Ground Contamination Desk Study

Gasholders Marketing Suite

King's Cross Central General Partner Ltd

December 2014

King's Cross

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Ground contamination desk study

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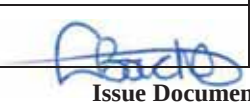
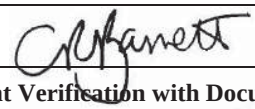
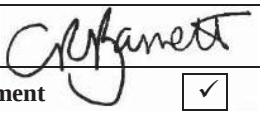
		Signature			

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1 Introduction

1.1 Background

King's Cross Central General Partner Limited (KCCLP) proposes to develop Zone F of the King's Cross Central (KCC) development area for a temporary use as a marketing suite for the Gasholder Triplets development. KCCLP will be acting through its Asset Manager, Argent (King's Cross) Limited ("Argent").

The existing building is currently in use as a restaurant and was previously a petrol filling station. Ove Arup and Partners Ltd (Arup) has been commissioned by Argent to carry out a ground contamination desk study for the site and provide a scope of ground investigations in support of a detailed planning application being made for the temporary use.

1.2 Report objectives

The objectives of this report are to identify and assess the existing information relating to the ground conditions and environmental setting. The report will outline potential contamination risks and further investigations that will be carried out prior to commencement of the development. The report will specifically:

- Provide a review of past and current uses of the site and surrounding area, discussing the environmental setting and nature of potential contaminative sources;
- Outline the local geology, hydrogeology and hydrology;
- Use the existing site data and details of the proposed development to inform an initial conceptual model and preliminary risk assessment;
- Provide recommendations regarding the implications of the findings for the temporary phase of development and identify requirements for intrusive ground investigation; and
- Describe the processes that would be undertaken if contamination is identified on site, including best practice construction works and any potential temporary remedial works.

Argent and their planning consultants have undertaken a pre-application meeting with London Borough of Camden (LBC). During that meeting it was agreed that the desk study should set out the scope of investigations, the method statement as to how the contamination investigation will be undertaken and the likely actions that will be implemented in the event that contamination is found on-site.

1.3 Information sources

EnviroInsight, GeoInsight and MapInsight reports have been obtained from GroundSure (reference GS-1777899, GS-1777900 and GS-1777898). The reports are included in Appendix A. In addition, information provided by the Environment Agency [1] in relation to hydrogeology and groundwater and by the British Geological Survey (BGS) [2] relating to geology was also reviewed. Records obtained from historical planning drawings [3], British Petroleum (BP)

[4] and the Fire Brigade [5] have been reviewed with regard to the location of abandoned/ decommissioned tanks included in Appendix B. A ground penetrating radar (GPR) survey was completed for the site, in July 2014 [6] and is discussed in section 3.

1.4 Report structure

This report has the following structure:

- Section 2 outlines the current configuration of the site and environmental setting;
- Section 3 describes the site history;
- Section 4 describes the anticipated ground conditions, following a review of published records;
- Section 5 describes the preliminary conceptual model;
- Section 6 outlines the preliminary risk assessment;
- Section 7 describes the proposed ground investigation methodology; and
- Section 8 describes the conclusions and recommendations including actions to be taken during development.

1.5 Limitations

Arup has based the ground contamination desk study 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 this third party information. Notwithstanding the efforts made by the professional team in undertaking this contamination assessment it is possible that ground conditions and contamination other than those potentially indicated by this report may exist at the site.

This report has been produced by Arup for use by KCCLP in connection with the proposed redevelopment of the site. It takes into account our client's particular instructions and requirements and addresses their priorities at the time. It is not intended for, and should not be relied upon by any third party and no responsibility is undertaken to any third party in relation to it, except as provided for in Arup's agreement with KCCLP.

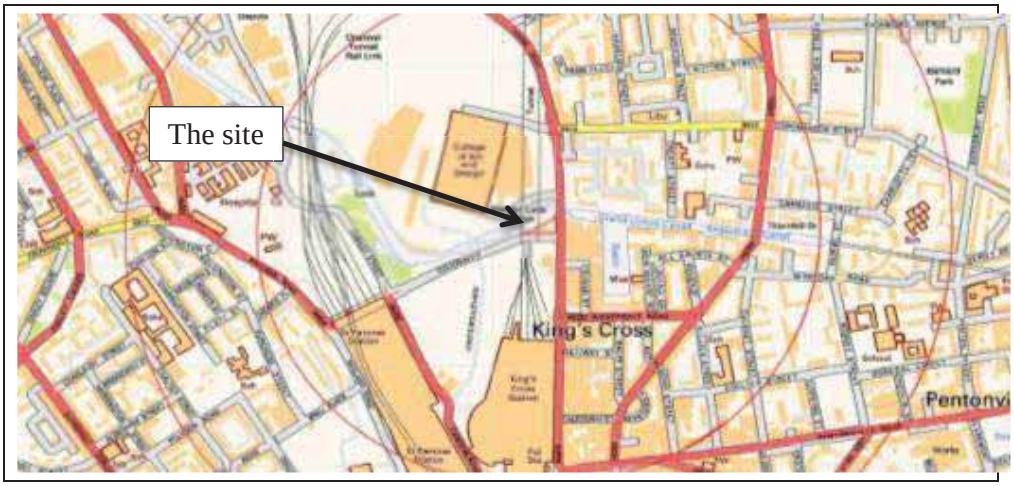
This report provides an assessment of the potential for contamination in the ground. The report does not provide an assessment of the potential for hazardous materials in the building fabric and the implications of those hazardous materials. A survey of hazardous materials in the building, for example asbestos containing materials, has not been carried out by Arup as part of this assessment.

2 The site

2.1 Site location

The site is located within Development Zone F on the eastern edge of the King's Cross Central development area and lies at the junction of York Way and Goods Way, as shown in the map extract in Table 1 below. The site is bounded by the A5200 York Way to the east, Goods Way to the south and Regent's Canal to the west and north.

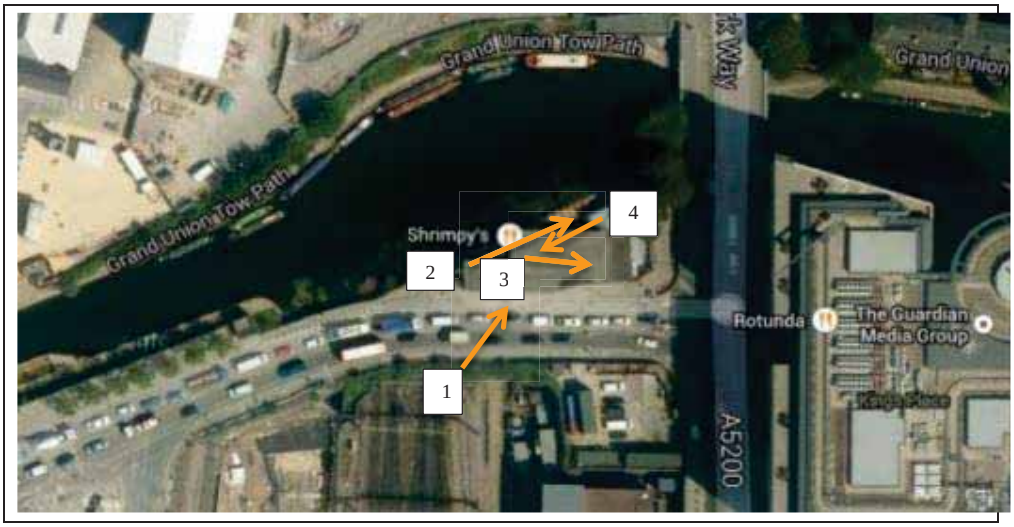
Table 1: Site location plan



2.2 Site description

The site comprises a triangular shaped piece of land, around 0.1ha in area, located within the Regent's Canal Conservation Area. The site was formerly a petrol filling station, originally built in the 1960s. The petrol station building and structures which remained on the site following its closure in 2011 comprised a single storey flat roofed red brick sales building, approximately 100-117sqm in area, and located in the centre of the site. The filling station forecourt to the west of the sales building contained a three pump island, sitting beneath a canopy of approximately 320sqm, with a height of approximately 5m. The site was served by separate access and egress crossovers onto Goods Way. All signs were moved in 2011 when the site use changed to food retail. The Filling Station site is currently occupied by a restaurant. The existing canopy provides a covered outdoor dining and events space, as shown in Table 2 below.

