WAC). Made Ground would typically be required to be tested and pass the WAC in order to be classed as inert. Inert materials may also be used as a construction material in other sites given appropriate waste management permitting;
- Hazardous; defined by the analysis of 'total' chemical parameters to assess the hazard properties. The classified waste may only be disposed of to a hazardous landfill (following treatment) if in addition it satisfies the TOC and leachability WAC;
- Stable non-reactive hazardous waste; defined in a similar manner to hazardous waste (i.e. classed as hazardous) but then satisfying a stricter set of WAC. Following treatment, it may be disposed of in specifically designed separate cells in non-hazardous landfills (if the operator has obtained a permit to operate these cells); and
- Non-hazardous waste; if the waste is not classified as inert or hazardous then it is non-hazardous. There is no WAC for non-hazardous waste.

Hazardous waste classification

The following documents were used to carry out the initial waste classification and disposal assessment of Made Ground and natural soil arisings generated by the development:

- Environment Agency (2009), Hazardous Waste – August 2009 Update;
- Environment Agency (2015), Hazardous Waste, Technical guidance WM3;
- The Hazardous Waste (England and Wales) Regulations; and
- Table 3.2 of Annex VI to Regulation (EC) No. 1272/2008.

Metals may be classified as hazardous based on a number of potential hazardous properties including carcinogenic (H7 lowest threshold 1,000mg/kg), ecotoxic (H14 lowest threshold 2,500mg/kg), toxic for reproduction (H10 lowest threshold 5,000mg/kg), harmful (H5 lowest threshold 250,000mg/kg) and toxic (H6 lowest threshold 30,000mg/kg). With the exception of H7, the other classifications are additive i.e. the concentrations are converted to the worst case (for harm) compound and added together before comparison with the thresholds.

Hydrocarbons in contaminated soils are generally categorised against the hazardous properties carcinogenic (H7) and ecotoxic (H14). For H7, waste would be defined as hazardous if category 1 or 2 carcinogenic compounds (e.g. benzene) exceeded 0.1% (1,000mg/kg), or category 3 compounds (e.g. diesel) exceeded 1% (10,000mg/kg). TPH is an aggregate parameter that includes a range of category 1, 2 and 3 compounds, along with other elements not classified as carcinogenic. In most circumstances TPH contaminated soil and stones should be assessed as 'unknown oil' (unless there is a specific documented record or a consistent hydrocarbon profile to indicate diesel or weathered diesel being the contaminating oil) and a worst case should be assumed.

For an unknown oil if the concentration of TPH is ≥ 0.1% the waste will be H7 Carcinogenic and H11 Mutagenic unless the concentration of benzo[a]pyrene is <0.01% of the TPH concentration. Substance specific thresholds have been set for specific PAHs.

The hazardous waste threshold for asbestos is 0.1% w/w. It is noted that the quantification weight percentage of asbestos is difficult to achieve as asbestos can be present in a wide range of forms. While it is likely that ACM, such as cemented asbestos, board or lagging, will exceed such a threshold, the quantity of ACM in a bulk sample will often be below this level. WM3 states that where a waste contains identifiable pieces of ACM (that can be identified as potentially being asbestos by a competent person if examined by the naked eye) then these pieces must be assessed separately. If the ACM cannot be segregated the waste is regarded as hazardous if the concentration of asbestos in the ACM pieces alone is greater than 0.1%.

D6 Risk assessment methodology

The method for risk evaluation takes into consideration the magnitude of the potential severity of the risk, as well as the probability of the risk occurring. The risk characterisations have been assessed based on the qualitative method of interpretation set out in CIRIA guidance C552 and NHBC/EA/CIEH risk classification methodology.

The method for risk evaluation involves the classification of the:

- Magnitude of the potential consequence (severity) of the risk occurring (refer to Table C1-1);
- magnitude of the probability (likelihood) of the risk occurring (refer to Table C1-2); and,
- Table C1-3 presents the risk assessment matrix.

Table D1-1 Classification of consequence

Classification	Definition
Severe	Short-term (acute) risk to human health likely to result in 'significant harm' as defined by the Environmental Protection Act 1990, Part IIA. Short-term risk of pollution of a sensitive water resource. Catastrophic damage to buildings or property. A short-term risk to an ecosystem, or organism forming part of such ecosystem.
Medium	Chronic damage to human health. Pollution of a sensitive water resource. A significant change to an ecosystem, or organism forming part of such ecosystem.
Mild	Pollution of a non-sensitive water resource, such as non-classified groundwater. Damage to buildings, structures and services.
Minor	Harm, which may result in a financial loss, or expenditure to resolve. Non-permanent effects to human health, which could easily be prevented by means such as personal protective clothing. Easily repairable effects of damage to buildings, structures and services.

Table D1-2 Classification of probability

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 level 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 over 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 not certain that such an event would take place.
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.

Table D1-3 Comparison of consequence against probability

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High likelihood**	Very high risk	High risk	Moderate risk	Moderate/ low risk
	Likely	High risk	Moderate risk	Moderate/ low risk	Low risk
	Low likelihood	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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Appendix E: Chemical Screening Spreadsheets

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