Geotechnical and Geo-environmental Consultants

GEO-ENVIRONMENTAL
PHASE I DESK STUDY AND PHASE II SITE INVESTIGATION REPORT

33 JULIANS ROAD
STEVENAGE
SG1 3ES

Reference Number 3355/Rpt 2v1
November 2023

Prepared for

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Report Title	Geo-environmental Phase 1 Desk Study and Phase II Site Investigation Report: 33 Julians Road, Stevenage, SG1 3ES.
Reference Number	3355/Rpt 2v1
Date	November 2023

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TABLE OF CONTENTS

FIGURES

APPENDICES

EXECUTIVE SUMMARY

This report describes the findings of a Geo-environmental Desk Study and Site Investigation of 33 Julians Road, Stevenage, SG1 3ES. It is proposed to redevelop the site for residential usage.

At the time of the walk-over the site was being used for residential, offices and storage. The ground between the building located on the northern part of the site was paved with block paving and used for parking. The southern end of the site was rough ground.

The review of the historical land use identified that the site was developed before 1881. The site has been used as residential and a yard for store by a hay and strew merchant, stabling of horses and for the storage of fruit and vegetables. A decommissioned underground storage tank was noted on site.

A review of the environmental setting indicated the site to be underlain by superficial deposits consisting of the Lowestoft Formation. The solid geology is the Holywell Nodular Chalk Formation and New Pit Chalk Formation. The superficial deposits are classified as a Secondary (Undifferentiated) Aquifer and the solid geology is classified as a Principal Aquifer. The site is located in a Zone III Source Protection Zone.

The conceptual model prepared for the site did identify potentially active pollution linkages between the on-site sources of contamination and the identified receptors.

The investigation consisted of the drilling of boreholes. During the drilling, soil samples were obtained and submitted for chemical analysis.

The following conclusions were made:

The Tier I Human Health Risk Assessment has determined there are concentrations of PAHs within the made ground beneath the northern end of the site that will pose an unacceptable level of risk where active pollution linkages are introduced. These pathways would be introduced by the inclusion of areas of soft landscaping and private gardens within the development. The natural soils will not pose an unacceptable level of risk to human health of future site occupants and users.

The Tier I Controlled Water Risk Assessment has determined that there are no concentrations of contaminants within the underlying soils that would pose an unacceptable risk to controlled waters. It should be noted that this conclusion is based on the results of the currently phase of investigation, it is considered that further site investigation and assessment should be undertaken to fully define the level of risk associated with contamination that may have originated from a decommissioned underground storage tank.

The risk assessment for bio-genic ground gas and vapours concluded that there are no concentrations at levels that would pose an unacceptable risk to human health and the proposed development.

The risk assessment in respect to the future planting and towards sensitive ecological receptors identified that the determinants at the site are at levels that would not pose an unacceptable level of risk to future planting and sensitive ecological receptors.

The risk assessment in respect to water supply infrastructure identified that concentrations of hydrocarbons within the made ground and soils adjacent to the former underground storage tank are at levels that will pose an unacceptable level of risk to the integrity of PE or PVC pipework.

Recommendations for further site investigation and remediation have been made.

1 INTRODUCTION

1.1 Background

Brown 2 Green Associates Ltd have been commissioned by Acre Stevenage Ltd undertake a Geo-Environmental Phase I Desk Study, including a preliminary risk assessment and Phase II Site Investigation of land at of 33 Julians Road, Stevenage, SG1 3ES. The site is centred on National Grid Reference 523070, 225490. The site location is presented in Figure 1.

1.2 Proposed Development

The work was commissioned to provide information for a planning application to redevelopment the subject site consisting of the demolition of the existing yard buildings (office and storage) and their replacement with six terraced family houses with associated gardens, landscaping, car and cycle parking, including the retention of existing residential (two flats) and office building to the front of the site (33 Julians Road). The proposed development is shown on drawing number 1140-DFA-PL-101 prepared by Dowen Farmer Architects. The proposed development layout is presented in Appendix II.

1.3 Objectives

The objectives of the work are to provide an assessment of the risk from contaminated land to inform about potential re-development of the site, address the requirements of the National Planning Policy Framework[1] and Planning Practice Guidance. These objectives are achieved by:

- Undertaking a site inspection to identify any current areas of potential environmental concern;
- Reviewing historical plans, geology, hydrogeology, site sensitivity, flood-plain issues, mining records and any local authority information available in order to complete a Desk Study in line with Environment Agency Contaminated Land Risk Management.
- Investigation of any identified pollution linkages to determine any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors; and,
- Provide a factual and interpretive report and recommendations on any potential development issues.

The information obtained in this study has been used to develop an initial Conceptual Site Model (CSM) and outline potential risks from contamination at the site. This CSM examines potential Source-Pathway-Receptor contaminant linkages in relation to identified or potential contamination issues at the site and vicinity, incorporating them into a Preliminary Risk Assessment. This report has been completed in accordance with Environment Agency Contaminated Land Risk Management.

The Preliminary Risk Assessment seeks to establish firstly whether unacceptable risk as defined in Part 2A of the Environmental Protection Act 1990 is present and secondly whether a possibility of harm to controlled waters, human health or property is present and further investigation is therefore needed to better inform about risk assessment.

[1] National Planning Policy Framework, Department for Communities and Local Government, September 2023.

Based on the findings of the Preliminary Risk Assessment a Phase 2 intrusive investigation has been undertaken with the objective of assessing if the pollution pathways identified within the site-specific conceptual model are active.

Consideration of geotechnical/engineering aspects of the proposed development falls outside the scope of this assessment.

1.4 Sources of Information

Background information relating to the site was acquired and referenced from the following sources:

- Historical mapping (Appendix IV);
- Environmental Database Search. All relevant data is summarised in the text of the report. A full copy is presented in Appendix V;
- On-line planning records held by Stevenage Borough Council;
- Consultations with Hertfordshire County Council – Petroleum Licencing (Appendix VI).
- British Geological Survey website (www.bgs.ac.uk).

A site walkover was carried out by a Geo-environmental Consultant from Brown 2 Green Associates on the 14th July 2023.

2 SITE LOCATION AND DESCRIPTION

2.1 Site Location and Surrounding Area

The site is in a residential area on the southern side of Julians Road. The land uses immediately adjacent to the site are summarised below:

Direction	Land Use
North	Julians Road and residential
East	Residential
South	Residential
West	Residential

The topography of the surrounding area slopes down towards the south-east.