Table 2: Site layout plan (arrows show direction of photos in table 3)



The history of the site will be discussed in more detail in section 3.

2.3 Current site use

An environmental reconnaissance survey of the site was carried out on 27th November 2014 by an environmental consultant from Arup. The site is currently occupied by a single storey restaurant building and a covered outdoor dining and events space (Shrimpy's restaurant on the site referred to as The Filling Station) which utilises the former petrol filling station sales building and canopy. A temporary screen wall has been erected around the building and a canal-side balustrade has been installed along with three temporary buildings to provide toilet accommodation and a marketing suite.

The Filling Station does not provide any parking for vehicles and is accessed via Goods Way. Photos taken during the site reconnaissance visit are included in Table 3 below and the location and direction in which the photo was taken is highlighted in Table 2 above.

Table 3: Site photos

Photo 1	

Photo 2	
Photo 3	
Photo 4	

2.4 Proposed site use

The site is proposed for redevelopment, which will involve demolition of the existing buildings and construction of a temporary building. Permission for the Gasholders Marketing suite is sought for a temporary period of four years. This allows for a construction period of one year and then for operation of the Gasholder Marketing Suite for a period of three years. The temporary structure will be used as a marketing suite for the Gasholder Triplets building development located 325m northwest of the site.

Two options have been considered for the design and construction of the foundations for the Gasholder Marketing Suite. These are described below:

- Option A (preferred option); construction of a high quality raft foundation including barrier membrane, cast directly over the existing site hard standing with minimal disturbance of the ground; and
- Option B (back up option); construction of new building founded on piles requiring dealing with obstructions and excavations for pile and pile caps.

Once the foundations are constructed the building will comprise of two storeys and there will be a car parking area with space for two cars and bicycle parking. The ground floor level will provide a meet and greet space, meeting room, back of house facilities and a terrace including landscaping to reflect the roof terrace and green roof design of the Gasholder Triplets development. The first floor will comprise of a show apartment, model space and first floor terrace, replicating those of the Gasholder Triplets building.

The site will remain hard covered with landscaping in planter boxes. The two foundation options being considered are described below. Option A is the preferred option and all the existing desk based review suggests there is a high likelihood that it can be constructed successfully. However, if the geotechnical investigation identifies significant issues with the ground conditions, for instance much deeper, softer or unstable Made Ground than expected then the raft option will not be feasible and a piled solution will be used.

2.4.1 Option A

Option A proposes the construction of the temporary Gasholder Marketing Suite building using a new high quality raft foundation built directly on the existing hard standing with minimal disturbance of the ground. The proposed raft foundation will be a reinforced concrete slab, approximately 400mm thick, cast directly over the existing site hard standing. To account for the variability in the existing ground level, a compacted fill will be used to initially level out depressions to maintain an economic slab depth. The raft foundation will also include (as a minimum) a damp proof membrane. Option A requires little or no excavations or breaking out during the construction period. Some geotechnical investigation will be undertaken, prior to construction, to confirm existing ground conditions.

2.4.2 Option B

Option B proposes the construction of the temporary Gasholder Marketing Suite building founded on piles, with localised excavation (pile caps and obstructions).

This will include pile groups of two or three piles at each building column location.

2.5 Environmental setting

2.5.1 General

A summary of the environmental setting based on the information obtained from the GroundSure reports, and Environment Agency website [1] is provided in the sections below.

2.5.2 Sensitive land use

The EnviroInsight report identifies three Local Nature Reserves (LNR) within 1km of the site. The closest LNR is the Camley Street Nature Park located 216m west of the site. The report also confirms that there are no Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protection Areas (SPA), National Nature Reserves (NNR), RAMSAR sites, ancient woodlands, world heritage sites or Environmentally Sensitive Areas (ESA) within 2km of the site.

2.5.3 Environmental permitting and registers

There are no Contaminated Land Register Entries and Notices, Integrated Pollution Prevention and Control (IPPC) permits or registered radioactive substances within 500m of the site.

There are three active licenced discharge consents within 500m of the site. All three consents were for the discharge of cooling water. Two of the consents were located 256m southeast of the site at Regent's Quarter, King's Cross and the third was situated 272m east of the site at Copenhagen School Outlet, Pentonville Road. There is one record of hazardous substance planning consents and enforcements within 500m of the site. This consent was for the storage of natural gas at St Pancras Holder Station, located 254m west of the site.

There are no currently registered landfill sites identified by the EnviroInsight on or within 1km of the site. There is one historical landfill (recorded by the Environment Agency) within 1.5km of the site. This is located approximately 1.43km to the southeast and is identified at Rosoman Street/ Skinner Street. There are no waste treatment, transfer or disposal sites within 500m of the site. There are nine Environment Agency licenced waste sites within 1km of the site. The closest is located 286m to the west and has a licence for household, commercial and industrial waste.

There is one Notification of Installations Handling Hazardous Substances (NIHHS) site within 250m of the site. The historical NIHHS is located 109m southwest of the site and is listed as British Gas.

There have been two recorded pollution incidents within 500m of the site. The first is located 33m east of the site, had a minor (category 3) impact on water and involved mixed waste and oils. The second is located 486m south of the site, had a minor (category 3) impact on land and involved diesel.

2.5.4 Hydrogeology and hydrology

There are no records of superficial deposits identified in the EnviroInsight report. The bedrock hydrology of the site is described as London Clay which is classified as unproductive.

There are 49 abstraction licences within 2km of the site; of which 29 are groundwater abstractions, six are surface water abstractions and 14 are potable water abstractions. The closest groundwater abstraction is a borehole located at Regent's Quarter, 182m south of the site. It is an abstraction for a heat pump with a limit of 2,160m^3 per day and 323,612m^3 per year. The nearest surface water abstraction is located at Maiden Point Bridge, 17m north of the site. This is an abstraction for non-evaporative cooling and has a daily limit of 19,520m^3 and annual volume of 7,010,000m^3. The closest potable water abstraction is 726m east of the site at Barnard Park and is for direct water supply with a limit of 3,024m^3 per day and 914,544m^3 per year.

The site is not situated in a source protection zone (SPZ) for potable water supply; however there are two SPZ within 500m of the site. They are located 331m and 488m east of the site. There are four surface water features within 250m of the site. These are located, on site, 19m east, 84m west and 238m west of the site.

There are no listed pollution incidents to controlled waters within 500m of the site.

2.5.5 Radon

The GeoInsight report confirms that the site is in a lower probability radon area, as less than 1% of homes are above the action level. No radon protective measures are stated as being necessary.

3 Site history

3.1 Historic plans

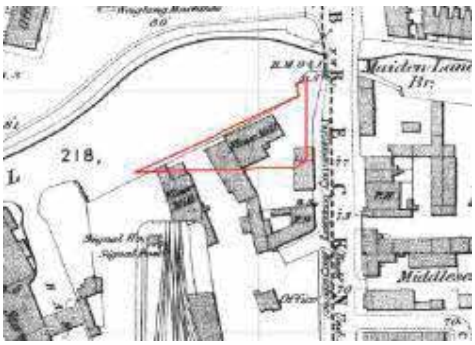
The area surrounding and occupied by the site has a history of industrial usage from the early 1800s until recent times. A series of historical Ordnance Survey (OS) maps and Goad maps [7] of the area, have been reviewed to provide an overview of previous land uses for the site and surrounding area and can be found in Table 4 below.

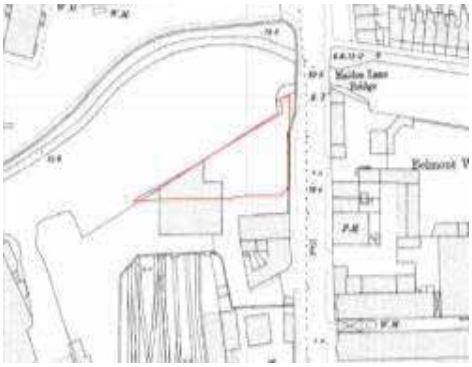
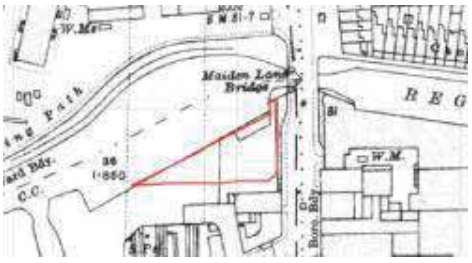
Prior to the 1820s the site and surrounding area was occupied by fields. In 1827, the Regent's Canal was constructed immediately north of the site. King's Cross railway station was constructed to the south of the site and was operational by 1852. Railway lines heading north from King's Cross enter a cutting and pass under the Regent's Canal and run west of the site and below the west corner of the site.

