

4.5 Soil and Groundwater

- 4.5.1 This section of the ECR assesses the effects of the proposed development with respect to ground and groundwater contamination. This chapter considers the potential impact from the disturbance of contamination and hazardous materials on human health and the environment, and the impacts of potentially contaminated ground or groundwater conditions on existing adjacent structures and the proposed development.
- 4.5.2 This chapter describes the methods used to assess the impacts, the baseline conditions currently existing at the application site and in the surrounding area, the potential direct and indirect impacts of the proposed development, arising from existing ground conditions and hazardous materials, and the mitigation measures required to prevent, reduce or offset the impacts.
- 4.5.3 The section below, reports the effects and specific commitments of the Consented Scheme on existing and proposed end users (receptors) at the site. It also describes the various Planning Conditions attached for the topic, as required, up to Construction Stage, and identifies how and where information, which required such conditions, is located.
- 4.5.4 This section revisits and builds upon (where necessary) Chapter 6: Soil and Groundwater of the 2013 ES, by assessing the detailed scheme for The Ropeyards specifically, introducing further mitigation (as required), before concluding whether the detailed scheme is in compliance and alignment with the findings of the 2013 ES.
- 4.5.5 Chapter 6: Soil and Groundwater of the 2013 ES, considered the following potential land contamination impacts:

Receptor	Potential Impact
Future Site Users (completed development residents/workers/visitors)	Direct or indirect ingestion of contaminated soil, inhalation, dermal contact (completed development) Concentration of flammable or asphyxiating in-ground gases in enclosed spaces (completed development) Inhalation or deposition of in-ground vapours indoors and outdoors (completed development)
Surrounding Land Uses	Inhalation or deposition of wind-borne dust (construction stage) Migration of contamination in sub-surface strata (including gases) (completed development and/or construction stage)
Construction Workers	Direct or indirect ingestion of contaminated soil, inhalation, dermal contact (construction stage) Concentration of flammable or asphyxiating gases in confined spaces (construction stage) Inhalation of asbestos during building demolition (construction stage)
New Built Environment	Chemical attack of buried concrete structures (completed development) Permeation of water supply pipelines (completed development) Concentration of explosive gases above the Lower Explosive Limit (LEL) (completed development).

4.5.6 Impacts were assessed for both the construction and operational phases, based on an assessment of the magnitude of contamination sources, as obtained from the desktop study and existing Ground Investigation information, and assessment of the pathway-receptor linkages from the description of the development at the time as summarised below.

Receptor	Sensitivity	Comments
Construction workers	High to Low	Construction workers involved in below ground construction will have a high sensitivity. Those involved with minimal intrusion above ground works will have much less sensitivity.
Future Site Users	High	Includes future residents, site operatives, visitors and maintenance workers.
Surrounding Site Users	High to Medium	Includes existing and planned residential buildings. Less sensitive receptors associated with retail, commercial and light industrial buildings.
New built environment	Medium	Includes the proposed development buildings, services, and landscaping.
Groundwater	Medium	The application site is not within a Source Protection Zone and there are no potable groundwater abstractions.

4.5.7 From the 2013 ES baseline data, potential contamination sources and associated chemicals of concern across the Masterplan site as a whole, comprised the following:

- Made Ground imported to the site as part of its historic development – PAHs, TPH, metals, asbestos and ground gases;
- Former power station (north-west) – solvents, TPH, PAHs, metals;
- Former gas works (north-east) – PAHs, TPH, metals;
- Former electricity substation and transformer room (north) – PCBs;
- Former works / warehouse buildings (north-west and central/southern areas) – PAHs, TPH, metals;
- Former garage (south) – PAHs, TPH, metals;
- Former timber yard (adjacent north-east) – PAHs, TPH, metals; and
- Former coal wharf (adjacent north-east) – PAHs, metals

4.5.8 Of the contaminants listed above, the previous ground investigations identified elevated Made Ground concentrations of lead, nickel, arsenic and PAH's across the wider site with respect to human health guideline concentrations for a residential use without plant uptake.

4.5.9 This Section has been written by TEC, and it is supported by Appendix 4.5.1.

4.6 Findings and commitments of the 2013 ES

Baseline

- 4.6.1 Note: Baseline conditions for the 2008 Masterplan site, are as presented within the 2013 ES (the 2017 ES Addendum makes no material change with respect to Land Contamination Impacts, and does not refer to the Ropeyards site (only A Blocks)). Reference should be made to the 2013 for previous baseline conditions of the 2008 Masterplan site.

Construction phase impacts

- 4.6.2 Chapter 6.5.2 of 2013 ES identifies the following Impacts during construction:

Risks to Construction Workers

- 4.6.3 Risks during construction may arise from dermal contact and ingestion of contaminated soil and shallow groundwater on site during groundworks. In general, ground investigation results from Made Ground did not report concentrations of contaminants above commercial/industrial end-use guideline values, which were considered at the time to be the most appropriate criteria for short term exposure. It was acknowledged that there were gaps in the data and that there is potential to encounter localised sources of contamination. It is anticipated that risks from dermal contact and ingestion will be mitigated, through the implementation of appropriate personal protective equipment (PPE) and hygienic practices during ground works.