The site location is presented in Figure 1.

2.2 Site Descriptions and Reconnaissance

The site layout is presented in Figure 2. A photographic record of the site is included in Appendix III.

The subject parcel of land is irregular in shape and covers 0.19 hectares. Access to the site is via an access road from Julians Road, located on the northern boundary.

At the time of the walk-over and investigation the site was being used as residential and offices. There are two buildings on the site. Along the northern boundaries there is an L-shaped two storey brick building. The northern arm of the building is used as residential and consist of a two-storey house. The southern arm of the building is an office. Along the western side of the house there is the access road that provides access to the rear of the site.

The rear of the site contains a single L-shaped building that is constructed of brick with a slate roof. The building is used as offices and storage. The southern part of the building consists of a warehouse style building, with a large entrance door and no windows. The land between the buildings is used for parking and is paved with block paving.

The land to the south of the buildings is rough ground and overgrown with grass and shrubs. The area is used for the storage of building equipment, including scaffolding, pipework, a shipping container and other metal items.

2.2.1 Storage of Chemicals and Hazardous Substances

Above Ground Storage Tanks (ASTs)

No above ground storage tanks (ASTs) or evidence of former ASTs were observed at the site.

Underground Storage Tanks (USTs)

No underground storage tanks (USTs) or evidence of USTs were observed at the site.

Anecdotal evidence has suggested that there was an underground storage tank on site. A copy of an email from the Contaminated Land Officer at the local council that was included with a planning application made in 2009 was reviewed. The email states:

Having looked a the historic information re this site, which refers to a underground fuel storage tank and old fuel pumps, I can confirm that I would like the contaminated land condition on any consent that is given to develop this land. In addition to this use, there is potential for organic contamination from the stabling / storage of horses on this land.

A copy of the email is contained in Appendix VI.

At the time of the site work, the site owner indicated the tank was originally located adjacent to the western boundary close to the front of the site and the tank had been decommissioned. Within the location indicated there was a manhole cover. The cover could not be lifted.

Contact has been made with the Hertfordshire Trading Standards – Petroleum Licencing to obtain any information held on the tank. The response confirmed that no Petroleum Licence was held by the site, as such it is highly likely the tank was never used for the storage of Petrol. A copy of the response is contained in Appendix VI.

Other Chemical Storage

No significant storage of chemicals was noted at the time of the walkover.

Polychlorinated Biphenyls

No equipment that may potentially contain polychlorinated biphenyls (PCBs) was observed at the site.

2.2.2 Asbestos Containing Materials

During the inspection no materials suspected to contain asbestos were observed at the site.

No asbestos survey reports were made available.

2.2.3 Waste Disposal

No waste disposal activities were identified.

2.2.4 Site Drainage

A formal drainage survey has not been completed but it is assumed the site is connected to the foul sewer which is likely to be located within Julians Road to the north.

No trade effluent is generated by the site.

No oil/water interceptors were identified.

No soakaways were identified.

Rainwater will either discharge to the sewer, infiltrate into the ground or is lost through surface water run-off or evapotranspiration.

2.2.5 Visual and Olfactory Evidence of Contamination

No specific visual or olfactory evidence of contamination was noted.

2.3 Potential Sources of Contamination

During the review of the site setting and reconnaissance the following plausible potential sources of contamination were identified:

- Use of the southern part of the site for storage of building materials.
- Decommissioned underground storage tank.

3 HISTORICAL LAND USE

3.1 Historical Mapping

The maps at scales of 1:1,250, 1: 2,500, 1:10,000 and 1:10,560 were reviewed to determine the history of the site. A summary of the site history is presented below. The historical maps are included in Appendix IV.

Date	Site	Surrounding Area
1881 1:2,500	The site is subdivided between four different land parcels. The northern end of the site contains a building fronting on to Julians Road with two pumps at the rear. This building is likely to be the building observed during the site walkover. A second building is located adjacent to the western boundary. The land between the buildings appears to be a yard. The southern end of the site is agricultural land.	Land to the west is housing with a public house immediately north west. A railway line, station and goods yard is shown 100m to the west. Land to the north of Julians Road and south of the site is agricultural. A land house with gardens is located top the east.
1898 1:2,500	The building adjacent to the western building has been replaced with a larger commercial sized building.	The land to the north and the garden of Julians has been developed as residential.
1923 1:2,500	An extension has been constructed on the southern end of the building located adjacent to the western boundary.	No relevant changes noted.
1946 and 1947 1:10,560	As 1923.	No relevant changes noted.
1962 1:2,500	As 1923.	A builder's yard is shown 50m to the west.
1970 1:1,250	As 1923.	The builder's yard has been removed. An electricity substation is located 50m to the west. A series of buildings recorded as depots are present 70m to the west and 50m to the east.
1973 1:2,500	As 1923.	No relevant changes noted.
1978 - 1992 1:1,250	The layout remains unchanged. The site is annotated to be a builder's yard.	No relevant changes noted.
1999 1:10,000	As1978 to 1992.	No relevant changes noted.

3.2 Listed Buildings and Historical Sites

No world heritage site or registered battlefields are present within a 250m radius the site.

The nearest listed building is The Old Cottage which is Grade II listed and located 100m to the west. The nearest scheduled monument is an old malt house and kilns on the high street located 214m to the west.

3.3 Local Authority – Planning

A review of on-line planning records from Stevenage Borough Council was completed on 5th August 2023.

In 2009 an application was made to convert the buildings at the rear of the site from offices to residential. As part of the application a desk study was prepared that provided a description of the historical land use. A summary of the stated historical land use is presented below and a copy is included in Appendix VI:

Before WWII the site was used by John Inns, a hay and strew merchant, for the stabling of horses and storage. The rear of the site was used as paddocks. The business was taken over by T C Mansfield Ltd, a fruit and vegetable merchant who continued to use the buildings for storage and the paddocks for horses.

The document stated that the site was never used for industrial purposes, a diesel fuel pump and associated underground storage tank had been emptied 11 years before the date of the document (before 2009) and showed no evidence of leakage. The report states that it will be removed. No information confirming the tank was removed was identified.