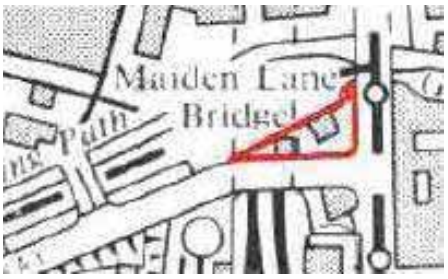
The following table is focussed on the site and immediate surrounds. In the wider area there is a long history of rail use and a large gasworks was located over 100m to the southwest. The gasworks has been extensively remediated and based on the ground conditions and elevation there was limited opportunity for these more distant historic sources to have resulted in contamination on this site.

The site was in use as a petrol filling station from at least the 1960s to 2011 when it was vacated. It is known that a number of tanks are located on site. Four tanks have been decommissioned in August 2011 and any residual tanks that may exist are expected to be decommissioned, emptied of fuel and foam filled for long-term safety. The on-site uses are considered to be the most significant with respect to the proposed development. The following table sets out the history of the site and immediate surrounds.

Table 4: Site history

Date	Map extract	On and off site features
1875-1877		**On site** The site is occupied by a flour mill. **Off site** The canal is located immediately north of the site with a potato market and goods depot located approximately 100m north of the site. A public house and residential buildings are located east and west and King's Cross railway station is located south of the site.

Date	Map extract	On and off site features
1891		**On site** The 1891 Goad maps shows a gas light and coke company store is located in the western part of the site and the flour mill (Goode Bros. Albion Mills) remains on the eastern part of the site. **Off site** Immediately southwest of the site a new tunnel is being constructed (Feb 1891) which runs in a north south direction west of the site.
1894		**On site** The flour mill building is no longer identified on the map. There is a large square unnamed building located to the west side of the site. This building extends south of the site footprint and has a similar layout to the store discussed above. **Off site** A basin linked to the canal is located approximately 60m southwest of the site.
1911	**On site and off site** No significant change in the immediate area	
1916		**On site** The unnamed building, to the west of the site, is no longer shown on site. There is a rectangular building running along the northern edge of the site. **Off site** No significant change nearby is apparent on the map
1920	**On site and off site** No significant change in the immediate area	
1938	**On site** No significant change. **Off site** Goods Way now runs immediately south and a bridge crosses the canal approximately 80m west of the site. The basin is no longer identified on the 1938 OS map.	
1948	**On site and off site** No significant change in the immediate area	

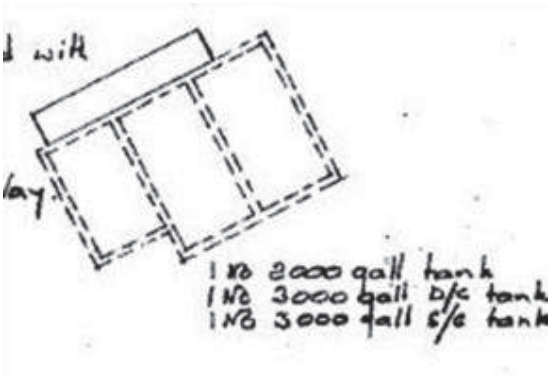
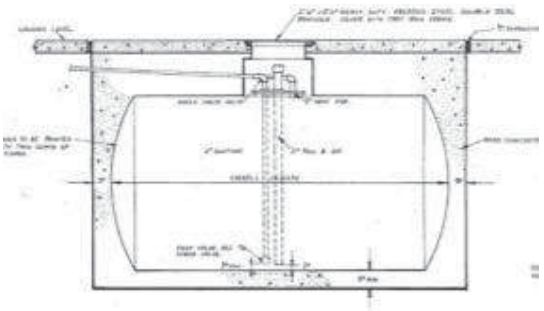
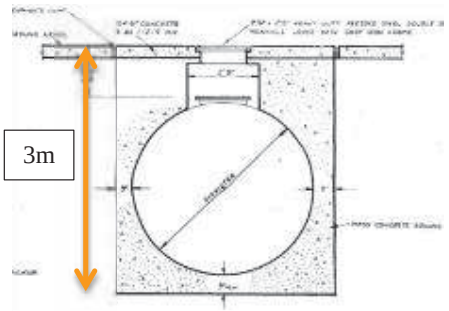
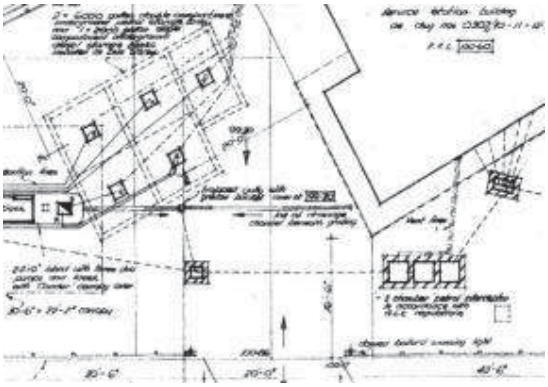
Date	Map extract	On and off site features
1952		**On site** An unnamed square building is identified towards the southwest region of the site and a rectangular one in the north east corner. **Off site** Ruins are identified approximately 100m southwest of the site (likely bomb damage).
1957	**On site** No significant change. **Off site** Ruins are no longer shown on the 1957 OS map.	
1963		**On site** The building located to the southwest of the site is no longer shown on the 1963 OS map. **Off site** A railway turntable is shown southwest of the site and a small tank(s) 80m southwest.
1973		**On site** Two unnamed square shaped buildings are located to the north and southwest of the site. These are likely associated with the petrol service station. **Off site** The map is relatively undetailed and the immediate surrounding area has a broadly similar layout
1974	**On site** The buildings are now identified as a garage. **Off site** 1974 OS map provides no details for the surrounding area.	
1982		**On site** Petrol station now has a canopy and represents the configuration of the present site footprint. **Off site** Tanks are again identified in the same position as the 1963 OS map. Industrial buildings located east of the site, include a warehouse and electricity sub-station.

Date	Map extract	On and off site features
1986		**On site** A garage building is identified, the canopy is not shown. **Off site** Buildings to the east of site are no longer shown on 1986 map.
1988, 1991 and 1994	**On site and off site** Same configuration as 1983 OS map.	
2002	**On site and off site** Same configuration as 1983 OS map, however garage is not labelled on 2002 OS map.	
2010	**On site** No significant change. **Off site** Tanks no longer identified to southwest of site and a car park is now identified in their place.	
2014	**On site** No significant change **Off site** Car park is no longer identified on 2014 OS map and building north of the site and canal is labelled as the College of Art and Design.	