Risk to Surrounding Site Users

- 4.6.4 Ground investigations identified elevated concentrations of metals in soils. Appropriate site controls employed during construction works will minimise nuisance effects associated with dusts.

Risks to Groundwater

- 4.6.5 During ground preparatory works, the risk to groundwater aquifers from leaching of potential contaminants in the Made Ground will be increased, due to the removal of hardstanding (on a temporary basis). Groundwater quality is also at risk of being impacted, as a result of foundation works for the application site. It is anticipated that the loads associated with the proposed development will require piled foundations, which are likely to be constructed into the Thanet Sands and potentially the Upper Chalk aquifer below.
- 4.6.6 It should be noted that the application site is not within a Source Protection Zone (SPZ) and there are no potable groundwater abstractions within 1km, indicating that groundwater below the site is unlikely to be utilised as a potable water resource. Consequently, the sensitivity of this receptor is considered to be low.
- 4.6.7 Appropriate housekeeping and implementation of clean drilling/piling techniques in accordance with EA guidance, Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention (EA, 2001) should be followed.

Operational phase impacts

4.6.8 Chapter 6.5.3 of 2013 ES identifies the following Impacts during operation:

Risk to Future Site Users

4.6.9 Future site users (residents, site maintenance workers and visitors) were considered to be locally at risk from any contamination within the near surface soils and groundwater, in areas of soft landscaping.

4.6.10 Previous ground investigations identified contamination by heavy metals (lead, arsenic and nickel) within made ground, and localised PAH contamination in the south of the 2008 Masterplan site.

4.6.11 Risk from ground gas was considered likely to be low, although additional ground gas monitoring was recommended to confirm the ground gas regime.

Risk to Groundwater Receptors

4.6.12 It was calculated that due to the proposed increase in hardstanding cover at the site as a whole (an increase of ~10%), additional groundwater leaching (and associated transfer of potential contaminated within the made ground) was considered unlikely to appreciably increase.

Risk to New Built Environment

4.6.13 Certain contaminants in soil or groundwater (hydrocarbons, solvents, ammoniacal nitrogen) can permeate through/corrode pipe work and possibly contaminate water supplies. Plastic water supply pipes can be at risk from attack from oils and phenols. Additionally, concrete infrastructure can be subject to attack from acids and high sulphate concentrations in soils.

4.6.14 Previous ground investigations and assessment works presented in the 2013 ES concluded that consideration should be given to the protection of potable water supply pipes in accordance with UKWIR guidance document (10/W/M/03/21, January 2011) and to concrete, in accordance with BRE Special Digest 1:2005.

Further Investigation

4.6.15 It is noted that potential impacts and associated mitigation measures identified in Chapter 6 the 2013 ES were based upon the previously identified baseline conditions and associated impacts of the Masterplan site as a whole. Along with detailing the mitigation measures required during the construction and operation phases, the 2013 ES also noted that further ground investigation was required to address the risks identified, and to close out data gaps.

Relevant planning conditions

4.6.16 This chapter relates to Reserved Matters planning update "*Submission of Reserved Matters (Appearance, Landscaping, Layout and Scale) pursuant to Condition 2 of s73 Planning Permission, dated 17.03.2017 (Ref: 16/3025/MA), for 688 residential units and 985 (GEA)*"

sqm of non-residential floorspace within Plots D and K3, K4, K5, and revised landscaping details” associated with the proposed Ropeyards site.

4.7 Assessment methodology

- 4.7.1 The following section outlines the methodologies applied to identify and assess the potential impacts and likely effects to result from the Proposed Development (The Ropeyards only).
- 4.7.2 Guidelines for the risk assessment of land contamination, as documented within the 2013 ES, (DEFRA Contaminated Land Reports 7-11 and Environment Agency Research and Development Publication No. 20 “Methodology for the Derivation of Remedial Targets for Soils and Groundwater to Protect Groundwater” GP3) have been superseded by guidance issued by the Environment Agency “*LCRM – Land Contamination: Risk Management*” (EA, 2023). However, it is noted that the general approach advocated by the revised guidelines is similar to that documented within the 2013 ES (i.e. determination of the Source-Pathway-Receptor contaminant linkages, by developing and refining a robust conceptual model of the site and surrounding area, using a phased assessment approach. Such an approach enables the allocation of a risk classification to identified receptors and determines what, if any, remedial measures are required to mitigate identified significant risks).

4.8 Assessment of the detailed scheme

- 4.8.1 Updated investigation and assessments were undertaken by TEC, in accordance with the above methodologies, since the publication of the 2013 ES. These works were undertaken within the red line boundary of The Ropeyards site. It is noted that extensive underground infrastructure is present within the Study Area (including two Transport for London Crossrail tunnels within the proposed park area) and so assessment of the baseline conditions within the Ropeyards Study Area was limited by their presence.
- 4.8.2 The updated investigation and assessment enabled the updating of the site-specific baseline conditions within the Ropeyards site rather than the 2008 masterplan site as a whole.