The document also provides information from 1977. Comments from the planning officer states that at the time the front building was used as offices and residential. The rear buildings were used for the storage of building materials. Evidence from Mr di Mambro, council for Geoghegan Brothers Ltd, states that the site was used for storage and was not a builder's yard. Before 1968, it was used for fruit and vegetable storage. Evidence from Thomas Mansfield, owner of the site from 1968 to 1975 states the site was used for the storage of fruit and vegetables, stabling, offices and a warehouse/cold storey. The diesel pump was present at this time.

3.4 Other Sources

A review has been made of satellite photographs contained on Google Earth. The photograph dated 2000 shows the layout of the site to be similar to that observed during the site walkover. No other changes are recorded.

3.5 Potential Sources of Contamination

During the review of the historical land use of the site and surrounding area, the following potential sources of contamination were identified where it is considered that there is a plausible pollution pathway:

- Use of the site for general commercial use as possible builder's yard, storage of fruit and vegetables.
- Decommissioned diesel underground storage tank and pump.
- General quality of made ground used to develop the site.

4 INDUSTRIAL SETTING

4.1 Contemporary Trade Directory Entries

There is one contemporary trade directory entry for the site. At 33b there is a listing for a domestic cleaning company. The firm is inactive.

Within 250m radius of the site there are 36 contemporary trade directory entries. The nearest is a site located 34 m to the north west. The site has been used as a tyre dealers, printers, T-shirt dealer and car breakdown and recovery services. All listings are inactive. Another site located 50m to the west has been used as a garage and MOT test centre. The site is still active.

Within 500m radius of the site there are no entries for filling stations.

4.2 Landfill Sites and Waste Disposal Facilities

There are no historical or operational landfill sites or waste management facilities within 250m radius of the site.

4.3 Environmental Permits, Incidents and Registers

The following information is a summary of the data contained Environmental Database presented in Appendix V.

	On Site	0 – 250m	Details of Nearest	Potential Risk to Site
Authorised industrial processes (IPC/IPPC/LAPPC)	0	2	LAAPC for the burning of waste oil. Located 53m to the west.	No
Radioactive Substances Authorisations	0	0	-	No
Licensed Discharge Consents	0	0	-	No
Consents issued under the Planning (Hazardous Substances) Act 1990	0	0	-	No
Control of Major Accident Hazard (COMAH/NIHHS/Explosive) sites	0	0	-	No
Pollution Incidents	0	0	-	No
Contaminated Land Register Entries and Notices (Part 2A EPA 1990)	0	0	-	No

4.4 Ground Workings, Mining and Natural Cavities

There are no BGS recorded mineral site on or within 250m radius of the subject site.

The database states that the site is not located in a Cheshire Salt Brine Subsidence Compensation Board District.

The database states that the site is not located in an area affected by coal mining.

The data base indicates that the site is not located within an area where there is the potential for mining instability.

The database states that there are no non-coal mining areas within 1000m of the site.

5 ENVIRONMENTAL SETTING

5.1 Geology and Hydrogeology

The British Geological Survey mapping indicates that the site is underlain by the following geology:

Drift/Solid	Geological Unit	Description
Drift/Superficial	Lowestoft Formation	Diamicton
Solid	Holywell Nodular Chalk Formation and New Pit Chalk Formation	Chalk

Geological logs held by the British Geological Survey were reviewed. The nearest is located 100m to the south. The log indicates the area is underlain by the following geological conditions:

Description	Thickness (m)	Depth to base (m)
Pleistocene (Buried Channel)	21.33	21.33
Chalk	?	

Other boreholes within the local area indicate the drift deposits consist of clay with interbedded sand and gravel and clayey gravel.

The Superficial Deposits are classified as a Secondary (Undifferentiated) Aquifer. The solid geology is classified as a Principal Aquifer.

The combined groundwater vulnerability for the site is classified as medium with an intermediate pollutant speed.

There are no licenced groundwater abstraction points within 1km radius of the site. The site is located within a Zone 3 Source Protection Zone.

The regional hydrogeological maps indicate that the groundwater flow direction within the chalk aquifer is towards the north-west.

If groundwater is present within the superficial deposits, it is anticipated that the groundwater flow direction will be towards a stream located to the east.

5.2 Geochemistry

The British Geological Survey estimates of the geochemistry of the soils beneath the site are:

Determinants	Soil Type	Concentration (mg/kg)
Arsenic	Rural	15 - 25
Cadmium		<1.8
Chromium		60 – 90
Nickel		15 – 30
Lead		<100

5.3 Hydrology

The Ordnance Survey Water Network Lines indicates the nearest surface water feature is the Stevenage Brook, located 163m to the east.

There are no licensed surface water abstraction points within 500m radius of the site.

5.4 Ecologically Sensitive Areas

There are no ecologically sensitive sites within 250m radius of the site.

5.5 Radon

The site is located in an area where less than 1% of homes are above the Action Levels and Radon protective measures are not necessary in the construction of new dwellings or extensions.

5.6 Natural Hazards

BGS GeoSure Data presented within the Environmental Database presented in Appendix V identifies the following ground conditions:

Hazard	Designation	Hazard
Potential for Shrinking or Swelling of Clays	Low	Ground conditions predominantly medium plasticity
Potential for Landslide Ground	Very Low	Slope instability problems are unlikely to be present
Potential for Ground Dissolution	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions
Potential for Compressible Ground	Negligible	No indicators for compressible ground identified
Collapsible Ground	Very low	Deposits with potential to collapse when loaded and saturated are unlikely to be present.
Potential for Running Sands	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water.

6 PREVIOUS REPORT

No previous site investigation reports were identified or made available.

7 INITIAL CONCEPTUAL MODEL

Brown 2 Green Associates Ltd has developed a conceptual model to identify potential sources, migration pathways and receptors within the study area. Assuming there is an active pollution pathway linkage between the source and receptor an assessment has been made of the level of risk. The level of risk is a consideration of both:

- the likelihood of an event (probability) [takes into account both the presence of the hazard and receptor and the integrity of the pathway]; and
- the severity of the potential consequence [takes into account both the potential severity of the hazard and the sensitivity of the receptor].