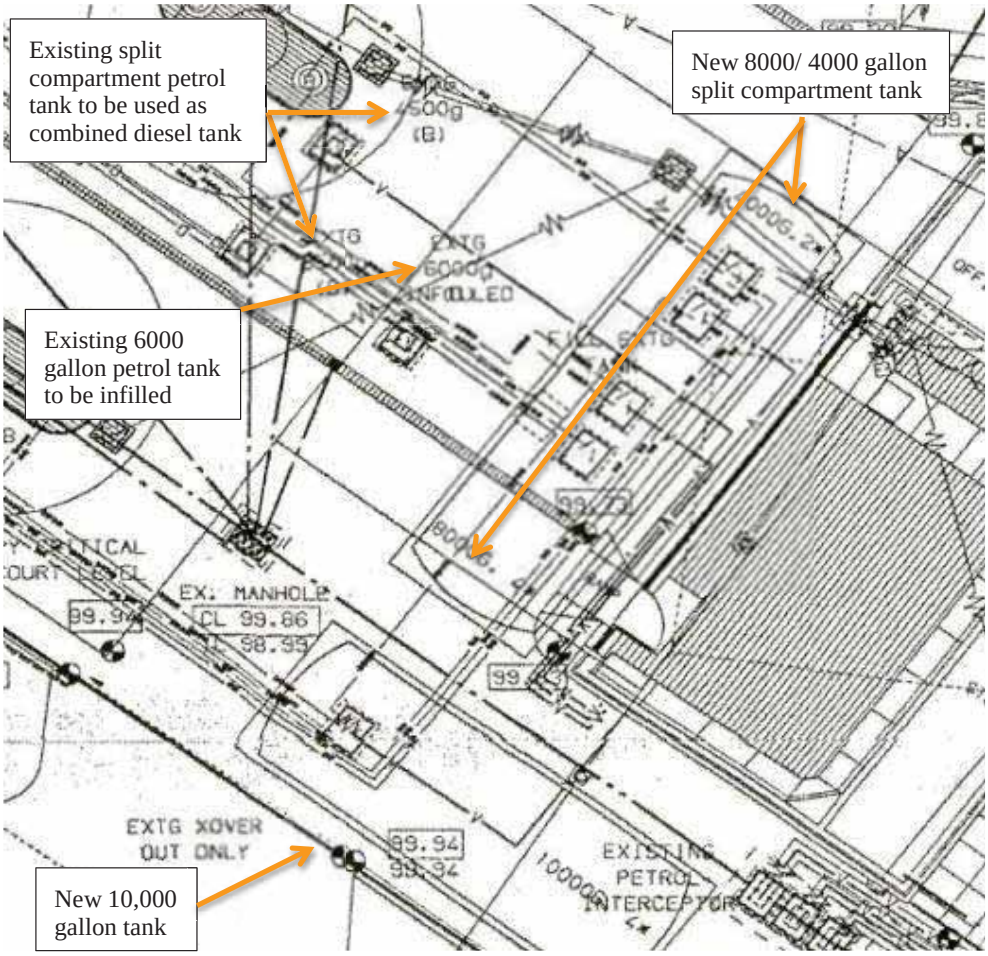
3.2 Fuel station records

The site has previously been used as a fuel filling and service station. Detailed searches for data regarding the construction and location of fuel tanks have been carried out; this included a search of planning records from the 1960's and 1980's planning applications. Drawings have been provided by BP (one of the previous operators) and a search of London Fire Brigade fire officer records was commissioned and various decommissioning records have been obtained. A ground penetrating radar (GPR) survey was undertaken and reported on. Table 5 describes the fuel station records obtained.

Table 5: Fuel station records

Drawing extract	Description
	Planning drawing (March 1964) Three tanks are identified in the east of the site; 1 No. 2000 gallon tank; 1 No. 3000 gallon below ground tank 1 No. 3000 gallon below ground tank
	
The planning drawings also show sections of the proposed tanks which were to be constructed encased in concrete (see above). Concrete would have encased the fuel tanks to a depth of approximately 3m.	
	Historical planning drawing (October 1965) 2 No. 6000 gallon double compartment underground petrol storage tanks. 1 No. 2000 gallon single compartment underground diesel storage tank These are shown located to the northwest of the site. A three chamber 'petrol' interceptor is located to the south of the site.

Drawing extract	Description



Fire Brigade records (April 1986) (shown above).

The drawing identifies an existing petrol interceptor to the south of the site and a two chamber interceptor to the north of the site.

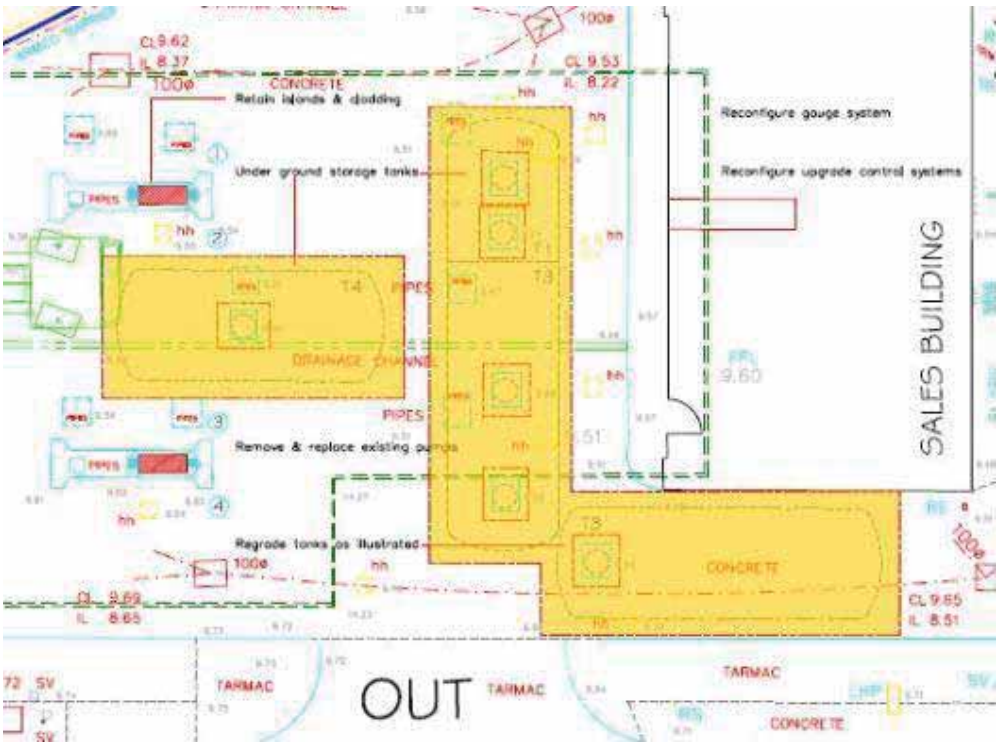
A new tank is identified immediately to the south of the main building and west of the two chamber interceptors.

In the centre of the site 4500 gallon, 2500 gallon and 6000 gallon 'existing tanks' are identified using text only (in similar locations to previous) and noted as being filled.

The drawing notes that the existing 6000 gallon petrol tank and 2000 gallon diesel tank are to be infilled (referring to two mentioned above) and the existing split compartment 2500/4500 gallon petrol tank is to be used as a combined diesel tank.

The drawing also shows a new tank to the west of the main building which is listed as two compartments of 8000 gallons and 4000 gallons.

The plan notes that all petrol lines are to be installed in cast in-situ waterproof ducts to prevent leakage. The filling point is located next to the canal at the western end of the site.

Drawing extract	Description
	BP preliminary site layout plan (2001) The plan shows three fuel tanks identified on site and highlighted in yellow. Two are shown in a similar position and size as the 1986 drawing, although more detail is provided on the location of the tank between the two petrol pumps running east west. The filling point is located in the same location

The records obtained provide the locations of the various fuel tanks, although there is some variation between the records. The fire brigade records show that the original tanks were installed in 1967 although it is possible they were installed before that date.

Based on this information it is likely that the original tanks were replaced when the site was redeveloped in 1986 and then were broadly in similar locations when taken over by BP in the early 2000s. The fire brigade records indicate that the original tanks were 'infilled' when the site was developed in the 1980s however there are no records to confirm that this was done.

Further records were provided for the decommissioning of the existing tanks and are included in Appendix B. A 'certificate of tank decommissioning' (Certificate No. 2011-2087) was provided by Lees Industrial Services Ltd. Four tanks were decommissioned, two diesel and two petrol using the britfoam resin-based hard foam method. The tanks were degassed and filled with foam concrete in 2011 before the site use changed to food retail in 2012. From the earliest records the tanks are shown encased in concrete which makes it less likely that they may have leaked significant into the surrounding ground; particularly given the size of the tanks and that they and the surrounding concrete were likely embedded within the London Clay (although the specific depth of London Clay at this site has not been confirmed). The London fire brigade records identify petrol interceptors, located to the south of the site.

4 Ground conditions

4.1 Previous ground investigations

A review of the GeoInsight report and BGS records has shown that no previous ground investigations have been carried out at the site. However there have been a number of previous ground investigations in the surrounding area.