Updated Baseline Conditions

- 4.8.3 This section provides additional, site-specific baseline condition information relating to the proposed Ropeyards site, in addition to the information presented within Chapter 6.4 of the 2013 ES for the 2008 Masterplan site. A Desk Study and Ground Investigation report was prepared for the Ropeyards site (formerly identified as RAR Blocks D&K) in 2023 by TEC. In addition, TEC have undertaken multiple phases of ground investigation and assessment of the wider RAR development site, which includes some work on the current Ropeyards site, since the publication of the 2013 ES.
- 4.8.4 This chapter reviews the updated site condition information contained both within the 2023 Desk Study and Ground Investigation report and previous TEC investigation and assessments undertaken since the publication of the 2013 ES, in the context of the current Ropeyards site boundary. In addition, a recent site walkover has been conducted of the current site, along with the obtaining of a recent Envirocheck report, which will reflect any changes to the Ropeyards site since the publication of the 2013 ES. The following assessment has been undertaken based upon available information and data only.

Sources of Information

4.8.5 The baseline information pertaining to the revised scheme proposed for Ropeyards site has been obtained from the following sources:

- ‘*RAR, Blocks D & K – Desk Study and Ground Investigation Report*’. Prepared by TEC on behalf of Berkeley Homes (East Thames) Ltd, dated December 2023 and referenced 2208001.001.01 (Rev. A dated January 2024) (included in Appendix 4.5.1);
- Environmental data and historic mapping obtained from Landmark Information Group (Envirocheck Report ref.: 322278804_1_1, obtained 26 October 2023) (included in Appendix 4.5.1); and
- Site Walkover Observations made by a TEC geoenvironmental consultant on 3rd October 2023 (documented in Appendix 4.5.1).

4.8.6 Additionally, information relating to the Ropeyards site have been obtained from the following previous reports undertaken for the wider RAR development site, which include works on the current site, undertaken since the publication of the 2013 ES:

- ‘*Royal Arsenal Riverside, Phases 18-19 – Preliminary Geoenvironmental and Geotechnical Assessment*’. Prepared by TEC on behalf of Berkeley Homes (East Thames), dated May 2016 and referenced 1508005.003.01. (*Phases 18-19 site is located within the southern section of the current Ropeyards site*) (included in Appendix 4.5.1);
- ‘*Royal Arsenal Riverside - Linear Park – Preliminary Geoenvironmental and Geotechnical Assessment*’. Prepared by TEC on behalf of Berkeley Homes (East Thames), dated February 2018 and referenced 1508005.014.01. (*Zone 1 of the Linear Park area is located immediately north of the current Ropeyards site, while Zone 2 to 4 of the Linear Park area comprises part of the northwestern, central, and southern sections of the current Ropeyards site*) (included in Appendix 4.5.1); and
- ‘*Royal Arsenal Riverside - Linear Park - Remediation Strategy and Verification Plan*’. Prepared by TEC on behalf of Berkeley Homes (East Thames) Ltd, dated March 2018 and referenced 1508005.016.01 (Linear Park include the northwestern, central and southern sections of the *current Ropeyards site*) (included in Appendix 4.5.1).

Historical Land Uses

4.8.7 The 2013 ES Section 6.4.2. documents the history of the 2008 Masterplan site as a whole, which includes the current Ropeyards site. For clarity and to allow a site-specific assessment of the current application site, the site history of the Ropeyards site was obtained from the historic mapping from the Envirocheck report (Landmark Information Group, 2023), as presented within the TEC report and documented below:

Table 4.5.1: The Ropeyards Site History

On Site Features	OS Mapping Dates
<p>Multiple structures are depicted across the site area (assumed to be terraced residential housing), along Warren Lane, Canon Row and Rope Yard Rails (roads), with the exception of the far eastern area of the site, in which no features are depicted (due to military sensitivity).</p> <p>1908 mapping indicates the north eastern site area comprised a Planing Mill and Timber Store.</p>	<p>1869 – 1940</p>
<p>The majority of structures on site have been cleared, with a car park recorded in the southern site area. Some of the smaller (assumed) residential structures still remain in the northern half of the site. Historic mapping identifies some of these structures as Alms houses, and another as a Salvation Army Hall. The roads of Warren Lane and Rope Yard Rails, remain present on site.</p>	<p>1957 – 1958</p>
<p>By 1970, the smaller (assumed) residential structures are no longer present on site. Multiple buildings identified as works, builder’s yards, factories and warehouses are recorded in the northern area of site, with an electricity sub-station recorded in the northwest corner, and another at the northern site boundary by 1987.</p> <p>By 1970, a larger building, identified as a garage, is recorded in the southern half of the site. Warren Lane remains present, but Rope Yard Rails (road) no longer runs the length of the site due to the presence of new buildings and area of hardstanding.</p> <p>By 1996, an additional road (Cornwallis Road) has been constructed in the northeastern site area (previously no features depicted).</p>	<p>1970 – 2009</p>
<p>By 2013, no buildings are depicted on site. Warren Lane and Cornwallis Road remain present</p>	<p>2013 - 2016</p>
<p>By 2023, The northern area of the site is depicted as Maribor Park and the orientation of Warren Lane has been adjusted and is present in the northern site area only. A newly constructed road is present across the central site area (New Warren Lane). A single building is depicted in the southern site area.</p> <p>Aerial photography from 2023, depicts Maribor Park as a grassed area with several footpaths crossing it. A large car park in depicted in the central site area and an office building and associated car park is depicted in the south of site (current site layout).</p>	<p>2023</p>