The classifications of the probability of an event occurring based on C552 CIRIA, 2001[2] are presented below:

Probability		Definition
High Likelihood	> 90% of hazard receptor linkage	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 that there is harm or contamination
Likely	45-90% of hazard receptor linkage	There is a pollution linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term
Low likelihood	10-50% of hazard receptor linkage	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	10% of hazard receptor linkage	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

The classification of the severity of an event is presented below:

Severity	Category	Definition	Examples
Severe: It is likely that the hazard source could cause harm to a designated receptor and harm would be significant.	Humans	Short term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA.	High concentrations of cyanide on the surface of an informal recreation area.
	Controlled Water	Short term risk of pollution of sensitive water resource.	Major spillage of contaminants from site into controlled water.
	Property	Catastrophic damage to building or property	Explosion causing building to collapse.
	Ecological systems	A short term risk to a particular ecosystem, or organism forming part of such an ecosystem.	Loss of ecosystem.
Medium: It is possible that the hazard source could cause harm to a designated receptor, but it is unlikely that the harm would be significant	Humans	Chronic damage to human health ("significant harm" as defined in the DETR, 2000).	Concentrations of a contaminant from site exceeds the generic, or site specific assessment criteria
	Controlled Water	Pollution of sensitive water resources.	Leaching of contaminants from a site to a Principal Aquifer.
	Ecological systems	A significant change in a particular ecosystem, or organism forming part of such an ecosystem.	Death of a species within a designated nature reserve.

[2] Contaminated land risk assessment. A guide to good practice (C552), D J Rudland, R M Lancefield and P N Mayell.

Severity	Category	Definition	Examples
Mild: It is possible that the hazard source could cause significant harm to a designated receptor, however it is likely to be mild	Controlled Waters	Pollution of non-sensitive water resource.	Pollution of non-classified groundwater
	Property	Significant damage to buildings/structures and crops ("significant harm" as defined in the DETR, 2000). Damage to sensitive buildings/structures or the environment.	Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor: The potential hazard source cannot cause significant harm to the receptor.	Financial or project	Harm, although not necessarily significant harm, which may result in a financial loss, or an expenditure to resolve.	
	Humans	Non-permanent health effects to human health (easily prevented by means such as Personal Protective Clothing, etc).	The presence of contaminants at such concentrations that protective equipment is required during site works.
	Property	Easily repairable effects of damage to buildings/structures	The loss of plants in landscaping scheme. Discolouration of concrete.

The comparison of Likelihood against Severity is presented below:

		Severity			
		Severe	**Medium**	**Mild**	**Minor**
Likelihood	**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**

The potential consequence of risk classifications is presented below:

Very High Risks	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risks	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate Risks	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Moderate / Low Risks	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be medium to mild and professional judgement is required. Some remediation works may be required in the long term where high sensitivity receptors are involved.
Low Risks	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risks	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

7.1 Potential Sources of Contamination

On-site Potential Sources

Based on the findings of the site walk-over and the desk study information review the following potential on-site sources of contaminants that may plausibly impact the site were identified:

- General quality of the made ground imported for the development of the site.
- Decommissioned underground storage tank.
- Possible use of the site as a builder's yard. Likelihood is low.

Off-site Potential Sources

Based on the findings of the site walk-over and the desk study information review the following potential off-site sources of contaminants that may plausibly impact the site were identified:

- General commercial land use within local area, including car workshops, depots and sub-station.

7.2 Potential Pathways

Plausible pathways identified for each contaminant are presented in the initial conceptual model detailed overleaf.

7.3 Potential Receptors

Brown 2 Green Associates Ltd has identified the following possible receptors:

- Human health - future users of the site (residential with private gardens).
- Human Health - neighbouring properties.
- Human health - construction workers
- Controlled water (groundwater secondary (Secondary (Undifferentiated) Aquifer over Principal Aquifer).
- Controlled water (surface water – Stevenage Brook located 163m to east)
- Buildings and construction materials (concrete).
- Water supply pipework.
- Listed buildings and historical sites.

7.4 Discussion of Potential Pollutant Linkages

Potential pollution linkages identified are presented in the initial conceptual model detailed overleaf.

Initial Conceptual Model and Risk Assessment

Potential Contaminant	***Potential migration pathway***	***Potential Receptors***	***Probability of Risk***	***Severity***	***Risk Classification***	***Comments*** ***Active/Inactive***
On-site Sources						
General use of the site as possible builder's yard and stabling of horses						
Metals (As, Cd, Cr, Pb, Hg, Se, Ni, V)	Ingestion of contaminated soil and dust by direct contact and soil attached to home grown vegetables. Inhalation of dust (indoor and outdoor).	Future site users	High likelihood	Medium	High	Potentially active in areas of soft landscaping and private gardens. Further assessment required.
	Inhalation of dust	Users of neighbouring properties	Low	Minor	Very Low	Occurring the rough deposition with areas of open space.
	Ingestion of contaminated soils by direct. Inhalation of dust (indoor and outdoor).	Construction workers	Likely	Minor	Low	Potentially active but short-term exposure. General site practices and site PPE (gloves) will reduce exposure.
Metals (Cu, Ni, Zn)	Uptake by plants	Planting and soft landscape areas	Likely	Minor	Low	Potentially active in areas to be developed as soft landscaping and gardens. Further assessment required.
PAHs in ash and coal tar	Ingestion of contaminated soil and dust by direct contact and soil attached to home grown vegetables. Inhalation of dust (indoor and outdoor).	Future site users	Likely	Medium	Moderate	Potentially active in areas of soft landscaping and private gardens. Further assessment required.
	Inhalation of dust	Users of neighbouring properties	Low	Minor	Very Low	Occurring the rough deposition with areas of open space.
	Ingestion of contaminated soil and dust by direct contact. Inhalation of dust (indoor and outdoor).	Construction workers	Likely	Minor	Low	Potentially active but short-term exposure. General site practices and site PPE (gloves) will reduce exposure.