The following investigations have been undertaken in the vicinity of the site:

- Ground Investigation; York Way (1973) Terrasearch Limited;
- Ground Investigation; Channel Tunnel Rail Link (CTRL) (1997) BGS borehole records;
- Multiple Ground Investigations; Zone A, King's Cross Central Development Area (1993 and 1996) Union Railways; (1997 and 2008) Soil Mechanics and (2008) Norwest Holst; and
- Ground Investigation; Development Zone J, King's Cross Central Development Area (2008) Soil Mechanics.

The 1973 ground investigation (GI) was undertaken east of York Way and included five boreholes and two trial pits. Made Ground was encountered with depths ranging from 2.3m to 3.7m. All five exploratory boreholes reached the London Clay with the elevation of the London Clay ranging from +17.65m to +20.0mOD.

The 1997 CTRL GI was located west of the Filling Station site. Two of the exploratory holes were located north of the Regent's Canal approximately 45m and 58m northwest of the site. The elevation to the top of the London Clay ranged between +21.1m and +21.7mOD. The remaining exploratory holes were located south of the Regent's Canal. The closest record was a trial pit located 35m south of the site boundary with observed stratigraphy comprising 2.6m on Made Ground. The remaining exploratory hole records undertaken southwest of the site encountered Made Ground to depths ranging from 0.65m to 2.3m.

Five GI were carried out at Zone A of the King's Cross Central Development Area between 1993 and 2008. The north edge of Zone A is located approximately 50m southwest of the Filling Station and only the exploratory holes located in the northwest corner of Zone A have been reviewed. Made Ground was encountered in all exploratory holes with depths ranging from 0.65m to 2.4m. The elevation of the top of the London Clay varied from +13.86m to +20.82mOD.

A GI was undertaken, in 2008, north of the Filling Station site as part of the Development Zone J development works. This investigation included three boreholes and four observation pits. Made Ground was identified with depths ranging from 1.5m to 3.4m. The elevation of the top of the London Clay was +23.9m to +22.0mOD (just north of the canal).

4.2 Expected ground conditions

The current ground level of the Filling Station has an elevation ranging between +22.5m and 23.1mOD.

Based on this ground level and the elevation of the London Clay from previous GI, it is expected that the stratigraphy at the site will comprise between 1m and 2m of Made Ground, above a significant depth of London Clay. It is possible that the Made Ground could be deeper locally if it has been disturbed by previous developments.

The site is bounded to the north by the canal. The canal wall is substantial and likely keyed into the London Clay. Investigations elsewhere have confirmed that if perched water is present on the land side then it is typically lower than the canal and hence, if there was a link between the Made Ground and canal then water would likely drain onto site rather than off site.

Drawings suggest that surface water drainage is discharged to the canal.

4.3 Obstructions

4.3.1 Tunnels

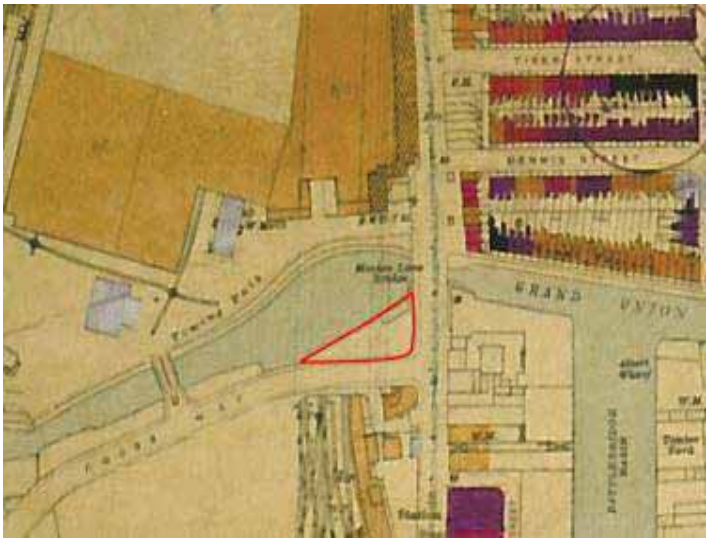
This report does not present an assessment of the potential for obstructions. Existing London Underground tunnels run directly beneath the site. These tunnels are identified as the Piccadilly line and run in a north south direction approximately 21.3mbgl. Three gasworks tunnels run west of the Filling Station site, in a north south direction. The eastern gasworks tunnel is located directly beneath the western side of the site. These tunnels have a 3m buffer zone which is known as the Network Rail ownership zone, in which excavation within this zone can only be undertaken to a maximum depth of 1m.

4.3.2 Unexploded ordnance

A review of the London County Council bomb damage map 1939-1945 [8] has been carried out to identify the risk associated with encountering unexploded ordnance (UXO) at the site. An extract from the London Council bomb damage map is included in Table 8 below.

The extract shows there to be no evidence of bomb damage at the site. The nearest damaged buildings are located approximately 50m northeast of the site and are described to be "seriously damaged, (non-repairable)". It is concluded that whilst the potential for finding UXO at the site cannot entirely be ruled out, the likelihood that UXOs are present is negligible.

Table 6: Extract of London bomb damage map



Colour reference

Black – total destruction

Purple – damaged beyond repair

Dark red – seriously damaged (non-repairable)

Light red – seriously damaged (repairable)

Orange – general blast damage

Yellow – blast damage

Light blue/green – clearance areas

V1 flying bomb

5 Preliminary risk assessment

5.1 Introduction

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, taking into account the use of the land and its environmental setting. The assessment of the impacts arising from potentially contaminated land is based upon considerations of plausible pollutant linkages (PPL) between contamination sources and sensitive receptors. The methodology of risk assessment is normally set out in terms of significant pollutant linkages (referred to as contaminant linkages in the latest version of the Part 2A statutory guidance [9]) 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. A preliminary contamination risk assessment has been undertaken using this framework based on the following information:

- Historical or current potentially contaminative activities operating on and in the vicinity of the site;
- Sensitivity of the site in the context of the wider environmental setting and ground conditions; and
- Sensitivity of the site itself and potential receptors.

5.2 Potential sources of contamination

Potential sources of ground contamination at the site have been identified based on a review of historical maps and a site reconnaissance survey. They are listed in Table 7 below, together with associated potential contaminants.

Table 7: Potential sources of contamination and associated contaminants

Potential sources of contamination	Common contaminants
Previous site use Two main site uses are identified on the historic maps including: • Flour mill • Petrol station These activities have the potential to have resulted in contamination. The principal source is considered the fuel tanks and associated pipeline	Total petroleum hydrocarbons (TPH), polyaromatic hydrocarbons (PAH). If petrol has leaked there is a potential for hydrocarbon vapours.
Historical Made Ground. London sites typically include a layer of Made Ground comprising various soil components and anthropogenic materials often including ash and demolition rubble. In this case, based on previous ground investigations in the surrounding area, it is expected that there is between 1m and 2m of Made Ground on site.	Metals, TPH, PAH, asbestos. Ground gas/vapour may be generated from historic fills although typically these would likely be at a low rate.

5.3 Potential receptors

The following potential receptors have been identified during continued and future occupation of the temporary phase of development of the site.

- Site users (adult occupants) for the temporary phase of development. This will include maintenance workers, visitors and office workers;
- Construction workers and neighbours during development;
- Surface waters namely the canal; and
- Building materials and services.

5.4 Site sensitivity

With regard to land use and ecology, the site and immediate surrounds is not located in an environmentally sensitive area. Regent's Canal is the nearest surface water (controlled waters) and is located immediately north of the site. The canal is cut off from the site by a substantial canal wall which is sealed into the London Clay.

It is believed that a layer of Made Ground is underlain by a significant thickness of London Clay which reduces the potential for contaminant migration. There are no groundwater aquifers that would be affected by the development.

The proposed development includes the erection of a temporary marketing suite with associated landscaping, to be used in association with the Gasholder Triplets development, King's Cross Central. Additional details are included below.

- Car parking area with space for two cars and bicycle parking.
- Ground floor level terrace including landscaping (in planter beds) to reflect the roof terrace and green roof design of the Gasholder Triplets development.
- Ground floor level includes a meet and greet area, meeting room and ancillary back of house facilities.
- First floor includes a show apartment, hospitality and events area and a first floor terrace.
- Entrance area at ground floor level will be based on the geometry of the Gasholder 10 atrium with access around a semi-circular landscaped area.