Current Site Use

- 4.8.8 Site observations of the 2008 Masterplan site, undertaken in 2012, were documented within the 2013 ES. Multiple phases of redevelopment works have been undertaken in, and around the site since this time and, therefore, TEC undertook an updated site walkover of the current Ropeyards site on 3rd October 2023, with the findings presented within TEC’s 2023 report.
- 4.8.9 At the time of the TEC walkover, the Ropeyards site comprised an area of public open space known as ‘Maribor Park’ within the northern part of the site, while temporary offices and adjacent hotel car parking are located in the southern section of the site. The site comprises a combination of hard and soft landscaping. The majority of the northern section comprises soft landscaping (grass) with some hardstanding pathways, and one roadway through the centre of site. The southern section of the site is generally laid to hardstanding comprising the temporary offices of Berkeley Homes (East Thames) Limited, a brick building, and car parking associated with the adjacent hotel. Some small areas of soft landscaping are also present

within the south of the site, and some trees and shrubs are present along the eastern and western boundaries of site.

4.8.10 The site is noted to slope down from the south-east of the site to the north-west, towards the River Thames. Available Ordnance mapping indicates the south-east corner of the site is situated at an approximate elevation of 10.6m Above Ordnance Datum (AOD), sloping down to an approximate elevation of 4.8m AOD in the north-west corner of the site. The park area in the north of the site is noted to be undulating throughout.

4.8.11 The site is surrounded to the north by residential properties, with the River Thames beyond; To the east, the site is bounded by residential properties; to the south by a Premier Inn Hotel, and the Berkeley Homes (East Thames) office; and to the west by Office buildings and residential properties.

Land Use of Surrounding Area

4.8.12 The land surrounding the proposed Ropeyards site has recently undergone redevelopment as part of the wider RAR 2008 Masterplan. A number of significant historic features within the wider area have been identified in the vicinity, as presented within the above referenced TEC report. Many of these were identified in the 2013 ES, however, the distances to identified features have been updated to reflect the Ropeyards site boundary. These are documented within the table below.

Table 4.5.2: Off Site Historic Features

Surrounding Features	Distance	Direction	OS Dates
River Thames	~85m	North	1864 - 2023
Military Store Department (comprising multiple buildings, stores and timber yards). <i>By 1896, large area of mapping devoid of features due to military sensitivity of the area – although Russian Military Mapping (1985) indicates the presence of a number of buildings in this area</i>	From adjacent	East	1869 – 1996
Railway Line	~150m	Southwest	1869 – 2023
Gas Works	~40m	North	1869 – 1870
Timber Yard	~70m	North	1869 – 1896
Workshops	~65m	Northwest	1869 – 1899
Works, Power Station with multiple chimneys by 1970	~15m	Northwest	1958 – 1989
Royal Arsenal West, comprising multiple buildings including Brass Foundry, Laboratories, Carriage Factory, electricity sub-stations, storage buildings. 1999 aerial photography indicates much demolition over this area. By 2006, much of the building and road layout of this area has changed.	From adjacent	East	1996 - 2023

Site Geology Determined from Previous Ground Investigations

4.8.13 Published geological records (BGS geological mapping data) was presented within the 2013 ES. This section documents site specific geological ground conditions at the site determined from the ground investigations within the Ropeyards site boundary, undertaken by TEC since the publication of the 2013 ES, as detailed within the following reports:

- ‘*Royal Arsenal Riverside, Blocks D & K – Desk Study and Ground Investigation Report*’. Prepared by TEC on behalf of Berkeley Homes (East Thames) Ltd, dated December 2023 and referenced 2208001.001.01 (Rev A, dated January 2024) (included in Appendix 4.5.1);
- ‘*Royal Arsenal Riverside, Phases 18-19 – Preliminary Geoenvironmental and Geotechnical Assessment*’. Prepared by TEC on behalf of Berkeley Homes (East Thames), dated May 2016 and referenced 1508005.003.01. (*Phases 18-19 site is located within the southern section of the current Ropeyards site*) (included in Appendix 4.5.1);
- ‘*Royal Arsenal Riverside - Linear Park – Preliminary Geoenvironmental and Geotechnical Assessment*’. Prepared by TEC on behalf of Berkeley Homes (East Thames), dated February 2018 and referenced 1508005.014.01. (*Zone 1 of the Linear Park area is located immediately north of the current Ropeyards site, while Zone 2 to 4 of the Linear Park area comprises part of the northwestern, central and southern sections of the current Ropeyards site*) (included in Appendix 4.5.1)

4.8.14 A generalised summary of encountered ground conditions for the site is provided in the table below. See TEC reports for full details.