Potential Contaminant	***Potential migration pathway***	***Potential Receptors***	***Probability of Risk***	***Severity***	***Risk Classification***	***Comments*** ***Active/Inactive***
PAHs in ash and coal tar	Downward and lateral migration.	Groundwater Surface Water	Low	Mild	Low	Potentially active but PAH from ash and coal are generally non-mobile and contained within carbonised deposits..
	Contact with contaminated soils.	Water supply infrastructure	Low	Mild	Low	Potentially active where in contact.
Asbestos	Inhalation of fibres.	Future site users and construction workers	Likely	Severe	Moderate	Potentially active.
Ground gas	Through soil.	Future users and buildings	Unlikely	Medium	Low	Potentially active should made ground be identified at thickness greater than 2m and with high organic matter content to act as source.
Presence underground storage tanks for the storage of diesel						
Total Petroleum Hydrocarbons, (diesel) presence as spot source area.	Ingestion of contaminated soil and dust by direct contact and soil attached to home grown vegetables. Only active if spillage in near surface soils from dispensing pump and area developed as garden. Inhalation of dust (indoor and outdoor). Contact with contaminated soils. Inhalation of vapours.	Future site users	Likely	Medium	Moderate	Potentially active in areas of soft landscaping and private gardens. Further assessment required.
	Inhalation of vapour	Users of neighbouring properties	Low	Mild	Low	Vapours migration though soil. Presence of clay deposits will restrict contamination movement. Due to time scale since tank was used vapours will degrade through natural attenuation.

Potential Contaminant	***Potential migration pathway***	***Potential Receptors***	***Probability of Risk***	***Severity***	***Risk Classification***	***Comments*** ***Active/Inactive***
Total Petroleum Hydrocarbons, (diesel) presence as spot source area.	Ingestion of contaminated soil and dust by direct contact. Inhalation of dust (indoor and outdoor). Contact with contaminated soils. Inhalation of vapours.	Construction workers	Likely	Minor	Low	Potentially active but short-term exposure. General site practices and site PPE (gloves) will reduce exposure.
	Contact with contaminated soils.	Water supply infrastructure	Likely	Medium	Moderate	Potentially active if pipework placed within contaminated soil
	Downward and lateral migration.	Groundwater Surface Water	Likely	Medium	Moderate	Potentially active. Site directly underlain by Secondary (Undifferentiated) Aquifer. Superficial deposits consist of argillaceous deposits. Downward migration will be restricted.
Asbestos	Inhalation of fibres.	Future site users and construction workers	Likely	Severe	Moderate	Potentially active.
Off-site Sources						
General commercial land use within local area, including car workshops, depots and sub-station						
Hydrocarbons	Vapours through soil	Future site users and construction workers	Unlikely	Minor	Very low	INACTIVE – No active pollution pathways identified due to distance from the subject site and the presence of argillaceous deposits acting as barrier to migration.

8 SITE INVESTIGATION

8.1 Exploratory Fieldwork

Six boreholes (WS1 to WS6) were drilled with a window sampler drilling rig on 14th July 2023 to a maximum depth of 5.0m below surface. During the drilling of WS4 a layer of brick paving was identified at 0.4m. Due to the risk from possible underground utilities the borehole was abandoned.

The sample locations were based on the site conceptual model to provide a general assessment of the quality beneath the soils beneath site and the potential source areas listed in the table below. The sampling locations are illustrated in Figure 3.

Sample Location	Rational/Potential Source Area
WS1	Adjacent to assumed location of former underground storage tank,
WS2	Adjacent to assumed location of former underground storage tank,
WS3	General quality of made ground within paved yard area,
WS4	General quality of made ground within land used for storage of building materials.
WS5	General quality of made ground within land used for storage of building materials.
WS6	General quality of made ground within land used for storage of building materials.

Soil samples destined for chemical testing were collected in laboratory prepared jars. Samples for organic analysis were placed in amber glass jars, samples for volatile analysis in vials with septums and samples for inorganic analysis in plastic tubs. During the site works recovered soils were geologically logged by an experienced Geo-environmental Engineer. The geological logs are presented in Appendix VII.

8.2 Chemical Analysis

The soil samples were submitted to Eurofins/Chemtest Ltd of Newmarket, Suffolk. The chemical analysis was carried out under UKAS/MCERTS accreditation protocols. The chemical analysis was carried out in accordance with the findings of the Desk Study and the observations made during the site works. The chemical testing programme included.

- Metals Suite (As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn, V);
- Speciated PAH (USEPA 16);
- TPH – CWG;
- pH;
- Soluble Sulphate; and
- Asbestos fibres

9 RESULTS

9.1 Summary of Site Investigation Observations

Ground Conditions

The geological logs are presented in Appendix VII.

Made Ground

The boreholes indicate that the block paving within the northern part of the site is underlain by up to 0.3m of made ground. The made ground consist of a dark brown and grey gravelly clay or clayey gravel with gravel of flint, concrete, tarmac, charcoal and brick fragments. In WS3 a granite gravel sub-base beneath the block paving was present,

In WS4 a layer of brick was identified at 0.4m below ground level.

In WS5 and WS6 up to 1.0m of made ground was identified. The made ground consist of 0.1m of gravel over dark brown, slightly gravelly, slightly sandy clay. The gravel being of flint and chalk with occasional brick and concrete fragment.

Natural Strata

The made ground is underlain by orangish brown mottled grey slightly sandy, silty clay, which in turn is underlain by an orangish brown mottled grey slightly gravelly, slightly sandy clay. This in turn is underlain by and orange brown and mottled grey clay.

Within the argillaceous deposits lenses of arenaceous deposits were recorded. In WS1 an orange brown slightly gravelly sand was identified at 3.2m to the base of the borehole at 5.0m. In WS5 a brown sandy gravel was identified between 2.0 and 2.6m bgl. In WS6 a clayey and slightly sandy gravel was identified between 4.0 and 4.4m below ground level.

Visual and Olfactory Evidence of Contamination

In WS1 a slight hydrocarbon odour was noted at a depth of between 2.5 and 2.8m. No staining was identified.

The made ground contains fragments of tarmac and charcoal, together with other anthropogenic material.

Groundwater Conditions

During the investigation no groundwater strikes or seepages were noted. In WS1 and WS5, the sand was damp. All boreholes were dry on completion of drilling.

9.2 Laboratory Results

The chemical analysis of the soil samples was undertaken by Eurofins/Chemtest Ltd of Newmarket under MCERT and UKAS accreditation. The test certificates are included in Appendix VIII.

10 RISK ASSESSMENT

10.1 Human Health

10.1.1 Approach

Brown 2 Green Associates Ltd has undertaken a Tier 1 Human Health Risk Assessment to determine if any potential contaminants within the underlying soil pose an unacceptable level of risk to the identified human health receptors.