Permission for the Gasholders Marketing Suite is sought for a temporary period of four years. This allows for a construction period of one year and then for operation of the Gasholders Marketing Suite for a period of three years. Some minor excavations are proposed to provide foundations including shallow piles into the London clay and pile caps. The site will be entirely hard covered.

The sensitivity of the site is considered low as its cut off from surface water, with no aquifers and a commercial end use for a short period of time.

5.5 Potential for significant contamination

Potential sources of contamination have been identified as follows:

1. Historical Made Ground. Made Ground is likely to have been introduced when the site was first developed and built up over time. The quality of the Made Ground in unknown. There is a possibility that in addition to any hydrocarbon contamination from the tanks it might contain slightly elevated metals, asbestos, some PAHs for instance (which is relatively typical of Made Ground).
2. Abandoned/ decommissioned historical fuel tanks. The number and location of historical fuel tanks remains uncertain. Based on information from Building Control, BP and London Fire Brigade records, it is likely that the original tanks were replaced when the site was redeveloped by BP in the 1980s and that in turn those tanks were degreased and filled with foam concrete in 2011 when the site was vacated by BP. The records suggest the tanks; are relatively shallow, are likely encased in concrete and are likely embedded within the London Clay. As a result there is a relatively low potential for significant widespread contamination as they were entirely encased, although that cannot be ruled out and some localised contamination may be encountered.
3. Petrol interceptors. Buried petrol interceptors have been identified on the London Fire Brigade records and earlier plans. The records suggest that the fuel interceptors; are relatively shallow and are small scale. As a result there is a relatively low potential for significant contamination although some localised effects cannot be ruled out.
4. Fuel lines/pipes. The previous drawings and GPR survey identified fuel lines running in an east west direction from the west of the site to petrol pumps located in the centre of the site and then to the filling point in the west of the site. It is likely that these pipes were cut off when the fuel tanks were decommissioned in 2011. The more recent records indicate that the fuel lines were installed in water tight concrete ducts that would have prevented contamination of the ground.

The potential for significant contamination is considered to be **moderate** (localised around tanks) to **low** (most of the site).

5.6 Risk of harm to human health

5.6.1 General

The current proposal is for temporary use of the site for a relatively insensitive end use with little disturbance of the ground and due to the temporary nature of the proposal. It is necessary to complete the work in a relatively short period of time and due to various constraints (such as the Canal Wall, tunnels and tanks) Option A is the preferred solution and considered high likely to be the selected option.

Option A

Option A proposes a raft foundation solution, built directly above the existing hard standing and build the Gasholders Marketing Suite on top. The slab will be a monolithic, well-constructed approximately 400mm reinforced with no penetrations or services entries through the slab and no joints. The construction

works will not penetrate the existing ground level and only some very minor breaking out of surface features and hard standing may be required.

It is not currently proposed to remove the decommissioned tanks and associated pipework. If contamination (leaked fuel) exists is it will be left in the ground and will be dealt with fully during the later main development phase of Development Zone F, in accordance with outline planning permission. Further detailed investigations and assessments will be under taken at that time.

Option B

If Option A is not feasible then construction of the Gasholders Marketing Suite will be founded on piles. This option will also seek to minimise excavations and ground break but some will be necessary. The proposed ground break and excavation will be reduced to the absolute minimum to provide a safe and efficient development.

It is not currently proposed to remove the decommissioned tanks themselves or the associated pipework for this option. If minor contamination is encountered during development (during excavations for pile caps and piling for instance) it is expected it will be left in the ground and will be dealt with fully during the later main development phase of Development Zone F, in accordance with outline planning permission.

If there is local significant contamination in an area where ground works is taking place then it some additional intervention will be required to facilitate safe development (for instance locally remove free product or grossly contaminated material around a pile cap installation in a controlled fashion). This will be done based on good practice. Recommendations for safe working and development control are provided in Section 6.

5.6.2 Risk to construction workers and neighbours

Option A

Considering that there are to be no or only very minor works at the surface only (possibly breaking out concrete), in open air, then the risk of harm to human health during development (without any mitigation) is considered **low**. With some additional precautions described below then that will be reduced to very low.

Option B

During development construction workers may come into contact with historic Made Ground and possibly leaked hydrocarbons. In addition, neighbours may be affected by fugitive dust during excavation works although such works will be minimal and tightly controlled (control measures are defined in section 6).

The risk of harm to construction workers is considered to be initially **moderate** (for instance from hydrocarbon vapours such as benzene) and this will be reduced by the use of good construction practice and personal protective equipment (PPE).

A targeted ground investigation will be undertaken before construction at the location of the tanks to identify their location and existing ground conditions. A

contamination watching brief will be implemented and if there is visual evidence of contamination then contamination sampling will be undertaken. Some testing will be done in any case to confirm the general quality of the ground and disposal options. The scope of the investigation is discussed in section 6 of this report. The findings will be assessed and additional protection and construction measures implemented as necessary (discussed in section 6). Assuming appropriate control measures are implemented the risk of harm to human health during development will be reduced to **very low.**

5.6.3 Site users after development

The existing buildings will be demolished and the Gasholders Marketing Suite building will be constructed. The building will comprise of two storeys. The ground floor of the building will provide an entrance lobby and include a meet and greet reception area. The first floor will be a mock up apartment. There will be soft landscaping provided in planters and above hard standing (not in contact with residual ground). The entire site will be covered in hard standing.

The current proposal is that the existing decommissioned tanks will remain in the ground. There are limited potential pollutant linkages after development if the site is hard standing. If there has been leakage of petrol into the ground there is a potential link between hydrocarbon vapours and users in the building.

Option A

The raft foundation solution will include a thick well-constructed monolithic slab (approximately 400mm) thick, over the existing hard standing. This will provide a significant barrier to vapour or gas ingress over the design life of the building. The existing design also includes provision of a DPM membrane below the slab. As there is a potential for leaked petrol (a source of hydrocarbon vapour) in the ground then it is proposed to upgrade DPM to a full vapour barrier and also to ensure that the installation is undertaken in accordance with good practice. This provides an additional layer of protection for the short term use.

The risk of harm to human health of site users of the temporary marketing suite is assessed to be **very low**.

Option B

A ground investigation will be undertaken prior to construction. If ground contamination is identified in the geotechnical investigation of the tanks (some will be done anyway), then contamination sampling will be undertaken to check the extent of hydrocarbon contamination and also be used to define the type of vapour protection. There will not be time for long term vapour monitoring as typically required.

The existing design for the building will include a raised floor with vented void below (based on building regulations). The void will be vented on two sides with air bricks. If significant contamination is identified by the ground investigation (which will investigate all tanks) then an additional vapour barrier will be installed above the void. The assessment of the ground investigation will consider if the concentrations of volatile hydrocarbons in soil are elevated (based on soil/

vapour partitioning risk assessment of soil concentrations or if free product is identified during investigation).

Assuming appropriate measures are installed the risk of harm to human health of site users of the temporary Gasholders Marketing Suite is assessed to be **very low**.

5.7 Risk of pollution to controlled waters

The site is bounded to the north by the Regent's Canal. The canal wall will be keyed into the London Clay. The wall acts as a substantial barrier and will prevent contamination of the canal from site (if contamination was present on the land side).

Drawings suggest that surface water drainage discharges to the canal (via surface water drainage ducts which are above any potential contamination (i.e. they are above the level of the top of the tanks).

Option A

The raft foundation solution will not penetrate the existing site hard standing and therefore will have a negligible impact and will not affect ground conditions that exist on the site.

The risk of pollution to controlled waters (during construction) is considered **negligible** and the risk of pollution after construction, if residual contamination remains in the ground until development of Development Zone F (expected to be four years) is **negligible**.

Option B

Some minor excavation and foundation works are expected and there is the potential that this may disturb the existing conditions on site although very localised and minor.

Excavation and ground penetration will be minimised during construction to limit the impact on the canal wall. If contamination is identified and requires excavation (during piling or construction of pile caps) then that material will need to be carefully controlled and to prevent run off entering the canal. Environmental Agency pollution prevention guidance (PPG) on construction methods near water will be adhered to. This will include PPG5 (works near water courses). There is surface water drainage direct to the canal and measures will be implemented to prevent this becoming a preferential pathway for contamination to enter the canal.