Table 4.5.3: Generalised Site Specific Ground Profile

Depth (mbgl)	Elevation (mAOD)	Encountered Material
MADE GROUND		
0.0 to >1.0 / >3.0	-	Sandy gravelly clay underlain by tarmacadam hardstanding and clayey gravelly sand / sandy gravel.
SUPERFICIAL DEPOSITS – KEMPTON PARK GRAVEL		
1.5 / 2.6 to 3.4 / 6.2	6.64 / 7.68 to 4.08 / 5.44	Dense to very dense brown, greenish brown and orangish brown, slightly clayey, slightly silty, gravelly sand. Gravel of fine to medium, angular to subrounded flint.
SOLID GEOLOGY – THANET FORMATION		
3.4 / 6.2 – 16.2 / 17.0	+4.08 / 5.44 to -6.52 to -8.16	Very dense pale greenish brown silty glauconitic sand.
SOLID GEOLOGY – BULLHEAD BEDS (SOUTHERN REDLINE BOUNDARY AREA ONLY)		
15.0 – 16.2	-	Light brown sandy gravel of rounded chert
SOLID GEOLOGY – WHITE CHALK SUBGROUP		
16.2 / 17.0 - >36.0	-6.52 to -8.16 to <-25.72 / <-25.86	Weak becoming moderately strong to medium strong, low to medium density, white chalk with occasional flint. Fractures were generally closely spaced and clean or infilled with white comminuted chalk, with variable discontinuities.

Site Groundwater Conditions Determined from Previous Ground Investigations

- 4.8.15 Groundwater observations within the Ropeyards site boundary have been determined from the TEC ground investigations undertaken in 2016, 2018 and 2023, i.e. since the publication of the 2013 ES.
- 4.8.16 Groundwater was encountered within the far south of the Ropeyards site (in 2016) at a depth of 10.4mbgl (within the Thanet Formation). During the 2018 investigation minor groundwater ingress was recorded within the shallow ground materials (at 2.5mbgl), with the main groundwater body encountered at a depth of 10.4mbgl, with standing groundwater depths during monitoring between 10.15mbgl to 10.32mbgl. While groundwater levels were not discernible during the 2023 works, subsequent static groundwater levels of 7.6mbgl and 8.3mbgl were recorded, following completion of the 2023 works.

Site Natural Ground Hazards Determined from Previous Ground Investigations

- 4.8.17 Evidence of potential dissolution at the Thanet Formation and Chalk interface was recorded during the ground investigation in 2023, with poor recovery recorded in BH02 during drilling of this location between 16.5mbgl and 18.0mbgl.
- 4.8.18 While not encountered during the 2023 intrusive investigation, possible jointing within the chalk mass, has been recorded by TEC, within the wider Royal Arsenal Riverside development, including the adjacent A Blocks and B Blocks. Therefore, consideration to such features will be required within the construction of the proposed development.

Site Land Contamination Observations and Geoenvironmental Risk Assessment Determined from Previous Ground Investigations

- 4.8.19 Since the issue of the 2013 ES, multiple ground investigations have taken place within the Ropeyards site, undertaken by TEC. Contamination observations, geochemical analysis and contamination risk assessment of the site has been undertaken as part of these works. A summary of the site conditions is provided below, with full details presented within the reports in Appendix 4.5.1.

TEC 2016 Reporting (Phases 18-19 site, located within the southern section of the current Ropeyards site)

- 4.8.20 In 2016, TEC carried out a ground investigation in the southern area of the Ropeyards site. The ground investigation comprised 9No. dynamic sample boreholes and 2No. deeper cable percussive boreholes. Olfactory evidence of contamination was recorded in one location within the ground materials encountered, in proximity to proposed Block K2 and associated soft landscaping (WS04 from 0.8mbgl - in proximity of the former/historic garage). VOC concentrations of up to 68.2ppm were recorded by the photo-ionisation detector (PID) within this material.
- 4.8.21 TEC completed a Human Health Generic Quantitative Risk Assessment (GQRA) in 2016, in accordance with applicable guidance at the time, and obtained samples of soil and groundwater during the 2016 ground investigation. The GQRA indicated no elevated contaminant concentrations within the sampled made ground (8No. samples), in relation to Generic Assessment Criteria (GACs) for a “residential without homegrown produce” site end use. It is noted that concentrations of organic hydrocarbon contaminants (PAH and TPH) were

recorded to be below the laboratory limit of detection. Chrysotile and amosite asbestos fibres were recorded within 3No. samples of made ground.

- 4.8.22 Controlled Waters Screening was undertaken in accordance with applicable Environment Agency guidance at the time, indicating elevated leachable concentrations of heavy metals (copper, lead and vanadium) were recorded within the sampled made ground (3No. samples), in relation to selected Environment Agency Environmental Quality Standards (EQS) values. No concentrations of leachable PAHs and TPHs were recorded above the laboratory limit of detection.
- 4.8.23 Furthermore, a groundwater sample taken from the Thanet Sand Formation (in 1No. location), reported no elevated contaminant concentrations in relation to the selected screening values. In addition, concentrations of PAHs and TPHs were recorded below the laboratory limit of detection.
- 4.8.24 During the 2016 works, 3No. rounds of ground gas monitoring were undertaken in boreholes installed within the Thanet Sand. Based on this, the proposed development was characterised, in accordance with guidance applicable at the time of the monitoring, as having a maximum Gas Screening Value of 0.0l/hr for methane and 0.0504l/hr for carbon dioxide. It was reported that the site may be categorised as a Characteristic Situation 1.