At a Tier 1 stage the long term (chronic) human health toxicity of the soil has been assessed with reference to Generic Assessment Criteria (GAC) detailed in Nathanail, C. P., McCaffrey, C., Gillett, A. G., Ogden, R. C. and Nathanail, J. F. 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham (Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3086). If no generic GAC (CIEH/LQM) is available, reference has been made to Category 4 Screening Values or GAC have been determined by Brown 2 Green Associates Ltd using CLEA 1.06 with adjustments based on input data used in the calculation of Category 4 Screening Values.

Where appropriate, as detailed in the Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration (CL:AIRE, 2020), a comparison of the 2-way confidence interval with the relevant GAC threshold is applied to determine whether the degree of contamination detected is statistically significant.

For the assessment of risk to human health from groundwater a qualitative risk assessment has been undertaken. Within this section we have only considered the risk to users of the site. An assessment of risk to human health beyond the boundaries of the site is considered as part of the risk to controlled waters.

10.1.2 Risk from Soil

Risk to Future Site Users

For the purposes of the Tier 1 assessment Brown 2 Green Associates Ltd have initially compared the laboratory test data directly to the relevant Brown 2 Green Associates Ltd Tier 1 human health screening criteria for residential with plant uptake end use with a soil organic matter content of 1%. The results of this direct comparison is presented below:

Determinant	Units	GAC	n	Conc. Above GAC	Locations above GAC	Path-way	Assessment
Arsenic	mg/kg	37	11	17	-	1	No Further Action
Cadmium	mg/kg	11	11	0.48	-	5	No Further Action
Chromium (III)	mg/kg	910	11	33	-	4	No Further Action
Copper	mg/kg	2400	11	26	-	5	No Further Action
Mercury (Inorganic)	mg/kg	40	11	0.12	-	1	No Further Action
Nickel	mg/kg	130	11	28	-	1	No Further Action
Lead *	mg/kg	200	11	160	-	1, 4	No Further Action
Selenium	mg/kg	250	11	1.5	-	1	No Further Action
Vanadium	mg/kg	410	11	47	-	5	No Further Action
Zinc	mg/kg	3700	11	230	-	5	No Further Action
Cyanide (total)***	mg/kg	791	6	<0.5	-	1	No Further Action

Determinant	Units	GAC	n	Conc. Above GAC	Locations above GAC	Path-way	Assessment
Naphthalene	mg/kg	2.3	11	5.1 5.6 2.9	WS2 (0.1-0.4m) WS3 (0.2-0.4m) WS4 (0.0-0.4m)	5, 2	Further Assessment (see below)
Acenaphthylene	mg/kg	170	11	18	-	5	No Further Action
Acenaphthene	mg/kg	210	11	2.8	-	5	No Further Action
Fluorene	mg/kg	170	11	7.2	-	1, 5	No Further Action
Phenanthrene	mg/kg	95	11	58	-	5	No Further Action
Anthracene	mg/kg	2400	11	22	-	5	No Further Action
Fluoranthene	mg/kg	280	11	170	-	5	No Further Action
Pyrene	mg/kg	620	11	160	-	1, 5	No Further Action
Benzo(a)anthracene	mg/kg	7.2	11	20 77 45 47	WS1 (0.1–0.3m) WS2 (0.1-0.4m) WS3 (0.2-0.4m) WS4 (0.0-0.4m)	1	Further Assessment (see below)
Chrysene	mg/kg	15	11	19 73 42 47	WS1 (0.1–0.3m) WS2 (0.1-0.4m) WS3 (0.2-0.4m) WS4 (0.0-0.4m)	1	Further Assessment (see below)
Benzo(b)fluoranthene	mg/kg	2.6	11	26 120 61 65	WS1 (0.1–0.3m) WS2 (0.1-0.4m) WS3 (0.2-0.4m) WS4 (0.0-0.4m)	1	Further Assessment (see below)
Benzo(k)fluoranthene	mg/kg	77	11	37	-	1	No Further Action
Benzo(a)Pyrene	mg/kg	2.2	11	24 89 54 59	WS1 (0.1–0.3m) WS2 (0.1-0.4m) WS3 (0.2-0.4m) WS4 (0.0-0.4m)	1	Further Assessment (see below)
Indeno(123-cd)pyrene	mg/kg	27	11	62 39 42	WS1 (0.1–0.3m) WS2 (0.1-0.4m) WS3 (0.2-0.4m) WS4 (0.0-0.4m)	1	Further Assessment (see below)
Dibenz(ah)anthracene	mg/kg	0.24	11	3.4 11 6.2 7.3	WS1 (0.1–0.3m) WS2 (0.1-0.4m) WS3 (0.2-0.4m) WS4 (0.0-0.4m)	1	Further Assessment (see below)
Benzo(ghi)perylene	mg/kg	320	11	54	-	1	No Further Action
TPH C_5-C_6 (aliphatic)	mg/kg	42	14	<0.05	-	2	No Further Action
TPH C_6-C_8 (aliphatic)	mg/kg	100	14	<0.05	-	2	No Further Action
TPH C_8-C_{10} (aliphatic)	mg/kg	27	14	0.21	-	2	No Further Action
TPH C_{10}-C_{12} (aliphatic)	mg/kg	130	14	53	-	2	No Further Action
TPH C_{12}-C_{16} (aliphatic)	mg/kg	1100	14	240	-	1	No Further Action
TPH C_{16}-C_{35} (aliphatic)	mg/kg	65,000	14	530	-	1	No Further Action
TPH C_{35}-C_{44} (aliphatic)	mg/kg	65,000	14	<10	-	1	No Further Action
TPH C_5-C_7 (aromatic)	mg/kg	70	14	<0.05	-	2	No Further Action
TPH C_7-C_8 (aromatic)	mg/kg	130	14	<0.05	-	2	No Further Action
TPH C_8-C_{10} (aromatic)	mg/kg	34	14	<0.05	-	2	No Further Action
TPH C_{10}-C_{12} (aromatic)	mg/kg	74	14	18	-	2	No Further Action
TPH C_{12}-C_{16} (aromatic)	mg/kg	140	14	180	WS1 (3.5m)	1	Further Assessment (see below)
TPH C_{16}-C_{21} (aromatic)	mg/kg	260	14	260	-	1	No Further Action
TPH C_{21}-C_{35} (aromatic)	mg/kg	1100	14	770	-	1	No Further Action
TPH C_{35}-C_{44} (aromatic)	mg/kg	1100	14	140	-	1	No Further Action
Benzene	mg/kg	0.087	6	<0.001		2	No Further Action
Ethylbenzene	mg/kg	47	6	<0.001		2	No Further Action
Toluene	mg/kg	130	6	<0.001		2	No Further Action

Determinant	Units	GAC	n	Conc. Above GAC	Locations above GAC	Path-way	Assessment
m&p-xylene	mg/kg	56	6	<0.001		2	
o-Xylene	mg/kg	60	6	<0.001		2	
MTBE **	mg/kg	49	6	<0.001		2	

Notes
Main Exposure Pathways: 1 = Soil and dust Ingestion, 2 = Vapour Inhalation (indoor), 3 = Dermal Contact, 4 = Dust Inhalation, 5 = consumption of home grown produce.