The risk of pollution to controlled waters (generally during construction) is considered to be **low** (mostly associated with run off to the canal)**.** This will be controlled and reduced to **very low**. The risk of pollution after development in the operational phase (for three years) is **negligible**.

5.8 Building materials and services

Option A

Following development of the site on top of a raft foundation solution, that does not penetrate the existing hard standing, the potential for building materials and services to come into contact with contaminated soils or shallow perched groundwater is **very low**.

Option B

If Option B is implemented then following development of the site there is the potential for building materials and services to come into contact with contaminated soils or shallow perched groundwater.

If some localised free product (petrol or diesel) is encountered, and piling or other foundations are to be constructed that may be in contact with that material then some additional localised intervention may be required to prevent effects on building materials (such as weakening or alteration of setting times for concrete). If shallow potable water is provided and hydrocarbons are identified then upgraded pipe materials will be required in accordance with Thames Water guidance. Assuming appropriate intervention or mitigation is implemented then the risk to building materials and services will be **very low**.

6 Conclusions and recommendations

6.1 Conclusions

A desk based review and assessment of the risks from contamination has been undertaken for the site, using the information sources described in this report.

The review has identified that prior to the 1820s the site and surrounding area was occupied by fields. In 1827, the Regent's Canal was constructed immediately north of the site. King's Cross Station was constructed to the south of the site and was operational by 1852. Railway lines heading north from King's Cross enter cutting and pass under the Regent's Canal and run west of the site.

Historical OS maps show that the site has been occupied by three main land uses since 1875. Between 1875 and 1877 the site was occupied by a flour mill. The flour mill was likely present before 1875 and is no longer shown on a map of 1896. A planning application for a petrol station on the site was submitted in the mid 1960's and the 1973 to 1976 OS map shows the site occupied by a petrol station. The petrol station was then redeveloped in 1986 by BP. Tanks were decommissioned in 2011 and the site changed use to food retail in 2012.

Several potentially contaminative sources have been identified associated with the previous use of the site and activities identified during a site reconnaissance visit. This includes historical Made Ground and previous site use, abandoned/ decommissioned fuel tanks, petrol interceptors and fuel lines. It is expected that the stratigraphy of the site will include approximately 2m of Made Ground.

The records obtained provide the locations of the fuel tanks, although there is some variation between the records and it is possible that tanks were never present in some of the locations identified. It is likely that the original tanks were replaced when the site was redeveloped in the 1980s and that in turn those tanks were degreased and filled with foam concrete in 2011 when the site use changes to food retail. The records suggest the tanks; are relatively shallow, were likely encased in concrete and are likely embedded within the London Clay (for instance based on the drawings the depth to the base of the concrete encasing the tanks was 3m). The more recent drawing confirm that the fuel lines to pumps and to the filling point were encased in water proof concrete ducts to prevent leakage.

As a result there is relatively low potential for significant widespread contamination as they were entirely encased, although that cannot be ruled out and it would not be unusual to encounter some localised hydrocarbon contamination. Consequently the potential for significant contamination is considered to be locally **moderate to** generally **low**.

The current proposal seeks permission for a temporary use of the site (four years; including one year for construction and three years for operation) for a relatively insensitive end use (commercial use as the Gasholders Marketing Suite) with little disturbance of the ground. Due to various constraints (such as the Canal Wall and tunnels), and the programme to construction the aim of the current phase of development (temporary) is to construct a raft foundation solution directly above the existing hard standing and build the Gasholders Marketing Suite on top. As a result construction works will not penetrate the existing ground level. If this option is not feasible then Option B will be undertaken and the temporary Gasholders Marketing Suite will be founded on piles. Construction for Option B

will then ensure the proposed ground break and excavation will be reduced to the absolute minimum to provide a safe and efficient development.

It is not currently proposed to remove the decommissioned tanks and associated pipework. If contamination is encountered during development (and investigation of the tanks will be undertaken before the main construction works) it is expected it will be left in the ground (based on an updated risk assessment demonstrating no significant risk to human health and the environment in the short term). The residual hydrocarbons will be dealt with fully during the later main development phase of Development Zone F. Option A will include a barrier membrane, the thickness of which will be dependent on the extent of contamination. This membrane will therefore protect against ground gas vapours. To facilitate safe development. If Option B is implemented and local significant contamination is identified in an area where ground works are taking place then it may be necessary to locally implement some control or removal to facilitate safe development (for instance locally around a pile cap installation) and prevent effects on construction works and concrete.

A summary of the appraisal is presented in Table 8 below.

Table 8: Summary of qualitative risk assessment

Item	**Qualitative assessment**		
Site sensitivity	Low		
Potential for significant contamination	Locally moderate to low		
	Risk assessment	**Mitigation**	**Residual risk**
Option A			
Human health during construction	Low	Health and safety measures. Site control and control of arisings and stockpiles. Dust control	Very low
Human health during operation	Very low	Upgraded DPM to vapour barrier and good installation.	Very low
Controlled waters	Negligible	Control construction near water. Follow PPG5.	Negligible
Materials and services	Very Low		Very low
Option B			
Human health during construction	Moderate	Localised ground investigation around all potential tank locations. Health and safety measures. Site control and control of arisings and stockpiles. Dust control Contingency for hydrocarbon vapours and free product response based on GI (additional PPE and local intervention).	Very low

Item	Qualitative assessment		
Human health during operation	Low	Localised ground investigation around all potential tank locations. Assessment of vapour risk and install additional vapour control measures where necessary.	Very low
Controlled waters	Very low	Localised ground investigation around all potential tank locations. Control of arisings near water. Follow PPG5. Control run off during construction.	Negligible
Materials and services	Moderate	Localised ground investigation around all potential tank locations. Specify appropriate potable water supply materials etc. if relevant. If free product identified at location of pile of pile cap then assess if additional intervention required (local removal)	Very low

6.2 Recommendations

6.2.1 General

Option A

It is proposed to undertake a targeted ground investigation (GI) at the site before development commences around the potential tank locations and some window sampling to prove the thickness of the Made Ground. The main reason for this investigation is to determine if option A is feasible. Some additional contamination testing will be undertaken at the same time to verify the ground conditions.

The investigation will include four window samples to verify the existing ground conditions, 11 shallow trial pits around the potential locations of the fuel tanks and a trench. The records mentioned above and shown in Figure 1.

Contamination sampling will be undertaken in the nine trial pits; that are located around the potential locations of the fuel tanks.

Option B

If option B is selected then additional investigation is proposed. The principle objective of the GI will be to investigate around the tanks and determine if any significant contamination has occurred. The GI will investigate down to the London Clay or base of tank and will aim to identify any leaks or spills that may have occurred.

It is proposed to investigate all potential tank locations shown on the four sets of drawings from different sources and some additional work along the fuel lines. The investigation will include trial pits on all four sides of all the potential fuel tank locations as identified in the records mentioned above and shown in Figure 2. This results in 15 locations and represents a dense sampling plan for

contamination sampling. If a tank is not identified at a potential location then the one pit will be excavated to check residual conditions and the others proposed around the edges of that particular tank will be cancelled.

6.2.2 Proposed contamination investigation methodology

Introduction

The specification for the ground investigation has been developed in accordance with relevant parts of BS10175 [10] and UK Specification for Ground Investigation [11]. The scope and methodology of the intrusive ground investigation is outlined for both options below.

The exploratory hole locations have been positioned taking into consideration the potential fuel tank and petrol interceptor locations. TP04 will only be excavated if the fuel tank is identified in TP05. Similarly if TP08 does not identify a fuel tank then TP09, TP16 and TP17 may not be excavated. The proposed exploratory hole locations are shown in Figure 2.

Contamination sampling

During the ground investigation the following steps will be undertaken:

- An Arup contamination specialist will be on site to witness the works and look for visual evidence of contamination around the edges of the tanks i.e. stains and odours;
- If the potential fuel tank is not identified then the remaining trial pits located around the same potential tank location will not be excavated;
- All samples will be taken under the supervision of an environmental specialist provided by the investigation contractor and all steps necessary will be taken to avoid cross contamination;
- No hydrocarbon-based lubricants are to be used on the excavations, which shall be kept free of contamination by fuels and oils associated with the works;
- Solid samples shall be taken at the time of excavation. Sub-sampling from bags or from excavations/ stockpiles left some time for sampling is not appropriate; and
- All soil samples for contamination testing will be subject to screening by photoionisation detector (PID) for hydrocarbon vapours.