TEC 2018 Reporting (*Linear Park - Zone 1 of the Linear Park area is located immediately north of the current Ropeyards site, while Zone 2 to 4 of the Linear Park area comprises part of the northwestern, central and southern sections of the current Ropeyards site*)

- 4.8.25 The 2018 TEC report documents an additional trial pit investigation across the proposed park area of the Ropeyards site. No additional visual or olfactory evidence of hydrocarbon contamination was noted during these works. However, visual evidence of potential asbestos containing material was recorded within made ground encountered in the proposed soft landscaped area, in the southeast of the Ropeyards site (TEC 2015 TP01 and TP03). In addition, potential pulverised fly ash (PFA) was recorded within the made ground encountered in the TP01 (in the south-east of the Ropeyards site).
- 4.8.26 A combined 26No. samples of made ground taken from proposed soft landscaped areas were subject to geochemical analysis for the site. The human health GQRA, undertaken in accordance with applicable guidance of the time, assessed the samples obtained against screening criteria for a *Public Open Space (resi)* site end use. There were no elevated contaminant concentrations recorded within the sampled materials, in relation to the selected screening values; however, asbestos was recorded within the made ground sampled from the proposed soft landscaped area of the Ropeyards site.
- 4.8.27 Additional elevated leachable concentrations of heavy metals (copper, lead and vanadium) were recorded within a further 3No. samples of made ground in relation to selected EQS values.

TEC 2023 Reporting (*The Ropeyards site*)

- 4.8.28 Additional ground investigation was undertaken in northern section of the Ropeyards site comprising dynamic sample boreholes and rotary boreholes. During these works, no further significant visual or olfactory evidence of contamination was observed within the encountered ground materials, and screening of soil samples with a PID recorded concentrations of volatile organic compounds (VOCs) to be less than the instrument level of detection (i.e. 0.0ppm).

- 4.8.29 Additional human health risk assessment was undertaken on made ground samples taken in 2023, along with an updated assessment of the 2016 and 2018 laboratory data. All results were assessed against screening criteria for a 'Residential without homegrown produce' site end use. Contaminants of Concern (CoPCs) identified within the sampled made ground comprised heavy metals (arsenic and lead), along with PAHs (benzo(a)pyrene and dibenz(a,h)anthracene).
- 4.8.30 The laboratory screening for asbestos during the 2023 assessment recorded the presence of amosite (described as loose fibrous debris) in WS03 at 0.7mbgl, and Chrysotile (described as loose fibres) at WS04 at 0.6mbgl. All remaining samples recorded asbestos as not-detected within the 2023 assessment.
- 4.8.31 The 2023 report concluded that, the site is considered to be representative of Characteristic Situation 1 in relation to ground gas risk. In addition, the site is not situated within a radon affected area. Therefore, no radon or bulk gas protection measures are considered necessary within the proposed development.

TEC Remediation Strategy and Verification Plan (2018)

4.8.32 A Remediation Strategy and Verification Plan was prepared by TEC for the Linear Park site (which encompasses the current Ropeyards site) in March 2018 (report reference 1508005.016.01), since the issue of the 2013 ES. The strategy was prepared, in accordance with appropriate guidance of the time and is understood to have been approved by the Royal Borough of Greenwich Council. The strategy identified 3No relevant pollutant linkages (RPL's) in relation to ground contamination and identified receptors, as detailed below:

- RPL1 Risk to site end users via exposure to Contaminants of Potential Concern within the made ground materials through the inhalation pathway in areas of proposed soft landscaping, where made ground remains;
- RPL2 Risk to brownfield site construction workers and future site maintenance workers via exposure to Contaminants of Potential Concern within the made ground materials through the inhalation pathway; and
- RPL3 Potential risk of statutory nuisance and human health risk via disturbance of in-situ ground materials during development works resulting in the generation of dust, including fine particulate matter.

4.8.33 As a result, remediation measures were recommended, in order to mitigate the identified risks in relation to the proposed site end use. While reference should be made to the report for full details, a summary of the required remediation measures is detailed below:

RPL1

- It is considered that hardstanding, where present, would remove the identified contaminant pathways in relation to site end users.
- Where soft landscaping is proposed, an engineered cover system would be considered appropriate, given the presence of asbestos within the underlying made ground across the site. The cover system would need to comprise the placement of a visual marker/break layer, overlain by a suitable cover thickness comprising topsoil and subsoil in accordance with the requirements of BS3662:2015 and BS8601:2013.

RPL2

- Given the brownfield nature of the site, the adoption of good brownfield working practices, including good site welfare and hygiene facilities and the provision of appropriate Personal Protective Equipment (PPE) should be implemented.
- In addition, given the presence of asbestos fibres within the underlying made ground, all groundworks should be undertaken in accordance current legislation and guidance for dealing with those soils contaminated with asbestos fibres.

RPL3

- It is considered that the development works will provide a long-term betterment with respect to dust generation, as all potentially contaminated materials remaining on site will be effectively capped.
- In addition, the mitigation measures required for RPL2, implemented to mitigate against potential airborne asbestos fibre release during groundworks, would also mitigate against potential risk from dust generation.

Summary of Baseline Conditions

4.8.34 The 2023 phase of investigation recorded the presence of similar contaminants of potential concern recorded during previous 2016 and 2018 phases of investigation (i.e. heavy metals, PAH's and asbestos). As a result, it is considered that the remediation mitigation measures detailed within the TEC Remediation Strategy and Verification Plan, prepared for the Royal Arsenal Riverside - Linear Park, which encompasses the current development area (TEC report reference 1508005.016.01, dated March 2018), would be considered appropriate. In addition, it is understood that this document has gained regulatory approval from the Royal Borough of Greenwich Council and therefore no further assessment is considered necessary within the Ropeyards site.