Abbreviations: GAC = General Assessment Criteria, n = number of samples.

Tier 1 GAC are based on Nathanail, C. P., McCaffrey, C., Gillett, A. G., Ogden, R. C. and Nathanail, J. F. 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham. **Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3086.**

* - Category 4 Screening Level.
** - EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment January 2010.
*** - Brown 2 Green HH-GSV using CLEA V 1.06 and tox data from DEFRA/Environment Agency SGV.

Asbestos was not identified in any of the soil samples submitted for screening analysis.

For determinants that exceed their respective GAC, statistical assessment has been completed. The results are summarised below.

Concentrations of individual polycyclic aromatic hydrocarbons (naphthalene, benzo(a)anthracene, chrysene benzo(b)fluoranthene, benzo(a)pyrene, indeno(123-cd)pyrene and dibenzo(a,h)anthracene (PAHs)) were identified within the made ground samples from the northern part of the site that is currently paved with block paving at levels that are significantly greater than the GAC. The source of the PAH is considered to be the tarmac and charcoal that was noted within the samples. Within the samples of made ground from the southern part of the site, all concentrations are less than the GAC. For the PAHs identified (except naphthalene) the principal exposure pathway is soil and dust ingestion. For naphthalene the principal exposure pathways are vapour (indoor) inhalation and the consumption of home-grown vegetables. The pathways of ingestion of soil and dust and consumption of home-grown vegetables would be introduced in areas to be developed as private gardens. It is considered that the pathways via indoor inhalation of naphthalene vapours would not be present as the naphthalene concentrations would be bound up within the structure of the tarmac and charcoal. Based on the findings of the assessment it is considered that the concentrations of PAHs identified within the made ground beneath the northern part of the site will pose an unacceptable level of risk to human health of future site users. Where the site is covered by hard standing or building footprint, a barrier that breaks the pollution linkage will be provided and therefore in these areas it is considered that the elevated PAH concentrations will not pose an unacceptable level of risk to human health.

No active pathways were identified to receptions within neighbouring properties as the PAHs are bound up within the structure of the tarmac fragments.

A single sample contained a concentration of TPH C12-C16 (aromatic) that was slightly above the GAC. This samples from obtained from WS1 at 3.5m, which was drilled adjacent to the anticipated location of the former underground storage tank. As the principal exposure pathway is soil and dust ingestion, due to the depth of the exceedance it is considered that the concentration will not pose an unacceptable level of risk.

The TPH concentrations between C10 and C40, which were predominately aromatic hydrocarbons were also identified within the made ground. Concentrations were all less than the GAC. It is

suspected that these concentrations are the PAH identified within the samples, together with semi-volatile organic compounds associated with the tarmac that was noted within the made ground.

Risk to Construction Workers

In respect to the risk to construction workers, this report and the generic assessment criteria (GAC) consider long term and chronic risk to humans based on defined exposure scenarios set out in the CLEA model. In some cases, contaminants may also pose acute hazards to workers at a site, or a worker's exposure scenario may differ from the scenarios considered when deriving the GAC. As exposure times for construction workers are generally short term, risks from site contamination are generally addressed through the use of appropriate working procedures and the use of personal protective equipment (PPE) in line with the Management of Health and Safety at Work Regulations (1999), Construction (Design) Management Regulations (2007) for some sites and the Control of Substances Hazardous to Health Regulations (2002).

10.1.3 Risk from Groundwater

As no pollution linkages have been identified due to the depth of groundwater being greater than 5m, it is considered contamination in the groundwater beneath the site will not pose an unacceptable level of risk to human health.

10.2 Ground Gas and Vapours

From the results of the site investigation, no sources of ground gas that would result in the generation of volumes of biogenic gas that would pose an unacceptable level of risk to human health and the proposed development have been identified. The Conceptual Site Model prepared for the Preliminary Risk Assessment did not identify any off-site sources. From the assessment it is considered that ground gas will not pose a significant risk to human health and the development.

The presence of the underground storage tank is considered as a source of hydrocarbons vapours. However, the results of the investigation did not identify any concentrations of hydrocarbons that will pose an unacceptable level of risk. The tank was also used for diesel and thus the potential for the presence of hydrocarbon vapours at significant concentrations that would pose an unacceptable level of risk is low and currently can be considered to be acceptable.

10.3 Risk to Controlled Water

To assess risk to controlled waters from the leaching of determinants from soil, a Qualitative Risk Assessment has been made based on the concentrations identified within the soil samples and site conditions. The potential for the remobilisation of PAH and metal from the made ground at level that would pose an unacceptable level of risk is considered to be very low. The PAH concentration are bound up within the structure of the source material (tarmac and charcoal) and the metal concentrations are presence at concentrations close to typical background concentrations. The presence of the argillaceous deposits will also prevent downward migration.

In regard to the TPH concentrations identified by the underground storage tank, the concentrations are at levels that would not be leached at level that would pose an unacceptable level of risk to controlled waters. The argillaceous deposits will also prevent further downward migration. This assessment is based on the findings of the current phase of the investigation. At the time of the investigation the exact position of the tank and dispending pump could not be determined. It is known the tank has been decommissioned, but the tank could still be in place. Further investigation and assessment of the risk associated with the tank should be undertaken.

10.4 Risk to Planting

An assessment of risk to from potentially phytotoxic metal compounds has been completed. In the absence of published assessment criteria specifically for contaminated land, GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields.