Solid samples will be taken at the time of excavation. A single sample collected for contamination and waste classification testing will comprise a number of containers including:

- Vial(s) for volatile hydrocarbon analysis;
- Amber glass jar(s) for hydrocarbon soil analysis (depending on size, multiple jars may be required to achieve analysis); and
- Plastic tub(s) for inorganic, metals and leachability soil analysis (depending on size and soil type, multiple tubs may be required to achieve analysis).

The vial(s) for volatile hydrocarbon analysis will be collected first, followed by the amber glass jar(s) and then the plastic tub(s). The number of containers taken in each case will be sufficient to allow all the potential contaminants to be analysed.

Small disturbed samples will be taken with clean stainless steel hand tools and placed in rigid containers made of a material that is non-reactive with the likely contaminants. The hand tools will be cleaned between each sample.

The containers will be filled to the brim to effectively exclude air. All soil samples will be immediately placed in cooler boxes (with ice packs) and will be kept between 4°C ± 2°C.

Analysis

For Option A; nine soil samples will be analysed for a suite of chemical determinands. For Option B; up to 18 selected soil samples (less if obvious contamination is not encountered or tanks are not encountered at some locations) will be analysed for a suite of chemical determinands. The anticipated contamination analysis at each exploratory hole is outlined in Table 9 below and the selected samples will be analysed for the suites of determinands listed in Table 10 below.

Table 9: Proposed ground investigation strategy

Objective	Location	Number	Suites
Option A			
General broad contamination suite		3	E1, E2, E3, E4, E6 and I
Hydrocarbons only in selected samples		6	E3 and E4
Option B			
General broad contamination suite	TP01, TP03, TP04, TP07, TP08, TP12, TP14	8	E1, E2, E3, E4, E6 and I
Hydrocarbons only in selected samples	TP02, TP05, TP06, TP09, TP10, TP11, TP13, TP15, TP16 and TP7	10	E3 and E4

Table 10: Proposed chemical analysis on soils

Determinands
Suite E1 General
Antimony, arsenic, beryllium, cadmium, chromium (total), copper, lead, mercury, nickel, selenium, vanadium, zinc, cyanide (total), pH, phenol, total organic carbon
Suite E2 Asbestos
Asbestos presence and identification (0.001%) in accordance with the method described in HSG248 [12]. Asbestos quantification if identified.
Suite E3 Speciated TPH
Speciated total petroleum hydrocarbons (TPH) by GC-FID with aliphatic/aromatic class separation with criteria working group (CWG) banding
Suite E4 PAH & BTEX
Polycyclic aromatic hydrocarbons (PAH) (USEPA16) by GCMS

Determinands
Benzene, toluene, ethyl benzene, m,p-xylene and o-xylene
Suite E6 PCB
Polychlorinated biphenyls (PCB)
Suite I Waste acceptance criteria (WAC) leachability in line with BS EN 12457 Part 2

6.2.3 Site safety and control during construction

The ground investigation data will be used to inform the requirements for site safety and control during construction.

Construction workers will come into contact with Made Ground, which may include elevated contaminant concentrations, and there is a potential for hydrocarbon impacted soils or localised free product (petrol and diesel) if leaks have occurred.

A watching brief shall be maintained throughout the works. The method for implementing the watching brief should be described in the construction method statement. The watching brief should be undertaken by experienced staff and should be defined on site, communicated to staff involved in the ground works (toolbox talks etc.).

The works should be undertaken in a fashion to prevent the creation of dusts. All Made Ground should be kept damp when being handled or when exposed at the surface.

Additional measures are described below:

- Sufficient hygiene units and PPE should be provided for works with Made Ground, other contaminated soils and groundwater;
- Suitably competent personnel should advise on and supervise the works;
- All staff should be briefed on the working methods;
- It is proposed that if vehicles entering or leaving the site will come into contact with potentially contaminated Made Ground or other contaminated soils then a control system should be in place to prevent the spread of contamination off-site;
- If free product is encountered prevention measures should be implemented to ensure minimal contact of operatives with such materials during construction; and
- If asbestos is identified by the investigation, or during construction, additional measure will be implemented in accordance with the Control of Asbestos Regulations 2012.

If free product, odours and vapours are encountered then additional measures will be considered as appropriate, such as:

- control of working hours;
- air quality monitoring (including at site boundary);
- health surveillance/personal monitoring;
- monitoring for explosive limits;

- odour control
- development of an emergency action plan; and
- use of additional respiratory protection equipment (RPE) if necessary.

6.2.4 Vapour protection

The data and findings of the investigation will be used to inform the requirements for additional precautionary vapour protection.

Option A

The raft foundation solution will include a vapour barrier membrane. The membrane will be installed following good practice, protected from damage during installation, in accordance with the manufacturer's requirements along with verification records of the installation.

Option B

Volatile hydrocarbon results will be assessed using the Contaminated Land Exposure Assessment (CLEA) model v1.06 vapour intrusion pathways (based on soil concentrations and soil/ vapour partitioning with ingress into buildings). If significant then a vapour barrier will be installed. In addition, if free product (petrol) is identified then vapour protection will be considered as the CLEA model does not fully take account of vapour risks from free product.

The proprietary vapour membrane will be installed in line with good practice and the manufacturer's requirements along with verification records of the installation. It will take account of any services penetrating the slab and suitable details will be provided around those services to prevent preferential pathways into internal spaces. The selected membrane will be suitably robust so as not to be damaged during installation.

The ground floor will either be a continuous suspended concrete slab (which in itself will provide some protection against ingress) or a beam and block floor with a void below. If the latter option is selected the void will be vented (passive venting with air bricks or similar) with the membrane above the void if necessary. If a suspended concrete slab then just a membrane will be installed. The site is relatively small and the use of suitable construction methods (including measures such as thicker membranes, cushioning materials and welding of all penetrations and joins) and good levels of QA/QC, oversight and inspection should result in a suitable level of protection for a temporary structure.

Depending on the results then additional reassurance may be specified to include some post construction air monitoring (such as passive tubes) within the completed development at targeted locations and periods of time to verify the measures have been successful.

6.2.5 Pipe materials for services

The UK Water Industry Research Ltd (UKWIR) has published a series of booklets [13] regarding pipe selection on brownfield sites. In addition, to the guidance written in the published booklets, a computer database has been developed that

details the identity, likely combinations, effects and trigger levels for pipeline protection from contaminants found on brown-field development sites.

Thames Water should be consulted regarding the pipe material specification of potable water supply pipes in contact with soils. Depending on the results of the investigation precautions to mitigate the effects associated with the hydrocarbon contaminants identified in the Made ground.

References

[1] Environment Agency website, accessed December 2014 http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

[2] British Geological Survey, OpenGeoscience website (historical borehole log scans), accessed December 2014 http://www.bgs.ac.uk/opengeoscience/

[3] Proposed service station for A.J. Salter at Junction of Goods Way and York Way. Drawing Nos. 0307/663/1 and 0307/663/6, Mobil Oil Company Ltd, received November 2014.

[4] Preliminary site layout plan. Drawing No. 12935-95, British Petroleum, received November 2014.

[5] General arrangement plan. Drawing No. 0307/8784/0 and standard tank installation, Drawing No. S.5.2.D, Fire Brigade, received 14th November 2014.

[6] GPR Survey, Charter Oaks Ltd, received 11th November 2014.

[7] 1891 Goad map, British Library, accessed on 2nd December 2014 http://britishlibrary.georeferencer.com/map/fyFWwLeva0RDYcKucAPy9y/201312021306-i2Gj3y/visualize

[8] London County Council Bomb Damage Maps 1939-1945.

[9] Department for Environment, Food and Rural Affairs (April 2012), Environmental Protection Act 1990; Part 2A, Contaminated Land Statutory Guidance.

[10] British Standard 10175 (2011), Code of practice for investigation of potentially contaminated sites.

[11] Thomas Telford Limited (2012), UK Specification for Ground Investigation, Second Edition, ICE Publishing.

[12] Health & Safety Executive HSG 248 (2005), Asbestos – The analysts' guide for sampling, analysis and clearance procedures.

[13] UK Water Industry Research Ltd (2010) Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites.

Figures