4.8.35 Recommended remedial measures will require verification, in accordance with the verification process documented within the Remediation Strategy and Verification Plan. This verification is required to validate works undertaken, following completion of the required mitigation measures.

Updated Summary of Contamination Sources

4.8.36 Sources of potential contamination for the Ropeyards site have been identified from the updated baseline conditions information applicable to the site. The baseline conditions data indicated the following potential contamination sources are applicable at the site:

- Made ground recorded across the site to depths in excess of 4.9mbgl – heavy metals, PAHs, asbestos and ground gases.
- Nearby current and historic industrial land uses – heavy metals, PAHs and asbestos.

Updated Impacts During Construction

4.8.37 Following the works undertaken by TEC since the publication of the 2013 ES within the Ropeyards site boundary, the following updated impacts are considered applicable to the site.

Risk to Construction Workers

4.8.38 Risk to construction workers from exposure to identified contamination sources during the construction of the proposed development may arise through ingestion, inhalation and dermal contact pathways. It is anticipated that risk to construction workers would be mitigated by the appropriate use of brownfield working practices, such as PPE and suitable hygiene practices. However, given the identified asbestos within the made ground on site. All construction works should comply with appropriate legislation and guidance, for dealing with soils contaminated with asbestos. This is largely consistent with the risk identified in the 2013 ES.

Risk to Surrounding Site Users

4.8.39 Ground investigations identified elevated heavy metals and asbestos in made ground on site. Although no risk via contaminant migration to surrounding off site users was identified, risk of dust generation from construction works could not be discounted, and appropriate control measures will be required to minimise effects of dust generation and dispersal. This is largely consistent to the risk identified in the 2013 ES.

Risk to Groundwater

4.8.40 Controlled waters (including groundwater) have been identified as a potential receptor during the construction phase. A potential risk to groundwater was identified within the 2013 ES. However, during the subsequent multiple phases of ground investigation undertaken at the Ropeyards site, and within the wider Masterplan site, no risk to controlled waters from leaching of potential contaminants from the made ground materials encountered, and subsequent migration to the groundwater was identified. Therefore, no specific mitigation measures are considered necessary.

4.8.41 As already documented within the 2013 ES, however, appropriate use of clean drilling/piling techniques in accordance with current guidance should be employed as good practice.

Updated Impacts During Operation

4.8.42 Following the works undertaken by TEC since the publication of the 2013 ES within the Ropeyards site boundary, the following updated impacts are considered applicable to the site.

Risk to Future Site Users

4.8.43 As detailed within the 2013 ES, the most sensitive future site user receptors are still considered to be the future residents (also considered are site maintenance workers and site visitors) who are at risk from identified contaminants (heavy metals, PAHs and asbestos) within the made ground, via ingestion, inhalation and dermal contact pathways. Suitable mitigation measures will be required to protect identified future site users.

4.8.44 The multiple phases of previous ground investigations undertaken by TEC on site and in the surrounding area, since the publication of the 2013 ES, did not identify a risk of ground gas, due to the absence of organic material recorded within the made ground, and absence of nearby landfills. The site is considered to be representative of Characteristic Situation 1 with no mitigation/gas protection measures required. This updates the conclusions and recommendations of the 2013 ES.

Risk to Groundwater

4.8.45 No gross contamination was identified within the made ground encountered by TEC. In addition, given the recorded depth to groundwater as reported within the TEC ground investigations on the Ropeyards site, no mitigation measures are considered necessary at the site with regards to controlled waters. In addition, much of the proposed development is to be laid to hardstanding, which would reduce infiltration in to the made ground and potential migration of potential contaminants. This updates the conclusions and recommendations of the 2013 ES.

Risk to New Built Environment

4.8.46 No risk from ground gas was identified during the multiple ground investigations and the site is considered representative of Characteristic Situation 1 (i.e. no ground gas protection measures required within the proposed buildings).

4.8.47 As detailed within the 2013 ES, given the presence of made ground, appropriate design of concrete class (in accordance with BRE Special Digest 1: 2005) and water supply pipes (in accordance with current UKWIR guidance) should be considered, and mitigation measures (e.g. upgraded pipes) may be required.

Demolition & Construction Phase

4.8.48 This section identifies and assesses the scale and nature of the main effects arising from the Proposed Development at the Ropeyards during the construction phase.

First Effect

4.8.49 Risk to construction workers via exposure to contamination source (heavy metals, PAHs and asbestos) within the made ground.

Mitigation

4.8.50 Adoption of appropriate good brownfield working practices, including a suitable asbestos management plan, and implementation of appropriate site maintenance procedures and risk assessments.

4.8.51 Given the brownfield nature of the site, the adoption of good brownfield working practices, including good site welfare and hygiene facilities and the provision of appropriate Personal Protective Equipment (PPE) should be implemented.

4.8.52 In addition, given the presence of asbestos fibres within the underlying made ground, during this phase of the proposed development, good practice working methods should be adopted as per current guidance (e.g. CL:AIRE (2016) Control of Asbestos Regulations 2012 – Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Material: Industry Guidance and, CIRIA Report C765 “Asbestos in soil and Made Ground – Good Practice Site Guide” (2017)), or superseding documentation.