For the assessment values defined in The Sludge (use in Agriculture) Regulations 1989 (Public Health England, Wales and Scotland), as amended in 1990 and The Sludge (use in Agriculture) Regulations (Northern Ireland) SR No, 245, 1990 have been adopted. In addition the Department of Environment (DoE) produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 which provided guidance on the application of sewage sludge on agricultural land. The specified limits of concentrations of selected elements in soil are presented in the 2nd Edition of the DoE Code of Practice and are designed to protect plant growth.

As all concentrations are below their respective assessment criteria, it is considered that the concentrations of phytotoxic metals are not at levels that would pose an unacceptable level of risk to planting.

10.5 Risk to Construction Materials

The assessment of the risk to concrete from the concentrations of sulphate and the pH in the soil has been made using BRE guidance Special Digest 1:2005 Concrete in Aggressive Ground.

Sulphate concentrations of <10mg/l and pH values of 8.4 and 8.7 were recorded in the soils. The site has been assessed as brownfield due to the presence of previous developments and made ground of unknown origin and a static groundwater regime apportioned in view of the findings of the boreholes.

Following the guidance set out in the Digest the characteristic sulphate content is 10mg/l and the characteristic pH is 8.4 in the soil; the Design Sulphate class for the site is DS-1 and the Aggressive Environment for Concrete Class is AC-1. Based on the results of the assessment it is considered that the made ground beneath the site will not pose an unacceptable level of risk to concrete through acid attack.

This recommendation is based on samples taken in the near surface materials on site. If deeper foundations are required additional testing should be undertaken and the conclusions of this section should be re-assessed in light of the additional test results available.

10.6 Risk to Water Supply Pipe

The assessment of risk to pipe work used in the potable water supply has been made using UK Water Industry Research (UKWIR) "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites" (Ref 10/WM/03/21)" January 2011 and supplement "Contaminated Land Assessment Guidance" dated January 2014. The results from samples of made ground (through which any new water supply pipes are likely to pass) have been compared with the threshold values listed in the UKWIR guidance. It should be noted that the threshold values are for use by designers in the selection of appropriate pipe materials. Exceedance of a threshold value indicates only that there could be a 'water quality issue'. Threshold values are generally protective of taste and odour quality of water in plastic water pipes and only threshold values for benzene and MTBE are protective of human health.

Within the made ground and soils located within the immediate vicinity of the former underground

storage tank, concentrations of TPH were recorded at levels that were above the thresholds for mineral soil (C11 to C20) of 10.0mg/kg and the threshold for mineral oil C21 to C40) of 500mg/kg. Based on the above there is the potential that the concentrations may permeate polymer-based pipe work and impact on the quality of potable water or cause degradation of the pipe construction should pipework be placed within this soil.

10.7 Risk to Sensitive Ecological Receptors

As no receptors were identified, it is considered that contamination will not pose an unacceptable risk to ecological receptors.

10.8 Risk to Historical Structures and Monuments

As no receptors were identified, it is considered that contamination will not pose an unacceptable risk to historical structures and monuments or sites of historical interest.

11 REVISED CONCEPTUAL MODEL

In the light of the results of the site investigation, results of the chemical analysis and the risk screening assessment presented in the previous sections the conceptual model developed has been updated. The conceptual model is presented below.

Source	***Potential migration pathway***	***Potential Receptors***	***Discussion, Remedial or Precautionary Measures and Mitigating Factors***
PAH concentrations within the made ground	Soil and dust ingestion Ingestion of contaminated home-grown vegetables (naphthalene only)	Future site users	Concentrations have been identified within the made ground located at the northern end of the site, which is currently paved with block paving. Active pollution pathways will be created with areas developed as soft landscaping. Further assessment will be required within the footprint of the existing buildings to determine the extent of the contamination.
TPH concentrations within the made ground and soils located adjacent to the former underground storage tank.	Contact with contaminated soils	Water supply infrastructure	Hydrocarbon resistant barrier pipework may be required if pipework is placed within contaminated soil.

12 GEO-ENVIRONMENTAL CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

Based on the findings of the current phase of investigation the following conclusions are made:

The Tier I Human Health Risk Assessment has determined there are concentrations of PAHs within the made ground beneath the northern end of the site that will pose an unacceptable level of risk in the areas proposed to be developed as private gardens or soft landscaping. The natural soils will not pose an unacceptable level of risk to human health of future site occupants and users.

The Tier I Controlled Water Risk Assessment has determined that there are no concentrations of potential contaminants within the underlying soils that would pose an unacceptable risk to controlled waters. It should be noted that this conclusion is based on the results of the currently phase of investigation, it is considered that further site investigation and assessment should be undertaken to fully define the level of risk.

The risk assessment for bio-genic ground gas and vapours concluded that there are no concentrations at levels that would pose an unacceptable risk to human health and the proposed development.

The risk assessment in respect to the future planting and towards sensitive ecological receptors identified that the determinants at the site are at levels that would not pose an unacceptable level of risk to future planting and sensitive ecological receptors.

The risk assessment in respect to water supply infrastructure identified that concentrations of hydrocarbons within the made ground and soils adjacent to the former underground storage tank are at levels that will pose an unacceptable level of risk to the integrity of PE or PVC pipework.

12.2 Recommendations

Based on the findings of the currently phase of contaminated assessment the following recommendations are made:

At the time of the site investigation, the site was active and access was not made available for the interior of the existing buildings, hence the quality of the ground present beneath the existing building is unknown. It is recommended that an additional site investigation should be undertaken to assess extent of the PAH concentrations identified and the general quality of the ground within the proposed private gardens and soft landscaping.

Also, another objective of the additional site investigation should be the identification of the exact location of the decommissioned underground storage tank and determine if the tank has been removed and concentrations of contaminants within the made ground beneath the southern end of the site. On completion of the additional investigation, the contaminated land site investigation should be updated to reflect the additional information.

Due to the presence of the hydrocarbon identified within the made ground, hydrocarbon resistant barrier pipework may be required within localised areas. The extent would be dependent on the line of the pipework in relation to the hydrocarbon concentrations. It is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

A Remediation Method Statement (RMS) to implement the required remediation measures should be prepared in accordance with the local Environmental Health Department and the Environment Agency. This should be undertaken by a competent person. On completion of the remediation, verification should be undertaken to ensure suitable and sufficient works have been undertaken.

It is recommended that a Pre-demolition Asbestos Survey is conducted by a competent person to assess the quantity of asbestos containing materials in existing buildings. Asbestos is classified as Hazardous Waste and therefore there is a duty of care for its proper disposal.