Residual Effect

4.8.53 Should the above mitigation be implemented in accordance with the approved Remediation Strategy and Verification Plan, the residual effect of the potential impact would be considered negligible.

Second Effect

4.8.54 Potential risk of statutory nuisance and human health risk (construction workers and surrounding site users) via disturbance of in-situ ground materials during development works resulting in the generation of dust, including fine particulate matter.

Mitigation

4.8.55 It is considered that the development works will provide a long-term betterment with respect to dust generation as all potentially contaminated materials remaining on site will be effectively capped.

4.8.56 In addition, the mitigation measures required for the above First Effect, implemented to mitigate against potential airborne asbestos fibre release during groundworks, would also mitigate against potential risk from dust generation. In addition, construction workers will be required to take all necessary measures to avoid creating a dust nuisance during both remediation and construction works. Best practicable means should be used to minimise dust.

Residual Effect

4.8.57 Should the above mitigation be implemented in accordance with the approved Remediation Strategy and Verification Plan, the residual effect of the potential impact would be considered negligible.

Third Effect

4.8.58 Risk to the built environment from aggressive ground (made ground contaminants).

Mitigation

4.8.59 Upgraded below ground infrastructure, including services and foundations which may come into contact with aggressive or contaminated ground conditions, in accordance with current guidance (BRE SD1 and UKWIR).

Residual Effect

4.8.60 Should the above mitigation be implemented, the residual effect of the potential impact would be considered negligible.

Operational Phase

4.8.61 This section identifies and assesses the scale and nature of the main effects arising from the Proposed Development at the Ropeyards during the operational phase.

First Effect

4.8.62 Risk to human health of future end users and future site maintenance and visitors workers via exposure to contamination (heavy metals, PAHs and asbestos) within the made ground in areas of proposed soft landscaping.

Mitigation

4.8.63 Provision and maintenance of an appropriate engineered clean cover system, following site preparation, where made ground remains, in accordance with TEC Remediation Strategy and Verification Plan prepared for the Royal Arsenal Riverside - Linear Park, which encompasses the current Ropeyards site (*TEC report reference 1508005.016.01, dated March 2018*). It is understood that this document has gained regulatory approval from the Royal Borough of Greenwich Council.

Residual Effect

4.8.64 Should the above mitigation be implemented in accordance with the approved Remediation Strategy and Verification Plan, the residual effect of the potential impact would be considered negligible. It is noted that such remedial measures will also require suitable validation, to ensure they have been implemented in accordance with the Strategy.

4.9 Limitations and Assumptions

4.9.1 This chapter has been prepared, based upon updated site specific baseline conditions, determined through appropriate ground investigation and assessment. However, it is noted limitations apply to this updated assessment, due to the nature of the site (e.g. ground investigation limitations due to extensive underground infrastructure).

4.9.2 However, based upon the current conceptual understanding of the site, it would be anticipated that similar ground conditions to those encountered as part of ground investigation and assessment works, exist across the site areas where access has been possible. Should significant thicknesses of made ground be encountered, or visual or olfactory evidence of potentially significant contamination be identified during the development works, further investigation and assessment may be required.

4.9.3 In addition, this assessment is based upon the suitable implementation and appropriate validation of the mitigation techniques.

4.10 Conclusions

4.10.1 This chapter relates to Reserved Matters planning update “*Submission of Reserved Matters (Appearance, Landscaping, Layout and Scale) pursuant to Condition 2 of s73 Planning Permission, dated 17.03.2017 (Ref: 16/3025/MA), for 688 residential units and 985 (GEA) sqm of non-residential floorspace within Plots D and K3, K4, K5, and revised landscaping details*” associated with the proposed Ropeyards site.

- 4.10.2 Mitigation measures identified in 2013 were based upon the previously identified baseline conditions, and associated impacts of the Masterplan site as a whole. Along with detailing the mitigation measures required during the construction and operation phases. Further ground investigation was required to address the risks identified, and to close out data gaps. This has been undertaken for The Ropeyards site by TEC since the issue of the 2013 ES.
- 4.10.3 As documented within this Chapter, the updated assessment of the baseline conditions present at the proposed RAR Plots D&K site, which includes multiple phases of ground investigation and assessment, has determined the presence of updated potential contamination sources and their potential impacts.
- 4.10.4 These updated assessment works indicate the main contamination risks within the current Study Area are considered to be risk to construction workers and surrounding site users during the demolition and construction phase, and risk to future site end users (including future residents and site maintenance workers) during the operational phase from identified contaminants within the made ground across the site area.
- 4.10.5 A Remediation Strategy and Verification Plan has previously been prepared to document the required measures to adequately mitigate the identified risks during both the construction and operation phase of the development works.
- 4.10.6 Therefore, should these mitigation measures be appropriately employed at each development phase in accordance with current and regulatorily approved guidance, and should the mitigation measures be appropriately validated by a suitably qualified party, it is considered that the identified contamination does not pose an unacceptable constraint to the proposed development. This would be also applicable to the proposed reserved matters amendment for the site.
- 4.10.7 Should significant thicknesses of made ground be encountered, or visual or olfactory evidence of potentially significant contamination be identified during the development works, further investigation and updated assessment may be required.